INTERNSHIP AT GTU-BOSCH CENTER OF EXCELLENCE IN AUTOMATION

NA INTERNSHIP REPORT

Submitted by

SUTHAR SHIVAM MUKESHKUMAR

190390119015

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

GUJARAT TECHNOLOGICAL UNIVERSITY

Gujarat Technological University, Ahmedabad

MAY,2023

S.P.B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

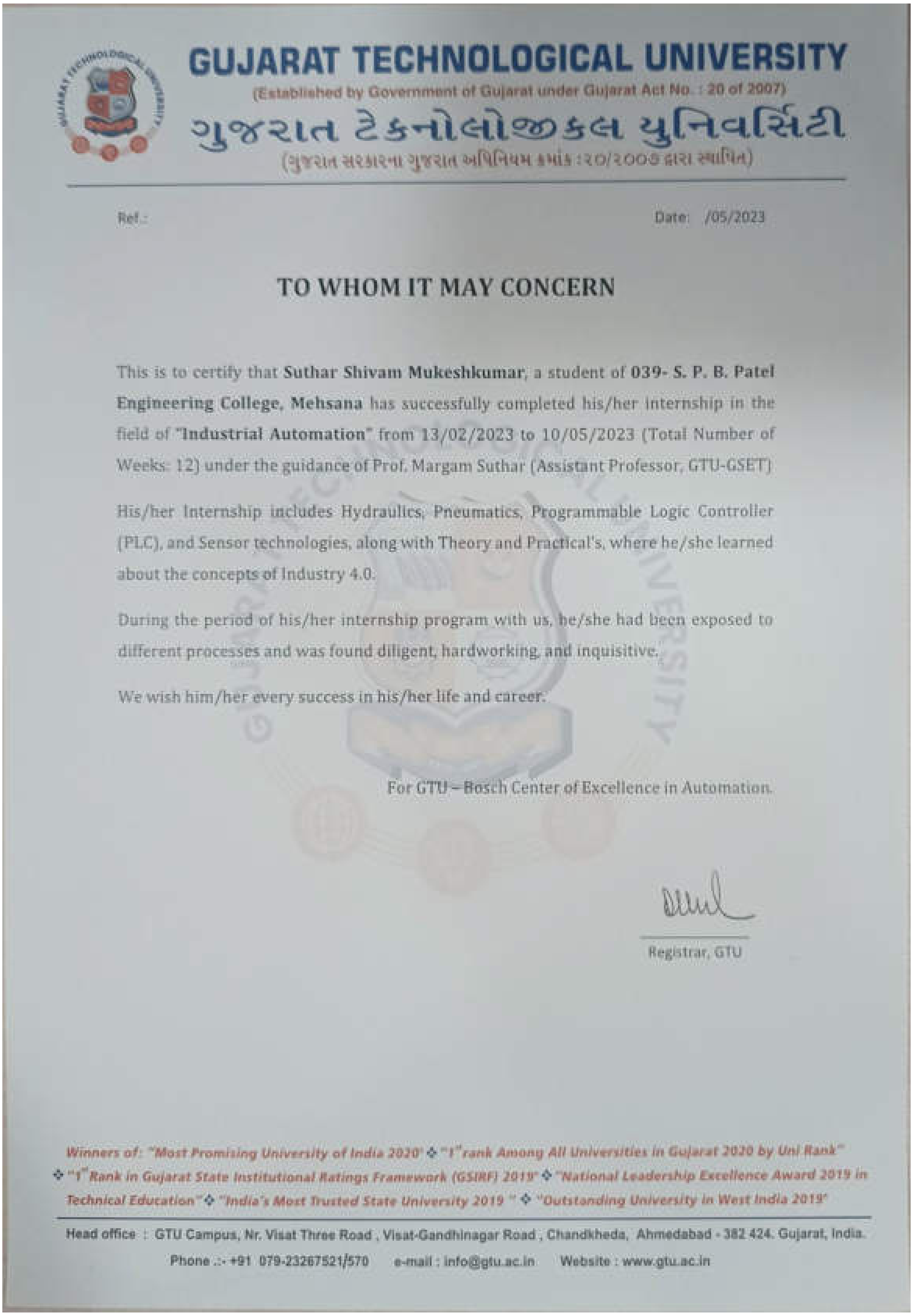
CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at GTU-BOSCH CENTER OF EXCELLENCE IN AUTOMATION** has been carried out by **SUTHAR SHIVAM MUKESHKUMAR** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Prof. Tausif Shaikh	Prof. Kunalsinh Kathia
Internal Guide	Head Of Department

Team ID: 212444

Company Certificate



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Date: /05/2023

TO WHOM IT MAY CONCERN

This is to certify that **Suthar Shivam Mukeshkumar**, a student of **039- S. P. B. Patel Engineering College, Mehsana** has successfully completed his/her internship in the field of "**Industrial Automation**" from 13/02/2023 to 10/05/2023 (Total Number of Weeks: 12) under the guidance of Prof. Margam Suthar (Assistant Professor, GTU-GSET)

His/her Internship includes Hydraulics, Pneumatics, Programmable Logic Controller (PLC), and Sensor technologies, along with Theory and Practical's, where he/she learned about the concepts of Industry 4.0.

During the period of his/her internship program with us, he/she had been exposed to different processes and was found diligent, hardworking, and inquisitive.

We wish him/her every success in his/her life and career.

For GTU – Bosch Center of Excellence in Automation.

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Head office : GTU Campus, Nr. Visat Three Road, Visat-Gandhinagar Road, Chandkheda, Ahmedabad - 382 424. Gujarat, India.

Phone :- +91 079-23267521/570 e-mail : info@gtu.ac.in Website : www.gtu.ac.in

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This is to certify that, ***Suthar Shivam Mukeshkumar*** (Enrolment Number - 190390119015) working on project entitled with ***Industrial Automation - Internship*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Suthar Shivam Mukeshkumar

Name of Guide : Mr.Shaikh TausifAhmad MohmmadSalim

Signature of Student : ____________________

*Signature of Guide : ____________________

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DECLARATION

We hereby declare that the Internship / Project report submitted along with the Internship / Project entitled **Internship at GTU-BOSCH CENTER OF EXCELLENCE IN AUTOMATION** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Mechanical Engineering** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me under the supervision of **Dr.Margam Suthar** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Name of the student	Sign of student
Suthar Shivam Mukeshkumar	______________

AKNOWLADGEMENT

First I would like to thank the Director of GTU-Bosch Centre of Excellence for providing the opportunity and resources to work on this internship. I also would like all the people that worked along with me in internship with their patience and openness they created an enjoyable working environment. It is indeed with a great sense of pleasure and immense sense of gratitude that acknowledge the help of these individuals.

I am highly indebted to **Prof.Tausif Shaikh** for making sure I gained sufficient knowledge during my internship and for her encouragement. I would like to thank my Head of the Department **Prof. Kunalsinh Kathia** for his constructive criticism throughout my internship.

I would like to thank **Mr.Jeet Joshi ,** Internship coordinator, Department of GTU-Bosch Centre of Excellence for their support and advice to get and complete internship. I am extremely great full to my department staff members and friends who helped me in successful completion of this internship.

ABSTRACT

Another area of interest was sensor technology, where the author learned about the various kinds of sensors and their uses. Additionally, they were able to get firsthand experience with setting up and configuring sensors as well as programming them to carry out particular tasks. The author now has a better understanding of the role sensors play in monitoring, controlling, and assuring the safety and efficiency of numerous industrial processes.

A deeper understanding of hydraulic and pneumatic systems, including their parts, functionality, and upkeep, was also learned by the author. They were able to gain knowledge and expertise in the design, construction, and troubleshooting of hydraulic and pneumatic circuits as well as in the identification and selection of the proper components for various applications. The manufacturing, construction, and transportation sectors, in particular, benefited greatly from this expertise.

LIST OF FIGURE

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ABBREVIATIONS

DCV	Direction Control valve
P.B.	Pusch Button
PLC	Programmable Logic Controller
RLL	Relay ladder logic
ST	Structured Text
FBD	Function Block Diagram
SFC	Sequential Function Chart
IL	Inctruction List
TON	On Delay Timer
TOFF	Off Delay Timer
RTO	Retentive on/off Timer
CU	Up Counter
CD	Down Counter
CUD	Up and Down Counter

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CHAPTER 1: ABOUT THE BOSCH CENTER OF EXCELLENCE

1.1 OVERVIEW OF THE GTU-BOSCH CENTER OF EXCELLENCE IN AUTOMATION

Fig:1.1 GTU-Bosch Center of Excellence

The Bosch Rexroth-Centre of Excellence in Automation Technologies is a joint initiative of Bosch Rexroth, Germany and Government of Gujrat for imparting hands on training with latest components used in the area of industrial automation such as hydraulic drives, pneumatic drives, proportional hydraulics, sensors, PLCs, mechatronics etc.

The primary objective of the centre is to bridge the gap between the Industries and the Academics. Centre caters to the needs of Polytechnics, Vocational Institutes, Engineering Institutes and Industries in the field of automation technology.

The centre aims at training industries personal and students of various institutions ,Engineering degree and PG level in Automation field to enable our industry personnel, faculty and students to have hands on experience and upgradation of technical skills which are essential for industrial progress.

Following five technical labs structured under COE.

- Hydraulic Lab.
- Pneumatic Lab.
- Programmable logic controller
- Robotic Lab.
- Sensor Lab.

1.1.1 Vision

- Be a world class training institute in Automation, recognized as employment generator through true commitment of quality, training and corporate social responsibility.

1.1.2 Mission

- Emphasis on transferring knowledge to each and every student in the area of Automation by providing the latest technological inputs required to all aspirants in the field of Automation.
- To bridge the gap between formal education and the demand of personnel of industries at supervisory level.
- To provide ecosystem for people to meet technological changes, maintain a close relationship with the practitioners of engineering disciplines to gain insight in to program development and outcome assessment.
- Emphasis on training middle Management personnel of industry.

1.1.3 Objective

- To bridge the Technical gap, Improve the technical competence, Employability and Entrepreneurship with a focus on the students of rural segment.
- To impart training to students of the PG, UG and diploma to meet industry requirements.
- To promote and support the education and training needs of industry personnel.
- To provide an insight in to major research in the field in Automation Technology.

CHAPTER 2: INTRODUCTION TO AUTOMATION

2.1 WHAT IS AUTOMATION IN INDUSTRY?

Today, the growing competitiveness of industry demands high quality and authentic products at a competitive rate. To meet this challenge, many industries are considering various new product designs and new integrated manufacturing techniques. Automation is the control of machines and processes by independent systems through the use of various technologies which are based on computer software or robotics. Industry implements automation to increase productivity and reduce labor costs.

Industrial automation utilizes various industrial communication devices such as programmable logic controllers (PLCs), programmable automatic controllers (PLCs) which are used to control the industry. In industries, control strategies use a set of technologies implemented to achieve the desired result, making automation systems necessary in industries.

2.2 WHY INDUSTRIAL AUTOMATION?

Industrial automation improves the rate of production through superior control of production. It helps to produce bulk by significantly reducing product processing time with better quality. Therefore, a given labor input it produces a large number of results.

Integrating several processes in an industry with automated machinery, minimizes cycle times and effort, reducing the need for human labor. Due to the industrial automation, the investment on workers has been saved. Thus, the investment in workers has been saved with industrial automation. Since automation reduces human involvement, the possibility of human error is also eliminated. Due to automation, consistent and reliable product quality can be maintained with greater automation compliance by adaptively controlling and monitoring industrial processes at all stages, from the laboratory to the industrial level.

The automation can completely reduce the need to manually check for various process parameters. Making the use of automation technologies, industrial processes automatically adjusts process variables to define values using closed-loop control techniques. The complexity of operating processes is reduced with industrial automation. The industrial automation decreases the level of personal safety by replacing it with automated machines working in harsh conditions.

2.3 TYPES OF INDUSTRIAL AUTOMATION SYSTEMS

2.3.1 Fixed Automation

In fixed automation, the sequence of processing operations is set by the equipment parameters. Each of the operation in a fixed or hard automation sequence is usually simple; it is the combination and coordination of many operations into one piece of equipment that makes the system more complicated. This type of automation is characterized by high initial investment cost and high production rates. It is, therefore, suitable for products with very high demand and volumes. Machine transfer lines, automatic assembly machines, and certain chemical processes instruments are examples of fixed automation.

2.3.2 Programmable Automation

The production equipment is designed to be able to modify the sequence of operations to the different product configurations in this automation. The sequence of operation is controlled by a programming, which is a set of coded instructions allowing the system to read and interpret them. This automation is particularly appropriate for batch production process where production volume is medium to high. It is hard to change and recognize the system for a new product or sequence of operations. Numerically controlled machines, steel rolling mills, paper mills, and industrial robots are the examples of programmable automation.

2.3.3 Flexible Automation

A flexible or soft automated system is a system that is capable of producing a wide range of products with essentially no time for changes from one product to another. It is a full programmable automation. There is no loss of production time when reprogramming the automation system and changing the physical parameter of the product. As a result, the system can produce different combinations and schedules of products instead of requiring them to be manufactured in separate batches. Examples of this automation system are self-guided vehicles, automobiles and CNC machines.

2.4 ADVANTAGES OF AUTOMATION

Higher Production Rates – The manufacturing sector heavily relies on automation since it enables higher output rates with lower costs and resources. These benefits have made automation a more widespread practise across a wide range of businesses.

Increased Productivity – The impact of automation on the workforce has been significant and is only expected to increase. With this rise in productivity, businesses are able to concentrate on more crucial duties like innovation while still finishing projects on schedule. These initiatives benefit the business and position it for growth.

More Efficient Use of Materials –How things are manufactured is being impacted by new technology. Automation results in higher-quality goods and a more effective use of resources. These advantages enable producers to produce better goods, which lowers production costs, raises consumer happiness, and increases return on investment.

Better Product Quality – For a long time, businesses have utilized automation as a cost- cutting measure. Because it enables businesses to produce their goods more quickly, more affordable and with higher quality, automation has become more popular in the marketing sector in recent years. As marketers attempt to capitalize on the benefits technology offers to enhance productivity, the usage of automation will definitely continue to expand.

Improved Safety – Automation provides a lot of benefits. Limiting human error, cutting expenses, and increasing manufacturing efficiency can all contribute to safety improvements. This is crucial in fields like mining and agriculture where there is a significant danger of damage.

Shorter Workweeks for Labour – Laborers may have shorter workweeks thanks to automation. Businesses can lower the number of personnel required to operate at their fullest potential by adopting automation in place of people. Employees will have more time to devote to other duties like management, training, or growth that call for interpersonal connection as a result.

Reduced Factory Lead Times – In manufacturing, automation has primarily positive effects. Factory lead times are slashed by at least 60% thanks to automation. This helps a factory's production output, but it also improves a product's effectiveness and quality.

Consistency – The business will become stable and consistent as a result of automation. Additionally, it will provide the company with a chance to adjust to changes in what their customers want. Businesses will seek more efficiency as they continue to deal with the shifting market conditions and customer expectations of today.

Saves Time – Time is greatly reduced through automation. Time that would have been spent on chores that can now be completed automatically by a machine or computer is saved. Automation has been the subject of a great deal of research, and several new developments are made every day to improve automation.

No Labour Issues – The solution to future workforce shortages lies in automation. In addition to being less expensive than people, it will also offer high-quality services that customers are ready to pay for.

2.5 DISADVANTAGES OF AUTOMATION

Worker displacement – The replacement of human labour by automation is its biggest drawback. This is due to the fact that a computerised task can be completed more quickly and accurately than a human could. For instance, Disney World has been ferrying visitors around the park for years using autonomous vehicles. Many individuals worry that this may lead to a decrease in human employment.

Needs large capital expenditure – Industry has always relied heavily on automation. Before converting to automation, however, producers must consider a few unforeseen effects. One of these effects is the requirement for significant capital investments in order to maintain and service automated systems. Additionally, these systems are more vulnerable to cyberattacks than manual systems would be, which could make businesses vulnerable if their infrastructure is not adequately secured.

Can become redundant – Many issues can be conveniently solved by automation. However, if a change is made that necessitates modifying the automation, this convenience may become unnecessary. These kinds of adjustments might end up costing the organization valuable time and resources while simply serving to increase burden.

Could introduce new safety hazards – Automation may result in new safety risks if operational circumstances vary erratically. For instance, even if a driverless automobile is built to operate independently, it may still cause an accident if a person crosses the street in an unfavourable situation.

Still requires human intervention – Despite the fact that automation generally has positive effects, some activities still call for human involvement. We'll use self-driving cars as an example since they can be trained to stop when they encounter the majority of roadside impediments. However, certain circumstances, such as driving through a barrier that is not clearly visible to the car's sensor, can lead to these machines misinterpreting information and producing undesirable effect.

CHAPTER 3: INTRODUCTION TO PLC

3.1 BRIEF HISTORY OF PLC

The term "industrial automation" refers to the usage of programmable logic controllers (PLC) in organizations that operate automatically. In 1968, the Hydramatic Division of the General Motors Corporation laid forth the requirements for the design of the first programmable controller. Their main objective was to do rid of the expensive relay-controlled systems and their rigidity. According to the criteria, a solid-state system with computer flexibility had to be able to meet three requirements: it had to be reusable, have the ability to operate in an industrial setting, and be simple to programme and maintain for plant engineers and technicians. A control system like that would decrease downtime for the machines and allow for future expansion.

The first programmable controllers were more or less just relay replace. Their primary function was to perform the sequential operations that were previously implemented with relays. These operations included ON/OFF control of machines and processes that required repetitive operations, such as transfer lines and grinding and boring machines. However, these programmable controllers were a vast improvement over relays. They were easily installed, used considerably less space and energy, had diagnostic indicators that aided troubleshooting, and unlike relays, were reusable if a project was scrapped.

Today’s PLCs are capable of communicating with other control systems, providing production reports, scheduling production, and diagnosing their own failures and those of the machine or process. These enhancements have made programmable controllers important contributors in meeting today’s demands for higher quality and productivity. Despite the fact that programmable controllers have become much more sophisticated, they still retain the simplicity and ease of operation that was intended in their original design.

3.2 TYPE OF PLCS

The 3 distinct types of PLC architecture available for use in industrial automation are known as fixed, modular and distributed.

3.2.1 Fixed PLC Type Architecture

Fig: 3.1 Fixed PLC

All of the hardware components are integrated into one unit when using a fixed PLC, which uses single unit architecture. In a fixed PLC, there are hardware elements such the power supply, CPU, memory, input, output, and communication interfaces built in. The terms fixed, integrated, nano, micro, compact, small, mini, basic, unitary, standard, and brick are the ones that fixed PLCs are most frequently referred to by manufacturers.

Advantages of Fixed PLCs

- Small in size so they do not take up very much space in an enclosure.
- Quick and easy to mount.
- Low in cost so they are an economical solution for basic applications.

Disadvantages of Fixed PLCs

- CPU processing power is low and memory is small so complex tasks can be difficult to realize.
- Inflexible because the number of input,output and communication interfaces are fixed.
- Only suitable for basic applications with small number of inputs and outputs.

3.2.1 Modular PLC Type Architecture

Fig: 3.2 Modular PLC

Each of the hardware components in a modular PLC is housed in a separate module. Using a standard mounting mechanism, each PLC module is connected to the others. A specific number of modules can be supported by the mounting system. It follows that a modular PLC can be set up to be application- specific.

According to the PLC system's architecture, a PLC module is a piece of hardware that performs a certain task. The processor, power supply, input, output, and communication modules are the primary components utilized in a modular type PLC. These modules' designs will vary depending on the manufacturer, and they typically cannot be swapped between PLC manufacturers.

When a more powerful CPU and numerous input and output devices are needed for industrial automation, modular PLCs are used. These applications, which employ modular PLCs, are typically more complicated in terms of operation, process control, and monitoring. Manufacturing, the food and beverage industry, mining, and logistics are a few examples of industries that employ modular PLCs often.

Advantages of Modular PLC

- Larger memory, faster processors, more inputs and outputs, more connectivity possibilities, complete customizability, and ease of expansion are all features of modular PLCs. This enables the modular PLC to handle more sophisticated and large-scale applications than a fixed PLC.
- Input and output modules that be installed remotely and connected to one another through a communication link are another feature of modular PLCs. Increased inputs and outputs, less cables needed, and flexible installation are all made possible by this.
- Each hardware component is separate housed in a module which can be replaced if it is faulty.

Disadvantages of Modular PLCs

- Large in size so they take up more space in an enclosure than a fixed PLC.
- The mounting system is more complex than a fixed PLC.
- Higher in cost than a fixed PLC so may not be cost effective for smaller applications.

3.2.2 Distributed PLC Type Architecture

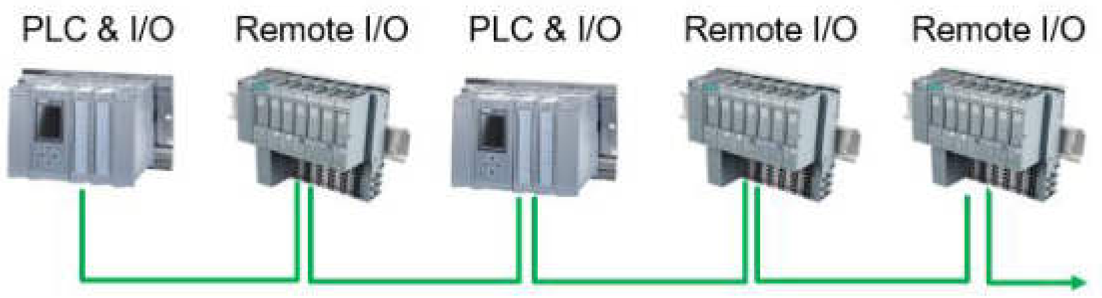


Fig: 3.3 Distributed PLC

A distributed PLC is a high-end PLC system that has the capacity to connect hardware components in many places via high-speed communication lines and a modular design. The distributed PLC system has several hardware modules placed in mounting systems at each site, which are referred to as nodes, racks, or drops.

A communication module is required for each drop, node, or rack in the distributed PLC system, which may also comprise a PLC processor module with input and output (I/O) modules or merely I/O modules. The node is referred to as dispersed I/O or remote I/O when it just has I/O modules and no PLC CPU module.

Due to their lack of geographic restrictions, distributed PLCs are employed in big factories and processing facilities. By using high-speed communication networks to connect the dispersed I/O and CPUs, they enable the separation of hardware components into separate places. A site-wide process control system, the distributed PLC type is thought to be.

The fact that distributed PLCs employ higher level programming languages, have vast memory, can handle massive quantities of I/O, and can do a lot of complicated process control tasks sets them apart from other types of PLCs.

Large industrial facilities in the past utilized Distributed Control Systems (DCS).

However, today's technologically advanced PLCs are performance-rich and capable of meeting the high demands of a distributed control system.

Advantages of Distributed PLC

- Plant wide control network with multiple processors and remote I/O drops.
- High performance processor.
- Able to handle large volumes of I/O.
- Can handle large amounts of complex process control tasks.
- Ease of maintenance.
- Save time and money on installation costs.

Disadvantages of Distributed PLCs

- Large in size with bigger installation footprint.
- The mounting system is more complex than a fixed PLC.
- Higher in cost than other types of PLC so they may not be cost effective for smaller less complex applications.
- Higher level programming skills may be require.

3.3 PLC ARCHITECTURE

The term PLC architecture refers to the design specification of the various PLC hardware and software components and the how they interact with one another to form

the overall PLC system. The architecture of a PLC is based on the same principles of that used in standard computer architecture. However, PLC architecture does differ because the design is based around providing high reliability, immunity to harsh industrial environment, ease of maintenance and access to large amounts of peripheral inputs and outputs.

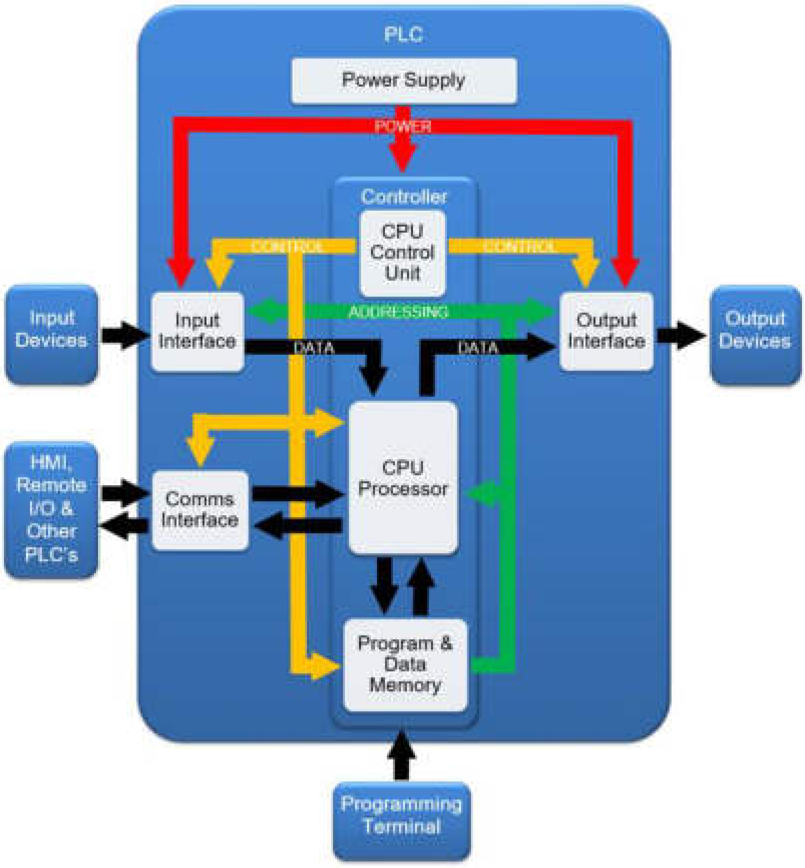


Fig: 3.4 Architecture Of PLC

If a PLC system is described as having closed architecture it refers to a proprietary system of hardware and software components that cannot (or is difficult to) connect to other manufacturers components and software. However if a PLC system is described as having open architecture it refers to the PLC system as having off the shelf components that adhere to a common standard and are easily connected to other manufacturer's hardware and software components.

3.3.1 The Basics of How PLC Architecture Works

Central Processing Unit, or CPU, is the brains of the PLC system. Control and processing components make up it. While the CPU processor takes care of all the computation and programme execution (such as ladder logic), the CPU control unit controls the interface between the different PLC hardware components.

The input devices, the CPU processor, and the output devices are all points of data flow. Additionally, the programme and data memory and the CPU processor exchange data. The programme (such as ladder logic) is then handled in a cyclical manner when all the data has been obtained. The output interface processes and executes the output devices using the data that is produced.

The communication interface and devices are also controlled and communicated with by the CPU. Data sharing among the various hardware components is organized using an addressing scheme.

The PLC programme is created using a programming terminal, which is also used to load the programme into the controller and monitor/control the PLC and its programme (for example, using ladder logic).

The power supply is in charge of meeting the power needs of the different PLC hardware components and controlling those needs.

3.3.2 Input and Output Module in PLC

Multiple inputs (I) and output (O) modules are used in the PLC system. They provide an interface between the central processing unit (CPU) and programmable devices.

The module which interacts with the input signal is called as Input Module. It is required to connect input devices like different types of switches.The module which interacts with the output signal is called as Output Module. The output module is required to connect output devices like electric applications.

The classification of input and output (I/O) modules of PLC is based on the types of signals.Basically, there are two types of signals- Discrete signals and Continous signals. Based on the signals, I/O modules are classified into two main parts.

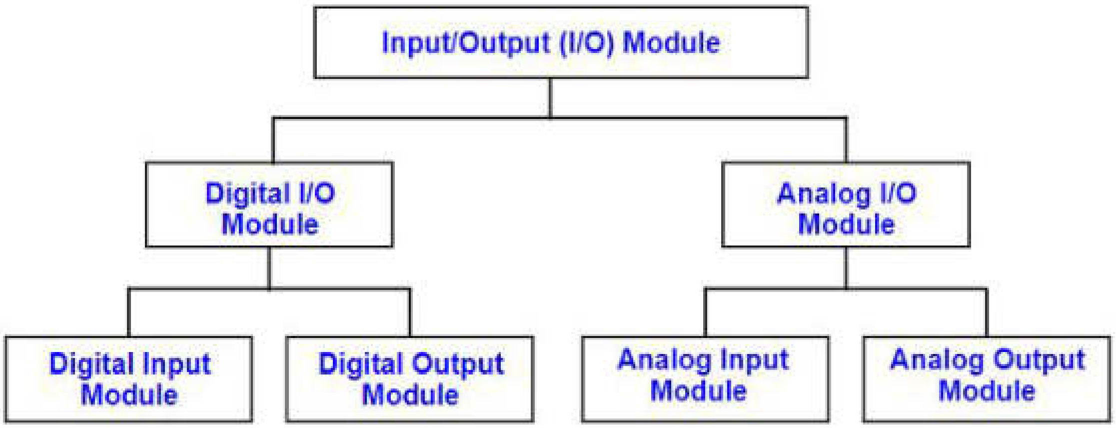


Fig: 3.5 Classification of I/O module

1. Digital I/O Module

The digital module is also called Discrete Module. In this module, the I/O signal work on the binary system i.e. only 0 or 1 value. For the digital input module, only the 1-bit signal is used. It is useful in the ON or OFF condition.

Based on Input and Output, the digital module is of two types.

- Digital Input Module
- Digital Output Module

Examples of input: Push switch, Toggle switch, Rocker switch, Selector switch, Proximity switch, Limit switch and etc are the example of the Digital Input Signal.
Examples of output: Lamp, Coil, Buzzer, Relay, Motor, Fan, Heater, Actuator, Solenoid Valve and etc are the example of the Digital Output Signal.

2. Analog I/O Module

The analog module is called a Continous Module. Usually, the voltage or current is given to the input module in the form of an analog signal. For the analog input module, 12-bit or 13-bit signal is used. Generally, analog input signals operate in the range of 4-20 mA, 0-20 mA, 1-5 V, etc. This analog signal provides any intermittent value between the two extreme limits (initial to final range) for the analog input module.

Analog I/O modules are also of two types.

- Analog Input Module
- Analog Output Module

Examples of analog input: Temperature detection switch, Pressure detection switch, Flow detection switch, Level detection switch, Limit detection switch, Position detection switch, PH Level detection switch are the best example of the Analog Input Signal.

Examples of analog output: Temperature Transmitter, Thermocouples, Pressure Transmitter, Flow Transmitter, Level Transmitter, etc., are the example of the Analog Output Signal.

3.4 APPLICATION OF PLC

3.4.1 Industrial Applications of PLC

- Transportation System likes Conveyor Belt System.
- Packing and Labeling System in Food & Beverage.
- Automatic Bottle or Liquid Filling System.
- Packaging and Labelling System in Pharma Industries.
- Transportation System like Escalator and Elevator.
- Industrial Crane Control System for Operation of Overhead Traveling Crane.
- Glass Industries for glass production and recording data.
- Paper Industries for the production of Pages, Books or Newspapers, etc.
- Cement Industries for manufacturing or mixing the right quality and quantities of raw materials, and accuracy of data regarding.
- Automatic Drainage Water Pump Monitoring and Controlling System.

3.4.2 Power Station Applications of PLC

- PLC uses for the Smart Grid System to Monitor and Detect fault conditions.
- It is used in the Power Generation, Transmission, and Distribution System.

- In the Power Substation, PLC can use the Auto Assembly Line System.
- A Single-Phase or Three-Phase Sequence Detect by using the PLC.
- In Oil, and Gas an Automation Power Plant, PLC needs for Valve Switching operation.
- Real-time PLC uses in Underground Coal Mine or Water Level Sensing and Data Survey.

3.4.3 Commercial Applications of PLC

- Smart Traffic Control Signal System.
- Smart Elevator Control System.
- Fire Detection and Alarm System.
- Automatic Machine Handling System.
- Automated Guided Vehicle System.
- In the Roller Coasters Machine.
- Automation System for Well Drainage System.
- Luggage Handling System. For example, at the Airport.
- Pressure Controller in Multi-Motor Pump Applications.
- Sequence or Numerical Counting and Packing System.
- Mining Equipment Line Detection and Remote Control System.

3.4.5 Domestic Applications of PLC

- Water Tank Level Control System
- Car Washing and Parking System.
- Flashing Light Controlling System.
- Automatic Door Opening/Closing System.
- Remote Monitoring Application like Air compressor (AC), Fan.
- Home Automation.

3.5 NETWORK AND COMMUNICATION WITH PLC

The different types of available communication protocol helps to expand the device network by connecting and communicating with each other. There are many old communication protocols still in use and widely getting used to expand network.The communication protocols not only being to used expand the PLC network and Also its used to expand number of IO devices by connecting additional modules (Expansion modules). Most commonly available protocols with PLC in all industrial PLC are:

1. Modbus RTU

This protocol primarily uses an RS-232 or RS-485 serial interfaces for communications and is supported by almost every commercial SCADA, HMI, OPC Server and data acquisition software program in the marketplace. This makes it very easy to integrate Modbus compatible equipment into new or existing monitoring and control applications

2. EtherNet/IP and Ethernet TCP/IP

IP (Inter-network or internet protocol) is a protocol to send data between computers, possibly using ethernet links, and/or other types of links like wifi. IP is mainly responsible for the routing, ie. finding the optimum path between the source and destination of each packet transmitted.

TCP (transfer control protocol) is one of the protocols that runs via IP, its responsibility is to make sense of the data, for example via “ports” for different kinds of data, and also to make sure packets of data are treated in the right order, and so on.

3. Modbus TCP/IP

Modbus TCP/IP is a simple Modbus protocol running on Ethernet over a TCP interface. Modbus is an application protocol that assigns the ways of managing and passing data between various layers without being affected by the protocol used by the next immediate layer.

TCP is Transmission Control Protocol and IP is Internet Protocol. These protocols are used together and are the transport protocol for the internet. When Modbus information is sent using these protocols, the data is passed to TCP where additional information is attached and given to IP. IP then places the data in a packet and transmits it.

4. Profibus and Profinet

There are many PROFIBUS devices available from a variety of manufacturers. These devices range from simple input or output modules to motor controllers and PLCs. A PROFIBUS DP device is any peripheral device which processes information and sends its output to the master. The DP device forms a passive station on the network (since it does not have bus access rights) and can only acknowledge received messages or send response messages to the master upon request. All PROFIBUS DP devices have the same priority, and all network communication originates from the master.

3.6 PROGRAMMING OF PLC

PLCs from different manufacturers can be programmed in various ways. IEC 61131-3 is the international standard for programmable logic controllers. The most common PLC programming methods used are:

- **Relay Ladder Logic (RLL)**

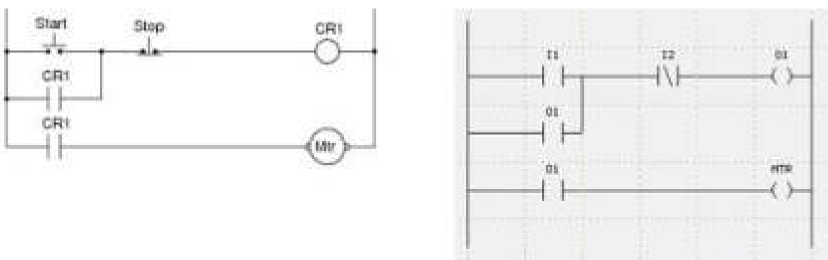


Fig: 3.6 Relay Ladder Logic

Ladder diagrams are specialized schematics commonly used to document industrial control logic systems. They are called ladder diagrams because they resemble a ladder, with two vertical rails (supply power) and as many rungs (horizontal lines) as there are control circuits to represent.

- **Structured Text (ST)**

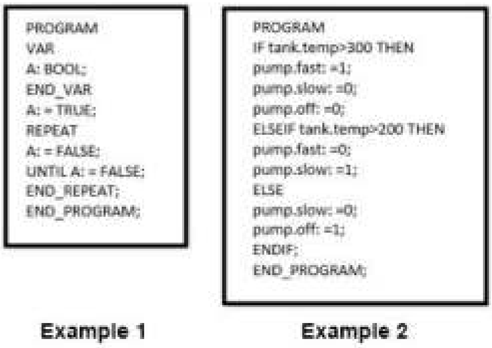


Fig: 3.7 Structured Text

Structured Text is PLC programming language defined by PLCOpen in IEC 61131-3. The programming language is text-based, compared to the graphics-based ladder diagram or Function Block Diagram. Structured text is a programming language that strongly resembles the programming language Pascal. Programs are written as a series of statements separated by semicolons. The statements use predefined statements and subroutines to change variables, these being defined values, internally stored values, or inputs and outputs.

- **Function Block Diagram (FBD)**

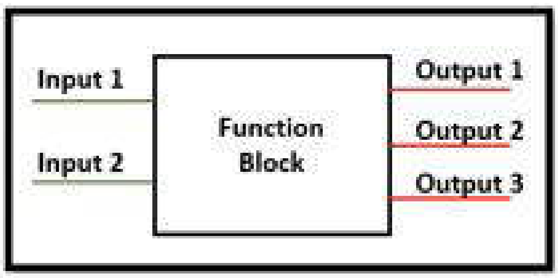


Fig: 3.8 Function Block

Function Block Programming is a language outlined in the IEC 61131-3 standard. It is a visual programming language that ties various instruction blocks together and allows them to execute a process based on conditional logic. The advantages of function block diagrams are that they're very easy to follow and understand.

- **Sequential Function Charts (SFC)**

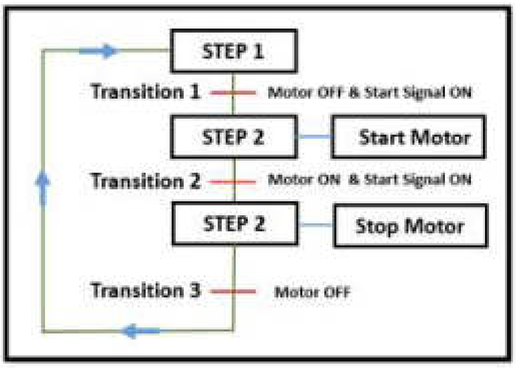


Fig: 3.9 Sequential Function Chart

In SFC programming, states or steps are represented by rectangular boxes. A vertical straight line connects the different steps, and each step has a corresponding output. There is a transition condition between steps. Figure 1 below shows the general diagram for the sequential function chart. SFCs are commonly used and easier to represent in scenarios where there are multiple states of operations. SFC programming's advantage is its ability to help the engineer break down large and complex processes into smaller pieces that are easy to understand.

- **Instruction List (IL)**

```
(*Tank 2: Check Low Alarm*)
        LD      T2_Level
        LT      T2_Low_Limit
        JMP     T2_Low_Limit_Alarm_Reset
(*Set Low Limit Alarm*)
        LD      BOOL#1
        ST      T2_Low_Limit_Alarm_Status
        JMP     T2_Low_Limit_Alarm_End
T2_Low_Limit_Alarm_Reset
        LD      BOOL#0
        ST      T2_Low_Alarm_Status
T2_Low_Limit_Alarm_End
```

Fig:3.10 Instruction List

An instruction list (IL) consists of a series of instructions. Each instruction begins in a new line and contains an operator and, depending on the type of operation, one or more operands separated by commas.

3.7 PROGRAMMING LANGUAGE USED FOR PLC

3.7.1 Relay Ladder Logic (RLL)

Ladder logic diagrams are structured to look like an electric circuit schematic. The logic flow is from left to right and simulates the current flow in an electric circuit. The basic logic expressions can be arranged to form AND, OR and NOT logic operations by implementing normally open/closed contacts and series/parallel connections.

There is always a left hand side rail and right hand side rail with inputs, logic expressions, internal variables and outputs packed in between. Each element is interconnected to form a line of code, called a rung.

The ladder logic diagram below shows the basic components and how they are arranged when writing a ladder logic program…..

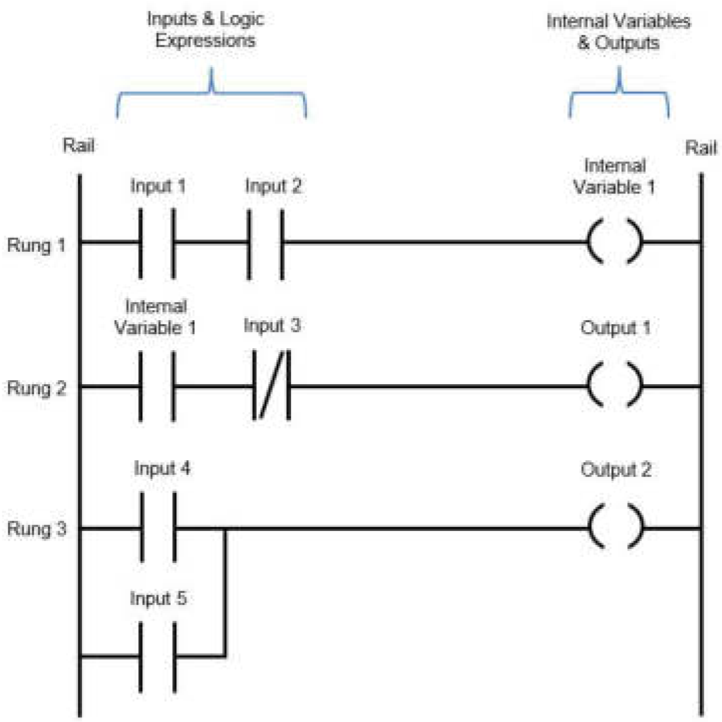


Fig: 3.11 Relay Ladder Logic

3.7.2 Ladder Logic Programming Rules

Every PLC manufacturer has slightly different ladder logic programming rules when it comes to building the logical expressions contained within a rung. Even a manufacturer with multiple PLC models can have varying rules depending on processing power of each PLC model. But there are seven basic rules that all PLC manufacturers use for ladder logic programming….

- A PLC scans each rung in the ladder diagram from the left hand side to the right hand side and from the top to the bottom.
- The PLC scan runs in a repeated cyclic manner where the inputs are monitored, the rung logic evaluated and then the state of the outputs are executed. The scan time is expressed in milliseconds (ms).
- The logic state of the outputs is evaluated as the program scans through the rungs. But they are only updated at the very end of each PLC scan, simultaneously.
- There must be at least one input or logic expression at the start of each rung.
- There must be at least one output at the end of each rung.
- Each rung in the ladder diagram represents one logic operation in the overall control operation.
- An input, output or logic expression can be used more than once in the ladder diagram. The same tag name and address is used to label it if used more than once.

3.7.2 Instruction and Symbols used for ladder logic programming

- **Input Instruction:**

1. **--[]--** This Instruction is Called XIC or Examine If Closed. ie; If a NO switch is actuated then only this instruction will be true. If a NC switch is actuated then this instruction will not be true and hence output will not be generated.

2. **--[\]--** This Instruction is Called XIO or Examine If Open ie; If a NC switch is

actuated then only this instruction will be true. If a NC switch is actuated then this instruction will not be true and hence output will not be generated.

- **Output Instruction:**

1**.--()--** This Instruction Shows the States of Output(called OTE).
ie; If any instruction either XIO or XIC is true then output will be high. Due to high output a 24 volt signal is generated from PLC processor.

3. **(L)** Output Latch (OTL)
OTL turns a bit on when the rung is executed, and this bit retains its state when the rung is not executed or a power cycle occurs. 3.--(U) Output Unlatch (OTU) OTU turns a bit off when the rung is executed, and this bit retains its state when the rung is not executed or when power cycle occurs.

- **Rung:** Rung is a simple line on which instruction are placed and logics are created.

- **Timer Function Block:**

1. On Delay Timer (TON)

An on-delay timer (TON) is a programming instruction which use to start momentary pulses for a set period of time., A simple construction of the On-delay timer programming instruction.

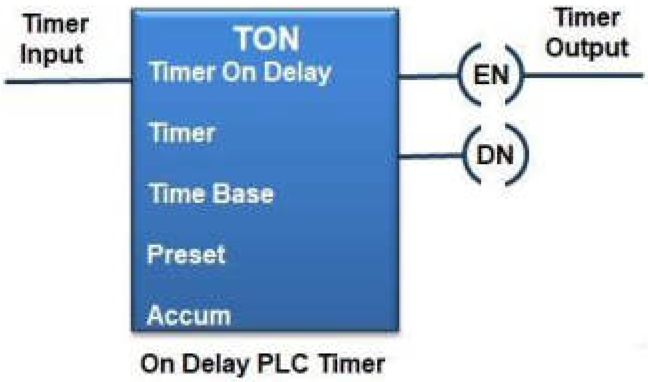


Fig: 3.12 On Delay Timer

2. Off Delay Timer (TOFF)

A off-delay (TOF) timer is a PLC programming instruction which use to switch off the output or system after a certain amount of time.A basic structure of Off delay timer programming instruction.

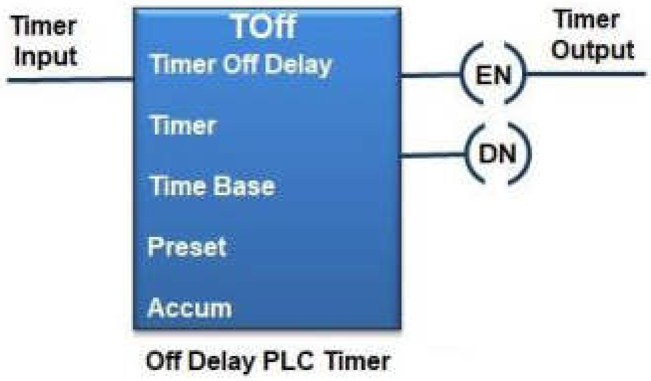


Fig: 3.13 Off Delay Timer

3. Retentive On/Off Timer (RTO)

The main function of the RTO is used to hold or store the set (accumulated) time.RTO is used in the case when there is a change in the rung state, power loss, or any interruption in the system.Retentive timer instruction look like this.

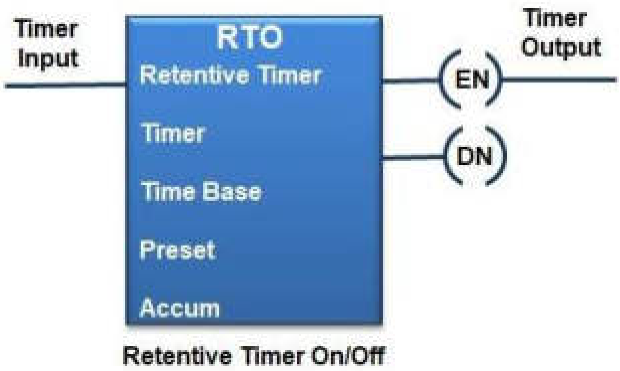


Fig: 3.14 Off Retentive On/Off Timer

- **Counter function block:**

1. Up Counter

Up counter counts from zero to the preset value. Basically, it increases the pulse or number.Up counter is known as the ‘CTU’ or ‘CNT’ or ‘CC’ or ‘CTR’. We can also set the initial and target value as an input to the counter.Here, the up-counter in PLC can count the value from the initial value to the target value. This initial value must be less than the target value. Most of the time, it is set as zero.

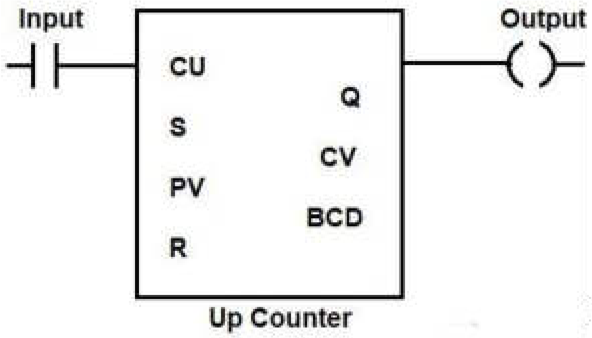


Fig: 3.15 Up Counter

2. Down Counter

The down counter counts from the preset value to zero. It decreases the pulse or number. Down counter is shortly known as the ‘CTD’ or ‘CD’.The down counter counts from target value to the initial value by decreasing it. This initial value must be less than the target value.

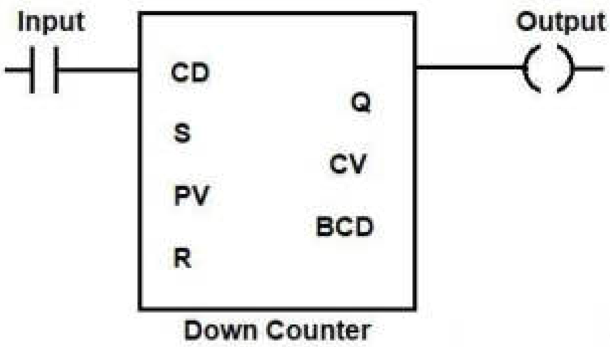


Fig: 3.16 Down Counter

3. **Up-Down Counter**

The up-down counter counts the value from zero to the preset value or from the preset value to zero.In other words, this counter can be act as down counter or up counter.Up-down counter is known as ‘CTUD’. For the bidirectional and quadrature operation mode, the up- down counter is selected depending on the status (high or low) of the specified count input terminal.In PLC programming, the up/down counter instruction is mostly used for the increment and decrements counting pulse or units.

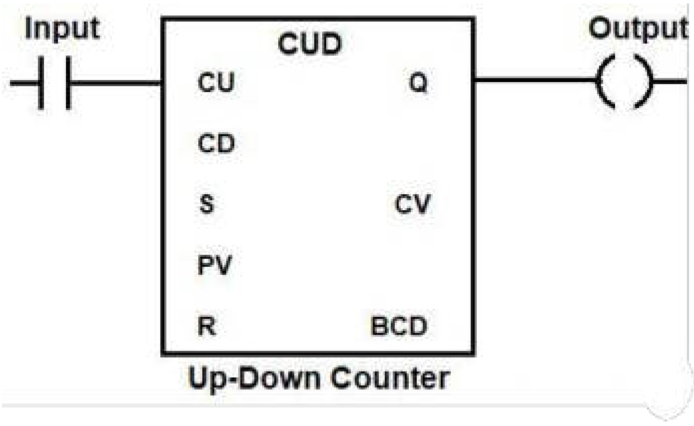


Fig: 3.17 Up-down Counter

- **Comparators**

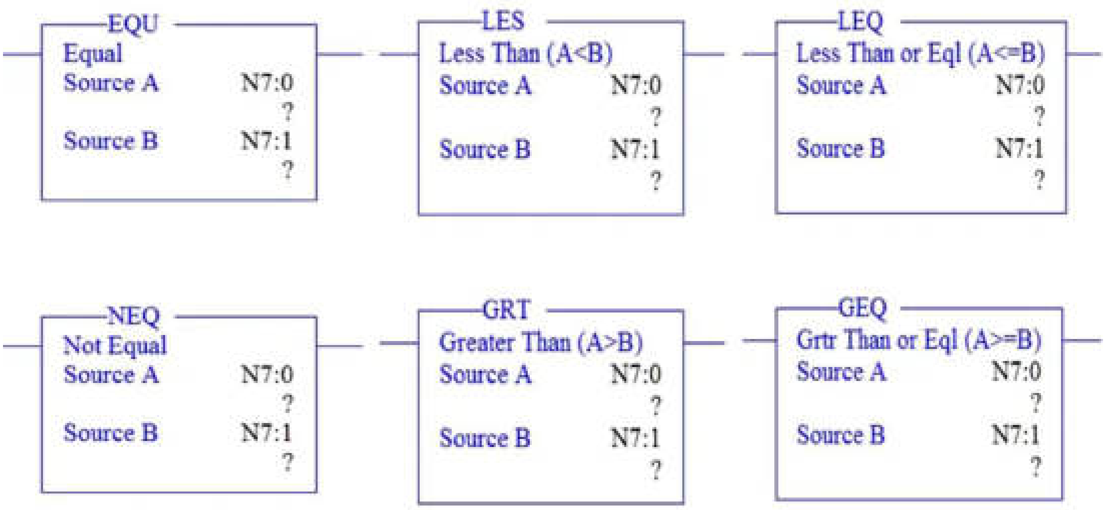


Fig: 3.18 Comparators

1. EQU :

Equal block is used to compare the two values stored in Source A and source B and gives output as “1” if both are equal and “0” if both are not equal.

2. **LES :**

Lesser than block is used to compare the two values stored in Source A and source B and gives output as “1” if Source A value is Lesser than Source B value and “0” if Source A value is greater than or equal to Source B value.

3. **LEQ :**

Lesser than or equal to block is used to compare the two values stored in Source A and source B and gives output as “1” if Source A value is lesser than or equal value to Source B value and “0” if Source A value is greater Source B value.

4. **NEQ :**

Not equal block is used to compare the two values stored in Source A and source B and gives output as “1” if Source A value is not same as Source B value and “0” if Source A value is same as Source B value.

5. **GRT :**

Greater than block is used to compare the two values stored in Source A and source B and gives output as “1” if Source A value is Greater than Source B value and “0” if Source A value is lesser than or equal to Source B value.

6. **GEQ :**

Greater than or equal to block is used to compare the two values stored in Source A and source B and gives output as “1” if Source A value is Greater than or equal value to Source B value and “0” if Source A value is Lesser Source B value.

3.8 PRACTICAL WORK ON PLC

- **Example 1**

Problem Statement: There are three switches S1, S2 and S3 and there are three lamps L1,L2 and L3 If any of switch one S1,S2 or S3 is "ON", then lamp L1 must glow (L2 & 13 must be "off") If any 2 switches among S1,S2 and S3 are "ON", then lamp L2 must glow (L1 & W L3 must be off) If all three switches are "ON", then lamp L3 must glow (L1 & 12 must be off).

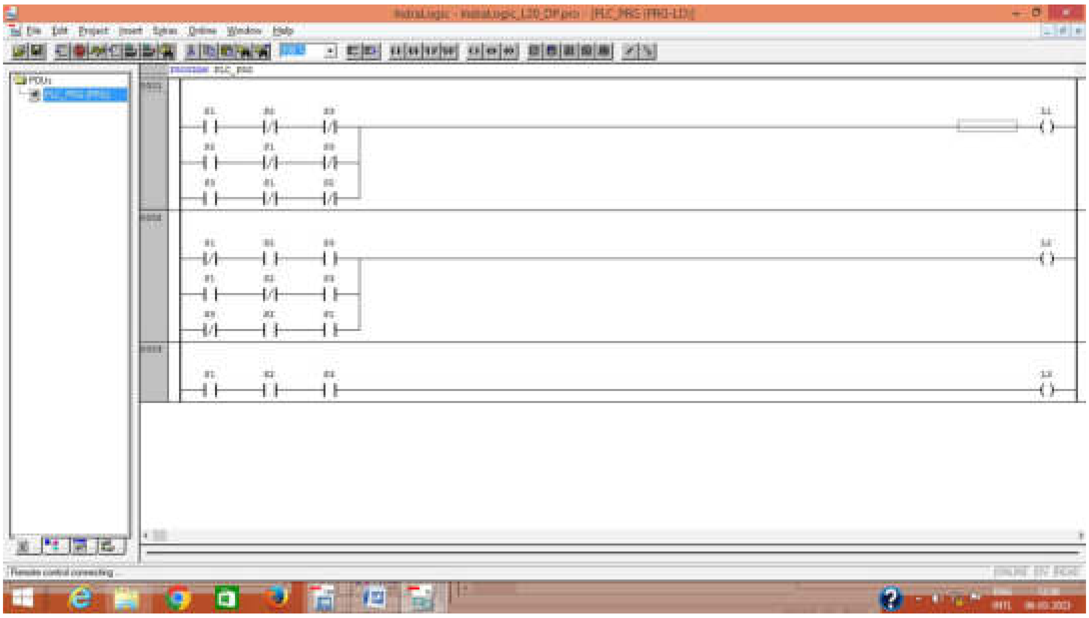


Fig: 3.19 PLC practical 1

- **Example 2**

Problem Statement: When S1 PB pressed motor M1 turns ON, when S2 PB pressed M1 turns OFF and M2 turns ON, When S3 PB pressed M2 turns OFF andM3turns ON, when $4 PB pressed M3 turns OFF and M1 restarts.

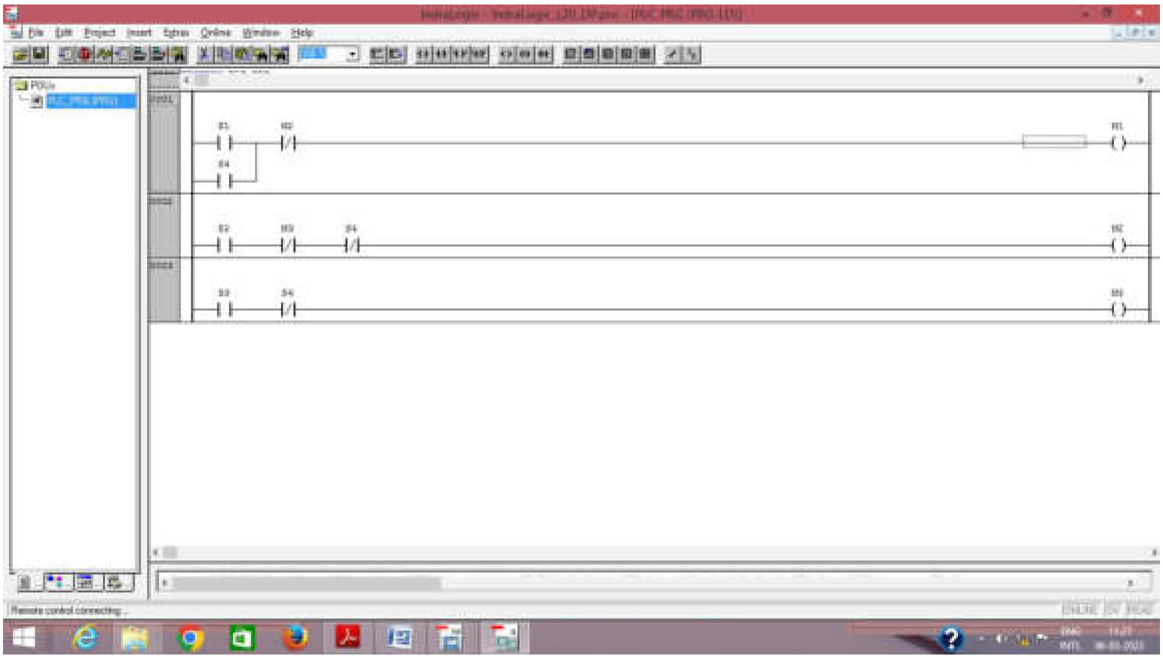


Fig: 3.20 PLC Practical 2

- **Example 3**

Problem Statement: When S1 PB pressed M1 and M2 turns ON, M3 should be OFF, when 52 PB pressed M2 and M3 turns ON, M1 should be OFF. When S3 PB pressed M1 and M3 turns ON,M2 should be OFF.

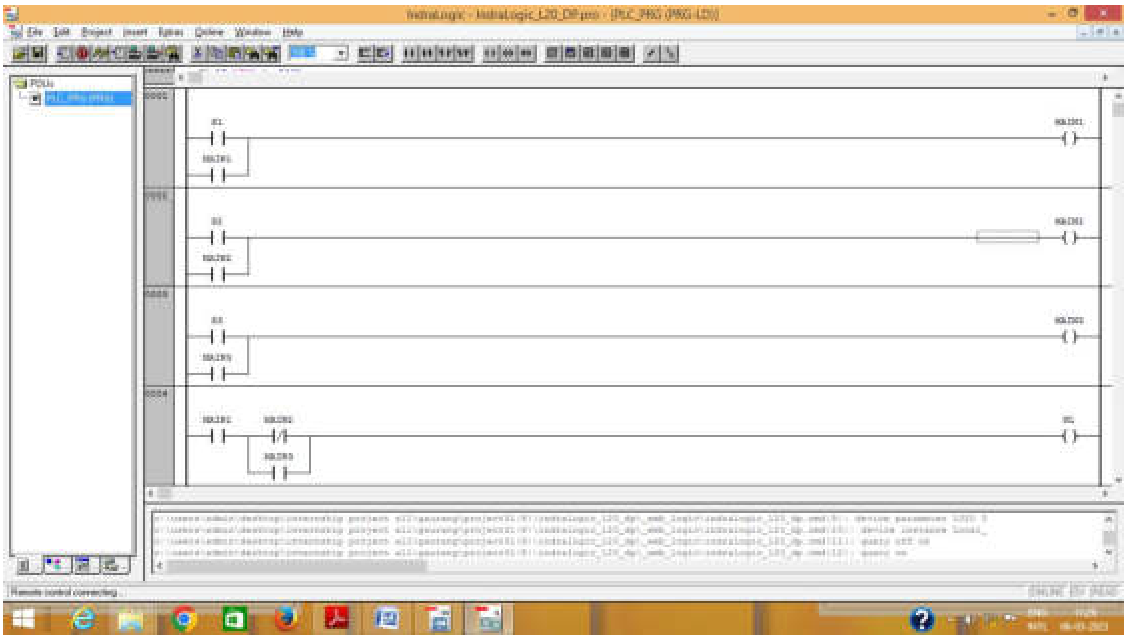


Fig: 3.21 PLC Practical 3

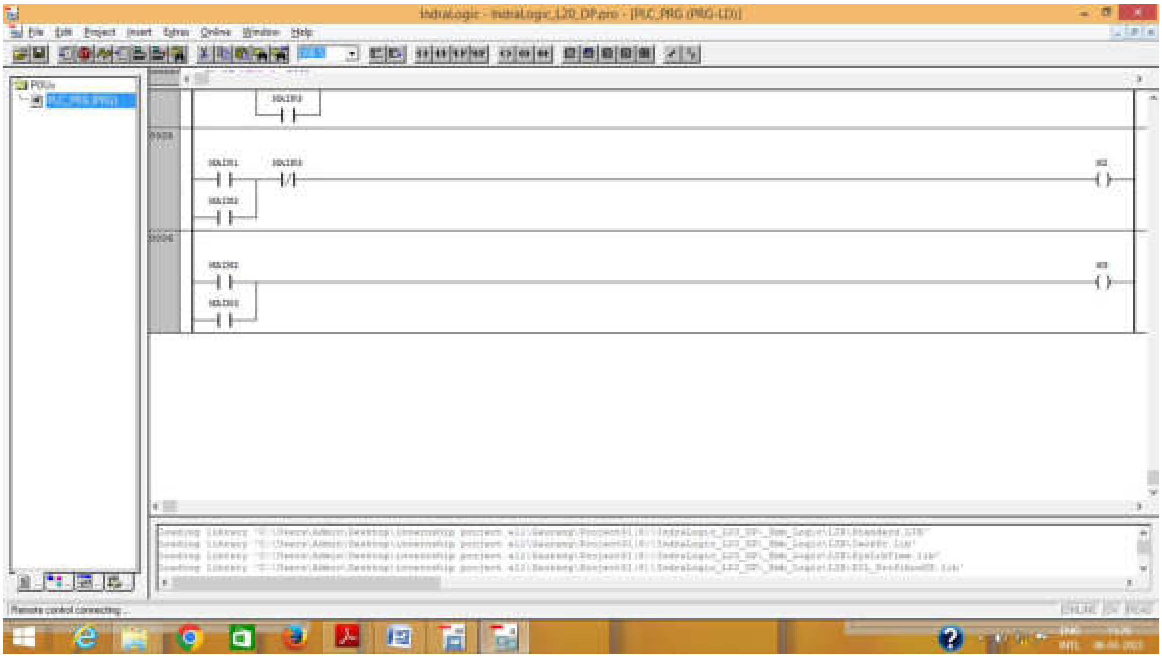


Fig: 3.22 PLC Practical 3

- **Example 4**

Problem Statement: When S1 PB pressed L1 would be OFF, L2 and L3 turns ON. When S2 PB pressed L2 OFF, L1 and 13 turns ON. When S3 PB pressed L3 turns OFF, L1 and L2 turns ON.Use of “Clock Memory” function(Fan Control Unit).

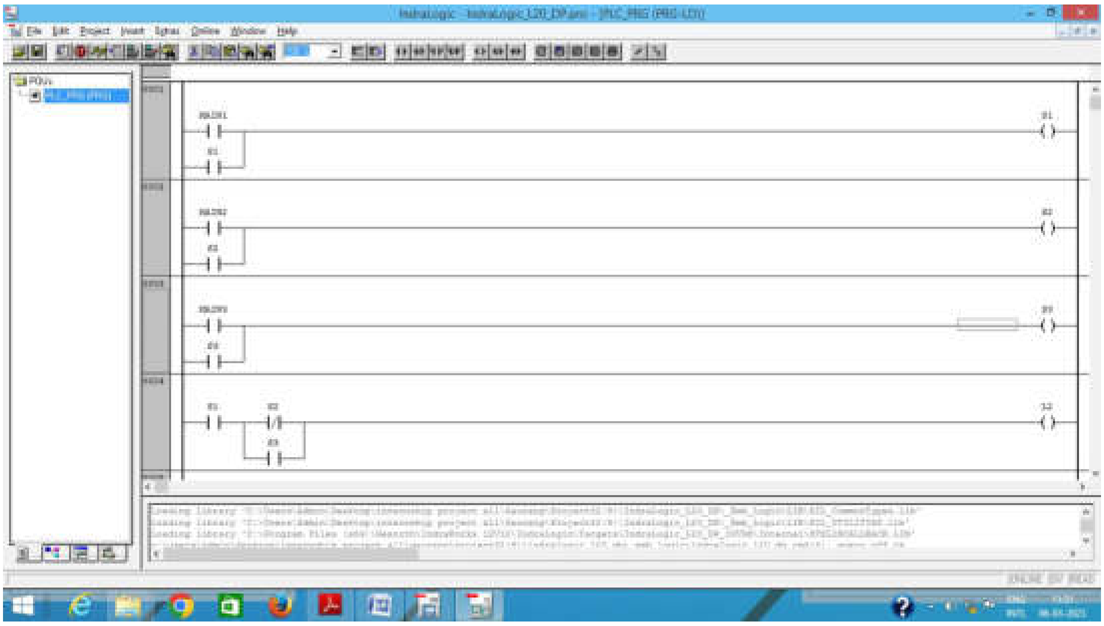


Fig: 3.23 PLC Practical 4

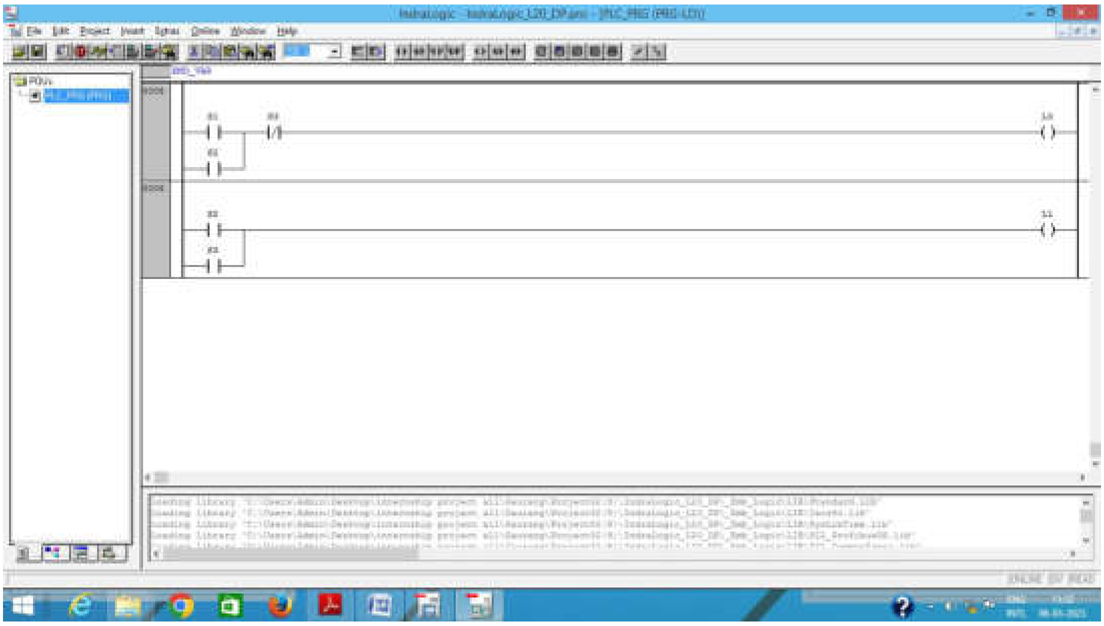


Fig: 3.24 PLC Practical 4

- **Example 5**

Problem Statement: When Start PB pressed Lamp L1 turns ON after 5 sec, L2 turns ON after 7 sec and L3 turns ON after 10 sec. Give Delay of 2sec to turns OFF after all 3 lamp turns ON and process repeats until stop button is pressed.

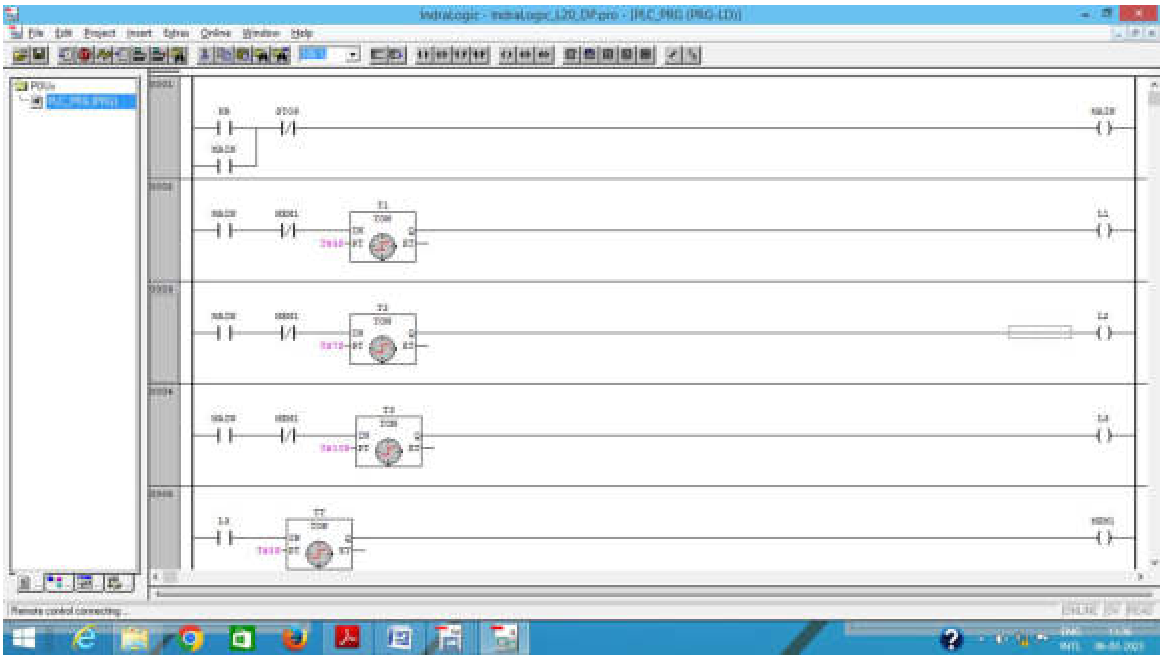


Fig: 3.25 PLC Practical 5

- **Example 6**

Problem Statement: There are three fans: Fan F1, fan F2 & "Stand-By fan F3 along with a Main Contactor. Start and Stop Switch is used to ON Main contactor. Two Fans F1,F2 start only after Main Contactor is started. If any one fan fails F1 or F2 then "Stand-By" fan F3 goes "ON".If any two fans from F1, F2 and F3 fail then main contactor must stop and a lamp must flash at 5Hz frequency. Note: here fan failure indication is to provide by input.

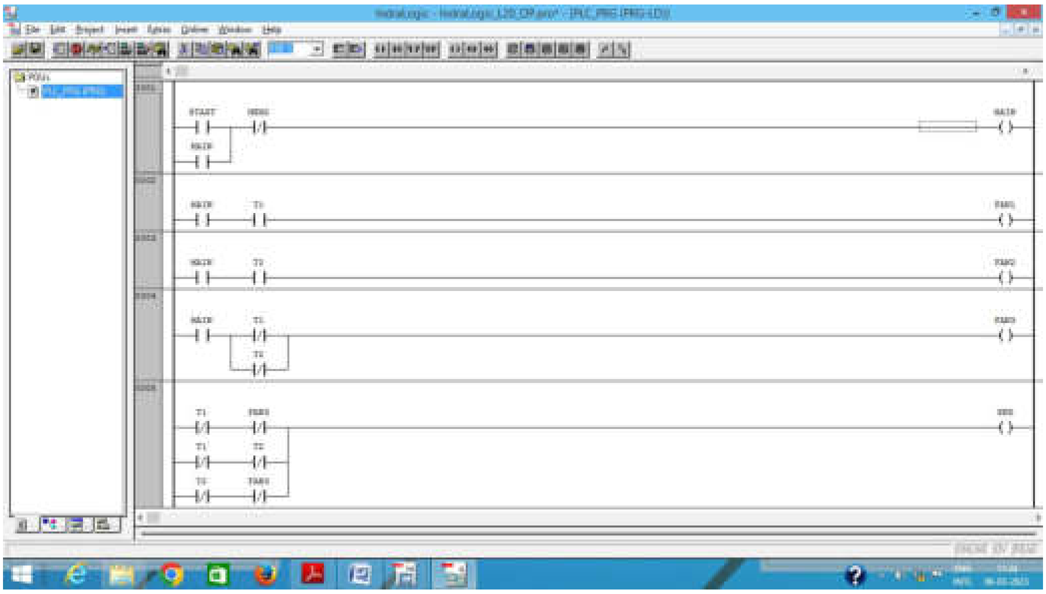


Fig: 3.26 PLC Practical 6

- **Example 7**

Problem Statement: In a Traffic Signal when input is given then Red Lamp turns ON for 5 Sec, yellow lamp turns ON for 7sec and green lamp turns ON for 10 sec again yellow lamp turns ON for 3 sec and then process repeats.

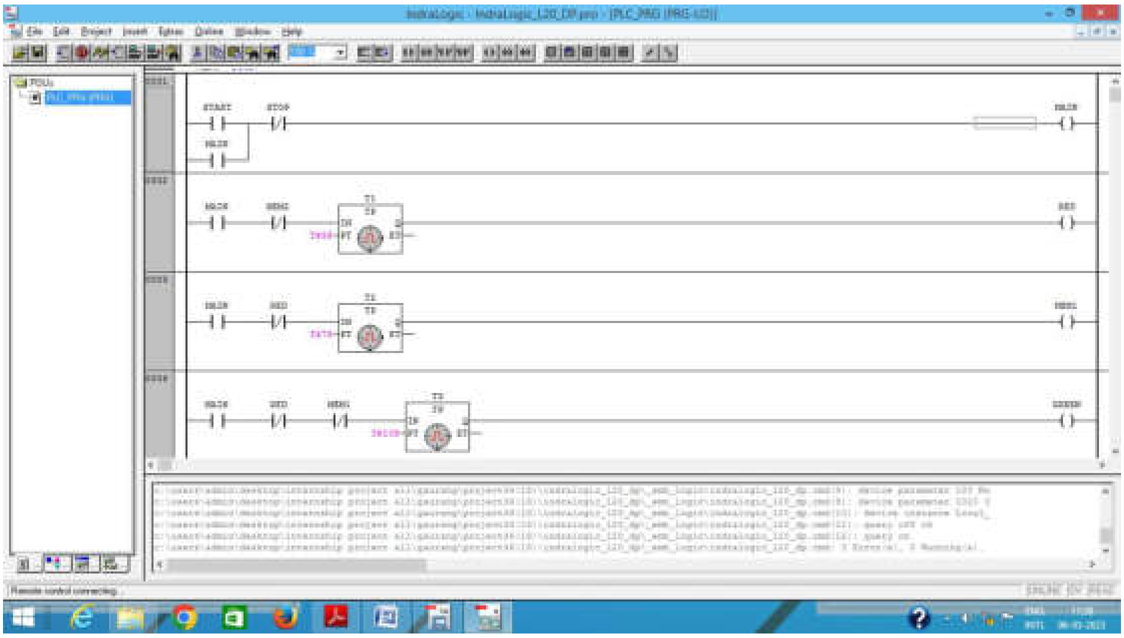


Fig: 3.27 PLC Practical 7

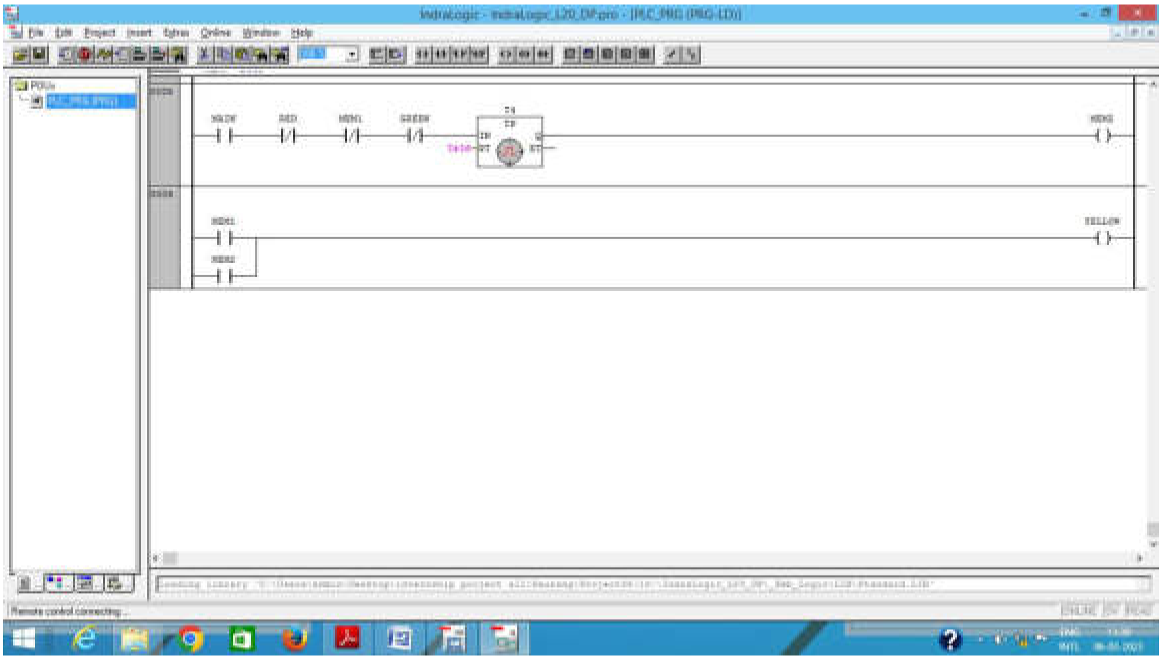
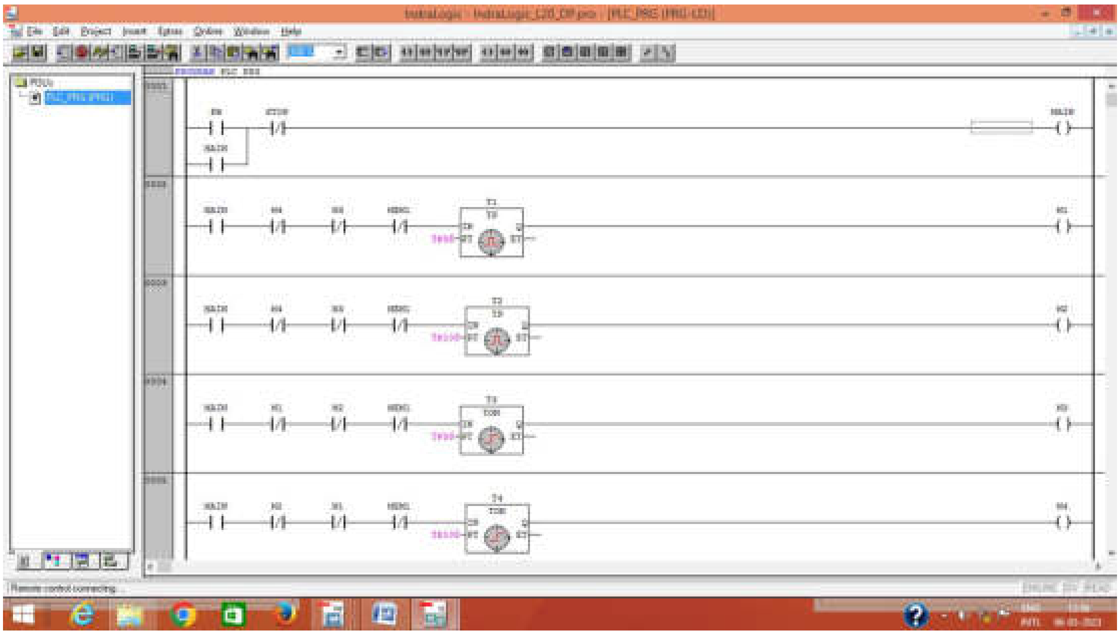


Fig: 3.28 PLC Practical 7

- **Example 8**

Problem Statement: In a food process plant when start switch is pressed Motor 1 turns ON for 5 and Motor 2 turns ON for 10 sec, after motor 2 turns OFF motor 3 turns on after 5 and motor 4 turns after 10 sec then 2 sec off delay and process repeats until stop button pressed.



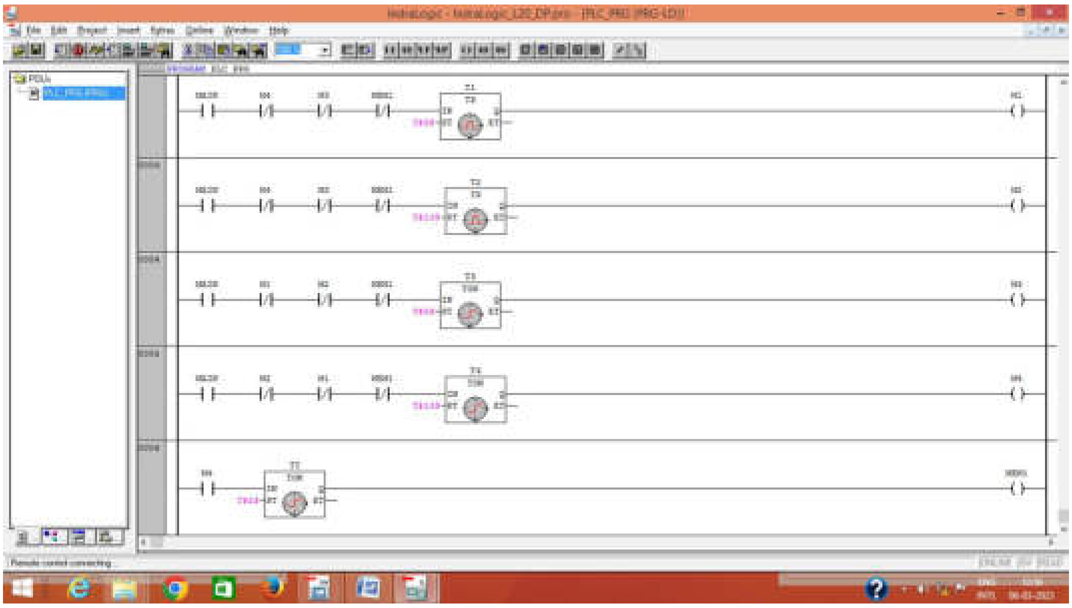


Fig: 3.29 PLC Practical 8

- **Example 9**

Problem Statement: There is an “Entry” and “Exit” in a parking area. Car is sensed at Entry and Exit. When there is no car in parking area Yellow light must be ON. When there are cars between 1-9 present in parking area, Green light must be ON. When there are 10 cars Red light must be on.

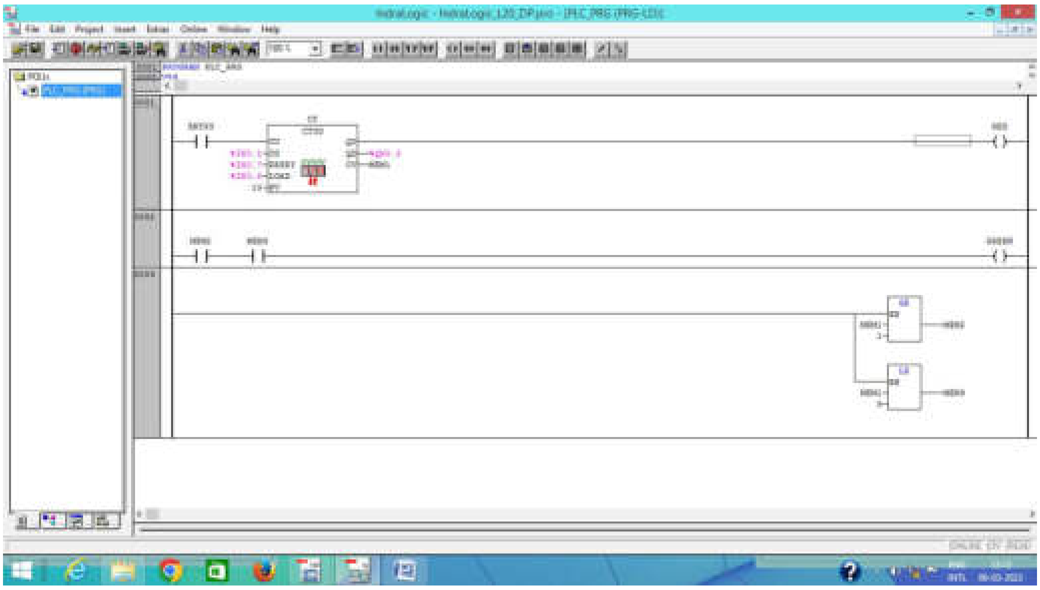


Fig: 3.30 PLC Practical 9

- **Example 10**

Problem Statement: When start switch is pressed L1 lamp will turns ON after 5 sec and L2 lamp turns ON after 7 sec, this process repeats 3 times and then it stops.

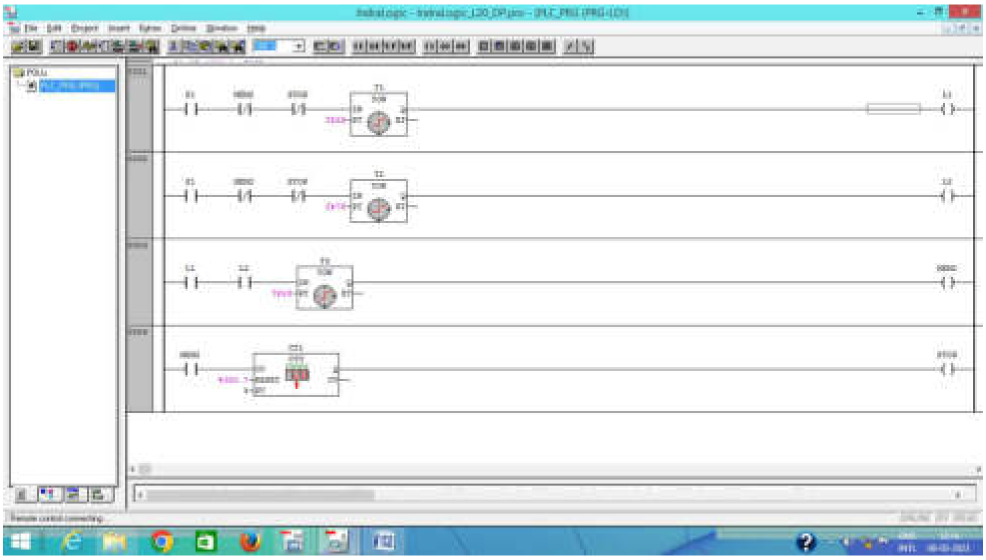


Fig: 3.31 PLC Practical 10

- **Example 11**

Problem Statement: When start button is pressed L1 turns On for 5 sec, L2 turns ON for 7 sec and L3 turns ON for 10 sec using 1 TON and 1 TOF,3 Counters.

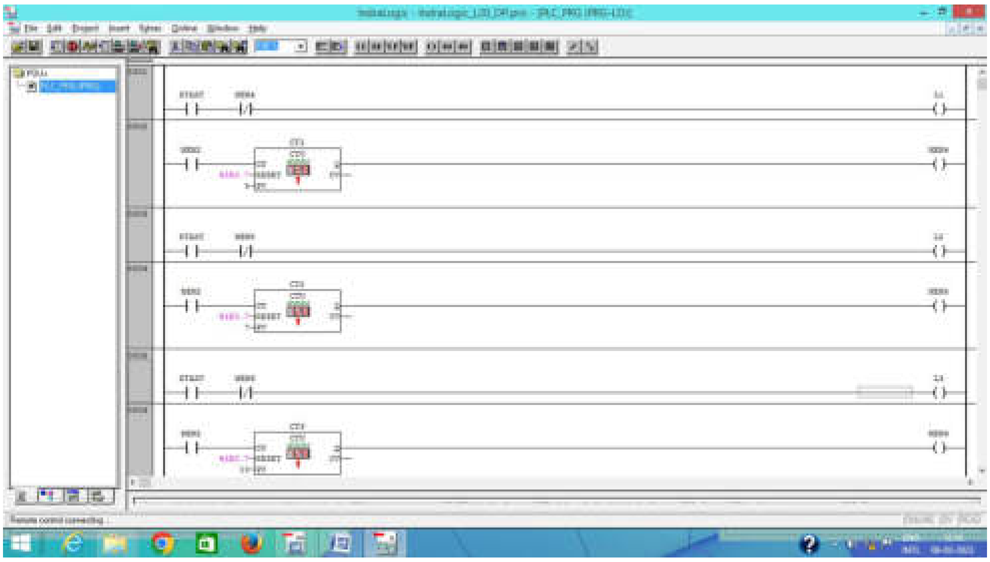


Fig: 3.32 PLC Practical 11

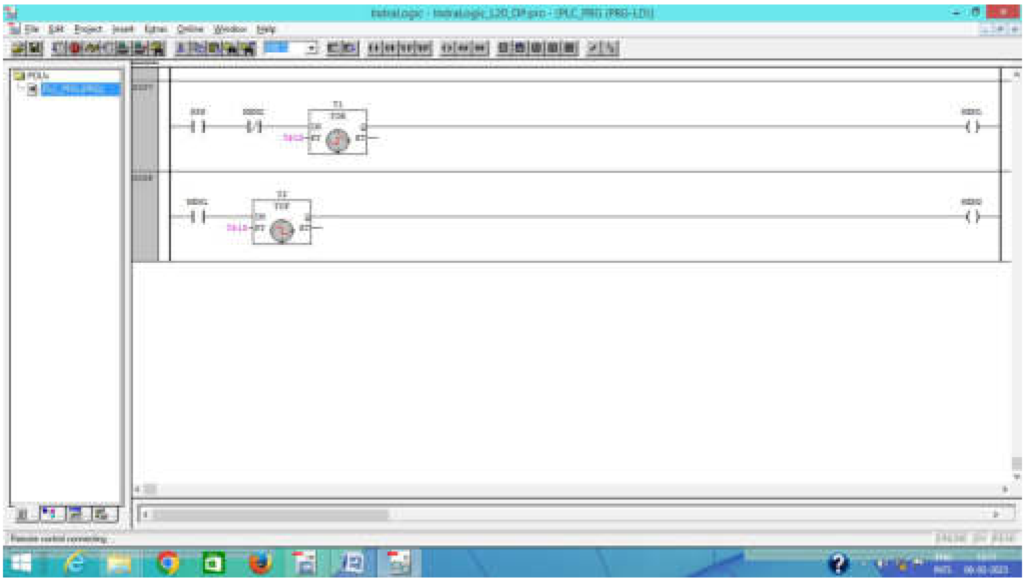


Fig: 3.33 PLC Practical 11

- **Example 12**

Problem Statement: There is a selector switch $1,one "start" button and one "stop" button. IF S.S pressed one along with start button then motor 1 must be ON. If S.S is pressed two times along with Start then motor 2must be ON.If S.S is pressed three times along with Start motor 3 must be ON. IF S.S pressed one time along with stop button then motor 1 must be OFF.If S.S is pressed two times along with Stop then motor 2 must be OFF. If S.S is pressed three times along with Stop motor 3 must be OFF.Use of "SET-

RESET" function.

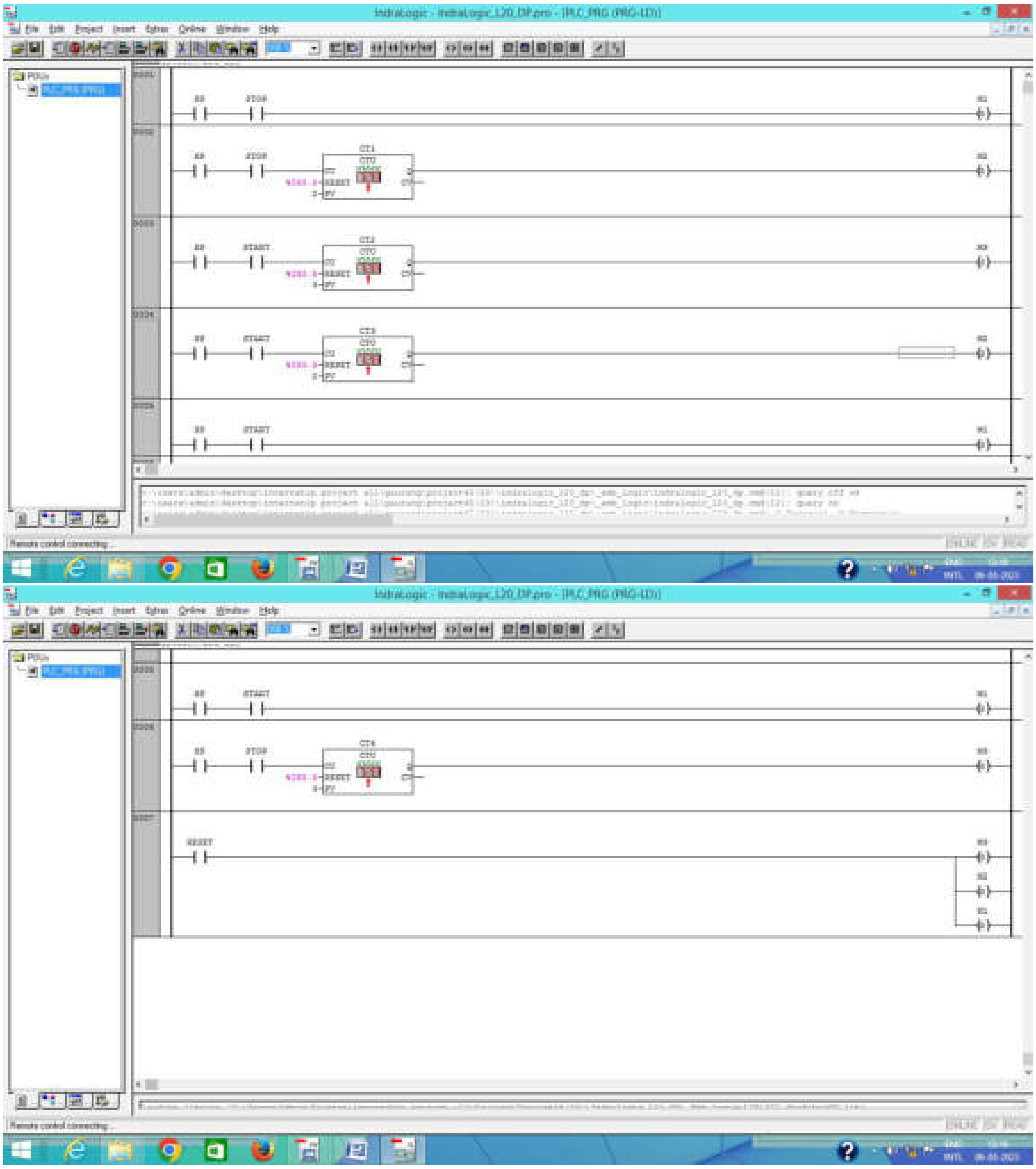


Fig: 3.34 PLC Practical 12

- **Example 13**

Problem Statement:A temperature sensor is used to monitor the temperature of a process continuously.If process temperature is between 95 to 105 degrees then lamp L1 must be "Steady- ON"If temperature is less than 95 degrees then lamp L1 must flash slowly.If temperature is more than 105 degrees then lamp L1 must flash speedily.

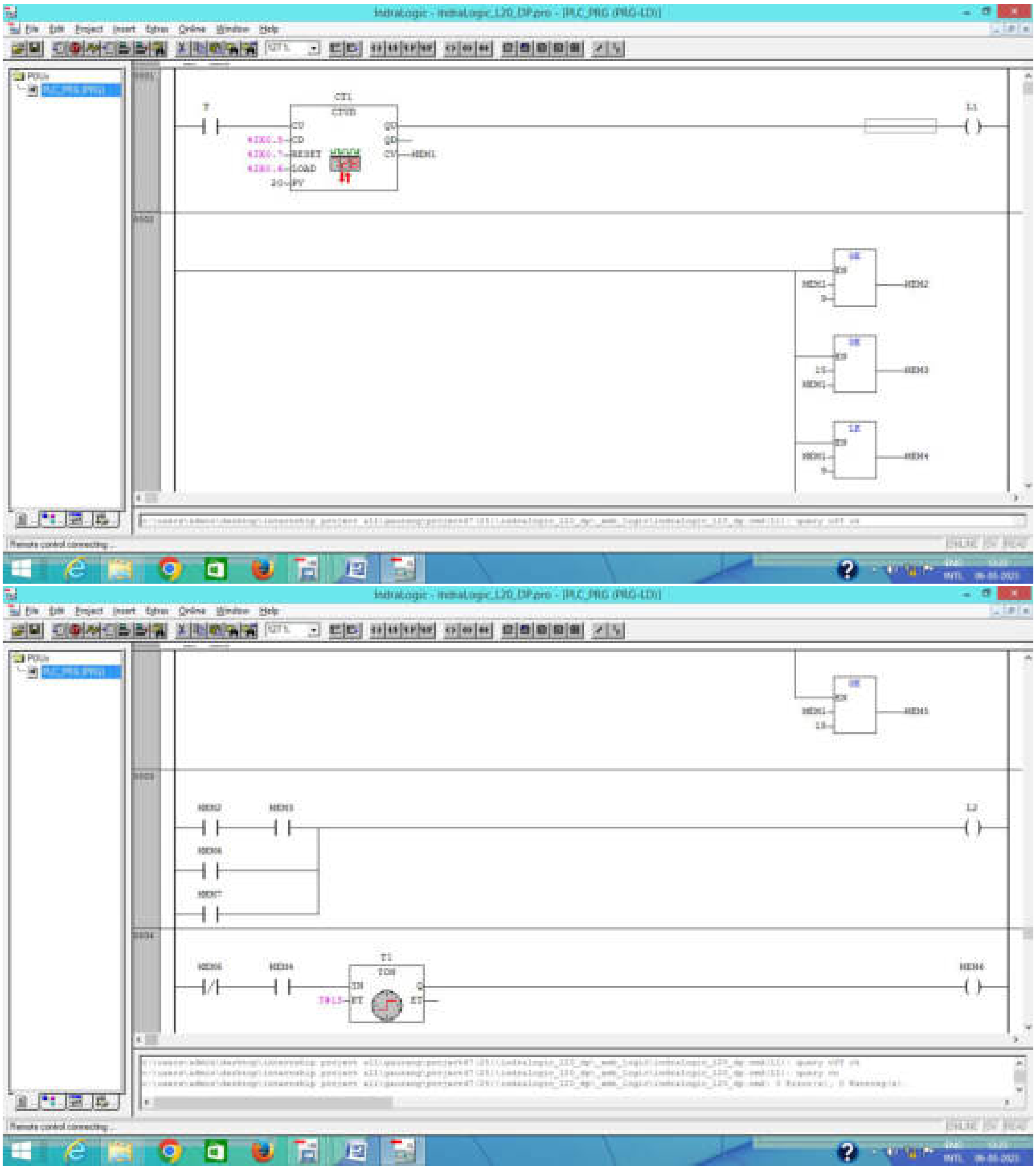


Fig: 3.35 PLC Practical 13

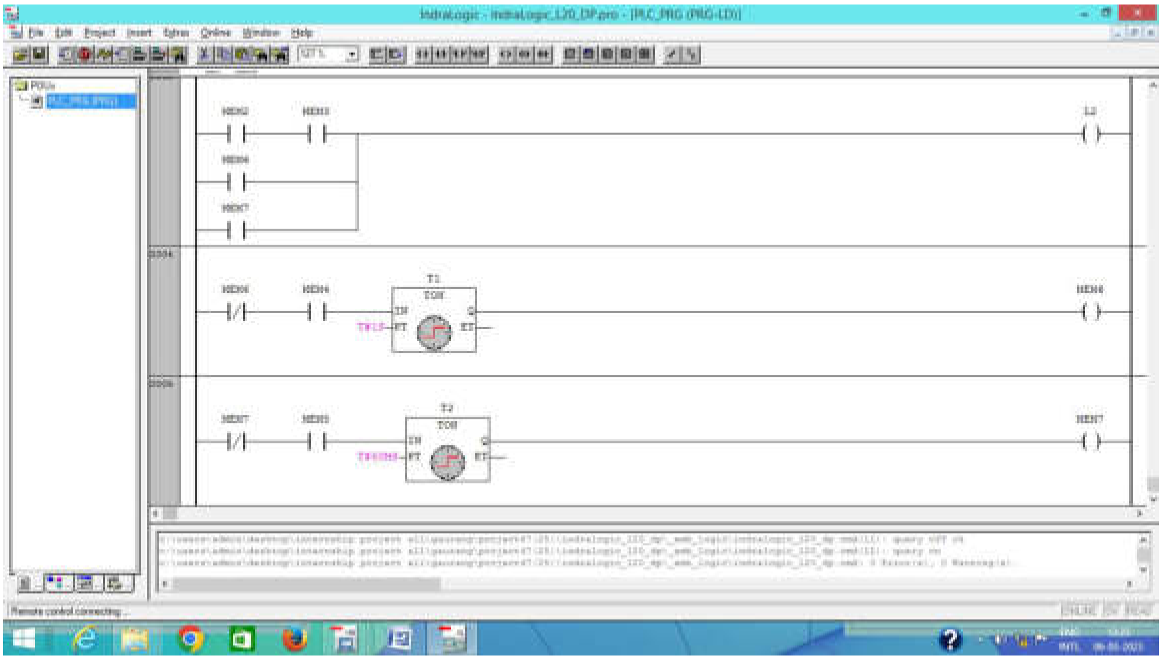


Fig: 3.36 PLC Practical 13

3.9 PLC USED FOR PRACTICAL

Fig: 3.37 PLC IndraControl L20

The IndraControl L20 is a modular and scalable control. It combines the benefits of a compact small control with a standardized I/O system on the basis of terminal technology. It is a hardware platform that can be used for PLC applications. It provides on board interfaces, e. g. high-speed inputs and outputs (8 each) and communication interfaces, such as Ethernet, PROFIBUS and RS232. The locally available I/O units can be extended by the Rexroth Inline I/O system, just by simply mounting the components side by side. Application programs, incl. Runtime, are completely stored to an easily accessible standardized Compact Flash medium. The eight-digit display with four operator keys, the Reset button with light- emitting diode, the RS232 interface, and the receptacle for the Compact Flash card are provided to the left of the unit. Further interfaces (Ethernet, PROFIBUS DP) are located in the central section of the unit. The terminals for digital inputs and outputs (eight each) and the voltage supply connectors are arranged to the right of the unit.

This system is with universal simulator and can be used to carry out 24 different exercises on a universal simulator. The PLC Snap-In feature enables the PLC to be used on a grooved plate. No tools are required to be able to use the standard PLC; the Inputs and outputs can be connected with normal instrument leads.

Main features

- Built in SMPS 24 Digital Inputs, Outputs
- 2 Analog Inputs, Outputs
- Programmable in Ladder, Structured & instruction Text, Sequential & Continuous Flow chart, Functional Block Diagram.

The Control Indra-Logic L20 Consists Of

- Hardware: IndraControl L20 incl. a connector set
- Firmware: IndraLogic L20 (on memory card)

The modular and scalable hardware platform IndraControl L20 can be used in combination with the Indralogic L20 Firmware for PLC applications. The software "IndraWorks Logic" serves to commission and project the IndraLogic L20. It consists of the following components:

- **IndraWorks:** Project planning, configuration.
- **IndraLogic:** PLC programming.
- **IndraWorks HMI:** Visualization and user interface as well as diagnostic functions (ProVi).
- **IndraWorks WinStudio:** Engineering tool to create user screens for IndraWorks HMI.
- **IndraLogic L20 TSP:** Target files (Target Support Package) to edit the Indralogic L20 with IndraWorks and Indralogic.
- **Target Manager:** Management of TSP files. e.g. while updating control functions.

All components are automatically installed.

CHAPTER 4: SENSOR TECHNOLOGY

4.1 INTRODUCTION TO SENSOR

Electronic technologies are rapidly growing. One of the things that really fascinate me that many of the electronic devices around us operate without human touch. Just like humans, with evolving technology, we can sense the things and objects around us. For this technology, the sensor plays an integral role to monitor and detect physical activities and providing information to other electronic devices.

A sensor is an electronic equipment that is used to detect and observe the physical activities and pass the notifcation/signal to other electrical control devices.

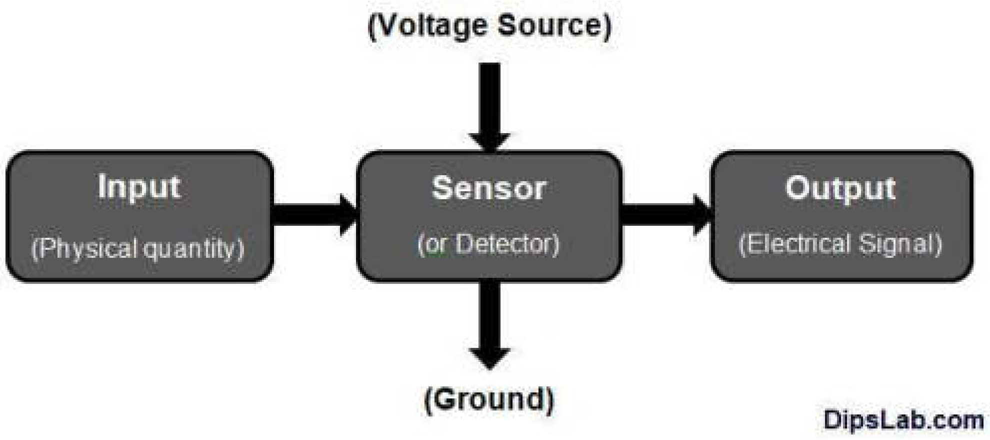


Fig: 4.1 Working of Sensor

In other words, a sensor is an electronic device that can transform energy from one form to another form. So, it is also called a Transducer. The main function of the sensor is to identify and communicate with physical quantities such as temperature, heat, pressure, distance, moisture, gas, and so on. And it provides output in the form of an electrical signal to connected control systems.

For example, in an automation system, the sensor is the most important piece of equipment that provides input to the programmable logic controller (PLC). In daily life applications, commercial and industrial devices, and educational projects, different types of sensors are used with a specific roles.

Sensors are split up into four main categories. Such as,

- Analog Sensor
- Digital Sensor
- Active Sensor
- Passive Sensor

4.1.1 Type of sensor

1.Temperature Sensor
2. Pressure Sensor
3. Touch Sensor
4. Image Sensor
5. Motion Sensor
6. Light Sensor
7. Vibration Sensor
8. Humidity Sensor
9. Proximity Sensor
10. Colour Sensor
11. Radiation Sensor
12. Position Sensor
13. Gas or Smoke Sensor
14. Flow Sensor or Float Sensor
15. Leak Sensor
16. Gas or Smoke Sensor

4.2 INTRODUCTION TO PROXIMITY SENSOR

Switches or detecting devices called proximity sensors may identify a certain object that is close by without making physical touch. All often ask for posture that is somewhat close to the thing being sensed—less than 12 inch. Nearly all proximity sensors are immune to environmental pollutants and conditions, and they practically never need maintenance.

4.2.1 Type of Proximity Sensor

1. Inductive Sensors

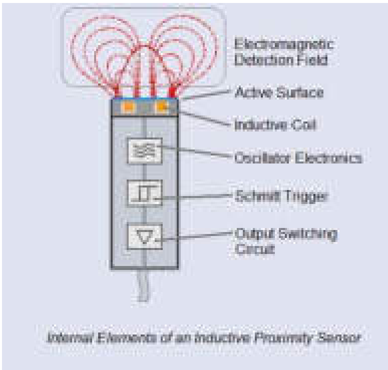
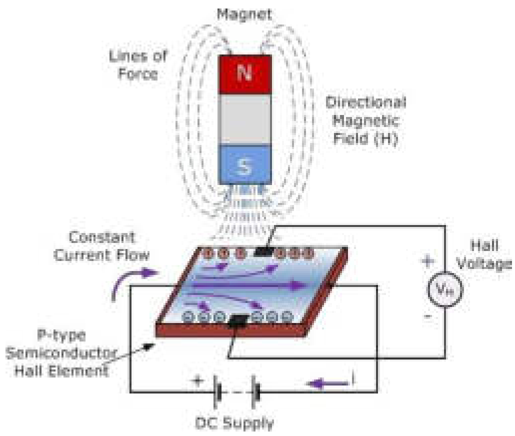


Fig: 4.2 Inductive Sensors

The best ferrous metal detectors are inductive proximity sensors, especially for steel that is thicker than 1 mm. When metal interferes with the magnetic field that these sensors emit, the sensor becomes aware that metal is there. There are shielded inductive sensors that add metal to the field in a predictable way since the presence of any metal, even metal the sensor is embedded in, will impact the sensor. This restricts the sensor's range while enabling it to detect anomalies in the field when fresh metal bits pass past it. Despite having a greater range, unshielded sensors cannot be installed on or close to ferrous metal.

2. Magnetic Sensors



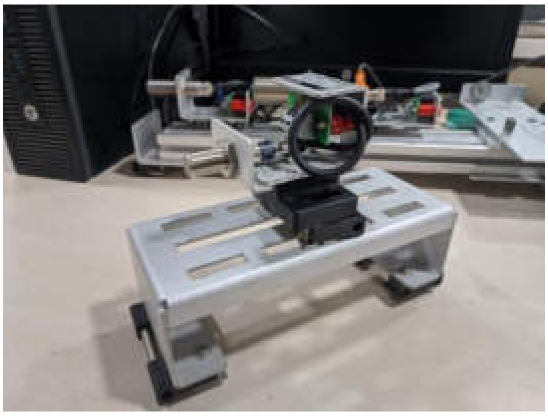
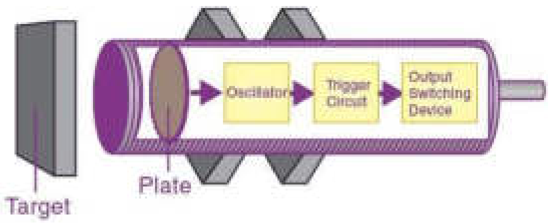


Fig: 4.3 Magnetic Sensors

The ability to detect magnets through non-ferrous metals, plastic, and wood makes magnetic proximity sensors more helpful in clean-in-place (CIP) systems and for monitoring cleaning equipment within pipelines. They also function over a wider range than inductive sensors. These sensors have a reed switch that can detect neighbouring magnets and is hermetically sealed. When a magnet is present, the reed contacts bend and touch one another, forming an electrical contact that notifies the system that a magnet is there.

3. Capacitive Sensors



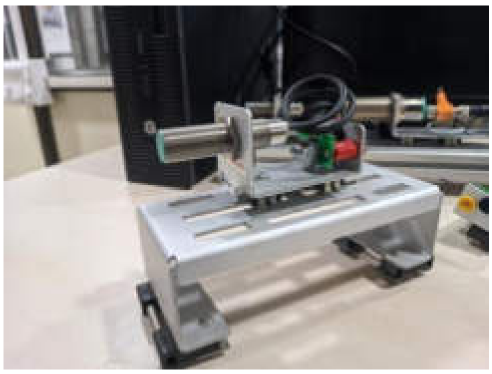
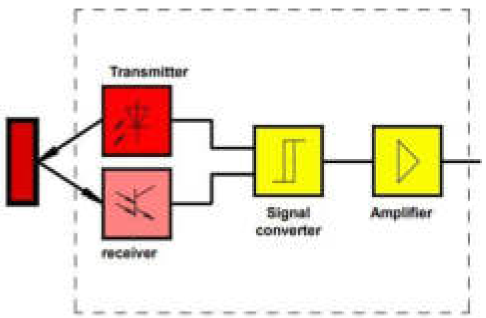


Fig: 4.4 Capacitive Sensors

Because capacitive proximity sensors can detect both metals and non-metals, they are suitable for applications including sight glass monitoring, tank liquid level measurement, and hopper powder level detection. Even when blocked by metallic or non-metallic obstacles, capacitive proximity sensors can still detect airborne particles. These sensors work like an open capacitator using a pair of conduction plates, with the space in between serving as an insulator. The sensor's detecting field is generally inert except for when something enters it and causes capacitance, which alerts the system. As opposed to inductive sensors, which can only detect ferrous metal, capacitive sensors can detect anything in their path, thus it's critical to direct them straight at the object you want to detect.

4. Photoelectric Sensors



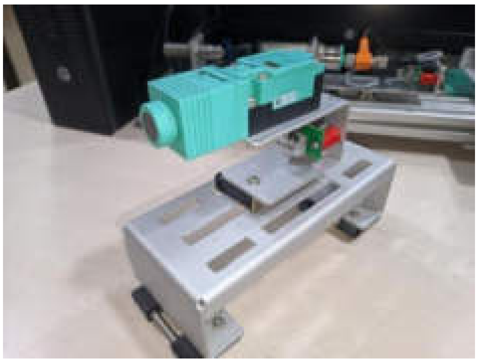


Fig: 4.5 Photoelectric Sensors

Photoelectric proximity sensors are ideally suited for use in environments like conveyor belts and automated sinks as well as in the middle of dense air pollutants. When something blocks the visible or invisible light that photoelectric sensors deliver to a receiver, they warn the system. They come in dark-on and light-on varieties, depending on whether the system is notified when light is received or not.

They come in three types:

Through-beam sensors have an emitter and a receiver that are placed on opposite sides of the region to be detected. These photoelectric sensors are the most dependable but also the priciest. More translucent or lighter-colored items that the beam may travel through can fool them.

Retroreflective sensors place the reflector on the opposite side of the area to be sensed, keeping the emitter and receiver in the same location. These are more practical and less expensive to install, but they are susceptible to being fooled by bright objects that cross the beam.

Diffuse sensors make advantage of the detected object as a reflector. They can differentiate between darker and lighter materials, making them handy for sorting, although they are hindered by less reflecting targets, such as dark matte materials.

5. Ultrasonic Sensors

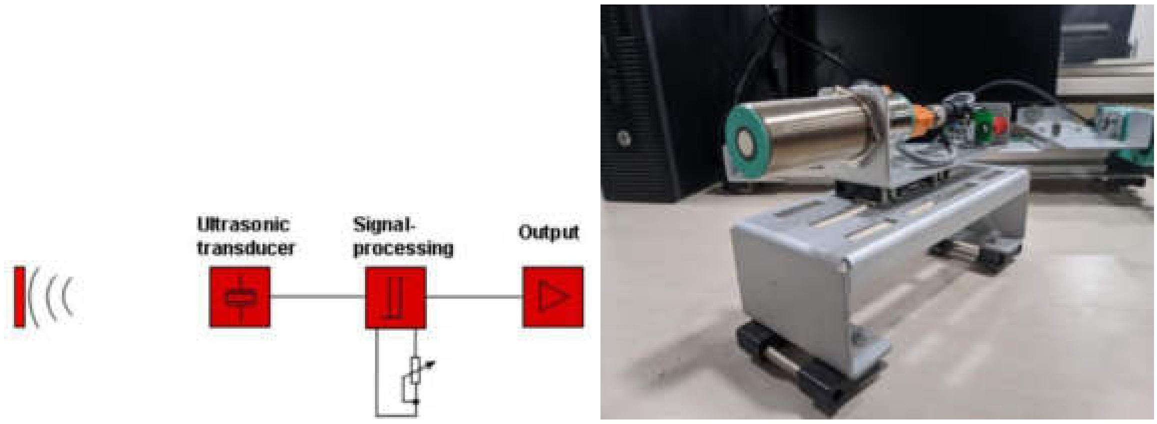


Fig: 4.6 Ultrasonic Sensors

Ultrasonic proximity sensors are widely employed in automated manufacturing and are effective for dark, bright, or transparent materials, including far clear glass, fluid level, and stacks of paper and wood. They work well for materials that muffle sound. The through-beam, retro-reflective, and diffuse configurations of photoelectric sensors are also accessible with these sound wave-based sensors. Unusual textures have the ability to impact ultrasonic sensors and cause sound distortion.

4.3 SENSOR TECHNOLOGY TRAINING KIT BY BOSCH REXROTH

1. Material Sample Kit

Fig: 4.7 Material Sample Kit

Contains various material samples and accessories for performing the sensor technology exercises. Metal, plastic, solenoid and paper samples in different sizes and strengths, reflective and retro foils etc.

2. Sensor Kit

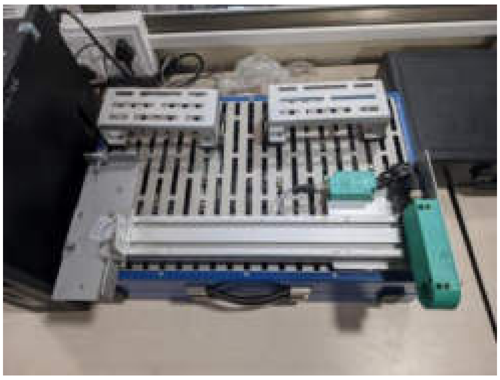


Fig: 4.8 Sensor Kit

Contain various type of sensor Capacitive,ultrasonic,Inductive,Magnetic,Photoelectric sensor andtheir mounting module,junction connection,limit switch etc.

4.4 PRACTICAL EXAMPLE ON SENSOR TECHNOLOGY

4.4.1 Behaviour Of Capacitive Sensor

Practice Implementation: Approach sensor with different material sample one after another. While doing so,observe the switching status of the led display.

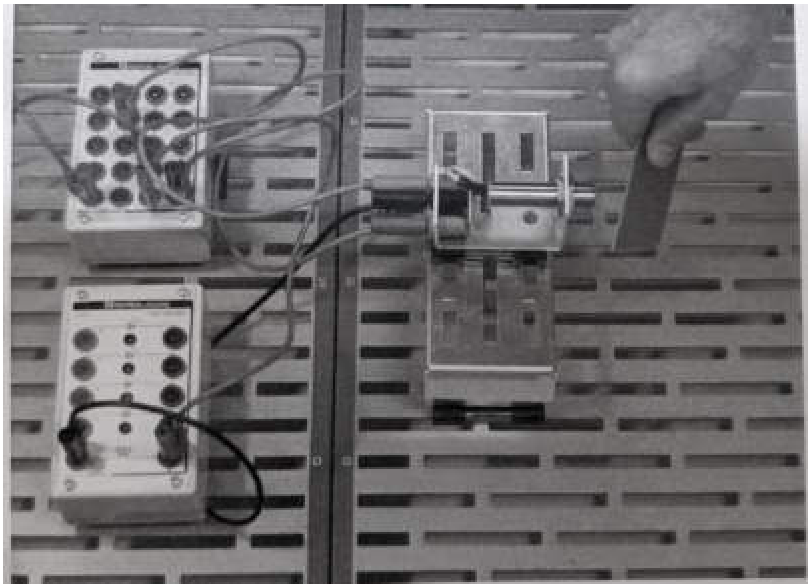


Fig: 4.9 Sensor Practical 1

Table 4.1 Practical Reading 1

Material	Sample Detected?
Steel	Yes
Plastic	Yes
Plastic clear	Yes
Copper	Yes
Cardboard	Yes
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Sheet of Paper	Yes
Foam	Yes

4.4.2 Behaviour Of Inductive Sensor

Practice Implementation: Approach sensor with different material sample one after another. While doing so,observe the switching status of the led display.

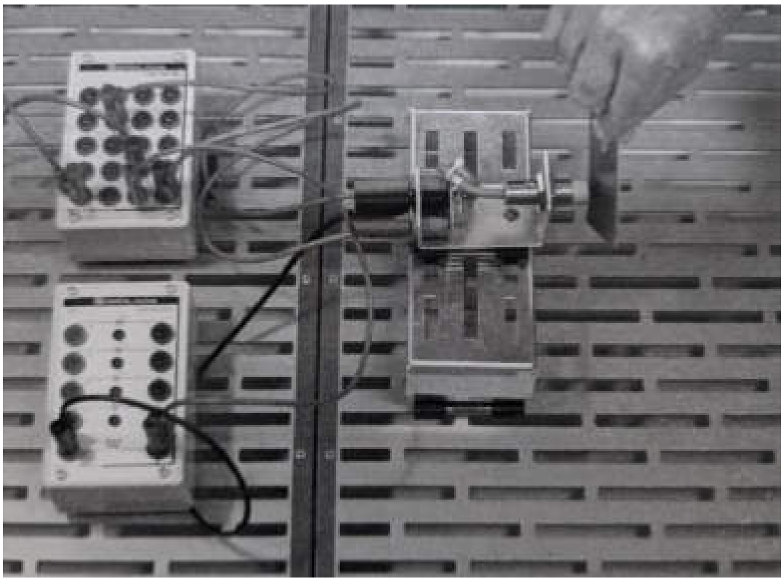


Fig: 4.10 Sensor Practical 2

Table 4.2 Practical Reading 2

Material	Sample Detected?
Steel	Yes
Plastic	No
Plastic clear	No
Copper	Yes
Cardboard	No
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Sheet of Paper	No
Foam	No

4.4.3 Behaviour Of Magnetic Sensor

Practice Implementation: Approach sensor with the solenoid vertically and in parallel to the sensor axis. While doing so,observe the switching status of the led display.

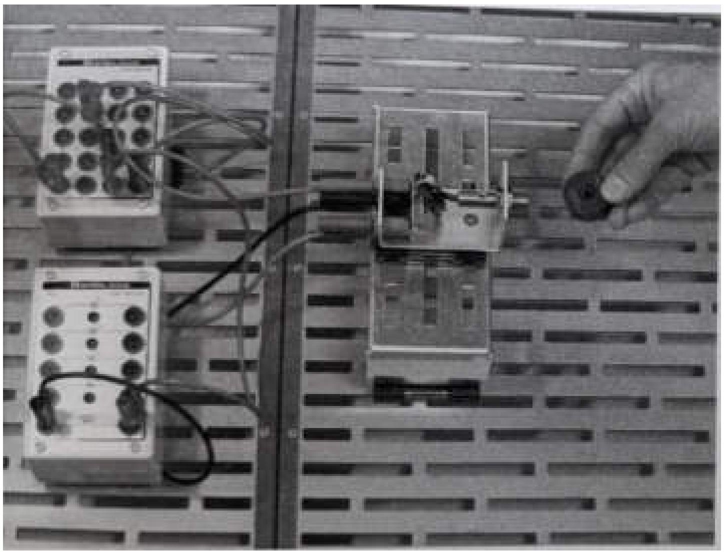


Fig: 4.11 Sensor Practical 3

Table 4.3 Practical Reading 3

Material	Sample Detected?
Steel	No
Plastic	No
Plastic clear	No
Copper	No
Cardboard	No
Aluminium	No
Solenoid Parallel	Yes
Solenoid Vertical	Yes
Sheet of Paper	No
Foam	No

4.4.4 Behaviour Of Reflection Light Sensor

Practice Implementation: Set the sensor sensitivity and check the material sample one by one that sensor just detected or not. Check clear plastic that light source passing or not.

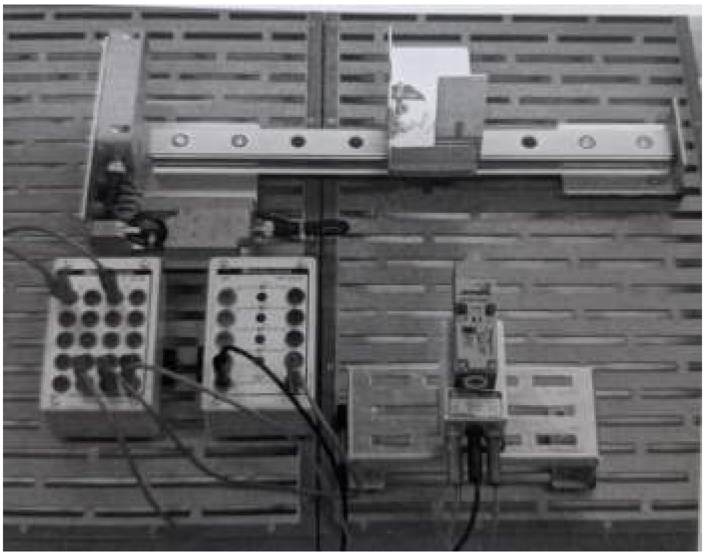


Fig: 4.12 Sensor Practical 4

Table 4.4 Practical Reading 4

Material	Sample Detected?
Steel	Yes
Plastic	Yes
Copper	Yes
Cardboard	Yes
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Sheet of Paper	Yes
Foam	Yes
Mirror Vertical	Yes
Mirror Rotated 45degree	No

4.4.5 Behaviour Of One-Way Light Sensor

Practice Implementation: Setting the sensitivity at the light scanner: Over the closer optical wave guide head, aim at the other optical wave guide head. Both must lie on one (optical) axis. Pass all the sample material through light barrier and observe the switching status of the LED.

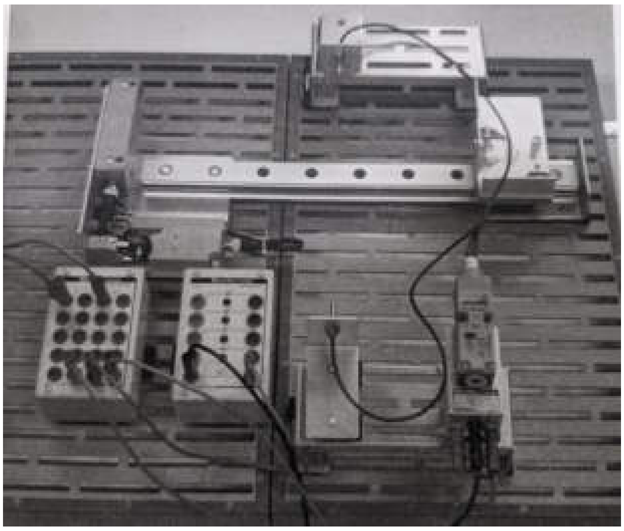


Fig: 4.13 Sensor Practical 5

Table 4.5 Practical Reading 5

Material	Sample Detected?
Steel	Yes
Plastic	Yes
Plastic clear	Yes
Copper	Yes
Cardboard	Yes
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Sheet of Paper	Yes
Foam	Yes

4.4.6 Behaviour Of Reflection light Barrier Light Sensor

Practice Implementation: Set the sensor sensitivity so that the reflector is safely detected. More the sample to the side. Carefully rotate the small slotted screw counterclockwise first until the yellow light goes out (if it was on). Rotate it back clockwise until the yellow LED is switched on dd approx. 45 degrees.

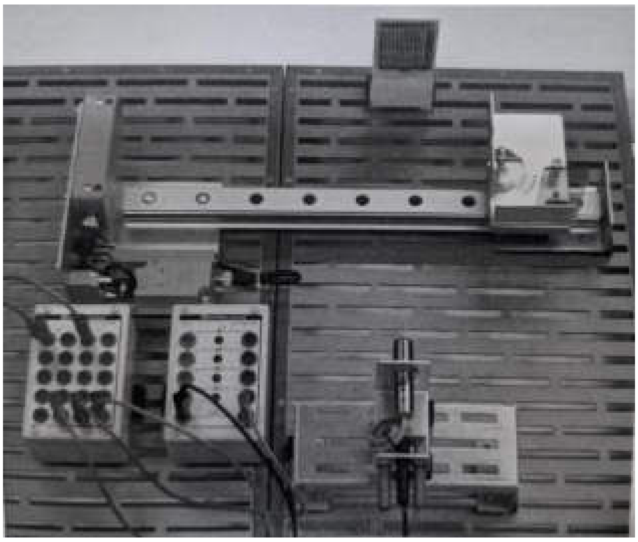


Fig: 4.14 Sensor Practical 6

Table 4.6 Practical Reading 6

Material	Sample Detected?
Steel	Yes
Plastic	Yes
Plastic clear	Yes
Copper	Yes
Cardboard	Yes
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Mirror Vertical	Yes
Mirror Rotated 45 degree	No

4.4.7 Behaviour Of Ultrasonic Sensor

Practice Implementation: Calibrating the switching point (250 mm): Using function 3 of the connected UB-Prog programming unit, you can calibrate the desired switching point. In this connection, the NO contact function is determined. Move the target about 250 mm away from the sensor. After the white sample, approach the ultrasonic sensor with all other material samples from the following table and observe the switching status of the LED display.

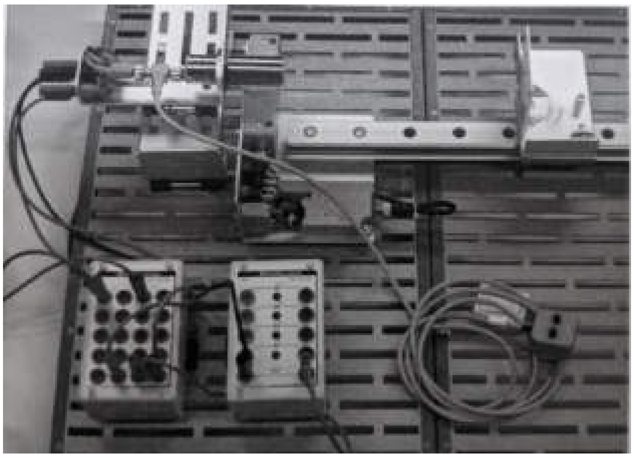


Fig: 4.15 Sensor Practical 7

Table 4.7 Practical Reading 7

Material	Sample Detected?
Steel	Yes
Plastic	Yes
Plastic clear	Yes
Copper	Yes
Cardboard	Yes
Aluminium	Yes
Solenoid	Yes
Brass	Yes
Sheet of Paper	Yes
Foam	Yes

CHAPTER 5: AUTOMATION STUDIO

5.1 INTRODUCTION TO AUTOMATION STUDIO

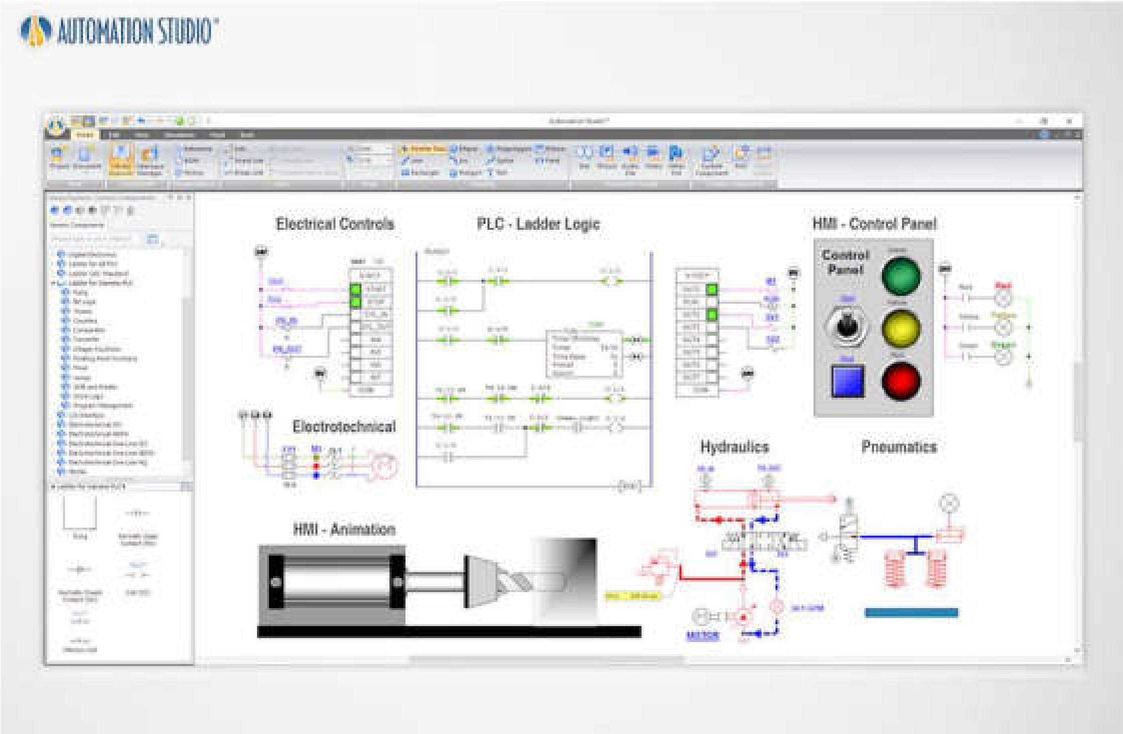


Fig: 5.1 Automation Studio

Automation Studio is a software tool that provides a diverse range of design and simulation capabilities, encompassing all machine/project technologies like electrical, fluid power, HMI, communications, and controls throughout the entire product lifecycle. This software assists in amalgamating these different technologies together that can be used to design, document and simulate the complete systems very easily and efficiently.

The software is designed for schools that teach technical subjects such as industrial technologies, mechatronics, electromechanical technologies, electrical & electronics, automation, and maintenance. Modeling and simulation are used to illustrate theoretical aspects.

Automation Studio has various symbol libraries. All libraries follow standards such as ISO, IEC, JIC and NEMA.

- Hydraulics
- Hydraulic Manifold Block
- Pneumatics
- Electrical (IEC & NEMA standards)
- Fluid Power & Electrical Component Sizing
- Valve Spool Designer
- OPC communications server
- Bill of Materials & Report
- PLC Ladder Logic
- HMI & Control Panel
- Digital Electronics
- Sequential Function Chart (GRAFCET)
- Electrical Controls
- Multi-Fluid Simulation
- Teachware
- Manufacturer's Catalogue
- Workflow Manager
- Block Diagram (Math) Workshop
- CANBus
- Communication Interface with Unity 3D
- System Analysis (FMECA)

Automation Studio is used as a design and simulation tool in the fields of hydraulics, pneumatic, electrical and automation.

1. Automation Studio Hydraulics:

Automation Studio Hydraulics' functions are used for hydraulic system engineering purposes. Automation Studio Hydraulics includes a specific symbol library and uses modeling techniques such the Bernoulli's law and the gradient method. It is the main aspect of Automation Studio: it is used to conceive and to test hydraulic systems while

taking into account thermal parameters. It displays inside views of the elements in the schematics. The Automation Studio library includes additional elements such as commands and control devices (PID controller, CAN bus, and servo-direction). Fluid power is one of the central elements in such simulation.

2. Automation Studio Pneumatics:

Automation Studio Pneumatics is similar to Automation Studio Hydraulics, but the simulation is done for air rather than fluids. This library, like Automation Studio Hydraulics, is used to design and test models. Thus, the simulation elements that are used are not the same as those in the hydraulics library.

3. Automation Studio Electrotechnical:

The electrotechnical module in Automation Studio is used for design, simulation, validation, documentation and troubleshooting of electrical diagrams. It includes multi-line and one-line representation according to the users' choice. The different aspects of the IEC and NEMA international standards are respected: components' identification, symbols, ratings, ports names, ... etc. The electrotechnical module works simultaneously with the fluid power technologies which allows the users to design and simulate complete systems.

5.2 PRACTICAL EXAMPLE ON SENSOR TECHNOLOGY

Practical 1

Statement: Sequencing of two double acting cylinder using pressure relief valve and 4/2 DCV On pressing extand P.B. and retract P.B.

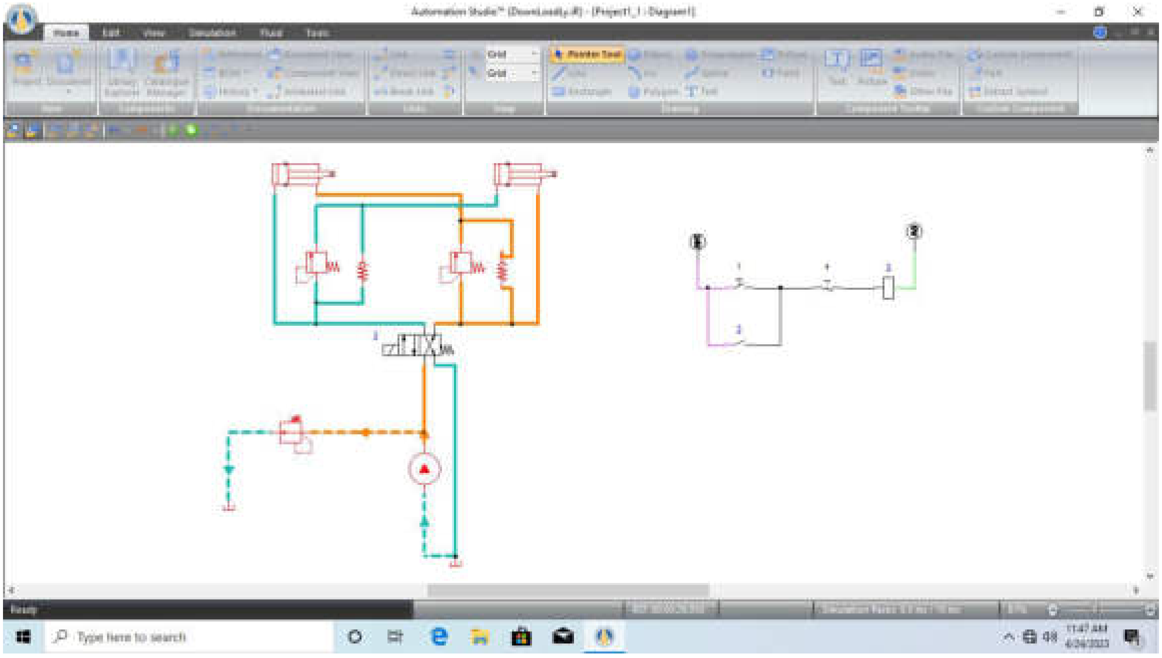


Fig: 5.2 Automation Studio Practical 1

Practical 2

Statement: Sequencing of two double acting cylinder using proximity sensor and 4/2 DCV On pressing extand P.B. and retract P.B.

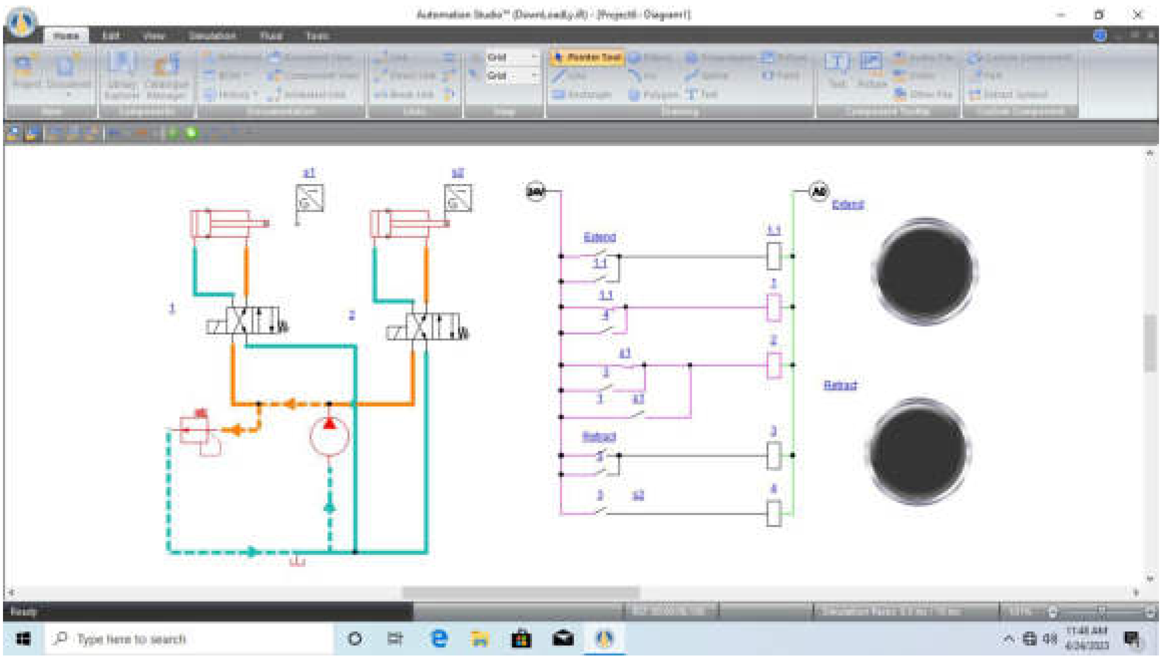


Fig: 5.3 Automation Studio Practical 2

Practical 3

Statement: Application of proportional valve extend and retact a cylinder using a proportional solenoid operated DCV, operator DCV using slider type set point generator.

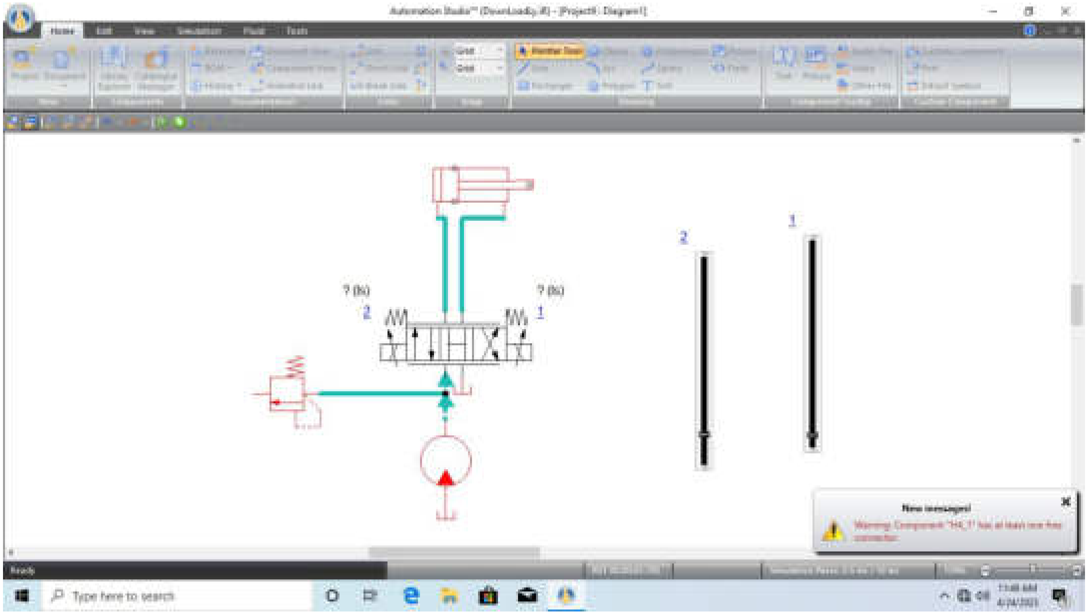


Fig: 5.4 Automation Studio Practical 3

Practical 4

Statement: Application of unloading valve.

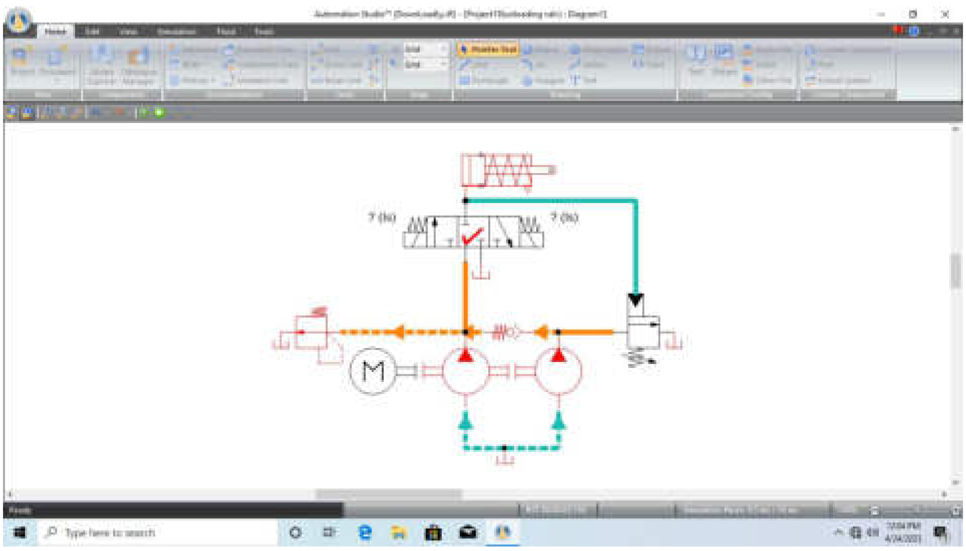


Fig: 5.5 Automation Studio Practical 4

Practical 5

Statement: Operate basic pneumatic circuit using 3/2 and 5/2 DCV.

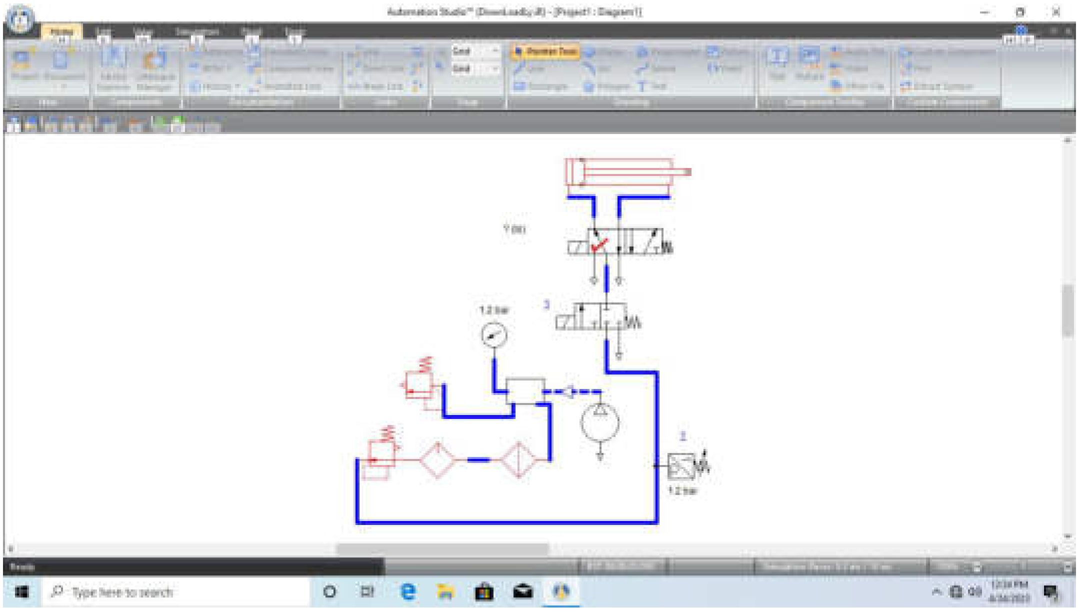


Fig: 5.6 Automation Studio Practical 5

Practical 6

Statement: Continously operate double acting cylinder circuit using 3/2 DCV roller operated and 5/2 pilot operated DCV.

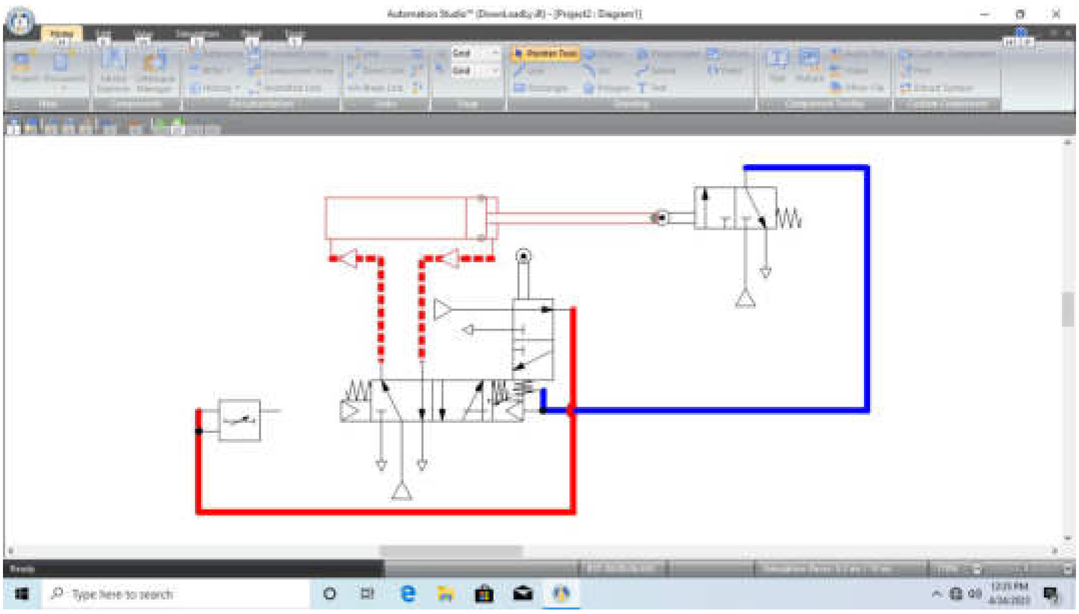


Fig: 5.7 Automation Studio Practical 6

CHAPTER 6: INTRODUCTION TO HYDRAULICS

6.1 BASICS OF HYDRAULIC SYSTEM

Hydraulics is the creation of forces and motion with the use of hydraulic fluids, which serve as the power transmission medium. The operation of heavy machinery depends largely on hydraulic systems.The term "hydraulics," which gets its name from the Greek word for water, originally referred to the study of the physical characteristics of water both at rest and in motion. In modern usage, the definition has been broadened to encompass the physical behaviour of all liquids, including hydraulic fluids. In the industry, hydraulic systems are not new. They have made it possible to run a variety of industrial machinery. Newer hydraulic-powered systems are being created as a result of the development of increasingly complex industrial equipment.

Two fields of hydraulics science can be distinguished: hydrodynamics and hydrostatics. The study of hydrodynamics focuses on fluid motion. Water wheels and turbines are examples of uses of hydrodynamics; the energy utilised is that produced by the velocity of the water and the torque converter. The study of hydrostatics focuses on liquids under pressure. Hydraulic jacks, hydraulic presses, and hydraulic cylinder actuation are a few examples of hydrostatics in action. Pushing on a trapped (contained) liquid in a hydrostatic device transfers power. Movement occurs in a system if the liquid flows or moves inside it. The majority of hydraulically based devices in use today work hydrostatically.

6.1.1 Basic Characteristics of Hydraulics

There are many appealing aspects of hydraulic systems. The high initial cost of the numerous components is, however, a drawback. Hydraulic systems are the most cost-effective method of power transmission due to their numerous benefits, which more than make up for this. The advantages of hydraulic systems are covered in the following sentences:-

Efficiency: Discounting any losses that can occur in its mechanical linkage, practically all the energy transmitted through a hydraulic system is received at the output end where the work is performed.

Dependability: The hydraulic system is consistently reliable. Unlike the other systems mentioned, itis not subjected to changes in performance or to sudden unexpected failure.

Control Sensitivity: The confined liquid of a hydraulic system operates like a bar of steel in transmitting force. However, the moving parts are lightweight and can be almost.

Flexibility of Installation: Hydraulic lines can be run almost anywhere. Unlike mechanical systems that must follow straight paths, the lines of a hydraulic system can be led around obstructions.

Low Space Requirement: The functional parts of a hydraulic system are small in comparison to those of other systems; therefore, the total space requirement is comparatively low.

6.1.2 Basic components of a hydraulic system

Regardless of its function and design, a hydraulic system has a minimum number of basic componentsin addition to a means through which the fluid is transmitted. A basic system consists of a hydraulic pump, reservoir for hydraulic fluid, directional valve, check valve, pressure relieve valve, selector valve, actuator, and filter. The basic hydraulic system is shown in below figure.

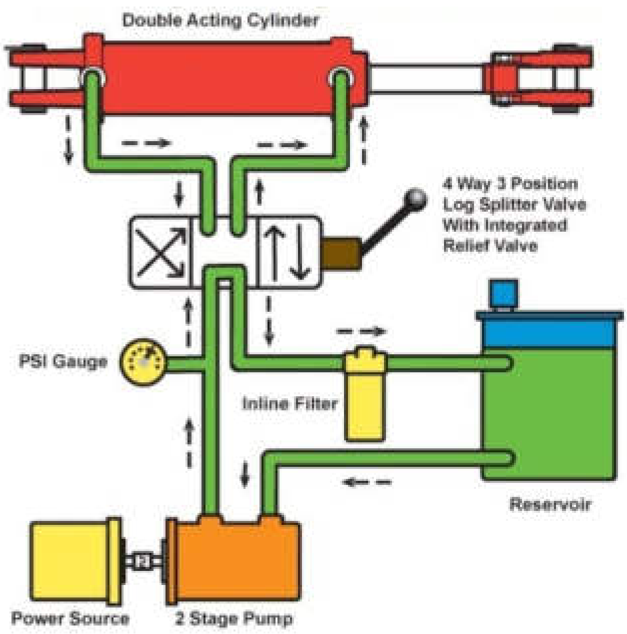


Fig: 6.1 Basic Components of a Hydraulic System

6.1.3 Application of Hydraulic System

1. **Machine tools:** CNC (computerized numerical control) machines, hydraulic presses, hydraulicshapers, etc.
2. **Material Handling Equipment:** Elevators, forklifts, cranes, lifts and hoists etc.
3. **Construction field:** Earthmoving machines such as excavators, cranes, dozers, loaders, dumpers,tippers, trucks, tractors, etc.
4. **Automobiles:** Hydraulic brakes, hydraulic steering, hydraulic suspension, hydraulic clutch, hydraulic power transmission, hydraulic coupling,
5. **Material testing laboratory:** UTM (universal testing machine) and other destructive testingMachines, BP (burst pressure) testing machine etc.
6. **Aerospace:** Landing gear, brakes, flight controls (such as), cargo loading door, rudder, elevator,flap, aileron, etc.
7. **Railways:** Hydraulic brakes, hydraulic steering, hydraulic suspension, hydraulic clutch, hydraulicpower transmission, hydraulic coupling hydraulic torque converter.
8. **Marine Field:** Ship steering system, ship-yards, ship-building.
9. **Medical Equipment:** Medical chairs and operating tables.
10. **Agricultural Equipment:** Harvesters, tractors, field sprayers, seeding machine, fertilizer machineetc.

6.1.4 Advantages and Disadvantages of Hydraulic System

- **The basic advantages offered by a hydraulic system are as follows:**

- Hydraulic power is easy to produce, transmit, store, regulate and control, maintain and transform.
- Weight to power ratio of a hydraulic system is comparatively less than that for anelectromechanical system.
- It is possible to generate high gain in force and power amplification.
- Hydraulic systems are uniform and smooth, generate step-less motion and variable speed andforce to a greater accuracy.
- The division and distribution of hydraulic power is simpler and easier than other forms of energy.
- Limiting and balancing of hydraulic forces are easily performed.
- Frictional resistance is much less in a hydraulic system as compared to a mechanical movement.
- Hydraulic elements can be located at any place and controlled reversely.
- The noise and vibration produced by hydraulic pumps is minimal.
- Hydraulic systems are cheaper if one considers the high efficiency -of power transmission.
- Easy maintenance of hydraulic system is another advantage.
- Hydraulics is mechanically safe, compact, and is adaptable to other forms of power and can be easily controlled.
- Hydraulic output can be both linear, rotational, and angular. The use of flexible connections in the hydraulic system permits the generation of compound motion without gears etc.
- Hydraulics is a better over-load safe power system. This can be easily achieved by using a pressure relief valve.

- **Hydraulic Systems Have Some Drawbacks Which Are As Follows:**

- Hydraulic elements have to be machined to a high degree of precision which increases the manufacturing cost of the system.
- Certain hydraulic systems are exposed to unfriendly climate and dirty atmosphere as the in case ofmobile hydraulics like dumpers, loaders, etc.
- The leakage of hydraulic oil poses problems to hydraulic users.
- Hydraulic elements have to be specially treated to protect them against rust, corrosion, dirt, etc.
- Hydraulic oil may pose problems if it disintegrates due to aging and chemical deterioration.
- Petroleum-based hydraulic oil may pose fire hazards thus limiting the upper level of working temperature. However, due to the availability of synthetic fire-resistant oils this problem is of academic interest nowadays. To combat the environmental effects of petroleum and chemical- based oils, efforts are on to use biodegradable oils now.

6.1.5 HYDRAULIC OIL

Main function of fluid in hydraulic system is to transfer forces and movements.

- Types – mineral oil, synthetic hydraulic fluids,
  ecologically acceptablefluids, water, special fluids
- Fluid requirements – Lubrication and anti wear characteristics, viscosity, viscosity index, compatibility with different materials, stability against shearing, stability against thermal loads, stability against oxidation, low compressibility, low thermal expansion, little formation of foam, high boiling point and low steam pressure, high density, good thermal conductivity, fire resistance, non toxic, good filtration capability, no formation of silt, cost and availability, ecologically acceptable fluids.

6.2 TYPES OF PUMP

The function of the pump is to pump hydraulic oil to the hydraulic circuit It converts the mechanical energy (rotation of shaft) into hydraulic energy. It can be divided in to two categories are as follow:

Positive Displacement pump

- Definition: Constant flow output regardless of pressure change at output.
- Examples: Gear pump, lobe pump, piston pump, vane pump

Non-Positive displacement pump

- Definition: Their flow output changed according to outlet pressure changes
- Examples: Axial pump,centrifugal pump

6.2.1 Gear Pump

A gear pump is a type of positive displacement (PD) pump. It moves a fluid by repeatedly enclosing a fixed volume using interlocking cogs or gears, transferring it mechanically using a cyclic pumping action. It delivers a smooth pulse-free flow proportional to the rotational speed of its gears. Gear pumps use the actions of rotating cogs or gears to transfer fluids. The rotating element develops a liquid seal with the pump casing and creates suction at the pump inlet. Fluid, drawn into the pump, is enclosed within the cavities of its rotating gears and transferred to the discharge. There are two basic designs of gear pump: external and internal.

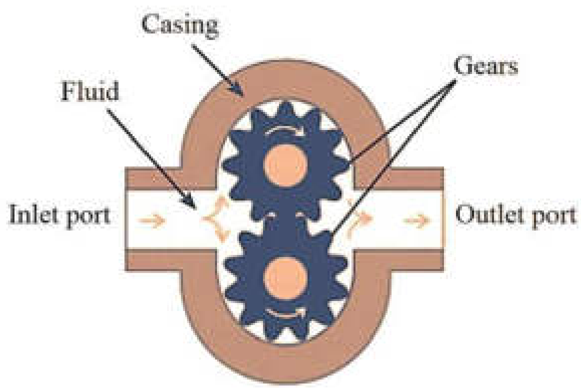


Fig: 6.2 Gear Pump

6.2.2 Rotary lobe Pump

Rotary lobe pumps are positive-displacement type pumps that use two or more lobes rotating around parallel shafts in the pump's body to move liquids. They are widely used in the hygienic processing industries, including food & beverage processing and biopharmaceutical manufacturing. Unlike gear pumps, the lobes used in these pumps do not make physical contact with each other, a feature that provides some distinct advantages in pumping certain types of materials.

The shafts to which the lobes are attached rotate in opposite directions when in operation, repeatedly creating and then collapsing cavities inside the body of the pump, and moving product from the pump's inlet port around the outside of the pump's lobes to the outlet port. Since the movement of the pump's lobes cause the pump to discharge a specific amount of fluid each revolution, the pump's output can easily be controlled by mechanically varying the speed of the pump's motor, typically with the use of a variable frequency drive (VFD).

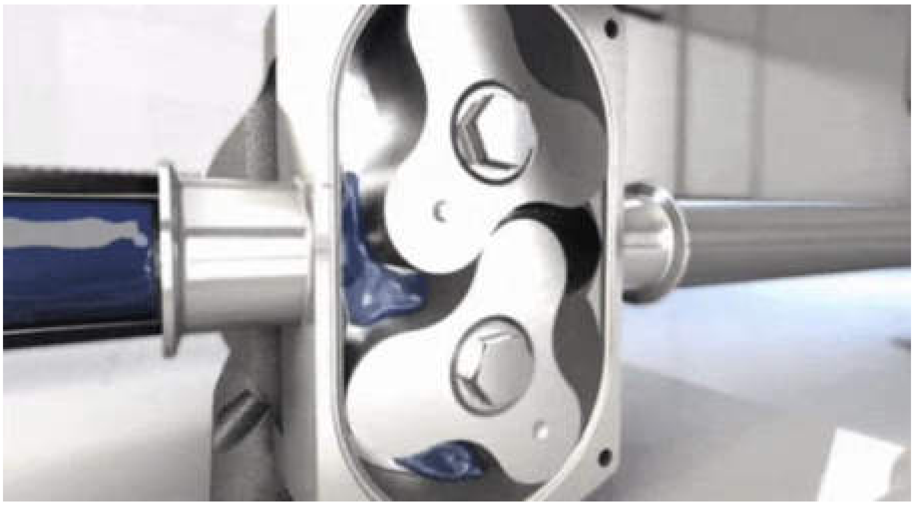


Fig: 6.3 Rotary lobe Pump

6.2.3 Axial piston Pump

Axial piston pumps are positive displacement pumps that use multiple cylinders grouped around a central axis. The group of cylinders, usually containing an odd number, is called a cylinder block. The pistons within each cylinder are attached to a swash plate. The swash plate is also known as a cam or wobble plate and attaches to a rotating shaft. As the shaft turns, the angle of the swash plate changes, which drives the pistons in and out of their respective cylinders.

Since the swash plate is at an angle to the axis of rotation, the pistons must reciprocate axially as they orbit around the cylinder block axis. The axial motion of the pistons is sinusoidal. As a piston rises, it moves toward the valve plate. At this point in the rotation, the fluid trapped between the buried end of the piston and the valve plate is expelled to the pump's discharge port through one of the valve plate's semi-circular ports. As the piston moves back toward the valve plate, the fluid is pushed through the discharge port of the valve plate.

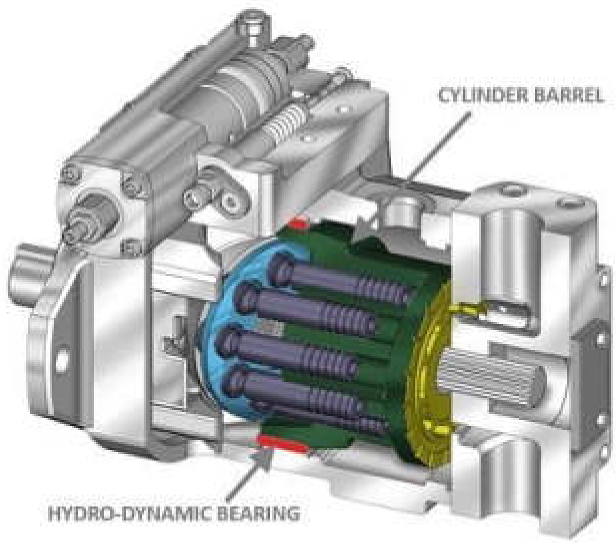


Fig: 6.4 Axial piston Pump

6.2.4 Vane Pump

A vane pump is a self-priming positive displacement pump providing constant flow at varying pressures. Operation is via a motor connected to a gearbox as typically the maximum rpm is 900. The pump is fitted with a relief valve to prevent the pump from building to a pressure which may damage the pump.

A slotted rotor with vanes is part of the pump head. The vanes divide the pump head into segmented chambers within the rotor and outer casing, which allows the vane pump to be self-priming because the chambers function similarly to valves. Vane Pump Head with Rotor-Mounted Vanes.

The majority of the pump head is round, but there is a flat area where the vanes enter and exit the mainrotor. When the pump is running, the centrifugal force will cause the vanes to push out towards the casing, maintaining a tight fit against the casing. The casing is flatter and tighter against the rotor as the vanes approach the pump outlet, pushing the vane into the rotor and allowing the fluid to dischargevia the pump outlet.

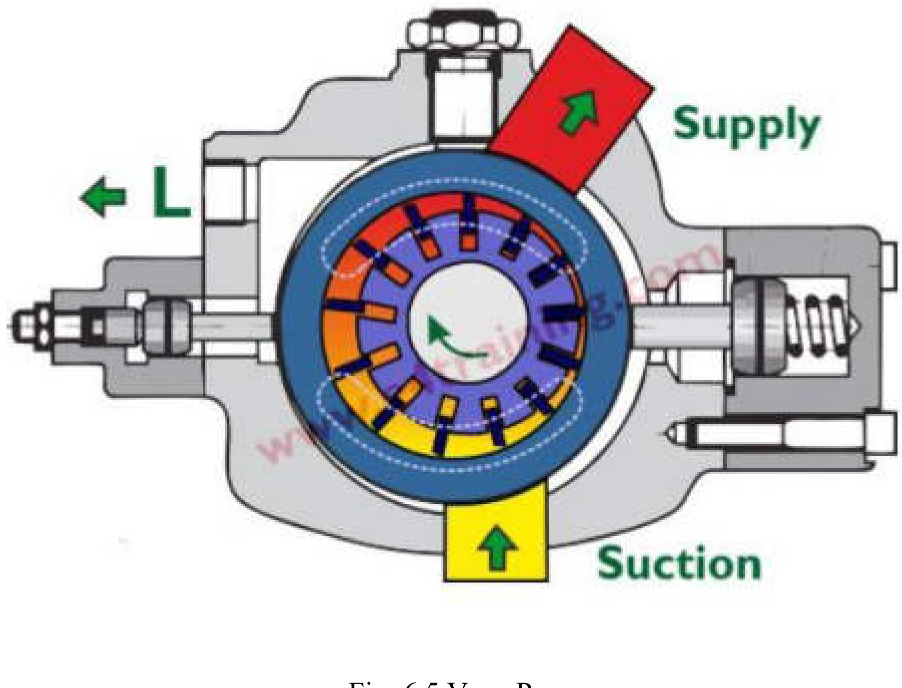


Fig: 6.5 Vane Pump

6.3 TYPES OF VALVE

1. Directional control valves (DCV)

Directional control valves allow fluids or gases to flow into different paths from valve ports, which provide a passageway for flow to or from other components/sources. They are one of the most important parts of hydraulic and pneumatic systems. A directional control valve consists of a mechanically or electrically actuated spool inside a cylinder. The spool's position allows or prevents fluid flow within the passageway; this often

occurs instantly, causing fluid to accelerate and decelerate rapidly.
When selecting a directional control valve, two primary elements must be considered: the number of ports and directional positions the valve can achieve. The number of positions refers to the number of flow paths a valve can provide.

There are five main operating methods used for directional control valves, all dependent on their applications: manual, spring, electrical, pneumatic, and hydraulic.

- **Directional Spool Valve**

Fig: 6.6 Directional Spool Valve

- **Directional Poppet Valve**

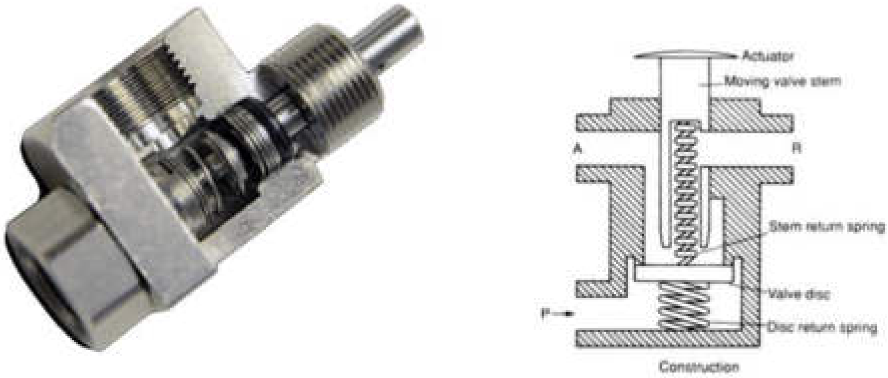


Fig: 6.7 Directional Poppet Valve

- **Electrically Operated DCV**

Fig: 6.8 Electrically Operated DCV

2. Check Valve

Check valves are used in a hydraulic system to stop flow in one direction and allow in the oppositedirection they are also known as non-return valve.

- Balls, plates, poppets are used as isolating elements
- They are mainly categorised as Simple check valves, pilot operated check valves and anti cavitationvalves.

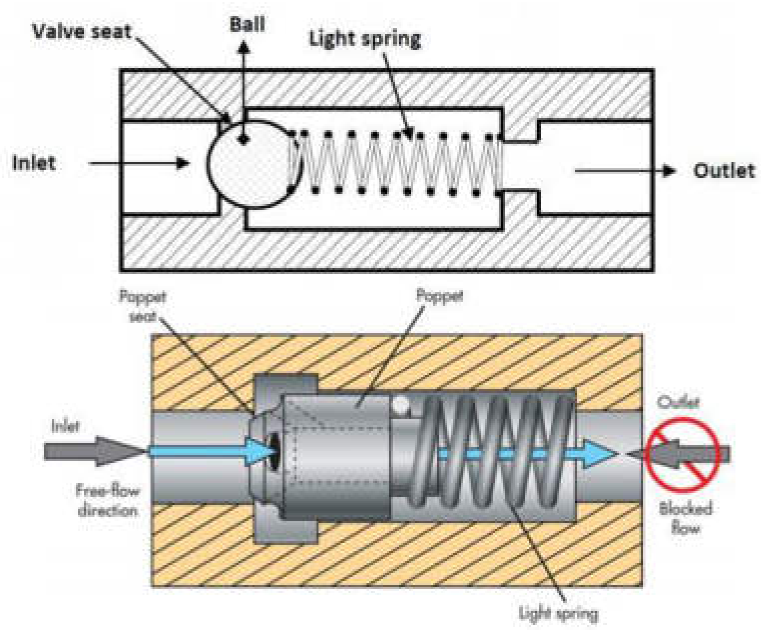


Fig: 6.9 Check Valve

3. Flow control valves

The purpose of a flow control valve is to regulate the flow rate in a specific portion of a hydraulic circuit. In hydraulic systems, they're used to control the flow rate to motors and cylinders, thereby regulating the speed of those components. The energy transfer must be equal to the total work done. Because the actuator speed determines the rate of energy transfer, speed is a function of the flow rate. Directional control valves serve a different purpose, directing the energy transfer system to the appropriate location at the appropriate time, although some pressure and flow rate control may be achieved using directional control valves, as theycan throttle the flow of fluid.

The simplest flow control valves have an aperture which opens or closes in order to increase or slow down the flow rate. Ball valves are among the simplest options, consisting of a ball attached to a handle. The ball has a hole through the center, and when the handle is turned, the hole is aligned with valve openings in order to permit flow. In order to shut off the flow, the handle is used to turn the hole perpendicular to the valve openings, which obstructs the flow.

- **Throttle Valves**

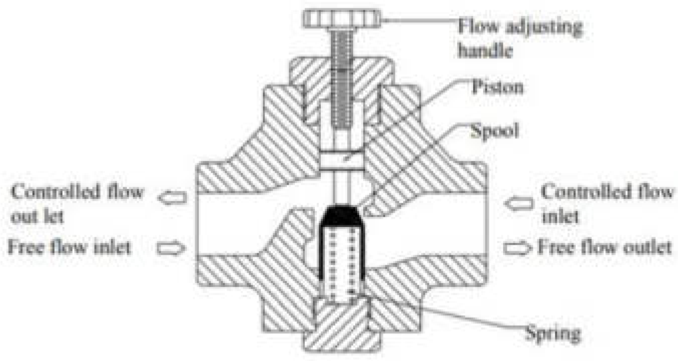


Fig: 6.10 Throttle Valve

- **Needle Valve**

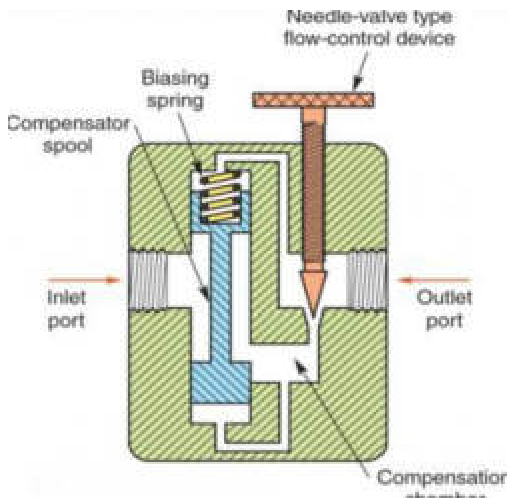


Fig: 6.11 Needle Valve

4. Pressure control valve

The valves enable the regulation of system pressure to adjust the force on a hydraulic piston rod or the torque on a hydraulic motor shaft. Pressure relief valves are used to set the maximum pressure in the circuit and protect it from overloading. Pressure reducing valves permanently maintain the output pressure at the set value while protecting the appliance from overloading. Unloading valves are designed for economical pressure control in accumulator-operated circuits that serve as a power source for emergency control.

These valves influence the pressure in a system or part of a system in a predetermined manner. There are pressure control valve according to the opening of their throttle i.e. spool or poppet valve. They arealso classified as directly operated or pilot operated valves. Types of pressure control valves are – pressure relief valve, pressure reducing valve.

- **Pressure Relief Valve**

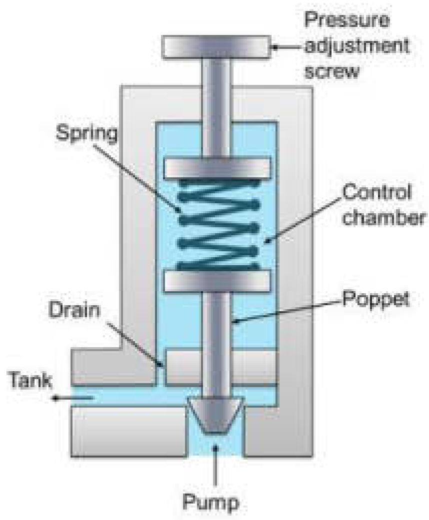


Fig: 6.12 Pressure Relief Valve

- **Pressure reducing valves**

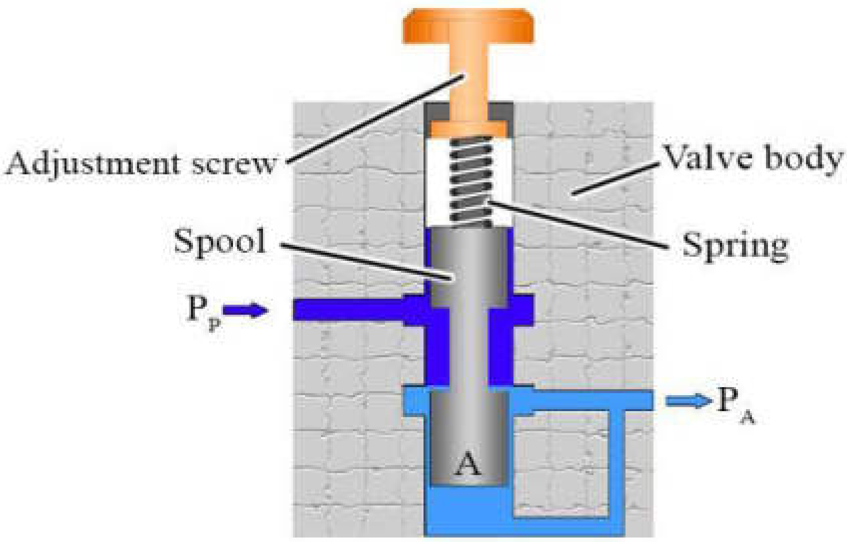


Fig: 6.13 Pressure Reducing Valves

6.4 TYPES OF CYLINDERS

6.4.1 Single Acting Hydraulic Cylinder

Single-acting cylinders operate only in one direction, so the oil has only one access port into the cylinder. The port is located at the head end of the cylinder, which can only function in one direction. When the oil is pumped into the port, it pushes the rod, causing it to extend—the rod returns for an external force such as the load or a spring. As oil is pushed through, the port is pressed on a plunger and causes the movement. When the cylinder gets empty of oil, the plunger returns itself to the original position.

Advantages for the single-acting cylinders are that they have compact and space-efficient sizes and simple structures. Single-acting cylinders are easy to maintain, reliable in function, and have substantial pressure and force potential. Single-acting cylinders are economical and the most straightforward designs.

Disadvantages for the single-acting cylinders may be that those equipped with retractable springs are vulnerable to component failure as the springs wear out. The wear manifests as a gradual reduction in force on the retracting movement. They are also difficult to seal and can become damaged over time through exposure to corrosive fluids. Single-acting cylinders are primarily used in construction plants, internal combustion engines, reciprocating engines, pumps, hydraulic rams, and jacks.

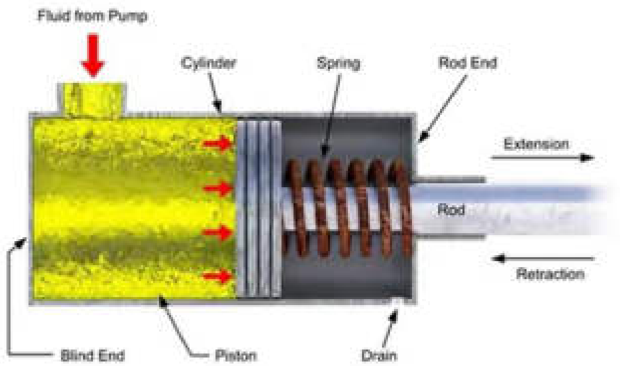


Fig: 6.14 Single acting hydraulic cylinder

6.4.2 Double-Acting Hydraulic Cylinders

Unlike the single-acting cylinder, the double-acting cylinder has two ports; one for extending the plunger and another for retracting. These ports are positioned at either end of the cylinder, the head,and the rod. Both ports are used when retracting the rod, as a rod is extended and a port at the headend is simultaneously used.
Double-acting cylinders have a crucial advantage over other types of cylinders. A ram lip's presence allows the rod to be additionally supported within the cylinder throughout the extending and retractingprocesses.

A double-acting cylinder is capable of pressure being exerted on either side of the piston alternatively. The outward and retraction movements can be achieved without external power sources when the cylinder is under pressure. The pressure can return the piston to its starting position or apply an alternating force on both sides of the cylinder to operate a crankshaft.

The advantages of double-acting cylinders are that they are easily accessible because they are the most commonly used hydraulic cylinders. They are rugged, reliable, and save energy. Double-acting cylinders need fewer hydraulic fluids, have controlled acceleration, and perform well repetitively accurately. Double-acting cylinders have precisely definable stroke measurements and have a massive variety of potential applications.

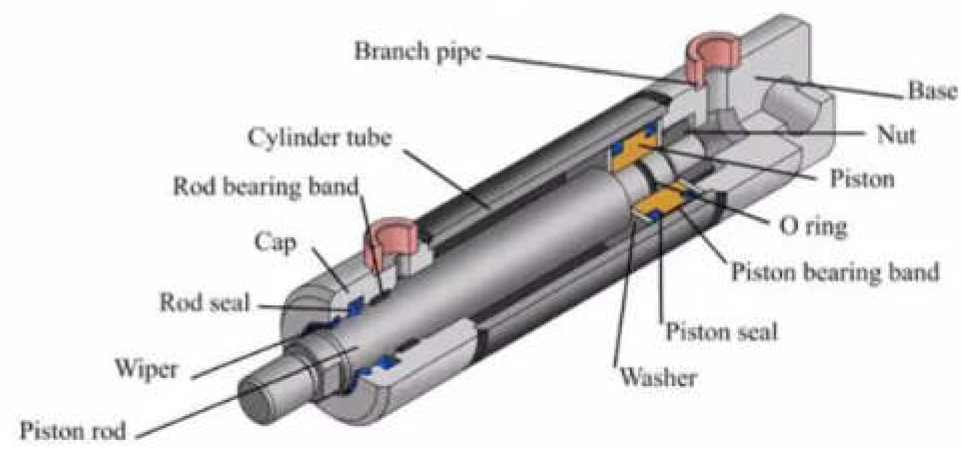


Fig: 6.15 Double acting hydraulic cylinder

6.4.3 Telescoping, Ram-Type, Actuating Cylinder

Telescopic cylinders are designed with a series of steel or aluminum tubes of progressively smaller diameters nested within each other. Telescopic cylinders can be single or double-acting. In general, telescopic cylinders are more expensive than standard cylinders. Most telescopic cylinders are single-acting, and double-acting telescopic cylinders are specially custom designed and manufactured. Telescopic cylinders are multi-stage units of two or more steps.

This type of cylinder is very different from the other designs. It functions in a very compact structure. Rams placed closely alongside each other to form collective cylinder units. These units work together with one or two ports to control the fluid flow. In this design, the rams and the ports are all contained with the cylinder's housing. A substantial advantage of this design is the cylinder's reach when all the rams are extended together.

Fig: 6.16 Telescoping cylinder

6.4.4 Tie rod cylinder

Tie rod-style hydraulic cylinders use high-strength threaded steel rods to hold the two end caps to the cylinder barrel. These designs are often used in industrial factory applications. Small-bore cylinders usually have four tie rods, and large bore cylinders may require up to 16 or 20 tie rods to retain the endcaps under the forces produced. Tie rod-style cylinders can be completely disassembled for service and repair and are not always customizable.

Fig: 6.17 Tie rod cylinder

6.4.5 Tandem hydraulic cylinder

In a tandem hydraulic cylinder, there are two interconnected cylinders that operate together. This generates a greater force than one cylinder would create on its own. Tandem hydraulic cylinders' general applications include fork lift trucks, elevated work platforms, cranes and barges.

Fig: 6.18 Tandem hydraulic cylinder

6.5 TYPE OF ACCUMULATORS

The purpose of an accumulator is to store hydraulic energy in the form of pressurized fluid, provided by the pump, and later provide it to the system whenever needed.

Because of their ability to store excess energy and release it when needed, accumulators are useful tools in developing an efficient hydraulic system. Accumulators are found in numerous applications, they are used in conjugation with the hydraulic system on large hydraulic presses, construction equipment, farm machinery, power brakes, automotive suspensions, hatch covers on ships, landing gear mechanism on airplanes, etc.

Accumulators are generally classified by means of the use of energy storage. There are basically threetypes of accumulators.

- Weight loaded accumulators
- Spring-loaded accumulators
- Gas loaded accumulators

6.5.1 Weight Loaded Accumulator

Weight loaded accumulator consists of a ram loaded with dead weight. The mass of dead weight may be concrete steel or other heavy material. The piston rod is much bigger in size to avoid buckling failure due to heavy load.

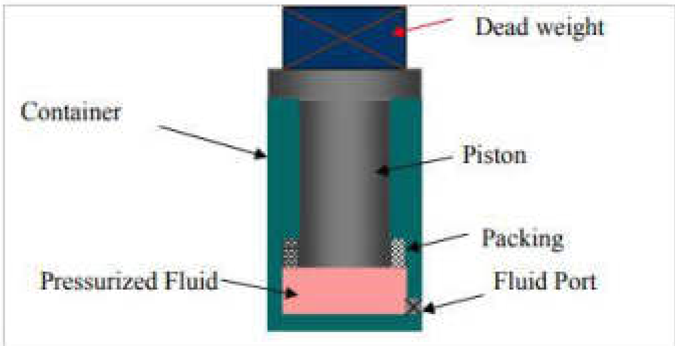


Fig: 6.19 Weight Loaded Accumulator

6.5.2 Spring Loaded Accumulator

Spring-loaded accumulator consists of a cylinder containing a spring-loaded piston, with fluid enteringon another side of the cylinder. The fluid is stored under pressure by the spring force. As the spring is compressed completely, the accumulator pressure reaches its peak and as the spring approaches itsfree length, the accumulator pressure drops to its minimum. The design is mostly multi-spring, to reduce the size of the accumulator for the same pressure.

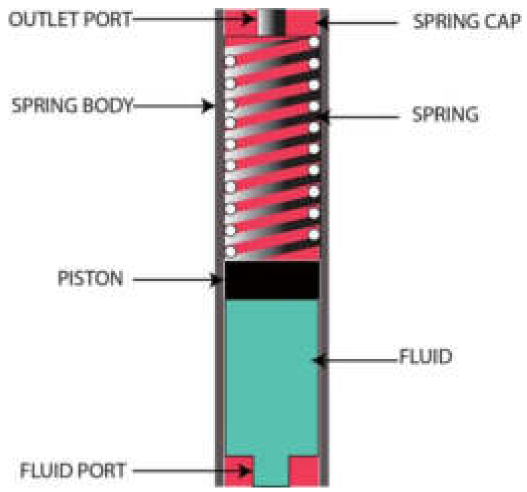


Fig: 6.20 Spring Loaded Accumulator

6.5.3 Gas Loaded Accumulator

A gas-charged accumulator pressurizes the fluid by the pressure of the gas. Gas loaded accumulatorsare also called hydro-pneumatic accumulators. When there is a separator placed between hydraulicfluid and gas, it is called separator type and when there is a barrier placed between hydraulic fluid and gas, it is called gas loaded accumulator with separator.As the fluid is charged in the shell, the fluid level rises, resulting in compression of the gas. The compression of gas induces pressure in it and thispressure exerts a force on the fluid surface.

Gas loaded accumulators are further divided as the non-separator type and separator type.Separator type gas loaded accumulators consist of:

- Bladder type
- Diaphragm type
- Piston type.

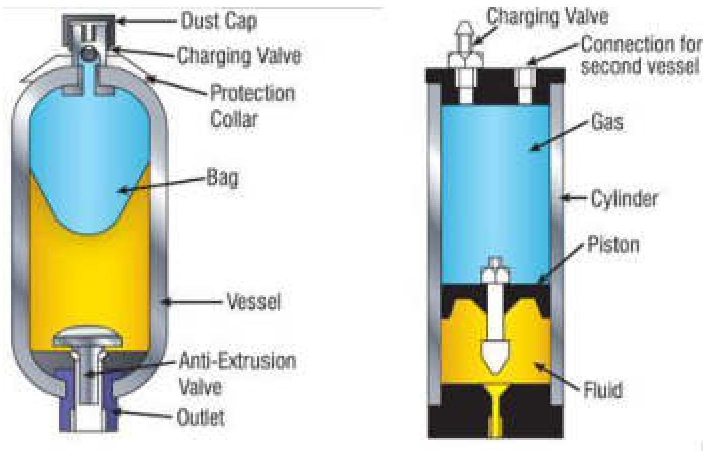


Fig: 6.21 Gas Loaded Accumulator

6.6 INTRODUCTION TO BOSCH REXORTH HYDRAULIC TRANNINHG KIT

Fig: 6.22 Hydraulic Tranninhg Kit

- **DS4 Hydraulic Training System**

The DS4 hydraulic training system allows for teaching in both industrial and mobile hydraulics, and inaddition, it can also be used for pneumatic systems training. It offers a complete solution for teaching and demonstration of the operation of modern hydraulic circuits and prepares the trainees for their work in the industry.

Thanks to the configuration options, the training system can be perfectly adapted to the relevant topic and extended for the use in further trainings on more advanced technologies. Due to the use of a load sensing power unit, the DS4 is also perfectly suited for mobile hydraulics training and is capable of demonstrating the concepts particular to mobile hydraulics using a hands-on practical approach. The device sets and the associated training manuals for the various study topics prepare the trainees for the tasks and requirements of their later professional life.

The DS4 hydraulic training system can be configured and extended and can grow with changes andadditions to your curriculum. Its essential components are:

1. Hydraulic power unit
2. TÜV-tested safety valves
3. Industry standard size 6 valving
4. Control blocks for the mobile application area
5. Cylinders with special protective covers to ensure student safety
6. Storage and mounting rack for electrical components
7. Toolbox for equipment storage
8. Grooved plate and grid for mounting components and circuits
9. Measuring glass
10. Load unit
11. Hose rack

6.6.1 Equipment picture

Fig: 6.23 Hydraulic valve mounting & Reservoir

Fig: 6.24 Flow Meter& Load Simulator

Fig: 6.25 Relay Board and Analog Module

Fig: 6.26 Hydraulic Valve

Fig: 6.27 Hydraulic Check & Throttle Valve

6.7 PRACTICAL WORK ON HYDRAULIC SYSTEM

Practical 1

Statement: Operating double acting cylinder with spring return lever operated DCV.

Fig: 6.28 Hydraulic System Practical 1

Practical 2

Statement: Sequencing of two double acting cylinder using pressure relief valve and 4/2 Lever operated DCV.

Fig: 6.29 Hydraulic System Practical 2

Practical 3

Statement: Control the extension speed of double acting cylinder using throttle valve with check valve**.**

Fig: 6.30 Hydraulic System Practical 3

Practical 4

Statement: operate a bidirectional hydraulic motor using 4/3 DCV with centre spool having isolated, with different load condition.

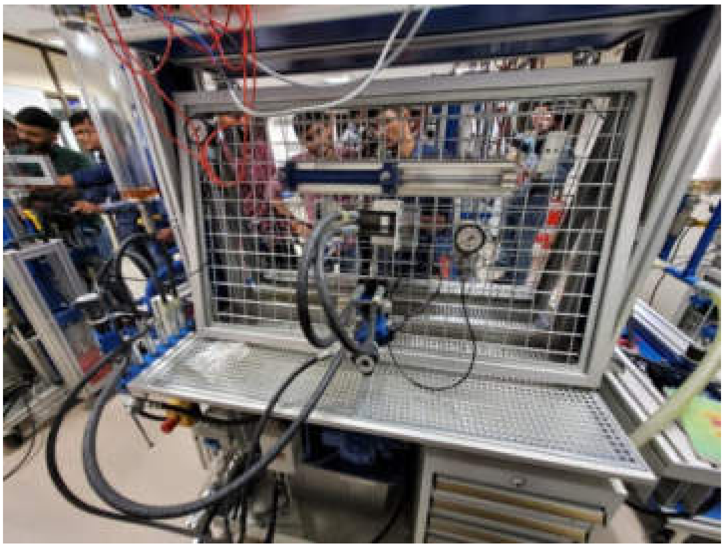


Fig: 6.31 Hydraulic System Practical 4

Practical 5

Statement: Check flow characteristics of a throttle valve operate hydraulic motor with 4/3 leveroperated DCV, Find out inlet pressure at inlet of throttle valve ,find out differential pressure across thethrottle valve.

Fig: 6.32 Hydraulic System Practical 5

Practical 6

Statement: Moving a cylinder with the help of a potentiometer using proportional Valve.

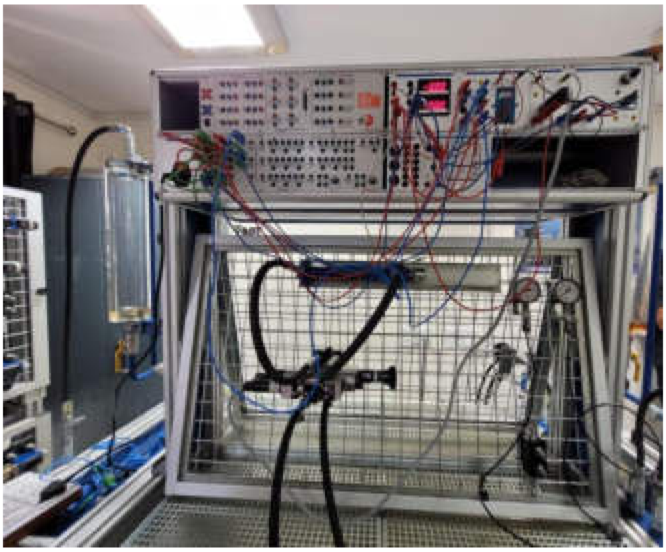


Fig: 6.33 Hydraulic System Practical 6

Practical 7

Statement: Setting backing distance after proximity switch during extension of cylinder.

Fig: 6.34 Hydraulic System Practical 7

Practical 8

Statement: Assuming that hydraulic cylinder is punching press that required to punch hole in threedifferent types of material for three different speed for individual.

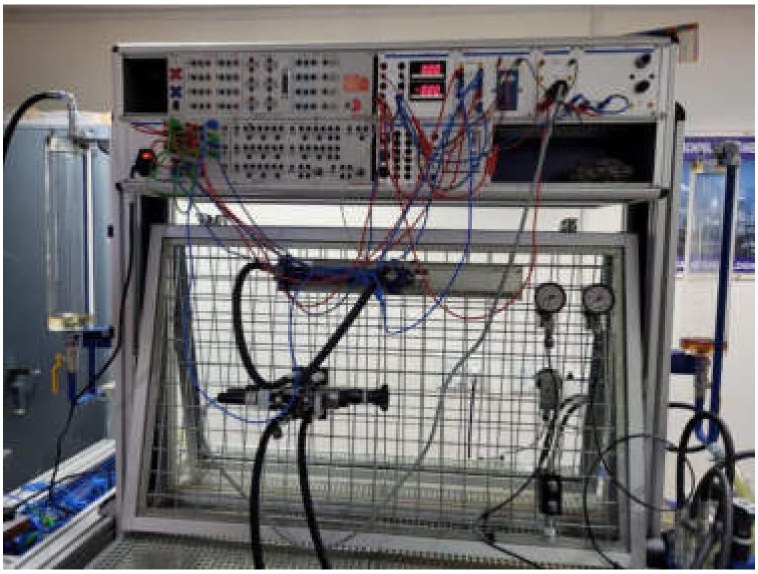


Fig: 6.35 Hydraulic System Practical 8

CHAPTER 7: INTRODUCTION TO PENUMATICS

7.1 BASICS OF PNEUMATIC SYSTEM

Pneumatics is a branch of engineering that uses wind or high-pressure air to perform certain operations. A pneumatic system is a connection of various components such as (compressors, filters, controllers, and actuators), that converts the pressure energy of compressed air into mechanical work.

Pneumatic systems are used where human strength and accuracy are not enough. Nowadays Pneumatic systems are widely used in various industries to automate several processes. It not only lifts heavy loads and increases the accuracy but it also decreases the time period to perform certain activities. Some of the most common examples of pneumatic systems are air brakes, pneumatic arms, pneumatic cable jetting, and pneumatic shock absorbs.

7.2 PNEUMATIC SYSTEM COMPONENTS

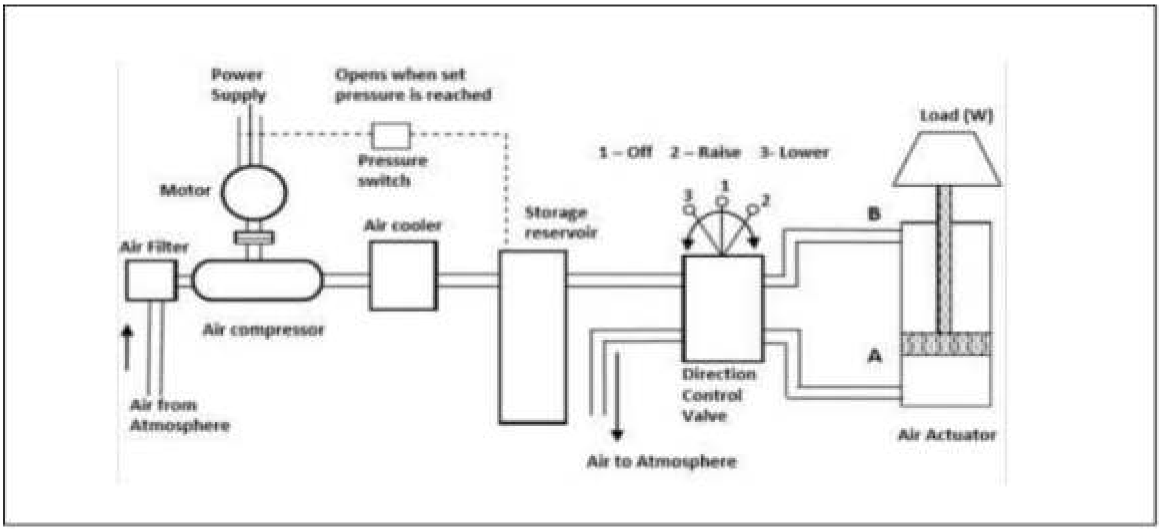


Fig: 7.1 Pneumatic System Component

7.2.1 Air Filter

Air contains various impurities such as pollen grains, dust particulate, soot, etc. These impurities need to be removed from the air before it enters a pneumatic circuit. Hence an air filter is used to restrict these impurities from entering the pneumatic circuit. The air filter is a fibrous or porous material that traps the solid particulate and allows air to move in. It may also contain some absorbent material such as charcoal that absorbs pollutant gas particles and soot.

7.2.2 Air Compressor

As the name suggests the device used to compress the air is called an air compressor. Generally, axial flow air compressors are used in pneumatic systems. These compressors have rotating blades called impellers that rotate with the help of a motor. The impeller creates a vacuum that sucks the air via an air filter. The pressure of air at the outlet of the impeller is more than the atmospheric pressure. The ratio of outlet pressure to the inlet pressure of the compressor is called the compression ratio. The compression ratio is different for different purposes.

Fig: 7.2 Air compressor

7.2.3 Air Cooler

Air temperature increases when the air is compressed in the compressor. This hot air is not suitable forfurther operation. Hence it is important to cool down the hot air coming out of the air compressor. Thecooling of air is done by an air cooler. The main objective of an air cooler is to reduce the temperature and moisture content in the air coming out from the air compressor.

There are two types of commonly used air coolers.

- Air-cooled air cooler.
- Water-cooled air cooler.

In an air-cooled air cooler, the hot air is enclosed in pipes and cool air is forced on it with the help of afan this cool air carries away heat from the hot air without decreasing the pressure. While in the case of a water-cooled air cooler the heat is exchanged by indirect contact between the hot air from the compressor and cold water. Much lower temperature can be obtained by a water-cooled air cooler thanthe air-cooled air-cooler. As cold water is available in large quantities, water-cooled air coolers are cost- effective and quick.

7.2.4 Storage Reservoir

Storage reservoirs play an important role in pneumatic systems as they ensure quick response to user demand. Storage reservoirs can store both dry and wet air depending on demand. A storage reservoir must be strong, must have high tensile strength, and must be durable. Hence the commonly used materials for storage reservoirs are Mild steel, Aluminum, Carbon steel, and Stainless steel. Storage reservoirs have several parts. Each part is first cut down into its required dimension. These parts are then assembled by welding and bending.

7.2.5 FRL unit

The full form of FRL is ‘filter, regulator, and lubricator’ these three are generally used as one unit in apneumatic system, but can also be used as different individual units. FRL is an important component of a pneumatic system as it reduces losses and increases the efficiency of the system. The three basicfunctions of an FRL unit are as follows.

To filter out the waste water, contaminants, and debris from the air coming out of the storage reservoir. This is done by filers and is generally the first step in an FRL unit. The second function of the FRL unit is to regulate the pressure and restrict it from crossing the upper limit. This is done by a pressure regulator. Pressure regulation is an important step as it prevents damage to the system and also reduces unwanted losses due to high pressure.

The last stage of the FRL unit is air lubrication. In the air, lubrication is done by mixing a thin mist of oil or other lubricants into compressed air. This is generally done after filtration and regulation. This lubricated air reduces the friction between the moving parts of a pneumatic system and thus reducesthe loss of energy and increases the life of the equipment. If an FRL unit is not present in a pneumatic system it would decrease the life of the system, increase the energy consumption and reduce the efficiency of the system.

7.2.6 Pneumatic Cylinder

Pneumatic cylinders are mechanical devices that produce force by using energy from pressurized air. These devices consist of a piston, piston rod, and cylinder. The pressure inside the cylinder rises as air enters on one side of the cylinder. The rise in internal pressure causes the piston to move in a specific direction. The piston rod transmits the developed force to the object to be moved.

The working fluid in pneumatic cylinders is compressed air. Hence, pneumatic cylinders are desirable for environments requiring a high level of cleanliness, as the fluid will not contaminate the surroundings in case of leakage. Pneumatic cylinders operate quietly and do not require large storage tanks for the working fluid.

Pneumatic cylinders are used in the automation of machines and industrial processes. The force and motion produced by pneumatic cylinders can be used in mechanisms such as clamping, ejecting, blocking, and lifting. In factories, they are used in repetitive pick-up and placement of objects into a machine or equipment. In piping systems, they are used in operating valves.

Fig: 7.3 Pneumatic Cylinder

7.2.7 Directional control valve

Directional control valves are the most important device used in a pneumatic system. The directional control valves or DVCs are used to control the direction and the amount of air entering the actuators.

The valves transfer the pressure energy of air to the actuators as per the command given by the operator. The generally used valve in a pneumatic system is a solenoid valve, also sometimes known as a spool valve. These valves are operated by the action of a solenoid coil coupled with an electromagnet.

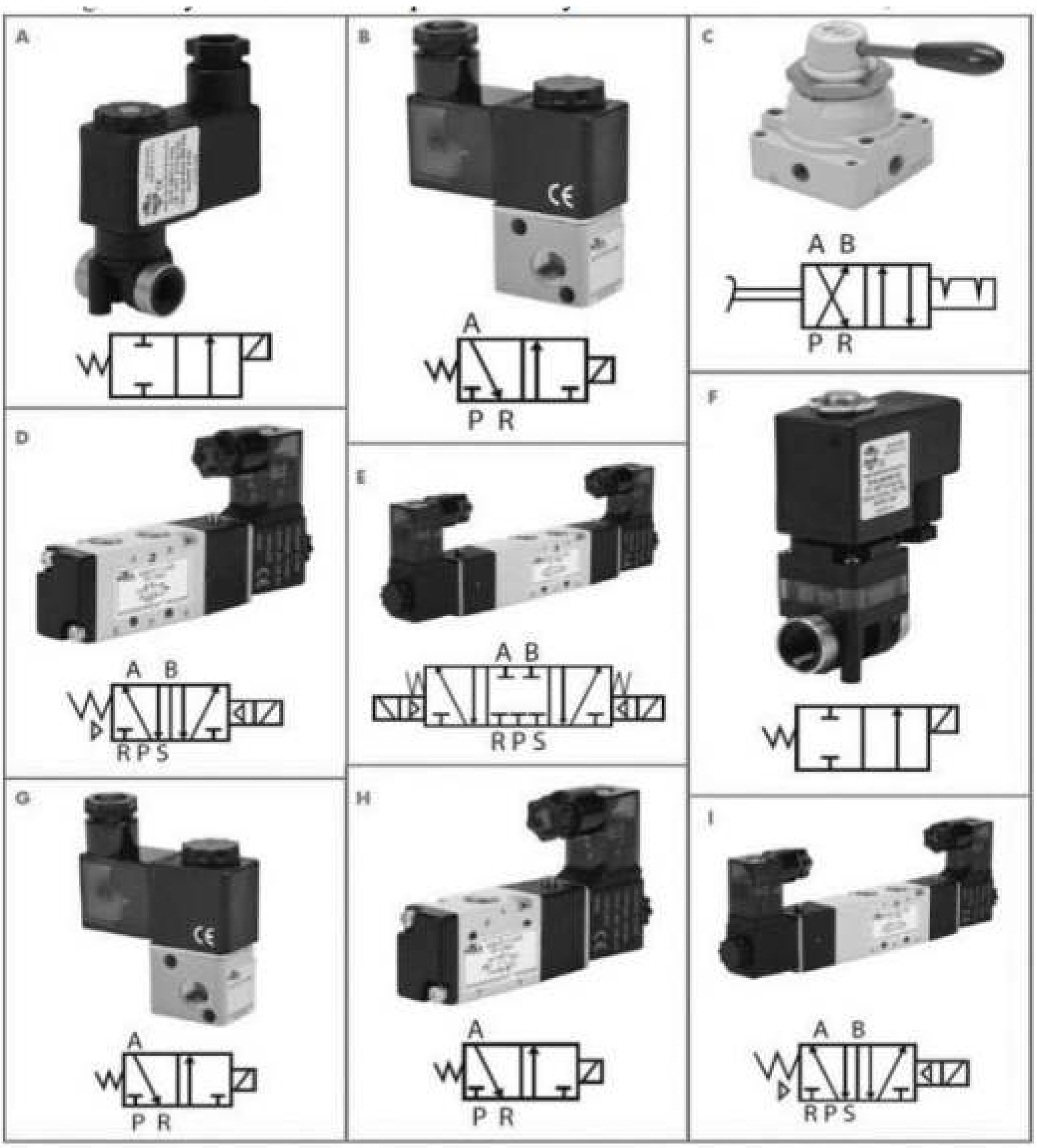


Fig: 7.4 Pneumatic Valve

7.3 APPLICATIONS OF PNEUMATIC SYSTEM

Pneumatic systems have an infinite number of applications in today’s modern era. Some ofthe main applications of pneumatic systems are.

- Automatic production lines.
- Doors of metro trains.
- Medical equipment.
- Car washing.
- Pneumatic brakes.

7.4 ADVANTAGES OF PNEUMATIC SYSTEM

- The air used is infinitely available.
- The working medium is inflammable.
- It is independent of the outside temperature.
- The system is safe and tidy.
- Generates instant mechanical work.
- Corrosion problems are not severe.

7.5 DISADVANTAGES OF PNEUMATIC SYSTEM

- The system is noisy.
- There are often leaks in the system.
- Low power-to-weight ratio.
- Always prone to dust and contaminants.
- Suitable only for low-pressure applications

7.6 PRACTICAL WORK ON PNEUMATIC SYSTEM

Practical 1

Statement: Operated cylinder by using 3/ 2 pilot operated DCV.

Fig: 7.5 Pneumatic Practical 1

Practical 2

Statement: Extend a double acting cylinder with on delay timer with 5 second.

Fig: 7.6 Pneumatic Practical 2

Practical 3

Statement: Controlling the spool of extension of double acting cylinder using throttle valvewith integrated check valve.

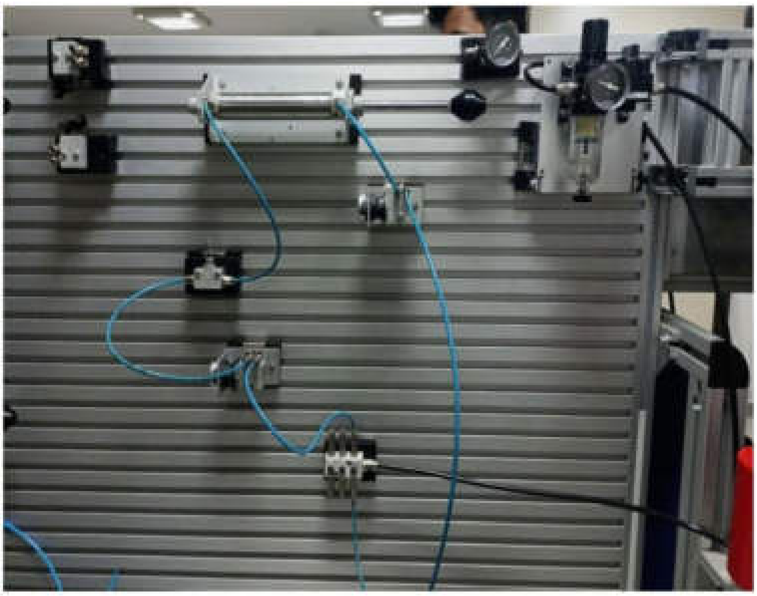


Fig: 7.7 Pneumatic Practical 3

Practical 4

Statement: Electrical control of a double acting cylinder using sensor such that piston does not retracts more than 50 %, use 5/3 DCV solenoid operated with spring return.

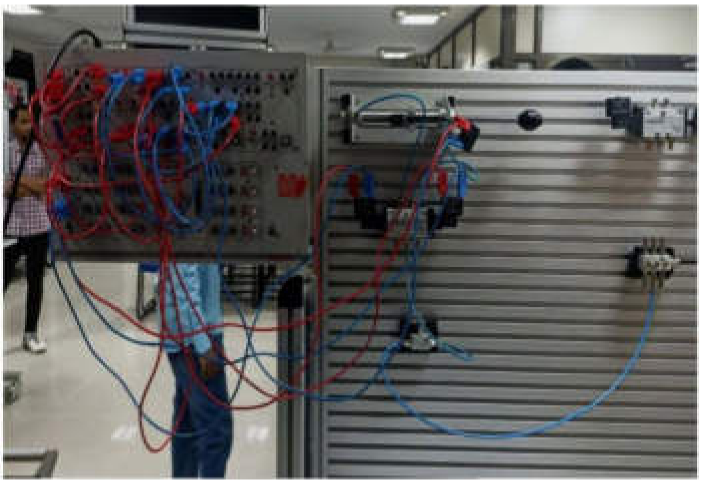


Fig: 7.8 Pneumatic Practical 4

Practical 5

Statement: The piston of double acting cylinder extends and embosses a work is within aid of a knuckle joint embossing piston of a cylinder retracting automatically when work has been embossed. it must be possible to start the embossing process with a two different push button but only when workpiece to be embossed is present at workstation. Take extension should be slow but retraction should be as fast as possible.

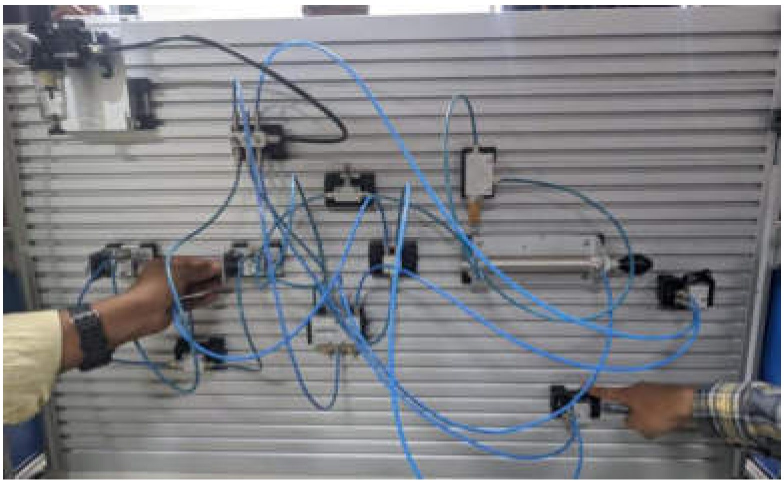


Fig: 7.9 Pneumatic Practical 5

Practical 6

Statement: Sequential Control with an integrated vacuum gripper a cover of a container is to be removed with a section gripper when start button pressed the cylinder extend and pass the suction gripper on the cover of a container and retract at the same time and suction is turned on after 5 second cylinder return to its original position and lift cover up after reaching to its end position vacuum is switched off and gripper released cover. complete sequence start only when a container is present.

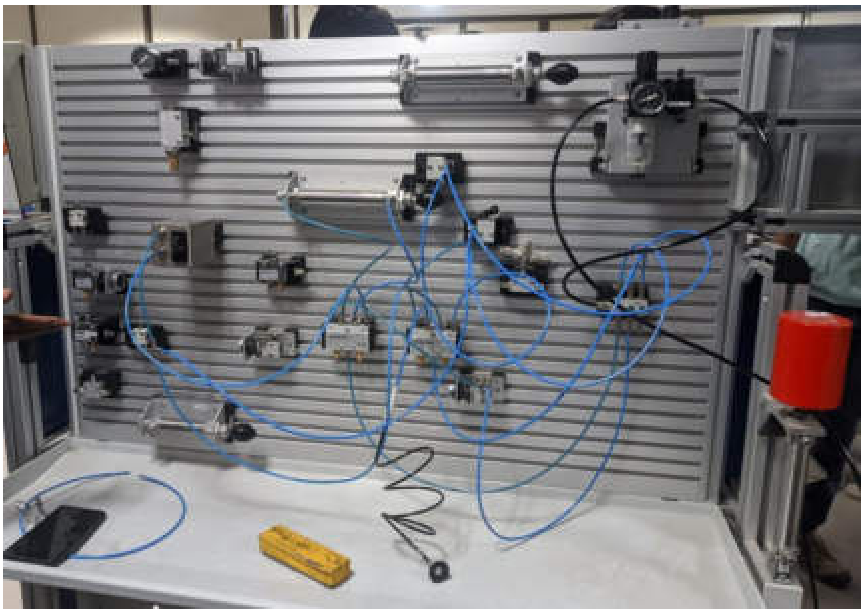


Fig: 7.10 Pneumatic Practical 6

Practical 7

Statement: Sequential control of Two double acting cylinder. Both cylinders will operate in sequence. When pressed extentiion P.B. then cylinder 1 will extend when cylinder 1 will complete extend and limit switch will be operated then cylinder 2 will extend. Same way when pressed retract P.B. then cylinder two will retract first and then cylinder 1 will retract.

Fig: 7.11 Pneumatic Practical 7

CHAPTER 8: PROJECT WORK

8.1 INTRODUCTION OF PROJECT OF AUTOMATED DRILLING CONTROL SYSTEM

Hydraulic drill control system

The hydraulic drill control system is a project designed to automatically adjust the drilling speed and force of a hydraulic drill based on the hardness of the material being drilled. This project aims to improve drilling efficiency and accuracy,prevent damage to the drill and the material, and ensure safe drilling practices.

The hydraulic drill control system consists of the following components:

- Hydraulic cylinder
- Capacitive sensor
- Inductive sensor
- Programmable Logic Controller (PLC)
- Flow control valve
- Pressure regulator valve
- Hydraulic pump and hoses
- Power supply
- Hydraulic Proportional valve
- Two Pneumatic cylinder
- Solenoid operated pneumatic DCV
- Two Proximity sensor
- Pressure gauge

8.1.1 Construction

To construct the hydraulic drill control system, the following steps are taken:

1. Hydraulic components such as a hydraulic drill, flow control valve, pressureregulator valve, and hydraulic pump and hoses are assembled.
2. A Capacitive sensor and Inductive sensor are connected to the material andhydraulic system to detect the metal and plastic, respectively.
3. The sensors are connected to the PLC to send data to the system and adjustthe drilling speed and force.
4. The system is powered by a power supply and programmed using ladderlogic or any other programming language.

8.2 WORKING OF PROJECT

The system works detecting the material being drilled using a capacitive and inductive sensor that material is metal or plastic. The material data is sent to the PLC, which compares it to a pre-determined threshold value to determine whether the material being drilled is metal or plastic. Based on that data, the PLC sends signals to the flow control valve and pressure regulator valve to adjust the drilling speed and force of the hydraulic drill. The hydraulic pump supplies the necessary pressure to the drill, and the flow control valve adjusts the flow rate of hydraulic fluid to control the drill speed. The pressure regulator valve adjusts the pressure of the hydraulic fluid to control the drill force.

8.3 PLC PROGRAMMING

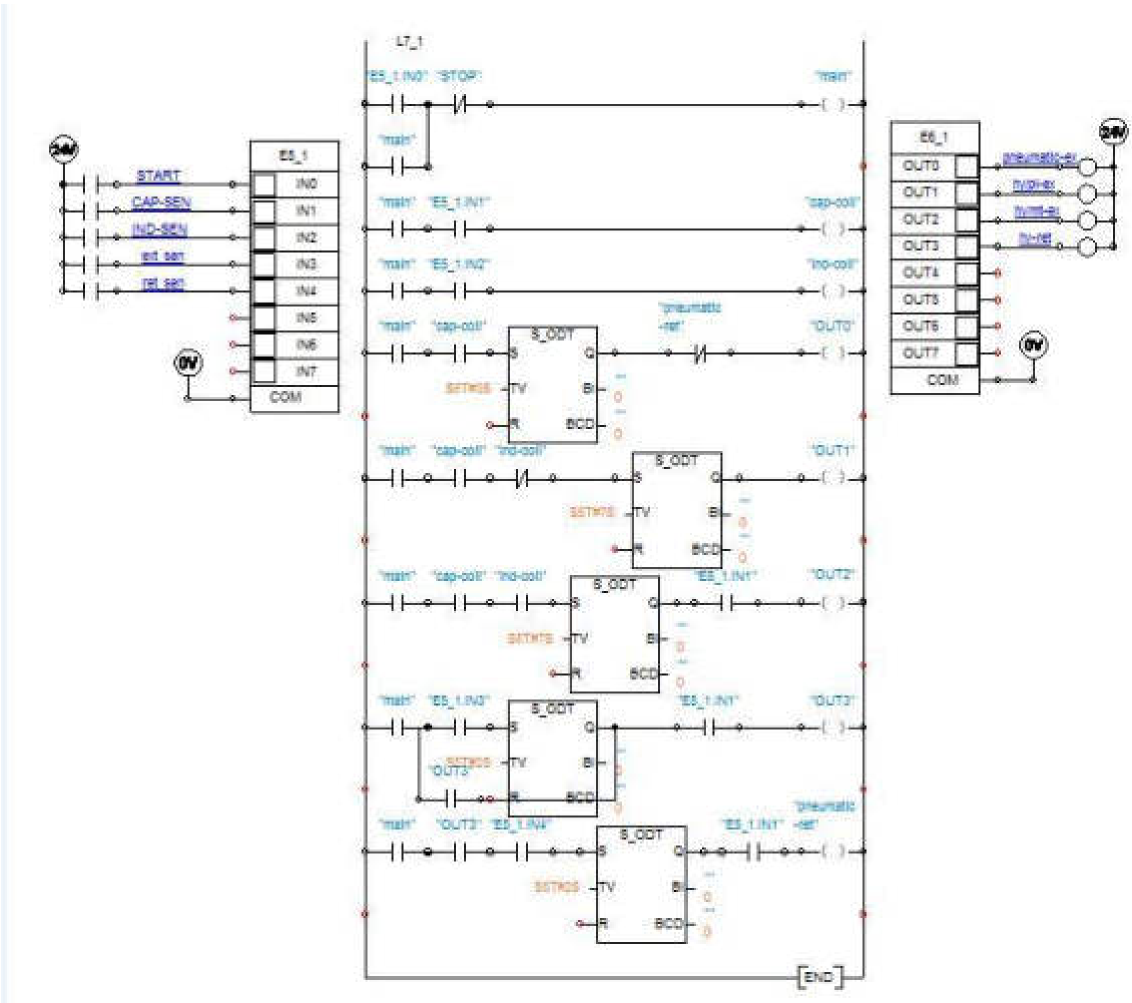


Fig: 8.1 Project's PLC programming

8.4 CIRCUIT DIAGRAM

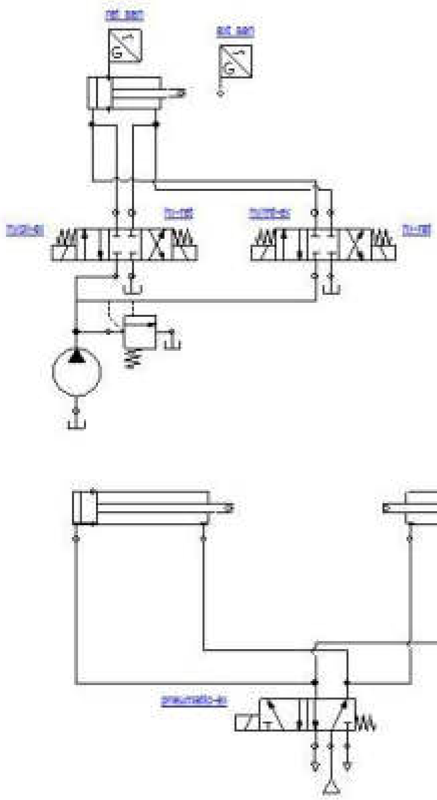


Fig: 8.2 Hydraulic & Pneumatic circuit Diagram of Project

8.5 SIMULATION IN AUTOMATION STUDIO

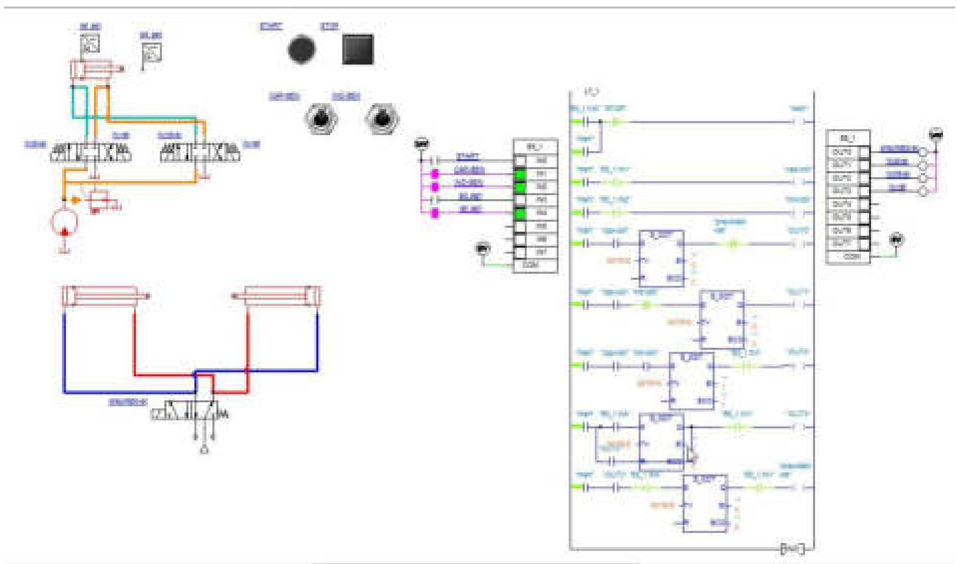


Fig: 8.3 Simulation of Project

8.6 Project Prototype

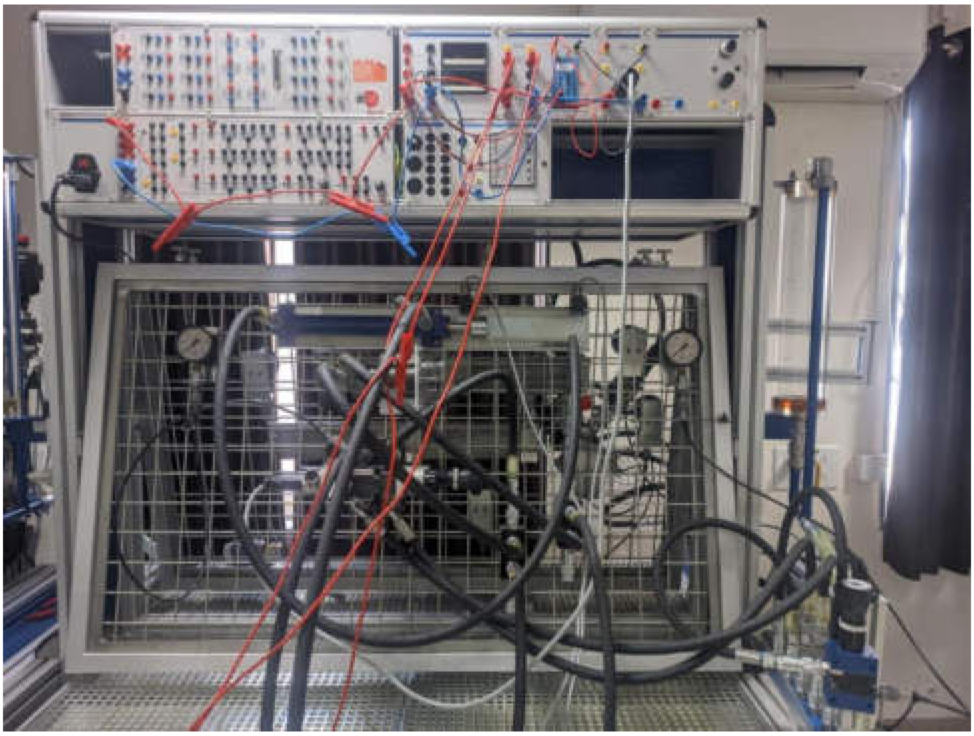


Fig: 8.4 hydraulic Connection

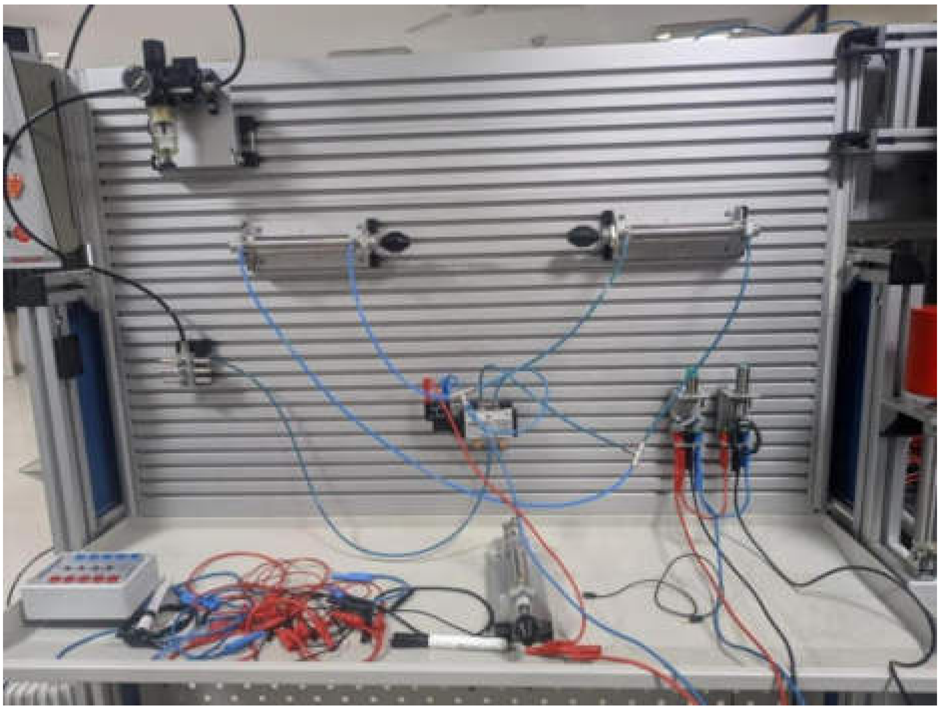


Fig: 8.5 Pneumatic Connection

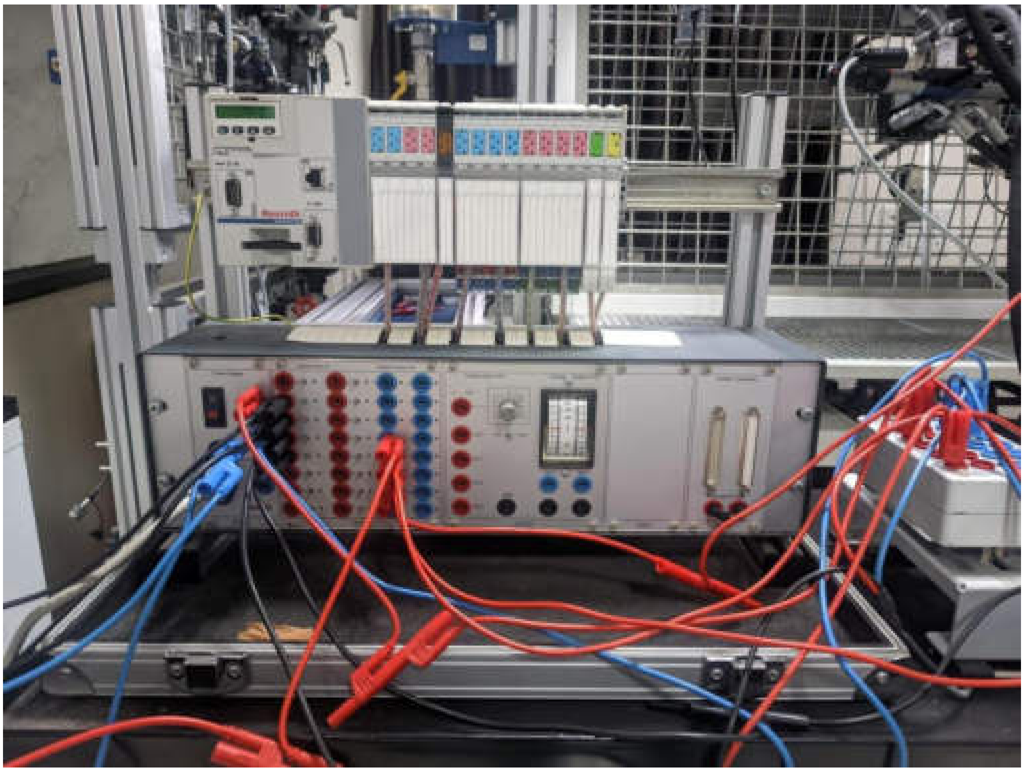


Fig: 8.6 PLC Connection

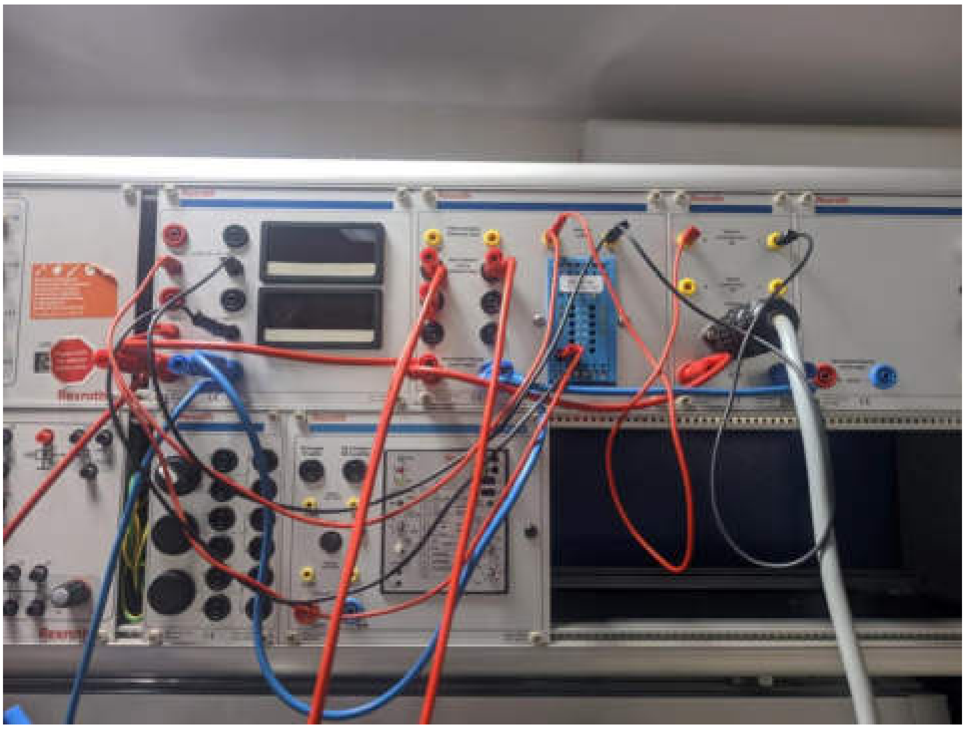


Fig: 8.7 Analog Output Module Connection

Fig: 8.8 Final Prototype of Project

CHAPTER 9: CONCLUSION

The internship at Bosch Rexroth has been very educative and has also provided us with the opportunity in order to complete our summer internship under industrial professionals over a course of 12 weeks in the field of Hydraulics, Pneumatics and PLC Programming. This program has helped us not only gain knowledge related to industrial grade equipment but also an insight into working of Hydraulic and Pneumatic components in manufacturing lines and their integration with PLC Programming as well as knowledge necessary for a fresher with mechanical background.

CHAPTER 10: REFRENCES

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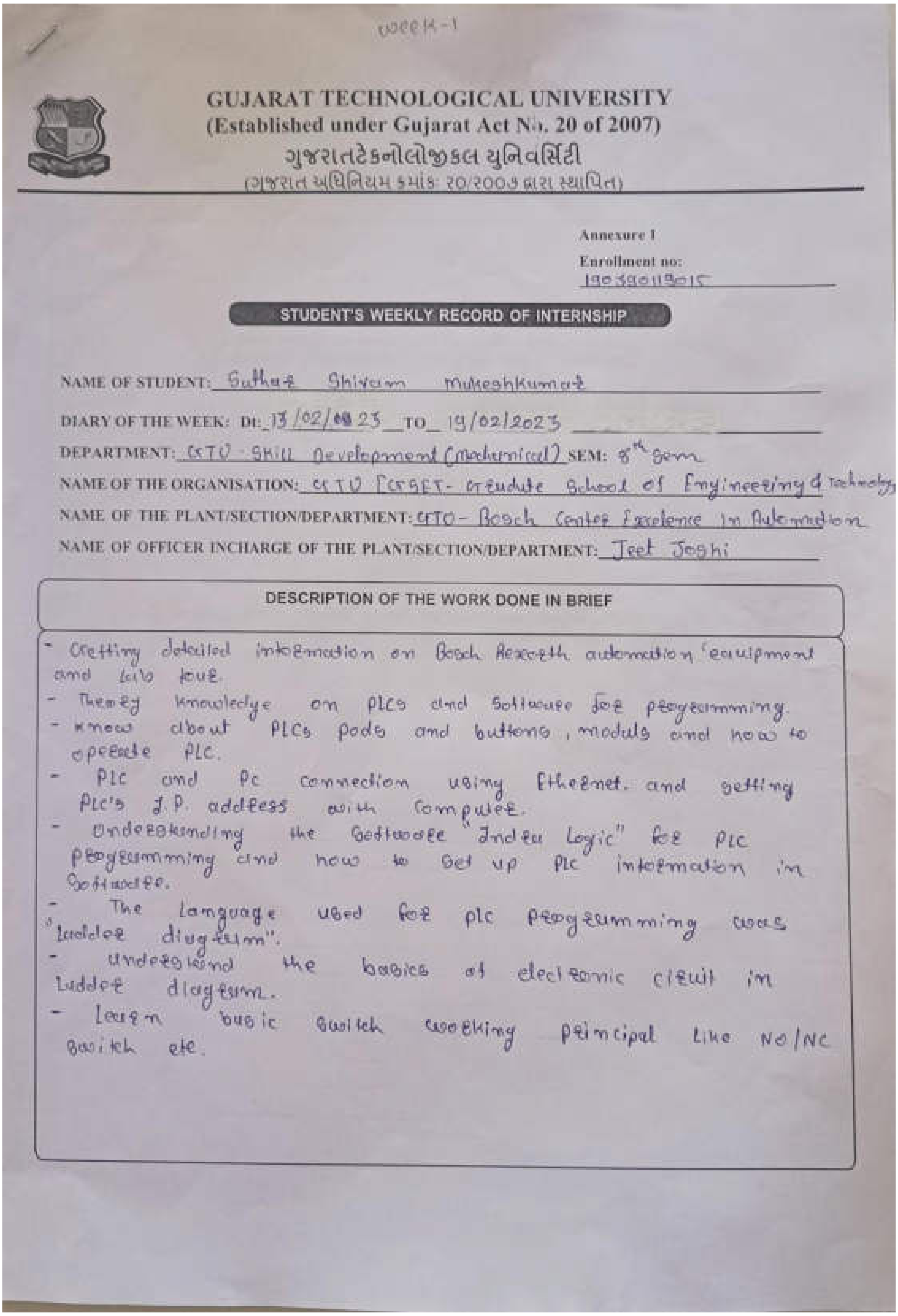
APPENDIX-1

ANNEXURE-1(WEEKLY REPORT)



week-1

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Annexure 1
Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar
DIARY OF THE WEEK: Dt: 13/02/2023 TO 19/02/2023
DEPARTMENT: GTU - Skill Development (Mechanical) SEM: 8th Sem
NAME OF THE ORGANISATION: GTU [GSET- Graduate School of Engineering & Technology
NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Center Excellence in Automation
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Getting detailed information on Bosch Research automation equipment and lab tour.
- Theory knowledge on PLCs and software for programming.
- know about PLCs pods and buttons, modules and how to operate PLC.
- PLC and PC connection using Ethernet and getting PLC's I.P. address with computer.
- Understanding the software "Indra Logic" for PLC programming and how to set up PLC information in software.
- The language used for plc programming was "ladder diagram".
- understand the basics of electronic circuit in ladder diagram.
- learn basic switch working principal like NO/NC switch etc.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 18/03/2023

Date: 20/2/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week-2

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Annexure I

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 20/02/2023 TO 26/02/2023

DEPARTMENT: GTU - Skill Development (Mechanical) SEM: 8th sem

NAME OF THE ORGANISATION: GTU/GSET - Graduate School of Engineering and technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Center of Excellence

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeel Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Practical done in software using "ladder diagram" and done simulation of logic gate like NO, NC, NOR, XNOR, OR, XOR, NOT, AND.
- Done simple programming like switching system of different lights, motors etc.
- Program on push Button (latching), using this PB button Done some loop system by giving 'memory' input.
- Practical Done on traffic light and parking system.
- Learn about how to use Function block like Timmer and counter block. (TP, TON, TOF), (CTU, CTD, CTUD).
- Practical Done on some Timmer Function like motor on, off in given time and same for counter.
- Using comparator Function (=, <, >, ≤, ≥) Done some practical like compare two or more input to operate a motor or light.
- Done complete practical using all above function in one system

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 18/03/2023

Date: 27/02/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 27/02/2023 TO 05/03/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: GTU [GTSET- Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Center of Excellence

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Get the basic knowledge of sensor technology and circuit and terminology used in sensors.
- get to know about sensor learning kit by Bosch Rexroth.
- get knowledge of fundamental of Electronic and Instruments like AC, DC current, voltages, Resistance, Ratings etc.
- Knowning of basic Relly switch working principal.
- Get in detail Analog and Digital signal and its convergent.
- know about components used in sensor technology learning like SMPS, Proximity sensor kit, models, motor, counter, tool & material box.
- Learned all theory of sensors their working principle, working structure, inside components and their circuit diagram.

Proximity sensors - inductive, capacitive, ultrasonic, photoelectric.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 18/03/2023

Date: 06/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-4

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Annexure I
Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar
DIARY OF THE WEEK: Dt: 06/03/2023 TO 12/03/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: CTO [GSET - Graduate School of Engineering & Technology]
NAME OF THE PLANT/SECTION/DEPARTMENT: CTO - Bosch Center Excellence in Automation
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Get to know connection of sensor with SMPS modul and set up.
- practical done on Behavior of inductive sensor. and capacitive sensors.
- Behavior of magnetic field sensors.
- Behavior of the reflection light scanner.
- Behavior of one-way light ~~sensor~~ barriers.
- Behavior of the reflection light barier (OBS)
- Behavior of an ultrasonic sensor.
- Check distance measuring equipment with the help of ultra sonic sensor and software "ulter 3000".
- All are above mentation practicle perform for check the condition of sensor that how it can behave with different material like metal, plastic, paper, wood, sheet and get the limitation of that sensor.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 18/03/2023

Date: 13/03/2023

✪ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week-5

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Annexure I

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 13/03/2023 TO 19/03/2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: GTU & GSET - Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Centre of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Introduction to hydraulic & Peneumatic System, design of basic hydraulic & Peneumatic circuit.
- Principles of hydraulic pumps, motors, actuators and valve.
- Different types of valve like liver operated, spring return, Solenoid operated etc.
- Safety considerations in hydraulic and peneumatic system.
- Understanding of hydraulic components kit given by bosch rexroth.
- Get fundamental Knowledge about Types of pump:-
  1) Positive Displacement pump [constant flow output]
  2) Non-positive displacement pump [flow output change according to outlet pressure change].
- understand component's symbols that are use in hydraulic & Peneumatic circuit.
- working of pressure reducing valve, Directional control valve, Pressure control valve, Throttle valve, Accumulators, check valve of hydraulic as well as peneumatic.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor
Shaikh

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 09/05/2023

Date: 20/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week- 6

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Annexure 1

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Guthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 20/03/2023 TO 26/03/2023

DEPARTMENT: Mechanical SEM: 8^{th}

NAME OF THE ORGANISATION: GTU [GSET - Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Center of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Detailed overview of automation studio software and its applications.
- Basics of system design and create and simulate hydraulic and pneumatic circuits.
- Basic circuit like single acting cylinder with spring return.
- Double acting cylinder., • Sequencing of two double acting cylinder.
• Application of proximity sensors in circuit, • Application of Accumulator., • Sequencing of cylinders using solenoid operated DCV. • Application of proportional valve, • Pressure compensated pump, Load sensing and pressure compensated pump, meter out & meter in circuit, Bleed-off circuit using flow control valve, Application of counter balance valve, Application of unloading valve (high-low circuit), Basic pneumatic circuit, All type of gate - And, NOR, OR, NOT, XNOR etc., continuously operating double acting pneumatic circuit

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 08/05/2023

Date: 27/03/2023

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week-1

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Annexure I
Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 27/03/2023 TO 02/04/2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: GTU [GSET - Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Centre of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Did practicals that simulated in Automation studio.
- operate double acting cylinder using 4/2, 4/3 DCV lever operated valve and DCV with Detent.
- Find the rod & piston side pressure while operating DAC with a 4/3 DCV
- performed Regenerative hydraulic circuit using a 'J' type center spooled DCV.
- Understand the Basics of Relay Board installed in hydraulic kit.
- Basic connection of NO, NC and performed basic operation using solenoid operated DCV and get basics of electro-hydraulic circuit.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 09/05/2023

Date: 03/04/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week - 8

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Annexure I

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 03/04/2023 TO 09/04/2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: GTU / GSET - Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU - Bosch Center of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

* Practical on - Sequencing of two double acting cylinders using pressure relief valve.
- Sequencing of two double acting cylinders using relay board and electrically operated DCVs.
- Different operation with Double acting cylinder using different DCV like 4/2, 4/3.
- Observation of speed of hydraulic motor at differnet speed.
- Pressure & flow characteristics variable of a pressure relief valve, meter out & meter in circuit, flow characteristic of a throttle valve & with flow control valve.
- Hydraulic cable crane with load using pressure switch, using hydraulic motor
- Hydraulic rectifier circuit.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 09/05/2023

Date: 10/04/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week - 9

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Annexure I
Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shriram Mukeshkumar
DIARY OF THE WEEK: Dt: 10/04/2023 TO 16/04/2023
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: GTU[GSET - Graduate School of Engineering & Technology
NAME OF THE PLANT/SECTION/DEPARTMENT: GTU-Bosch Center of Excellence in Automation
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Basics of Proportional valves. [4/3 proportional DCV with integrated electronics.]
- Performed Practical using potentiometer like moving a cylinder with help of a potentiometer using Proportional DCV.
- Adjusting the system pressure using PDCV
- using command value module performed practicls:- Traversing a cylinders with different speed, Accelerating & decelerating the cylinder using ramps., Setting braking distance after proximity switch during extension of cylinder.

* Penumetic Practicals:- operate single acting and double acting cylinder using 3/2 Push button, Pilot, roller operated DCV.
- controlling speed of cylinder with throttle valve.
- operate cylinder Extension and retraction with on time Delay
- performed Different ~~g~~ logic gates - OR, AND, NOR, NAND, NOT.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 09/05/2023

Date: 17/04/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-10

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Annexure 1
Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Mukeshkumar

DIARY OF THE WEEK: Dt: 17/04/2023 TO 23/04/2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: GTU/GSET- Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU-Bosch Center of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeel Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Performed practicals on sequencing of cylinder by manually and electrically.
- Performed practicals on controlling speed and position of cylinder using sensor and limit switch.
- Control of a double acting cylinder using sensor at that 50% of retraction of cylinder.
- Sleeves pressing into metal block using penumetic cylinder with sequencing.
- Holding material with vaccum cups gripper using pilot pressure.
- Controlling system pressure using an proportional DCV in circuit.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 09/05/2023

Date: 24/04/2023

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week - 11

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Annexure I
Enrollment no: 190590119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Abhiram Mukeshkumar

DIARY OF THE WEEK: Dt: 24/04/2023 **TO** 30/04/2023

DEPARTMENT: Mechanical **SEM:** 8th

NAME OF THE ORGANISATION: CKTU [ASET- Advanced School of Engineering & Technology]

NAME OF THE PLANT/SECTION/DEPARTMENT: CKTU- Bosch Center of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- This week we had to make one application of hydraulic and Pneumatic system using PLC that would include a pneumatic or Hydraulic system or integrated based on our learning.
- Application : Automatic Drill control system
- Discussion on which components are suitable for our application
- Component List :

Capacitive Sensor	Double acting Hydraulic Cylinder
Inductive Sensor	Two Double-acting Pneumatic cylinder
Proportional valve	2/3 DCV Solenoid operated
Analog output module	PLC

- Complete Simulation of our application in the automation Studio Software.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 09/05/2023

Date: 01/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-12

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Annexure I

Enrollment no: 190390119015

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shivam Maheshkumar

DIARY OF THE WEEK: Dt: 01/05/2023 TO 07/05/2023

DEPARTMENT: Mechanical **SEM:** 8th

NAME OF THE ORGANISATION: GTU [GSET-Graduate School of Engineering & Technology

NAME OF THE PLANT/SECTION/DEPARTMENT: GTU-Bosch center of Excellence in Automation

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Jeet Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

- Complete the ladder diagram of the system in indraa logic software.
- checking ladder diagram in PLC simulator that working or not.
- Had done the physical connection of hydraulic and pneumatic circuits and PLC connection with the system.
- Set proportional valve according to differente speed requirement with the help of analog output module.
- connect input and output sensor for start the process
- check the system work properly according too the set value of proportional valve.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 09/05/2023

Date: 09/05/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

APPENDIX-2

ANNEXURE-2(FEEDBACK FORM)

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Annexure 2

Feedback Form by Industry expert

Student Name: Suthar Shivam Mukeshkumar Date:

Work Supervisor: Jeet Joshi Title:

Company/Organization: GTU-Bosch Centre of Excellence in Automation

Enrollment No: 190390119015

Internship Address: GTU Nr. Vishwakarma Government Engineering College, Nr Visat Three Roads, Visat-Gandhinagar Highway

Dates of Internship: From 13/02/2023 to 10/05/2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility			✓	
Uses technical knowledge and expertise				✓
Analyzes problems effectively				✓
Communicates well and writes effectively				✓

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent)

Additional comments, if any: NO

Signature of Industry person with name and Stamp:

Signature of the Faculty Mentor

Shaikh

INTERNSHIP AT CREATIVE LASER TECH

INTERNSHIP REPORT

Submitted by

SUTHAR SHUBHAM MUKESHKUMAR

190390119016

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

Gujarat Technological University, Ahmedabad

May, 2023

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at CREATIVE LASER TECH** has been carried out by **SUTHAR SHUBHAM MUKESHKUMAR** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Prof. Tausif Shaikh	Prof. Kunalsinh Kathia
Internal Guide	Head Of Department

An ISO 9001 : 2015 Certified Company

CREATIVE LASER TECH

creativelasertech@gmail.com
+91 81282 80331 | +91 99749 09905

TO WHOM IT MAY CONCERN

Date: 08/05/2023

This is to certify that Shubham Suthar a student of S.P.B. Patel Engineering College has completed his industrial internship in the field of Industrial Engineering and Production from 13th February 2023 to 7th May 2023 under the guidance of Mr. Sujit Patel, Mr. Ajay Patel and, Mr. Nayan Patel.

His internship activities include learning the manufacturing processes, production process flows, manufacturing fundamentals and quality control.

During the period of his internship program with us, he has been exposed to different processes and was found diligent, hardworking and inquisitive.

We wish him every success in his life and career.

For, **Creative Laser Tech (Chhatral)**

G.A.Patel

CREATIVE LASER TECH CHHATRAL

Plot - 910/1, Phase-I, GIDC, Chhatral-382729, Ta. Kalol, Dist. Gandhinagar, Gujarat (India)

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : 14 May 2023 (21:02:53)

This is to certify that, ***Suthar Shubham Mukeshkumar*** (Enrolment Number - 190390119016) working on project entitled with ***Creative Laser Tech*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Suthar Shubham Mukeshkumar

Name of Guide : Mr.Shaikh TausifAhmad MohmmadSalim

Signature of Student : ____________

*Signature of Guide : ____________

Disclaimer :
This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate, Only if all above activities has been Completed.

S.P.B. Patel Engineering College, Mehsana

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

DECLARATION

We hereby declare that the Internship / Project report submitted along with the Internship / Project entitled **Internship at CREATIVE LASER TECH** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Mechanical Engineering** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me under the supervision of **Prof. Tausif Shaikh** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Name of the Student	Sign of Student
Suthar Shubham Mukeshkumar	_________________

ACKNOWLEDGMENT

I would like to express my deep appreciation to all those who provided me the opportunity to complete this internship report. I would like to express my special thanks to our HOD Prof. Kunalsinh Kathia and internal guide Prof. Tausif Shaikh.

Furthermore I would also like to express my appreciation to Mr. Nayan Patel who gave me the opportunity to intern at Creative Laser Tech. I also thank Mr. Ajay Patel, Mr. Sujit Patel, Mr. PavanKumar Gupta who provided encouragement, knowledge and assignments to make my internship successful.

I view this chance as a significant turning point in my professional progress. In order to achieve my intended career goals, I will make every effort to utilize newly acquired skills and information as effectively as possible and to keep working to enhance them.

ABSTRACT

This report contains the work done by the author during his internship at Creative Laser Tech (Chhatral). It shows the process of learning industrial standards, manufacturing process, their process work flow. In the report, the author discusses the manufacturing of sheet metal parts and steps of assembly of those parts . The author also discusses the structure of the company, all the departments, their work, and all the machinery used by the company.

It also explains what the author learned during this internship period such as, components of laser machine, components of bending machine, different method of sheet bending etc.

List of Figures

List of Abbreviations

CNC - Computer Numerical Control

2D - Two Dimensions

3D - Three Dimensions

CAD - Computer Aided Design

TIG - Tungsten Inert Gas

MIG - Metal Inert Gas

SS - Stainless Steel

MS - Mild Steel

P.P.E.S - Personal Protective Equipment

LC - Least Count

OD - Outer Diameter

ID - Inner Diameter

Table of Contents

CHAPTER 1: ABOUT THE COMPANY

1.1 Overview

Creative Laser Tech is engaged in the business of manufacturing all types of sheet metal work according to customer requirements. Laser cutting and CNC bending are the main services of Creative Laser Tech. Company operates an expert worker of CNC bending service providers and CNC laser cutting operators, as well as programs that ensure material and quality. The company has high productivity and results with efficiency. Using the latest software and easy programming, new education, and calculation mechanism, the company have successfully delivered its service to its clients. The company located at Chhatral G.I.D.C. is an ISO 9001: 2015 certified company. Also According to customer needs company to provide powder coating and zinc coating services too.

Name:	**CREATIVE LASER TECH**
Established:	**2014**
Location:	**CHHATRAL G.I.D.C**
Service:	**SHEET METAL FEBRICATION**
Annual Turnover:	**12 TO 15 Cr**
No. Of Employees:	**20**

Fig 1.1 Company Exterior

Fig 1.2 Company Interior 1.2company Layout

1.3 Company Services

1.3.1 Laser Cutting

Fig 1.4 Laser Cutting

Laser cutting is mainly a thermal process in which a focused laser beam is used to melt material in a localized area. A co-axial gas jet is used to eject the molten material and create a kerf. A continuous cut is produced by moving the laser beam or workpiece under CNC control. There are three major varieties of laser cutting: **fusion cutting, flame cutting and remote cutting.**

In **fusion cutting**, an inert gas (typically Nitrogen) is used to expel molten material out of the kerf. Nitrogen gas does not exothermically react with the molten material and thus does not contribute to the energy input.

In **flame cutting,** oxygen is used as the assist gas. In addition to exerting mechanical force on the molten material, this creates an exothermic reaction which increases the energy input to the process.

In **remote cutting,** the material is partially evaporated by a high-intensity laser beam, allowing thin sheets to be cut with no assist gas.

The laser cutting process lends itself to automation with offline CAD/CAM systems controlling either three-axis flatbed systems or six-axis robots for three-dimensional laser cutting.

1.3.2 Sheet Metal Bending

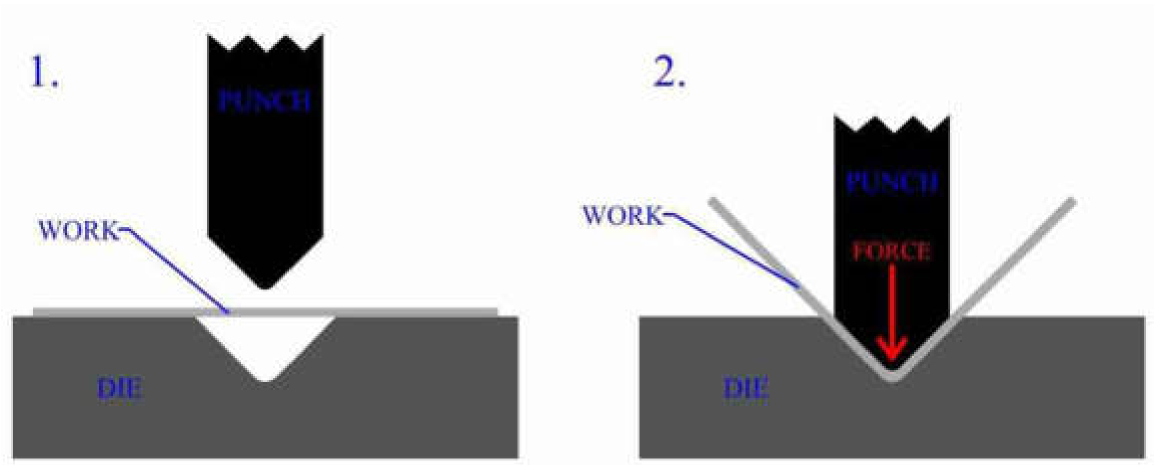


Fig 1.5 Sheet Metal Bending

The sheet metal bending process involves applying a force to a sheet metal part to change its geometry. This force causes stress on the sheet metal beyond its yield strength, causing the material to physically deform without breaking or failing.

The press brake is a commonly used tool to bend sheet metal. It works by lowering a punch onto a sheet metal positioned on a die, creating the desired geometry. There are six types of bending methods. One of them Bottoming Bending method is used by company.

1. V- Bending
1. Air Bending
2. Bottoming Bending
3. Wipe Bending
4. Roll Bending
5. Rotary Bending

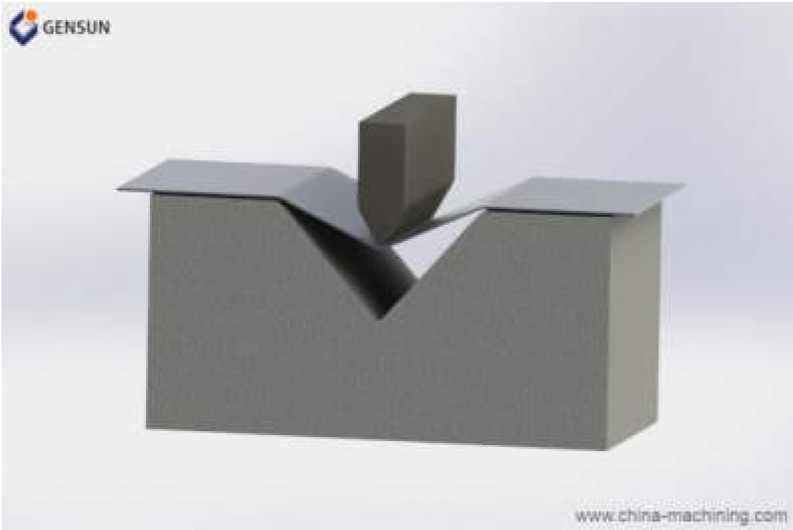


Fig: 1.6 Air Bending

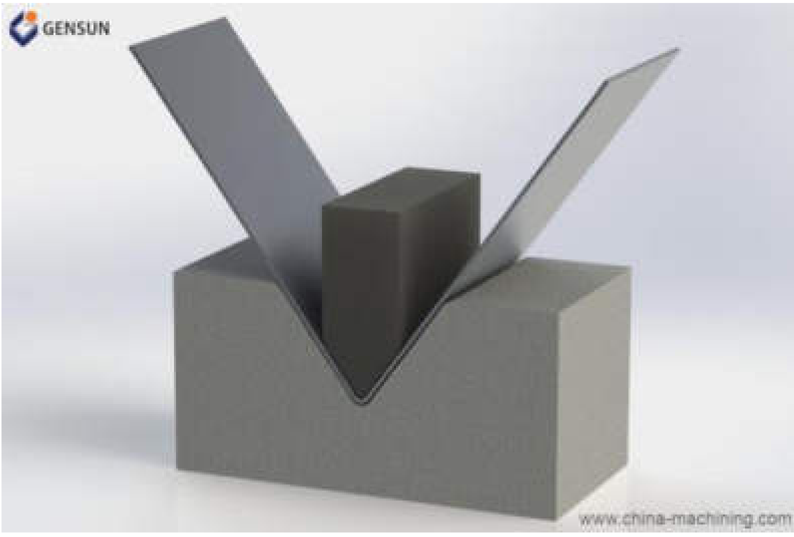


Fig: 1.7 Bottoming Bending

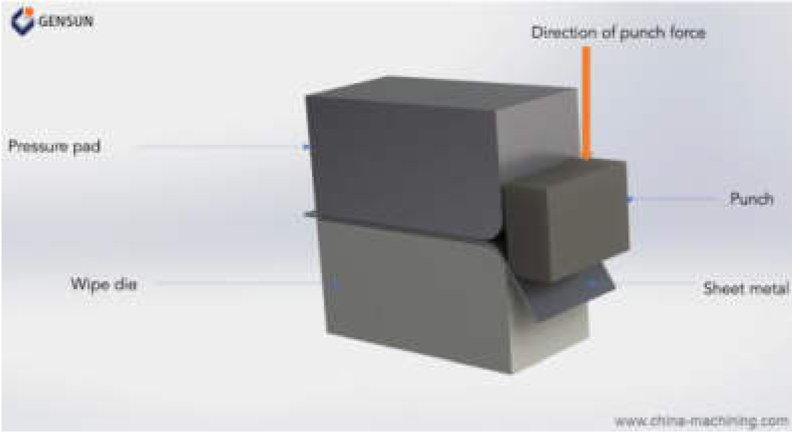


Fig: 1.8 Wipe Bending

Fig: 1.9 Roll Bending

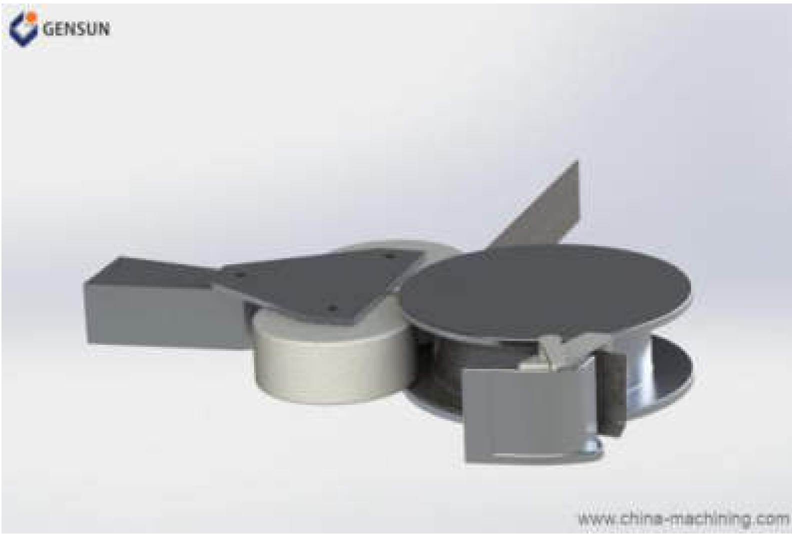


Fig: 1.10 Rotary Bending

1.3.3 Powder Coating

Powder coating is a dry coating process used as a metal finish mostly on industrial equipment. Powder coating is applied as dry powder through an electrostatic process, then cured with heat. It is well known for providing high-quality finishes in terms of both functionality and overall look.

Fig: 1.11 Powder Coating

1.3.4 Zinc Plating

Zinc plating involves the electro-deposition of a thin coating of zinc metal onto the surface of another metal object, known as a substrate. The zinc coating creates a physical barrier that prevents rust from reaching the underlying metal surface. Zinc is chosen because of its innate ability to fight corrosion.

Powder Coating And Zinc Plating are external services which is provided by vendors, these services provided on the client needs

CHAPTER 2: SHOP FLOOR

2.1 Introduction

It is a core part of any industry, where all the major manufacturing activities take place. from sheet receiving to making a complete part and dispatch. In this company there are four sections where a raw material (metal sheet) pass through for making complete goods.

Sections:

1. Raw material section
2. Laser cutting section
3. Bending section
4. Assembly section

Fig : 2.1 Shop Floor Area

2.1.1 Raw Material Section

Where the metal sheets are placed according to their material types and according to their thickness. Also sheets are inspected in this section. As a raw material, company use mostly six different metal sheets, SS 304 and SS 316, MS HR and CR, Copper, X5NiCr, Aluminium, Galvanized Iron sheets. In this section main two activities are performed, one is inspection of sheets and taking measurements of sheets for design department.

There are two partitions of materials first is materials that owns by the company and the second materials provided by the client which is called "party material". For example copper sheets are never bought by the company it is always provided by the client, while MS and SS sheets are mostly available in the company because of company's clients, most of the clients are the demand with MS and SS so the company must have stocks for MS and SS sheets. It reduced transportation time and also it will help with new urgent orders.

Company mostly work with six different metal sheets as below:

1. SS 304 & 316 sheets:

Stainless steel sheet/plate is versatile and used in a variety of applications. It is primarily selected for its resistance to corrosion, longevity and formability. Typical uses of stainless steel sheet/plate include, construction, food service applications, transportation, chemical, marine, and textile industries. Standard size of SS sheets are 2000mm × 1000mm, 2500mm × 1250mm, 3000mm × 1500mm. And thickness range from 0.4mm to 6.00mm.(For company use)


Fig: 2.2 SS sheet

2. MS (HR & CR) sheets:

Mild steel is a type of carbon steel with a low amount of carbon – it is actually also known as "low carbon steel." Although ranges vary depending on the source, the amount of carbon typically found in mild steel is 0.05% to 0.25% by weight. Mild Steel Plates serves a various purpose such as making general structural, boilers & pressure vessels, Pen-stock, flanging & forming, atmospheric corrosion resistance products, Ship Building, Oil & Gas equipment & Pipeline manufacturing, various engineering application, construction plates, Industrial Flooring, galvanizing pots, fabrication of various types. 2000mm × 1000mm, 2500mm × 1250mm, 3000mm × 1500mm, 4000mm × 2000mm, 5000mm × 1250mm, 3660mm × 1830mm, 4000mm × 1750mm these sizes of sheets are used by the company and it's vary according to client requirements.and sheets thickness available from 3mm to 150mm but in company use 1.5mm to 22mm because limitation of laser machine.

HR MS sheet has undergone the rolling process at a temperature above its re-crystallization temperature (generally up to and exceed 1700° F). Compared to unprocessed MS, the processed material exhibits greater formability and work-ability, making it easier to work with in subsequent processing operations.It is typically used in application that do not required extremely tight tolerances.

Such as: Automobile Parts, Agricultural Equipment, Construction Materials

Fig: 2.3 HR sheets

CR MS sheet is hot rolled MS sheet that has undergone additional processing to improve its dimensional and mechanical properties. During the cold rolling process, cooled hot rolled MS passes through another series of rollers at room temperature. Since the material is no longer hot and malleable, a significantly higher amount of pressure is required to compress it into the desired thickness.It is typically used in application that required extremely tight tolerances.

Such as: Aerospace Structure, Home Appliances, Metal Furniture, Mechanical Components

Fig: 2.4 CR sheets

3. X5NiCr Sheets:

The material X 5 Ni-Cr is not part of any material group. The steel material "X 5 Ni-Cr" has five alternative names. contains Chrome, Manganese, Nickel, Phosphorus, Silicon and Sulfur.Typically used within the Marine, brewing, petrochemical, pharmaceuticals and Food processing industries, common applications of X5NiCr include but are not limited to; Pressure Vessels, Valves, Flanges and fittings, heat exchangers, condensers, filters etc.

Fig: 2.5 X5NiCr Sheets

4. GI Sheets:

Galvanized iron sheet is a building material, which is made of mild steel sheet and coated with a layer of zinc on the surface. Galvanizing is an economical and effective anti-rust method that is often used. Its surface is smooth and shiny with big spangles, regular spangles, small spangles, or zero spangles.Considering the different galvanizing processes, we have hot-dip galvanized sheets and electro - galvanized sheets. Due to its excellent corrosion resistance and good appearance, it is a cost-effective choice in buildings, automobiles, furniture, home appliances, vessels, etc.

Fig: 2.6 GI Sheets

5. Aluminium Sheets:

Aluminium is the most abundant metal on Earth, and it is the third most abundant mineral after silicon and oxygen. It has a lot of desirable qualities, low density, is non-toxic, has a high thermal conductivity, has excellent corrosion resistance and can be easily cast, machined and formed. It is also non-magnetic and non-sparking. It is the second most malleable metal and the sixth most ductile, and is 100% recyclable without losing any of its original properties. Due to its wide range of benefits, aluminium is the second most used metal on the planet, meaning almost everyone has used an aluminium product at some point in their life. It is extremely versatile and perfect for all manner of consumer products in area of Trains, Ships, Cars, Window Frames, Spacecrafts, Construction, Electronics, Power Lines, Aircraft, appliances.

Fig: 2.7 Aluminium Sheets

6. Copper Sheets:

It is a major industrial metal because of its high ductility, malleability, thermal and electrical conductivity and resistance to corrosion. Due to it’s excellent properties in thermal conductivity and electrical Conductivity it is widely use in Electrical component and Heat exchangers.

Fig: 2.8 Copper Sheets

2.1.2 Laser Cutting Section

In laser cutting section sheets are cut through laser according to their pattern or design which is provided by design engineers and they make designs according to the need of the clients. Also they generate a CNC code for cutting. Further, we discuss this topic in detail.This section is equipped with LVD 's LYNX FL 4020 laser machine. For the efficient Production output of this section requires at least three workers, one as machine operator and two as helpers, basically their work is to set the sheets on the bed of the machine for cutting and take out the required cutting parts from the cut sheets.

Fig: 2.9 Lase cutting Area

2.1.3 Bending Section

As the name of this section suggests, here the sheets are bent with a bending machine. For bending the sheets necessary bending marks are created on the sheets by laser cutting, bending machine operator bends the sheets according to those bending marks. Also, they

keep design print out with them which contains the bending distance and overall dimensions of the product, with the help of these data, the operator makes a program for the bending machine.For bending they use LVD'S PPED 135/30 Bending machine.

Fig: 2.10 Bending Area

2.1.4 Assembly Section

This section is comprised of professional assemblers,and technicians, who specialize in all of the work processes, including reading drawings, understanding the assembly process and executing the actual assembly.There are three welder who are specialized in TIG and MIG welding and two grinder men.

2.2 Machines In Shop Floor

2.2.1 List of Machine

1. Laser Cutting Machine LYNX FL4020
2. Bending Machine PPED 135/30
3. Mig Welding
4. Tig welding
5. Horizontal Band Saw Machine
6. Hydraulic Press Machine
7. Drilling Machine

2.2.2 Laser Cutting Machine

Laser cutting machines are a tool used in a wide range of industries for precision cutting and designing projects. Machine emits a high powered laser beam to either cleanly cut or etch a specific design on materials such as steel, plastic or wood. The beam will either burn, vaporize or melt away the excess product, leaving a superior finished design or edge.

A laser cutting machine has settings known as the computer numerical control (CNC), as well as laser optics, which control and direct the laser beam's intensity for the desired design effect, or the specific cuts required in a manufacturing or design project. The laser beam is generated by a process whereby electrical discharges or a lamp trigger a lasing material within a confined container causing a chemical reaction, resulting in a high powered beam being released. The beam is then reflected using a mirror in a stream of monochromatic light. From the mirror, the light is then directed by fibre optics or mirrors to the work area, with the narrowest point of the beam cutting or making the design etch on the material.

For industrial applications, a laser cutting machine is often used to cut structural and piping materials and flat sheet material such as metal. The CNC setting can also be changed to etch or engrave all types of designs on metal, wood and plastic. Speciality

CAD software is used to program the CNC and direct it to perform either the cutting, engraving or etching specifications required for the laser cutting project.

Fig: 2.11 Laser Cutting Machine

- **Specification Of LYNX FL 4020 Laser Cutting Machine:**

Maximum sheet Size	4065 × 2035 mm
Maximum sheet weight on table	1250kg
Table change cover time	35 sec
Maximum positioning speed X-Y	120 m/min
Repetitive accuracy	+/- 0.025mm
Positioning accuracy	+/- 0.050mm
Machine Length × Width × Height	13450 × 7800 × 2750 mm
Machine Weight	16000kg
Laser Type	IPG
Max cutting performance	4 kw
Mild Steel	20 mm
Stainless Steel	12 mm
Aluminium	15 mm
Copper	8 mm
Brass	8 mm
Cutting head	Precitec ProCutter

- **Components Of Laser Machine**

Air Compressor

Laser Module

Air Filter

Gases (O2 & N2)

Nozzle

Laser Lens

Suction Device

1. Air Compressor:

The fiber laser cutting machine generally chooses an auxiliary gas when cutting some thin metal plates. As we all know that the cost of nitrogen and oxygen is higher. Nevertheless, the use of compressed air is very economical and practical, which can reduce the production cost by about half. Therefore, the use of compressed air as an auxiliary gas for cutting is becoming more and more common, which has also led to the rise of the market for air compressors for CNC laser cutting.

The air compressor can be combined with high-purity oxygen and nitrogen to provide cutting gas to the cutting head. At the same time, it can also be used as a power source to supply the cylinder for clamping table. Besides, it also has a cleaning function. It is able to remove dust from the optical path system to ensure that the optical originals are clean.

Fig: 2.12 Air Compressor

2. Laser Module:

The laser module is the heart of the laser machine. The working of the module is very simple, it provides the power to generate the laser beam. Also keeps the laser beam controlled and stable. It's power range is between 1KW to 100 KW cooled room or area is required for laser module because of there are chances to failed module components due to the heat. Water chiller is required for cooling purpose.

Fig: 2.13 IPG Laser Module

3. Air Filter:

Compressed air should be cleaned to remove any oil or moisture before entering the laser head to avoid contaminating the optics. Because of its high oxygen content, compressed air is considered a reactive cutting gas for metal fabrication.

4. Gases(o2 & N2):

Oxygen was one of the first assist gases used due to its high reactivity. The extra heat generated when using oxygen assist gas allows lower-powered lasers to cut through thicker materials. Oxygen cutting tends to run at a lower flow rate and pressure than nitrogen cutting. This can lead to slightly slower cutting speeds with certain metals but can result in reduced gas consumption and lower operating costs.

Generally**, Nitrogen** is considered the best assist gas for producing high cut quality. A nonreactive gas with most materials, nitrogen is best used with aluminum, mild steels, galvanized steels, and UHSS automotive steels. Because nitrogen cutting is a colder process, it can produce high-quality edges for a wide range of materials.

5. Nozzles:

The nozzle is one of the important parts of the laser cutting machine. It is located at the bottom of the laser head and can emit a laser beam and auxiliary gas. Its function is to gather auxiliary gas to form high pressure and release it to the surface of the cutting material. At the same time, it prevents pollutants such as slag and smoke from bouncing upwards, thereby protecting the internal lens. Generally, there are two types of laser cutting nozzles: single-layer nozzles and double-layer nozzles. People do fusion cutting with a single-layer nozzle. That is to say, people use nitrogen as auxiliary gas to cut stainless steel, aluminum alloy, brass, and other materials. Double nozzles are usually used to cut carbon steel, which uses oxygen as the assist gas.

The diameter of the nozzle determines the velocity of the airflow entering the cutout. Therefore, it affects the melt removal and cutting stability.The faster the gas flow into the incision, the stronger ability to remove the melt. The operator should select the nozzle size according to the laser power and the thickness of the metal sheet to be cut. Theoretically, the thicker the sheet, the larger the nozzle should be used. And the higher the proportional valve setting pressure, the greater the flow rate.

Fig: 2.14 Laser Machine Nozzle

6. Laser Lens:

The heart of a laser cutting machine is the cutting head in which the laser lens is placed. This is needed to bundle the laser beam. Only in this way does the beam achieve the necessary power to melt metals. After bundling, the beam is about 2,500 times stronger than before. The laser lens for a cutting system is not made of glass as in the case of magnifying glasses or binoculars, for example. The laser lenses therefore consist of zinc selenide (ZnSe). This material is heat-resistant up to a temperature of 1,500°C and gives the laser lenses their typical orange colour.

The quality of the lenses used in laser cutting machines has a direct impact on the accuracy and precision of the machine. Poor quality lenses can lead to inaccurate results or even damage the material being cut. To ensure the highest quality results, it is important to use lenses that are designed to withstand the high temperatures and powerful laser beams associated with laser cutting.

Fig: 2.15 Laser Lens

7. Suction Device:

Suction helps to clear smoke from the working field, keeping operating personnel safer from smoke inhalation and improving visibility. After the suction, the device converts metal vapor into solid metal dust so that metal vapor or particles are not entering the atmosphere.

2.2.3 Bending Machine

Sheet metal bending machine allows manufacturers to turn a straight piece of sheet metal into an angled component, and this can be much more cost-effective than welding or a fixing two separate pieces together.

The bending process typically works by using bending tools to apply force to the sheet metal in a way that causes permanent. However, there are many different bending methods and pieces of bending machinery that can be used to achieve the best result. Complex bending calculations ensure that tight tolerances can be met.

Sheet metal is bent when it is forced between two tools by the pressbrake: an upper tool (known as a punch) and a bottom tool (known as a V-die). The pressbrake controls the movement of the punch and provides the press force using hydraulic rams or electrical servo motors. The bend angle is predominantly determined by the depth of penetration of the punch within the V-die.

Fig: 2.16 Bending Machine

- **Specification of PPED 135/30 Bending Machine:**

Pressing force	**1350 kN**
Working length	**3050 mm**
Distance between uprights	**2600 mm**
Stroke	**200 mm**
Distance table/ram	**500 mm**
Table width	**180 mm**
Maximum load table	**1000 kN/m**
Working height	**970 mm**
Approach speed	**90 mm/s**
Working speed	**10 mm/s**
Return speed	**95 mm/s**
Motor	**15 KW**
Oil	**275 L**

- **Types of Punch:**

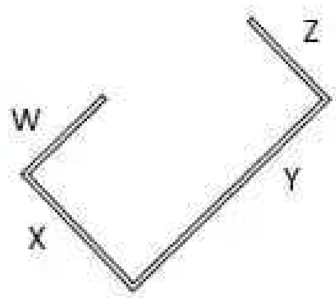
1. Standard Punch:

Standard punches are used where the bending process is not geometrically complicated. where bending product is easy in geometry and bends are very normal.

Fig: 2.17 Standard Punch

2. Goose neck Punch:

The application of the goose neck punch in the bending is mainly the avoidance of the W direction, and the bending diagram is as follows:



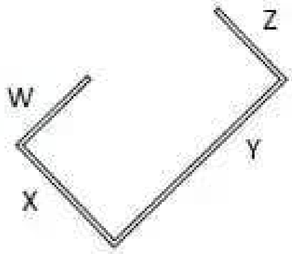
X direction: when X min > 9mm, it can be bent (when the size is required in the W direction).

Y direction: when 0<Y<85mm, the Z direction cannot be avoided. When Y≧85mm, Z=Y-85

Fig: 2.18 Goose neck Punch

3. Goose neck Punch:

The application of the goose neck punch in the bending is mainly the avoidance of the W direction, and the bending diagram is as follows:



X direction: when Xmin>6mm, it can be bent (when the size is required in the W direction)

Y direction: When 0<Y<75mm, the Z direction cannot be avoided. When Y≧75mm, Z=Y-75

Fig: 2.19 Goose neck Punch

4. Sash Punch:

When Xmin>10mm,W and X direction can increase in proportion.

When 0<Y<20mm,Z=0.

When Y>20mm, Y and Z directions can increase in proportion.

The bendable length in the W direction is greater than the bendable length in the Z direction.

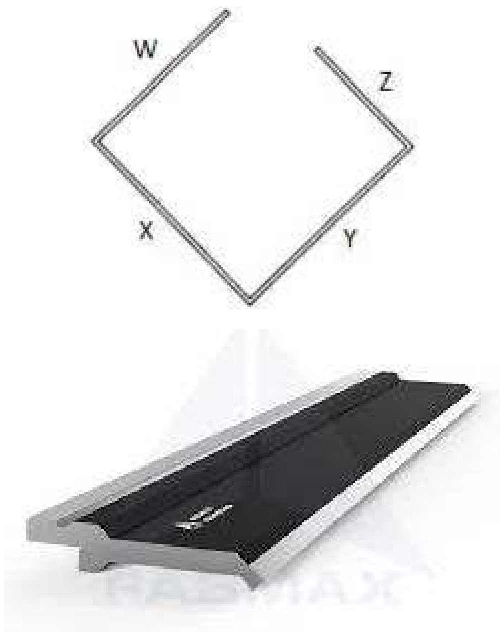
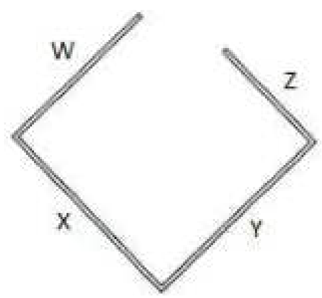


Fig: 2.20 Sash Punch

5. Arrow Punch:

Suitable for bending symmetrical products, both the front and rear directions can be avoided, and the bending opening can be as small as 6mm.



When X<50mm,Y<50mm,W and X direction can increase in proportion.

Fig: 2.21 Arrow Punch

6. Acute Punch(Type 1):

Suitable for angles between 45° and 180°

Use a small angle of the tip of the tool to avoid the tapped hole and other work pieces that need to be avoided.

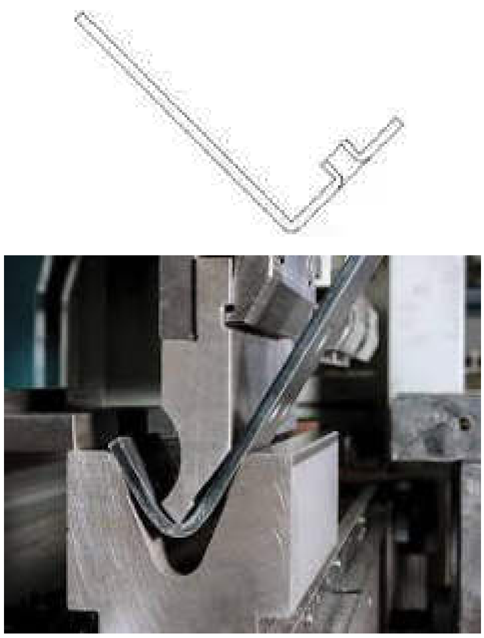


Fig: 2.22 Acute Punch T1

7. Acute Punch(Type 2):

Applicable range is between 30 ° and 180 °
Use a small angle of the tip of the tool to avoid the tapped hole

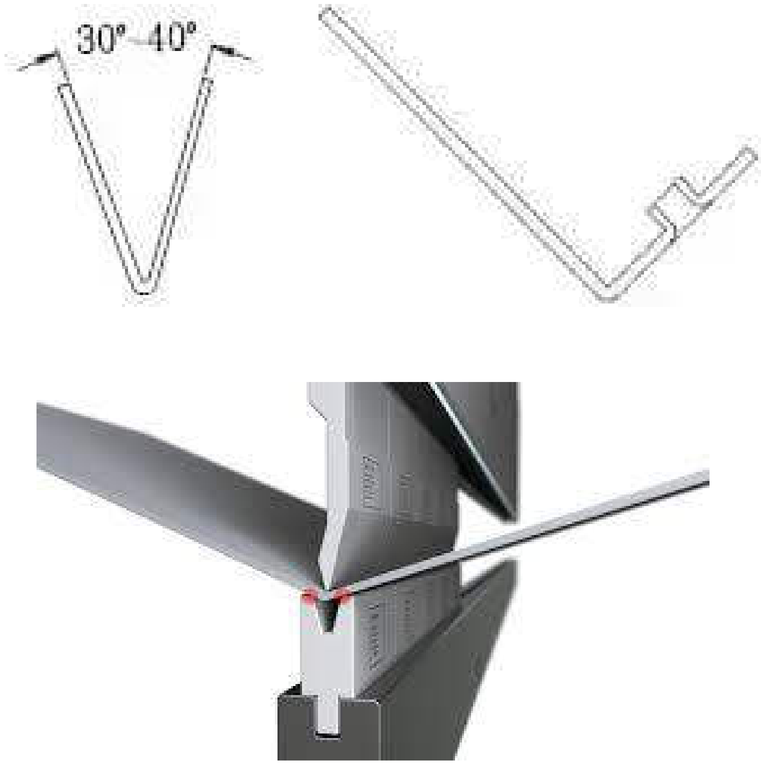
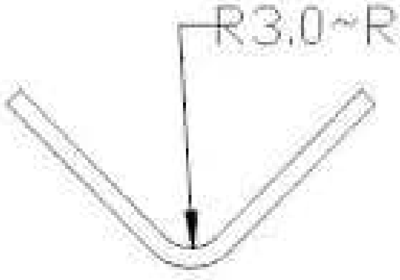


Fig: 2.23 Acute Punch T2

8. Radius Punch:

This large radius punch is mainly used for bending the inner arc angle of R, and the radius of the arc angle is R3~R10.



The radius punch is matched with the corresponding V groove.

Fig: 2.24 Radius Punch

9. Hemming Punch:

The figure diagram shows the shape of the product after bending and flattening. All similar shapes can be bent. It should be used with 30° upper and lower molds. Can also be used for pressing, riveting, shaping, etc.

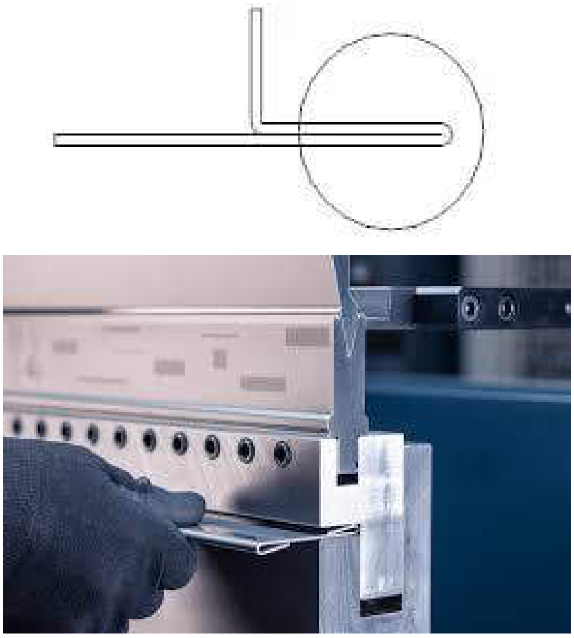
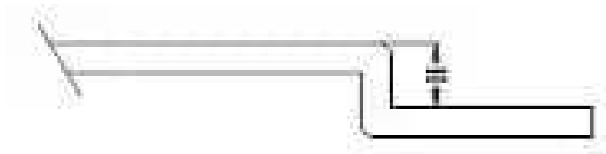


Fig: 2.25 Hemming Punch

10.Offset Punch:

Used for Z bending which can't be folded by common press brake dies.H=1~10mm



The shape of the bend product is as shown in the upper figure, usually called Z bend or offset.

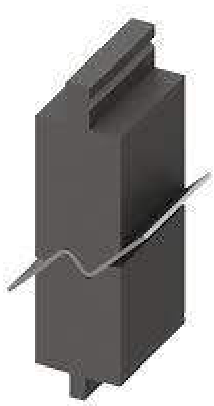


Fig: 2.26 Offset Punch

- **Types Of Dies:**

In Sheet metal Bending there are main three types of dies as follow:

1. V shape Die:

The most common type of press brake die is the V-die. A set of V-dies with variously sized die openings can be used to bend a range of materials in different bend angles, depending on the punches used and the depths they descend into the die during an air-bending operation.

Fig: 2.27 Single V dies

2. U shape Die:

U-bend dies have a rounded bottom, but otherwise are similar to single V dies and are used for radius U-bends.

Fig: 2.28 U die

3. Z shape Die:

Z-bend dies are another common name for offset dies because of the shape of the resulting part that is made in a single bend as show in Fig 2.29.

These types are commonly used for bending, for some specific bend like Channel, Double v shape, for Hemming, 90º Bend, there are different dies are used as per the shape we required.

Fig: 2.29 Z Die

2.2.4 Mig Welding Machine

MIG welding is a versatile process and can be easily used to weld various metals and alloys, including copper, aluminum, nickel, and iron. The process can join dissimilar metals. The shielding gas protects the arc and the metal transfers across the electric arc.The most commonly used Active Mig Welding Gas is a mixture of Argon and Co2, although Pure Co2 is also still used. Active gases are used for Mig Welding most metals (except Aluminium and Mig Brazing, where pure Argon is used).

Fig: 2.30 Mig Welding Process and Machine

Machine Parts are Gas cylinder, Arc gun, Filler rod, Arc module. Wearing mask, gloves and eye protector is compulsory because of high vapor generation, sparks, electric shock due to high voltage.

2.2.5 Tig Welding Machine

In TIG welding, a tungsten electrode heats the metal you are welding and gas (most commonly Argon) protects the weld puddle from airborne contaminants also protect tungsten. TIG welding produces clean, precise welds on any metal. To protect welding gun elements from the heat of the tungsten elements provide a water tank for cooling purpose.

TIG welding uses a non-consumable tungsten
Filler metal, when required, is added by hand
Produces high quality, clean welds
Welds more metals than any other process

Fig 2.30 TIG Welding Process and Machine

2.2.6 Horizontal Band Saw Machine

A horizontal band saw uses a thin, flexible, continuous steel strip with cutting teeth on one edge. Horizontal band saws are used primarily for cutting metal stock, such as angle iron and other round and flat stock. The blade runs horizontally on two pulleys through two separate guides.

Fig: 2.31 Horizontal Band Saw Machine

2.2.7 H Frame Hydraulic Press

A hydraulic press is a kind of mechanical machine that uses liquid to transfer energy to shape, deform the various types of metals. It works on Pascal's principle. The machine is mainly used for uplifting the Application of smaller forces. Basically, the Hydraulic press contains three parts: The mainframe, power system, and hydraulic control system. In this, the pressure in a liquid is applied by a pump that works like a pump and creates mechanical force. Part production and fabrication are the most common uses for hydraulic press.

Fig; 2.32 Hydraulic press (H Frame)

2.2.8 Drilling Machine

Drilling Machine, device for producing holes in hard substances. The drill is held in a rotating spindle and is fed into the workpiece, which is usually clamped in a vise resting on a table. The drill may be gripped in a chuck with three jaws that move radially in unison, or it may have a tapered shank that fits into a tapered hole in the spindle. Means are always provided for varying the spindle speed and on some machines for automatically feeding the drill into the workpiece. Drill presses for occasional use in general-purpose machine shops usually have only one spindle. Although drill presses are used mainly for drilling holes, they can also be used for enlarging holes with a boring tool or finishing holes with a reamer. Drilling machines over here are mainly used here for reworking procedures.

Fig: 2.33 Drill Machine

2.3 Manufacturing Process

2.3.1 Introduction

The product here goes through multiple manufacturing processes. Process flow includes all materials from receiving to dispatch. There are multiple types of products manufactured so the process for each product may be different. Some products are received only for laser cutting, while some products are received for complete assembly, which includes the process of preparing and assembling the individual components for that product.

2.3.2 Process Flow

The client provide drawing to a design department, where design engineer prepare drawing for three sections one for the laser cutting section, second for the bending section , and third for the assembly section. After that, process flow of that product decided on the pending work and urgent work.

Here I prepared a process flow according to my observation. This process flow continue after the taking order from the client.

Received raw material (sheets) from client

↓

Take measurements of the sheets for nesting

↓

Prepare nesting sheet for laser cutting

↓

Cut sheets according to nesting

↓

Grinding the cut parts (if required)

↓

Transport to bending section

↓

Bend the cut sheets according to bend sketch, which is prepared by design engineer

↓

Transport to the assembly section

↓

Assemble all the parts of that product

↓

Grinding weld joints and finishing the products

↓

Wrap and dispatch for powder coating (if client demand for that)

↓

Received powder coated product

↓

Final cleaning and wrap

↓

Dispatch

CHAPTER 3: DESIGN DEPARTMENT

3.1 Introduction

Design is a critical part of the product development cycle. It involves optimizing the design of your product for its manufacturing and assembly process, merging the design requirements of the product with its production method. Design is considered the first step of any production and it display the end result before wasting material and it's the best tool to communicate with your shop men, technician and others.

Design department of Creative Laser Tech provides the designs of the products according to customer requirement with control copy of each designs. Department uses Auto-CAD to make 2D sketches and Solid-works & Solid Edge software to make 3D models of every products. Also uses CADMAN-L programming software for automatic nesting that come with laser cutting machine (LVD,LYNX FL-4020).

The design section is based on below steps:

1. Separate all parts from the model drawing of the product provided by the customers.
2. Generate 2D drawings for all parts of the product for the nesting process.
3.Make a 3D model of the product for understanding its final appearance.
3. Nesting process carried out and generate codes for laser cutting machine.
4. After that code uploaded into the laser cutting machine.

3.1 Introduction Of Software

3.2.1Autocad

Autocad software is widely used for 2D drafting and analyzing ideas to determine the best solution for a problem at the early stages of a design project before going on to the laser cutting process.

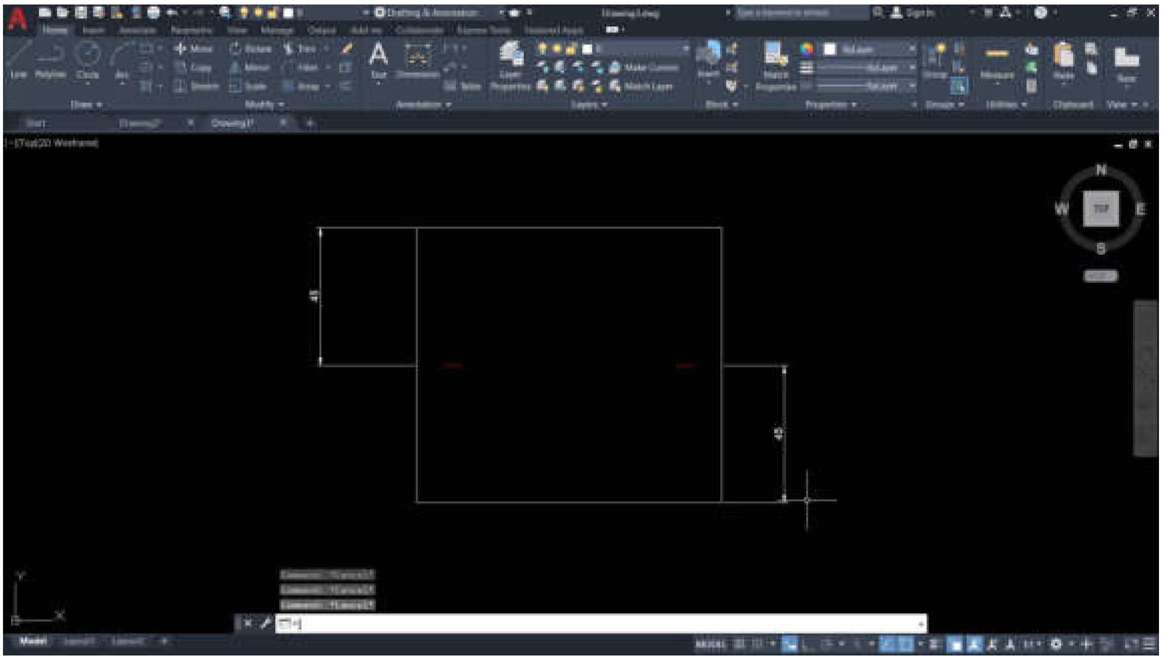


Fig: 3.1 Autocad Interface

It is a critical part of the product development cycle. It involves optimizing the design of your product for its manufacturing and assembly process, merging the design requirements of the product with its production method.

Example: suppose I have client, he want to make a 50×50mm “ L” shape angle which is look as per the Fig: 3.2 and 100mm long with 5mm sheet thickness. So as per the product at where I give the bending mark? and which dimension sheet should I used?

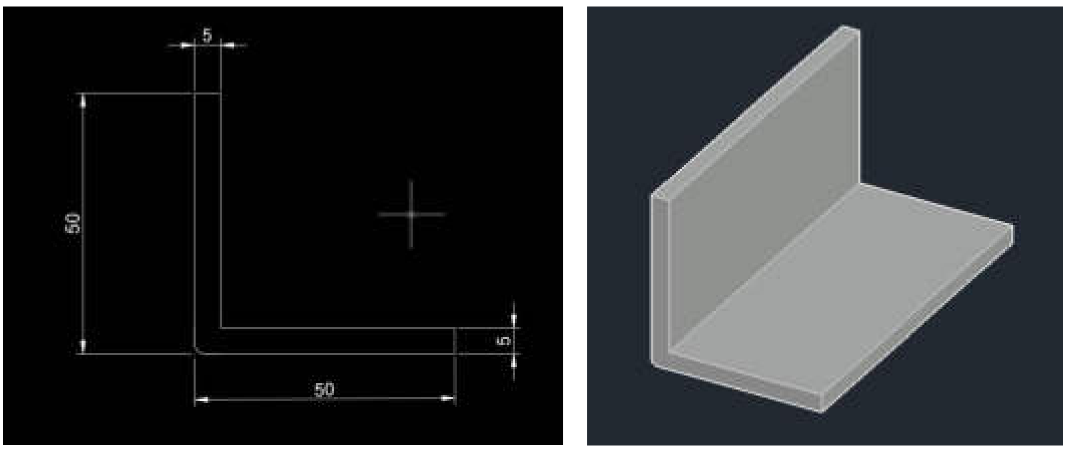
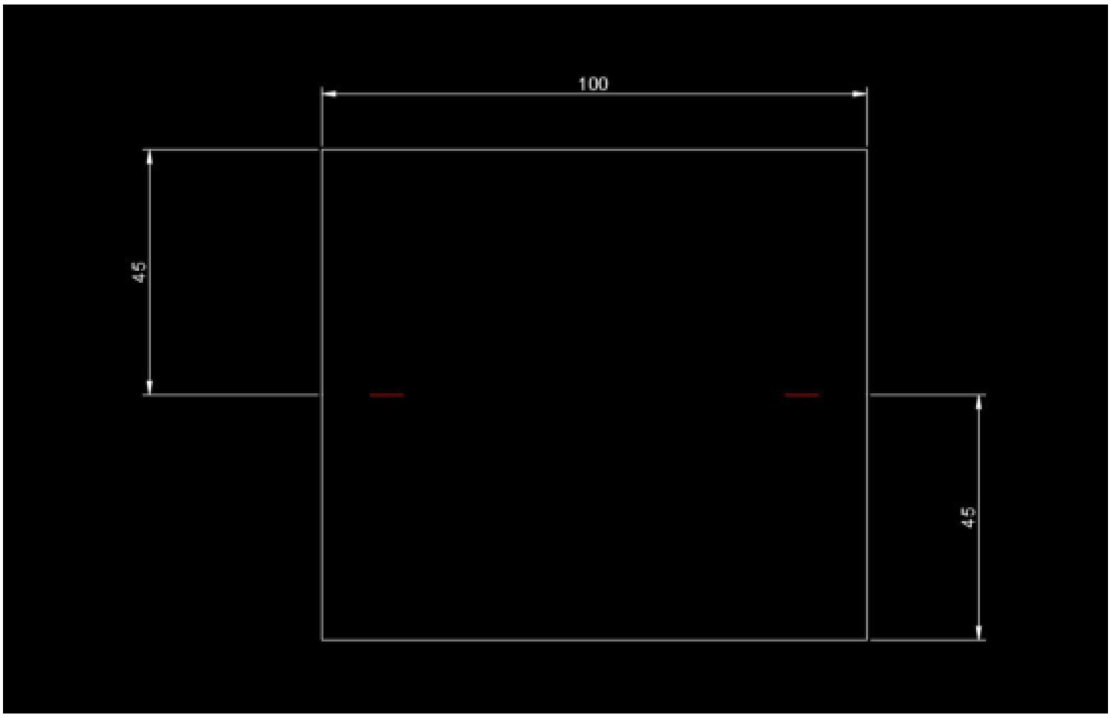


Fig: 3.2 L clamp 2D & 3D sketch

Consider fig: 3.2 2D sketch where over all dimension of product is 50×50 mm after the bending. So there is a fact that any bend part flat sheet dimension is always less than the after bending dimension because when we bend any sheet , sheet thickness is add in the dimension as per the Fig:3.2. So as per the product we required 100×100mm 5mm thick sheet and we place bending mark in middle of the sheet but this is not correct. As I above mention before bending sheet measurements is always lesser than the after bending measurements.

For correct dimension of sheet we need to subtract thickness 5mm on each side than we get the correct dimension of sheet. So that we required 90×100mm sheet for this product. And bend is placing at 45 mm from the edge. And their actual 2D draft is look like as below:



Here red colour line is used as bending mark. And this Draft is used in nesting program for laser cutting. When this sheet cut out and apply bend at middle of the sheet as per the drawing then the product is look like Fig: 3.2 3D sketch and their dimension is 50×50mm 100 long and 5 mm thick. In short for any product we need to subtract sheet thickness for every sides then and then we get the actual dimension of required sheet and bending position.

3.2.2 Solid Edge

Solid Edge is a 3D computer-aided design (CAD) program created by Siemens Digital Industries Software. Running on Microsoft Windows, Solid Edge incorporates solid modeling, assembly modeling, and 2D orthographic view functionality for mechanical designers. It is a proven CAD platform for creating sheet metal design drawings with a lot of design detailing. Solidworks drafting, with a range of features and functions, addresses the challenges of personalization, reduce engineering design time, optimize quality and hep conformity to design standards.

Solid Edge has provisions to:

- Incorporate various types of flanges like base, edge, mitre, and swept.
- Incorporate tabs and slots.
- Generate basic as well as advanced bends like lofted, sketched, etc.
- Read readily available bend tables for bend allowance and K factors with material properties.
- Create forming features like extruded flanges, embosses, louvers, lances, and ribs.
- Add weldmetal to sheet metal parts.

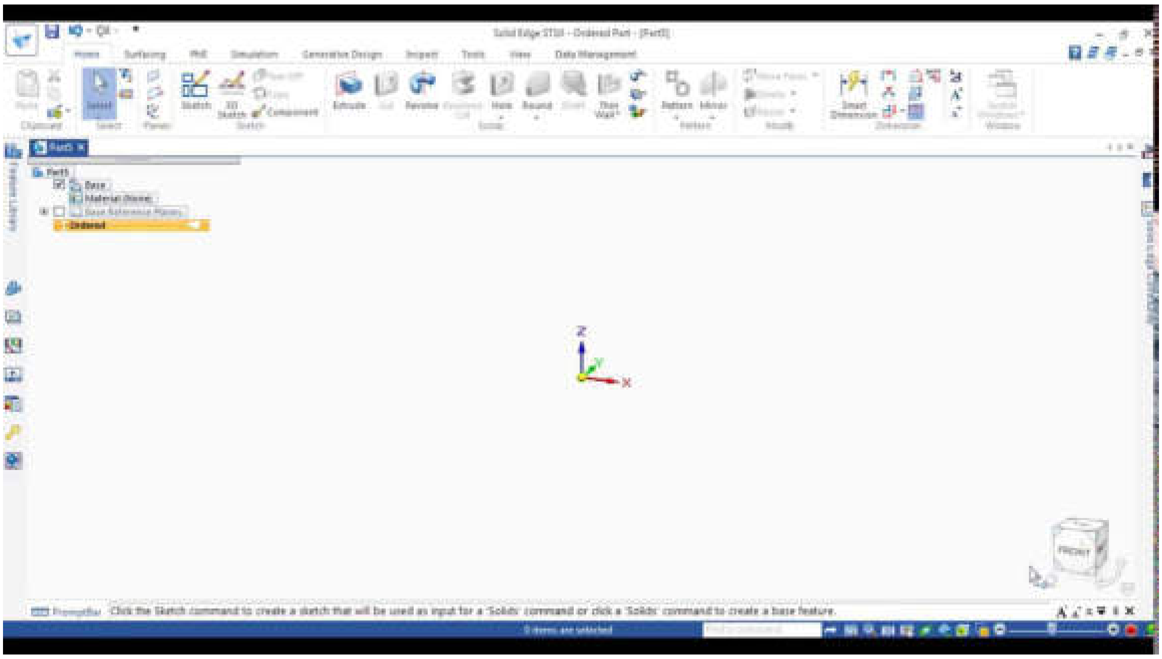


Fig: 3.3 Solid Edge Interface

3.2.3 CADMAN-L

CADMAN is a full programming system for the design, production planning, automatic program generation and management of unfolding, punching, laser cutting and bending of sheet metal parts.

CADMAN®-L offers flexibility and customization in many ways. Multiple laser cutting technology tables are available and can be assigned to any material, any thickness, even to individual contours within the same part.The CAM programmer’s skill set and ideas are not compromised because of the highly customizable GUI allowing users of all skill levels to get the best of the machine.

Key Features:

- User-friendly customizable GUI ribbon.
- Part database with 3D automatic unfolding and interactive CAD functionality.
- Laser cutting technology database.
- Complete flexibility to manually or automatically nest laser parts.

- Larger inside contours can be cut into multiple scrap pieces for easier evacuation.
- Fully integrated with TOUCH-L controller.
- On screen simulation of cutting sequence and beam path indication.
- Sheet database with automatic creation and storage of remnants.
- Re positioning for LVD Impulse machines equipped with re-positioning system.
- Part of the CADMAN Software Suite, communicates to the central CADMAN database.

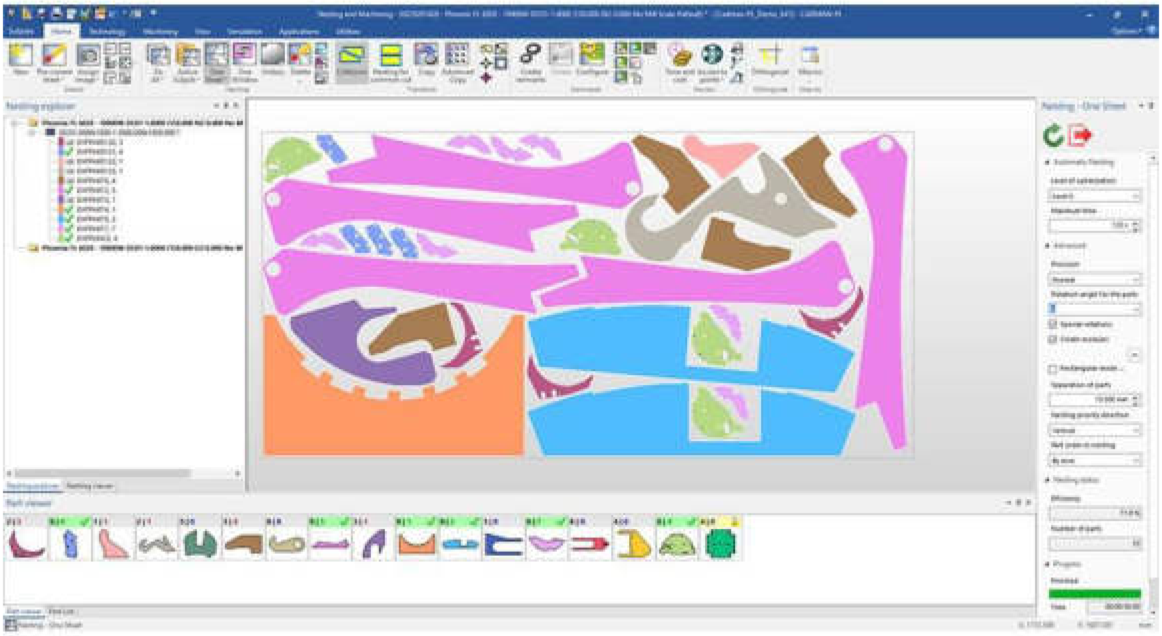
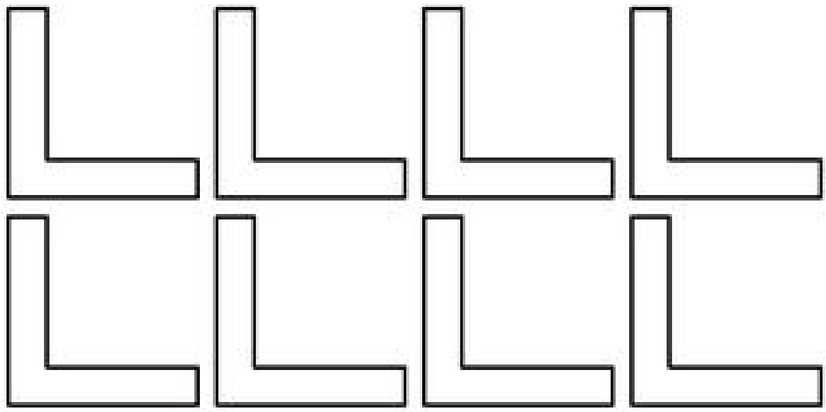


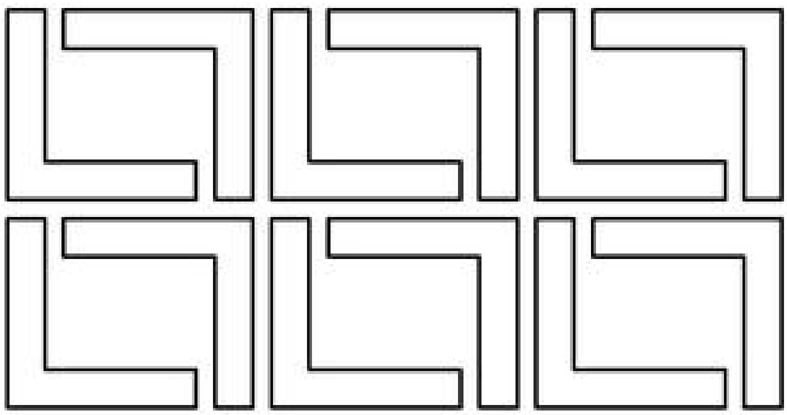
Fig: 3.4 CADMAN-L Design Example

Nesting process:

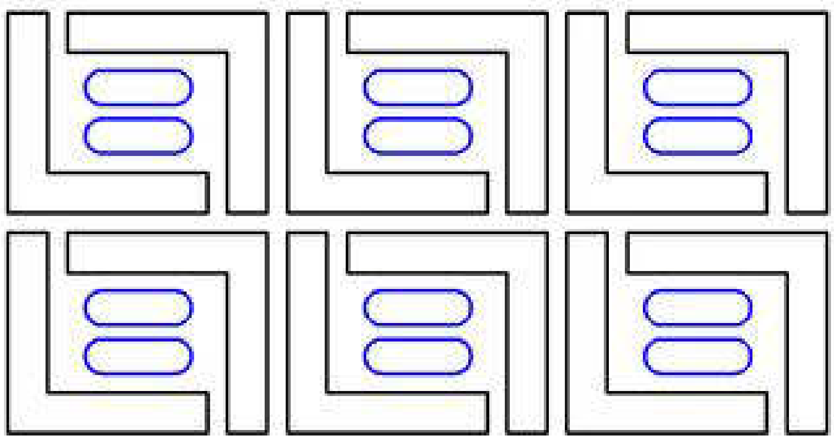
To minimize the amount of scrap material produced during cutting, companies use nesting software.It automates the calculation of ideal distribution of the cutting patterns to avoid waste. The process involves the analyses the parts (shapes) to be produced at a particular time. Using algorithms, it then determines how to lay these parts out in such a way as to produce the required quantities of parts, while minimizing the amount of raw material wasted. Here the advantages sought can include minimizing tool movement that is not producing product, or maximizing how many pieces can be fabricated in one build session. Here is the example how nesting process work.



Simple Nesting



Improved Nesting with rotated parts



Minimizing waste by mixing Different parts

Benefits of Nesting Software

- Improve material efficiency.
- Reduce programming time.
- Increase mobility.
- Fabricate more parts in less time.
- Logistics improvement.
- Reduce damaged, incorrect and lost parts

CHAPTER 4: SHOPFLOOR SAFETY

4.1 Introduction Of Shop floor Safety

Shop floor safety is a composite field related to safety, health, and welfare of people at work. It narrates the strategy and methods in place to ensure health and safety of employees within a workplace.Shop floor safety includes employee awareness related to the knowledge of basic safety, workplace hazards, risks relating to hazards, implementation of hazard prevention, and putting into practice necessary safer methods, techniques, process, and safety culture in the workplace. It also includes safety rules and regulations designed mostly based on existing government policies. Every organization puts in place several safety rules and regulations for its people. Safety training and education for employees is imparted periodically with a view to making them aware about and updating them with latest safety measures.

Shop floor safety is about putting a stop to injury and sickness to employees in the industry. Therefore, it is about safeguarding assets and health and life of the employees. It also features in cutting down the cost of lost-work hours, time spent in putting short-term help and the schedule and services that may fall off due to less of service providers, pressure on those providers who are selecting the absent employees portion or poor case, having to shut out or shut down a program due to lack of providers.

It covers a multiple number of safety issues and topics such as:

• General safety (issues and concerns that are common across all industries)
• Site-specific safety issues
• Process and production safety
• Material safety
• Fire safety
• Electrical safety
• Chemical safety
• Building and structural safety (including temporary installations)
• Environmental safety

4.2 General Safety Instructions

- No smoking in company premises
- No weapons in company premises
- No gambling in company premises
- No mobile phone in company premises or while operating machine.
- Stop the machine by using the emergency switch, in the event of any unusual outcome.
- Do not operate machine without appropriate P.P.E.S.
- Never open the Guard or Safety Interlock while machine is running.
- Do not wear loose clothes on shop floor as they could get with the moving parts of the machine.
- Do not chew tobacco while operating the machine as it could cause hallucinations and can lead to potential accidents.
- In the event of any accident, immediately inform the Supervisor to ensure timely medical attention and the Supervisor to submit the Accident Report to the Safety officer within 24 hours.
- Do not use compressed air to blow dust or dirt off your clothes.
- Gather at Assembly point in case of any emergency.
- Do not run in the company premises.
- Avoid usage of harsh words or fighting in company premises.
- Use work permit as and when necessary.
- Always turn off lights, fans, and other electrical appliances, when not in use for long time.
- Prevent oil leakages and oil spillages to avoid oi wastage and slippery floor causing potential unsafe conditions.
- Dispose of Hazardous waste such as oily cotton waste, oily sawdust, oily papers, used PPES, old filters, etc. into the oily waste dustbin (Red Bin) on the shop floor.
- Dispose of plastic waste such as bottles, wrappers, etc. in the plastic waste dustbin (Yellow bin) on the shop floor.
- Dispose of Hard Paper waste such as cardboard, corrugated boxes, etc., in the Hard Paper Waste dustbin (Blue Bin) on the shop floor.
- Dispose of normal paper waste in the Paper waste dustbin (Green Bin) on the shop floor.

4.3 Personal Protective Equipment For Safety (P.P.E.S.)

The P.P.E.S. are a very essential in day-to-day operations on the shop floor as it protects operators from near misses and hazards caused due to unsafe act or conditions. The figure below describes the usage of and benefits of all the protective equipment in P.P.E.S.

Fig: 4.1 P.P.E.S.

4.4 Fire Safety

4.4.1 Introduction

Fire is considered the most common threat for workplace accidents & incidents. Any industry can experience an unsuspected fire at their workplace which may lead to multiple fatalities, property loss, legal complications, fines & imprisonment. Fire & explosion is the top business interruption which is about 59%. There are the 3 key things required to catch the fire which are heat source, fuel, and oxygen. If any one of this is eliminated, then fire will stop. This can be better explained with the help of a Fire Triangle. One of the major reasons is electrical short circuit or oil spillage. About 39% of fire incidences are happening due to electric short circuit. Other reasons are unsafe hot work such as welding, improper handling, and storage of flammable materials, not following the 5s rules and smoking at undesignated area.

4.4.2 Five Principles Of Preventing Fire

- Avoiding risks.
- Evaluating and eliminating risks which can't be avoided.
- Combating the risk at source.
- Adapting to the technical progress.
- Replacing the dangerous by the no dangerous or less dangerous.

4.4.3 Fire Safety Tips

- Install Fire Alarms. Smoke alarms are the best early fire warning system.
- Plan a Fire Escape Route. In the event of a fire, always have an escape plan.
- Keep Flames and Other Heating Equipment in check.
- Have a Fire Extinguisher.

4.4.4 Types Of Fire

- Type-A fire: Fire due to normal things like rubber, wood, etc. is called Type-A fire.
- Type-B fire: Fire due to chemical such as gasoline, propane etc. is called Type-B fire.
- Type-C fire: Fire due to electrical equipment is called Type-C fire.
- Type-D fire: Fire due to some metals such as Potassium, Sodium, Magnesium etc. is called Type-D fire.
- Type-K fire: Fire due to cooking oils and greases, animal fats and vegetable fats is called Type-K fire.

4.4.5 How To Use Fire Extinguisher

However, the specifics may vary according to fire extinguisher, most fire extinguishers operate the same basic way. One needs to stand six to eight feet away from the fire and remember to PASS:

Fig: 4.2 PASS Method

4.4.6 Types Of Fire Extinguishers

Fig: 4.3 Fire Extinguisher Types

4.5 Electrical Safety

4.5.1 Introduction

The major hazards associated with electricity are electrical shock, fire, and arc flash. Electrical shock occurs when the body becomes part of the electric circuit, either when an individual encounters both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor.

The severity and effects of an electrical shock depend on several factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet or dry. Water is a great conductor of electricity, allowing current to flow more easily in wet conditions and through wet skin.

4.5.2 General Electrical Safety Instructions

- Do not use wires without plugs in any area of the shop floor.
- Don’t touch MCB switch without appropriate P.P.E.
- One must have an electrical license before operating on electrical equipment maintenance.
- Check for concealed wiring.
- Use safety shoes and rubber equipment.
- All electrical tools must be grounded.
- No equipment should be used with wet hands.
- Avoid using elevators in case of fire emergency.

4.6 Chemical Safety

4.6.1 General Instructions

- Use MSDS (Material Safety Data Sheet) for safety information of chemicals.
- Use PPE for hazardous chemicals.
- Don't touch, smell or taste chemicals.
- Use safety shower for 15 to 20 minutes if encountered any chemicals.
- Use pump for pouring chemicals.
- Use funnels for chemical transfer.
- Use eye shower for 15 minutes.
- Keep containers closed to avoid release of fumes.
- Use Neoprene gloves for corrosive materials.
- Use hand truck to carry chemicals.
- Inform immediate supervisor in case of chemical spillage.

4.7 Cylinder Safety

4.7.1 General Instructions

- Store cylinders in dry and environment friendly place.
- Cylinder identification should be based on color coding.
- Cylinders to be inspected on regular intervals for gas leaks.
- Cylinders to be checked for expiry dates periodically.
- Check for broken pipes.
- Suitable gas regulators should be used.
- Always use non-return valves.
- Use hose pipe clips instead of wires for clamping.

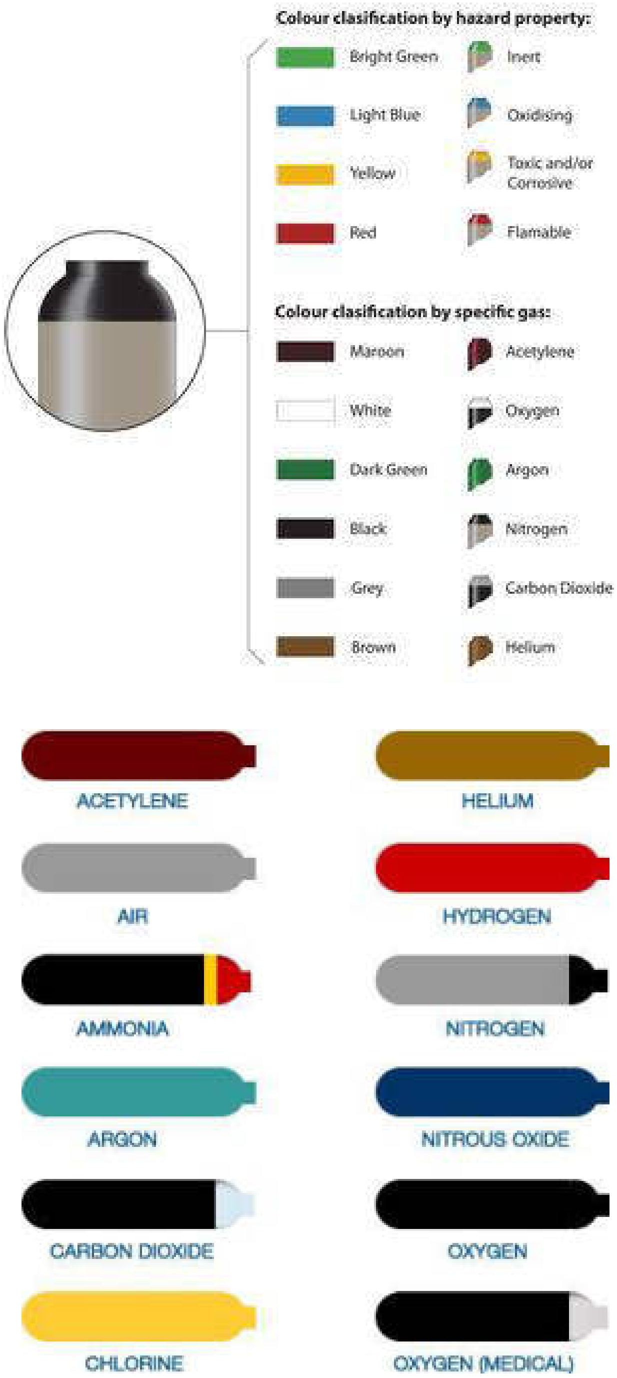


Fig: 4.4 Cylinder Colour Coding

4.8 Injuries And Hazards

4.8.1 First Aid Injury / Accident

An unexpected event that may result in property damage, and does result in an injury or illness, loss, or harm to an employee. In other words, when you provide basic medical

care to someone experiencing a sudden injury or illness, it's known as first aid **injury / accident**. In some cases, first aid consists of the initial support provided to someone in the middle of a medical emergency. In other cases, first aid consists of the care provided to someone with a minor injury. The Injured person is away from work < or= 2 hrs.

4.8.2 Non -Reportable Incident

A non-recordable incident is the workplace incident which does not involve death, injury or illness that requires medical treatment beyond first aid, days away from work,restricted work, transfer to another job, loss of consciousness, a significant injury or illness diagnosed by a physician. The Injured person is away from work < or= 48 hrs.

4.8.3 Reportable Incident

An unexpected event that may result in property damage but does not result in an injury or illness. If someone has been injured and hospitalized or died because of a work-related accident this may have to be reported. The Injured person is away from work > 48 hrs.

4.8.4 Near Miss

An unplanned event does not cause harm but has the potential to cause injury or ill-health.

4.8.5 Hazards

The feeling of assurance that one has, knowing that he will return safely from work, is more significant than anything else. There are occupational safety and health risks in every company. Factors affecting workplace safety include unsafe working conditions, environmental hazards, substance abuse, and workplace violence. Among these the most common cause for human injury is unsafe working condition and unsafe acts.

Fig: 4.5 Industrial Hazards

CHAPTER 5: QUALITY DEPARTMENT

5.1 Introduction

The quality department deals with the inspection of components, quality maintenance of production processes and enhancing the quality practices for future adaptations. It works in coordination with the production department.

5.1.1 Measuring Instruments

1. Vernier Caliper [LC = 0.02mm]:

Vernier caliper is an instrument for making very accurate linear measurements introduced in 1631 by Pierre Vernier of France. It utilizes two graduated scales: a main scale like that on a ruler and an especially graduated auxiliary scale, the vernier, that slides parallel to the main scale and enables readings to be made to a fraction of a division on the main scale. Vernier calipers are widely used in scientific laboratories and in manufacturing for quality control measurements.

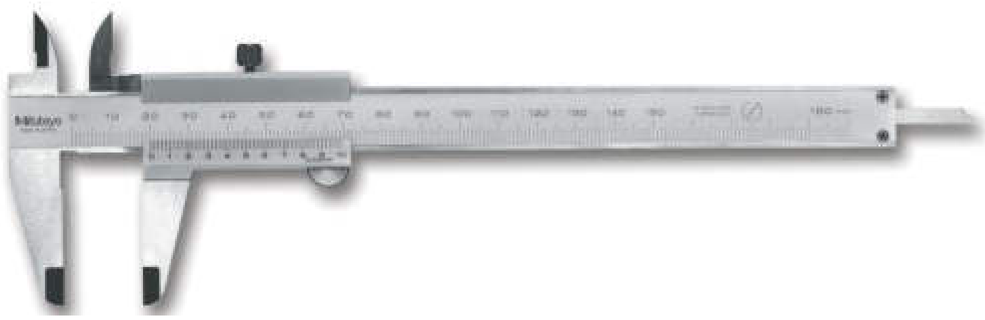


Fig: 5.1 Vernier Caliper

2. Micrometer Screw gauge [LC = 0.001mm]:

A micrometer, sometimes known as a micrometer screw gauge, is a device incorporating a calibrated screw widely used for accurate measurement of components in mechanical engineering and machining.

Fig: 5.2 Disc Micrometer

Fig; 5.3 Micrometer

3. Radius Gauge:

A radius gauge, also known as a fillet gauge, is a tool used to measure the radius of an object. Radius gauges require a bright light behind the object to be measured. The gauge is placed against the edge to be checked and any light leakage between the blade and edge indicates a mismatch that requires correction. A good set of gauges will offer both convex and concave sections and allow for their application in awkward locations. Every leaf has a different radius, for example with radius intervals of 0.25 mm or 0.5 mm. The material of the leaves is stainless steel. Each gauge is one of two types; either internal or external, which are used to check the radius of inner and outer surfaces, respectively.

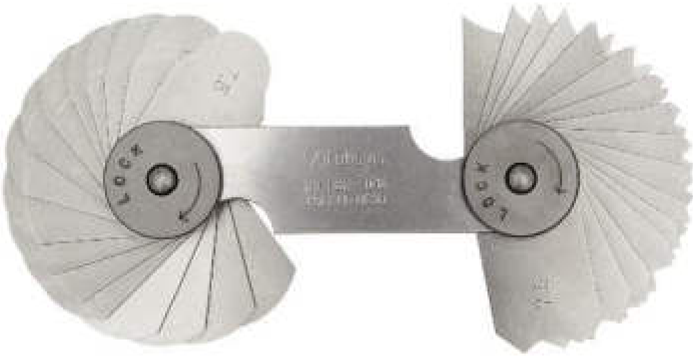


Fig: 5.4 Radius Gauge

4. Slip Gauge Set:

Slip gauges also known as Gauge blocks or Johannsson gauges are cuboidal-shaped blocks of high-grade steel with a high finish. They are used mainly used as measuring standards in the engineering field. These are first hardened to resist wear and carefully stabilized so that they are independent of any subsequent variation in size or shape.

Fig: 5.5 Slip Gauge

5. Plug Gauge (Go - NOGO):

Plug gauges, in some cases called pin gauges, are metrology tools whose purpose is to gauge the inside diameters of holes that have been drilled or machined into a manufactured part, component, or assembly.

Fig: 5.6 Plug Gauge

6. Feeler Gauge:

Feeler gauges, sometimes called thickness gauges or feeler gages, are mechanical measurement instruments that are used to provide a precise reading of the gap that exists between two parallel surfaces, such as the clearance between two machine parts or elements. Feeler gauges are typically sold as what is termed a set, with each set consisting of a series of dimensionally accurate pieces of shim stock that are joined using a common shaft and nut or riveted connection.

Fig: 5.7 Feeler Gauge

CHAPTER 6: MAINTENANCE OF MACHINES

6.1 Maintenance For Laser Machine

Daily Maintenance

- Check working gas and cutting gas pressure.
- Check chiller water level.
- Inspection of laser lens at the end of the day.
- Clean up cutting waste.

Weekly Maintenance

- Clean the debris from the air outlet.
- Check filter in the gas path.
- Change laser lens (if required).
- Check water chiller indication.
- Remove debris from machine base.

Monthly Maintenance

- Clean air filter and fan unit.
- Lubricate the gears of X,Y,Z guides.
- Deep clean machine.

Annually

- Full service

6.2 Maintenance For Bending Machine

Daily Maintenance

- Inspection machine firstly.
- Safety device are working.
- Check three position down pedal is working.
- Clean the tools, bed, supports and backgauge carefully.
- Check the parallelism of the beam and back gauge.

Weekly Maintenance

- Emergency stop button is working properly.
- Check the filter.
- Check the side guards and rear guards.

Monthly Maintenance

- Clean hydraulic pipes and components.
- Check oil level.
- Clean the oil filter on the compressed air tank.

Annual Maintenance

- Change the oil in the hydraulic circuit.
- Replace the oil separator micro filter.
- Clean and lubricate the guides of the mobile beam.

CHAPTER 7: CONCLUSION

7.1 Overall Analysis And Summary Of Internship

In the internship, I learned the basics of industrial engineering, how the production flow works, how to manage the production line, how to operate the laser machine and brake press bending machine, design process, nesting process. As an intern at this company I learned how the industry works. With this internship, I can combine my theoretical knowledge with all the practical skills and work done in this company.

Due to this internship, I experienced the real corporate world, in short, my experience as an intern will help me in my future career, and this internship has made me learn a lot of many things and dynamic places at the production as well as administration level.

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APPENDIX-1

Annexure-1(Weekly Dairy)

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Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 13 Feb, 2023 TO 19 Feb, 2023 (week-1)
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Creative laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

- take out information about company.
- know the process of workflow in company.
- learn about laser machine parts and take information of material which is used by company.
- learn about laser nozzle and how to centering.
- Complete one task was given by supervisor.

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TOTAL HOURS: 42 Hours

Shubham
SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 19-2-2023

Date: 19-2-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure 1
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 20 Feb, 2023 TO 26 Feb, 2023 (week)-2
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Creative Laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

- learn how to operate laser machine.
- work in Assembly department.
- draw a 2D sketch of sheet design in autocad. (∵ laser machine was off).
- learn details technicality of TIG welding.
- quality check.

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TOTAL HOURS: 42 Hours.

S. Subham
SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 26-2-2023

Date: 26-2-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure 1
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 27 feb 2023 TO 5 march, 2023 (week-3)
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Creative Laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT:
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

- work in assembly department for assemble the ceramic powder hopper.
- learn about how to check ss grade.
- arranged material according to the cutting cell.
- check quality of some bending parts.
- learn aboute basics of sheet metal bending.

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TOTAL HOURS: 142Hours

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 5-3-2023

Date: 5-3-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure 1
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 6 march, 2023 **TO** 12 March, 2023 (week-4)
DEPARTMENT: Mechanical **SEM:** 8th
NAME OF THE ORGANISATION: Creative laser Tech.
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

- operate laser machine
- check quality of finished products.
- Take measurements of old sheets for set for the nesting Programme.
- work in Assembly department.
- operate bending machine.

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TOTAL HOURS: 42 Hours

Shubham
SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 12-3-2023

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Annexure 1
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 13 March, 2023 TO 19 March, 2023 (week-5)
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Creative Laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Take measurements of scrape sheet for Nesting set up.
→ 2D Drafting in Autocad.
→ operate laser machine.
→ Part counting.
→ quality checking.
→ Change laser lens & fix laser center

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TOTAL HOURS: 42

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR.

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 20-03-2023

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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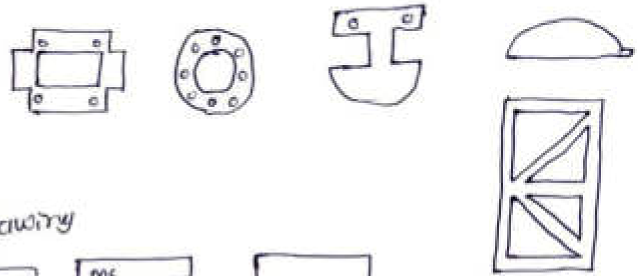
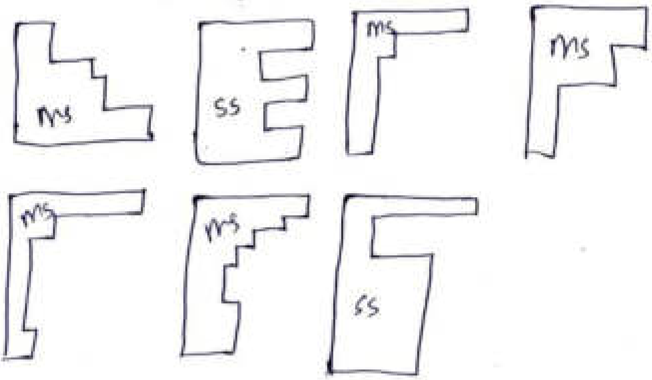
SUPPLEMENTRY NOTES
(add additional sheets if required)

→ 2D sketch :-



→ scrape sheets drawing



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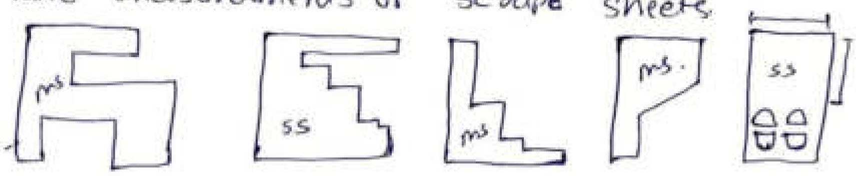
Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar.
DIARY OF THE WEEK: Dt: 20 march, 2023 **TO** 26 march, 2023 (week-6)
DEPARTMENT: Mechanical **SEM:** 8th.
NAME OF THE ORGANISATION: Creative Laser Tech.
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ 2D Drafting in Autocad.
→ Copper cutting (3mm sheets)
→ Aluminium cutting in laser machine. (1mm sheets)
→ Dispatch CLT-023, CLT-026, CLT-033
→ check welding
→ Take measurements of scrape sheets



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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 27-03-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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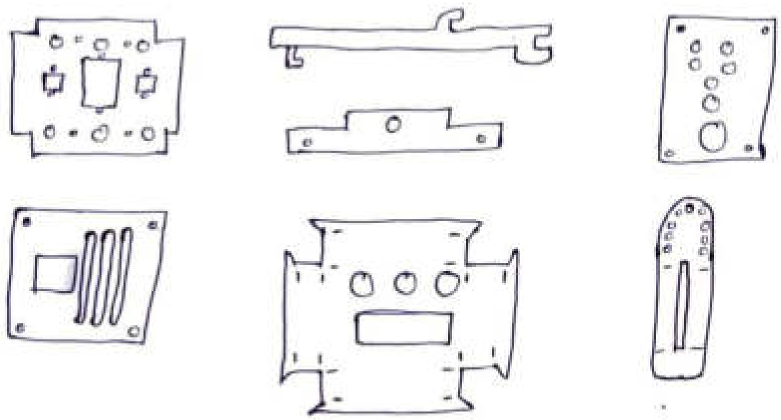
SUPPLEMENTRY NOTES
(add additional sheets if required)

→ 2D sketching.



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Annexure 1
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 27 March, 2023 TO 2 April, 2023 (week-7)
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Creative laser Tech.
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Bend copper Parts & SS-304 Clamp.
→ cut Aluminium sheets C1 mm
→ Take measurement of new sheets
→ dispatch CLT-029.
→ Cut copper 3mm sheets
→ replace oxegyen cylinder to the compresed air due to Compressor motor burnout.

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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 03-04-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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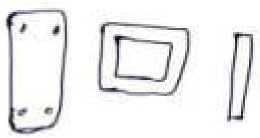
Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar.
DIARY OF THE WEEK: Dt: 3 April, 2023 **TO** 9 April, 2023 (week-8)
DEPARTMENT: Mechanical **SEM:** 8th
NAME OF THE ORGANISATION: Creative Laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ cut Batch wise MS CHRD (1.5mm sheets)
→ dispatch CLT-034 & CLT-027.
→ prepare & dispatch for powder coating.
→ cut small parts of MS (1mm sheet)



→ take measurements of scrap sheet for Nesting set up.
→ fixing machine panels in Assembly department.
→ bend 1mm Aluminium sheet

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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 10 - 04 - 2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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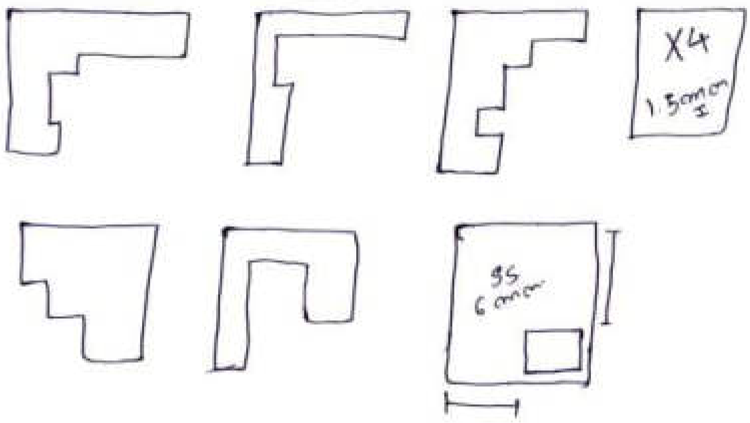
SUPPLEMENTRY NOTES
(add additional sheets if required)

→ Scrap. sheet Drawing



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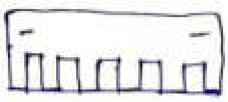
Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 10 April, 2023 **TO** 16 April, 2023 (week - 9)
DEPARTMENT: Mechanical **SEM:** 8th
NAME OF THE ORGANISATION: Creative laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ cut metal furniture products.
→ Count ss part for dispatching.
→ fix laser center and change assist gas cylinder.
→ take measurements of new sheet & inspection those sheets.
→ Cut ms (1.5mm sheets) according to batches.
→ Cut ms & ss thicker plates.
→ Cut 10 mm Aluminium sheets



→ quality checking of oil tanks.

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TOTAL HOURS: 42

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 17-04-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 17 April, 2023 TO 23 April, 2023 (week-10)
DEPARTMENT: Mechanical SEM: 8th.
NAME OF THE ORGANISATION: Creative Laser Tech.
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujil Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Take measurements of new sheets for nesting.
→ operate Bending machine bend SS & copper parts.
→ Cut metal furniture Products.
→ Make a Nesting programme for & learn how to overcome of material scrap
→ clean machine laser head & Nozzles.
→ Arrange scrape sheets.
→ Bend Aluminium sheet (10mm thick)
→ repair crane remote.

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Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 17 April, 2023 TO 23 April, 2023 (week-10)
DEPARTMENT: Mechanical SEM: 8th.
NAME OF THE ORGANISATION: Creative Laser Tech.
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujil Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Take measurements of new sheets for nesting.
→ operate Bending machine bend SS & copper parts.
→ Cut metal furniture Products.
→ Make a Nesting programme for & learn how to overcome of material scrap
→ clean machine laser head & Nozzles.
→ Arrange scrape sheets.
→ Bend Aluminium sheet (10mm thick)
→ repair crane remote.

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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 24-04-2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

//

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Annexure I
Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar
DIARY OF THE WEEK: Dt: 24 April, 2023 **TO** 30 April, 2023 (week-11)
DEPARTMENT: Mechanical **SEM:** 8th.
NAME OF THE ORGANISATION: Creative Laser Tech
NAME OF THE PLANT/SECTION/DEPARTMENT: Production
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Deep clean of laser machine which include laser heads, machine bed, scrap storage, inner panels, hydraulics, lens & Nozzles.

→ Take measurements of old ~~ste~~ scrap sheets for nesting setup.

→ Cut Acrylic material sheet (3mm thickness)

→ Bend Aluminium sheets (1mm thickness)

→ dispatch Aluminium sheets for hole punching operation.

→ cut metal furniture products.

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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 09 - 05 - 2023

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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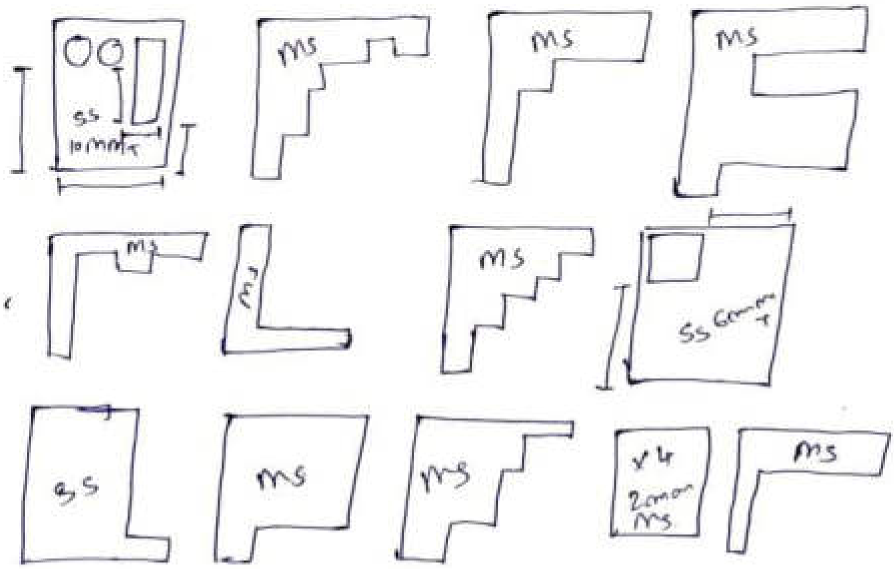
SUPPLEMENTRY NOTES
(add additional sheets if required)

Scrap sheet Drawing for nesting set up



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Annexure I

Enrollment no: 190390119016

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Suthar Shubham Mukeshkumar

DIARY OF THE WEEK: Dt: 1 May, 2023 TO 7 May, 2023 (Week -12)

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: Creative Laser Tech

NAME OF THE PLANT/SECTION/DEPARTMENT: Production

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Sujit Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ Cut SS 304 & SS 316 washers 50 Nos.

→ Cut 10 mm Aluminium (supportive parts)

→ operate laser machine & Bending machine.

→ Drilled on MS plate

→ Check welding of ceramic powder hopper & give rework due to weak welding at the bottom of the hopper

→ Arrange old scrap sheet according to their shape & thickness

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TOTAL HOURS: 42

Shubham
SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 09 - 05 - 2023

✪ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

APPENDIX-2
Annexure-2

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure 2

Feedback Form by Industry expert

Student Name: Suthar Shubham Mukeshkumar Date: 7 May, 2023

Work Supervisor: Mr. Sujit Patel Title:

Company/Organization: Creative Laser Tech.

Enrollment No: 190390119016

Internship Address: Plot-901/1, Phase-1, GIDC Chhatral, Ta Kalol, Gandhinagar, Gujarat

Dates of Internship: From 13 Feb, 2023 to 7 May, 2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility			✓	
Uses technical knowledge and expertise				✓
Analyzes problems effectively				✓
Communicates well and writes effectively			✓	

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent): ✓

Additional comments, if any:

Signature of Industry person/Name and Stamp: CREATIVE LASER TECH CHHATRAL

Signature of the Faculty Mentor

TEAM ID – 322929

INTERNSHIP REPORT

AT

HUBER GROUP INDIA PRIVATE LTD VAPI.

AN INTERNSHIP REPORT

Submitted by

NISHYANK BHATT

200390119501

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Semester – VIII Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

Gujarat Technological University, Ahmedabad

May, 2023

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at HUBER GROUP INDIA PRIVATE.LTD** has been carried out by **NISHYANK BHATT** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23

Sign	Sign
Prof. Tausif Shaikh	Prof. Kunalsinh Kathia
Internal Guide	Head of Department

COMPANY CERTIFICATE

hubergroup

HGIPL/CERT/04/2023
25th April, 2023

CERTIFICATE

This is to certify that Mr. Nishyank Bhatt, student of S.P.B Patel Engineering College, Ahmedabad, has undergone Industrial training at Engineering Department in our Company for the period 23.01.2023 to 22.04.2023.

During his entire training period, he was found sincere, hardworking and showed keen interest in learning things.

I wish him all the success in his career.

For Hubergroup India Private Limited,

Aniruddha Panchal
Head - Human Resources

Hubergroup India Private Limited CIN: U24220GJ1991PTC016598

Registered & Corporate Office:
Plot No. 808/E, Phase-II, G.I.D.C.
Vapi 396 195, Gujarat, India

T +91 260 7158000
F +91 260 7158008

E info.in@hubergroup.com
W www.hubergroup.com

PMMS CERTIFICATE

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : 14 May 2023 (21:09:35)

This is to certify that, ***Bhatt Nishyank Pranthesh*** (Enrolment Number - 200390119501) working on project entitled with ***Huber Group India Private limited*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Bhatt Nishyank Pranthesh

Name of Guide : Mr.Shaikh TausifAhmad MohmmadSalim

Signature of Student : ____________________

*Signature of Guide : ________________________

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S.P.B. Patel Engineering College, Mehsana

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

DECLARATION

We hereby declare that the Internship submitted along with the Internship / Project entitled **Internship at HUBER GROUP INDIA PRIVATE.LTD** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Mechanical Engineering** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me under the supervision of **Prof. Tausif Shaikh** & **Nitesh Patel (External Guide)** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Name of the Student	Sign of Student
1. **Nishyank Bhatt**	________________

ACKNOWLEDGMENT

The internship opportunity I had with **Huber Group India Pvt. Ltd.** was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professionals who led me though this internship period.

Bearing in mind previous I am using this opportunity to express my deepest gratitude and special thanks to the **Mr. Nitesh Patel (Assistant Manager) as well as guide** who in spite of being extraordinarily busy with his duties, took time out to hear, guide and keep me on the correct path and allowing me to carry out my internship at their esteemed organization and extending during the training.

I express my deepest thanks to **Mr. Nirav Rana DGM** for taking part in useful decision & giving necessary advices and guidance and arranged all facilities to make this internship easier. I choose this moment to acknowledge his contribution gratefully.

I also would like to express my deepest gratitude to **Prof. Tausif Shaikh** for giving me the support for internship courses and help me in prepare this report within the scheduled time during the period of my Internship work, I have received generous help from my Professor, which I would like to put on record here with deep gratitude and great pleasure.

I would like to thank Head of the Department **Prof Kunalsinh Kathia** for his constructive criticism throughout my internship.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

Thank You

Nishyank Pranthesh Bhatt.

ABSTRACT

This report contains the work done by me during this internship at ***Huber Group India Private Ltd***. Report starts with Introduction of company and their products. It contains details description of Fire & Safety in plant. Also describe Major Equipment & Instrumentations information which use in process. For ex. Centrifugal pump, Nitrogen Generation system, Pressure Regulation Station, Ultrasonic Thickness Gauge, Different types of Valves, Types of Compressor, Etc. The maintenance of different machinery in the report. For ex. maintenance of pump, maintenance of reactor, maintenance of flitter press. The alignment of pump how it's done, with help of shaft alignment machine. The detail about fire and safety and PPE kit etc.

The purpose of this internship was to fulfill the core requirement for the award of a Bachelor Degree in Mechanical Engineering to get a practical aspect of the theoretical work studied at the university and to understand the operations in the Manufacturing sector and to enable students gain experience in various tasks. I gained knowledge on the above topics and developed confidence to apply them during the 12-weeks course of my internship.

In conclusion, this was an opportunity to develop and enhance skills & competencies in my career field which I actually achieved.

LIST OF FIGURES

LIST OF TABLE

ABBREVIATIONS

- QA - Quality Assurance
- QC - Quality Control
- MCU - Machine Control Unit
- NTP - Normal Pressure & Temperature
- EPU - Equipment Pump Unit
- ECH - Equipment Chiller Unit
- ENP - Equipment Nitrogen Plant
- EAD - Equipment Air Dryer
- EAC - Equipment Air Compressor
- ETP - Equipment Thermopack
- HMI - Human Machine Interface
- LEL - Lower Explosive Unit
- UEL - Upper Explosive Unit
- PDI - Pre dispatch inspection

TABLE OF CONTENTS

CHAPTER 1.

1. INTRODUCTION

1.1 Company Profile:

- The Huber Group India Private Limited in vapi one of the leading international specialists for printing inks and printing aids, its work daily to provide innovative solutions, technologies and services for packaging, newspaper and commercial printing and always with your needs in mind. Even as a global player for raw materials, his focus is always on providing chemical substances such as PU resins and UV oligomers in their purest form and driving forward product ink
- With over 255 years of experience in the world of ink, Huber group is one of the leading international ink specialists. However, what makes us special is that as a family business we focus on your Huber Group India Pvt. Ltd. Micro Inks Limited company was founded by the Bilakhia Brothers as a small scale industry in Vapi, India in 1987 and listed on India
- Huber Group company, it is ISO 9001:2000 and ISO 14001:2015 certified.Hubergroup India has mainly five unit plant.
  1. Huber group india private limited vapi unit-1
  2. Huber group india private limited vapi unit-2
  3. Huber group india private limited vapi unit-3
  4. Huber group india private limited Jani Vankad Daman unit-4
  5. Huber group india private limited Morkhal silvassa unit-5
- The company was incorporated on 13th Nov,1991 as Hindustan Inks and resins limited and obtained certificate of commencement of business on 13th January 1922. The company is promoted by Bilakhia group who are technocrats with experience over decade in field of printing inks and synthethic resins. The main promoters of company are *Shri Yunus G.Bilakhia and Shri Anjum G. Bilakhia.* The company has a set up wholly-owned subsidiary in USA,with a paid up equity capital of $6.5 million, called *Micro Inks.corporation*. Company name changed from Hindustan Inks and resins limited to *Micro Inks* after adopting of its wholly owned subsidiary. In 2005, Micro Inks was acquired by German based *Huber group,* one of oldest and leading global players in the industry.
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1.2 Different types of department:

i. Engineering Store Department
ii. Raw material department
iii. Production department
iv. Utility department
v. Quality department
vi. Maintenance department
vii. Civil department
viii. R&D Department
ix. Workshop department Scrap yard
x. Transportation department
xi. Adhesive plant
xii. PU plant
xiii. Resin plant
xiv. Pigment plant
xv. INK plant
xvi. Flush Plant
xvii. SFD plant
xviii. MGA plant
xix. Blue plant
xx. Gypsum plant
xxi. STP plant (sewage treatment plant)
xxii. Scrap yard
xxiii. Transportation department

1.3 Plant Layout

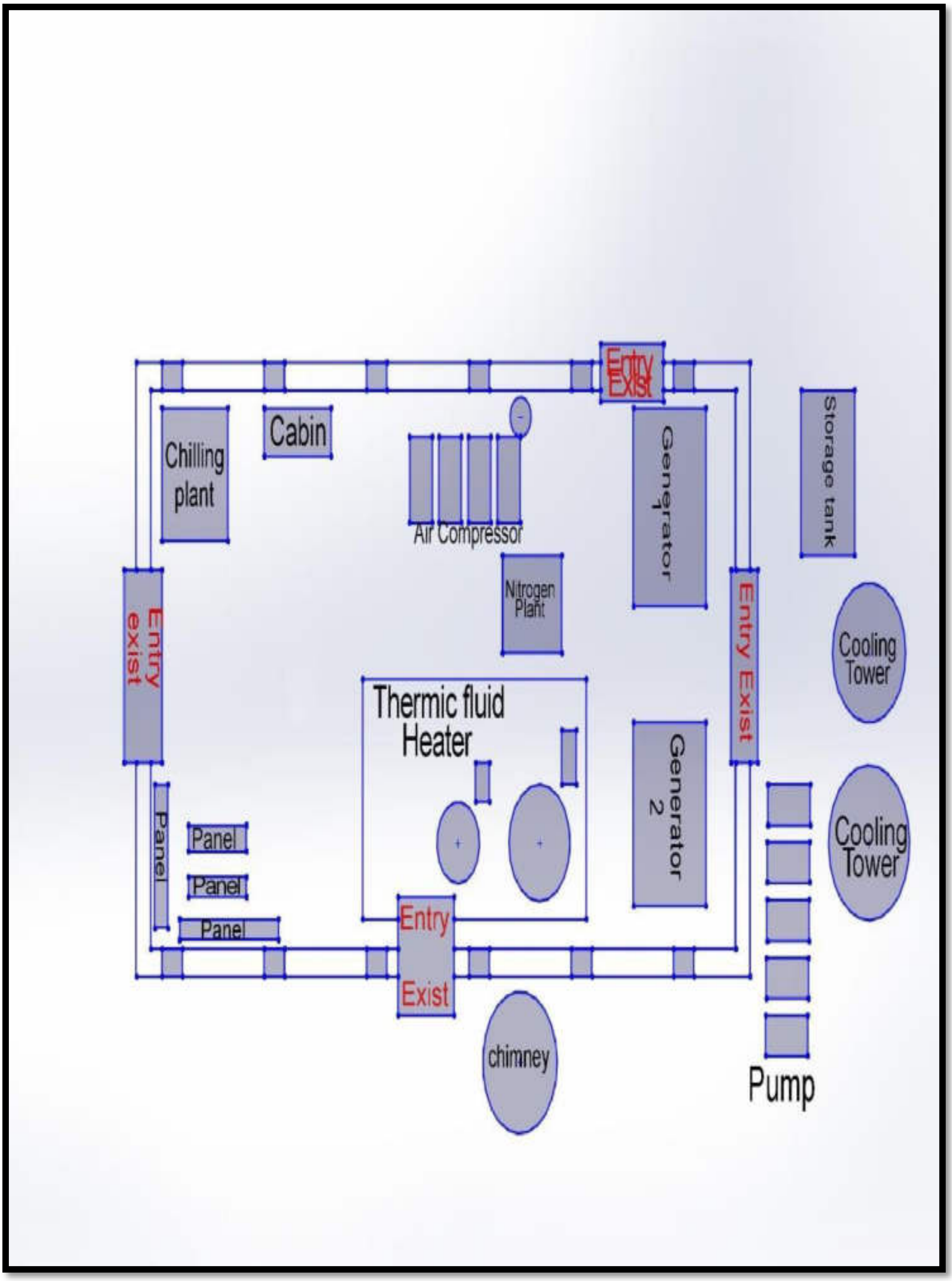


Fig 1.1 Plant Layout

CHAPTER 2

SAFETY

2.1. Safety Department

Safety Officers are responsible for planning, implementing and overseeing company's employee safety at work. Their main duty is to ensure that the company is in compliance and adheres to Occupational Health and Safety (OHS) guidelines. Five types of safety controls look like in practice;

Elimination: Physically remove the hazard.

Substitution: Replace the hazard.

Engineering controls: Isolate people from the hazard.

Administrative controls: Change the way people work.

Personal protective equipment (PPE): Protect the worker.

2.2. Safety Equipment's for fire hazards

Fire Extinguisher

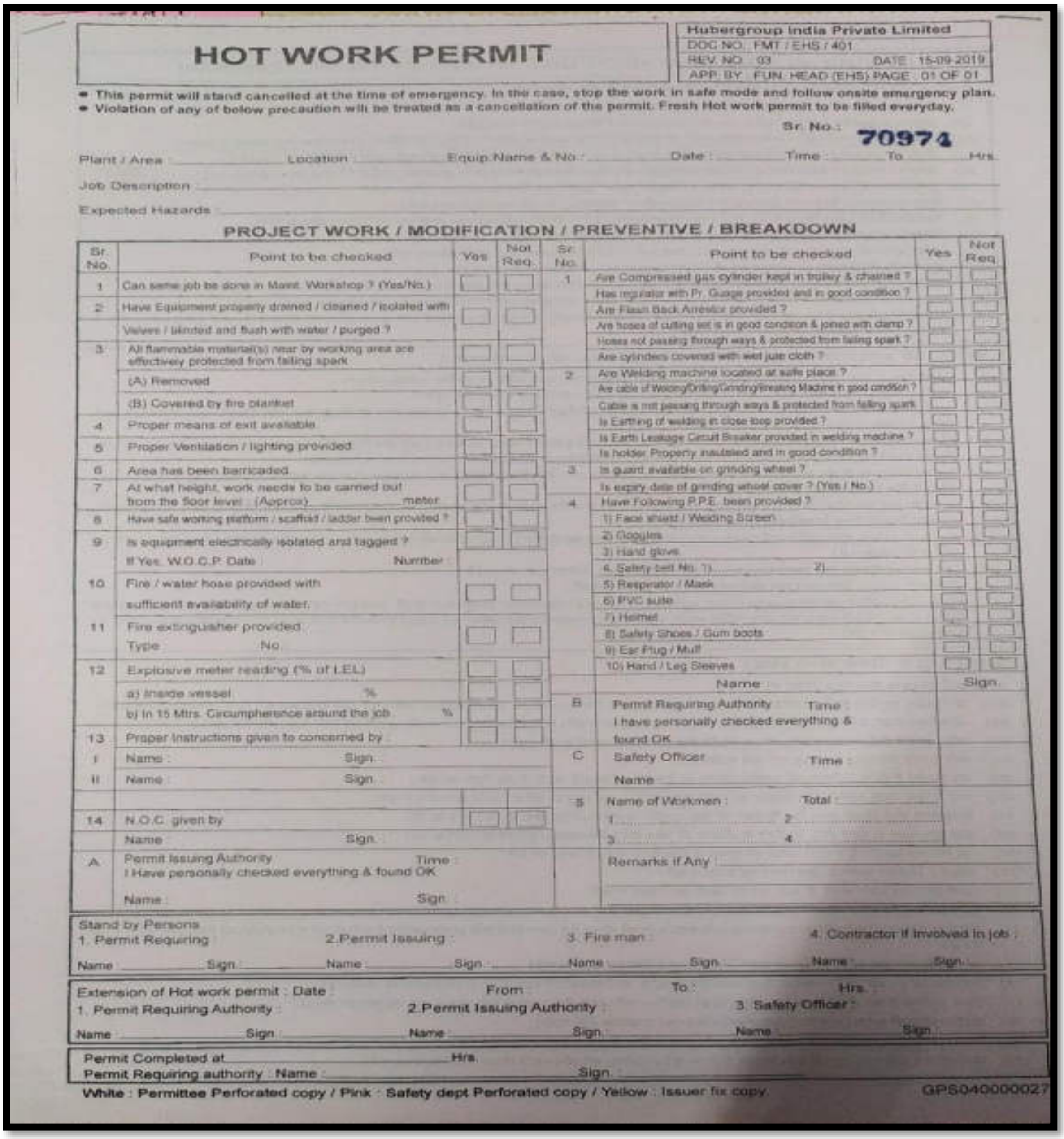
Most buildings contain a variety of hand-held firefighting equipment. This range of equipment is designed to help contain small fires before they spread and become too large to control. Portable fire extinguishers are available with a number of different extinguishing agents to help you combat a flame. A portable extinguisher may contain the following substance:

- water
- foam
- dry powder
- CO_2
- wet chemical

2.3 Work Permit:

2.3.1 Hot Work Permit:

Authorization to perform tasks in conditions that produce sparks, flames or any other source of ignition. Examples of include welding, soldering, flammable gases and other heat inducing operations.



HOT WORK PERMIT

Hubergroup India Private Limited	
DOC NO.: FMT / EHS / 401	
REV. NO.: 03	DATE: 15-09-2019
APP. BY: FUN. HEAD (EHS)	PAGE: 01 OF 01

- This permit will stand cancelled at the time of emergency. In this case, stop the work in safe mode and follow onsite emergency plan.
- Violation of any of below precaution will be treated as a cancellation of the permit. Fresh Hot work permit to be filled everyday.

Sr. No.: 70974

Plant / Area: ______ Location: ______ Equip. Name & No.: ______ Date: ______ Time: ______ To ______ Hrs.

Job Description: ______

Expected Hazards: ______

PROJECT WORK / MODIFICATION / PREVENTIVE / BREAKDOWN

Sr. No.	Point to be checked	Yes	Not Req.
1	Can same job be done in Maint. Workshop ? (Yes/No.)		
2	Have Equipment properly drained / cleaned / isolated with Valves / blinded and flush with water / purged ?		
3	All flammable material(s) near by working area are effectively protected from falling spark		
	(A) Removed		
	(B) Covered by fire blanket		
4	Proper means of exit available		
5	Proper Ventilation / lighting provided		
6	Area has been barricaded		
7	At what height, work needs to be carried out from the floor level : (Approx) ______ meter		
8	Have safe working platform / scaffold / ladder been provided ?		
9	Is equipment electrically isolated and tagged ? If Yes, W.O.C.P. Date: Number:		
10	Fire / water hose provided with sufficient availability of water.		
11	Fire extinguisher provided. Type: No.		
12	Explosive meter reading (% of LEL)		
	a) Inside vessel %		
	b) In 15 Mtrs. Circumpherence around the job %		
13	Proper Instructions given to concerned by :		
I	Name : Sign :		
II	Name : Sign :		
14	N.O.C. given by Name : Sign :		
A	Permit Issuing Authority Time : I Have personally checked everything & found OK Name : Sign :		

Sr. No.	Point to be checked	Yes	Not Req.
1	Are Compressed gas cylinder kept in trolley & chained ?		
	Has regulator with Pr. Guage provided and in good condition ?		
	Are Flash Back Arrestor provided ?		
	Are hoses of cutting set is in good condition & joined with clamp ?		
	Hoses not passing through ways & protected from falling spark ?		
	Are cylinders covered with wet jute cloth ?		
2	Are Welding machine located at safe place ?		
	Are cable of Welding/Drilling/Grinding/Breaking Machine in good condition ?		
	Cable is not passing through ways & protected from falling spark		
	Is Earthing of welding in close loop provided ?		
	Is Earth Leakage Circuit Breaker provided in welding machine ?		
	Is holder Properly insulated and in good condition ?		
3	Is guard available on grinding wheel ?		
	Is expiry date of grinding wheel cover ? (Yes / No.)		
4	Have Following P.P.E. been provided ?		
	1) Face shield / Welding Screen		
	2) Goggles		
	3) Hand glove		
	4. Safety belt No. 1) ______ 2) ______		
	5) Respirator / Mask		
	6) PVC suite		
	7) Helmet		
	8) Safety Shoes / Gum boots		
	9) Ear Plug / Muff		
	10) Hand / Leg Sleeves		
	Name	Sign	
B	Permit Requiring Authority Time : I have personally checked everything & found OK		
C	Safety Officer Time : Name		
5	Name of Workmen : Total : 1 ______ 2 ______ 3 ______ 4 ______		
	Remarks if Any :		

Stand by Persons
1. Permit Requiring Name ______ Sign ______
2. Permit Issuing : Name : ______ Sign : ______
3. Fire man : Name : ______ Sign : ______
4. Contractor if involved in job : Name : ______ Sign : ______

Extension of Hot work permit : Date : ______ From : ______ To : ______ Hrs.
1. Permit Requiring Authority : Name ______ Sign : ______
2. Permit Issuing Authority : Name : ______ Sign : ______
3. Safety Officer : Name : ______ Sign : ______

Permit Completed at ______ Hrs.
Permit Requiring authority : Name : ______ Sign : ______

White : Permittee Perforated copy / Pink : Safety dept Perforated copy / Yellow : Issuer fix copy. GPS040000027

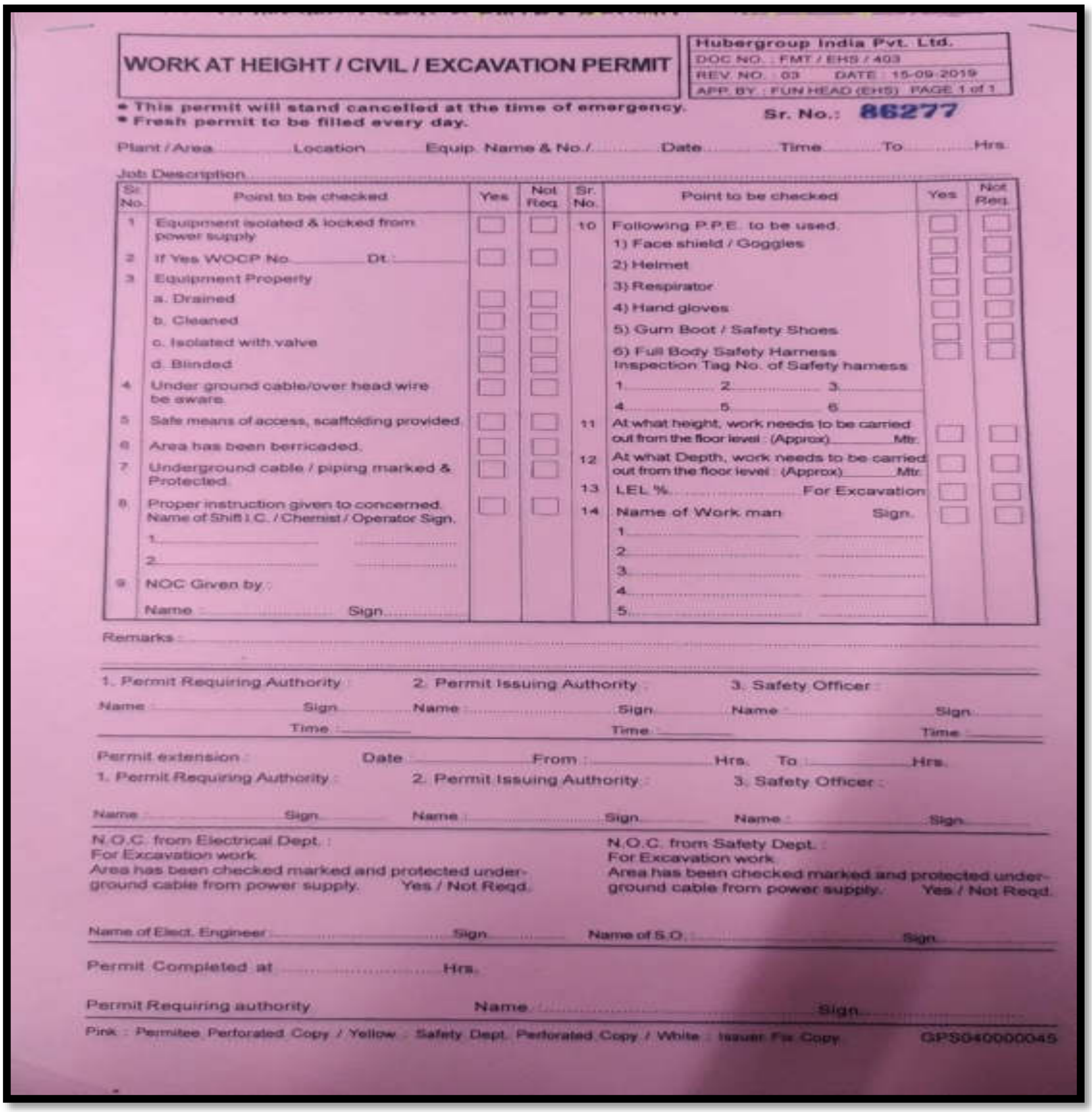
Fig2.1 Hot Work Permit

2.3.2 Height Work Permit: -

Authorization to work on elevated spaces (2m from the ground) be it ladders, scaffolds, Mobile Elevated Work Platforms (MEWP) and other spaces that are off the ground.

Excavation Permit: -

Authorization for personnel to mine or dig land in order to build infrastructure, extract resources or unearth hidden artifacts. The risk involved in excavation includes falling, being trapped, explosions, airborne contaminants, etc.



WORK AT HEIGHT / CIVIL / EXCAVATION PERMIT

Hubergroup India Pvt. Ltd.
DOC NO. : FMT / EHS / 403
REV. NO. : 03 DATE : 15-09-2019
APP. BY : FUN HEAD (EHS) PAGE 1 of 1

* This permit will stand cancelled at the time of emergency.
* Fresh permit to be filled every day.

Sr. No.: 86277

Plant / Area .... Location .... Equip. Name & No./ .... Date .... Time .... To .... Hrs.

Job Description ....

Sr. No.	Point to be checked	Yes	Not Req.	Sr. No.	Point to be checked	Yes	Not Req.
1	Equipment isolated & locked from power supply	☐	☐	10	Following P.P.E. to be used.	☐	☐
					1) Face shield / Goggles	☐	☐
2	If Yes WOCP No. ______ Dt. ______	☐	☐		2) Helmet	☐	☐
3	Equipment Properly				3) Respirator	☐	☐
	a. Drained	☐	☐		4) Hand gloves	☐	☐
	b. Cleaned	☐	☐		5) Gum Boot / Safety Shoes	☐	☐
	c. Isolated with valve	☐	☐		6) Full Body Safety Harness Inspection Tag No. of Safety harness	☐	☐
	d. Blinded	☐	☐		1. ...... 2. ...... 3.		
4	Under ground cable/over head wire be aware.	☐	☐		4. ...... 5. ...... 6.		
5	Safe means of access, scaffolding provided.	☐	☐	11	At what height, work needs to be carried out from the floor level : (Approx) ______ Mtr.	☐	☐
6	Area has been berricaded.	☐	☐	12	At what Depth, work needs to be carried out from the floor level : (Approx) ______ Mtr.	☐	☐
7	Underground cable / piping marked & Protected.	☐	☐	13	LEL % .... For Excavation	☐	☐
8	Proper instruction given to concerned. Name of Shift I.C. / Chemist / Operator Sign.	☐	☐	14	Name of Work man Sign.	☐	☐
	1. ______				1. ______		
	2. ______				2. ______		
9	NOC Given by :				3. ______		
					4. ______		
	Name : ...... Sign.				5. ______		

Remarks : ....

1. Permit Requiring Authority : 2. Permit Issuing Authority : 3. Safety Officer :
Name : ...... Sign. ...... Time : ______ Name : ...... Sign. ...... Time : ______ Name : ...... Sign. ...... Time : ______

Permit extension : Date ______ From : ______ Hrs. To : ______ Hrs.
1. Permit Requiring Authority : 2. Permit Issuing Authority : 3. Safety Officer :
Name : ...... Sign. ...... Name : ...... Sign. ...... Name : ...... Sign. ......

N.O.C. from Electrical Dept. :
For Excavation work
Area has been checked marked and protected underground cable from power supply. Yes / Not Reqd.

N.O.C. from Safety Dept. :
For Excavation work
Area has been checked marked and protected underground cable from power supply. Yes / Not Reqd.

Name of Elect. Engineer : ...... Sign. ...... Name of S.O. : ...... Sign. ......

Permit Completed at .... Hrs.

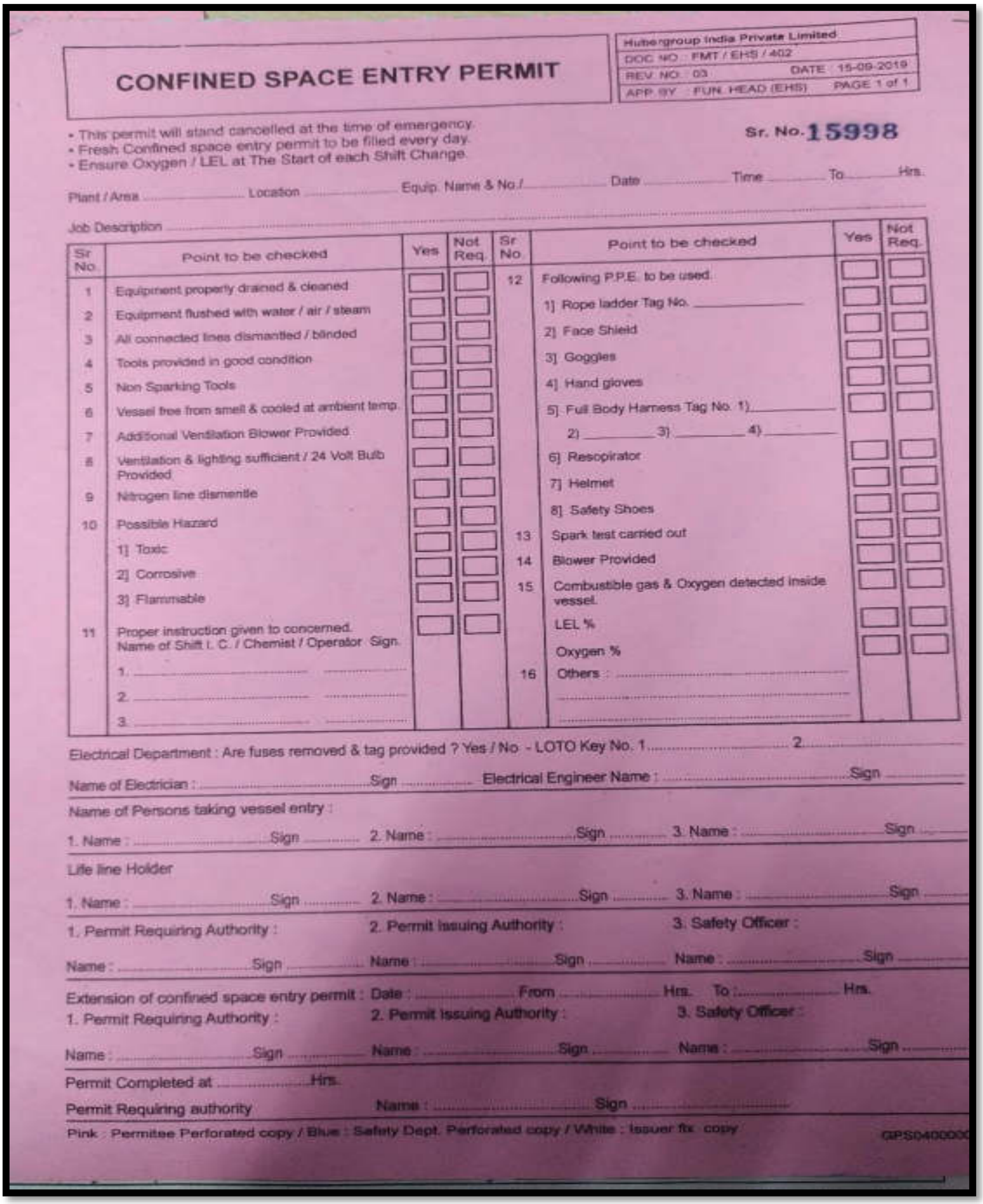
Permit Requiring authority Name .... Sign. ....

Pink : Permitee Perforated Copy / Yellow : Safety Dept. Perforated Copy / White : Issuer File Copy GPS040000045

Fig 2.2 Height Work Permit

2.3.3 Confined Space Work Permit:

Authorization to perform tasks in a narrow space which is prone to hazards like asphyxiation, a substance that has the ability to engulf, toxic atmosphere, etc. Confined spaces refer to vents, shafts, sewages, tanks and much more



Hubergroup India Private Limited
DOC NO : FMT / EHS / 402
REV NO : 03 DATE : 15-09-2019
APP BY : FUN. HEAD (EHS) PAGE 1 of 1

CONFINED SPACE ENTRY PERMIT

- This permit will stand cancelled at the time of emergency.
- Fresh Confined space entry permit to be filled every day.
- Ensure Oxygen / LEL at The Start of each Shift Change.

Sr. No. 15998

Plant / Area .... Location .... Equip. Name & No./ .... Date .... Time .... To .... Hrs.

Job Description ....

Sr No.	Point to be checked	Yes	Not Req.
1	Equipment properly drained & cleaned		
2	Equipment flushed with water / air / steam		
3	All connected lines dismantled / blinded		
4	Tools provided in good condition		
5	Non Sparking Tools		
6	Vessel free from smell & cooled at ambient temp.		
7	Additional Ventilation Blower Provided		
8	Ventilation & lighting sufficient / 24 Volt Bulb Provided		
9	Nitrogen line dismentle		
10	Possible Hazard		
	1] Toxic		
	2] Corrosive		
	3] Flammable		
11	Proper instruction given to concerned. Name of Shift I. C. / Chemist / Operator Sign. 1. .... 2. .... 3.		

Sr No	Point to be checked	Yes	Not Req.
12	Following P.P.E. to be used.		
	1] Rope ladder Tag No. ________		
	2] Face Shield		
	3] Goggles		
	4] Hand gloves		
	5] Full Body Harness Tag No. 1)________ 2)________ 3)________ 4)________		
	6] Resopirator		
	7] Helmet		
	8] Safety Shoes		
13	Spark test carried out		
14	Blower Provided		
15	Combustible gas & Oxygen detected inside vessel.		
	LEL %		
	Oxygen %		
16	Others :		

Electrical Department : Are fuses removed & tag provided ? Yes / No - LOTO Key No. 1 .... 2 ....

Name of Electrician : .... Sign .... Electrical Engineer Name : .... Sign ....

Name of Persons taking vessel entry :

1. Name : .... Sign .... 2. Name : .... Sign .... 3. Name : .... Sign ....

Life line Holder

1. Name : .... Sign .... 2. Name : .... Sign .... 3. Name : .... Sign ....

1. Permit Requiring Authority : 2. Permit Issuing Authority : 3. Safety Officer :

Name : .... Sign .... Name : .... Sign .... Name : .... Sign ....

Extension of confined space entry permit : Date : .... From .... Hrs. To : .... Hrs.

1. Permit Requiring Authority : 2. Permit Issuing Authority : 3. Safety Officer :

Name : .... Sign .... Name : .... Sign .... Name : .... Sign ....

Permit Completed at .... Hrs.

Permit Requiring authority Name : .... Sign ....

Pink : Permitee Perforated copy / Blue : Safety Dept. Perforated copy / White : Issuer fix copy GPS040000

Fig 2.3 Confined Space Permit.

1. Fire Hose Reels:

Fire hose reels are ideal for extinguishing class A fires. That is fires that are fuelled by paper, rubber, wood, and other non-conductive materials. As fire hose reel discharge water, they cannot be used to combat electrical fires. There are other types of fire safety equipment designed to deal with electrical fires – namely C02 fire extinguishers.

Fig 2.4 Fire Hose Reels

2. First Aid Kits:

They might not be the first thing to spring to mind when you think of the different types of fire safety equipment, but first aid kits are essential in the aftermath of a fire. Having adequate first aid measures on hand will help with minor injuries sustained during a fire. It's also a matter of compliance – as a business owner or manager, you need to provide your staff members with first aid.

Fig 2.5 First Aid Kits

3. Emergency & Exit Signs:

Whilst firefighting equipment is important during an emergency when a flame is out of control, you need to evacuate a building. Emergency and exit signs will help to provide a clear path to an exit during a fire.

4. Smoke Alarms:

Some types of fire safety equipment are designed for detection. Smoke alarms should be installed in all commercial and domestic buildings.

5. Personal protective equipment's:

PPE means personal protective equipment or equipment you use to guarantee your (own) safety.

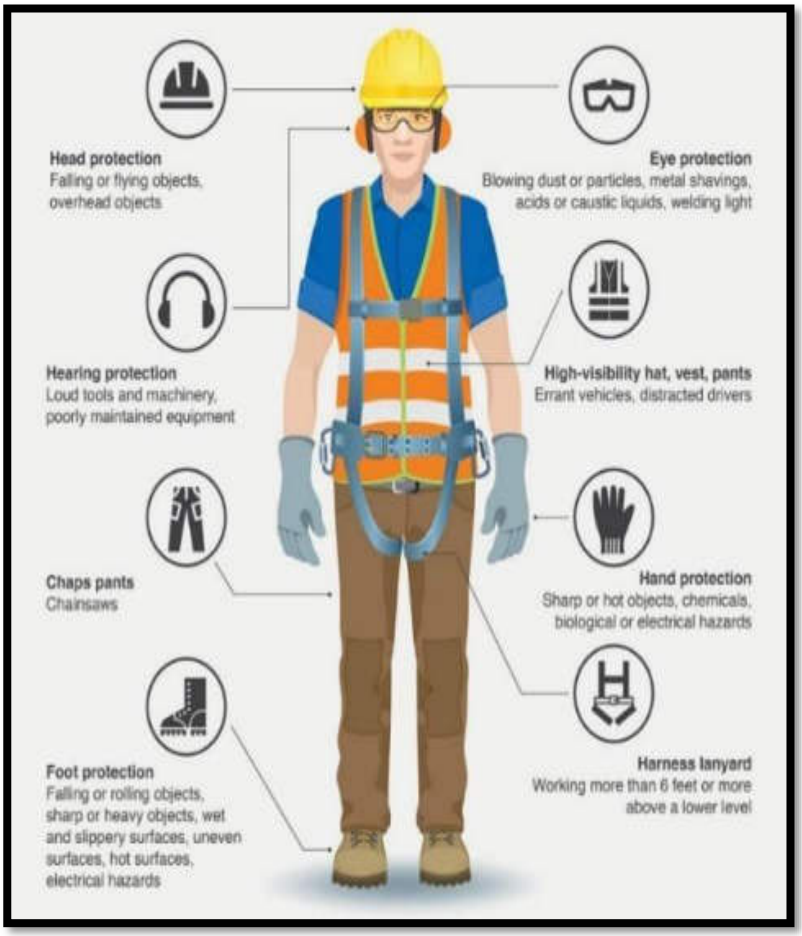


Fig 2.6 PPE kit

CHAPTER 3

3. COOLING TOWER

3.1. What is cooling Tower?

Cooling tower is a heat removal device that uses water to transfer process waste heat into the atmosphere. Likewise, an industrial cooling tower operates on the principle of removing heat from water by evaporating a small portion of water that is recirculated through the unit.

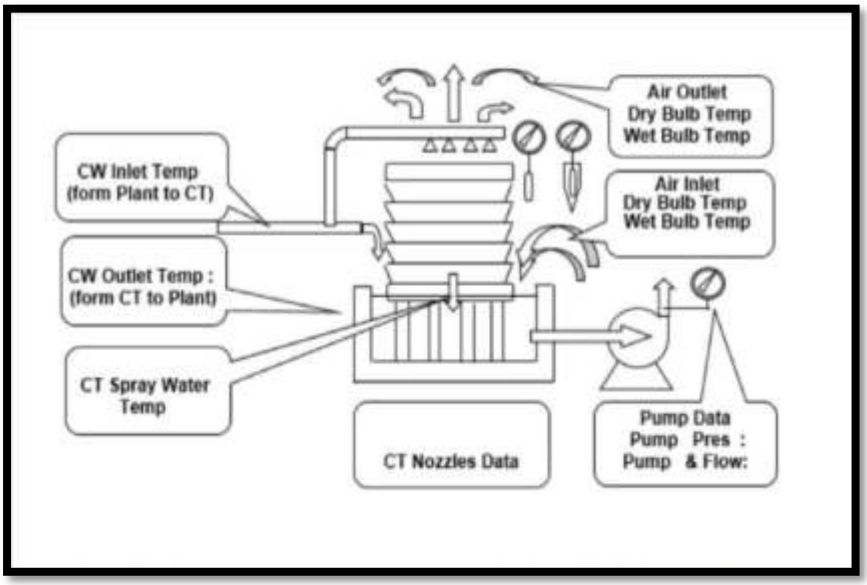


Fig.3.1 Cooling Tower

3.2. Types of Cooling tower:

Cooling towers come in a few unique designs that use different technologies to cool process water. Below, we'll discuss some of the different cooling tower types.

The cooling industry typically categorizes cooling towers in multiple ways, including:

- Whether their air flows horizontally or vertically
- Whether they use mechanical fans or natural convection
- Where and how their fans are positioned

1. Crossflow
2. Counterflow
3. Natural Draft
4. Induced Draft
5. Forced Draft

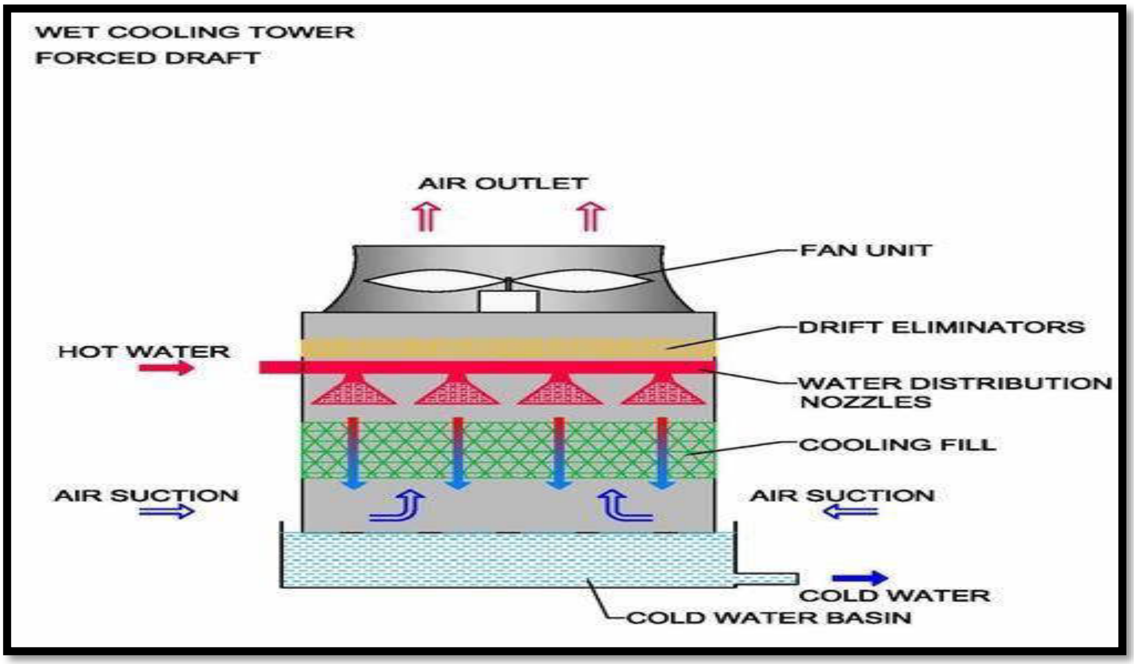


Fig 3.2 Cooling Tower

Induced drought cooling tower:

In this plant natural cooling tower and Induced drought cooling tower used. Cooling tower cool the warm water discharge from the condenser and feed the cooled water back to the condenser.

3.3 Natural cooling tower:

A cooling tower is a specialized heat exchanger in which air and water are brought into direct contact with each other in order to reduce the water's temperature.

This is Induced draught cooling tower, an induced draft cooling towers, the incoming cooling water is injected throughout the cooling tower with a spray distribution header. The spray is directed downwards to baffles for maximizing the time of contact of water.

Fig3.3 Natural cooling tower

3.4 Induced drought cooling tower

- An induced draught cooling tower is a type of mechanical draught tower which has one or more fans located at the top of the tower.
- That draw a upwards against the downward flow of water passing around the packing. Since the air flow is counter to the water flow.
- The incoming warm water is injected throughout the cooling tower with a spray distribution header. The spray directed downwards to baffels for maximizing the time of contact of water with air. The cooled water falls in a pond situated at the bottom of the cooling tower.

fig 3.4 induced draft cooling tower

3.5 Working:

Hot industrial process water flows toward the cooling tower and enters at the top. The water then flows down through the cooling tower. As it does, equipment within the tower spreads the water out over a large surface area, often by converting the water into small droplets or thin films that have a larger surface area than deep water in a tank. The increased water-to-air contact boosts heat transfer through evaporation.

The water flows through the cooling tower, losing heat along the way, until it reaches the sump at the bottom. The sump sends most of the cold water back to cool the hot machinery. When heat transfer from the equipment heats the water again, the water flows back to the cooling tower, and the process repeats.

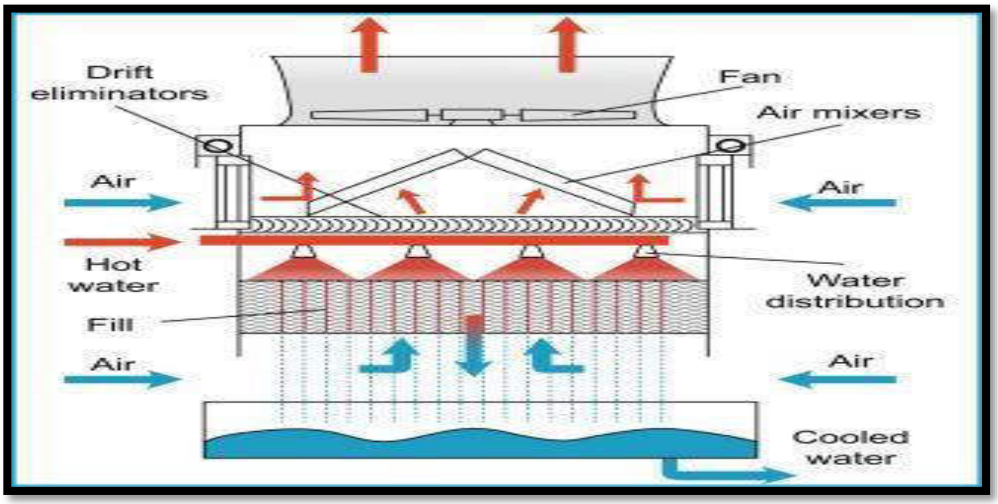


Fig 3-5 Working

3.6. Technical Specification:

Table Technical Specification CT

Sr No	Description
1.	Design
2.	Motor Power
3.	Cooling capacity
4.	Flow rate
5.	Basin capacity
6.	Supply Voltage
7.	Supply phase
8.	MOC

3.7. Cooling Tower Calculation details:

- CT Load = (Flow X Sp. Heat X Density X D T)/ 3024
- CT Range = CT inlet Tem. - CT Outlet Temp
- CT Approach = CT Outlet. Temp - Wet Bulb Temp

CHAPTER 4

4. CHILLING PLANT

4.1 What is Chilling Plant?

A chiller is a mechanical device used to facilitate heat exchange from water to a refrigerant in a closed loop system. The refrigerant is then pumped to a location where the waste heat is transferred to the atmosphere. We offer our chilling plant with excellent efficiency and functions. We are one of the leading manufacturers, exporters and suppliers of Cooling Systems which include Industrial Water Chiller, Air Cooling Systems, Water Cooling Systems and Brine Chilling Plant.

Fig 4-1 Chilling Plant

4.2. Components

- Compressor
- Condenser
- Expansion Valve
- Evaporator

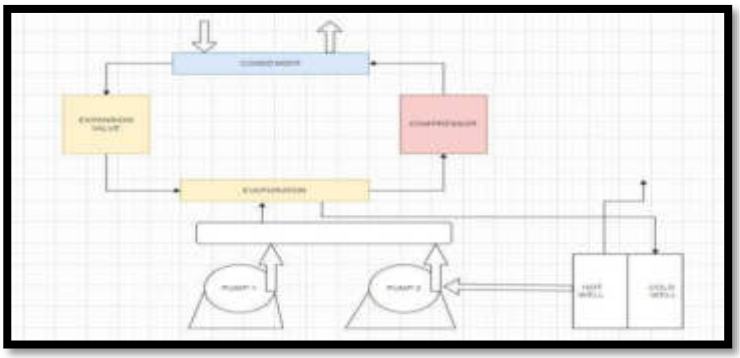


Fig 4-2 Chilling Plant Flow Diagram

4.3. Description:

- Maker: Trane
- Capacity: (Chilled water ΔT x Flow rate(m3/hr) x 1000)/3024.
- Cooling water for 1 TR varies from 0.8 m3/Hr to 1.1 m3/Hr.

4.4 Technical Specification:

Table 3 Technical specification of chilling plant

Sr No	DESCRIPTION	SET POINT
1	Evaporator approach temperature in °C	1.3 to 3
2	Condenser entering water temperature in °C	15 to 32
3	Condenser leaving water temperature in °C	18 to 36
4	Condenser approach temperature in °C	2 to 9
5	Chilling water inlet pressure in Kg/Cm2	1 to 2
6	Chilling water outlet pressure in Kg/Cm2	0.5 to 1
7	Cooling water inlet pressure in Kg/Cm2	1.5 to 3
8	Cooling water outlet pressure in Kg/Cm2	1.5 to 2
9	Chilling water hot well temperature in °C	7 to 13
10	Chilling water cold well temperature in °C	7 to 11

CHAPTER 5

5. CHEMICAL REACTOR

A chemical reactor is an enclosed volume in which a chemical reaction takes place. In chemical engineering, it is generally understood to be a process vessel used to carry out a chemical reaction, which is one of the classic unit operations in chemical process analysis.

Type of reactor
Batch Reactor
Glass lined reactor
Mild steel rubber line reactor
Tile line reactor

5.1 Stainless Steel:

The batch reactor or simply a stainless steel reactor is the generic term for a type of vessel widely used in the process industries. Its name is something of a misnomer since vessels of this type are used for a variety of process operations such as solids dissolution, product mixing, chemical reactions, batch distillation, crystallization, liquid/liquid extraction and polymerization. In some cases, they are not referred to as reactors but have a name which reflects the role they perform (such as crystallizer, or bioreactor).
A typical batch reactor or a stainless steel reactor consists of a tank with an agitator and integral heating/cooling system. These vessels may vary in size from less than 1 litre to more than 15,000 litres. They are usually fabricated in steel, stainless steel, glass-lined steel, glass or exotic alloy. Liquids and solids are usually charged via connections in the top cover of the reactor. Vapors and gases also discharge through connections in the top. Liquids are usually discharged out of the bottom.
The advantages of the batch reactor lie with its versatility. A single vessel can carry out a sequence of different operations without the need to break containment. This is particularly useful when processing toxic or highly potential

Fig. 5.1 Stainless Steel Reactor

5.2 Glass Lined Reactor

Glass-lined reactors are used worldwide, in very severe environments in chemical industries as well as for the glass layer sanitary properties in pharmaceutical industries.
The requirements for glass-lined reactors are reliability, safety, flexibility, efficiency, cost effective operation and availability for industrial processes.
In order to meet these requirements, especially regarding availability, in the 1980s, the European chemical and pharmaceutical industries defined and standardized, along with glass-lined chemical equipment manufacturers, a range of glass-lined reactors ranging in size from 63 litres to 40,000 litres and above, called "DIN reactors".
Of course, for specific productions or applications, a standard DIN reactor may not be suitable, so Pfaudler manufactures and also customizes reactors according to the client's specifications.

Fig 5-2 Glass Reactor

5.3 Valves:

A valve is a device or natural object that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. Valves are technically fittings, but are usually discussed as a separate category. In an open valve, fluid flows in a direction from higher pressure to lower pressure.

- **Types of valves:**

- Ball Valve:

  It has very good shut off capabilities. Quarter turns completely open and closed position. Recommended for use in fully open and closed position. The main reason for using this valve is it is less expensive.

Fig No.5.3 Ball valve

- Gate Valve:

It gives little pressure drop. Recommended for use in fully open and closed position. Partial open condition can cause valve seat deformation. Provides good shut off.

Fig No 5.4 Gate valve

- Butterfly Valve:

Flow is regulated through a disc type element. 90˚ rotation can fully open or close the valve. The body of this valve is Thinnest. It requires less space. It has less pressure drop than Globe valve. The main use of this valve is flow regulation in large pipes.

Fig No.5.5 Butterfly valve

- Globe Valve:

It is moly used in steam line. It has best shut off capacity. It gives high pressure drop. In this type of valve inside and outside portions are different from each and other.

CHAPTER 6

6.PUMPS:

6.1 Types of pump:

Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. They are a sub-class of dynamic axisymmetric work-absorbing turbomachinery.The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from which it exits.
Common uses include water, sewage, agriculture, petroleum, and petrochemical pumping. Centrifugal pumps are often chosen for their high flow rate capabilities, abrasive solution compatibility, mixing potential, as well as their relatively simple engineering A centrifugal fan is commonly used to implement an air handling unit or vacuum cleaner. The reverse function of the centrifugal pump is a water turbine converting potential energy of water pressure into mechanical rotational energy.

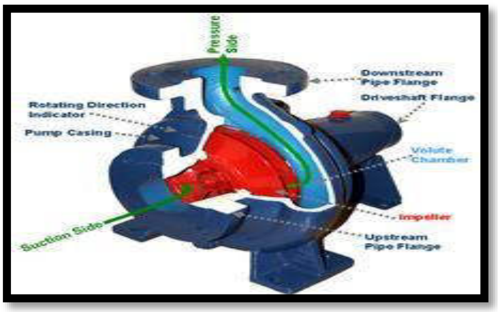


Fig 6-1 Centrifugal Pump and Oil grade

➢ Screw pump:

A screw pump is a subset of positive displacement pump that use one or more than one screw; to perform pump action along its spindle axis. The complete assembly consists of two main parts; the driving motor (prime mover and the pump assembly. The motor provides the necessary rotary motion to the pump drive screw coupled to its shaft; which combined with low clearance in between screw create suction pressure.

With better suction capabilities and low maintenance for the same range of speed; it is also regarded as the most reliable pump for a variety of operation. A screw pump is known for its low turbulence, ease of use with high viscous fluids, low vibration; self-primed and ability to work with minimal air pocket in fluid with low operating noise.

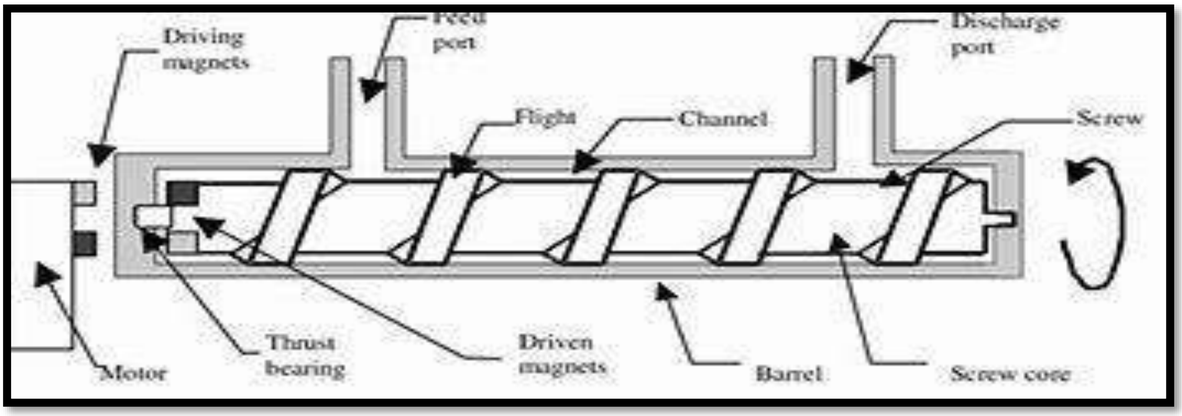


Fig 6-2 Screw Pump

➢ Gear pump.

As the gears rotate they separate on the intake side of the pump, creating a void and suction which is filled by fluid. The fluid is carried by the gears to the discharge side of the pump, where the meshing of the gears displaces the fluid. The mechanical clearances are small—in the order of 10 µm. The tight clearances, along with the speed of rotation, effectively prevent the fluid from leaking backwards.

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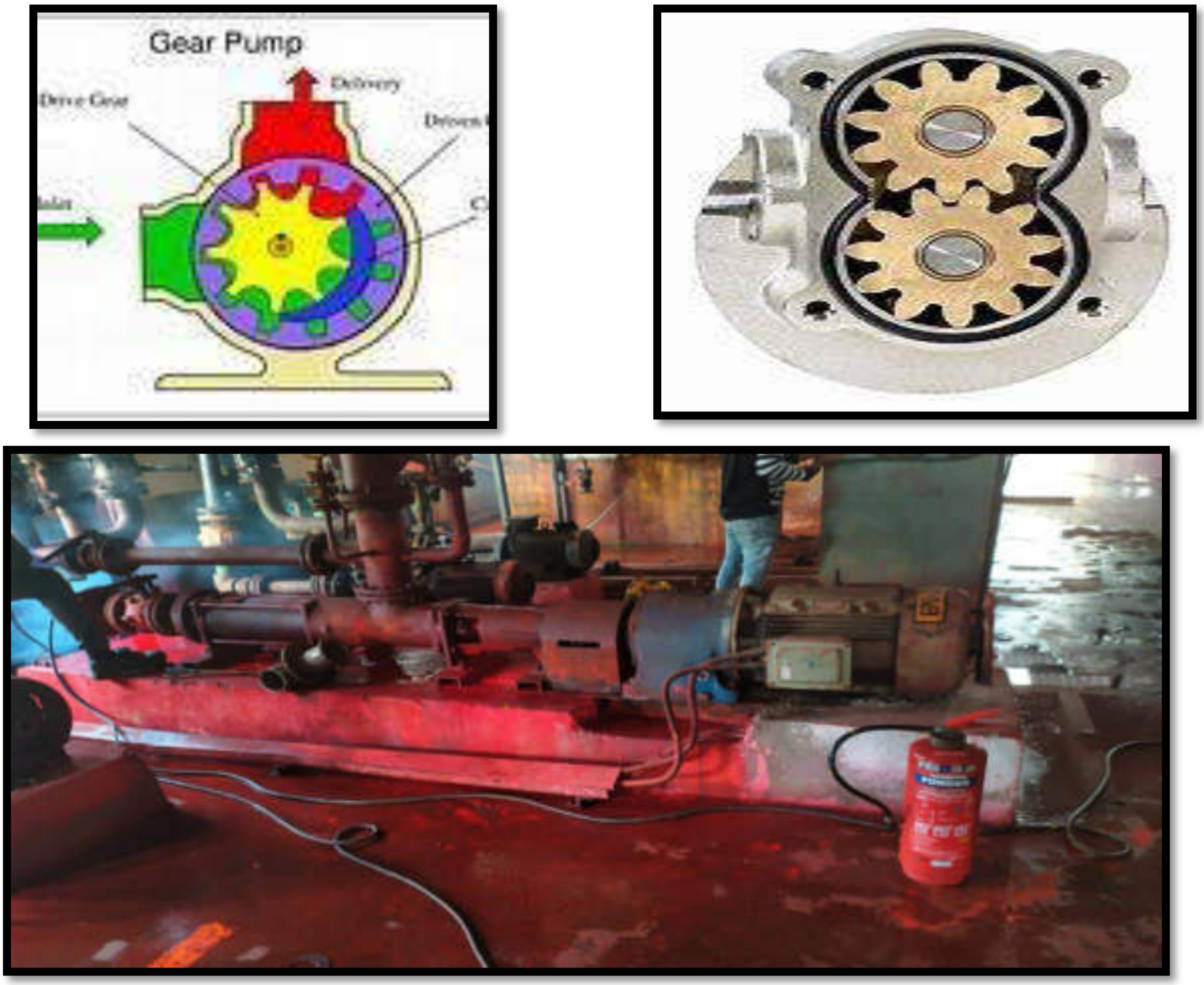
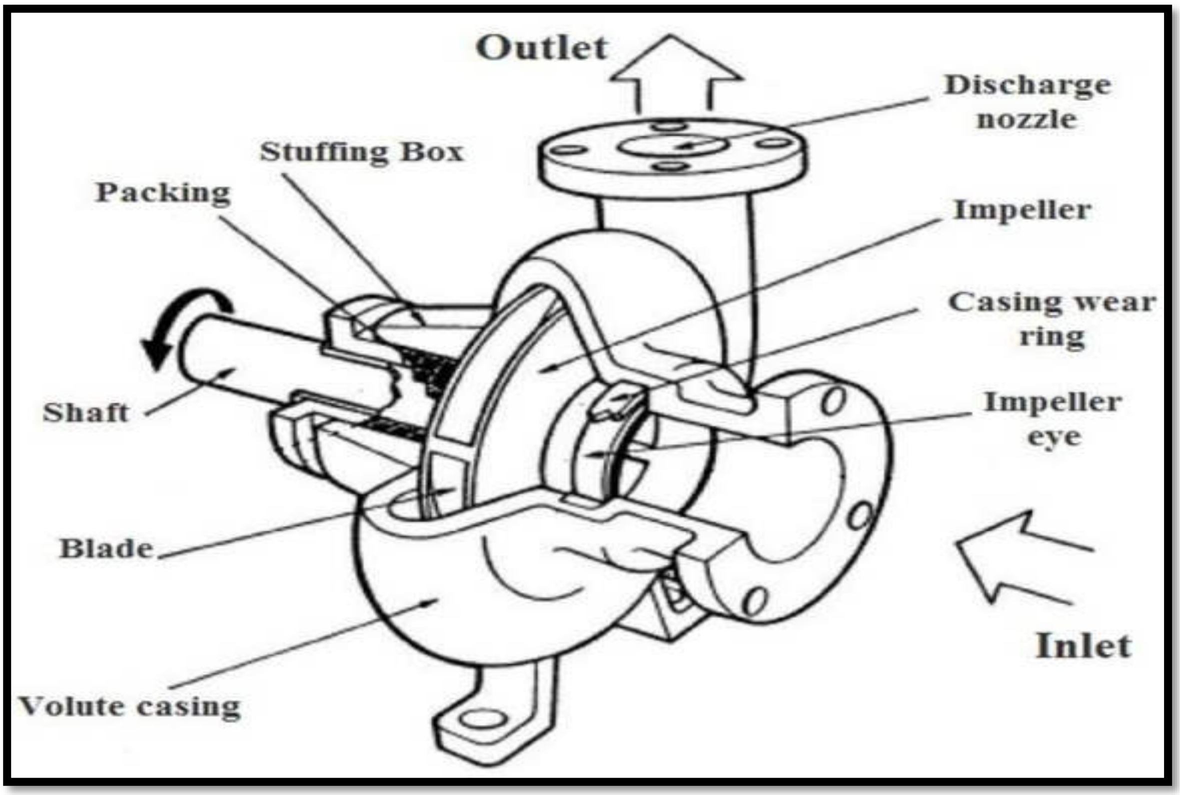


Fig 6.3 Gear pump

6.2 Different Components of Pump:



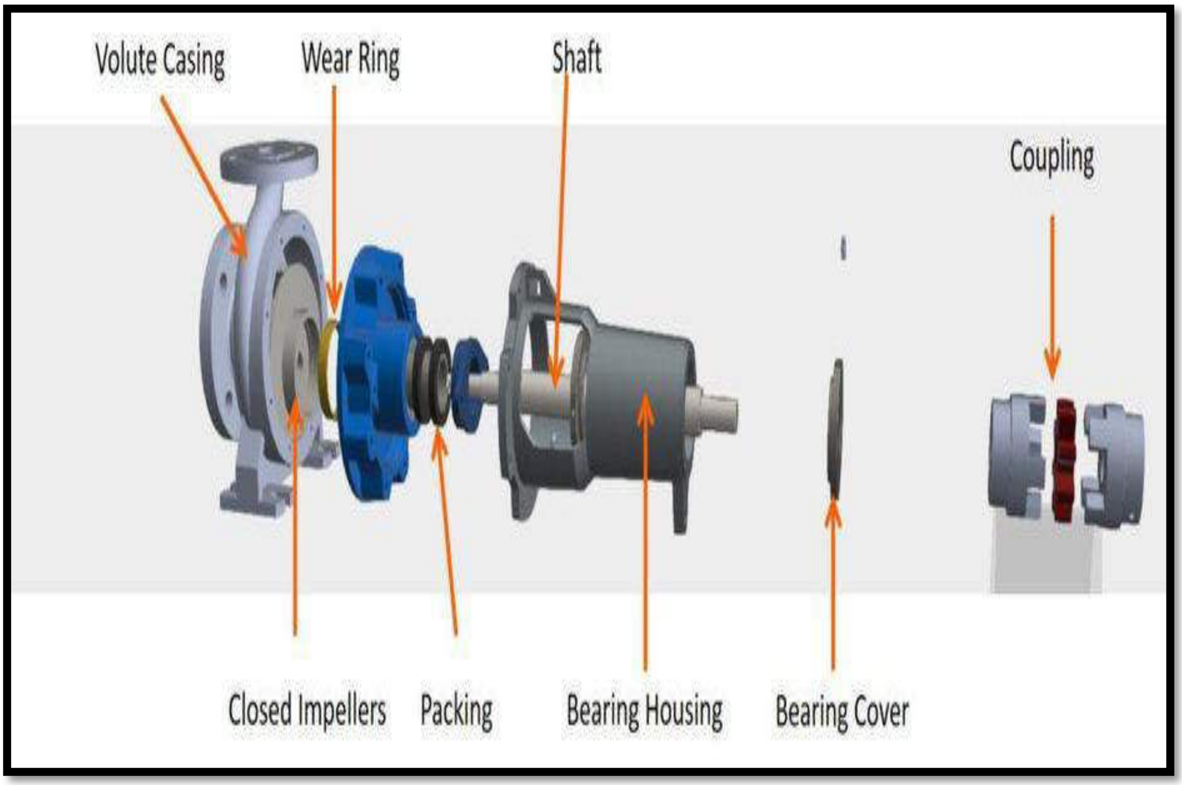


Fig 6.4 Components of pump

6.3 Pump inside flow tested by ultrasonic thickness gauge machine:

Fig 6.5 Pump 3036 Flow check

6.4 How alignment of pump is done:

- The transmission of power from a motor to a pump is achieved by connecting the motor shaft to the pump shaft, either directly or through a coupling of some type. Misalignment can occur in three ways: Radial (offset or parallel) The center lines of the two shafts are parallel but offset.Axial (or end float) The two shafts are aligned but one (or both) axles are prone to in/out movement along the center line. Angular The center lines of the two shafts are not parallel.If these problems are not corrected, a system may suffer from a number of problems including the early failure of the pump or motor. Shaft misalignment can cause premature wear of a pump's seal, packing, shaft, and bearings. This can then lead to excessive leakage and the system as a whole may exhibit excessive vibration and noise, reduced efficiency, and increased power and maintenance costs.

Centrifugal pumps used in petrochemical, chemical and refinery applications are regularly checked for alignment during installation, at frequent intervals during operation, and after service and maintenance.

Fig 6.6 Doing the alignment of pump

6.5 The alignment of pump is carried out in two stages:

1. Vertical positioning
2. Horizontal positioning

For horizontal adjustments, it is common to use hammers (soft face, no-bounce or hollow) to nudge motors into position on their mountings. This requires reasonable access, does not offer great control and may cause damage. Some motors feature horizontal jackscrews and these allow fine adjustments but can be prone to rusting and sticking. These can also interfere with the positioning of shims.

.

Fig 6.7 Alignment is correct

Green tick means the alignment is perfect.

means alignment is equal.

Red cross means alignment is wrong, we have to correct it

6.6 Vacuum Ejector:

A **vacuum ejector**, or simply **ejector** is a type of vacuum pump, which produces vacuum by means of the Venturi effect.

In an ejector, a working fluid (liquid or gaseous) flows through a jet nozzle into a tube that first narrows and then expands in cross-sectional area. The fluid leaving the jet is flowing at a high velocity which due to Bernoulli's principle results in it having low pressure, thus generating a vacuum. The outer tube then narrows into a mixing section where the high velocity working fluid mixes with the fluid that is drawn in by the vacuum, imparting enough velocity for it to be ejected, the tube then typically expands.

6.7 Checking of reactor thickness by thickness gauge machine and NDT method:

Fig 6.8 NDT Method Reactor Thickness Check

6.8 Pigment plant all reactor thickness checking done from top shell bottom side view:



Fig 6.9 Reactor Thickness by Thickness Gauge Machine

6.9 Flitter press:

An **industrial filter press** is a tool used in separation processes, specifically to separate solids and liquids. The machine stacks many filter elements and allows the filter to be easily opened to remove the filtered solids, and allows easy cleaning or replacement of the filter media.

Filter presses cannot be operated in a continuous process but can offer very high performance, particularly when low residual liquid in the solid is desired. Among other uses, filter presses are utilized in marble factories in order to separate water from mud in order to reuse the water during the marble cutting process.

Fig 6-10 Filter Press

CHAPTER 07
BOILER

A boiler is an enclosed vessel that heats a liquid, such as water, to create steam or the vaporized form of a liquid. After that, the steam or hot water is circulated via a piping device to transport heat for a range of purposes, including heating, power generation, and other processes.

According to the position of water and hot gasses:

Fire Tube Boiler.

Water Tube Boiler.

According to Axis of Shell:

Horizontal Boiler

Vertical Boiler.

According to the position of the boiler:

External Fired Boiler.

Internally Fired Boiler.

According to fuel firing.

Solid fuel-fired Boiler.

Liquid fuel-fired Boiler.

Gaseous fuel-fired Boiler.

7.1- Fire tube boiler:

This plant fire tube boiler used, which capacity is 12 ton/hr. In this fire tube boiler for combustion fuel is used as briquette and other fuel can be used as bagasse. A fire tube boiler is a type of boiler in which hot gasses passes from a fire chamber to primary and secondary tube running through a sealed container of water.

The heat of the gasses is transferred through the walls of the tube by thermal conduction, heating the water from combustion chamber to secondary tube then ultimately creating steam. After hot gasses passes from the secondary tube the flue gasses enter to the dust collector. Where dust is remove from the flue gasses and exhaust the flue gasses through the chimney with help of induced drought fan.

In this fire tube boiler soft water used. When we used hard water in the boiler then in the boiler is scaling and corrosive the boiler container. So boiler is not running longer years.

In this boiler is 10 kg/cm^2 steam pressure maintains when steam pressure is above the 10 kg/cm^2 boiler is automatic cutoff with the help of pressure switch.

7.2 Water softening process in boiler:

Water softening process. There are four process.

- For back wash (service wash) of rinse use of water. Control valve number 2 and 3 is open. And all the control valve is closed. There are total seven valve. Backwash is continuing for 10 minutes.
- Then again wash the rinse use of salty water. In this process the control valve 3 and 6,7 is open and all the other valve is closed. This process is continuing for 25min to 30 min.
- Then again wash the rinse use of water this process is slow rinse. In this process the control valve 3 and 6 is open and other valve is closed. This process is minimum 30 minutes.

  And last process is valve number 1 and 4 is open and other all the control valve is closed. This process is fast rinse. After some time check the present of hardness of water is 7 then valve number 1 or 5 is open and other valve is closed. Then soft water collects in soft water tank.

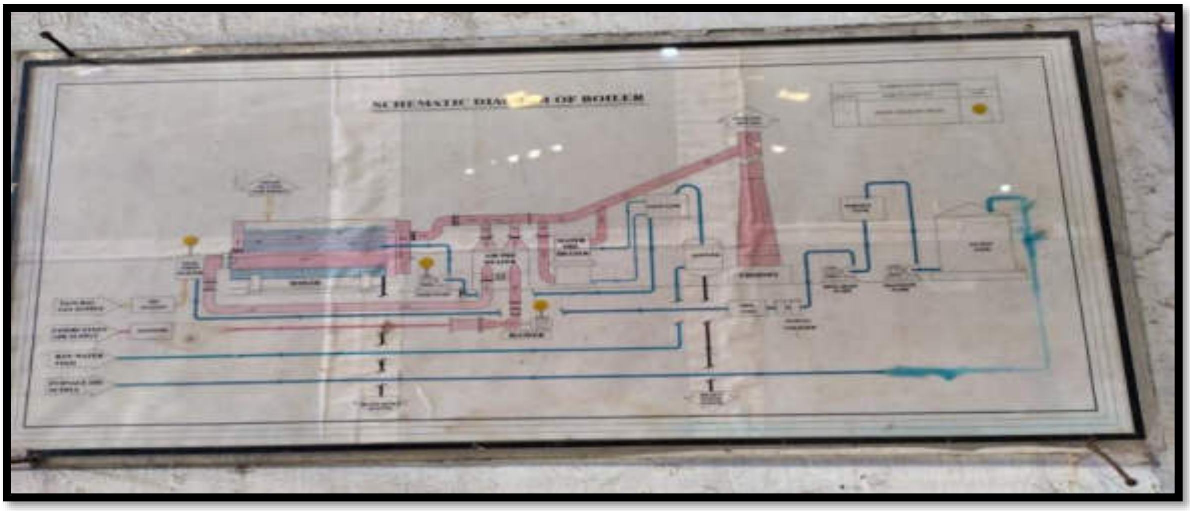


Fig 7.1 Schematic Diagram and inside view of boiler

7.3 THERMIC FLUID HEATER (THERMOPAC)

7.3 What is Thermopac?

Thermopac boiler are used to heat the oil to higher temperature without significant increase in pressure.

The Thermopac series of thermic fluid/thermal oil heaters is designed for maximum efficiency, using a variety of liquid and gaseous fuels. It is designed with fuel flexibility.

7.4 Working of thermopac boiler.

A thermic fluid heater is a close loop in which using thermic fluid as the heat transfer fluid. These system operated at elevated temperature. While maintaining low system pressure. The maximum temp 285*C of thermic fluid can be achieved in a thermic fluid heater. In thermic fluid heater consist of two concentric coils in which inner coils acts as a radiations zone and outer coils acts as a convection zone.

7.5 Properties of Thermia-B

- Oil must be thermally stable.
- The Oil must possess adequate stability to oxidation.
- The Oil must not be too viscous at ambient temperature or otherwise the pump motor maybe subjected to heavy draw of current during cold start.
- The Oil during hot run, must not lose its viscosity too much.
- The Oil must have fairly high boiling point at atmospheric pressure (320 C to 340 The Oil must be completely free from water, and any insoluble substance within it.

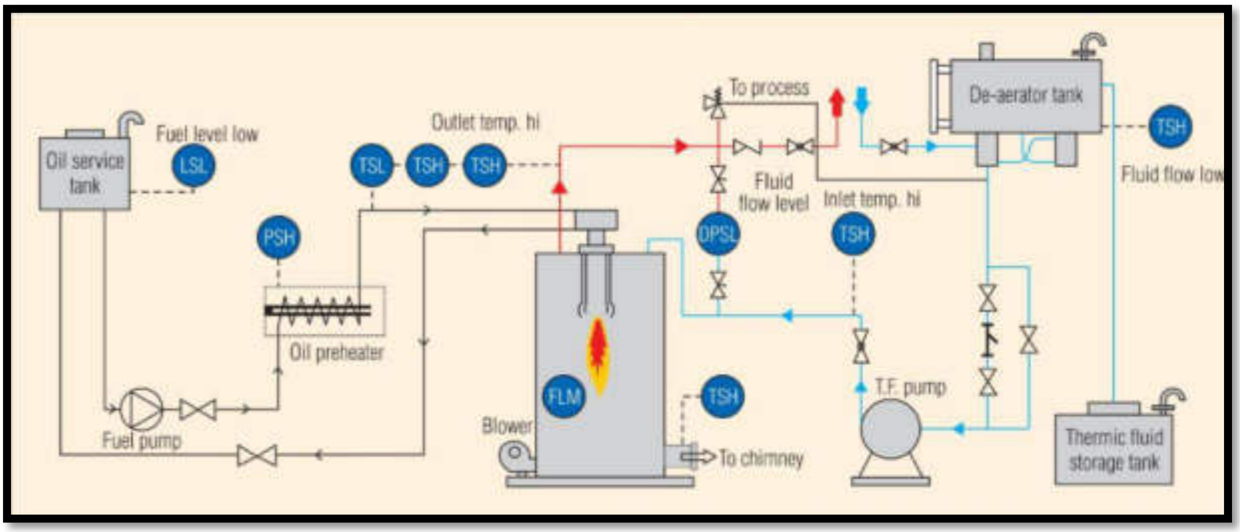


Fig 7.2 Schmetic Diagram of Thermo Boiler

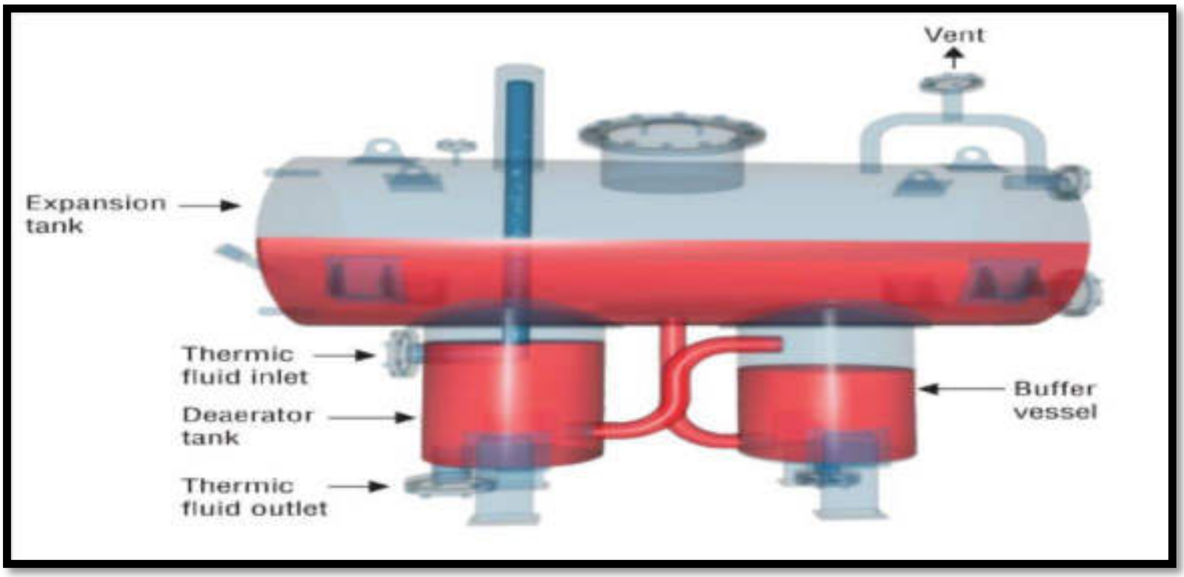


Fig 7.3 Deaerator and expansion tank

7.6 De-aerator:

De-aerator tank fitted in return line is used to remove air from the system during the started phases and even helps in remove vapors present in the system.

De-aerator tank capacity depends upon flow rates.

De-aerator tank is design to take care of expansion fluid during expansion time along with that it can also it can remove entrapped gasses or vapors.

In this chiller R-1324a used as a refrigerant.

There are two types of chillers: water-cooled and air-cooled chiller. The cooling process begins when water enters the evaporator from the hot well where heat is transferred from the water to the refrigerant. Now chilled water is then sent to the cold well tank. where it is distributed to the various plant via pump.

The heat absorbed by the refrigerant in the evaporator. The low pressure low temperature vapor refrigerant moves from the evaporator to the compressor, which increase the pressure and temperature.

After that, high temperature high pressure vapor refrigerant enters the condenser. Where refrigerant is condensed in condenser

After condensing, high pressure low temperature liquid refrigerant goes through an expansion valve to reduce pressure

Before returning to the evaporator, where the process begins again.

7.7 Expansion tank:

The thermic fluid in the complete circuit expands in volume, when it is heated. The rate of expansion in volume is 7 % per 100*C rises in temperature of thermic fluid. Hence the selection of size of expansion tank depends upon fluid content of the total system. As a guideline the expansion tank capacity should be minimum 20 % of the total volume of oil to be filled up in the system.

Fuel oil temp. – (90-120) ° C in case of

Fuel pump pr. (16-25) kg / cm^2

Primary pump pr. - (3-6.0kg / cm^2

Thermopac inlet pr. (2.0-5.0) kg / cm^2

Thermopac outlet pr. - (1.5-4.5) kg / cm^2

Thermopac inlet temp - Max. 265 ° C

Thermopac outlet temp- Max .290

Fig 7.4 Thermopac Boiler

7.8 Operating condition parameter:

Table Technical Specification of Thermopac

1.	Fuel oil Temperature	(90-120) C
2.	Primary pump pr	(16-25)kg/cm^2
3	Thermopac inlet pr	(2.0-5.0) kg/cm^2
4	Thermopac outlet pr	(1.5-4.5)kg/cm^2
5	Thermopac inlet temp	Max 265C
6	Thermopac outlet temp	Max290C
7	Expansion tank temp	30-80) C
8	Expansion tank level	Min 2”
9	Day tank FO level	Min 30 CM

Fig 7.5 Reading of thermopac boiler

7.9 PSA (pressure swing adsorption) nitrogen plant

Following are the important component of nitrogen plant.

- Air compressor
- Air dryer
- Air receiver tank
- Activated carbon filter tank
- Primary and secondary pre-filter
- PSA tank
- Surge tank

PSA Nitrogen making process:

In atmospheric air contains 78% of nitrogen and 21% of oxygen. In nitrogen plant PSA (Pressure Swing Adsorption) Method is generated by Physical separation of oxygen from atmospheric air and outlet the Nitrogen is collected for use.
The compressed air is passed through PSA Tower which is interconnected with automatic changeover valves. In this Process, We can provide separate /Desiccant air Dryer. This has tendency of adsorbing moisture from compressed air. After that Dried compressed air will

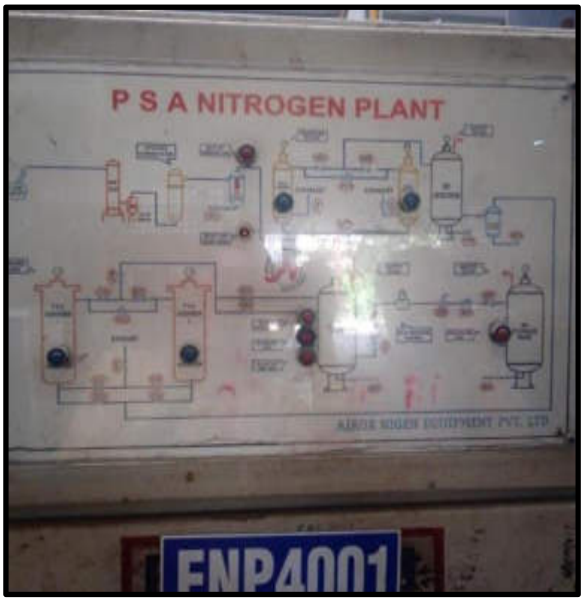


Fig 7.6 PSA Diagram

CHAPTER 8

8.PRESSURE REGULATING VALVE

8.1 Working:

- Steam enters the PRV station at a higher pressure than it is required for downs the team, and the station reduces the pressure to the desired level before delivering steam.
- Within a steam PRV station, the controlling valve—which reduces the steam pressure—is typically a pneumatic control valve. However, a regulating valve (also called a PRV) may sometimes be used instead
- In either case, you'll want the controlling device to have a long operational life so you can reduce maintenance needs, downtime, and total cost of ownership for the PRV station.

Fig 8.1 PRV Valve

8.2 Different Types of Instruments use in industry are as follows:

1. **Level Indicator**: - To determine liquid level in a process tank, vessel or drum.

Fig 8.2 Level Indicator

2. **Temperature Indicator:** - To measure the Temperature in a system.

fig 8.3 temperature gauge

3. **Pressure Gauge:** - To measure the Pressure in a system.

Fig 8.4 Pressure Gauge

Chapter 09

9. 5S KAIZEN SYSTEM.

1. 5S Methodology

Step 1: Sort

- The first step of 5s, Sort, involves going through all the tools, furniture, materials, equipment, etc. in a work area to determine what needs to be present and what can be removed.
- Some questions to ask during this phase include

✓ What is the purpose of this item?

✓ When was this item last used?

✓ How frequently is it used?

✓ Who uses it?

✓ Does it really need to be here?

Step 2: Set in Order

- Next step is to put the collected items in particular order: ❑ Which people (or workstations) use which items?
- When are items used?
- Which items are used most frequently?
- Should items be grouped by type?
- Where would it be most logical to place items?
- Would some placements be more ergonomic for workers than others?
- Would some placements cut down on unnecessary motion?
- Are more storage containers necessary to keep things organized?

➢ Step 3: Shine

- Shine stage of 55 focuses on cleaning up the work area, which means sweeping, mopping, dusting, wiping down surfaces, putting tools and materials away, etc.
- Also involves performing regular maintenance on equipment and machinery.
- Doing 5S daily makes people take ownership of the space, which in the long run means people will be more invested in their work and in the company.

➢ Step 4: Standardize

➢ By writing down what is being done, where, and by whom, you can incorporate the new practices into normal work procedure. This paves the way for long-term change.

➢ Tools for Standardizing:

- 5s checklists
- Job cycle charts
- Procedure labels and signs STOP

Step 5: Sustain

- The final stage of 5S is discipline. Sustain means a formal, rigorous review program to ensure that the benefits of the approach are maintained.
- The key points for doing the same are:
  - ✓ Communication.
  - ✓ Education.
  - ✓ Rewards and Recognition.

ANNEXURE -1

WEEK 1

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ગુજરાતટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt
DIARY OF THE WEEK: Dt: 23/01/2023 TO 28/01/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ process of HR corporate office (Document purpose), safety Training give, safety shoes, safety helmet, Google
⇒ Fire fighting safety process and company map view presentation.
⇒ V3 engg different product & plant like pigment, Flush, Ink plant, MGA, ~~Beta Blue~~, gypsum, Beta Blue, New blue, BFD, BSR, SFD, For online Data entry of each material and their part are store in SAP software. for detail requirement of it, for Maintenance module also.
⇒ Machine include filter press, Reactor of two types MSRL (Mild steel Rubber lining) SSCLAD (stainless steel.)
⇒ From small filter press to big filter press are there.
⇒ Reactor also 2KL to 80KL capacity Reactor are there.

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

TOTAL HOURS: _____ 56 ______

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Nitesh Patel.

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

WEEK 2

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt

DIARY OF THE WEEK: Dt: 30/01/23 TO 04/02/23

DEPARTMENT: V-3 Engineering SEM: 08

NAME OF THE ORGANISATION: Huber Group India Private limited

NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Installation of sewage water treatment plant. (STP), Trial of plant and water filtration process.

⇒ 6 pump, 2 Blower, 2 NRV, 2 Tank, 1 for dosing Tank and 1 for clean water. Membrane - 400 LPH capacity (5 year) warranty, suction down discharge up final purify water goes in tank.

⇒ pump - KSB company. Dismental parts are :- casing, Grease ring, Impellar, lock nut, Mechanical seal - Rotary part stationary part, 1 kg head : 10m flow pump, shaft & sleeve

⇒ coupling and spider. L90, L95, L100, RRL, screw pump is used where high viscous material is used.

⇒ In screw pump universal joint is there, S.S screw type, screw pump, Roller bearing, Glan Busher, Hydraulic filter press, PP plate is used poly propane, cylinder, cloth filter is used.

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TOTAL HOURS: 56

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Nitesh Patel.
Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date:

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

WEEK 3

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt.
DIARY OF THE WEEK: Dt: 06/02/23 TO 11/02/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited.
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Nozzle feed the material which is coming from reactor, same duration of time heat the material than air take place to dry the material, accutuator value is automatic work open close pneumatic system than waste water is been taken to R.O & ETP plant for purify waste water.

⇒ MSRL 50KL gear Box, shaft, gear coupling attach, hatent stool for handle load, Bearing housing, coupling, Agitator, Blade 45°C Top desk, Temperature sensor, Low pressure steam pipe for heating pintch value at bottom of reactor for removal of material

⇒ Gear pump is used where sticky material is used (Alpha, Antigo) company :- motor, By pass value, RB coupling, gear Box, oil, oil seal, Head, stuffing Box, glan, shaft, casing, rotor, hydra

⇒ Beta Blue plant :- From filter press the cake or pastry form convert into powder form, Ball mill machine is there component are inlet, outlet, feeder, cylinder, Drive base, large ring gear, motor.

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TOTAL HOURS: 56

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Nitesh Patel.

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date:

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WEEK 4

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Annexure I

Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt

DIARY OF THE WEEK: Dt: 13/02/23 TO 17/02/23

DEPARTMENT: V-3 Engineering SEM: 08

NAME OF THE ORGANISATION: Huber Group India Private limited.

NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Centrifugal pump Dismantalling because of Deteriorate in gland as well as varnish block in line.

⇒ To check flow of water inside line checking of thickness of line which is connected to centrifugal pump. Flow measure

⇒ First check the line of how much INCH line is there, 6 inch, 4 inch, 8 inch, Than to check the flow we had taken ultrasonic flow meter to check the flow inside the line that how much pressure as well as flow is flowing outside the line, first set all the parameter in ultrasonic flow meter like temperature, thickness, etc, Take measure from scale and place the clamp as well as ultrasonic sound sensor inside the clamp than connect it to flow meter where it sense the flow and show reading.

⇒ preventive Maintenance taken of Reactor MSRL-15 KL, In Blade Rubber lining is done before using it because the blade are MS and chemical added so blade get corrosion so coating of rubber lining is done.

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Signature of officer-in-charge
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WEEK 5

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt

DIARY OF THE WEEK: Dt: 20/02/23 TO 25/02/23

DEPARTMENT: V-3 Engineering SEM: 08

NAME OF THE ORGANISATION: Huber Group India Private Limited.

NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Every 3 and 6 month preventive maintanance is done to check that coating is there or not, than greasing the gear coupling

⇒ Pigment MSRL-20 Reactor 1.5KL to 50KL capacity Reactor are there. PP line is there poly propane, in this Reactor rubber lining is not necessary in this reactor. Testing of rubber lining in reactor, check that rubber and chemical is properly stick on blades or not, High frequency, high voltage spark tester machine is there to check the rubber lining.

⇒ Input current voltage - 220 to 250 V.

⇒ output current voltage - 0 to 40 V.

⇒ Filter press membrane cloth tie and put it on filter press.

⇒ New plate and new membrane each plate nozzle is provide to enter the water inside plate 46 plate are there. For complete washing of cloth and machine all plate are put on filter press machine, Filter press membrane Trial. New plate = 40 no of plate

⇒ Nozzle leakage detect. pump pressure and head = 14 kg.

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WEEK 6

Week-06

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank. P. Bhatt
DIARY OF THE WEEK: Dt: 27/02/23 TO 05/03/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Required pressure of pump is 12kg of water, 5 Impellar multi stage pump is there for high pressure requirement.
⇒ Thermopack Boiler 15KL capacity m.s, Transfer pump for passing oil, cooling pot and nitrogen line is there for cooling of oil.
⇒ cooling pot and nitrogen tank is there for cooling of oil which is dropping in pump on mechanical seal, oil temperature is 298°C
⇒ It damage seal that's why cooling pot is needed.
⇒ New filter pressure Trial pump discharge pressure change 8kg pressure, For washing 3,4kg pressure of water, from outlet line water and material is going, cooling tower ∴ Induced draft
⇒ To cool water which is coming from plant. From plant hot water come it cools that water and supply to plant again, cycle to continuous
⇒ Screw pump not working the material stuck and not flowing ahead.
⇒ By checking the pump, Fault detected, Rubber stator replaced because old stator suction was not properly working ⇒ Russel screw it work like reduce thickness of material and give shining to INK colour.

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WEEK 7

Week-07

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt
DIARY OF THE WEEK: Dt: 06/03/23 **TO** 12/03/23
DEPARTMENT: V-3 Engineering **SEM:** 08
NAME OF THE ORGANISATION: Huber Group India Private Limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Centrifugal pump shaft size reduce by 2mm. because of Bearing damage, replace new shaft and bearing.
⇒ Sigma machine saw it's heating is done at 73° to 90°C heating is done for washing of INK. From cake form to liquid form the process is done.
⇒ Reactor thickness checking done MSRL-3030, 3042, By NDT method thickness is measured and checking insulation of reactor is done, why to do thickness checking ? ∵ Each and every reactor there is PM and insulation checking is done as well as gear oil & greasing is done, every 3 to 4 year thickness checking is done because material is chemical so rust and ~~so~~ chances of corrosion is there that's why it is done.
⇒ By checking thickness 3030 16mm is there at side bottom.
⇒ Thickness is check by NDT method (Non destructive method)
⇒ They use 3 different type of spray are used in NDT method.

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WEEK 8

Week - 08

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt
DIARY OF THE WEEK: Dt: 13/03/23 TO 19/03/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Red colour spray, green colour spray, yellow colour, This 3 type of spray is used to check that the welded portion crack is there or not. To check the crack spray is used, Firstly they remove the insulation and cover of outter portion reactor.
⇒ check surface where the corrosion is maximum. They grind the portion before checking thickness, After grinding clean portion with chemical than buffing is done for soft surface
⇒ centrifugal pump mechanical seal damage, new mechanical seal installation done 3 type of mechanical seal are there 1.) single stage, 2.) Multi stage 3.) Below, In this type of pump multi stage seal is putted because the vibration and balance of mating ring and glan plate. RRL coupling is used for better alignment, To check alignment Dial indicator is used it is put on coupling.

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WEEK 9

week - 09

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt
DIARY OF THE WEEK: Dt: 20/03/23 TO 26/03/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Force draft cooling tower. It uses atmospheric cooling and wet technology and force draft. The fan is located at top
⇒ water nozzle, Drift eliminator. Hot water line, air suction cold water out.
⇒ Reactor thickness measurement taken. First grinding the surface of reactor clean properly and grind till the surface gets smooth. upper dish portion the grinding was done with help of thickness machine the measure was taken 14mm to 16mm it was measure by Thickness gauge machine.
⇒ Beads mill ball bearing was damage by sound of mill it was known that ball bearing is damage. Beads mill from sigma machine the material come it grind and give shining to material. New ball bearing was replace in mill and check on trial was pending.

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WEEK 10

Week - 10

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank P. Bhatt
DIARY OF THE WEEK: Dt: 27/03/23 TO 02/04/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited.
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ press side new reactor coming measurement taken of new reactor for installing it, press side reactor shell get puncher.
⇒ Rubber lining done in pigment plant of reactor.
⇒ Gear pump - positive pump suction is 0 to 180° part of gear pump - Idler, casing, spur gear. used for - varnish, Resin highly pressure pump, Types of agidator in reactor 1) Helical agitator : These impeller are an alternative to anchor impeller which can generate laminar flow, this type of agitator create an axial flow pattern.
⇒ pump seal damage : centrifugal pump Impeller → close, semi close, open, close ⇒ fully liquid material, semi open - use for semi solid part transfer, fully open - more solid part and light weight material transfer seal - 1) mechanical seal : when high pressure and vacuum is there in reactor than and it is used in pump, 0 leakage is there, more than 2kg pressure is there than seal is used. 2) Gland : when gland is used when the pressure is below 2kg/cm² than glan is used in pump.
⇒ Flow meter setting : menu option, quick set up, sensor input, pass 93.

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WEEK 11

Week -11

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Annexure I

Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank P. Bhatt

DIARY OF THE WEEK: Dt: 3/04/23 TO 9/4/23

DEPARTMENT: V-3 Engineering SEM: 08

NAME OF THE ORGANISATION: Hulur Group India Private Limited.

NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Input Data :- pipe thickness, circumference of pipe, solution of pipe, punch value :- use for fire line, high pressure line of water.
⇒ Thermopac Boiler :- pilot gas firing, main gas firing, modulation
⇒ FO as combustion fuel carbon so maintenance is needed.
⇒ Heat is transfered from radiation & combustion from flame.
⇒ 3 pass after first pass, second pass, third pass, flue gases exist to chimney, 2 shell, 2 type of configuration.
⇒ Dryer - Decigant, refrigerant. Filter dryer (silica & alumina 2 type molecular & activated alumina, compressor & motor operate on the same shaft & common casing.
⇒ Nitrogen plant :- PSA system (pressure swing adsorption) It is base on PSA technology consist of 2 absorber tower filled with CMS (carbon molecular sieve) as compressed air passes oxygen molecule are absorbed into pore. 2 types of NO_2 generator, PSA type, membrane type, air temp °C : 30 to 45

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WEEK 12

Week - 12

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Annexure I
Enrollment no: 200390119501

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Nishyank . P. Bhatt
DIARY OF THE WEEK: Dt: 10/4/23 TO 16/4/23
DEPARTMENT: V-3 Engineering SEM: 08
NAME OF THE ORGANISATION: Huber Group India Private Limited
NAME OF THE PLANT/SECTION/DEPARTMENT: Maintenance Dept.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Nitesh Patel.

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ SAP- System application & product in Data processing.
⇒ Air dryer - 6.5 to 7.5 Kg/cm² PSA - 6 to 7 Kg/cm² surge Tank, air temp. 30 to 45, LEL - lower explosive limit, UEL - upper explosive limit.
⇒ MGA chiller. water chiller - 75 KW. Brine chiller (125 TR) Ton of refrigeration Brine (methanol, ethanol, glycol.).
⇒ coolant = R 407 refrigerant. screw type compressor PT, TT coolant condenser (vapour → liquid). (shell tube).
⇒ Filter, expansion value (reduce pressure) chiller → Brine outlet (8-15) water.
⇒ Water D-M plant (raw water, Demineralise water, neutral water filter (remove mud) activated carbon remove oil strong acid Tank, Degasser Tank separate O_2 & CO_2, weak base ion create charge remove ion mix bed remove hardness PH booster (9.5 to 10.5) raw water DM storage Tank, Make up pump, Deaerator Tank CO_2 remover, feed water pump increase pressure, economiser, steam drum.

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Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

ANNEXURE -2

GUJARAT TECHNOLOGICAL UNIVERSITY
(Established under Gujarat Act No. 20 of 2007)
ગુજરાતટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure 2

Feedback Form by Industry expert

Student Name: Nishyank . P. Bhatt Date:

Work Supervisor: Nitesh Patel Title:

Company/Organization: Huber Group India Private Ltd.

Enrollment No: 200390119501

Internship Address: Plot No 808/E, 305/6/7, phase II G.I.D.C Vapi 396195

Dates of Internship: From 23/01/2023 to 24/04/2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility			✓	
Uses technical knowledge and expertise				✓
Analyzes problems effectively			✓	
Communicates well and writes effectively			✓	

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent):

During intern observed good knowledge of equipments

Additional comments, if any:

Huber group India Private Limited Vapi

Signature of Industry person with name and Stamp:

Nitesh Patel

Signature of the Faculty Mentor

Shaikh

INTERNSHIP OFFER LETTER

hubergroup

20th January, 2023
HGIPL/01/23

Prof. Kunal Kathia
Head of Department (Mechanical Engineering)
S.P.B. Patel Engineering College, Linch
Mehsana Highway.384435

Sub: ***Summer Internship***

Dear Sir,

This is with reference to your letter dated 18th January, 2023; we are pleased to inform you that we will accommodate **Mr. Nishyank Pranthesh Bhatt** in our organization for the training.

You are requested to inform the concerned student to meet the undersigned on the date of joining.

Thanking you.

Very truly yours,
For ***Hubergroup India Private Limited.***

Anirudhha Panchal
Head - Human Resources

roup India Private Limited

CIN: U24220GJ199

ed & Corporate Office:
06/E, Phase-II, G.I.D.C.
195, Gujarat, India

T +91 260 7158000
F +91 260 7158008

E info.in@hubergroup.com
W www.hubergroup.com

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7. The Huber Group India Private Limited in vapi one of the leading international specialists for printing inks and printing aids, its work daily to provide innovative solutions, technologies and services for packaging, newspaper and commercial printing and always with your needs in mind. 1. www.hubergroup.com

End of Report

INTERNSHIP AT JINDAL SAW LTD.

A PROJECT REPORT

Submitted by

JENISH PIYUSHBHAI DABHI

200390119503

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Mechanical engineering

S.P.B. Patel Engineering College, Mehsana

S.P.B. PATEL
ENGINEERING COLLEGE

Gujarat Technological University, Ahmedabad

April, 2023

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S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

Gujarat Technological University, Ahmedabad

April, 2023

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College, Mehsana

Near sankush water park, linch, Mehsana

Gujarat 384435

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **INTERNSHIP** has been carried out by **DABHI JENISH PIYUSHBHAI** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Sign.	Sign
Prof. TASUIF Shaikh	Prof. Kunalsingh Kathiya
Internal Guide	Head of the Department

JINDAL SAW LTD.

JSAW/HR&A/ 2023

Date: - 29th April, 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. Jenish Piyushbhai Dabhi, a student of S.P.B Patel Engineering College - Mehsana, Gujarat has successfully completed his internship in Mechanical Maintenance Department, for learning purpose from 31st January, 2023 to 29th April, 2023.

During his training period with us, his conduct was very good.

We wish him all the best for him future endeavors.

For, JINDAL SAW LIMITED

S. K. Yadav
Head – HR, ER & Admin

JINDAL SAW LIMITED MUNDRA

S. No. [illegible] Village, Mundra Taluka, District Kutch, Gujarat - [illegible] Ph: [illegible] Fax: [illegible]
Corporate Office: Jindal Centre, 12 Bhikaji Cama Place, New Delhi 110066. CIN [illegible] Phone: +91 (11) [illegible]
Fax: +91 (11) [illegible]
Regd. Off.: A-1, UPSIDC Ind. Area, Nandgaon Road, Kosi Kalan, Dist. Mathura (U.P.) - [illegible] Website: www.jindalsaw.com
(FORMERLY SAW PIPES LTD.)

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : 14 May 2023 (21:47:28)

This is to certify that, ***DABHI JENISH PIYUSHBHAI*** (Enrolment Number - 200390119503) working on project entitled with ***Offline intership*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : DABHI JENISH PIYUSHBHAI

Name of Guide : Mr.Shaikh TausifAhmad MohmmadSalim

Signature of Student : Jenish

*Signature of Guide : Shaikh

Disclaimer :

This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate, Only if all above activities has been Completed.

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College, Mehsana

Near sankush water park, linch, Mehsana

Gujarat 384435

DECLARATION

We hereby declare that the Internship report submitted along with the Internship entitled **INTERNSHIP AT JINDAL SAW LTD.** submitted in partial fulfillment for the degree of Bachelor of Engineering in Mechanical to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me at **JINDAL SAW LTD. NANA KAPAYA PLANT under** the supervision of Prof. Tusiff Shaikh and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference

	Name of the student	Sign of Student
1.	JENISH PIYUSHBHAI DABHI	Jenish

ACKNOWLEDGMENT

The present report is the outcome of my work done during internship in the JINDAL SAW LTD.. The objective of the internship was to compare The knowledge earned in the campus with the industrial applications. The Practical knowledge is far different from the theoretical knowledge earned During our studies I observed and study the equipment used for the process, Its construction, startup, maintenance, shutdown procedures, operating Problems and its solution, safety measures, emergencies, etc. The theories And usual practices given in the books and literature differ up to an Appreciable extent from the industrial practices Different features used to Learn are industrial management and discipline. It is also important in the Life. This will only happen in…

	Name of the student	Sign of Student
1.	JENISH PIYUSHBHAI DABHI	Jenish

ABSTRACT

Industrial training is an important phase of a student life. A well planned, properly executed and evaluated industrial training helps a lot in developing a professional attitude. It develop an awareness of industrial approach to problem solving, based on a broad understanding of process and mode of operation of organization. The aim and motivation of this industrial training is to receive discipline, skills, teamwork and technical knowledge through a proper training environment, which will help me, as a student in the field of Mechanical Engineering.

This Report Contains information about the knowledge I have acquired during my in-plant training at JINDAL SAW LTD, NANA KAPAYA-MUNDRA PLANT. JINDAL Mainly Produce metal products like SAW, ERW, DI, SMLS pipes, SS Pipes and SS products and other material and chemical processes and products like PE coating, teflon coating, Epoxy coating. In this industry they apply core mechanical engineering principles. This Industry is much more excellent in quality and management. In this internship we learn about different types of mechanical fundamentals, phenomenons and abilities for contributing to the corporate world and society to lead humanity to sustainable development and satisfaction of customer needs.

LIST OF FIGURES

LIST OF TABLE

LIST OF ABBREVIATIONS

API American Petroleum Institute

CVN Charpy V-notch

HAZ heat-affected zone

NDT non destructive testing

PSL product specification level

SAW submerged arc welding process for pipe during manufacture

SAWH submerged arc helical welding process for pipe during manufacture

SAWL submerged arc longitudinal welding process for pipe during manufacture

UT ultrasonic testing

TABLE OF CONTENTS

CHAPTER -4 MACHINE USED FOR LSAW PIPE MANUFACTURING

CHAPTER -5 COATING

CHAPTER -1 :- INTRODUCTION TO OP JINDAL GROUP OF COMPANIES

1.1 INTRODUCTION TO OP JINDAL

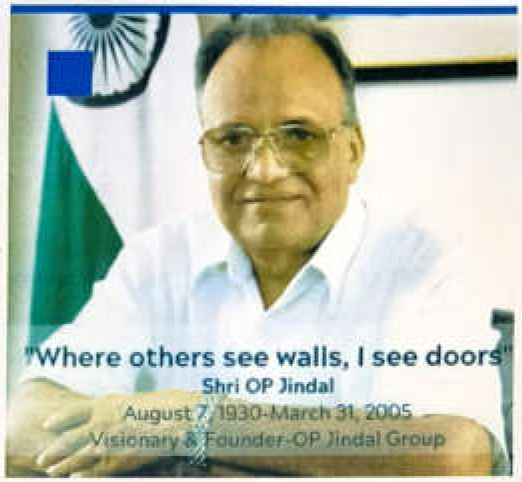

fig.1.1 OP Jindal Courtesy of OPJEMS

Om Prakash Jindal (7 August 1930 – 31 March 2005), popularly known as O.P. Jindal, was born in Hisar, Haryana. He established a successful business enterprise Jindal Steel and Power under the flagship of the Jindal Organization, of which he was the chairman. In November 2004, Jindal was awarded the "Life Time Achievement Award" for his outstanding contribution to the Indian Steel Industry by the Bengal Chamber of Commerce and Industry. According to the latest Forbes List, he was ranked 13th amongst the richest Indians and placed 548th amongst the richest persons of the world. He died in a helicopter crash on 31 March 2005.

Jindal was appointed Minister of Power in the Government of Haryana. He won the Hisar Legislative Assembly seat of Haryana three times consecutively. He was also a Member of the Committee on Food, Civil Supplies and Public Distribution from 1996 to 1997.

Jindal was elected to the Haryana Vidhan Sabha (the Haryana state assembly) in February 2005 and was the Minister of Power in the Government of Haryana at the time of his death. He was the Chairman of the N.C. Jindal Charitable Trust; Patron and Trustee of Agroha Vikas Trust and Agroha Medical College.

1.2 INTRODUCTION TO OP JINDAL GROUP OF COMPANIES

fig.1.2 OP Jindal Group Courtesy of OPJEMS

Over the years, the Group has grown to become a global conglomerate with business interests spanning across mining, power, industrial gases, seaport facilities and in the flagship steel manufacturing. From mining iron ore and coal, the Group produces sponge iron, ferro alloys and a wide range of hot-rolled and cold-rolled steel products ranging from HR coils/sheets/plates, hot-rolled structural sections and rails to CR coils/sheets, high-grade pipes and value added items such as stainless steel, galvanized, colour coated steel, coated pipes and long products. The Group has further diversified into petroleum, diamond and high value metals and mineral exploration. Presently the Group has manufacturing facilities across India, US, UK, Middle East & Indonesia and mining concessions in Chile, Indonesia, South Africa & Mozambique and marketing offices across the world.

Growth has been a way of life for the O P Jindal Group and 'Growth with a social conscience' has been the guiding philosophy. The Group places high commitment on sustainable development of its people and the communities in which it operates. The Group's strength lies in dynamic and aggressive approach of the Group companies, with each one committed to consolidating its strengths and excelling in the chosen field. Taking their father's dream forward, the four brothers have taken the O P Jindal Group to the next level. Mr. Prithavi Raj Jindal is leading Jindal SAW Ltd.. Mr. Sajjan Jindal operates JSW Ltd. Jindal Stainless Ltd. is led by Ratan Jindal, while Naveen Jindal is heading Jindal Steel & Power Ltd.

CHAPTER-2 :- JINDAL SAW LTD

2.1 INTRODUCTION TO JINDAL SAW LTD

fig.2.1 Jindal SAW ltd. Courtesy of Jindal SAW ltd

Jindal SAW Limited is the largest pipe manufacturing company in India. As part of one of the country's top most industrial houses and the foremost indigenous steel producer and exporter, Jindal SAW has effectively established itself as a global major and market leader. With its four Strategic Business Units, spread in India and overseas, it is the only company that offers Total Pipe Solutions.

Jindal SAW Ltd., is the most experienced longitudinally welded line pipe manufacturer in Asia after Japan. The company's products have found wide acceptance in the markets of Gulf, Middle East, South East Asia, Africa, North America and Latin America with a track record of manufacturing and supplying approx. 19,500 Kms of Line Pipes, of which more than 10,500 Kms of Line Pipes have been exported to major companies across the world.

2.1.1 PRODUCTS FROM JINDAL SAW LTD

- LINE PIPES

Longitudinal Submerged Arc Welded by UOE Process(LSAW)

Longitudinal Submerged Arc Welded by JCOE Process(LSAW)

Helical Submerged Arc Welded (HSAW)

- ANTI - CORROSION COATINGS

EXTERNAL:

3 Layer Polyethylene(PE) / 3 Layer Polypropylene(PP)

Fusion Bonded Epoxy (FBE) / Dual Layer Fusion Bonded Epox (DFBE)

Tape Coating Coal Tar Enamle (CTE)

Concrete Weight Coating (CWC)

Insulation Coating

INTERNAL:

Internal Fusion Bonded Epoxy

- CONNECTOR CASINGS
- HOT PULLED INDUCTION BENDS

2.1.1 PLANTS OF JINDAL SAW LTD

- Kosi Kalan, Mathura
- Nana Kapaya, Mundra. Samaghogha, Mundra
- Bellary, Karnataka Pragpar, Mundra
- Baytown, Texas, USA

2.2 INTRODUCTION TO JINDAL SAW NANA KAPAYA PLANT

In Jindal SAW ltd. the Nana Kapaya Plant plays a vital role in manufacturing it is a like a heart of Jindal SAW pipe production because it is roughly 15 km away from Mundra Port so it reduces transportation cost of pipes and becomes easy to export to west countries and arab oil producers and across the world also this is important because of pipe production, coating, joining and coupling provisions are available in this plant.

It has three units running currently

1. JCO 1
2. JCO 3
3. External Coating Plant

2.3 PRODUCTS AND SERVICES IN NANA KAPAYA PLANT

In JCO 1 following specifications can be produced

Product : LSAW/ DSAW Line Pipe

(Longitudinal Seam)

Pipe Diameter : 457 mm (18") - 1219 mm (48")

Strip Width : 1317 - 3779 mm

Wall Thickness : 6.4 - 38.1 mm

Material Grade : API 5L, Grade up to X 80

Pipe Length : 8 - 12.5 meters

Plant Capacity : 300,000 MT PA

In JCO 3 following Specifications can be produced

Product : LSAW/ DSAW Line Pipe

(Longitudinal Seam)

Pipe Diameter : 406.4 mm (16") - 1524 mm (60")

Strip Width : 1250 - 4727 mm

Wall Thickness : 6.4 - 50 mm

Material Grade : API 5L, Grade up to X 80

Pipe Length : 8 - 13 meters

Plant Capacity : 300,000 MT PA

In External Coating following specifications can be produced

Pipe Diameter : 4" to 68"

Fusion Bond Epoxy (FBE) : 3.5 Million Sq.Mtr PA

Dual FBE : 3.5 Million Sq.Mtr PA

3 Layer Polypropylene/ Polyethylene/ Tape Coating : 3.5 Million Sq.Mt

CHAPTER-3 :- THE PRODUCTION PROCESS

3.1 PRODUCTION PROCESS

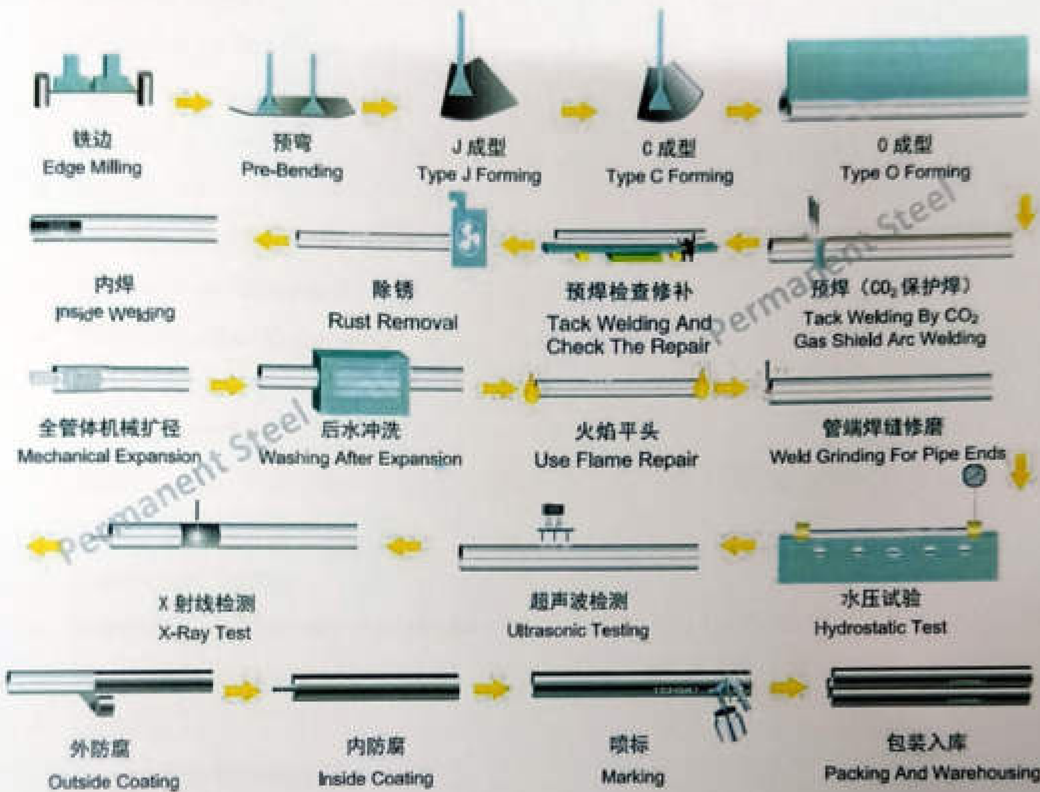

fig.3.1 JCOE Manufacturing Processes courtesy of Permanent Steel

The production processes are very carefully and engineered flow so it makes products with suitable quantity and quality of products. So it basically follows the processes listed below

- Plate Ultrasonic Testing
- Shifting to Conveyer
- Edge Milling
- Pre Bending

- Forming
    - JCOE forming
    - UOE forming
- Auto MIG Welding
- Inside Welding
- Outside Welding
- Removal of Tab Plate
- Cleaning
- Rounding
- X-Ray Test
- Washing Before Expansion
- Mechanical Expansion
- Washing After Expansion
- Straightness
- Hydrostatic Test
- End Facer
- X Ray Test
- Ultrasonic Testing
- Weighing and Measuring Length
- Product Inspection
- Coating
    - Pre-Heating 1
    - Abrasive Blasting 1
    - Surface Inspection
    - Pre-Heating 2
    - Abrasive Blasting 2
    - Blasted Surface Inspection
    - Induction Heating Before Chemical Pre-Treatment
    - Chromate Application and Acid Wash
    - Induction Heating Before Epoxy Layer
    - Epoxy Application
    - Adhesive Application
    - PP/PE Application
    - Quenching Zone
    - Thickness Test and Visual Test

  - End Brushing Machine
- Marking
- Packing and Warehousing

CHAPTER -4 MACHINE USED FOR LSAW PIPE MANUFACTURING

4.1 CRANE

Plate ultrasonic testing is a useful method for verifying the reliability and security of plate materials used in a variety of sectors. Internal flaws can be found and measured, preventing possible failures and guaranteeing that materials adhere to the necessary norms and requirements.

4.3 PLATE MILL

fig.4.3 Plate Mill Courtesy of Jindal

The milling machine mills the two sides of the plate to exacting standards in order to meet width, edging and groove shape specifications.

Specification:

Nominal pressure of squeeze head: 2x2000 ton

Movement for each squeeze: 2200mm(max)

Thickness range of steel plate: 6-50mm

4.4 PRE BENDING PRESS

fig.4.4 Pre Bending Machine Courtesy of Jindal

The crimping machine crimps the edges of the plate to form the required curvature.

Specification:

Press Cylinders: 4 sets

Bending radius of die: 800mm

4.5 JCO PRESS

fig.4.5 JCOE Press courtesy of Jindal

Pipe dia: 406-1626mm (16"-64")

Material: API 5L GR B X100

Plate Width: 1.1-5.1 m

Plate Length: 6-12.8 m

Thickness: 8-70 mm

Weight: 10 ton

Control: CNC

Production rate: 8-10 pieces/hr

4.6 AUTO MIG

fig.4.6 AutoMIG Tack Welding courtesy of Jindal

The two edges of the open seam pipe are brought together by the tack welding machine. then welded by the tack welder using a metal inert gas arc welding(MIG) process.

Specification:

Adjustment for roller beam:

mechanical adjustment

Roller beams: 9

Welding method: CO2 MIg welding

4.7 SAW WELD

fig.4.7 ID OD SAW Welding courtesy of Jindal

The interior longitudinal seam of the pipe is welded from the inside by fixing 4 welding heads while moving pipe and using submerged-arc welding process.

Specification :

Multiple wires: 4

Welding current:

Direct Current 400-2000A

Alternating Current 300-1200A

Welding head tracking system :mechanical tracking

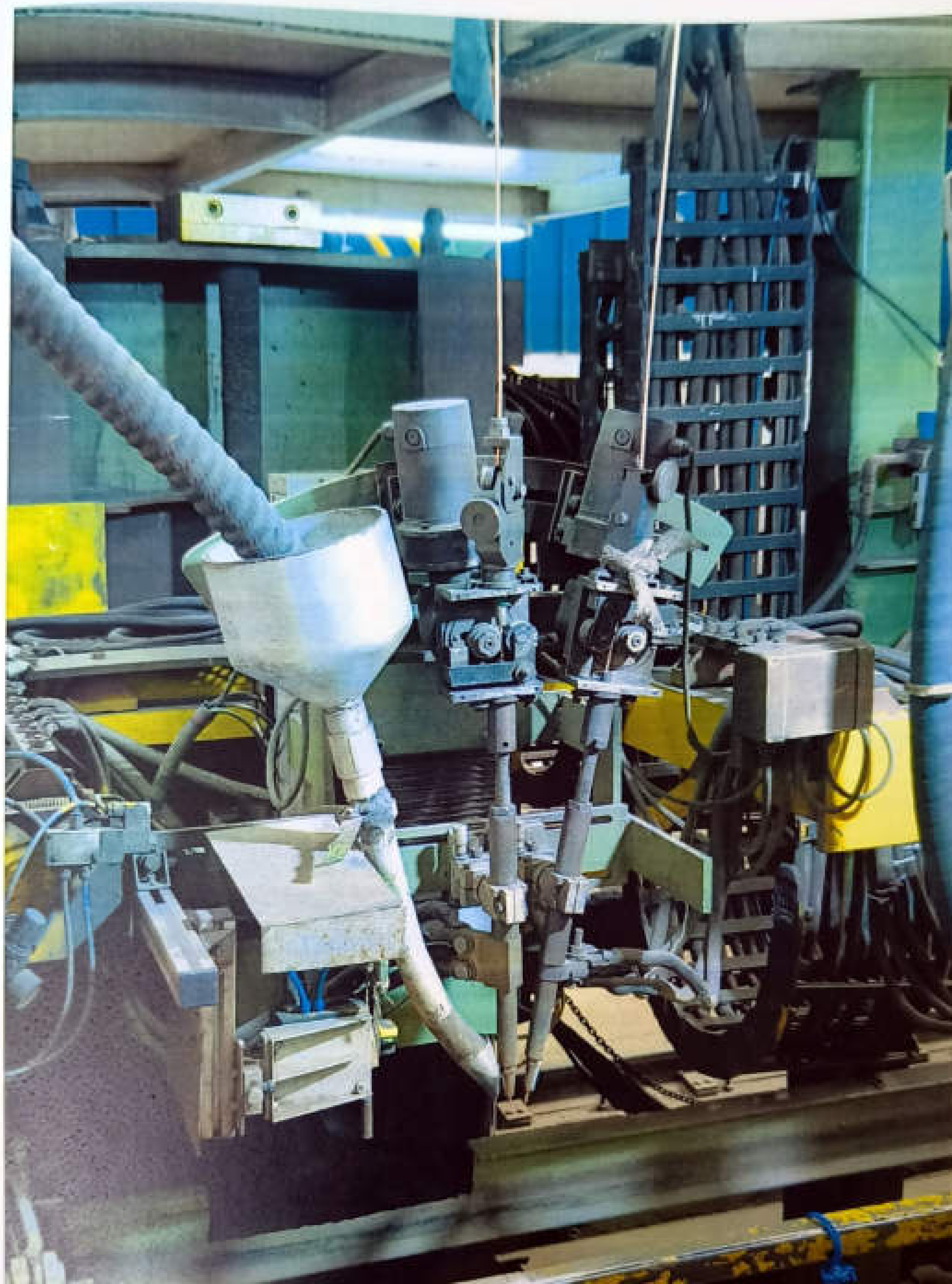

fig.4.8 SAW welding arrangement courtesy of Jindal

The exterior longitudinal seam of the pipe is welded from the inside by fixing 4 welding heads while moving pipe and using submerged-arc welding process.

Specification:

Multiple wire s: 5

Welding current: Direct Current 400-2000A

Alternating Current 300- 1200A

Welding head tracking system: mechanical tracking

4.8 STRAIGHTNESS PRESS

fig.4.9 Straightness Press courtesy of Jindal

There are two general calculations for straightness or curvature:

First, the local bending of seamless steel pipe or straight seam steel pipe: that is, the ruler with a length of one meter depends on the maximum bending of the steel pipe, and the chord height (mm) is measured, which is the local bending value, and its unit is mm. /m, indicating a method such as 2.5mm/m.

Second, the total bending length of the steel pipe: use a string, pull from the two ends of the pipe, measure the maximum chord height (mm) of the bending of the steel pipe, and then convert into the length (in meters) percentage, which is the length of the steel pipe The full length curvature of the direction.

4.9 MECHANICAL EXPANDER

fig.4.10 Mechanical Expander courtesy of Jindal

The pipe is subjected to full-length expansion to increase the precision of the pipe dimensions and to improve the internal stress distribution.

Specification:

Nominal tensile force: 1600 ton

Expanding frequency: 15-18 seconds for each time

Expanding ratio: 0.3%-1.5%

4.10 OVALITY PRESS

fig.4.11 Ovality Press courtesy of Jindal

In the cross-section of the lsaw steel pipe, there is a phenomenon that the outer diameter is not equal, that is, there is a maximum outer diameter and a minimum outer diameter which are not necessarily mutually perpendicular, and the difference between the maximum outer diameter and the minimum outer diameter is ellipticity (or not Roundness). In order to control the ellipticity, some lsaw steel pipe standards specify the allowable index of ellipticity, which is generally specified as not to exceed 80% of the outer diameter tolerance (executed after consultation by the supply and demand sides).

LSAW steel pipe is curved in the length direction, and its curve degree is called curvature. The bending degree specified in the standard is generally divided into the following two types: Partial bending: Using a one-meter-long straight ruler at the maximum bending of the steel pipe, measure the chord height (mm), which is the value of the local bending degree. Its unit is Mm/m indicates the method is 2.5mm/m. This method also applies to tube end curvature. Full-length total bending: Using a string, pull from both ends of the tube, measure the maximum chord height (mm) at the bend of the steel tube, and convert it into the length (in meters) as the percentage of the length of the tube.

4.11 HYDROTESTER

fig.4.12 Hydrotester courtesy of Jindal

Using end face sealing technology eliminates blind zones during hydrostatic testing. The tester is also equipped with automatic recording and storing functions.

Specification:

Maximum load-bearing capacity: 4000 ton

Testing pressure : 3-50 Mpa

Seal form: end pressure : 25Mpa

radial pressure ~ 25Mpa

4.12 END FACER

fig.4.13 End Facer courtesy of Jindal

The machine levels the pipe end with rotating cutter heads to ensure that required groove and edge specifications are met.

Technical specification :

Pipe end groove : flat end or beveled end (subject to the specification)

Wall thickness range : 6-50mm

Technical specification :

Diameter range: 18" to 64"

4.13 ULTRASONIC TESTER

fig.4.14 Ultrasonic Tester courtesy of Jindal

The superiority of phased array ultra sonic technology:

(1)Adopting electron control method for fast linear scanning or sector scanning without moving probe or moving less. thus greatly improve detection efficiency .

(2)Controlting the sound beam by setting detection angles, its good sound beam reachability can enhances reliability and accuracy of detection.

(3) Dynamic control the deflection and focus of sound beam realizes the detection of pipes with different wall thickness without replacing probes.

Technical specification:

Testing method: pulse echo method

Detection channels: ~ 24

Probe: phased array probe

4.14 X-RAY TEST

fig.4.15 X Ray Tester courtesy of Jindal

The system can inspect longitudinal, circumferential and spiral weld seam of the pipes with following ranges:

Pipe Diameter: 200 mm to 3000 mm

Pipe Length: 6 m to 16 m

Wall Thickness: max. 25 mm

CHAPTER -5 COATING

5.1 EXTERNAL COATING

fig.5.1 3LPP Coating courtesy of Jindal

Jindal has two high capacity anti-corrosion coating lines suitable for coating a full range of welded and seamless pipes from 16" up to 68" diameter and 18m length.

Our anti-corrosion coatings include single and dual layer fusion bonded epoxy (FBE), three layer polyethylene (3LPE) and three layer polypropylene (3LPP) systems.

Jindal offers pipes in compliance with all major international standards used for coating onshore and offshore pipelines.

Where necessary by additional client specification requirements addressing industry requirements

Jindal's external coating solutions will provide the optimum combination of resistance to chemical and physical changes arising from:

- Heat aging
- Ultra Violet radiation
- Corrosive soil
- Sweet water
- Salt water
- Micro-organisms
- Atmospheric corrosion
- Water vapour
- Cathodic disbondment

Mechanical and physical impact resistance is also vital and our coating solutions will provide high levels of protection against damage during

- Handling
- Transportation
- Stockpiling
- Installation
- Burial

Coated pipes supplied by Jindal ensure the pipeline will withstand prolonged exposure to harsh environmental conditions with as little maintenance as possible, ensuring a long and predicable lifespan

5.2 3LPP COATING

3-Layer Polypropylene (3LPP) is a multilayer coating composed of three functional components; a high performance Fusion Bonded Epoxy (FBE) primer, followed by a copolymer adhesive, and an outer layer of polypropylene which provides one of the toughest, most durable pipe coating solutions available. 3LPP systems provide excellent pipeline protection for small and large diameter pipelines at up to high operating temperatures.

HIGH TEMPERATURE CORROSION PROTECTION

The FBE component of the 3LPP system provides excellent adhesion to steel, providing superior long term corrosion resistance and protection of pipelines operating at high temperaturesThe superior adhesion properties of the FBE also results in excellent resistance to cathodic disbondment, reducing the total cost of cathodic protection during the life of the pipeline

ENGINEERED SOLUTIONS

Advanced manufacturing techniques allow the 3LPP system to be customized to your specific project can be applied in a wide range of thicknesses to cost effectively meet unique project specifications and performance requirements

EXCELLENT MECHANICAL PROTECTION

The tough outer layer of polypropylene protects pipelines during transportation and installation thereby reducing costly repairs and providing added in-ground protection against shear forces, chemicals and abrasive soil conditionsBy increasing the thickness of the polypropylene outer layer, 3LPP can provide the highest level of mechanical protection across many diverse environments without requiring the use of costly select backfill

5.3 PROCESSES OF 3LPP EXTERNAL COATING

External 3-Layer Polyethylene Coating is applied in shops in controlled conditions of proper surface preparations and careful coating application.

Surface Preparation:

For a long lasting and quality coating a proper and adequate surface preparation is compulsory. This is achieved with series of following operations:

•**Pipe surface cleaning**:

Solvent cleaning in case of any presence of oil or grease which are detrimental to any coating.

•**Pipe preheating**:

To remove moisture from pipe surface and also to carbonize any detrimental hydrocarbon contamination of bare pipes

•**Abrasive blast cleaning:**

fig.5.2 Abrasive Blaster courtesy of Jindal

A Normally 2 stage of abrasive blast cleaning is performed with 2 separate blasting machines. Each blasting machines is fitted with 2 high speed, high powered turbines which throws abrasive at very speed due to centrifugal force. The blasting machines are equipped with automated grit recycling systems and arrangement for removing fines from the system. A small quantity of frequent addition of fresh steel grit is fed to maintain uniform surface finish.

Salt and chlorides contamination of surface finish is verified to a level < 2 microgram /m2 by calibrated salt contamination meters. In case of higher contamination the pipes are cleaned further with phosphoric acid followed by RO water rinse before coating application.This produces a surface finish of SA2.5 with anchor pattern of 60-100 microns based on the size of steel grits /shots are selected. Steel grits prepare a sharp, angular anchor profiles strongly recommended for thick coatings for better adhesion with steel substrate.Coating application:

•Pipe heating:

Properly blast cleaned pipes are heated to 210-245°C as per the FBE powder manufacturer's recommendations with induction heater or gas ovens.

•FBE powder spray:

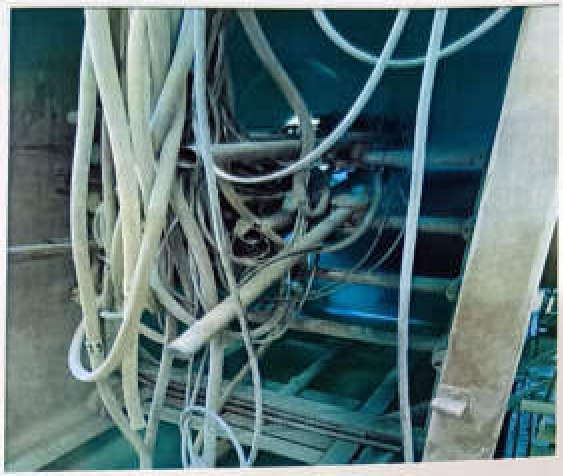

fig.5.3 FBE powder spray courtesy of Jindal

Fusion bonded epoxy powder is sprayed on heated pipe surface with multiple electrostatic Powder guns positioned suitably for maximize deposition on pipe surface. The unused powder is collected with vacuum system and is recycled after screening. The powder when deposited on hot pipe surface melts and covers rough surface of pipes for wetting and adhesion.

•Co-polymer adhesive:

fig.5.4 Co-Polymer Adhesive courtesy of Jindal

Powdered or extruded adhesive is applied on FBE layer within recommended Inter coat time or gel condition of FBE. The adhesive is manufactured in petrochemical plants by suitable grafting of PE/PP material.

•Top coat polyethylene/polypropylene:

fig.5.5 PP/PE Coating courtesy of Jindal

Extruded PE or PP layer is applied by side extrusion or lateral extrusion immediately after adhesive application. The coating film is pressed with a soft silicon pressure roller to remove any air entrapped. Multiple wraps (typically 3-6) are applied to achieve desired coating thickness. The melt temperature, coating application parameters are monitored and recorded.

•Quenching:

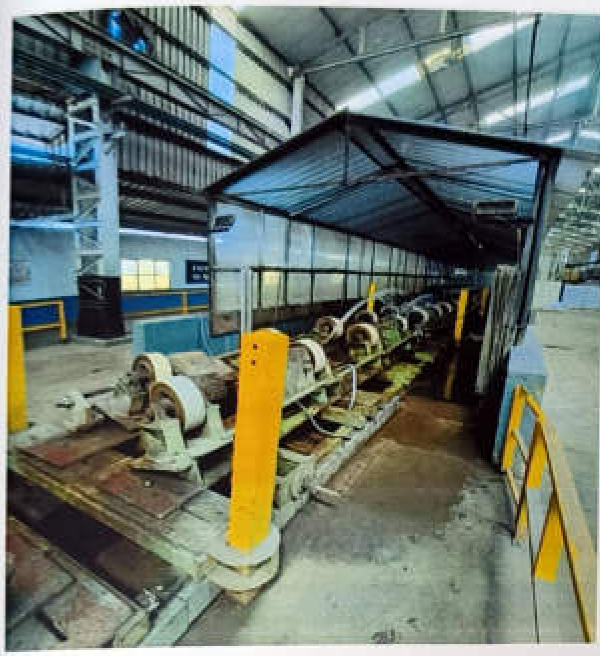


fig.5.6 Quenching Process courtesy of Jindal

The hot surface of freshly coated pipes is cooled with cold water to cool the molten surface suitable enough for handling of pipes.

•End cleaning or cutback preparation:

The coating from pipe ends for a length of 125-175 mm is removed by series of tooling or brushing operation. The cutback is provided considering the heat affected zone of girth welding in field. The coating of cutback area is restored by suitable field joint coating procedures after girth welding.

5.4 TESTS :

•FBE powder:

Gel Time, Moisture Content, Thermal Characteristics with Differential Scanning Calorimeter are checked for each of powder batch to establish the quality of powder similar to FBE powder manufacturers test properties. Any deviation beyond +/-20% level is considered as deterioration of powder in transit or storage condition and quarantined.

•Co-polymer adhesive:

Moisture Content, Vicat Softening Temperature and Melt Flow Rate are checked for each of incoming batch to establish the quality of adhesive similar to its Manufacturers test properties. Any deviation beyond +/-20% level is considered as deterioration of material and quarantined.

•PE/PP top coat:

Moisture Content, Softening Temperature, Melt Flow Rate and Oxidative Induction Time are checked for each of incoming batch to establish the quality of PE/PP similar to its manufacturers test properties. Any deviation beyond +/-20% level is considered as deterioration of material and quarantined.

Finished Coating Tests:

•Visual inspection:

fig.5.7 Visual Inspection courtesy of Jindal

The coating surface is checked for any visual defect such as blisters, air entrapments, and lumps etc. which are detrimental for performance of coating.

•Coating thickness:

The coating is checked with non destructive thickness testers. The coating thickness of primary and intermediate layers is established on first pipe of the shift for same set of application parameters.

Finished Coating Tests:

•Visual inspection:

fig.5.7 Visual Inspection courtesy of Jindal

The coating surface is checked for any visual defect such as blisters, air entrapments, and lumps etc. which are detrimental for performance of coating.

•Coating thickness:

The coating is checked with non destructive thickness testers. The coating thickness of primary and intermediate layers is established on first pipe of the shift for same set of application parameters.

•Holiday inspection:

fig.5.8 Holiday Inspection courtesy of Jindal

Each Pipe is checked at 25 kV as specified for detecting any discontinuity in coatings by suitable DC based Holiday detectors.

•Peel or bond strength test:

Selected sample pipes are checked for the bond strength by a peel tester. The coating is peeled at defined rate for 50-65 mm and the strength of coating is recorded.

•Impact test:

The coated pipe is tested for impact energy at 7 Joules/mm. The tested area is rechecked with Holiday tester for any cracks.

•Hardness test:

The Shore-D hardness is checked for coated pipes for ensuring values >55 Shore D.Performance Tests:

•Indentation test:

The coating sample is tested under a load of 2.5 kg with indenter of 1.8 mm diameter at 23 °C and at 65 °C to evaluate its indentation resistance against rocks, pebbles etc for site conditions.

•Elongation:

The coating sample is checked for 300-600% elongation of the gauge length for evaluating the flexibility properties.

•Coating cure test:

The FBE coating portion is checked for its cure properties in differential scanning calorimeter. Thorough curing of FBE above 95% is maintained to ensure performance of coating.

•Flexibility:

The coated steel sample is bent at 2.5-3° at sub zero temperatures to evaluate its flexibility. Any cracks or stain marks in coating constitutes a failure.

•Hot water adhesion test:

The FBE coated pipe sample is immersed in hot water at 95 °C for 24 h. The coating is then evaluated for its hot water adhesion properties. Any disbondment is constitutes a failure.

•Cathodic disbondment test:

An artificial hole is drilled through coating and the sample is tested in site simulated condition: -1.5V, DC, 23 or 65 °C temperature with 3% salt solution. The accelerated disbondment of coating is evaluated after 24 h, 48 h or 28 days.

5.5 INTERNAL COATING

fig.5.9 Internal Coating courtesy of Jindal

Internal coating is applied for anticorrosive properties or flow improvement properties of coatings for gas flow or for abrasion resistance in mineral ore slurry pipelines or for chemical resistance of transported fluid. A typical water pipe lines are coated with liquid epoxies or with powdered epoxies. Due to the nature of ease in application, low cost and better performance, the liquid epoxies are preferred. There are following advantages of the internal liquid epoxies over concrete mortar linings:

1. Thin coatings (0.4-1 mm) compared to CML (15-25 mm) i.e. better throughput flow of pipeline.

2. Lesser friction due to smooth nature (Coating Rz<5 microns) or C value >150.

3. Lesser commissioning time as no flushing is required to wash pipelines for cement particles

4. Higher flexibility, reduced weight, reduced chances of damages or cracks

5. Higher chemical, fungi, slime, bacterial resistance

6. Reduced cost of transportation

7. No leaching out of coating material resulting unchanged water properties

8. Food grade epoxies are certified from NSF or WRAS organizations for drinking water

Internal Liquid Epoxy Coating Process :

It is applied in shops in controlled conditions of proper surface preparations and careful coating application.

Surface Preparation:

For a long lasting and quality coating a proper and adequate surface preparation is compulsory. This is achieved with series of following operations:

•Pipe surface cleaning:

Solvent cleaning in case of any presence of oil or grease which are detrimental to any coating.

•Pipe preheating:

To remove moisture from pipe surface and also to carbonize any detrimental hydrocarbon contamination of bare pipes.

•Abrasive blast cleaning:

Normally 2 stages of abrasive blast cleaning are performed with 2 separate blasting machines. Each blasting machines is fitted with two high speed, high powered turbines which throws abrasivfe at very speed due to centrifugal force.

This produces a surface finish of SA2.5 with anchor pattern of 60-100 microns based on the size of steel grits /shots are selected. Steel grits prepare a sharp, angular anchor profiles strongly recommended for thick coatings above thick coatings for better adhesion with steel substrate.

Coating application:

•The ends of pipes after through blast cleaning is masked for preparing the cutback.

•The two components (Resin and Hardener) of the liquid epoxies are mixed as per the paint manufacture's recommendation either by manual mixing or by Plural feed system. The two components after initial mixing are again passed through static mixer for thorough mixing. Finally the liquid epoxy is sprayed by flat angular nozzle using air less paint systems.

•The liquid epoxies are applied to specify thickness as per recommended procedures and are allowed to natural curing of amine components.Finished

5.6 STENCILING MACHINE

fig.5.10 Stenciling Robot courtesy of Jindal

In Jindal for stenciling and marking robotics of Kawasaki are used and the data gets printed by cartridge of ink at the end effector the format of stenciling is followed as per API standards mentioned.

CHAPTER -6 INSPECTION, TESTING AND QUALITY CONTROL

6.1 CHARPY V NOTCH TEST

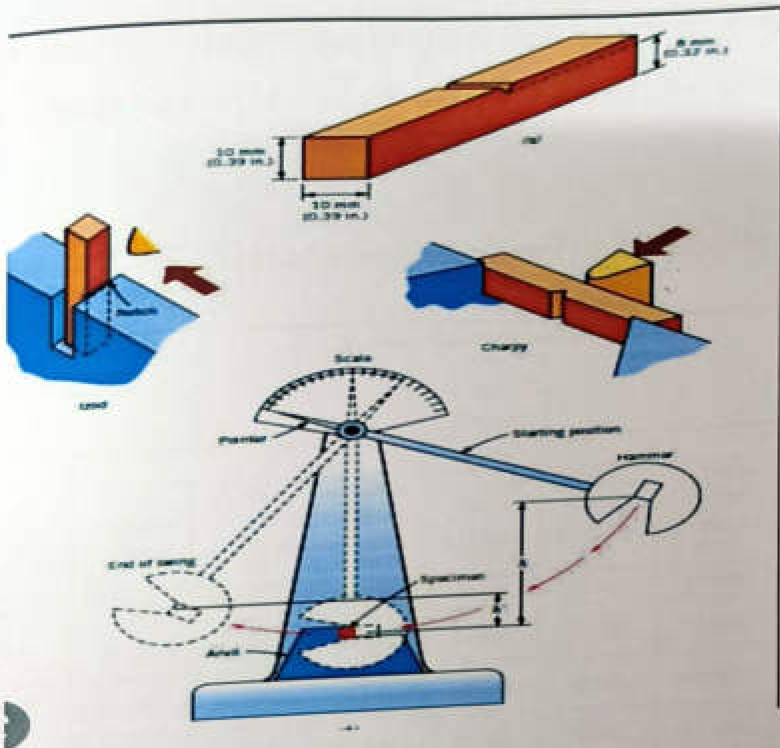

fig.6.1 CVN Test courtesy of ResearchGate

The Charpy impact test, also known as the Charpy V-notch test, is a high strain-rate test that involves striking a standard notched specimen with a controlled weight pendulum swung from a set height. The impact test helps measure the amount of energy absorbed by the specimen during fracture.

The standard Charpy-V notch specimen is 55mm long, 10mm square and has a 2mm deep notch with a tip radius of 0.25mm machined on one face.

If subsize test pieces are used, the required minimum average (of a set of three test pieces) absorbed energy values shall be the required values for full-size test pieces times the ratio of the specified width of the subsize test piece to the specified width of the full-size test piece, with such derived values rounded to the nearest joule (foot-pound force).

Individual test values for any test piece shall be ≥ 75 % of the required minimum average (of a set of three test pieces) absorbed energy values.

Table 1 -CVN Absorbed Energy Requirements for Pipe Body

Specified Outside Diameter D mm (in.)	Full-size CVN Absorbed Energy min K_V J (ft-lbf)						
	Grade						
	≤ L415 or X60	> L415 or X60 to ≤ L450 or X65	> L450 or X65 to ≤ L485 or X70	> L485 or X70 to ≤ L555 or X80	> L555 or X80 to ≤ L625 or X90	> L625 or X90 to ≤ L690 or X100	> L690 or X100 to ≤ L830 or X120
≤ 508 (20.000)	27 (20)	27 (20)	27 (20)	40 (30)	40 (30)	40 (30)	40 (30)
> 508 (20.000) to 762 (30.000)	27 (20)	27 (20)	27 (20)	40 (30)	40 (30)	40 (30)	40 (30)
> 762 (30.000) to 914 (36.000)	40 (30)	40 (30)	40 (30)	40 (30)	40 (30)	54 (40)	54 (40)
> 914 (36.000) to 1219 (48.000)	40 (30)	40 (30)	40 (30)	40 (30)	40 (30)	54 (40)	68 (50)
> 1219 (48.000) to 1422 (56.000)	40 (30)	54 (40)	54 (40)	54 (40)	54 (40)	68 (50)	81 (60)
> 1422 (56.000) to 2134 (84.000)	40 (30)	54 (40)	68 (50)	68 (50)	81 (60)	95 (70)	108 (80)

6.2 DROP WEIGHT TEAR TEST

fig.6.2 DWT test courtesy of Jindal

DWTT measures both the crack initiation and crack propagation characteristics of metallic materials at operating temperatures. By evaluating materials over a range of anticipated thermal conditions, we can help determine how working conditions will affect the strength, longevity and durability of a material.

Depending on the method used and the goal of testing, DWTT samples can be notched or unnotched samples. The specimen is dropped from a predetermined height, and the mode and extent of fracture is determined. Experts use this data to make determinations about the transition temperature of materials, helping understand how brittleness and ductility will affect your materials over time.

For each test (of a set of two test pieces), the average shear fracture area shall be ≥ 85 %, based on a test temperature of 0 °C (32 °F) or, if agreed, a lower test temperature. For wall thickness > 25.4 mm(1.000 in.), DWT test acceptance requirements shall be by agreement.

NOTE 1 Such shear-fracture area ensures a sufficiently ductile fracture at or above the test temperature.

NOTE 2 A sufficient combination of shear-fracture area and CVN absorbed energy is an essential pipe-body property to ensure the avoidance of brittle fracture propagation and the control of ductile fracture propagation in gas

pipelines

6.3 HYDROTEST

fig.6.3 Hydrotester courtesy of Jindal

A hydrostatic test is a way in which pressure vessels such as pipelines, plumbing, gas cylinders, boilers and fuel tanks can be tested for strength and leaks. The test involves filling the vessel or pipe system with a liquid, usually water, which may be dyed to aid in visual leak detection, and pressurization of the vessel to the specified test pressure. Pressure tightness can be tested by shutting off the supply valve and observing whether there is a pressure loss. The location of a leak can be visually identified more easily if the water contains a colorant. Strength is usually tested by measuring permanent deformation of the container.

Hydrostatic testing is the most common method employed for testing pipes and pressure vessels. Using this test helps maintain safety standards and durability of a vessel over time. Newly manufactured pieces are initially qualified using the hydrostatic test. They are then revalidated at regular intervals according to the relevant standard.

Each pipe is hydraulically tested before pipe is coated. The hydraulic test pressure is applied for 5 sec. The hydraulic test pressure is the pressure calculated as per the following formula:

P= 2ST/D

Where,

P = hydraulic test pressure MPa,

D = specified OD of the pipe in mm,

T = specified thickness of the tube in mm, and

S = stress 60% of the specified minimum yield stress in MPa.

The maximum test pressure to be limited to 5 MPa wherever applicable.

6.4 X RAY TEST

fig.6.4 X Ray Tester courtesy of Jindal

The X-ray radiographic examinations system features a small focus, high-performance X-ray tube and digital radiographic technique(computed radiography) to produce highly sensitive radiographs. X-ray Images is easily to judge through the monitor in all cases. The result of judgment of each radiographic is fed into the system from an input terminal for computer-aided total judgment of the quality of each pipe.

Ionizing radiation to inspect materials and components with the objective of locating and quantifying defects and degradation in material

Table 2 - X Ray Imperfection limits for PSL 2 Pipes

Size mm (in.)	Adjacent Size mm (in.)	Separation min mm (in.)	Number of Imperfections in Any 150 mm (6.0 in.) Length of Weld max	Accumulated Diameters of Imperfections in Any 150 mm (6.0 in.) Length of Weld max mm (in.)
3.2 (0.125) [a]	3.2 (0.125) [a]	50 (2.0)	2	6.4 (0.25)
3.2 (0.125) [a]	1.6 (0.063)	25 (1.0)	Varies	6.4 (0.25)
3.2 (0.125) [a]	0.8 (0.031)	13 (0.5)	Varies	6.4 (0.25)
3.2 (0.125) [a]	0.4 (0.016)	9.5 (0.4)	Varies	6.4 (0.25)
1.6 (0.063)	1.6 (0.063)	13 (0.5)	4	6.4 (0.25)
1.6 (0.063)	0.8 (0.031)	9.5 (0.4)	Varies	6.4 (0.25)
1.6 (0.063)	0.4 (0.016)	6.4 (0.25)	Varies	6.4 (0.25)
0.8 (0.031)	0.8 (0.031)	6.4 (0.25) [b]	8	6.4 (0.25)
0.8 (0.031)	0.4 (0.016)	4.8 (0.188)	Varies	6.4 (0.25)
0.4 (0.016)	0.4 (0.016)	3.2 (0.125)	16	6.4 (0.25)

[a] 2.4 mm (0.094 in.) for pipe with $t \leq 6.4$ mm (0.250 in.)

[b] Two imperfections ≤ 0.8 mm (0.031 in.) in diameter may be as close as one diameter apart, provided that they are separated from other imperfections by at least 13 mm (0.5 in.).

6.5 ULTRASONIC TEST

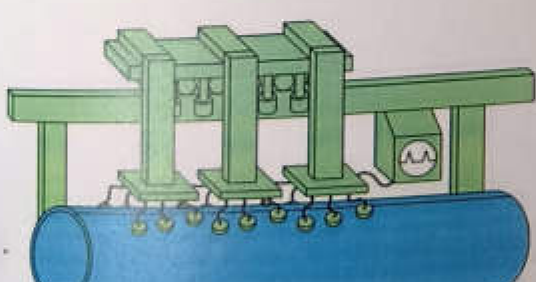

fig.6.5 Ultrasonic Tester courtesy of Nippon Steel

Longitudinally or helically SAW welded pipes are still the major component for pipeline constructions around the world. Within the manufacturing process, the pipes have to be ultrasonically tested according to industry accepted standards. As a result, ultrasonic testing of the weld seam is well-established in production of both types of pipes.The ultrasonic test is performed after welding and/or after the hydrotester. expander. While the test after welding is usually for internal process control, the inspection after the hydrotester/expander is normally the final verification of quality before the pipe is finished and approved for shipment to the customer. SAW pipes are inspected to detect three main flaw types that can occur during manufacturing: Longitudinal defects along the weld axis, transverse defects perpendicular to the weld axis; and laminations.

Table 3 - Ultrasonic Test Calibration and Defects

Item	Reference Indicators [a]							
	Notch Location		Notch Orientation		Notch Dimensions			Diameter of Radially Drilled Hole [b]
	OD	ID	Longitudinal	Transverse	Depth [c] %	Length [d] max mm (in.)	Width max mm (in.)	mm (in.)
EW seam	e,l	e,l	e,l	f	10.0	50 (2.0)	1.0 (0.040)	3.2 (0.125) [l]
LW seam	e	e	e	f	5.0 [g]	50 (2.0)	1.0 (0.040)	1.6 (0.063) [g]
SAW seam [h]	e	e	e	i	5.0 [g]	50 (2.0)	1.0 (0.040)	1.6 (0.063) [g]
COW seam [h]	e	e	e	i	5.0 [g]	50 (2.0)	1.0 (0.040)	1.6 (0.063) [g]
Coil/plate end seam [h]	e	e	e	i	5.0 [g]	50 (2.0)	1.0 (0.040)	1.6 (0.063) [g]
Jointer seam [h]	e	e	e	i	5.0 [g]	50 (2.0)	1.0 (0.040)	1.6 (0.063) [g]
PSL 2 SMLS pipe	e	e	j	f	12.5	50 (2.0)	1.0 (0.040)	3.2 (0.125)
PSL 1 SMLS pipe, quenched and tempered	k	k	j	f	12.5	50 (2.0)	1.0 (0.040)	3.2 (0.125)
PSL 1 SMLS pipe, other	k	f	j	f	12.5	50 (2.0)	1.0 (0.040)	3.2 (0.125)

NOTE 1 Notches are rectangular or U-shaped.

NOTE 2 For electromagnetic inspection, it might be necessary for the reference standard to contain OD notches, ID notches, and a radially drilled hole (see E.5.3.4).

[a] It is not necessary to locate reference indicators in the weld.

[b] Drilled hole diameters are based on standard drill-bit sizes. A hole is not required if a notch is used to establish the reject threshold.

[c] Depth is expressed as a percentage of the specified wall thickness. It is not necessary that the depth be less than 0.3 mm (0.012 in.). The depth tolerance is ± 15 % of the specified notch depth or ± 0.05 mm (0.002 in.), whichever is the greater.

[d] Length at full depth.

[e] Required if a notch is used to establish reject threshold.

[f] Not required.

[g] At the option of the manufacturer, N10 notches or 3.2 mm (0.125 in.) holes may be used (see Table E.8 for applicable acceptance limits).

[h] At the option of the manufacturer, for SAW and COW seams, the reject threshold may be established using weld-edge notches or weld-edge radially drilled holes.

[i] Either a transverse notch or a 1.6 mm (0.063 in.) radially drilled hole is required.

[j] At the option of the manufacturer, the notches may be oriented at an angle that would facilitate the detection of anticipated defects.

[k] Required for pipe with $D \geq 60.3$ mm (2.375 in.) if a notch is used to establish the reject threshold.

[l] If agreed, the reference standard shall contain OD and ID notches and a radially drilled hole.

6.6 GUIDED BEND TEST

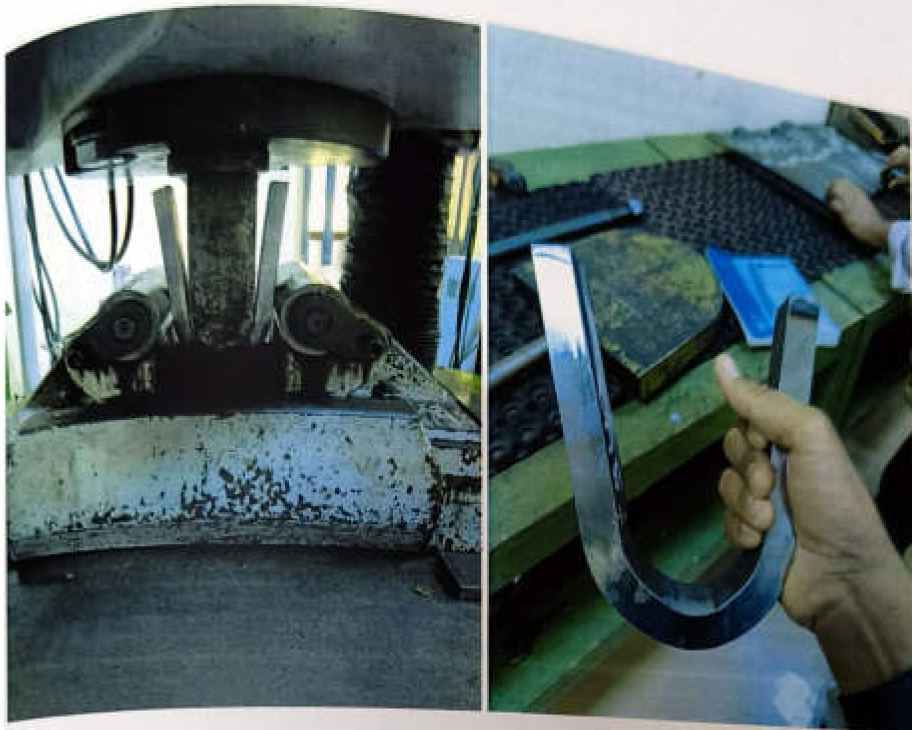

fig.6.6 Guided Roll Bend Test courtesy of Jindal

For guided bend 40 mm strip is cut to weld seam with the weld near the middle of the sample, without fracture, be doubled over a round bar the diameter of which is calculated as given below. The weld reinforcement is removed from the faces. One face bends and one root bend specimen is bent approximately 180° in a jig substantially. Frequency of guided bend test is same as flattening test frequency.

Team ID 311302.

6.7 INSPECTION FREQUENCY

Table 4 - Inspection Frequency

No.	Type of Inspection	Type of Pipe	Frequency of Inspection [e]
1	Heat analysis	All pipe	One analysis per heat of steel
2	Product analysis	SMLS, HFW, SAW, or COW	Two analyses per heat of steel (taken from separate product items)
3	Tensile testing of the pipe body $D \le 141.3$ mm (5.563 in.)	SMLS, HFW, SAW, or COW	Once per test unit of not more than 400 pipes with the same cold-expansion ratio [a]
4	Tensile testing of the pipe body $D > 141.3$ mm (5.563 in.) and ≤ 323.9 mm (12.750 in.)	SMLS, HFW, SAW, or COW	Once per test unit of not more than 200 pipes with the same cold-expansion ratio [a]
5	Tensile testing of the pipe body $D > 323.9$ mm (12.750 in.)	SMLS, HFW, SAW, or COW	Once per test unit of not more than 100 pipes with the same cold-expansion ratio [a]
6	Tensile testing of the longitudinal or helical seam weld of welded pipe with $D \ge 219.1$ mm (8.625 in.) and ≤ 323.9 mm (12.750 in.)	HFW, SAW, or COW	Once per test unit of not more than 200 pipes with the same cold-expansion ratio [a,b,c]
7	Tensile testing of the longitudinal or helical seam weld of welded pipe with $D > 323.9$ mm (12.750 in.)	HFW, SAW, or COW	Once per test unit of not more than 100 pipes with the same cold-expansion ratio [a,b,c]
8	Tensile testing of the coil/plate end weld of welded pipe with $D \ge 219.1$ mm (8.625 in.)	SAWH or COWH	At least once per 50 coil/plate end welds from pipe with the same cold-expansion ratio [a,b,d]
9	CVN impact testing of the pipe body of pipe with specified outside diameter and specified wall thickness as given in Table 22	SMLS, HFW, SAW, or COW	Once per test unit of pipe with the same cold-expansion ratio [a]
10	If agreed, CVN impact testing of the longitudinal seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	HFW	Once per test unit of pipe with the same cold-expansion ratio [a,b]
11	CVN impact testing of the longitudinal or helical seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAW or COW	Once per test unit of pipe with the same cold-expansion ratio [a,b,c]
12	CVN impact testing of the coil/plate end weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAWH or COWH	At least once per 50 coil/plate end welds from pipe with the same cold-expansion ratio [a,b,d]
13	If agreed, DWT testing of the pipe body of welded pipe with $D \ge$ 508 mm (20.000 in.)	HFW, SAW, or COW	Once per test unit of pipe with the same cold-expansion ratio [a]
14	Guided-bend testing of the longitudinal or helical seam weld of welded pipe	SAW or COW	Once per test unit of not more than 50 lengths of pipe with the same cold-expansion ratio [a]
15	Guided-bend testing of the coil/plate end weld of welded pipe	SAWH or COWH	At least once per 50 coil/plate end welds from pipe with the same cold-expansion ratio [a,b,d]
16	Flattening test of welded pipe	HFW	As shown in Figure 6
17	Hardness testing of hard spots in cold-formed welded pipe	HFW, SAW, or COW	Any hard spot exceeding 50 mm (2.0 in.) in any direction
18	Hydrostatic testing	SMLS, HFW, SAW, or COW	Each pipe
19	Macrographic testing of the longitudinal or helical seam weld of welded pipe	SAW or COW	At least once per operating shift plus whenever any change of pipe size occurs during the operating shift; or, if 10.2.5.3 or 10.2.5.4 applies, at the beginning of the production of each combination of specified outside diameter and specified wall thickness
20	Metallographic testing (or optional hardness test in lieu of metallography) of the longitudinal seam weld of welded pipe	HFW excluding full-body normalized pipe	At least once per operating shift plus whenever changes of grade, specified outside diameter or specified wall thickness are made; plus whenever excursions from operating heat treatment conditions are encountered
21	Visual inspection	SMLS, HFW, SAW, or COW	Each pipe, except as allowed by 10.2.7.2
22	Pipe diameter and out-of-roundness	SMLS, HFW, SAW, or COW	At least once per 4 h per operating shift plus whenever any change of pipe size occurs during the operating shift
23	Wall thickness measurement	All pipe	Each pipe (see 10.2.8.5)
24	Other dimensional testing	SMLS, HFW, SAW, or COW	Random testing, with the details left to the discretion of the manufacturer
25	Weighing of pipe with $D <$ 141.3 mm (5.563 in.)	SMLS, HFW, SAW, or COW	Each pipe or each convenient group of pipe, with the choice being at the discretion of the manufacturer
26	Weighing of pipe with $D \ge$ 141.3 mm (5.563 in.)	SMLS, HFW, SAW, or COW	Each pipe
27	Length	SMLS, HFW, SAW, or COW	Each length of pipe shall be measured, except that pipe made in lengths that are uniform within 30 mm (0.1 ft) need not be individually measured, provided the accuracy of the length is verified at least once per 4 h per operating shift
28	Nondestructive inspection	SMLS, HFW, SAW, or COW	In accordance with Annex E

[a] The cold-expansion ratio (if applicable) is designated by the manufacturer and is derived using the designated before-expansion outside diameter or circumference and the after-expansion outside diameter or circumference; an increase or decrease in the cold-expansion ratio of more than 0.002 requires the creation of a new test unit.

[b] Pipe produced by each welding machine shall be tested at least once per week.

[c] For double-seam pipe, both longitudinal weld seams in the pipe selected to represent the test unit shall be tested.

[d] Applies only to finished helical seam pipe containing coil/plate end welds.

[e] "Test unit" is as defined in 3.1.60.

CHAPTER - 7 STANDARDS CERTIFICATIONS

Mills in India have the following Certification:

API 5L

ISO 9001

ISO 14001

OHSAS 18001

ISO/TS 29001

IS 3589

IS 5504

Low Temperature Applications

Material Testing Labs are accredited by:

NABL as per ISO/IEC 17025

Mills in USA have the following Certification:

API 5L

API Q1

ISO 9001

The testing laboratories are accredited by National Accreditation Board for testing & Calibration Laboratories (NABL).

Team ID 3...

WEEK-1

GUJARAT TECHNOLOGICAL UNIVERSITY
(Established under Gujarat Act No. 20 of 2007)
ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I
Enrollment no: 200090119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dubhi Jenish Piyushbhai
DIARY OF THE WEEK: DT: 31/01/2023 TO 05/02/2023
DEPARTMENT: Mechanical maintenance SEM: 8th.
NAME OF THE ORGANISATION: Jindal SAW ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical Maintence.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> This week I have gathered knowledge about Jindal group of companies which include.
- -> Jindal SAW Ltd.
- -> JSW.
- -> JSL
- -> Jindal Steel & Power.
- -> Jindal Panther TMT Robars.

-> Also knowledge about necessity of saftey and importance of following SOPs for safe operations in plant and reduce risk of operations accidents

-> As Jindal SAW management insist on saftey measures so we dedicated the time for observing necessary in plant. and learning saftey habits

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TOTAL HOURS: 48hr

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 31 - 1 - 23

Date: 5 - 2 - 23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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week 2

Annexure 17
Enrollment no: 200790119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Bubhi Jainish Piyushbhai

DIARY OF THE WEEK: Dt: 06/08/2023 TO 12/08/2023

DEPARTMENT: Mechanical maintance SEM: 8th

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week we have gathered information about Jindal SAW Nana Kapaya Unit with knowledge of responsibilites of following departments includes in achiving organizational goals.

- Human resource department
- Project & Devlopment department.
- Human saftey Equipment department.
- Production department.
- maintance department.
- quality department
- Design department.
- Stores & inventory department.

-> Also get information of Products being manufactured and overview Principle of Process.

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TOTAL HOURS: 48hr

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 6-02-23

Date: 12-02-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week - 3

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Annexure 1-1

Enrollment no: 200490119509

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jenish Piyushbhai

DIARY OF THE WEEK: Dt: 13 /02/2023 TO 19 /02/2023

DEPARTMENT: Mechanical maintenance SEM: 8th.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintenance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> Visited the Plant JCO-1 for concerning study the process now they are going on for manufacturing SAW Pipes and we have seen following operations.

- -> Raw matrial inspection.
- -> sheet trimming.
- -> Edge Preperation.
- -> Forming
- -> SAW welding -> washing section.
- -> Expanding -> RTR.
- -> washing
- -> Ultrasonic test (MPI)
- -> Beveling & facing [end facing].
- -> Hydro testing.
- -> X - Ray test
- -> Fut. final ultrasonic test
- -> storing & clampping.

-> know the full Process of the sheet to Pipe manufaturing Process.

-> learn about the how sheet is checked & how they give the uniqe identification to recognize the Pipe.

-> just for example one Pipe identifiction no is

-> [L12C04594]

-> Also get information about Roles of mechanical maintance department and maintance activites and its Planning and scheduling.

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TOTAL HOURS: - - 45 hr - - - - -

Jagnish
SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 13-02-23

Date: 14-02-23

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-4

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Annexure I - 4

Enrollment no: 200390119503.

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dubhi Jenish Piyushbhai

DIARY OF THE WEEK: DT: 20/02/2023 TO 26/02/2023

DEPARTMENT: Mechanical Maintenance SEM: 6th.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical Maintenance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> Studied Design department which derives solution related to design of product, layouts, floor space management, machine tools & equipment designs, components or tools which needs modification for R&D, also they design layout sites as per requirement for project.

-> As they use:

-> AutoCAD for 2D drafting of components and civil infrastructure design.

-> Solid works for 3D modeling of components which are more used for parts & tool design.

-> I also learned about standardizations of products

-> Also observed & learned inter connection coordination and dependency of mechanical maintenance department on design dept. due to need of design for assembling, dismantling, modifying & repairing the machine tool or parts to be manufactured.

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TOTAL HOURS: 44hrs

SIGNATURE OF STUDENT

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Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 20-02-23

Date: 26-02-23

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week 5

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Annexure F - 5
Enrollment no: 200390119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jenish Piyushbhai

DIARY OF THE WEEK: DE: 27/02/2023 TO 05/03/2023.

DEPARTMENT: Mechanical Maintenance. SEM: 8th

NAME OF THE ORGANISATION: Jindal SAW Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintenance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In thish ~~[illegible]~~ week the very fruitful for me becuse of thish week I saw so mamny breck down in plant.

-> First I saw the cheap conver removel and how to fix it. thish breck down is accure in milling machine. In thish the conver belt is brake up and the worker change it.

-> I saw the P-cotting pressure roller for the cotting depatment. It is manufactured for the press the cotting perfectly. In thish they use the box of 200x300mm, bearing block, cylinder of: 300mm dia capacity of cylinder = 500 kg which are 2 cylinder and it's numatric air cylinder.

-> I saw the trolly break down. In thish the end facing trolly main cylinder bolt is brokeup so i saw that how in a very small space to manage everything and work very effectivly and with accuracy.

-> I saw that. saftey depertment now they test the pipe their processes. they cut the pipe after 500 or 100 pipe and take the small section of it and test it all parameters main focus of quality depertment is on the welding. They use latest machinery for it.

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TOTAL HOURS: 48hr

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 27-2-23

Date: 5-03-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week- 6

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Annexure I - 5
Enrollment no: 200990119509

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Tanish Piyushbhai.

DIARY OF THE WEEK: Dt: 04/03/2023 TO 12/03/2023

DEPARTMENT: Mechanical maintance. SEM: 8th.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: mechanical maintance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week in jindal SAW ltd, the HSE department arrange the saftey week. In this week we learn so many things regarding the saftey.
-> The HSE (Saftey Department) arrange different different activities.
-> The activities are as follows!.
-> saftey flag hoisting by Respected unit head.
-> safety pray
-> saftey speech by HOD'S
-> saftey march - (Rally) inside the Plant.
-> saftey speech competition
-> general saftey Awarness training.
-> General saftey Awarness training.
-> Blood Donation camp.
-> saftey quiz competition.
-> Skit competition on saftey
-> Prizes / Award Declaration & Distribution
-> so as per that I saw so mummy thing and I learn a lot of things in a this week regarding saftey. It is the "celebration of 52nd national saftey week"

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TOTAL HOURS: 4 months

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 4-03-23

Date: 12-03-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-1

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Annexure I

Enrollment no: 200390119509

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Jenish P Rabhi

DIARY OF THE WEEK: Dt: 13-3-23 TO 19-3-23

DEPARTMENT: mechanical maintenance SEM: 8th

NAME OF THE ORGANISATION: Jindal Saw Ltd

NAME OF THE PLANT/SECTION/DEPARTMENT: Nana Kapaya Plant

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: mr. Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week I have studied maintenance with much more detail and also valued machines designes, construction and their working principle.

-> In this weeks, saftey officers meet us and detailed give brief instruction, about types of helmates, various masks, types of glasses, flamable cylinders saftey, various spicel equipments for saftey, for saftey accomdas, uses of fire extinguisher.

-> learned mesh modelling & surface modelling involved to create various complex object, which are also hard to imagine. I have designe various part.

-> I saw a maintenance of edge prefamation machine. edge milling machine maintance.

-> we show the which type of tool is use and how they used it. and show working principle.

-> Conveyor has a v-groove pully for transfor of pipe, sumed bearings is used a motor a gearbox is comm for movement, motor is use in it 2.5 H.P. single phase.

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TOTAL HOURS: 48 hours

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 13-3-23

Date: 14-3-23

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week 4

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Annexure I
Enrollment no: 200390119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jenish. P.

DIARY OF THE WEEK: Dt: 20-3-23 TO 26-3-23.

DEPARTMENT: Mechanical maintance. SEM: 8th.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Ashutosh Dubey.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ The Plant IIO-I has capacity maximum of appox 900 amcotted Pipes in a day. Also It Produces approx 170 Pipes Per day as general Production. So it needs much more attention to quality control. They use Ultrasonic test method, x-ray test, and most Popular hydrotesting method for testing of Pipes.
→ so I have studied and Performed maintance of hydrotestin. It was a Preventive maintance Performed during Plant shutdown. for solvation of Pipe lifter cylinder leakage and vibrating Pully for rolling of Pipe. It also had fault that the water Pressure inside the Pipe was not staying stable. It was working on the Principle of hoop strees of a cylinder, a compresssure fills, entire Pipe with water and Pressurizes it. I got complete knowledge of how to maintane it and how safely done the Process. I saw so many things that learn me soo much. I saw that as a supervisiour how to handle task & how to manage labor, helper. fitter.

Team ID 311302.

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TOTAL HOURS: [illegible]

SIGNATURE OF STUDENT

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Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 20-3-23

Date: 26-3-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week - 9

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Annexure I

Enrollment no: 200390119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jenish P.

DIARY OF THE WEEK: Dt: 27-3-23 TO 2-4-23

DEPARTMENT: Mechanical maintenance SEM: 8th sem.

NAME OF THE ORGANISATION: Jindal SAW Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintenance.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Ashutosh Dubey.

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In any production unit the internal material transition and handling should be carried as less as possible so it needs to study plant layout and necessary study all process involved for production. I studied it and formed product flow inside plant.

-> The sequence of process are as follows:-

(1) Plate yard (2) Plate ultrasonic testing (PUT) (3) EOT crane shifting to Edge milling (4) Edge milling (5) C-Press (6) JCO-Press (7) Auto mig welding [8] Tab-welding [9] ID welding [10] OD welding [11] Visual inspection [12] flux removal system (trolly). [13] Wash station #1 [14] Real time radiography (RTR) [15] ST-Press [16] Expander [17] Wash station #2 [18] ovality press [19] Hydrotester [20] End facer [21] material pulling inspection. [22] FUT [23] X-Ray. [24] Visual station [25] final Inspection [26] yard.

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SUPPLEMENTRY NOTES
(add additional sheets if required)

-> for performing above process plant also meets other resorces for it like. water for washing, hydrotesting cooling and various oils for operating process, pipes shaft levers, lubrication etc... are being stored in underground tanks or onfloor vessels.

-> Also replaced wire brush, milling tools bits and tool bits for end facer, The end facer was of maximum capacity of 48" dia pipe.

-> Also maintained other unmanaged end facer of capacity 62" dia pipe which had fault of instability vibrating spindle of it.

-> Replaces die of c-press with a maintained die to get a perfect shape of ends without any misallignment.

-> Also maintained other misalliness tasks and learned very small fault most, important information

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TOTAL HOURS: ----------

Jemish
SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 27-3-23

Date: 2-4-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Team ID 311302.

week-10

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Annexure 1

Enrollment no: 200390119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jenish P.

DIARY OF THE WEEK: DT: 3-4-23 TO 9-4-23

DEPARTMENT: mechanical maintenance SEM: 8th sem.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: mechanical maintenance

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: mr. Ashutosh Dubey.

DESCRIPTION OF THE WORK DONE IN BRIEF

-> I have observed that after the internal and external welding process pipe gets observable distortion in circumference of pipe and shrinkage of pipe dimensions and also gets high amount of residual stress due to forming & heat generated in welding so it needs such correction.

-> for solution of this problem expander plays a very important role, it has major components as a dual working actuator connected with a tapered slide guide consisting block has dies mounted on it and it works as it helps pulls the tapered guide them the slide block and dies will expand and it will force the pipe outside and expands it to counter the shrinkage.

-> I have studied the maintenance work of it needed for avoiding breakdown. It had fault of leakage of oil from actuator and solved it very soon and very quick.

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SUPPLEMENTRY NOTES
(add additional sheets if required)

-> To increase the lifespan of pipe and reduce risk of bad effect of environment like corrosion, pipe needs an additional layer of coating and so we have studied the external coating process now coating pipe with Epoxy & Polypropylene.
-> It include following process which I have studied
-> Bare pipe loading -> Preheating-1 -> Abrasive Blasting 1 -> Surface Inspection -> Preheating-2 -> Abrasive Blasting-2 -> surface inspection -> induction heating before -> Blasted surface pre treatment -> chromate application & chemical -> induction heating before Epoxy -> Acid wash -> Epoxy booth -> Adhesive application & PP/PE application. -> Quenching zone -> Thickness, visual test station -> Brushing machine. -> final inspection zone. -> stenciling & dispatch.
-> Also I have studied & focused on miscellaneous equipments maintenances required time to time.

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TOTAL HOURS: 42 hours

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Shaikh
Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 9-4-23

Date: 9-4-23

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

week-11

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Annexure I

Enrollment no: 200990119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dubhi Jenish P.

DIARY OF THE WEEK: Dt: 10-4-23 TO 16-4-23

DEPARTMENT: Mechanical maintenance SEM: 8th sem.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintenance

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr Aushotosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> We all know that the good quality product is a most important factor to any bussiness a customer relationship. So it needs to inspect the product being manufactured. In Jindal SAW ISO-1, API-5L PSL-2 specification is being follow ed and it needs some information for inspecting a determining pipe quality as follows:-

1) Delivery conditions
2) chemical composition a cauiplent
3) Tensile test a Test specimen information
4) CVN impact test result.
5) DWT test result.
6) Hydrotesting pressure a time duration.
7) NDT (x-ray, ultrasonic test, electromagnetic) testing of
8) other tests specited.
9) Acceptance criteria for above tests. maintaining quality.

-> Also it needs to know the frequency of various test for

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TOTAL HOURS: - - [illegible] - - - - -

- - - [illegible] - - - - -
SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 16 - 4 - 23

Date: 22 - 4 - 23

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I

Enrollment no: 200340119503

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Dabhi Jemish P.

DIARY OF THE WEEK: Dt: 17-4-23 TO 23-4-23

DEPARTMENT: Mechanical maintenance SEM: 8th sem.

NAME OF THE ORGANISATION: Jindal SAW ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Mechanical maintenance

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: MR Ashutosh Dubey

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In thish week I have notices that all the components and their issuing records & maintain store inventory needs much more accuracy to achieve that accuracy Jindal uses SAP ERP system program for it and specially pm module for maintenance department and pm status for plant maintenance.

-> It also plans material requirement and labor requirement thish module also communicate with other module like. Production planning material management & sales & distribution module.

-> It includes process as follow! -

-> notification -> maintenance order -> pr for parts -> po (part order) -> goods services -> goods issue -> planned approach order -> schedual & relase order -> Execute order -> close the order.

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SUPPLEMENTRY NOTES
(add additional sheets if required)

-> Also the Project of shifting VOE Process to other site, and also they were executing sheets and moving in plate thinner plate ultrasonic to the ICO-I unit before June month to protect plates from moisture due to rain and it will prevent corrosion of mic parts and plates.
-> studied about usage of coating & now various types of coatings are unique each other.
-> I also know that Jindal also makes machinery which are not practically importable they does receive engineering of any machine tool and they make it as per required specification. These type of tools are made by joint operation of project & development design department, mechanical maintenance, civil department and other departments as per need. A senior engineer explained me the development process of ICO press of 10,000 ton.

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TOTAL HOURS: - - 42 hours - - -

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 17-4-23

Date: 23-4-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Team ID 311302.

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Annexure 2

Feedback Form by Industry expert

Student Name: Dabhi Jenish

Date: 29th April, 2023

Work Supervisor: Hema Chaturvedi

Title:

Company/Organization: Jindal saw limited, Nanakapaya, Mundra-Kutch

Enrollment No: 200390119503

Internship Address: Nana kapaya, Mundra - 370421

Dates of Internship: From 31st January 2023 to 29th April, 2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility				✓
Uses technical knowledge and expertise				✓
Analyzes problems effectively			✓	
Communicates well and writes effectively			✓	

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent):

Jenish is Technically sound and he has keen interest in machines.

Additional comments, if any:

Signature of Industry person with name and Stamp:

Hema Chaturvedi

Signature of the Faculty Mentor

Shaikh

JINDAL SAW LIMITED MUNDRA

CHAPTER - 8 REFERENCES

- https://www.permanentsteel.com/m/newsshow/ovality-and-bending-of-lsaw-steel-pipe.html
- https://www.hu-steel.com/news361_781.html
- https://www.prdcompany.com/real-time-x-ray-inspection-systems/
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CHAPTER -9 :- CONCLUSION

It was a wonderful learning experience at **JINDAL SAW LTD** for 12 weeks of duration. I gained a lot of insight and knowledge regarding almost every aspect. I got exposure to all the departments at the plant, their working culture and their functioning. The friendly welcome from the firm and its employees is quite appreciable, sharing their experience and giving their piece of wisdom which they have gained over their long journey of work in this field helped me in understanding several new aspects of the industrial approach. I am very much thankful for the wonderful facility from **JINDAL SAW LTD.** In this experience will surely help me in my future to shape my career.

INTERNSHIP AT AMMANN INDIA PVT LTD.

AN INTERNSHIP REPORT

Submitted by

Mr. Pratham Kirti Jain

200390119506

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

GUJARAT TECHNOLOGICAL UNIVERSITY

Gujarat Technological University, Ahmedabad

May, 2023

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at Ammann India Private Limited** has been carried out by **Pratham Kirti Jain** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Sign	Sign
Prof. Kunalsinh Kathia (Mechanical Engg. Department)	Prof. Kunalsinh Kathia (Mechanical Engg. Department)
Internal Guide	Head of Department

PMMS CERTIFICATE

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VII, ACADEMIC YEAR 2021-2022

Date of certificate generation : 01 August 2022 (13:19:03)

This is to certify that, ***Pratham Kirti Jain*** (Enrolment Number - 200390119506) working on project entitled with - from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Pratham Kirti Jain

Name of Guide : Mr. Kunalsinh R. Kathia

Signature of Student : ______________

*Signature of Guide : ______________

Disclaimer :
This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate, Only if all above activities has been Completed.

INTERNSHIP CERTIFICATE

AMMANN

Ammann India Private Limited
(Formerly Ammann Apollo India Private Limited)
Block No. 157, At Ditasan, P.O.Jagudan, State Highway, Mehsana, Gujarat - 382710, INDIA
Phone : +91 2762 662200, Email : info.ain@ammann.com
CIN No : U29248GJ1997PTC033432

May 01, 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Pratham Kirti Jain** has successfully completed his Project Internship Training in **Purchase** Department as per his academic regulations during **January 23, 2023 to April 28, 2023 (12 weeks).**

We found him sincere, hardworking, technically sound and result oriented.

We wish him all the best for his future endeavours.

For, Ammann India Private Limited

Ammann India Private Limited
Ditasan

Praful Patel
Senior Manager – Human Resources

S.P.B. Patel Engineering College, Mehsana

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

DECLARATION

We hereby declare that the Internship report submitted along with the Internship entitled **Internship at Ammann India Private Limited** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Mechanical Engineering** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me under the supervision of **Prof. Kunalsinh Kathia** & **Mr. Sagar Joshi (External Guide)** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Pratham Kirti Jain ________________________

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to all the individuals who have contributed to my successful completion of this internship. I would like to thank my internal guide, **Prof. Kunalsinh Kathia**, for his brilliant guidance and belief in my abilities. He always pushed me to go the extra mile, and I'm proud to have had the opportunity to work with him.

I want to thank my industrial guides, **Mr. Sagar Joshi** (Deputy General Manager) and **Mr. Manish Kumar** (Deputy Manager) for their invaluable mentorship and unwavering encouragement. They showed me the ropes, shared their insights, and made my time at the company truly unforgettable.

I would be remiss if I did not acknowledge the incredible team at [company name] who welcomed me with open arms. **Mr. Anirudh Singh** (Department General Manager), **Mr. Pawan Sharma** (Assistant General Manager), **Mr. Amit Shah** (Manager), **Mr. Shailesh Zala** **(**Assistant Manager), and, all took time out of their busy schedules to share their knowledge and expertise with me. I am honoured to have learned from them and grateful for their mentorship.

Lastly, I want to thank my fellow interns and colleagues at the company who made my experience more enjoyable. Their positive attitudes and hard work inspired me to keep pushing myself, and I am glad to have had the chance to work alongside them.

Thank you to everyone who contributed to my growth and learning during this internship. I am forever grateful for your support and mentorship, and I look forward to taking the lessons I have learned into my future endeavours.

ABSTRACT

My internship experience provided me with a diverse range of tasks, allowing me to gain practical knowledge and skills in various aspects of supplier management, quality control, and material inventory management. The tasks that I worked on included cost evaluation of suppliers, reduction summary analysis, quality check of existing components, quality check for incoming material, material consumption analysis throughout a year, approval of sample parts, on-field problem solving, PO creation, nesting of sheet metal for appropriate utilization of sheet, and using SAP software.

During my internship, I learned how to assess the quality of existing and incoming components and the importance of maintaining high-quality standards for production. I also gained practical experience in creating purchase orders and solving on-field problems related to material management. Using SAP software, I learned to manage material inventory efficiently, including the nesting of sheet metal to optimize material usage. These skills are crucial for reducing material waste and improving cost efficiency in production processes.

Another significant aspect of my internship was learning about supplier relationship management, which involved assessing supplier performance, identifying areas of improvement, and collaborating with suppliers to ensure timely delivery of high-quality materials. Through this experience, I gained insight into the importance of maintaining positive supplier relationships and working collaboratively to achieve mutual goals.

One of the key takeaways from my internship was the importance of approaching tasks with a technical mindset. I learned that taking a technical approach involves considering all factors involved in completing a task and identifying the best approach to achieve the desired outcome. This approach was essential in my work on material consumption analysis, as it required careful consideration of various factors such as production volume, material cost, and material usage.

Overall, my internship provided me with valuable insights and practical experience in supplier management, quality control, and material inventory management. The knowledge and skills that I gained during this internship will be instrumental in my future career endeavours.

List of Figures

List of Tables

List of Abbreviation's

SAP – Systems, Applications & Products in Data Processing

DP – Plant Division

DM – Machine Division

SCM – Supply Chain Management

MM – Material Management

PO – Purchase Order

PR – Purchase Requisition

BOM – Bill of Material

RFQ – Request for Quotation

GR – Goods Receipt

QCD Parameters – Quality, Cost and Delivery Parameters

Table of Contents

Chapter: 1 Overview of The Company

1.1 History and Overview of Ammann Group

Fig. 1.1 Ammann Group

Ammann Group is a leading global supplier of construction equipment, including asphalt mixing plants, concrete mixing plants, and compactors. The company was founded in 1869 in Switzerland by Jakob Ammann and has since grown into a global organization with operations in over 100 countries.

Here is an overview of the history and development of Ammann Group:

- **1869:** Jakob Ammann establishes a foundry in Switzerland, which later becomes known as Ammann & Co.

- **1911:** Ammann & Co begins manufacturing road rollers.

- **1929:** Ammann & Co introduces its first asphalt mixing plant.

- **1957:** The company changes its name to Ammann & Co AG.

- **1963:** Ammann & Co introduces its first concrete mixing plant.

- **1970s:** Ammann & Co expands globally, establishing subsidiaries in Europe, Asia, and the Americas.

- **1984:** Ammann & Co AG becomes a public company and is listed on the Swiss Stock Exchange.

- **1990s:** Ammann & Co expands its product range to include compactors and pavers.

- **2000s:** Ammann & Co expands its global footprint further, establishing new subsidiaries in Africa and the Middle East.

- **2010s:** Ammann & Co continues to innovate and develop new products, including environmentally friendly asphalt mixing plants and compactors.

Today, Ammann Group is a global leader in the construction equipment industry, with a wide range of products designed for various construction applications. The company is committed to innovation and sustainability and has a strong focus on providing high-quality products and excellent customer service. With over 150 years of experience and a global presence, Ammann Group is well positioned to continue its growth and success in the construction equipment industry.

1.2 Global Presence and Market Position

The Ammann Group has a global presence, with manufacturing facilities and sales offices in more than 100 countries. The company's products are sold through a network of more than 150 dealers worldwide. The Ammann Group is a market leader in the asphalt plant and compactor markets and has a strong presence in the concrete plant and paver markets.

1.3 History and Overview of Ammann India Pvt Ltd.

Ammann India Private Limited is a subsidiary of Ammann Group, a Swiss-based global leader in the manufacturing of asphalt and concrete mixing plants, compactors, and pavers. Ammann India was landed in Ahmedabad, Gujarat, and has since expanded its operations to include sales and service centres across India. The company offers a range of products including asphalt and concrete mixing plants, pavers, and compactors, as well as services such as training, technical support, and spare parts.

In 2012, Ammann India established a state-of-the-art manufacturing plant in Savli, Vadodara, which produces asphalt mixing plants and concrete batching plants. The plant is spread over an area of 50,000 square meters and has the capacity to produce over 200 plants per year. Ammann India's focus on innovation and sustainability is evident in its products and operations. The company has developed a range of energy-efficient and eco-friendly products, such as the Ammann ABP HRT (High Recycling Technology) asphalt mixing plant, which uses up to 100% recycled asphalt, reducing carbon emissions and costs.

Ammann India has won several awards and accolades for its products and services, including the Frost & Sullivan India Building and Construction Equipment Market Penetration Leadership Award in 2014 and the Golden Peacock Eco-Innovation Award in 2019.Overall, Ammann India Private Limited has established itself as a reliable and innovative player in the Indian construction equipment market, with a strong focus on customer satisfaction and sustainability.

In 2013, Ammann Group and Apollo Group, an Indian construction equipment manufacturer, formed a joint venture known as Ammann Apollo India Private Limited. The joint venture brought together the strengths of both companies to better serve the Indian market.

Later, the Apollo Group was fully captured by Ammann India Private Limited and overall, the joint venture between Ammann Group and Apollo Group has been successful in bringing together their respective strengths to better serve the Indian market, while also promoting innovation and sustainability.

1.4 Company Layout

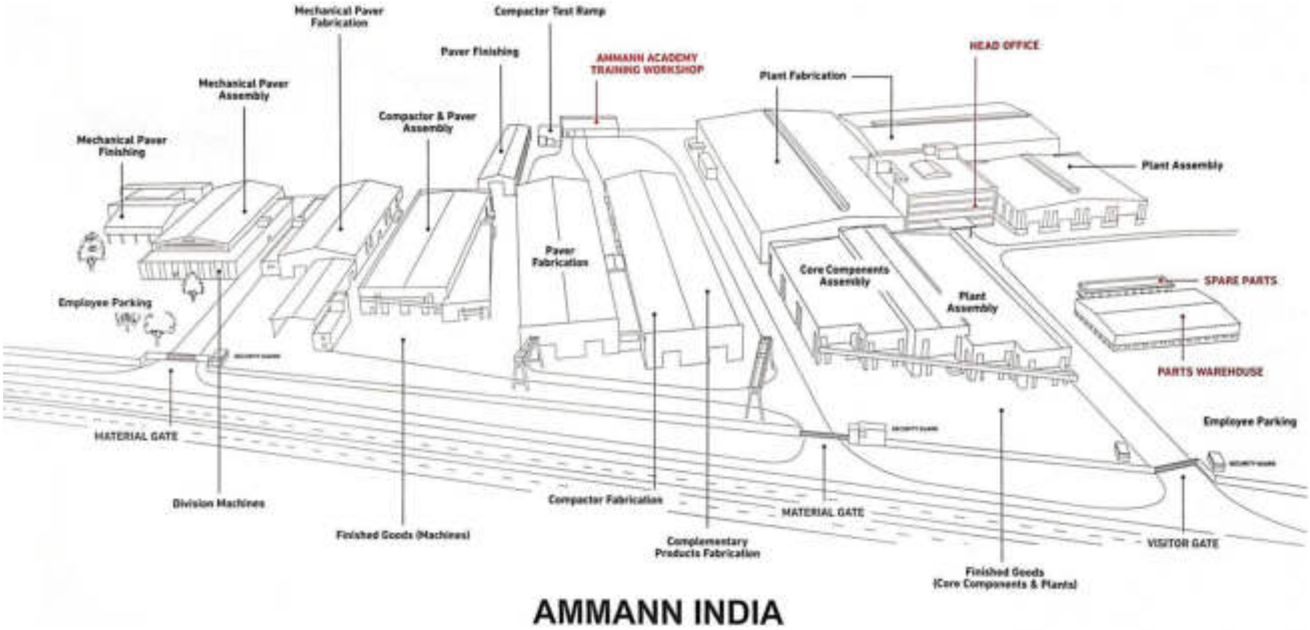


Fig 1.2 Company Layout

1.5 Organization Structure

1.6 Products and Services offered by Ammann India

Ammann India offers a range of equipment for the Indian construction industry, including:

- **Asphalt Plants:** The company offers a range of asphalt plants, including batch mix plants, continuous mix plants, and mobile plants. These plants are designed for efficient and sustainable production of high-quality asphalt.
  There are various **Asphalt Plants** manufactured in Plant Division: -

  - Batch Asphalt Mixing Plants
    - ABC 100 – 260 t/h Valuetec
    - ABC 80 – 160 t/h Ecotec
    - ANP 80–160 t/h
  - Continuous Asphalt Mixing Plants
    - Wet mix 100–250
    - Drum Mix 60–120

Fig 1.3 Asphalt Plants

- **Concrete Plants:** Ammann India offers a range of concrete plants, including stationary and mobile plants, and mixers for various applications.

    - Concrete-Mixing Plants
        - ➢ CC 30 – CC 150 ELBA

Fig 1.4 Concrete Plants

- **Compactors:** The company offers a range of soil and asphalt compactors, including various sizes and specifications of product.
  There are various **Soil and Asphalt Compactors** manufactured in Plant Division: -

    - Soil Compactors
        - ➢ ARS 110.1 T3
        - ➢ ARS 110.2
        - ➢ ARS 121
        - ➢ ARS 122
    - Asphalt Compactors
        - ➢ ARX 90.2
        - ➢ ARX 91
        - ➢ ARX 32.2

Fig 1.5 Soil Compactors (ARS Series)

Fig 1.6 Asphalt Compactors (ARX Series)

- **Pavers:** Ammann India offers a range of asphalt pavers, including wheeled and tracked pavers, with options for various widths and paving depths. Also, Kerb Pavers are manufactured as well.

  There are various **Asphalt Pavers** manufactured in Plant Division: -

  - Asphalt Pavers
    - AP 550
    - AP 600
    - AP 800
    - AP 1000
    - WM 6 / RM 6
    - AFT 500
    - AFT 950 (Under Development)

Fig 1.7 Asphalt Pavers (AP & AFT Series)

- **Other Products and Services:** Ammann India provides a range of after-sales services, including maintenance, repair, and spare parts for its equipment. Also, Ammann India provides wide range of complementary and retrofit products. Additionally, software solution for Asphalt and Concrete Plants.

Other **Products and Services** manufactured in **Plant Division**: -

- Complementary Products
    - Bitumen Tank
    - Heat Tek

Fig 1.8 Complementary Products (DP)

- Retrofits Products
    - Bitumen Tank
    - Baghouse
    - Noise Reduction
    - Low Temperature Mixes
    - Burners
    - Control System
    - Recycling System
    - Dryer
    - Wear Protection
    - Mixer

Fig 1.9 Retrofit Products

- Spare Parts
  - ➢ AMDURIT
  - ➢ AMMLUB Lubrication System
  - ➢ AMMAPAX Flue Noise Suppressor
  - ➢ AMMATEX Filter Bags
  - ➢ ELBA Wear Protection

Fig 1.10 Spare Parts

- Technical Services
  - ➢ Periodic Maintenance
  - ➢ Electrical Check
  - ➢ Calibration Service
  - ➢ Burner Maintenance
  - ➢ Maintenance Control

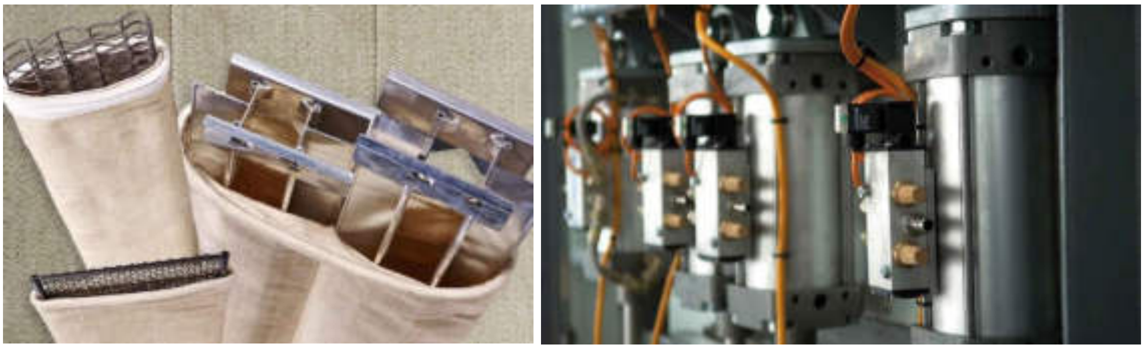


Fig 1.10 Technical Services

Other **Products and Services** manufactured in **Machine Division**: -

- Complementary Products
  - KLM 40 (Curb-casting Machine)
  - KLM 1200 (Curb-casting Machine)
  - ATM Bitumen Sprayers (Bitumen Pressure Distributors)
  - Mechanical Brooms (Surface Preparation Before Asphalt Surfacing)
  - Hydraulic Brooms (Surface Preparation Before Asphalt Surfacing)

Fig 1.11 Complementary Products (DM)

1.7 Marketing and Sales Strategies of Ammann India

Ammann India's marketing and sales strategies focus on customer satisfaction, product quality, and timely delivery of products and services. The company's sales team works closely with customers to understand their specific requirements and provide customized solutions that meet their needs.

Ammann India has a strong online presence and uses digital marketing channels to reach out to potential customers. The company's website provides detailed information about its products and services, and customers can request quotes and place orders online. Ammann India also uses social media platforms such as Facebook, LinkedIn, and Twitter to engage with customers and promote its products and services. The company's sales network includes a team of experienced sales professionals and a network of dealers and service centres across the country. Ammann India provides regular training and support to its sales team and dealers to ensure that they have the knowledge and expertise to provide high-quality service to customers.

1.8 Corporate Social Responsibility & Sustainability Initiatives of Ammann Group and Ammann India

The Ammann Group and Ammann India are committed to corporate social responsibility and sustainability. The company's sustainability initiatives focus on reducing the environmental impact of its operations, promoting employee well-being, and supporting local communities. The Ammann Group has implemented several initiatives to reduce its carbon footprint, such as using renewable energy sources, improving energy efficiency in its manufacturing processes, and reducing waste and emissions. The company also supports several social initiatives, including education, health, and community development projects in the countries where it operates.

Ammann India is committed to environmental sustainability and has implemented several initiatives to reduce its carbon footprint, such as using renewable energy sources, reducing waste and emissions, and promoting the use of environmentally friendly materials. The company also supports several social initiatives, including education, health, and community development projects in India.

Chapter: 2 Departments at the Company

2.1 Departments at Ammann India Private Limited

Ammann India Private Limited is a subsidiary of the Swiss-based Ammann Group, which produces construction equipment and machinery. The company has several departments that support its operations in India. Some of these departments are:

- **Engineering/Design:** This department designs and develops new products and custom solutions for customers, as well as conducts research and development to improve existing products.
- **Production:** This department is responsible for manufacturing and assembling Ammann's products, including asphalt plants, concrete mixing plants, and compactors.
- **Quality Control:** This department ensures that all Ammann products meet the company's high standards for quality and safety through testing, inspections, and audits.
- **Purchase:** This department manages the sourcing of raw materials, production planning, logistics, and inventory management to ensure timely delivery of products to customers.
- **Finance and Accounting:** This department manages Ammann's financial operations, including budgeting, forecasting, and accounting.
- **Sales and Marketing:** This department is responsible for promoting Ammann's products and services to potential customers, as well as managing existing customer relationships.
- **Human Resources:** This department recruits, trains, and manages Ammann's employees, as well as handles payroll, benefits, and employee relations.
- **Service and Maintenance:** This department is responsible for providing regular maintenance, repair services, and troubleshooting assistance for Ammann's equipment.

They ensure that the machines are functioning optimally and provide technical guidance to customers.

- **Project Management:** This department handles large-scale projects involving Ammann's equipment. They work closely with customers, engineers, and contractors to ensure successful project execution, including equipment installation, commissioning, and project coordination.

- **Research and Development (R&D):** The R&D department focuses on innovation and improvement of Ammann's products. They conduct research, testing, and analysis to enhance product performance, efficiency, and sustainability. They also explore emerging technologies and market trends to stay ahead in the industry.

- **Health, Safety, and Environment (HSE):** This department ensures compliance with health and safety regulations at Ammann's facilities. They implement safety protocols, conduct training programs, and promote a culture of workplace safety. They also work towards environmental sustainability by monitoring and reducing the company's ecological footprint.

- **IT and Systems:** The IT department manages and supports the technology infrastructure at Ammann India. They oversee network systems, software applications, data management, and cybersecurity measures. They also provide technical support to employees for efficient operations and digital transformation initiatives.

- **Legal and Compliance:** This department handles legal matters, contracts, and regulatory compliance for Ammann India. They ensure that the company operates within the legal framework and adhere to relevant industry regulations and standards.

- **Corporate Communications:** This department is responsible for internal and external communication strategies. They manage brand image, public relations, marketing communications, and corporate social responsibility initiatives.

- **Customer Support:** This department provides technical support and after-sales service to Ammann's customers, including maintenance, repairs, and spare parts.

These departments work collaboratively to ensure smooth operations, deliver high-quality products and services, maintain customer satisfaction, and drive the growth and success of Ammann India Private Limited.

2.2 About Purchase Department

Fig 2.1 Sourcing and Purchasing with Procurement

The exact structure of a purchase department can vary depending on the organization's size, industry, and specific needs. However, Ammann India Private Limited have a Purchase department in which there are different roles in overall department are mentioned below: -

- **Procurement and Sourcing Team** – It includes New Product Development, Vendor Development, Negotiation, Spend Analysis, ABC Analysis, FSN Analysis, Generating Purchase Orders, etc.

- **Supply Chain Management (SCM) Team** – It includes Vendor Management, Contract Management, Processing Purchase Orders, Generating Good Receipt, Posting Invoices, Coordinating Deliveries, Managing Inventory Levels, Spend Analysis, ABC Analysis, FSN Analysis, etc.

2.3 Purchasing Roles and Responsibilities

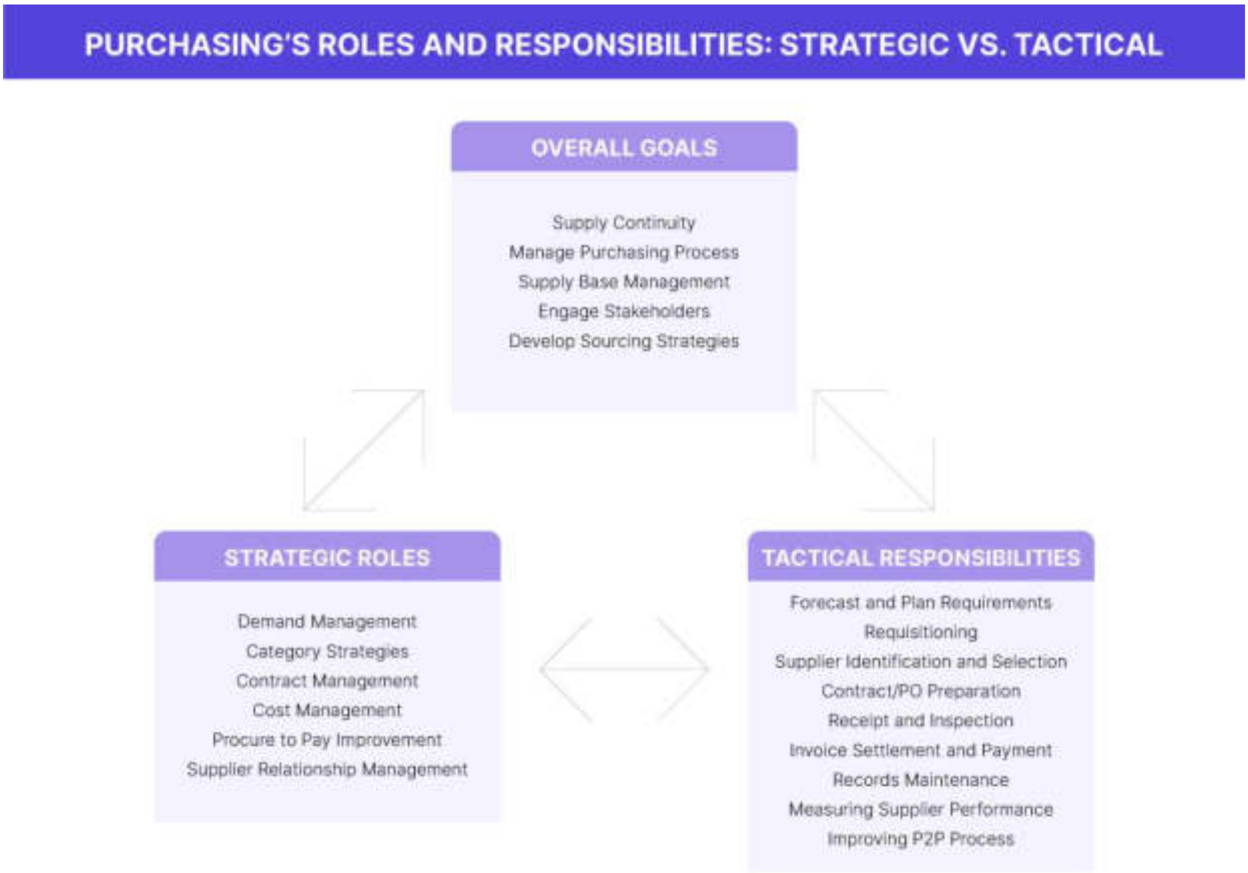


Fig 2.2 Purchasing Roles and Responsibilities

Chapter: 3 Purchasing, Procurement & Supply Chain Management

3.1 What is Purchase Department?

Fig 3.1 Purchase Department

A purchasing department, also known as a procurement department or buying department, is a division within a company that is responsible for acquiring the goods and services needed to run the business. The department is typically responsible for identifying and selecting vendors, negotiating contracts, and managing relationships with suppliers to ensure that the company's procurement processes are efficient and cost-effective.

The size and structure of a purchasing department can vary depending on the size and complexity of the company. In larger organizations, the purchasing department may have specialized teams responsible for different aspects of the procurement process, such as sourcing, contracting, and supplier relationship management.

Overall, the purchasing department plays a critical role in the success of a business by ensuring that it has the necessary resources to operate and grow effectively.

3.2 What is the main function of a purchasing department?

A company's purchasing department may have a large influence on its ability to reach its strategic and daily operational goals. Its ability to acquire enough materials while lowering costs can allow a company to raise its profits, lower its expenditures and achieve growth. Purchasing departments can use their contacts with suppliers to improve the overall quality of a business' product and lower risks in a company's operations by effectively managing these relationships.

On the operational level, purchasing departments ensure businesses receive everything they need for projects. This can include raw materials for manufacturing, supplies for employees, office spaces or technology. When purchasing departments provide these goods efficiently, it can ensure production remains high and products and services reach customers on time.

3.3 Additional purchasing department functions and roles

Fig 3.2 Purchasing Functions and Roles

Purchasing departments manage a variety of roles in a company, depending on its type or size. Some of their additional functions and roles include:

1. **Assessing the needs of the company -** Before making purchases, it's often important for purchasing professionals to understand the requirements of their company. They

can communicate with department heads, regional managers, and company leadership to determine what goods and services they require. They may also use analytics to examine reports of past consumption and evaluate how their company's plans may change the types or amounts of supplies they require. Procurement personnel often pay particular attention to how the needs of various business locations and departments differ.

2. **Conducting research -** After they determine the needs of their company, procurement professionals can research potential sources of goods and services. They may speak to other purchasing personnel or inspect company references to determine whether a supplier could provide quality goods in the proper amounts. Sometimes, they may travel to trade shows or to manufacturing plants to speak directly with potential suppliers and see whether they might be right for their business.

3. **Comparing and negotiating prices -** One of the primary tasks of a purchasing department is to find the most affordable ways to supply their company. When researching suppliers, they can learn about the prices they charge and compare them to similar organizations or markets to find the best rates. When they find a supplier, they may also work on building a relationship with them to help negotiate prices and a better deal for their company.

4. **Coordinating deliveries -** After locating suppliers, purchasing staff can work with suppliers to design delivery schedules for each branch of the company. They may also coordinate with logistics and warehouse staff at their company to ensure all deliveries arrive on time. Purchasing departments also may help resolve any obstacles to delivery or change delivery quantities and schedules based on the requirements of their business.

5. **Managing supplier relationships -** Purchasing departments often maintain relationships with important vendors. They may provide benefits for long time suppliers to improve their relationship and avoid competition for resources. One of their responsibilities is ending contracts with suppliers if they raise prices, become unreliable or reduce the quality of their products. In some cases, procurement departments may build relationships with secondary suppliers to mitigate risk in case they have to change their primary supplier.

6. **Managing competition -** In some industries, regulations require businesses to choose suppliers in a competitive bidding process. This is often the case when government agencies award contracts to private businesses. In these cases, purchasing departments

manage the bidding process and award contracts to a company that best meets their requirements.

7. **Monitoring performance -** As their relationships with suppliers continue, purchasing departments may monitor their performance and make necessary changes. They can assess the quality of the goods their company receives and return or replace any items that don't meet their standards. They may also watch for missing items or late deliveries and try to resolve these situations. Procurement staff also may meet with suppliers to assess their relationship and coordinate for any planned changes.

8. **Obtaining subsidies and benefits -** In some industries, companies may be eligible for government subsidies or benefits. In these cases, purchasing departments can apply for aid and ensure their company gets it. They may also seek additional benefits for their company from long time suppliers, such as reduced prices or free shipping.

9. **Maintaining compliance -** Many industries have regulations that govern their procurement methods and ensure competition is possible. This is especially important for government agencies seeking contracts with suppliers. Purchasing departments in these industries work to maintain compliance with all regulations that affect their company or organization. Procurement staff also often ensure their companies honour all their contracts with suppliers.

10. **Improving quality -** Another important role of purchasing departments is to improve the quality of their company's product. This often can help their company build customer loyalty, increase its profits, and compete with other firms. To do this, procurement staff can monitor the availability of supplies and look for ways to get better goods without raising costs.

11. **Managing budgets -** Purchasing departments often develop budgets for their operations and submit funding requests to company leadership. The goal of budgeting is to ensure their company can operate effectively while maintaining low costs. They may also organize payments to suppliers and request refunds. Many purchasing departments work closely with their company's finance department, which can help financial staff provide funds for upcoming procurement expenses and allow staff to assess the financial resources available to them.

12. **Developing strategies -** Purchasing personnel often work closely with other professionals at their organization to plan for its future. For example, they may

collaborate with executive leaders to learn how company growth might affect the supply requirements of the business. Procurement staff meets with product developers to understand the supply needs of a new product or with financial staff to learn the available funding for their department. Sometimes, they may work with suppliers to plan for changes in their company's operations to account for a new product.

13. **Maintaining records -** Purchasing departments help maintain documents related to their activities, including lists of potential suppliers, records of purchases, invoices and documentation of refunds and returns. Procurement departments may develop contracts with suppliers and create easily accessible documents that outline the terms of their agreement. They may also monitor and record inventory of essential supplies to ensure their business can complete its daily operations efficiently.

3.4 The Purchasing Process

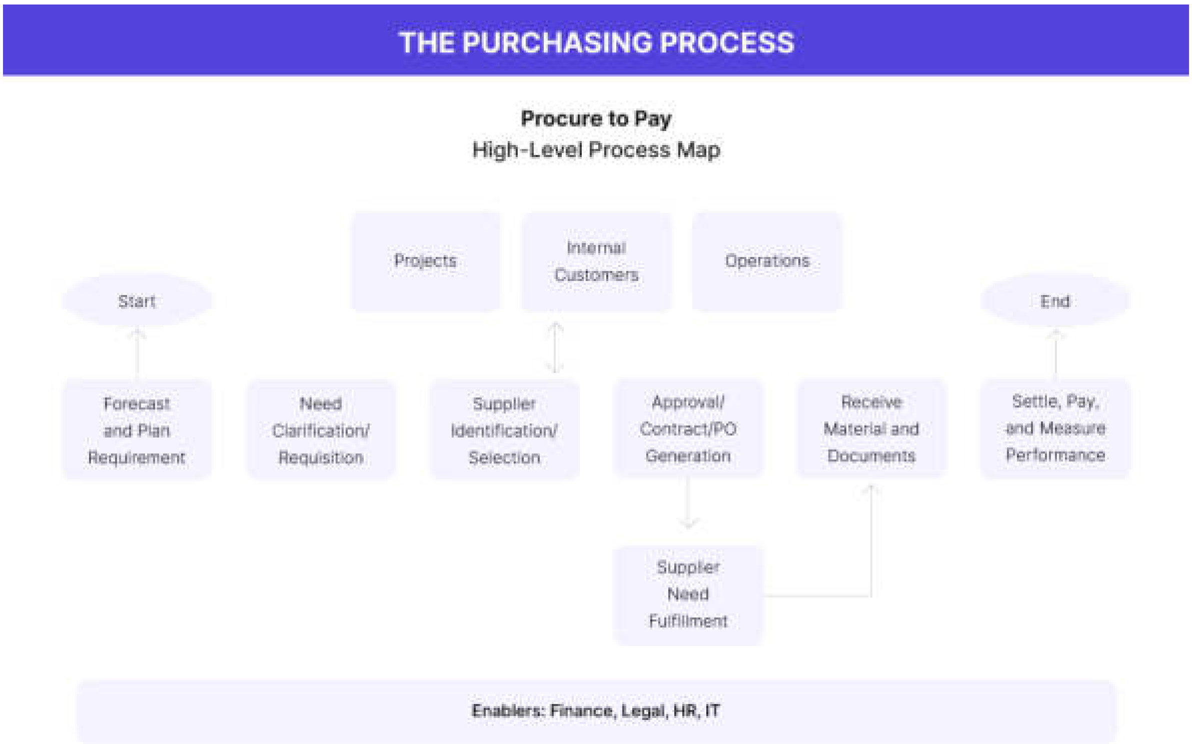


Fig 3.3 The Purchasing Process

3.5 What is Procurement?

Procurement can be referred to as the range of activities undertaken by businesses in obtaining goods and services. While procurement generally refers to the final stage of purchasing, it can also include the entire procurement process overall. Organizations can function as either the buyer or the seller though the focus is generally on the soliciting company. In a nutshell, procurement is referred to as performing "the five rights": getting the right quality, in the right quantity, at the right time, for the right price, from the right source. An abundance of competitors and choices has conditioned customers to settle for higher quality, faster delivery, and products and services customized to their individual needs at a lower total cost.

3.6 Optimal Procurement Strategy

Fig 3.4 Procurement Department

Several factors drive an emphasis on optimal procurement strategy, processes, and execution. Some of the key ones include:

- Cost efficiency and increased availability of information resources among entities in the entire supply chain, which eliminate potential time delays in the network.
- Domestic and international market-level competition. This requires organizations to be fast, agile, and flexible always.
- Ever evolving and demanding customer expectations and requirements.
- The ability of an organization's procurement and supply chain to identify and mitigate risk minimizes disruptions in both supply and downstream products or services to mitigate the impact on lost sales. With evolving customer needs, organizations and

their suppliers must be responsive or face the prospect of lost opportunities, and revenue share.

No business in the world is so self-sufficient that they have everything available internally. They tend to depend on other businesses when they need to buy goods and services that are essential to their business operations. In this context, it is essential to understand that the procurement process isn't just about purchasing goods or services to run day-to-day operations. It extends to ensuring that the company gets added value in the long run too.

Holistically speaking, purchase decisions depend on delivery time, product quality, intrinsic value, and competitive pricing. The impact of procurement on the rest of the business functions is undeniable. Any misstep can derail timelines across a plethora of business processes. Therefore, organizations need to establish a more robust procurement and supply chain management strategy for added business benefits, success, and continuity. Thus, procurement can again be considered a holistic strategic approach to identifying, planning, and acquiring the organization's current and future needs. Pursuing strategic responsibilities for the same can dictate the long-term success and growth of organizations.

3.7 Types of procurement

There are four different types of procurement:

- **Direct procurement:** Direct procurement is the purchase of items that directly impact a company's final product. It includes purchasing raw materials, wholesale goods, procurement software, or services that play a critical role in the production of your product.
- **Indirect procurement:** Indirect procurement involves purchasing items that don't directly contribute to the production of the company's product. This includes office supplies, furniture, equipment maintenance, marketing, or consulting services.
- **Goods procurement:** Goods procurement is the material procurement of tangible items, such as office supplies, raw materials, and other physical goods. It can also include procuring software subscriptions.
- **Services Procurement:** Services procurement is procuring people-based services that help you run your business. It can include anything from software purchases to hiring contractors. Services procurement can also include items that fall under the direct and indirect procurement categories.

3.8 Procurement Process

Fig 3.5 Procurement Process: Beginning to End!

- **Identifying the need:** The first step is to identify the need for procurement of mechanical parts or components. This may involve identifying a gap in the supply chain or a need for a specific component to meet project requirements.

- **Defining specifications:** Once the need is identified, the responsible person will define the specifications for the part or component, including its size, material, and performance needed. These specifications will help in identifying the most suitable supplier.

- **Sourcing suppliers:** After the specifications are defined, the responsible person will identify potential suppliers that can meet the demand. This may involve researching suppliers, soliciting quotes, and evaluating supplier capabilities.

- **Evaluating suppliers:** Then the responsible person will evaluate the suppliers based on factors such as quality, reliability, cost, delivery time, and compatibility with the project requirements. This evaluation will help in selecting the most suitable supplier.

- **Negotiating contracts:** Once a supplier is selected, the responsible person will negotiate the terms of the contract, including the price, delivery schedule, payment terms, and quality requirements.

- **Placing the order:** After the contract is negotiated, the order will be placed as per the need of the industry.

- **Tracking delivery:** During the delivery process, the responsible person will track the progress of the delivery to ensure that the parts or components are delivered on time and meet the required quality standards.

- **Quality control:** After the parts or components are delivered, the responsible person will perform quality control checks to ensure that they meet the required specifications and quality standards.

- **Inventory management:** Finally, the responsible person will manage inventory levels to ensure that the required parts or components are always available when needed.

3.9 What is Supply Chain Management?

Supply chain management is the handling of the entire production flow of a good or service — starting from the raw components all the way to delivering the final product to the consumer. A company creates a network of suppliers ("links" in the chain) that move the product along from the suppliers of raw materials to those organizations that deal directly with users.

Fig 3.6 Supply Chain Theory

3.10 How does supply chain management work?

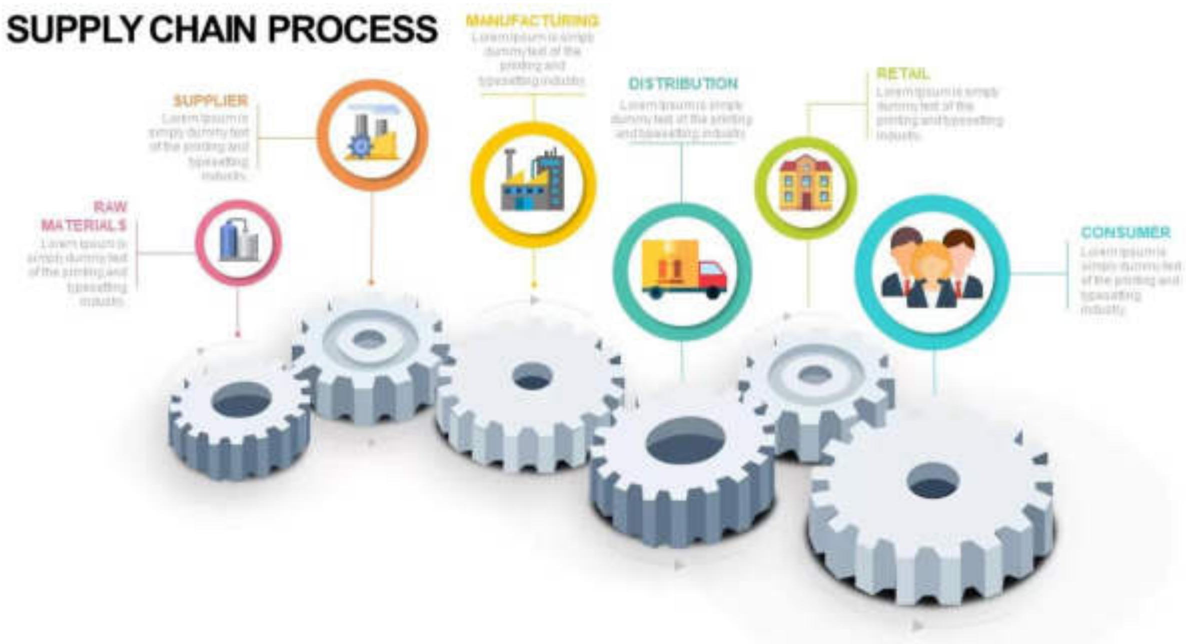
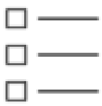


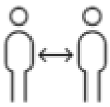
Fig 3.7 Supply Chain Process

According to CIO, there are five components of traditional supply chain management systems:



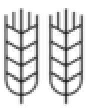
Planning

Plan and manage all resources required to meet customer demand for a company's product or service. When the supply chain is established, determine metrics to measure whether the supply chain is efficient, effective, delivers value to customers and meets company goals.



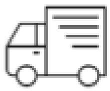
Sourcing

Choose suppliers to provide the goods and services needed to create the product. Then, establish processes to monitor and manage supplier relationships. Key processes include ordering, receiving, managing inventory, and authorizing supplier payments.



Manufacturing

Organize the activities required to accept raw materials, manufacture the product, test for quality, package for shipping and schedule for delivery.



Delivery and Logistics
Coordinate customer orders, schedule deliveries, dispatch loads, invoice customers and receive payments.

Returning
Create a network or process to take back defective, excess, or unwanted products.

3.11 Circular Supply Chain Cycle

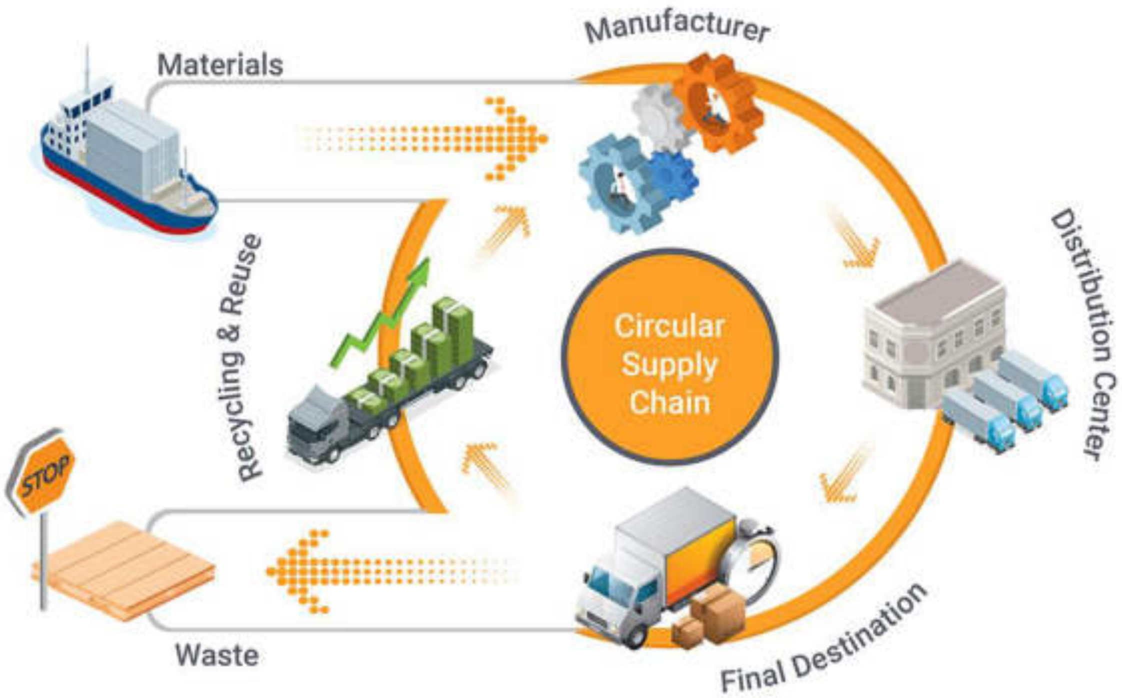


Fig 3.8 Circular Supply Chain

The circular supply chain, at first glance, appears to predominantly be a methodology for companies to reduce environmental impact, but it's much more than that.

Instead of throwing products away at the end of their lifecycle, they can be turned back into profit with lower costs than making a new product from scratch. Throwing away products wastes the investment companies have already poured into the product (labour, materials, and energy). It simply costs less to refurbish or recycle materials into new goods. By connecting the end of the linear supply chain with the beginning, companies can save money by reducing the overall cost of producing their products.

Chapter: 4 SAP MM (Material Management)

4.1 About the SAP Software

Fig 4.1 SAP MM Screen Interface

SAP is the world leader in enterprise applications in terms of software and software-related service revenue. Based on market capitalization, it is the world's third largest independent software manufacturer supporting all sizes of industries helping them to operate profitability, grow sustainably and stay ahead of the competition in the market.

4.1.1 SAP at a Glance

SAP is known worldwide for its unique innovations that help the customers run their business with high efficiency. Some of its facts and figures stand as follows –

- More than 263,000 customers in 188 countries.
- More than 68,800 employees in more than 130 countries.
- Annual revenue of €1682 billion.

4.1.2 ISO Certificates

SAP Development: ISO 9001:2008 certificate
SAP Active Global Support: ISO 9001:2008 certificate
SAP Active Global Support: ISO 27001:2005 certificate

4.2 SAP Modules

SAP Solutions include several functional modules, which support transactions to execute key business processes, such as: -

- Financial Accounting (FI)
- Financial Supply Chain Management (FSCM)
- Controlling (CO)
- Materials Management (MM)
- Sales and Distribution (SD)
- Logistics Execution (LE)
- Production Planning (PP)
- Quality Management (QM)
- Plant Maintenance (PM)
- Project System (PS)
- Human Resources (HR)

4.3 SAP MM – Transaction Codes

T-Code	Function	T-Code	Function
MM01	Create Material	ME42	Change RFQ
MM02	Change Material	ME43	Display RFQ
MM03	Display Material	ME21N	Create PO
MB51	Material Document List	ME22N	Change PO
MB52	List of Warehouse Stocks on Hand	ME23N	Display PO
XK01	Create Vendor	ME29N	Release PO
XK02	Change Vendor	MM60	Current Price Extraction
XK03	Display Vendor	MIGO	Post Good Movements
OX09	Create Storage Location	MB1C	Post Other GR
ME11	Maintaining Purchase Info Records	MB01	Post GR for PO

ME51N	Create PR	OMJJ	Define New Movement Types
ME52N	Change PR	MRBR	Release Blocked Invoices
ME53N	Display PR	MMBE	Stock Overview
ME41	Create RFQ	MMDE	Delete All Materials

Table 4.1 SAP MM – Transaction Codes

4.4 SAP MM - Procurement Cycle

4.4.1 Creating Purchase Order

Purchase order is the formal and final confirmation of the requirements that is sent to the vendor to supply material or services. A purchase order includes important information such as name of the material with its corresponding plant, details of purchasing organization with its company code, name of vendor, and date of delivery. A purchase order can be created by following the steps given below: -

T-Code: ME21N

Step 1 – On the SAP Menu screen, enter the T-Code or select Create Vendor/Supplying Plant Known by following the above path.

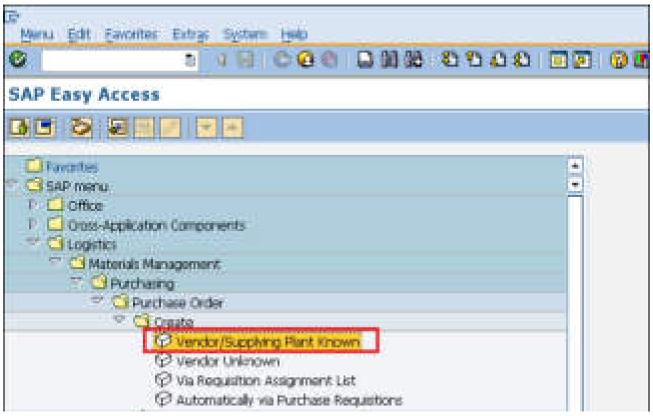


Fig 4.2 Creating the Purchase Order

Step 2 – Fill in all the necessary details such as name of the vendor, purchasing organization, purchasing group, company code, and details of the material, for example, material number, price, currency, and plant.

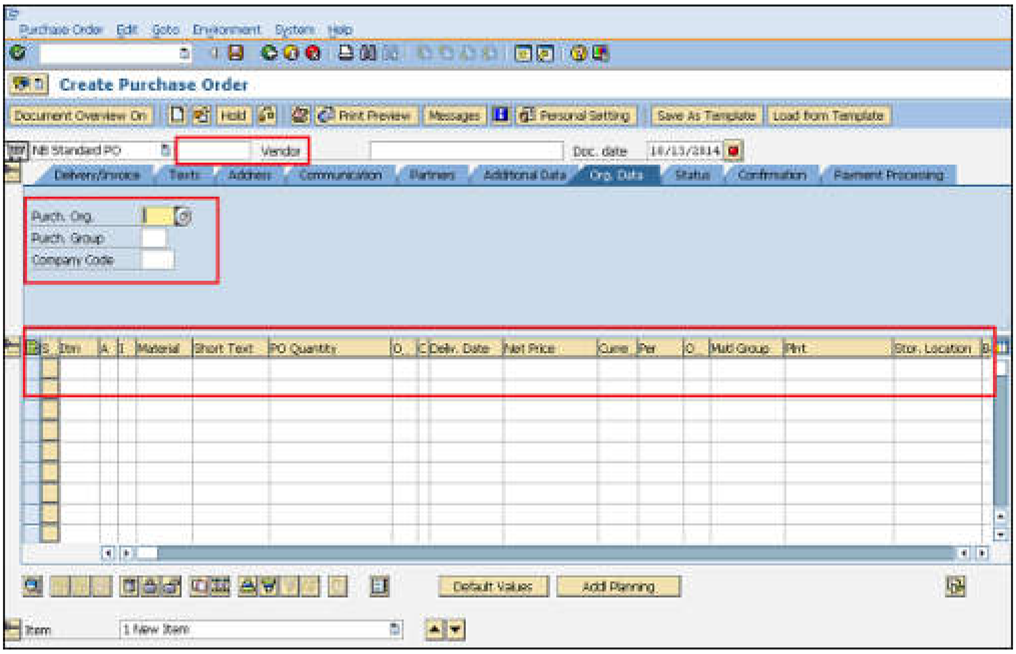


Fig 4.3 Filling up the required details for PO

Step 3 − Fill in all the necessary details under Item, by selecting the tabs as shown in the following screenshot −

- Invoice/Delivery Tab (Provide the tax code, Payment terms and conditions, and incoterms)
- Assignment Tab (Provide a valid G/L code, business area, and WBS element)

Click on Save. A new Purchase Order will be created.

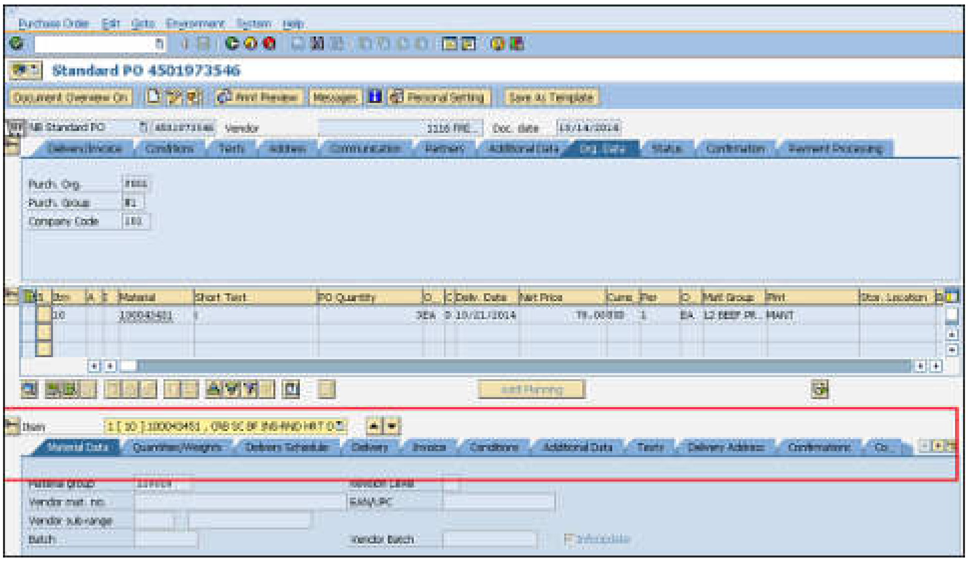


Fig 4.4 Apply Tax Code for PO

4.4.2 Posting Good Receipts

After processing the purchase order, the vendor delivers the material to the ordering party and this process is called Goods Receipt. It is the phase where the material is received by the ordering party and its condition and quality are verified. Once the material is verified against the predefined quality, a goods receipt is posted. Goods receipt can be posted by following the steps given below.

T-code: MIGO

Step 1 – On the SAP Menu screen, enter the T-Code or select Goods movement (MIGO) by following the above path.

Step 2 – Fill in all the necessary details such as movement type (101 for goods receipt), name of the material, quantity received, details of storage location and the plant where the material will be placed. Click on Save. Goods Receipt is now posted for the material.

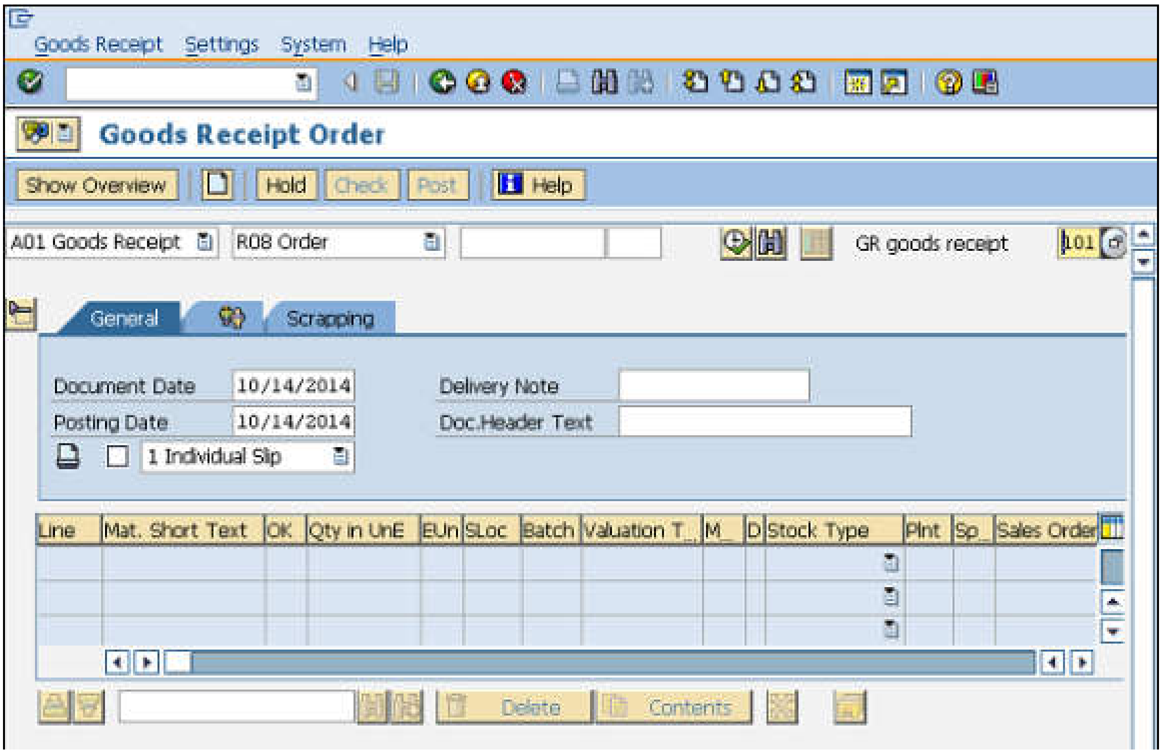


Fig 4.5 Good Receipt SAP Interface

4.4.3 Posting Invoice

Invoice is received from the vendor after goods receipt, and then the invoice is verified by the ordering party. This is the phase where the vendor (seller) is paid from the company and reconciliation of the invoice and PO is accomplished. An invoice can be posted by following the steps given below.

T-Code: MIRO

Step 1 − On the SAP Menu screen, enter the T-Code or select Enter Invoice by following the above path.

Step 2 − Fill in all the necessary details such as invoice posting date, amount that is paid to the vendor along with the quantity for which the amount is paid. Click on Save. Invoice is now posted for the goods receipt.

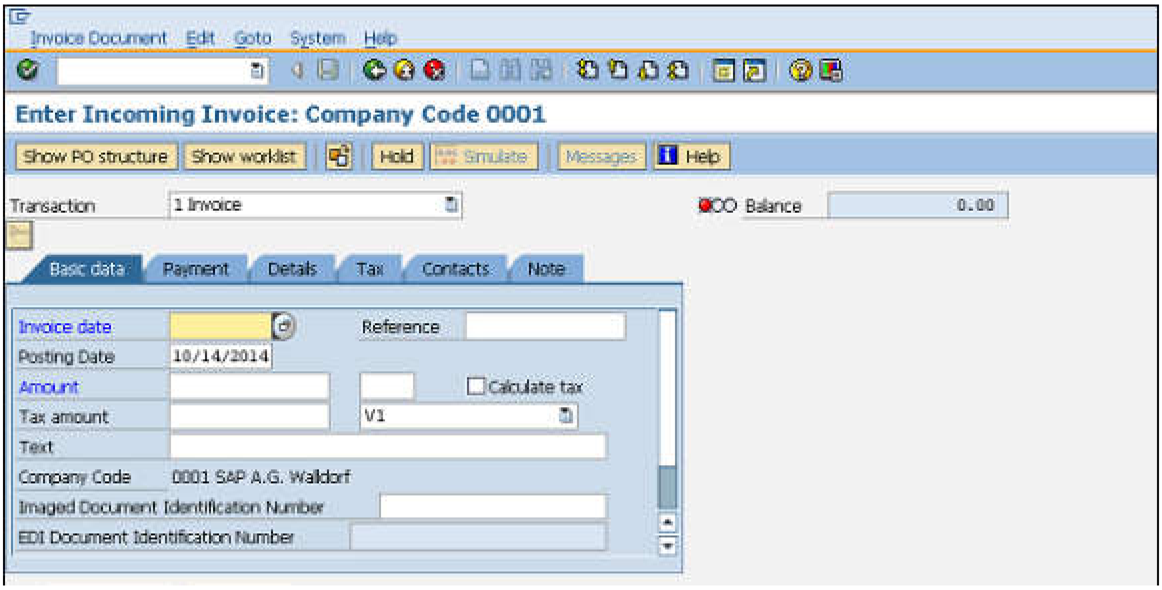


Fig 4.6 Incoming Invoice SAP Interface

4.5 SAP MM – Purchase Order Types

For different procurement types, there are four types of purchase orders, which are as follows: -

- Subcontracting Purchase Order
- Consignment Purchase Order
- Service Purchase Order
- Stock Transfer Purchase Order

4.5.1 Subcontracting Purchase Order

In subcontracting, the vendor (the subcontractor) receives components from the ordering party with the help of which it produces a product. The product is ordered by your company through a purchase order. The components required by the vendor (seller) to manufacture the ordered products are listed in the purchase order and provided to the subcontractor.

Follow the steps given below to create a subcontracting purchase order.
T-Code to create Purchase Order: ME21N
Subcontracting Item Category: L

- Provide the T-Code in the command field.
- It will take you to the purchase order screen.
- Provide all the necessary details such as the name of the vendor, item category, name of material, plant for which material is procured, and the date of delivery.
- Click on Save. Subcontracting Purchase order will be created.

4.5.2 Consignment Purchase Order

In consignment, material is available at the organization store premises, however it still belongs to the vendor (seller)/Owner of the material. If you utilize the material from the consignment stocks, then you must pay to the vendor.
Follow the steps given below to create a consignment purchase order.
T-Code to create Purchase Order: ME21N

Consignment Item Category: K

- Provide the T-Code in the command field.
- It will take you to the purchase order screen.
- Provide all the necessary details such as the name of the vendor, item category, name of material, plant for which material is procured, and the date of delivery.
- Click on Save. Consignment Purchase order will be created.

4.5.3 Service Purchase Order

In service, a third party provides services to a company. These services include maintenance functions such as electricity and oiling of machines.

Follow the steps given below to create a service purchase order.
T-Code to create Purchase Order: ME21N

Service Item Category: D

- Provide the T-Code in the command field.
- It will take you to the purchase order screen.
- Provide all the necessary details such as the name of the vendor, item category, name of material, plant for which material is procured, and the date of delivery.
- Click on Save. Service Purchase order will be created.

4.5.4 Stock Transfer Purchase Order

In stock transfer, goods are procured and supplied within a company. One plant orders the goods internally from another plant (receiving plant/issuing plant). The goods are procured with a special type of purchase order known as the stock transport order.

Follow the steps given below to create a stock transfer purchase order.
T-Code to create Purchase Order: ME21N

Stock Transfer Item Category: U

- Provide the T-Code in the command field.
- It will take you to the purchase order screen.
- Provide all the necessary details such as the name of the vendor, item category, name of material, plant for which material is procured, and the date of delivery.
- Click on Save. Stock Transfer Purchase order will be created.

Chapter: 5 Internship at Ammann India Private Ltd.

5.1 Roles and Responsibilities

5.1.1 My Role in Purchase Department at Ammann India Pvt. Ltd.

As a Project Trainee in purchase department my role is to ensure that I complete all the task I had assigned for within the appropriate deadlines with whole and sole responsibility. All the task assigned to me were communicated through the Ammann India's Organization mail and Microsoft teams.

5.1.2 My Responsibilities in Purchase Department at Ammann India Pvt. Ltd.

My Responsibilities at Ammann India Private Limited: -

- Monthly In-warding and Consumption Audit for Plant Division
- Low-Cost Supplier Evaluation
- Inventory Control in Machine Division
- Quality Control for incoming material in storage
- Vendor Relation Management
- PO Creation
- Confirming Stock Availability
- Nesting Verification for Sheet Metals
- Cost Evaluation for Suppliers
- Cost Reduction Analysis
- Sample Part Approval Process
- PR Checking

All the responsibilities mentioned were performed regularly during the duration of Internship under the guidance of different mentors at purchase department.

5.2 Tasks and Works Assigned

5.2.1 Task – Cost Per kg Calculations as per weight for parts of 80% value

Sr. No	Supplier Name	Supplier Code	Part Number	Description	Unit Weight	QOM	Price	Cost/kg	Month - Year of Purchase	Store Location	Remarks
1	Royal Steel India			Drum W (DD)- ARS122	-	N.A.			Dec-22	2300, 01 Zone 1	Heavy Weight Component
2	Ammann Czech Republic a.s.			Vibrator AS	-	N.A.			Jan-23	Store - 2	Heavy Weight Assembly
3	Rane Axle and Pressing Private Limi			Drum WELDMENT- ARX90	-	N.A.			Feb-23	2300, 01 Zone 1	Heavy Weight Component
4	Bombay Metal Corporation			Wear Plate 10x320x2500	62.05	Kg			Mar-23	2400	N.A.
5	Royal Steel India			Drum W- ARS110	-	N.A.			Dec-22	2300, 01 Zone 1	Heavy Weight Component
6	Bombay Metal Corporation			Wear Plate 10x320x1187 left/right	30.02	Kg			Mar-23	2400	N.A.
7	Ashapuri Products			Pinion 57TX1.5"P HUB DRUM	37.40	Kg			Feb-23	2300 D/7/13-14	N.A.
8	Paras Engineering Works			Frame Bogie wheel L	99.50	Kg			Jan-23	2300 Zone 3	N.A.
9	Paras Engineering Works			BOGIE WHEEL FRAME RH	99.50	Kg			Jan-23	2300 Zone 3	N.A.
10	Paras Engineering Works			Hub RAW	64.10	Kg			Mar-23	2300, AB/15	N.A.
11	Metaltec Products Pvt Ltd			FRONT AXLE PLATE 32 MM	32.65	Kg			Feb-23	2400, 02	N.A.
12	Ammann Czech Republic a.s.			Control cable S PÁKOU	2.70	Kg			Jul-22	A/3/13-14	N.A.
13	DAYTONCOOL TECH PRIVATE LIMITED			Console base bottom AW	23.86	Kg			Jan-23	2400, 02	N.A.
14	Ammann Czech Republic a.s.			Flow Divider RTM16S3M-1X/160F2H420F45..	17.40	Kg			Oct-22	2300, M/1/13	N.A.
15	MAHALAXMI ENGINEERING			Hub	27.01	Kg			Mar-23	2300, AC/9	N.A.
16	Paras Engineering Works			Plate RÁMU SVAREK	90.86	Kg			Mar-23	2300 AA/5	N.A.
17	Ammann Czech Republic a.s.			Isolator 6EK 002 843-071	0.22	Kg			Aug-22	2300 I/8/12	N.A.
18	Rochi Engineers Pvt. Ltd.			Pipe Engine to DOC with Heat Insul~	2.96	Kg			Feb-23	2400, S2 1/15	N.A.
19	Ashapuri Products			Chain wheel 9TX80P ALL H.S	10.00	Kg			Mar-23	2300, F/1/14	N.A.
20	Rochi Engineers Pvt. Ltd.			Exhaust Pipe OD 101.60*1.6 THK.	5.90	Kg			Feb-23	2400, S2 G/20	N.A.
21	Metaltec Products Pvt Ltd			Plate Rear	13.70	Kg			Oct-22	2400, S2	N.A.
22	Royal Steel India			Drum AW	-	N.A.			Sep-22	2300, Zone 1	Heavy Weight Component
23	Ashapuri Products			Pinion 24TX1.5"P AP 550 H.S	12.87	Kg			Feb-23	2300, F/1/13	N.A.
24	Rochi Engineers Pvt. Ltd.			Pipe Engine-DOC With Heat Insulati~	3.32	Kg			Jan-23	2300, F/12/14	N.A.
25	Ammann Czech Republic a.s.			Tooth hub 11 R KR 70-103	1.36	Kg			Feb-23	2300, H/4/10	N.A.
26	Rochi Engineers Pvt. Ltd.			Exhaust Pipe	2.83	Kg			Feb-23	2300, F/10/14	N.A.
27	Ashapuri Products			Pipe OD113xID95x815LG. WITH BUSH	18.70	Kg			Feb-23	2300, F/2/13	N.A.
28	Rochi Engineers Pvt. Ltd.			Silencer CUMMINS ROTARY ARS	-	N.A.			Jun-22	2001 Ro2	Obsolete Component
29	Ammann Czech Republic a.s.			Ring CHROMOVANÝ TRKR 219X20-33	1.21	Kg				2300, H/4/14	N.A.
30	Ashapuri Products			Tamper shaft Basic 780mm	7.70	Kg			Jan-23	2300, D/4/14	N.A.
31	Ashapuri Products			Guide roller AS	17.00	Kg			Feb-23	2300, F/2/14	N.A.
32	MICRO METAL INDUSTRIES			Plate	7.83	Kg			Feb-23	2400, 02	N.A.
33	Royal Steel India			Drum AW	-	N.A.			Feb-22		Heavy Weight Component
34	MAHALAXMI ENGINEERING			Adapter plate ARS121 PUMP	20.28	Kg			Mar-23	2300, Z/12	N.A.
35	DAYTONCOOL TECH PRIVATE LIMITED			Console base AW	20.51	Kg			Jan-23	2300, Zone 3	N.A.
36	Paras Engineering Works			Support Tamper bar	6.55	Kg			Feb-23	2300, C/5/14	N.A.
37	Ammann Czech Republic a.s.			Filter head	0.54	Kg			Jan-23	2300, H/6/17	N.A.
38	ACME Industries			Tamper frame L	3.12	Kg			Feb-23	2300, D/4/13	N.A.
39	ACME Industries			Tamper frame R	3.10	Kg			Feb-23	2300, D/5/13	N.A.
40	Metaltec Products Pvt Ltd			Plate 25mm Front	8.21	Kg			May-22	2400, 02	N.A.

Table 5.1 Cost Per kg Calculations as per weight for the parts of 80% value

Fig 5.1 Weight for the parts of 80% value

5.2.2 Task – Reduction Summary Analysis

Sr No	Supplier		Date	WM6	AP550	AP600	AP800	AP1000	ARX90	ARX91	ARS110	ARS122	AFT500	AFW500	KLM1200	KP40	BPD	ATM4000	ATM6000	ATM10000	ARS110.2 T1	ARS110.1 T3	ARS130.1 T3	ARS150.1 T3	AFT500 BS4
1	Ingeco	Increase	10.05.2022		45352	45352																			
		Decrease	20.10.2022		17808	17808																			
		%			39%	39%																			
2	Adept	Increase	26.04.2022		8828	8828							700												
		Decrease	29.09.2022		2522	2522							360												
		%			29%	29%							51%												
3	Western	Increase	10.05.2022	9303	10666	11267																			
		Decrease	05.08.2022	9303	10666	11267																			
		%		100%	100%	100%																			
4	Preksha	Increase	24.05.2022	334																					
		Decrease	05.08.2022	334																					
		%		100%																					
5	Akruti	Increase	01.06.2022	3719	1204	1082																			
		Decrease	26.07.2022	3083																					
		%		83%	0%	0%																			
6	Prakash	Increase	12.05.2022	2283																					
		Decrease	15.09.2022	1957																					
		%		86%																					
7	VS	Increase	03.05.2022	434	12793	8527			1961		2195														
		Decrease	03.08.2022	434	12793	8527			1961		2195														
		%		100%	100%	100%			100%		100%														
8	Paras	Increase	31.05.2022		11925	12656					4300	2750	1096												
		Decrease	16.09.2022		7399	8130					7328	4264	1016												
		%			62%	64%					170%	155%	93%												
9	Shanti	Increase	21.05.2022	8635																					
		Decrease	03.10.2022	8635																					
		%		100%																					
10	MicroMech	Increase	09.06.2022		3406	883																			
		Decrease	17.10.2022		1549	434																			
		%			45%	49%																			
11	Technomech	Increase	09.06.2022	7452																					
		Decrease	17.10.2022	3449																					
		%		46%																					
12	Connect Cable	Increase	16.05.2022	578	1013	773			756	590	1064	695	548												
		Decrease	04.08.2022	359	559	446			476	373	586	586	319												
		%		62%	55%	58%			63%	63%	55%	84%	58%												
13	Vinayak Rubbe	Increase	24.11.2021	1306	1076	1076			1550	548	564	496	3411												
		Decrease	04.11.2022	576	325	325			447	122	115	92	1417												
		%		44%	30%	30%			29%	22%	20%	19%	42%												
14	Akshay Industry	Increase	06.05.2022	875	1788	1788																			
		Decrease	18.11.2022	875	1788	1788																			
		%		100%	100%	100%																			
15	Soham	Increase	15.07.2022	63	3844	5104	2067	5354					258	201	148		59								
		Decrease	11.01.2023	63	3371	4782							258		148		59								
		%		100%	88%	94%	0%	0%					100%	0%	100%		100%								
16	Pioneer	Increase	17.06.2022	17423	17293	5008																			
		Decrease	15.12.2022	9863	9777	5008																			
		%		57%	57%	100%																			
17	Exide	Increase	20.07.2022																						
		Decrease	02.01.2023	107	214	214			29	29	102	107	184												
		%																							
18	Wheels India	Increase	31.05.2022								4943	5967	2986												
		Decrease	02.01.2023								1973	2107	2196												
		%									40%	35%	74%												
19	Ashapuri	Increase	12.05.2022	6717	12706	9323																			
		Decrease	16.11.2022	3655	9554	8544																			
		%		54%	75%	92%																			
20	Parth Industries	Increase	04.05.2022	1734																					
		Decrease	17.11.2022	1734																					
		%		100%																					

Table 5.2 Reduction Summary Analysis

5.2.3 Task – Washer Quality Check for Apollo Pavers in purpose of evaluating the suppliers

Sr. No	Description	Location	Outside Dia.	Inside Dia.	Thickness
1	Washer 8.3/26x2 galZn	Y/11/40	33.47 mm	8.70 mm	2.16 mm
2	Washer 26/44x3 galZn	Y/10/38	45.37 mm	25.46 mm	3.17 mm
3	Washer 14/24x2.5 galZn	Y/10/30	25.44 mm	13.28 mm	2.06 mm
4	Spring washer 7/8"	Y/10/40	36.05 mm	23.02 mm	3.10 mm
5	Washer 10/22x2 galZn	Y/10/28	22.32 mm	10.22 mm	1.77 mm
6	Spring washer M24 (ID24.5XOD44XTHK 5)	Y/10/39	38.98 mm	24.83 mm	4.83 mm
7	Spring washer M10 (ID10.2XOD18.1XTHK2.2)	Y/10/29	17.32 mm	10.25 mm	2.32 mm
8	Spring washer M8 (ID8.2XOD14.8XTHK2)	Y/10/27	14.15 mm	8.10 mm	2.00 mm
9	Washer 10/20x1.6 galZn	Y/10/26	19.07 mm	8.38 mm	1.49 mm
10	Spring washer M12 (ID12.2XOD21.1XTHK2.5)	Y/10/31	20.26 mm	12.19 mm	2.45 mm
11	Spring washer M16(ID16.2XOD27.4XTH3.5)	Y/10/35	26.25 mm	16.19 mm	3.45 mm
12	Washer S.S.PLAIN M10(OD-30ID-11TH-2)304	Y/10/41	29.57 mm	11.14 mm	1.90 mm
13	Washer 18/30x3 galZn	Y/10/34	29.6 mm	17.10 mm	2.78 mm
14	PLAIN WASHER M12(OD24-ID-13.5-2 T)SS 304	Y/10/52	23.41 mm	12.95 mm	1.94 mm
15	Washer 13/31x2.75 galZn	Y/10/32	33.64 mm	12.92 mm	2.40 mm
16	Spring washer M6 (ID6.1XOD11.8XTHK1.6)	Y/10/25	11.15 mm	6.01 mm	1.46 mm
17	Spring washer M5	Y/1/5	8.75 mm	5.18 mm	1.09 mm

Table 5.3 Quality Check for Apollo Paver Washers

Fig 5.2 Quality Control Inspection of Washer for Apollo Pavers

5.2.4 Task – Work Order with BOM Quantity for Model Assemblies

Model	Assembly	Work Order no.	Required by
ARS110.2 BS V	Rear Frame Assembly ARS110.2 CEV st V	2549960	30.04.2023
ARS110.2 BS V	Frame W for Hood	2550509	30.04.2023
ARS110.2 BS V	Rear Frame W ARS110.2 CEV st V	2550510	30.04.2023
ARS110.2 BS V	Frame W for Articulation Joint	2550511	30.04.2023
ARS110.2 BS V	Fuel tank AW	2550512	30.04.2023
ARS110.2 BS V	Air Intake AS	2550513	30.04.2023
ARS110.2 BS V	Smooth drum AS	2550543	30.04.2023

Sr. No.	Model	Ass. Part No.	Work Order no	Item Code	Description	Qty	Supplier
1	ARS110.2 BS V		2549960		Lock Washer RIPP LOCK 16 flZn	28	1380 Ammann Czech Republic a.s.
2	ARS110.2 BS V		2549960		Lock Washer RIPP LOCK 8 flZn	8	456368 CAPCO INDUSTRIES PRIVATE LIMITED
3	ARS110.2 BS V		2549960		Pipe clip 16 MM	1	448471 Jacktech Hydraulics
4	ARS110.2 BS V		2549960		Pipe clip 22 MM	7	448238 Fluid Power Engineers
5	ARS110.2 BS V		2549960		Pipe clip 25 MM	1	448238 Fluid Power Engineers
6	ARS110.2 BS V		2549960		Hex screw M16x45 10.9 galZn	8	448342 Harjivandas Hathibhai Patel
7	ARS110.2 BS V		2549960		Filler neck	1	448656 Meera Auto Agency
8	ARS110.2 BS V		2549960		Stiffener	2	447803 Ashapuri Industries
9	ARS110.2 BS V		2549960		Plate for front weldment	1	447803 Ashapuri Industries
10	ARS110.2 BS V		2549960		Mounting Plate 36x131x437 L	1	460179 SMTB Engineering Pvt Ltd
11	ARS110.2 BS V		2549960		Mounting Plate 36x131x437 R	1	460179 SMTB Engineering Pvt Ltd
12	ARS110.2 BS V		2549960		Mounting Plate 32x237x400 Rear	2	447803 Ashapuri Industries
13	ARS110.2 BS V		2549960		Pipe clip PCS Plastic 35x30	2	448238 Fluid Power Engineers
14	ARS110.2 BS V		2549960		Hex screw M16x60/38 10.9 galZn	6	454991 CREST PRECISION SCREWS PVT. LTD.
15	ARS110.2 BS V		2549960		Hex screw M8x20 8.8 galZn	1	449549 Wuerth Industrial Services India Pv
16	ARS110.2 BS V		2549960		Hex screw M8x25 8.8 galZn	8	454991 CREST PRECISION SCREWS PVT. LTD.
17	ARS110.2 BS V		2549960		Hex screw M10x20 8.8 galZn	2	449549 Wuerth Industrial Services India Pv
18	ARS110.2 BS V		2549960		Hex screw M10x30 8.8 galZn	1	449549 Wuerth Industrial Services India Pv
19	ARS110.2 BS V		2549960		Hexagon Nut M16 10 flZn	14	454991 CREST PRECISION SCREWS PVT. LTD.
20	ARS110.2 BS V		2549960		Hexagon weld nut M6 St	4	449469 VRAJ TRADELINK PVT LTD
21	ARS110.2 BS V		2549960		Hexagon weld nut M8 St	24	449469 VRAJ TRADELINK PVT LTD
22	ARS110.2 BS V		2549960		Hexagon weld nut M10 St	3	449469 VRAJ TRADELINK PVT LTD

Table 5.4 Work Order with BOM Quantity for Model Assemblies

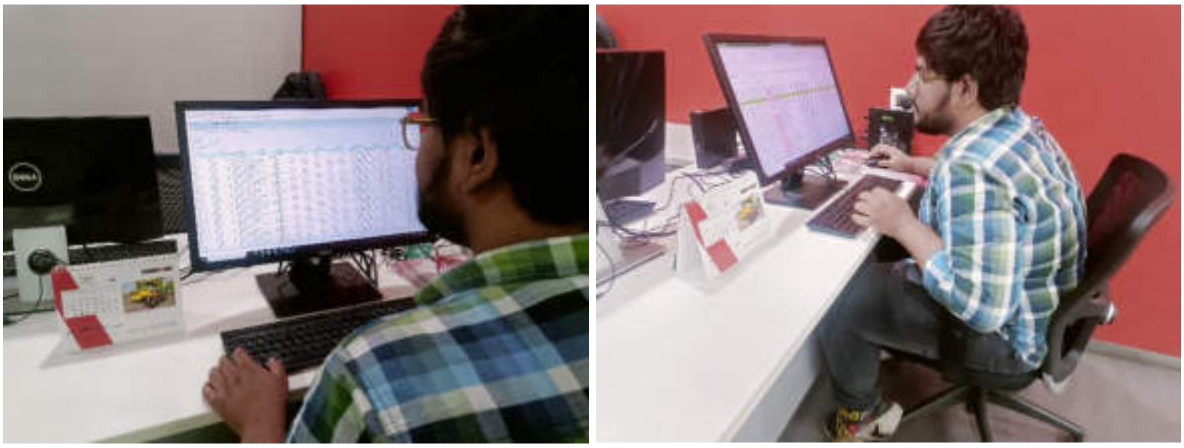
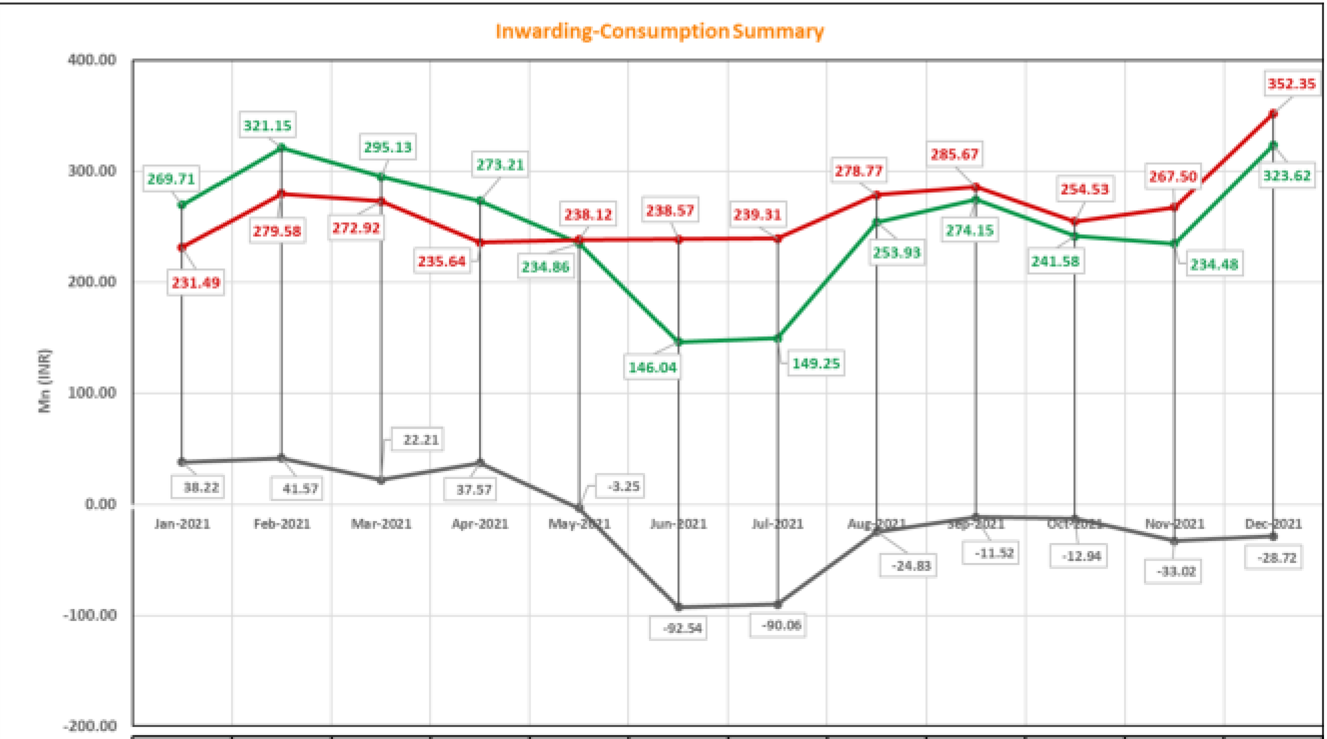


Fig 5.3 Work for BOM Quantity of Model Assemblies

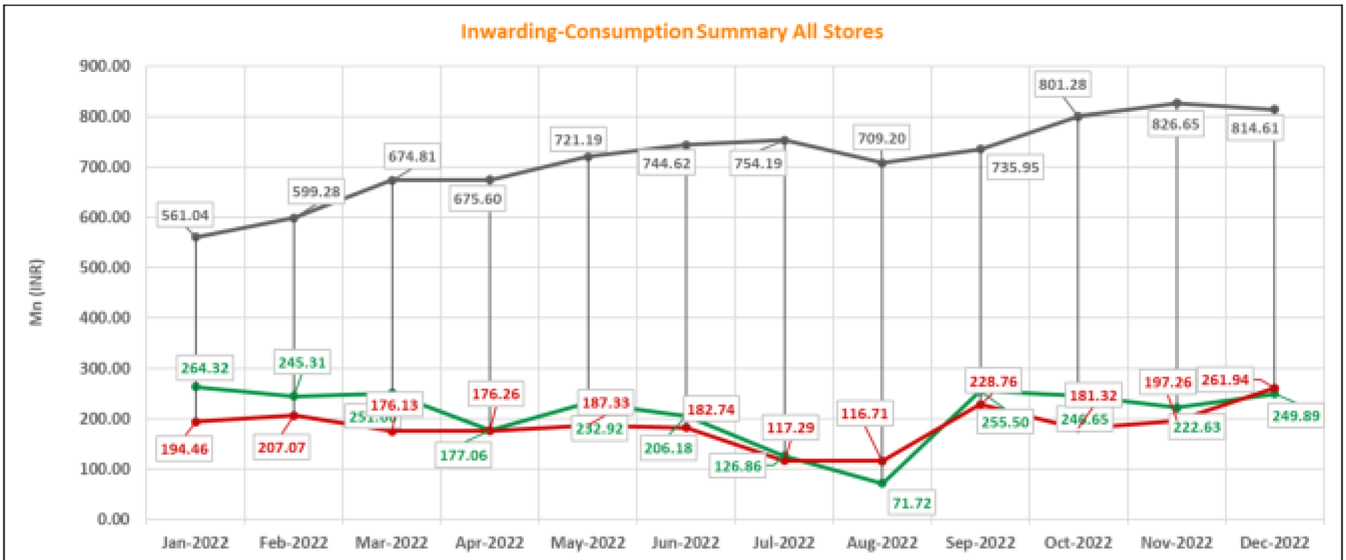
5.2.5 Task – In-warding Consumption Summary for Plant Division for 2021



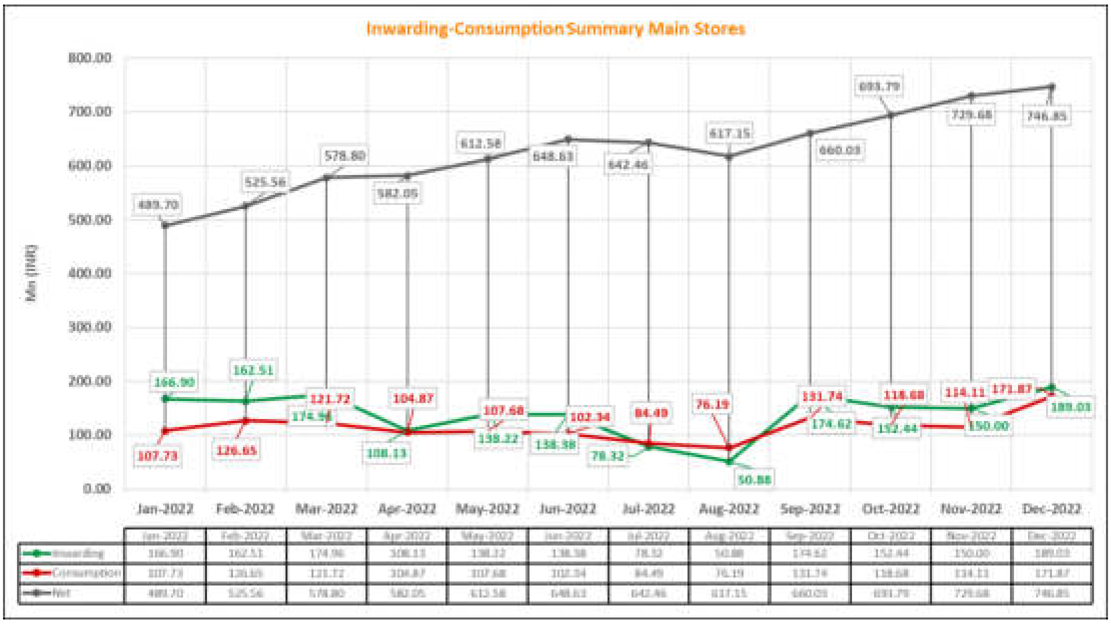
	Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021	Jun-2021	Jul-2021	Aug-2021	Sep-2021	Oct-2021	Nov-2021	Dec-2021
Inwarding	269.71	321.15	295.13	273.21	234.86	146.04	149.25	253.93	274.15	241.58	234.48	323.62
Consumption	231.49	279.58	272.92	235.64	238.12	238.57	239.31	278.77	285.67	254.53	267.50	352.35
Net	38.22	41.57	22.21	37.57	-3.25	-92.54	-90.06	-24.83	-11.52	-12.94	-33.02	-28.72

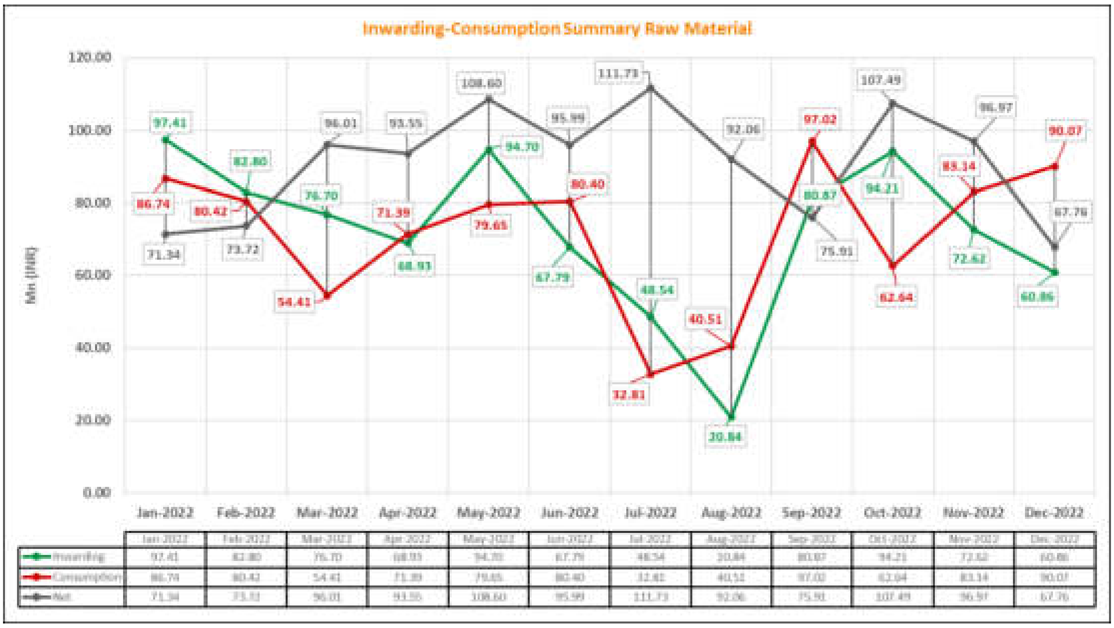
Fig 5.4 In-warding Consumption Summary DP 2021

5.2.6 Task – In-warding Consumption Summary for Plant Division for 2022



	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	Dec-2022
Inwarding	264.32	245.31	251.66	177.06	232.92	206.18	126.86	71.72	255.50	246.65	222.63	249.89
Consumption	194.46	207.07	176.13	176.26	187.33	182.74	117.29	116.71	228.76	181.32	197.26	261.94
Net	561.04	599.28	674.81	675.60	721.19	744.62	754.19	709.20	735.95	801.28	826.65	814.61





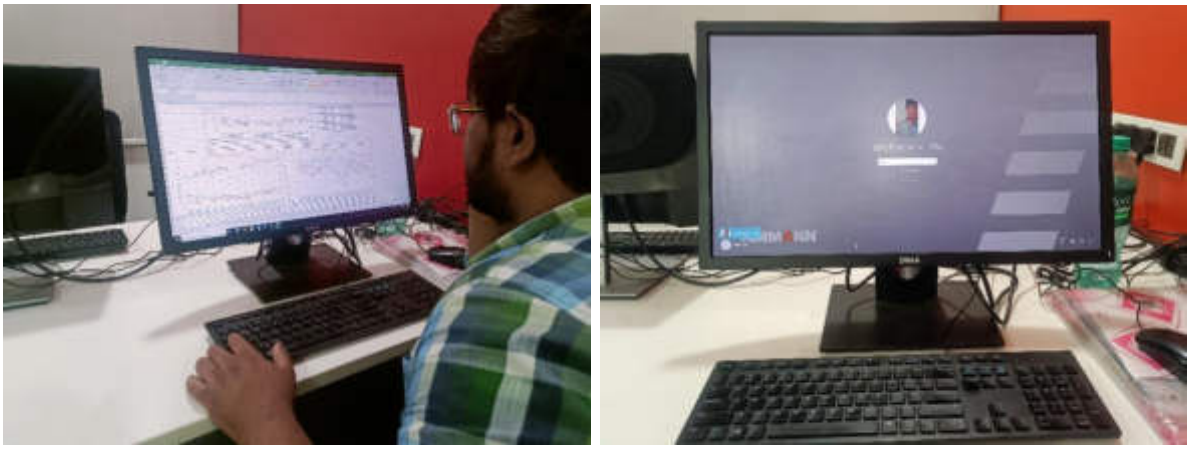
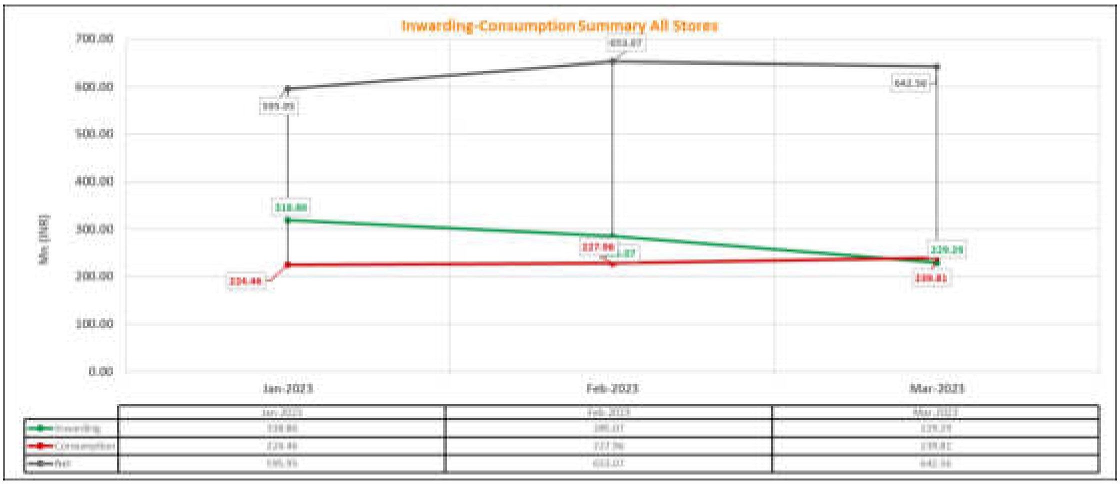
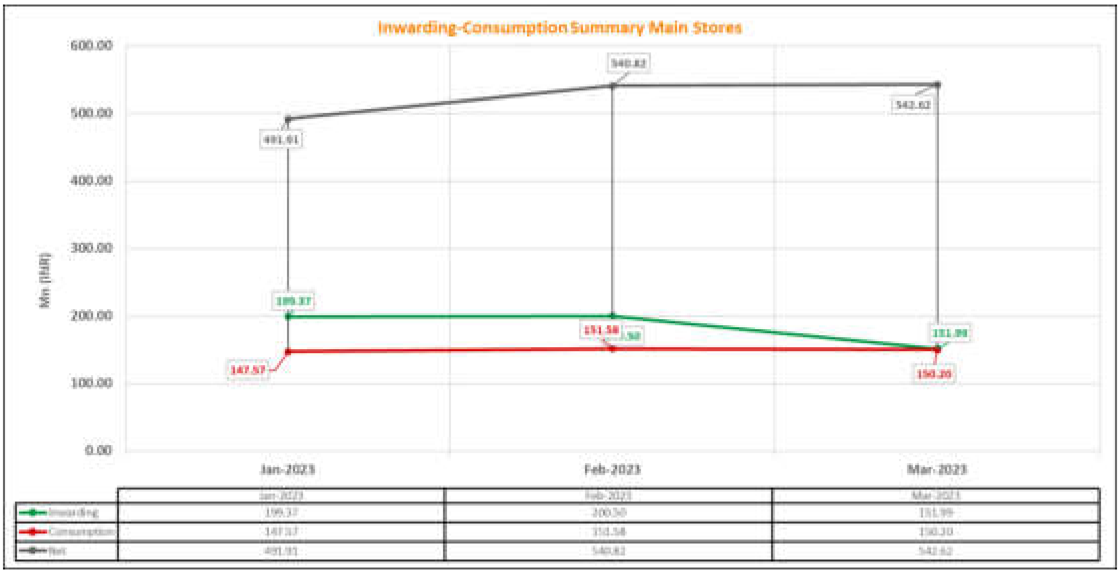


Fig 5.5 In-warding Consumption Summary DP 2022

5.2.7 Task – In-warding Consumption Summary for Plant Division for 2023





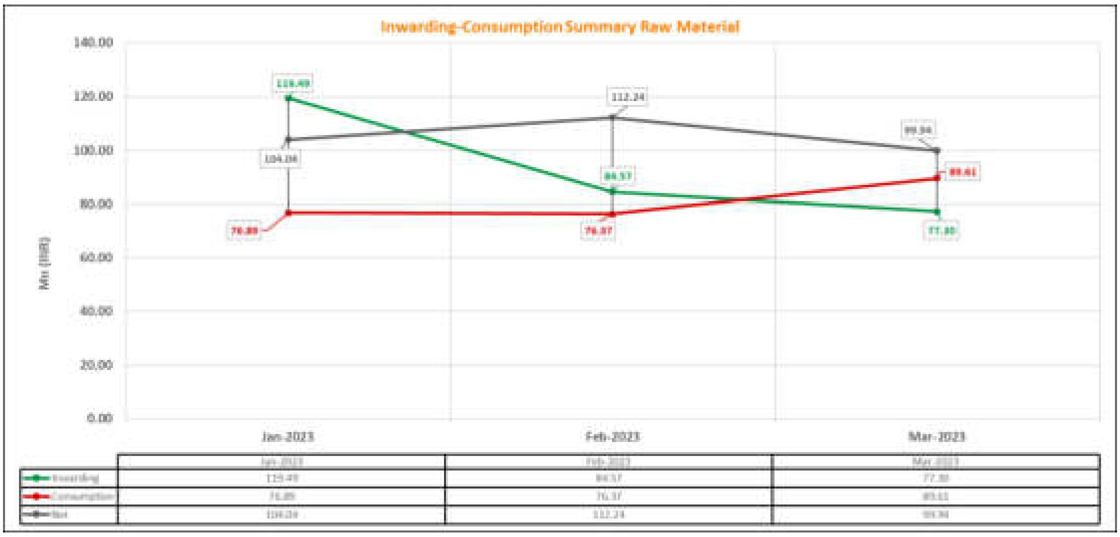


Fig 5.6 In-warding Consumption Summary DP 2023

5.2.8 Task – Low-Cost Supplier Analysis for materials on QCD Parameter

			Supplier 1					
S.No.	Part Number	Description	Supplier Code - Supplier 1	Supplier Name - Supplier 1	SOB (2022) - Supplier 1	Unit Price - Supplier 1	Qty (2022) - Supplier 1	Total Qty - Supplier 1
1		Drum W (DD)		Royal Steel India	84%		138.00	164.00
2		Extendable Pipe ASSEMBLY		Pioneer Hydraulics	95%		785.00	822.00
3		MPT TANDEM PUMP:46CC, 19SPLINE		Danfoss Power Solutions Gmbh & Co.	98%		163.00	166.00
4		Conveyor Chain 80MM PITCH 92 FLAT		Western Engineering Works	93%		8272.64	8920.32
5		Drum WELDMENT		Rane Axle and Pressing Private Limi	53%		91.00	171.00
6		Diesel Engine H4 BS4 73HP@2200 12V ARX		Ashok Leyland Limited	98%		61.00	62.00
7		Water-Air Cooler WM6 CEV BSIV		UNITED INDUSTRIAL ENTERPRISES (I)	99%		230.00	232.00
8		Hydraulic Pump Tandem H1T053R		Danfoss Power Solutions Gmbh & Co.	86%		117.00	136.00
9		Tyre 23.1X26/12 PR [1504mmOD]		ATC Tires Pvt. Ltd	99%		240.00	242.00
10		Vibration motor A10FM45		BOSCH REXROTH INDIA LIMITED	96%		193.00	202.00
11		Adhesive POLYGRIP PLUS-909 1litre		SOMNATH PAINTS	71%		20000.00	28000.00
12		Drum W		Royal Steel India	88%		21.00	24.00
13		Tyre 12.00 X 20		JK TYRE & INDUSTRIES LTD	78%		470.00	599.00
14		Gearbox AP550 AP600		Cyclo Transmission Ltd	80%		99.00	124.00
15		Pipe 110x1165		Pioneer Hydraulics	96%		767.00	798.00
16		Oil water cooler ARX90		AKG INDIA PRIVATE LIMITED	97%		73.00	75.00
17		Link chain 1.1/4" (31.75X19.56X19.05)		Chevi Industries	94%		4093.81	4377.28
18		Chain wheel 64Teeth X 1.5" P [RWA-04]		Prakash Industries	57%		346.00	603.00
19		Chain wheel HUB DRUM		Tribhuvan Industries Limited	53%		272.00	510.00
20		Cover L RAW		PATEL TECHNOMATION PVT.LTD.	66%		155.00	235.00
21		Welding Wire MIG SIZE 1.2 MM		NOBLE ELECTRODES PVT.LTD	58%		29340.00	50340.00
22		Auger Segment 1/2 L.H[B-3-4640C]NI HARD4		ADEPT METATECH	93%		1112.00	1196.00
23		Pinion 57TX1.5"P HUB DRUM		Ashapuri Products	82%		418.00	512.00
24		Link chain 1.5" (BS)		Chevi Industries	78%		1712.97	2193.77
25		Installation kit Heater 12V		GAMATEC s.r.o.	98%		89.00	91.00
26		Auger Segment 1/2 R.H[A-3-4640C]NI HARD4		ADEPT METATECH	92%		1064.00	1152.00
27		Hub RAW		Paras Engineering Works	69%		153.00	222.00
28		Cover R RAW		PATEL TECHNOMATION PVT.LTD.	70%		113.00	161.00
29		Fluid Motor vibration		Danfoss Power Solutions Gmbh & Co.	96%		96.00	100.00
30		Drum cover odlitek		SAGAR FEREX	78%		144.00	185.00
31		Diesel engine 3T NV 88 "YAMMAR"		YANMAR ENGINE MANUFACTURING INDIA	56%		9.00	16.00
32		Flow Control Valve 160 - 1/2"BSP PORT		Hydro Pneumatic Equipment	75%		193.00	256.00

			Supplier 2					
S.No.	Part Number	Description	Supplier Code - Supplier 2	Supplier Name - Supplier 2	SOB (2022) - Supplier 2	Unit Price - Supplier 2	Qty (2022) - Supplier 2	Total Qty - Supplier 2
1		Drum W (DD)		Rane Axle and Pressing Private Limi	16%		26.00	164.00
2		Extendable Pipe ASSEMBLY		Vivek Engineering	5%		37.00	822.00
3		MPT TANDEM PUMP:46CC, 19SPLINE		Danfoss Power Solutions India Pvt.	2%		3.00	166.00
4		Conveyor Chain 80MM PITCH 92 FLAT		Galaxy Conveyors Pvt Ltd	7%		647.68	8920.32
5		Drum WELDMENT		Royal Steel India	47%		80.00	171.00
6		Diesel Engine H4 BS4 73HP@2200 12V ARX		Raj Kamal Automobiles	2%		1.00	62.00
7		Water-Air Cooler WM6 CEV BSIV		Reliance Sales Agency	1%		2.00	232.00
8		Hydraulic Pump Tandem H1T053R		Danfoss Power Solutions India Pvt.	14%		19.00	136.00
9		Tyre 23.1X26/12 PR [1504mmOD]		J K TYRE & INDUSTRIES LTD.	1%		2.00	242.00
10		Vibration motor A10FM45		Bosch Rexroth (India) Ltd	4%		9.00	202.00
11		Adhesive POLYGRIP PLUS-909 1litre		Manaki Enterprise	29%		8000.00	28000.00
12		Drum W		Rane Axle and Pressing Private Limi	13%		3.00	24.00
13		Tyre 12.00 X 20		CEAT LIMITED	22%		129.00	599.00
14		Gearbox AP550 AP600		Ingeco Gears Pvt Ltd	20%		25.00	124.00
15		Pipe 110x1165		Vivek Engineering	4%		31.00	798.00
16		Oil water cooler ARX90		UNITED INDUSTRIAL ENTERPRISES (I)	3%		2.00	75.00
17		Link chain 1.1/4" (31.75X19.56X19.05)		RENOLD CHAIN INDIA PRIVATE LIMITED	6%		283.46	4377.28
18		Chain wheel 64Teeth X 1.5" P [RWA-04]		Ashapuri Industries	43%		257.00	603.00
19		Chain wheel HUB DRUM		ANANT TECHNOCAST	47%		238.00	510.00
20		Cover L RAW		ANANT TECHNOCAST	20%		47.00	235.00
21		Welding Wire MIG SIZE 1.2 MM		SHAKUNT ENTERPRISES PVT. LTD.	22%		11010.00	50340.00
22		Auger Segment 1/2 L.H[B-3-4640C]NI HARD4		Tribhuvan Industries Limited	7%		84.00	1196.00
23		Pinion 57TX1.5"P HUB DRUM		Laxmi Traders & Enginners	18%		94.00	512.00
24		Link chain 1.5" (BS)		RENOLD CHAIN INDIA PRIVATE LIMITED	22%		480.79	2193.77
25		Installation kit Heater 12V		Air Temp Refrigeration Services	2%		2.00	91.00
26		Auger Segment 1/2 R.H[A-3-4640C]NI HARD4		Tribhuvan Industries Limited	8%		88.00	1152.00
27		Hub RAW		DRASHTI ENTERPRISE	31%		69.00	222.00
28		Cover R RAW		Tribhuvan Industries Limited	18%		29.00	161.00
29		Fluid Motor vibration		Danfoss Power Solutions India Pvt.	4%		4.00	100.00
30		Drum cover odlitek		ANANT TECHNOCAST	19%		35.00	185.00
31		Diesel engine 3T NV 88 "YAMMAR"		YANMAR INDIA PRIVATE LIMITED	44%		7.00	16.00
32		Flow Control Valve 160 - 1/2"BSP PORT		HYDROFIT HYDRAULICS PRIVATE LIMITED	25%		63.00	256.00

			Supplier 3						
S.No.	Part Number	Description	Supplier Code - Supplier 3	Supplier Name - Supplier 3	Combine 3	SOB (2022) - Supplier 3	Unit Price - Supplier 3	Qty (2022) - Supplier 3	Total Qty - Supplier 3
1		Drum W (DD)							
2		Extendable Pipe ASSEMBLY							
3		MPT TANDEM PUMP:46CC, 19SPLINE							
4		Conveyor Chain 80MM PITCH 92 FLAT							
5		Drum WELDMENT							
6		Diesel Engine H4 BS4 73HP@2200 12V ARX							
7		Water-Air Cooler WM6 CEV BSIV							
8		Hydraulic Pump Tandem H1T053R							
9		Tyre 23.1X26/12 PR [1504mmOD]							
10		Vibration motor A10FM45							
11		Adhesive POLYGRIP PLUS-909 1litre							
12		Drum W							
13		Tyre 12.00 X 20							
14		Gearbox AP550 AP600							
15		Pipe 110x1165							
16		Oil water cooler ARX90							
17		Link chain 1.1/4" (31.75X19.56X19.05)							
18		Chain wheel 64Teeth X 1.5" P [RWA-04]							
19		Chain wheel HUB DRUM							
20		Cover L RAW		Tribhuvan Industries Limited	4-105347|Cover L RAW|Tribhuvan Industries Limited	14%		33.00	235.00
21		Welding Wire MIG SIZE 1.2 MM		RAAJRATNA ELECTRODES PVT LTD	1481420|Welding Wire MIG SIZE 1.2 MM|RAAJRATNA ELECTRODES PVT LTD	20%		9990.00	50340.00
22		Auger Segment 1/2 L.H[B-3-4640C]NI HARD4							
23		Pinion 57TX1.5"P HUB DRUM							
24		Link chain 1.5" (BS)							
25		Installation kit Heater 12V							
26		Auger Segment 1/2 R.H[A-3-4640C]NI HARD4							
27		Hub RAW							
28		Cover R RAW		ANANT TECHNOCAST	4-105411|Cover R RAW|ANANT TECHNOCAST	11%		18.00	161.00
29		Fluid Motor vibration							
30		Drum cover odlitek		Tribhuvan Industries Limited	4-15331|Drum cover odlitek|Tribhuvan Industries Limited	3%		6.00	185.00
31		Diesel engine 3T NV 88 "YAMMAR"							
32		Flow Control Valve 160 - 1/2"BSP PORT							

Table 5.5 Low-Cost Supplier Analysis for materials on QCD Parameter

5.2.9 Task - BOM Planning Sheet Creation for Assemblies

Part No	Description	-O-PVW-0004A-001	-O-PVW-0004A-002	-O-PVW-0004A-006	-O-PVW-0004A-008	-O-PVW-0004A-010	-O-PVW-0004A-017	-O-PVW-0004A-019	-O-PVW-0004A-021	AF-O-PVW-0004A-025	AF-O-PVW-0004A-004	AF-O-PVW-0004A-023	AF-O-PVW-0004A-024	1655367	1652250	1652251	1652252	1619910	1619820	1621569	AF-O-PVW-0004A-015	AF-O-PVW-0004A-029	AF-O-PVW-0004A-018
	Circlip EXTERNAL 50 MM	2	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M14x30 10.9 galZn	2	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cyl head screw HexSkt M6x20 10.9 galZn	10	24	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Countersunk screw HexSkt M10x30 10.9 ga~	36	27	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Washer DOWTY 1/4" BSP	3	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M6x15 8.8 galZn	29	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M6x20 8.8 galZn	48	8	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M8x20 8.8 galZn	95	144	66	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M10x25 8.8 galZn	31	28	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M12x25 8.8 galZn	4	18	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M12x35 8.8 galZn	18	42	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M12x40 8.8 galZn	72	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
	Hex screw M16x40 10.9 galZn	6	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hex screw M16x50 10.9 galZn	2	11	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hexagon nut M6 8 galZn	18	16	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hexagon nut M8 8 galZn	53	123	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8
	Hexagon nut M10 8 galZn	42	11	24	0	0	0	0	0	0	0	0	6	0	0	0	0	10	14	10	7	0	7
	Hexagon nut M12 8 galZn	26	20	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hexagon nut M14 10 galZn	68	70	70	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Washer 14/24x2.5 galZn	77	40	24	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Washer PLAIN M14	72	66	72	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Washer 18/30x3 galZn	33	25	12	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spring washer M6 (ID6.1XOD11.8XTHK1.6)	55	24	12	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
	Spring washer M8 (ID8.2XOD14.8XTHK2)	137	146	58	6	3	0	0	12	0	0	4	0	0	0	0	0	0	0	0	0	0	0
	Spring washer M10 (ID10.2XOD18.1XTHK2.2)	193	106	42	0	8	0	0	0	0	0	0	6	2	0	0	0	0	0	0	2	0	2
	Spring washer M12 (ID12.2XOD21.1XTHK2.5)	88	94	32	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
	Spring washer M16(ID16.2XOD27.4XTH3.5)	24	24	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Locknut M16	8	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.6 BOM Planning Sheet Creation for Assemblies

5.2.10 Task – Material arrangement at the plant as per planning for Inventory Control

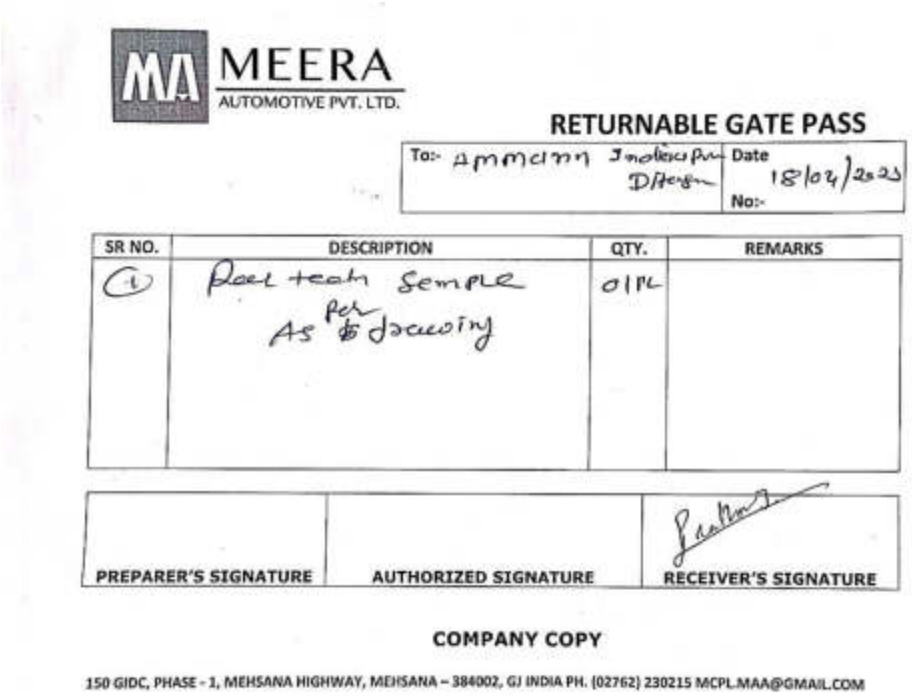
Material no.	Supplier Code	Supplier Name	Material Description	PO	Storage location	Quantity QU	Price / Per	Status
		MAHALAXMI ENGINEERING	Plate for pump mounting - PMP		2300 DM Main. 01	1 PCE		Received on 22/04/2023
		Ambica Industries	Pin Clutch		2400 DM Main. 02	500 PCE		Material will be dispatched till evening of 05/05/2023
		AUSTIN ENGINEERING COMPANY LIMITED	Bearing V18S092 CB-S-0370-18-B-2-00		2300 DM Main. 01	2 PCE		Price Finalization Pending from Supplier's Side (Expected - 27/04/2023)
		Meera Automotive Pvt. Ltd.	Joint Propeller shaft (1050 bolt-on)		2300 DM Main. 01	28 PCE		Vishnu Bhai will Coordinate with sagar sir for part approval
		CONNECT CABLES	Battery Cable U2-BLACK-300 DUAL CLAMP		2300 DM Main. 01	9 PCE		Received on 20/04/2023
		PACOLINE INDUSTRIES PRIVATE LIMITED	Lamp AUX-30 LED 24V white		2300 DM Main. 01	15 PCE		2 PCE Received and 2 PCE dispatched but Docket number is yet to receive
		ANUPAM ENTERPRISE	Coupling Spider Rotex 38 T-PUR 98ShA		2300 DM Main. 01	5 PCE		Received on 25/04/2023
		Ambica Industries	Stud Bolt M12X1.75 - 55 Lg		2400 DM Main. 02	6 PCE		Received on 29.04.2023
		Ambica Industries	Round Bar 16-765		2400 DM Main. 02	3 PCE		Received on 29.04.2023
		VIJAY ENGINEERS	Coupling Love Joy R/L-5234/0		2400 DM Main. 02	50 PCE		Dispatching will be processed on 06/05/2023 & will be Received till 09/05/2023
		PARTH RUBBER TECH PVT LTD	Rubber 08x175x300		2300 DM Main. 01	5 PCE		Received on 02/05/2023
		MAHALAXMI ENGINEERING	Spacer for FAN AP600/550 BSIV		2300 DM Main. 01	2 PCE		Received on 25/04/2023
		Chevi Industries	Linkage Master 1.25" full lock ASA		2300 DM Main. 01	10 PCE		Received on 02/05/2023
		Chevi Industries	Linkage Master 1.5" full lock ASA		2300 DM Main. 01	10 PCE		Received on 02/05/2023
		ANUPAM ENTERPRISE	Coupling Bowex-45		2300 DM Main. 01	12 PCE		Minimum 4 Weeks of Processing
		VISHWKARMA MFG.CO.PVT.LTD	Steering Column fixed		2300 DM Main. 01	25 PCE		Material will be dispatched on 04/05/2023

Table 5.7 Material Arrangement for Inventory Control

Fig 5.7 Material Arrangement for Inventory Level Control

5.2.11 Task – Approval of a Sample Standard Part

Fig 5.8 Approval of a Sample Standard Part



MEERA
AUTOMOTIVE PVT. LTD.

RETURNABLE GATE PASS

To:- Ammann India Pvt D/Hegm	Date 18/04/2023 No:-

SR NO.	DESCRIPTION	QTY.	REMARKS
1	Reel teeth Semple As per drawing	01PC	

PREPARER'S SIGNATURE	AUTHORIZED SIGNATURE	RECEIVER'S SIGNATURE

COMPANY COPY

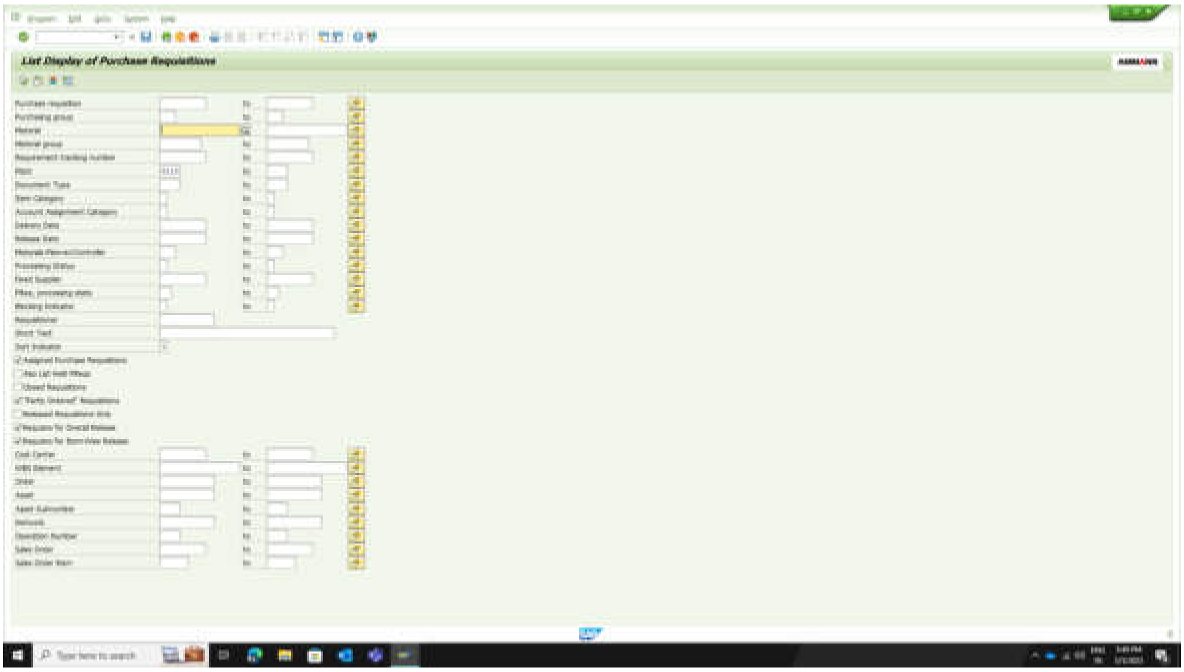
150 GIDC, PHASE - 1, MEHSANA HIGHWAY, MEHSANA – 384002, GJ INDIA PH. (02762) 230215 MCPL.MAA@GMAIL.COM

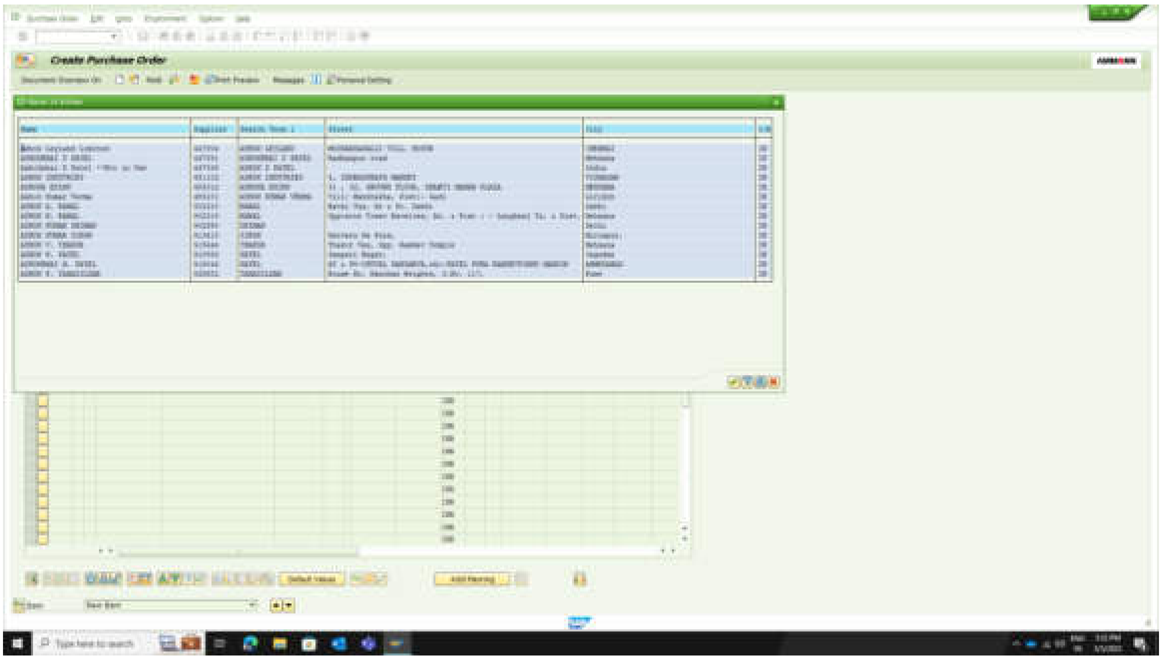
Fig 5.9 Meera Automotive Gate Pass for Company for Sample Part

5.2.12 Task – On-Field Problem Solving, Identification of different parts due to missing of identification tag from supplier side

Fig 5.10 On-Field Problem Solving

5.2.13 Task – PO Creation for respective open PR's





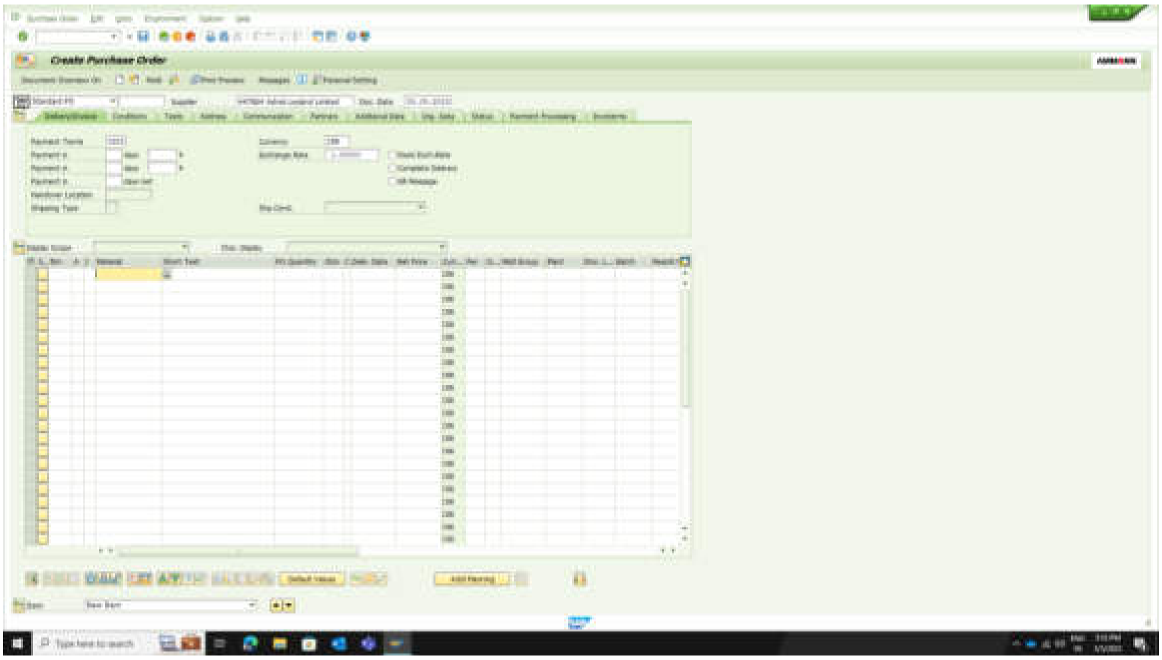


Fig 5.11 Creating PO for Respective Open PR

5.2.14 Task – Effective Nesting of Sheet Metal for Appropriate Utilization Factor

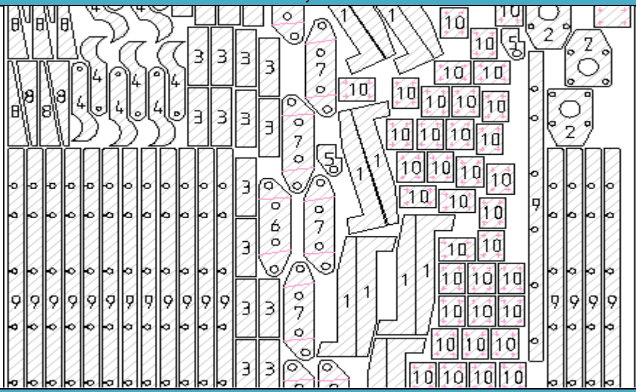
Date	Fri Apr 07 15:23:15 2023

Nest Overview Report

Plan information					
Project Name	AP550BSV12MM	Number of nests	9	Number of sheets	8
Machine	2: Trumpf TruLaser 3060 Sinumerik 840D	Strategy	Oxygen/Standard/7.5 In Lens	Programmer	AINSYP

MS, 12mm

Nest Layout



Production Information					
Nest Name	P9 AP550BSIV12MM	Weight	377.55 Kg	Cutting length/Sheet	123.12 Mt.
Sheet Size	2000X2004 MM	Cutting Time	01:34:38	Total Cut Length	123.12 Mt.
Quantity	1 Sheet	Net Utilization	89.09%	Total Piercing	202
Material	MS, 12mm	No of Sheet Run	1	Rapid Move Length	40.38 Mt.

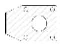
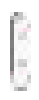
ID	Part Image	Part Name	Per Sheet	Nested	Part Wt.	Part X	Part Y
1		1484885-12-2-E250	12	12	2.78	457.00	125.00
2		1484898-12mm-2-E250	4	4	2.34	215.00	145.00
3		1484907-12-4-E250	22	22	1.35	220.00	65.00
4		1485123-12mm-2-E250	10	10	1.39	298.57	84.14
5		1485346-12mm-2-E250	3	3	0.59	76.20	120.00
6		1488430-12mm-1-E250	2	2	2.88	100.00	374.52
7		1488434-12mm-1-E250	6	6	2.88	100.00	374.52
8		1580073-12mm-2-E250	9	9	1.21	320.00	65.00
9		SCREED-PLATE-DIST-1201	17	17	5.38	1177.00	50.00
10		1485460-12mm-4-E250	52	52	0.92	115.00	85.00

Fig 5.12 Effective Nesting of Sheet Metal for Appropriate Utilization Factor

5.2.15 Incoming Quality Check for Material Ordered

Fig 5.13 Rejected Parts

Chapter: 6 Internship Outcome and Experiences

As an intern at Ammann India Private Limited, I had the opportunity to work on a range of tasks related to cost evaluation, supplier relationship management, quality control, inventory management, and material consumption analysis. Throughout my internship, I gained valuable knowledge and hands-on experience in these areas, which have contributed significantly to my personal and professional growth.

One of the key tasks I worked on was cost evaluation and reduction. I learned how to analyze supplier performance and evaluate the cost reduction measures implemented by suppliers. I also gained experience in evaluating the quality of existing components and incoming materials, which helped me understand the importance of quality control in the manufacturing process.

Fig 5.14 Ammann India Main Office

In addition to these tasks, I also learned how to perform material consumption analysis, which helped me identify opportunities for cost savings and inventory management. I also gained experience in creating Purchase Orders (POs) and in nesting sheet metal for optimal utilization. Furthermore, I learned how to use SAP software for material management and analysis.

Throughout my internship, the team at Ammann India was incredibly supportive. They were always willing to help and provide guidance, which made the learning experience all the more valuable. The organizational culture at Ammann India was also welcoming and inclusive, which made it easy to learn and grow.

Fig 5.15 My Learnings and Experiences

Overall, my internship experience at Ammann India was exceptional. I gained valuable knowledge, developed new skills, and formed lasting professional relationships. I am grateful for the opportunity and would recommend Ammann India to anyone looking for a challenging and rewarding work environment.

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Appendix 1 – NOC Letter

SAFFRONY INSTITUTE OF TECHNOLOGY
S.P.B. PATEL ENGINEERING COLLEGE

AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY (YEAR 2008)
APPROVED BY ALL INDIA COUNCIL FOR TECHNICAL EDUCATION (AICTE) (YEAR 2006)

SIT/SPBPEC/S2023/NOC/31

Date: 20th January 2023

To,
Ammann India Pvt Ltd
Plot No. 2, 80, Ditasan,
Ahmedabad - Patan Highway Rd, Jagudan,
Gujarat 384460

Subject: NOC for Industrial Internship of our student at your organization.

Dear Sir/Ma'am,

Greetings of the day!

S.P.B. Patel Engineering College, Mehsana is one of the leading Engineering Institutions in the North Gujarat. At present, we offer seven engineering branches – Mechanical, Automobile, Civil, Electronics and Communication, Electrical, Information Technology and Computer Engineering as well as three post graduate programs – Masters in Production Engineering, Computer Science and Electronics & Communication.

We wish to send our final year 8th Semester Mechanical Engineering students for **Industrial Internship of 12 weeks tentatively** starting from **January 2023** at a reputed organization like yours.

The objective is to give students practical exposure to real life working environment & current technologies in addition to theoretical knowledge. In this regard, we request you to provide Industrial Internship in your esteemed organization for the following student:

Sr. No.	Name of Student	Enrolment No.	Mobile No.
1	Pratham Kirti Jain	200390119506	9664322682

We request you to give our student an opportunity for practical learning at your organization.

We also request you to provide a internship certificate/letter after successful completion of the internship.

Yours sincerely,

Shaikh

Prof. Tausif Shaikh
Department Placement Coordinator
Assistant Professor, Mechanical Engineering Department
S.P.B. Patel Engineering College, Linch
Email: tausif.shaikh@saffrony.ac.in
Mobile No: 8200754891

S.P.B. Patel Engineering College Linch

Near Shanku's Waterpark, Ahmedabad-Mehsana Highway,
At & Post : Linch, Dist. : Mehsana, Gujarat-384 435. Phone / Fax (02762) 285721
www.saffrony.ac.in • E-mail : info@saffrony.ac.in

Appendix 2 – Weekly Annexure

Week 1

GUJARAT TECHNOLOGICAL UNIVERSITY
(Established under Gujarat Act No. 20 of 2007)
ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I
Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Mr. Pratham K. Jain.
DIARY OF THE WEEK: Dt: 23/01/23 TO 27/01/23
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

→ In the first week of internship, I got to know about the industry and it's background. The products and services provided by the industry.
→ I learnt about Asphalt and Concrete Plants, about their working, Components, Construction, manufacturing processes, etc.
→ There were several manufacturing machines used to manufacture in-house parts and some of them are bought out items which are ordered directly to outside interested parties.
→ Additionally, some components are sent seperately to other industries, to manufacture as per requirement.
→ Manufacturing is done by input of raw material in the form of sheets whose thickness varies from 2 to 30mm or more as per industrial standards & requirement.
→ Manufacturing machines includes Plasma Arc cutting M/c, drilling Machines, Bending Machines, Shearing Machines. Laser Cutting Machines, Plate rolling M/c's, etc.

→ Finishing & Stress Relieving process also includes such as shot Blasting. Also, Painting for final touch to components.
→ For Fabrication, MIG Welding is used and Arc welding is used for special purposes.
→ For Circumferencial welding on Cylindrical Component (such as Drum / Mixer, Bitumin Tank) Robot welding is performed with supporting fixture.
→ Support Roller Fixture is used to support and flexible the rotation of Cylindrical Component.
→ Safety observations regarding safety and color code for different gas cylinder is also mentioned at floor space of plant.
→ In Asphalt plant, I have observed regarding various components manufacturing processes. Components includes feeders (with Conveyor), Single Duct Screen, Drum, Hot Elevator & Chain / Conveyor Bucket, Vibrating Screen, Hot bin, Pug Mill, Bitumin Tank and pipes, Storage Silo, Bag House, etc.
→ In Concrete plant, Components includes Aggregate frame, Extension plate, Skip Truck, Weighing Unit, CBT Mixture, Mounting Frame, Machine Support - ABC, Platform, etc.
→ Material Handling Equipments are also used, such as overhead Cranes, Fork Lift Truck, Pallets, Magnetic Grippers, etc.
→ I have also observed possible welding defects in various components. Some welding defect includes Incomplete Fusion, & Undercut defect, Missing weld, etc.
→ Other possible defects observed are Bitumin Leakage, Dimension Deviation, Improper Frame alignment, etc.

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TOTAL HOURS: 30

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of ~~Faculty Mentor~~ officer-in-charge of Dept/section/plant

Signature of officer-in-charge of Dept. / Section / Plant
Faculty Mentor

Date:
17/02/2023

Date: 18/03/2023

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 2

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Annexure I

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Mr. Pratham K. Jain

DIARY OF THE WEEK: DT: 30/01/23 TO 03/02/23

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

→ In second week of internship, I got to know about the Machine Division. Types of Construction machines manufactured in machine division are Pavers and Compactors.

→ Basically, I got to know about two types of paver, The one is sensor pavers which includes AP550, AP600, AP800, AP1000, etc.

→ The another one is mechanical Paver. There is only one type of model manufactured in this Category. Includes WM-6 (Mechanical Paver).

→ Then other machines manufactured are Compactors. These compactors exists in two types - 1) Single Drum Rollers 2) Tandem Rollers.

→ These compactor includes various models such as ARS 110.1, ARS 110.2, ARS 122, ~~ARS~~ ARX 90.2, ARX 91, etc.

→ These pavers ~~includes~~ & Compactors includes in-house manufacturing in addition to boughtout items/Parts.

-> Various Material Handling Equipments are used such as Jib Crane Floor Mounted, Jib crane Wall mounted, overhead Crane, Fork lift Truck, stacker, etc.

-> I have observed the assembly of Sensor Paver in which various Hydraulic hose pipes are fitted on the chasis. The chasis is made in the plant and all other parts are brought as boughtout parts.

-> I have learned about wheel hub Assembly in which the Rear & front hub is applied with grease and then bearing is being fitted in the Hub. Here Tapper Roller Bearing is used.

-> Once Bearing is fitted then oil seals are fitted on the bearings.

-> After that, I have observed the fitting of Hydraulic Nipple / Fitter, as on inlet - outlet part for hydraulic hose pipe.

-> This Hydraulic fitters are installed with the use of Torque wrench to fit it with suitable Torque depending upon it's size.

-> I have also observed the installation of Gear Box, Belt Conveyor with chain, chain sprocket, Disc Brake, Motor, engine, etc.

-> Engine used are of Ashok Leyland (BS4 Engine which may vary).

-> Also Flow process of WM-6 (Mechanical Paver) which lies under category of Line -Assembly.

-> Also Compactors are assembled in same way, Chasis is Built in-house and drum is boughtout part which can be modified as per requirement.

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TOTAL HOURS: 35

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of ~~Faculty Mentor~~ officer-in charge dept-/ section / P

Date: 17/02/2023

AMMANN INDIA PVT. LTD. DITASAN

Signature of officer-in-charge of-Dept. / Section / Plant. Faculty mentor

Date: 18/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 3

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Annexure I
Enrollment no: 200390119506.

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain
DIARY OF THE WEEK: Dt: 13/02/23 TO 17/02/23
DEPARTMENT: Mechanical Engineering SEM: 8th.
NAME OF THE ORGANISATION: Ammann India Pvt Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department – Machine Division
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

I have observed the Assembly flow about Compactor ARX90.2 and also gained knowledge about their sub-assemblies. I have Explored various components of ARX90.2 with the name of their supplier respectively. I have Also discovered about the fabrication of Compactors. Their In-house Fabrication. I have also got to know about the Purchase procedure. Their subdivisions such as Supply chain Management (SCM) and Strategic Sourcing. I gained knowledge about Sheet Metal brought in industry and Sheet metal grades. I have also got to know about No axle Concept of Ammann Group. My Guide has discussed a lot of technical concept regarding Compactors and Pavers with me. I was also assigned for certain task to find some answers regarding the concepts that was must needed to know for understanding the product in better way.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer-in-charge
of Dept. / Section / Plant

DITASAR

27/02/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 4

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Annexure 1

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain

DIARY OF THE WEEK: DT: 20/02/23 TO 24/02/23.

DEPARTMENT: Mechanical Engineering SEM: 8th.

NAME OF THE ORGANISATION: Ammann India Pvt Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department - Machine Division

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

I have got to know about concept of Wiring Harness, guided by my Mentor. I got to know about Electrical wiring drawings and their technical terms. I have got to know regarding the knowledge of Pre-Inspection Test for ARX 90.2. I gained knowledge about Method of Inspection and Acceptance Criteria of the parameter. I have observed the NPD Models, (New Product Development). In which I have observed Rejected Parts. The Rejected part was Frame of Articulated joint in 12 Quantity. They were found Rusted due to uncertainity of weather. Also, observed several issues such as inappropriate RPM in vibrating Motor in screed of Sensor Paver. In Addition, There was ~~an~~ Speed issues in NPD Model ARS110·1 T3 (Pre-Series), at PDI (Pre-Dispatch Inspection) Department. I gained knowledge about Maintenance services of ARS122. I have also ~~obs~~ observed drum Assembly. Drum is also filled with various liquids depends on use such as Water, Oil, Calcium Chloride, etc.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer-in-charge of Dept. / Section / Plant

27/02/2023

DITASAN

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 5

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Annexure I
Enrollment no: 200390119506.

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain
DIARY OF THE WEEK: Dt: 27/02/23 TO 04/03/23
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Ammann India Private Limited.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi.

DESCRIPTION OF THE WORK DONE IN BRIEF

This week I got to know about the lubication schedule of ARS 122. Maintenance for every 6 Months, once a Year, Every 2 years, etc. I had visited the quality department to check various Instruments used for quality check approval. I have learned about Run Test for AR x 90.2 on various duration categorized for various function. A Technical learning was given by my External guide about casting, Types of Cast Iron used for fulfilling Tensile Criteria. I was also asigned for task of accuring physical weight of various components. I also learned about various Fluids used in ARS 122 for various functions. I was also assigned for a task to update Reduction Summary from various supplier. I also learned to SAP Software for finding store location for material, also to find their drawing documents using SAP.

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TOTAL HOURS: 51

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 13/03/2023

Signature of Officer in charge of Dept / Section / Plant

ANNMANN INDIA PVT. LTD. DITASAN

Date: 15/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 6

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Annexure I

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain.

DIARY OF THE WEEK: Dt: 06/03/23 TO 10/03/23

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

This week I observed a pallet of parts with Red Card which indicates rejection. The part was rejected due to its poor grinding quality. Deeper cuts at the edge were visible. I was assigned for a task of quality check to measure the dimension of different washers used in Apllo paver. The motive was to check the quality of washer supplied by respective vendors. A Technical ~~Ca~~ Session was taken by my external guide on wiring harness and its processes such as crimping, Tapping process and defects for wiring harness. I learned about ACE Compaction Features. It includes ~~d~~ differents version such as ACE (Ammann Compaction Expert), ACE^{force}, ACE^{Pro}, etc. Each is used for different applications and purposes.

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TOTAL HOURS: 35

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of Officer-in-Charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITASAN

Date: 15/03/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 7

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Mr. Pratham Kirti Jain

DIARY OF THE WEEK: Dt: 13/03/2023 TO 17/03/2023

DEPARTMENT: Mechanical Engineering SEM: 8th.

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

In this week of internship, I learned about the Tampering effect in paver in the detail. I got knowledge about it's main function, working Temperature, Material Properties of Tamper Bar, also type of metal used to manufacture those tamper bars. Similarly, I learned about vibration & vibratory plate used in paver in detail. Also I learned about ~~some~~ the term ROHS Compliance. I got to know about it in detail about its problems and respective solutions excists. I got the knowledge about topping process performed on a BAY / Dashboard to prepare wiring of any machine. I also got knowledge about Terminal Crimping of the electrical wires used. Also defects which are possible in terminal crimping which affects the ~~ee~~ electricity transferred for specific function.

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TOTAL HOURS: 43

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of In-charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITASAN

Date: 30/3/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 8

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I
Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Mr. Pratham Jain
DIARY OF THE WEEK: DT: 20/03/2023 TO 24/03/2023
DEPARTMENT: Mechanical Engineering SEM: 8th.
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

In this week of internship, I was assigned by various task in collaboration to work with SAP software. I was assigned for a task of analyzing inwarding - Consumption of Plant Division and Machine Division for duration of Jan 21 to Dec 21. I learned about this task in SAP. I got to know about the parameters affect the inventory. I explored various store locations for plant and Machine division with the respective of their movement type and function. I was assigned for a task for updating data for BOM (Bill of Materials) quantity for parts with their respective assembly using SAP software of compactors ARS 110.2 BSV, ARX 90.2 BSV, & ARX 32.2. Also I got to update some about asphalt pavers such as WM6 BS(CEV)V, AP550 BS (CEV) V and AP600 BS (CEV) V.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 17/05/2023

Signature of Officer-in-charge of Dept/Section/Unit

AMMANN INDIA PVT. LTD. DITASAR

Date: 30/5/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 9

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I

Enrollment no: 200390119506.

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain

DIARY OF THE WEEK: DT: 27/03/2023 TO 31/03/2023.

DEPARTMENT: Mechanical Engineering. SEM: 8th.

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

I got an update regarding the inwarding - Consumption summary about making some changes in Previous sheet. I had to take Some specific Store in consideration for the summary of Machine Division for year 2022 and 2023. Also ~~I was~~ it was reccommended to consider the opening stock at the starting of year. I received three different sheets of work order to update material and there respective BOM quantities of Machine WMG BS(CEV)V power, APB50 BS(CEV) V power & AP600 BS(CEV)V. Further I learnt about new concept of the department known as Procure to Pay process. I learnt about Requirement identification. Also several steps in Procure to Pay process such as Purchase requisition, Supplier selection, Negotiation, Purchase Order, Goods or Service Reciepts, Invoice Receipt, Invoice Processing, Payment, Record keeping, etc.

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TOTAL HOURS: 43

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of Officer-in-Charge of Dept. / Section / Plant

DITASAN INDIA PVT. LTD.

Date: 17/05/2023

Date: 01/05/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 10

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Kirti Jain.

DIARY OF THE WEEK: DT: 03/04/2023 TO 07/04/2023.

DEPARTMENT: Mechanical Engineering. SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

I was assigned for the task of analysis of supplier on various factors such as cost, ~~[illegible]~~ QCD, SOB, etc. I had an L1L2 Supplier sheet in which all the suppliers were listed for materials respectively. There were two or more suppliers of/for each material. The purpose of Task was to analyze the lowest rate of supplier among the available supplier for respective material. I learnt about a new concept in strategic sourcing. The PPAP (Product Part Approval Process) is an output of APQP (Advanced Product Quality Planning). I learned ~~all~~ about 18 elements for Automotive industry. Such as Design Documentation, Engineering change documents, Customers, Design Failure Mode and effect Analysis (DFMEA), Process Flow Diagrams, Process Failure Mode and Effect Analysis (PFMEA), Control Plan, Measurement System Analysis Studies, Dimensional Results, Records of Material Performance Results, etc.

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

TOTAL HOURS: 44

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITASAN

Date: 17/05/2023

Date: 01/05/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 11

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Annexure 1

Enrollment no: 200390119506

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Jain

DIARY OF THE WEEK: Dt: 10/04/2023 TO 14/04/2023

DEPARTMENT: Mechanical Engineering. SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

In this week I gained a fruitful knowledge about the different SAP modules used in different industries for different departments and applications, I got to learn about various SAP Modules such as Financial Accounting, Financial SCM, Controlling, Material Management, Sales & Distribution, Logistic execution, Production Planning, Quality Management, Plant Management, Project Systems and Human Resources. I learned about various T-codes also known as Transaction codes for SAP MM module. I have also completed a course on udemy on supply chain management which was useful for me to understand about the ~~scm~~ SCM process and its actual working.

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TOTAL HOURS: 44

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 17/05/2023

Signature of officer in charge of Dept. / Section

ARMANN INDIA PVT. LTD. DITASAN

Date: 03/05/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, interest taken, Work done etc.

Week 12

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Annexure I

Enrollment no: 200390119506.

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Pratham Jain

DIARY OF THE WEEK: DT: 17/04/2023 TO 21/04/2023

DEPARTMENT: Mechanical Engineering SEM: 8th.

NAME OF THE ORGANISATION: Ammann India Pvt Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department.

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Sagar Joshi

DESCRIPTION OF THE WORK DONE IN BRIEF

In this week I have performed inventory Consumption summary task with consideration to plant division for several store location and from Jan 2022 to Mar 2023. Also I was assigned for some new Tasks. I have to ~~mat~~ arrange the materials for several PO's generated. I have to manage the material to arrange it before the time. I have also arrange a sample part and have done its ~~a~~ quality check for the approval of the part for production of New AFT 500 BS ~~IV~~ models. I also learned about creating Purchase order ~~by~~ also processes of posting goods ~~to~~ receipt and invoices to fulfill the required Inventory planned for the production.

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TOTAL HOURS: 43

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 17/05/2023

Signature of officer in-charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITABAN

Date: 01/05/2023

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Appendix 3 – Annexure II

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Annexure 2

Feedback Form by Industry expert

Student Name: Pratham Kirti Jain Date: 01/05/2023

Work Supervisor: Mr. Sagar Joshi (Depty Manager). Title: Internship At Ammann India Pvt. Lmt.

Company/Organization: Ammonn India Pvt Lmt.

Enrollment No: 200390119506

Internship Address: Plot No. 2, 80, Ditason, Ahmedabad - Patan Highway, Jotana, Gujarat, 384480

Dates of Internship: From 23/01/2023 to 28/03/2023.

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility				✓
Uses technical knowledge and expertise				✓
Analyzes problems effectively				✓
Communicates well and writes effectively			✓	

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent):
Very much interested for indepth technicality.
Understood Function properly.

Additional comments, if any:

Signature of Industry person with name and Stamp: Sagar P Joshi (DM- Purchase) 01/05

Signature of the Faculty Mentor

AMMANN INDIA PVT. LTD. DITASAN

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Appendix 4 – ID Card

Appendix 5 – Attendance Sheet

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Student Visit for Project Work

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
1	23/01/23	9:00 AM	6:00 PM	02		
2	24/01/23	8:55 AM	5:50 PM	02		
3	25/01/23	9:02 AM	5:55 PM	02		
4	27/01/23	9:01 AM	6:05 PM	02		
5	30/01/23	8:50 AM	6:03 PM	02		
6	31/01/23	8:56 AM	5:58 PM	02		
7	01/02/23	8:59 AM	6:05 PM	02		
8	02/02/23	9:02 AM	6:02 PM	02		
9	03/02/23	9:05 AM	5:58 PM	02		
10	13/02/23	8:54 AM	5:57 PM	02		
11	14/02/23	8:52 AM	6:04 PM	02		
12	15/02/23	8:50 AM	6:08 PM	02		
13	16/02/23	8:56 AM	6:03 PM	02		
14	17/02/23	8:52 AM	6:06 PM	02		
15	20/02/23	8:54 AM	6:05 PM	02		
16	21/02/23	8:54 AM	5:58 PM	02		
17	22/02/23	8:52 AM	5:59 PM	02		
18	23/02/23	8:54 AM	6:05 PM	02		
19	24/02/23	8:58 AM	6:02 PM	02		
20	27/02/23	8:56 AM	6:05 PM	02		
21	28/02/23	8:57 AM	6:01 PM	02		
22	01/03/23	8:54 AM	6:05 PM	02		
23	02/03/23	9:00 AM	6:02 PM	02		
24	03/03/23	8:52 AM	6:10 PM	02		
25	04/03/23	8:55 AM	6:00 PM	02		
26	06/03/23	8:53 AM	6:05 PM	02		
27	07/03/23	8:56 AM	6:02 PM	02		
28	09/03/23	8:52 AM	6:05 PM	02		
29	10/03/23	8:58 AM	5:58 PM	03		

AMMANN

Student Visit for Project Work

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
29	13/03/23	8:54AM	6:03PM	02		
30	14/03/23	8:58AM	6:06AM	02		
31	15/03/23	8:57AM	6:06PM	02		
32	16/03/23	8:55AM	6:01PM	02		
33	17/03/23	8:50AM	6:01PM	02		
34	20/03/23	8:53AM	6:06PM	02		
35	21/03/23	8:54AM	6:05PM	02		
36	22/03/23	8:58AM	6:02PM	02		
37	23/03/23	8:52AM	6:01PM	02		
38	24/03/23	8:55AM	6:05PM	02		
39	27/03/23	8:52AM	6:01PM	02		
40	28/03/23	8:51AM	6:03PM	02		
41	29/03/23	8:50AM	6:05PM	02		
42	30/03/23	8:58AM	6:08PM	02.		
43	31/03/23	8:52AM	6:05PM	02		
44	03/04/23	8:55AM	6:05PM	02		
45	04/04/23	8:57AM	6:05PM	02		
46	05/04/23	8:52AM	6:01PM	02		
47	06/04/23	8:58AM	6:05PM	02		
48	07/04/23	8:59AM	6:04PM	02		

1. Video Shooting and Photography are strictly prohibited.
2. Student must carry Identity Card issued by College during the factory visit and to be worn when in the premises.
3. Student wearing Chappal & Sandal will not be allowed to enter the premises. In the interest of their Health and Safety, we prefer student's wear Safety shoes.

Signature of College Instructor: ______________________

Signature of Human Resources: ______________________

Student Visit for Project Work

AMMANN

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
1	10/04/23	8:53AM	5:58PM	02		
2	11/04/23	8:58 AM	6:02 PM	02		
3	12/04/23	8:59AM	6:01 PM	02		
4	13/04/23	8:56AM	6:04 PM	02		
5	14/04/23	9:00AM	6:02 PM	02		
6	17/04/23	8:56AM	6:02PM	02		
7	18/04/23	8:54AM.	6:05PM	02		
8	19/04/23	8:51AM	6:01PM	02		
9	20/04/23	8:56AM	6:05PM	02		
10	21/04/23	8:58AM	6:01 PM	02		
11	24/04/23	8:51AM	6:03 PM	02		
12	25/04/23	8:53 AM	5:59PM	02		
13	26/04/23	8:50AM	6:02PM	02		
14	27/04/23	8:52AM	6:05PM	02		
15	28/04/23	8:58AM	6:01PM	02		
16	02/05/23	8:55AM	6:04PM	02		
17	03/05/23	8:51AM	6:02PM	02		
18						
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26						
27						
28						
30						

INTERNSHIP AT OPTECH MEDICAL SYSTEM

AN INTERNSHIP REPORT

Submitted by

Smit Sureshbhai Patel

200390119504

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

Gujarat Technological University, Ahmedabad

May, 2023

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College

Near Shanku's Water Park,

Ahmedabad – Mehsana Highway,

Linch, Gujarat

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at Optech Medical System** has been carried out by **Mr. Smit Patel** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Prof. **Kunalsinh Kathia**

Internal Guide

Mechanical engineering department

Prof. **Kunalsinh Kathia**

Head of department

Mechanical engineering department

PMMS Certificate

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : (07 May 2023 (13:43:12)

This is to certify that, ***Patel Smit Sureshbhai*** (Enrolment Number - 200390119504) working on project entitled with ***Optech medical system*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	Completed

Name of Student : Patel Smit Sureshbhai   Name of Guide : Mr. Kamalsinh R. Kathia

Signature of Student : S.S. Patel   *Signature of Guide :

Disclaimer :
This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate. Only if all above activities has been Completed.

INTENSHIP CERTIFICATE

OPTECH MEDICAL SYSTEM

Plot no C-1/253, G.I.D.C. Estate, Phase-1,
Naroda, Ahmedabad-382 330.
Gujarat. INDIA.

M. : +91 9825699591
Ph. : +91-79-22801486
Email :- optechritesh@yahoo.com

Date: 30/04/2023

TO WHOM IT MAY CONCERN

This is to certify that <**Patel Smit Sureshbhai**>, a student of <**S.P.B.PATEL ENGINEERING COLLEGE**> has successfully completed his internship in the field of Manufacturing and Assembly in Mechanical Department from <**30/01/2023**> to <**30/04/2023**> (Total number of Weeks: _84_) under the guidance of Dhruval Patel.

His internship activities include I have work in assembly department and to prepaid for motorized instrument table (MIT). And also prepaid or manufacturing for operation table system.

During the period of his internship program with us, he had been exposed to different processes and was found diligent, hardworking and inquisitive.

We wish him every success in his life and career.

For <OPTECH MEDICAL SYSTEM>

Authorised Signature with Industry Stamp

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

S.P.B. Patel Engineering College, Mehsana

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

DECLARATION

We hereby declare that the Internship report submitted along with the Internship entitled Internship in industrial training & Assembly department & manufacturing department submitted in partial fulfilment for the degree of Bachelor of Engineering in Mechanical to Gujarat Technological University, Ahmedabad, is a bona fide record of original project work carried out by me Optech Medical System under the supervision of Mr. Dhruval Patel and internalguide by Prof. Kunalsinh Kathia that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Name of the Student	Sign of Student
1. **Patel Smit Sureshbhai:-**	S.S.Patel

ACKNOWLEDGMENT

I wish to express my appreciation to Prof. Kunalsinh Kathia, for the knowledge imparted during my academic tenure at Saffrony Institute of Technology. A special thanks goes to Prof. Kunalsinh Kathia for making sure I gained sufficient knowledge during my graduate studies and for her encouragement.

First I would like to thanks Mr. Ritesh Patel (manager) Optech Medical System, i would like to thanks Prof. Kunal sink kathia sir (Internal Guide) Who provided the proper guidance to me. For me it was unique experience to this company.

And also all thanks to the people and works to the organization. Also thanks to company manager to guidance me the all the details about the company. I wantto thanks to all department and works to support to me and all product details with share me.

Abstract

This report contains the work done by the author during his internship at ***OPTECH MEDICAL SYSTEM***. It shows the work I did in the company during my internship period. In the report, the author discusses the process of manufacturing and steps of assembly of the machines. The author also discusses the structure of the company, all the departments and their work . It also explains what the author learned during this internship period.

List of Figures

Abbreviations

MIT (MOTORIZED INSTRUMENT TABLE)

GMAW (GAS METAL AEC WELDING)

MIG (METAL INERT GAS ARC WELDING)

TIG (TUNGSTEN INERT GAS ARC WELDING)

S.S (STAIN LESS STEEL)

M.S (MILD STEEL)

Table of Contents

Chapter 1. Overview of The Company

1.1 :- History and Overview of Optech Medical System

Fig 1.1 Optical Equipment

Optech medical system to manufacturing in medical and surgical equipment and also start form this company side product in small eyes care hospital motorized instrument table (MIT). This company first start the very small product in diamond motor . And to growth of this company to start in medical and surgical parts.

This company can start in small product or batch production system to growth in this product can used in diamond finishing and shining. After to this company can join in ophthalmic refraction unit. In this unit can prepaid and manufacturing optical chair, motorized instrument table, operation table etc. There are three series of optical chair and two table are prepaid and also side product for motorized instrument table (MIT). There are different motion and design look for this instrument or equipment. All product are used for medical and surgical operation for eyes care hospital and eyes operation for this table can used.

Fig 1.1 Optical Equipment

Today this industry can improve in quality and accurate product equipment for using a medical and surgical parts or machine. Optech medical system the brand of ophthalmic re aeration unit this product can transport in all over India and also small eyes care hospitals provide in small MIT table it's a new product in start 2022.

Medical and surgical equipment refers to a rang of devices or instrument used in healthcare setting to diagnose monitor prevent various medical conditions. These equipment are design to be safe effective and reliable and they play a crucial role in providing high quality medical care to patients.

Surgical equipment includes instrument used various surgical procedures such as scalpels forceps scissors and reactors as well as surgical devices such as lasers electrosurgical units and surgical robots. These tools and instrument are used by surgeons and other healthcare professionals to perform surgeries and other invasive procedures to treat cure various medical conditions.

1.2 :- Market Position

The Optech medical system market position is great to compare the other chair manufacturing company. And best quality and accuracy of product used in small eyes care hospitals. This company is small but service and best product seller in this area. With over in 18 years to work in this company best medical and surgical equipment to sell.

1.3 :- **History and overview of Ophthalmic refraction unit**

An ophthalmic refraction unit is a device used by eyes care hospitals and clinic. It is an essential tool in the processes of determining a patients and doctor to easy used for this equipment. An ophthalmic refraction unit is a specialized device used in eyes care clinics to measure and correct refractive by presenting a range of lenes to the patient and determining the for a glasses or contact lenses.

1.4 :- **Product and services offered by Optech Medical System**

Optical chair 1:- There are three series of chair optical 1, compact chair and optical chair 2. This chair can be used in doctor model chair. First the design is ready for AutoCAD and solid work software used for prepaid design of optical series chair 1. There are four motion in this chair. Up, down ,forward and backward.

Optech medical system a range of equipment for the India medical and surgical hospitals.

Fig 1.4 Optical chair 1

Specification of optical chair series 1:-

- Floor Space :1830 mm (72") (L) X 1370 mm (54")(W)
- Table Top Size :865 mm (34") (L) X 510 mm (20") (W)
- Table Rotating Angle :90 degree
- Chair Up/Down: 200 mm (8")
- Lamp: LED Lamp 7V
- Power Supply: DC 110/230V, 50/60Hz

Optical Chair 2:-

This chair typically used in ophthalmic refraction unit for performing eye care and vision tests. The chair is designed to be adjustable to provided the patient with a comfortable and stable position during the eyes care hospitals. Its usually has a headrest that can be moved up or down motion titled and rotated to accommodate the patients head position.

In some case an optical chair 2 may also be equipped with a buit in refractor. Which is a diagnostic instrument used to determine a patient corrective in during the check the number in eyes care hospitals.

Technical Specification:-

- Fully flexible chair with up-down
- Square base optimizes access to patient.
- German DC CE-Marked Noiseless, Motor- Driven UP & Down Movements
and RECLINING.
- Adjustable footrest, which can be fully raised to sleeping position.
- Foot switch for up down movement only.
- An auto-return button returns patient to the low, upright position.

Specification of Optical Chair Series 2 :-

- Height min./ max: 530mm (21") / 740mm (29")
- Floor Space : 24" x 24"
- Reclining Position Length: 182CM (72")
- Maximum load: 160 KG
- Backrest Optional: Electrical Manual
- Power: 300 VA
- Input tension: 230V 50/60 Hz. & 110V 50/60 Hz.
- Total Weight: 108 KG

Fig 1.4 Optical chair 2

Compact Optical Chair :-

A compact optical chair is a specialized chair designed for use in eye care hospital or clinic particularly during eye check number. These chair are typically compact in size and feature adjustable seating positions armrest and headrest to ensure patient comfort and stability.

This compact chair is adding the additional features such as foot rest adjustable lighting and storage for medical equipment. These chair designed to be both comfortable and functional providing patient will safe and comfortable experience to allowing eye care professionals to perform their work effectively.

Overall a compact chair is an important piece of equipment in any eye care hospitals or clinic and choosing the right side chair can very help full ensure that patients receive the highest quality of care possible. Specific features and specifications of a compact optical chair may vary depending on the manufacturing and model but here are some general specifications such a chair.

Specifications of Compact Optical Chair:-

Compact Size :- The chair is designed to take up minimum space in eye care clinic or hospitals.
Adjustable seating position:- the chair should be adjustable to different seating positions such as upright reclined or flat.
Head rest :- the headrest should be adjustable to provide comfortable head support and prevent patient movement during the check number of eyes.
Armrest:- the armrest should be sturdy and adjustable to support the patient arms and prevent moving during the check the number.
Footrest:- some chair may also include and adjustable footrest are providing additional patient comfort.
Material:- the chair should be made of high quality material are easy to clean and maintain compact optical chair parts. This compact chair basically iron and mild steel material used during the manufacturing of chair.
Weight capacity :- the chair should be able to support the weight of different patients.
Lighting:- some chair may also include adjustable lighting to provide the nearest arm side to fixed in chair.
Storage :- some chairs may includes storage for medical equipment such as drawer.

Technical Specification:-

- Fully flexible chair with up-down
- Square base optimizes access to patient.
- German DC CE-Marked Noiseless, Motor- Driven UP & Down Movements
and RECLINING.
- Adjustable footrest, which can be fully raised to sleeping position.
- Foot switch for up down movement only.
- An auto-return button returns patient to the low, upright position.

Fig 1.4 Compact Optical chair

Motorized Instrument Table :-

A motorized instrument table is a type of table that is designed to hold medical instrument and equipment during surgical or medical procedures. It has an adjustable height that can be controlled by an electric motor. Allowing it to be raised or lowered to optimal height for the user. This type of table is typically made of stainless steel or other materials that easy to clean and sterilize.

It may also have features such as locking wheels adjustable. Built in electrical outlets for powering medical devices. Motorized instrument table are often used in operating rooms emergency rooms and other medical facilities where precise positioning and easy access to medical equipment are critical. They can also be used in research laboratories and other medical and surgical equipment and this instrument are very precision and accuracy are important.

Over all motorized instrument table are important tool for medical professionals need to have quick and easy access to the equipment they need to perform their effectively and efficiently. Motorized instrument table product new product in this company.

Fig 1.4 Motorized Instrument Table

Specification of Motorized Instrument Table :-

Size and weight:- the size of the table can vary but most motorized instrument tables are designed to be compact enough to fit in tight spaces while also providing simple surface area for equipment. The weight of the table can also vary but they are generally made of light weight but materials that can support heavy medical equipment.
Height adjustment range:- The hight adjustment range of the table is an important specification. Most motorized instrument table can be adjusted to a height of 30 to 45 inches but some models can go even higher or lower.
Weight capacity:- the weight capacity of the table can support without collapsing. Most motorized instrument table have a weight capacity of 300 to 500 pounds. \

Power supply:-The table is powered by an electric motor that can be connected to a standard electrical outlets. Some models may require a higher voltage or amper so it is important to check the specification before purchasing this motorized instrument table.
Material:- The table is typically made of stainless steel or other durable material that are easy to clean and sterilize.
Additional features:- some motorized instrument tables come with additional features such as locking wheels adjustable shelves and built in electrical outlets for powering medical devices.

Operation table :-

This table can used in medical and surgical operations rooms for supporting the patient during the operations in eyes or other. It is designed by of this company to providing a stable and comfortable platform for the paitent and enable easy accesses for surgical team.
Operations table for medical equipment have a number of features that allow for flexibility in positioning the patient depending on the specific surgical and medical procedure.
In this table can make in foundry for stainless steel and simple mild steel materials are using and prepaid for the table. In this company can machining and grinding cutter to used in table structure can remove small dust practical and good finishing of the table.

Technical Specification:

- Complete comfort Operation chair with Surgery Bed, on Castor Wheels
  for moving the patient to/ from the ward.
- The patient can be prepared for the operation, operated and offered postoperative care on the same platform.
- Easy transformation from a smooth transportation chair into versatile operation table.
- Mannual Hand set with 2 memory positions, Auto return function and reset key, Removable foot Switch for electric Up / Down and chair position.
- Smooth CE-Marked German DC Actuator- Controlling the Operation table
- lifting column designed for a maximum patient weight 250 Kilograms

Specification:

- Height range min./ max :630 mm (25") / 840 mm (33")
- Lifting speed : 8 mm/sec Bed length: 1830 mm (72")
- Bed Width: 610 mm (24") Base Size: 890 mm (35") / 490 mm (19"
- Input Electrical: 230 V 50/60 Hz. & 110 V 50/60 Hz.
- Maximum Load capacity: 180 Kgs.
- Gross weight :105 Kgs

Features of operation table:-

- Adjustable height :- The table can be raised or lowered to allow the surgeon to work at a comfortable height.
- Positioning table :- the table can be tilted and angled access and to help manage the patient situation.
- Leg and arm support :- these supports can be adjusted to allow for proper positioning of the patients during surgery.
- Adjustable headrest:- The headrest of the operating platform is adjustable to enable the ideal position as per the patient comfort and the surgeon's convenience.
- Overall operation tables for medical and surgical equipment are crucial in surgical process providing a stable and adjustable platform to ensure and safe while undergoing surgical procedures.

Vision box or drum :-

The vision drum or phoropter is commonly used in eye care hospitals and clines for determining eye glass for patients. Ophthalmic refraction unit and this company can stated for this product can manufacturing in started since 2020.

This vision drum or box versatile tool that can be used for a variety of test including measuring distance vision near vision and astigmatism. It allows the doctor to quickly and accurately determine the best for the patient which can be used create eye glasses or contact lenes that will improve the patient vision.

Vision drum or box is used for check number of small eyes care and take vision hospitals are using this product. This company can sell the product in take vision company.

Specification of vision drum :-

- Size and weight :- the vision drum is usually a fairly large and heavy instrument measuring around 60 cm in length 30 cm in width and 20cm in height. It can weight around 4-6 kg.
- Lenses of vision drum :- the vision drum contains a series of interchangeable lenes of different strength arranged in a rotating disc. These lenses can be adjusted to measure the patients refractive error and determine the appropriate .
- Controls:- the vision drum has a series of knobs and dials that are used to adjust the lenses and other components during the eye check number.
- Prism :- some vision drum may also include prism lenses which are used to diagnose and correct eye number.
- Axis and cylinder :- the vision drum also includes axis and cylinder lenes which are used to correct number or not.

Fig 1.4 vision drum

1.5 Marketing and Sales Strategies of Optech Medical System:-

Optech medical system marketing and sales strategies focus on customer satisfaction product quality and timely delivery of products and services. The company sales team work closely with customers to understanding their specific requirement and provide customized solutions that meet their needs. The company website provide detailed information about its product and services and customers can quotes and place online. this company has provided better quality of product and better finishing work best services providing. Optech medical system is brand of the medical and surgical equipment and good services of product transport to one place to another place.

This company can started in very small product is diamond motor. This product is batch production system and also company growth is very small. And now stated is medical and surgical equipment to join in ophthalmic unit. First start in 10 chair optical chair to success this product in market now started in many product can manufacturing in this days.

Product will be started in three optical chair, operation table and side product in started in 2022 motorized instrument table etc. All product can used in eyes care hospitals and surgical units. This company product high sell in rumax international private limited.

This company is one supplier of ophthalmic & optometric products in India 14 years. Having distributor network all over India and excellent after sales services. In house R&D facility to provide innovation products of this company. It is supplied product in medical and surgical unit all over India good market strategies of rumax international private limited.

We are giving best nature of ophthalmic items which are affirmed internationally. Three Instruments is channel accomplice of some world realized ophthalmic assembling organization. At the same time we are continue searching for nature of items material, parts, adornments, working programming, most recent form, highlights and so on.

This is the fundamental resource of our organization. We are attempting to advance our organization by keeping low cost from the absolute first day of our organization. Be that as it may.

CHAPTER: 2 INTRODUCTION ABOUT PROCESSES

Optech medical system in this company basically mechanical, fabrication, and chemical processes are used for chair, operation table and motorized instrument table product are manufacturing. Mechanical process means in any operation or other procedure which is transacted on a machine. And which may include but is not limited to a copier any recorder or tape processor or other automated device like cnc machine.

Fabrication is the process of constructing products by combining typically standardised parts using one or more individual processes for example steel fabrication is the production of metal structure using a rang of processes such as cutting bending and assembling.

Chemical processes is the any process determined by the atomic and molecular composition and structure of the substances involved its know as chemical processes. In these three processes are used for this company manufacturing and prepaid for medical and surgical equipment like optical chair series 1 and optical series 2 and compact optical chair manufacturing and also prepaid for operation table and motorized instrument table manufacturing.

Basically mechanical and fabrication both processes are used for company to any product manufacturing. But this company can stared a new process in chemical processes. This process are used for this company part finishing ang good shaining of chair and table parts.

The chemical processes may involve formation of a derivative, purification of the derivative and recovery of the original material in a pure form of the derivative. Know as "Purification."

These industry standards generally list several passivation processes that can be used, with the choice of specific method left to the customer and vendor. The "method" is either a nitric acid -based passivating bath, or a citric acid-based bath, these acids remove surface iron and rust, while sparing the chromium. The various 'types' listed under each method refer to differences in acid bath temperature and concentration.

There are five liquid are used for this process.

- Simple water
- Acid + water
- Simple water
- Phosphating(7 time process)
- Passivation

2.1 Design Process of Optech Medical System:-

In this company to any product are manufacturing or prepaid to first thing design and material selection process are done. In this company manufacturing medical and surgical equipment are prepaid. First design are prepaid for using AutoCAD and solid work software are used design prepaid to both software can be used for design.

And now design is done go to material selection basically in this company used for iron, mild steel and stainless steel grad 304 used for product. Chair and motorized instrument table(MIT) iron and mild steel material used for both product. And operation table basically have two material are prepaid for company mild steel (MS) and stainless steel used for medical and surgical product prepaid for this company

Design section based on below steps:-

- Define the problem.
- Identify decision variables.
- Research in depth.
- Ideating possible solution .
- Consider alternative solution .
- Select an approach.
- Creating a prototype.
- Develop a design.
- Test and evaluate.
- Measuring a hole part.
- Convert the 2d and 3d part.
- Redefine the design.
- Crate a solution.
- Find the making improvement the final product.
- Design is ready for the manufacturing.

2.2 About Manufacturing processes:-

In this company are three manufacturing processes used for mechanical, fabrication and chemical using for this company and prepaid for a medical and surgical equipment or instrument of this company.

Mechanical processes:- In this processes physical machine that may involve force and movement. It is an engineering branch that combines engineering physics and mathematics principle with material science to design and analysis manufacturing and maintain the system.

Cutting processes:-

Cutting is a technique where the operator moves a material such as metal and the tool in relation to each other in order to shape the workpiece into the desired from through shaving its know as cutting processes. Cutting is the separation or opening of a physical object into two or more portions through the application of an acutely directed force in workpiece. Cutting is to cut off parts from workpieces using a tool.

Fig 2.1 cutting processes

Cutting is a common technique that we generally much thought to simply it is the separation of a physical object into two or more segment as a consequence of an acutely directed force. In the types of cutting processes. They include laser cutting, blade cutting and water jet cutting those all are cutting processes include.

Metal cutting Is a fundamental and has been at the processes is very important in cutting processes. Including forming, shearing, abrading heat and electrochemical. Each of these physical phenomenon consists of subcategories such as laser cutting, blade cutting and water jet cutting.

Grinding:-

Grinding is machining processes that's used to remove material form workpiece via grinding wheel. Grinding is an abrasive machining process that uses a grinding wheel or grinder as the cutting tool. Grinding is used to finish workpiece that must show high surface quality and high accuracyof shape and dimension.

It has some roughing applications in which grinding removes high volume of metal very rapidly. Grinding is a method of reducing the size of hard materials or sharpening tools, generally accomplished in several stages.

To produce desired fineness of end products, grinding is done after crushing. For example, through crushing the mineral ore to below a certain size and finishing by grinding it into powder, the ultimate fineness depends on the fineness of dissemination of the desired mineral

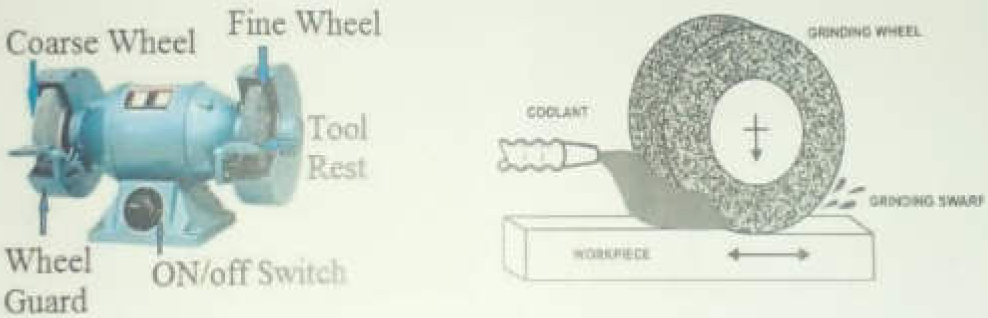


Fig 2.2 grinding processes

The various grinding methods include straight cylindrical, taper, end face, and total shape grinding. Similar to surface grinding, it is a general grinding method in wide use of this grinding processes.

Metal grinding is a process used to smoothness and finish of metal parts, most often used for finishing edges, deburring, smothering welding joints, creating a sharp edge, and for certain custom edge finishes.Most grinding machines work by using an abrasive wheel remove material from the workpiece. The abrasive wheel is typically made of diamond or aluminum oxide and is rotated at high speeds. The abrasive particles on the wheel are what actually remove the material from the workpiece.

Machining :-

Machining is any process in which a cutting tool is used to remove small chips of material from the workpiece (the workpiece is often called the "work"). To perform the operation, relative motion is required between the tool and the work.

Machining is a part of the manufacture of many metal products, but it canalso be used on other materials such as wood, plastic, ceramic, and composite material. A person who specializes in machining is called a machinist. A room, building, or company where machining is done is called a machine shop.

Fig 2.2 machining processes

Much of modern-day machining is carried out by computer numerical control (CNC), in which computers are used to control the movement and operation of the mills, lathes, and other cutting machines. This increases efficiency, as the CNC machine runs unmanned therefore reducing labor costs for machine shops.

Machining is one of those best ways that can help increase efficiency on your metals. When machining the metals, they are always fitted with internal quality assurance detectors. This brings along a lot of efficiency in terms of increasing the speed of production of the metals and ensuring good usage of raw materials. Machining is part of the manufacture many metal product but it can also be used on other materials such as wood plastic ceramic and composite material etc.

Casting:-

Casting processes involve the use of molten material, usually metal. This molten material is then poured into a mould cavity that takes the form of the finished part. The molten material then cools, with heat generally being extracted via the mould, until it solidifies into the desired shape.

Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods. Heavy equipment like machine tool beds, ships' propellers, etc. can be cast easily in the required size, rather than fabricating by joining several small pieces.

Fig 2.2 casting processes

Popular casting materials include: plaster (Gypsum), resin, metal (bronze,Aluminum lead, silver and gold), and casting rubber. While there are tools specifically designed for mould making and casting, many modelling and ceramic tools are equally functional in this discipline.

Casting is a manufacturing process in which a liquid material is usually poured into a mounding , which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mounding to complete the process.

Casting materials are usually metals or various time setting materials thatcure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is manufacturing processes which a liquid material is usually poured into a mold which contains a hollow cavity of the desired shape and then allowed to solidify.

Turning:-

Turning is a machining process where a lathe is used to rotate the metal while a cutting tool moves in a linear motion to remove metal along the diameter, creating a cylindrical shape. The cutting tool can be angled differently to create different forms. It can be done manually or with a CNC turning machine.

Turning is the most common lathe machining operation. During the turning process, a cutting tool removes material from the outer diameterof a rotating workpiece. The main objective of turning is to reduce the workpiece diameter to the desired dimension. There are two types of turning operations, rough and finish the part.

Fig 2.2 turning

Turning is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Ducto the high tolerances and surface finishes that turning can offer, it is idealfor adding precision rotational features to a part whose basic shape has already been formed.

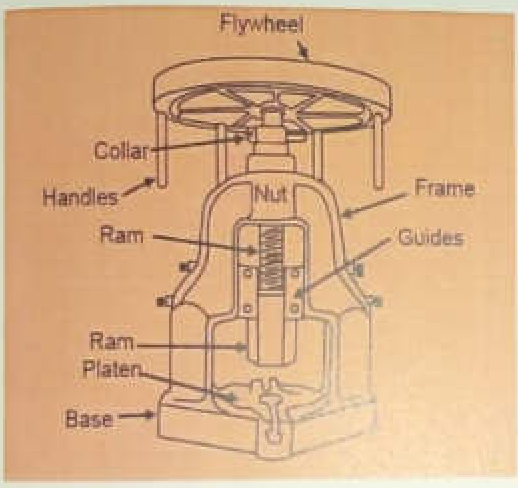
Turning can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using an automated lathe which does not. Today the most common type of such automation is computer numerical control, better known as CNC. When turning the workpiece of a relatively rigid material such as is rotated and cutting tools is moved along one two or even three axis of motion to produce precise diameter and depths.

Turning can be on the outside of the cylinder to have tubular components to various geometries.

Bending:-

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis.

Bending is a manufacturing process that produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal. Commonly used equipment include box and pan brakes, brake presses, and other specialized machine presses.



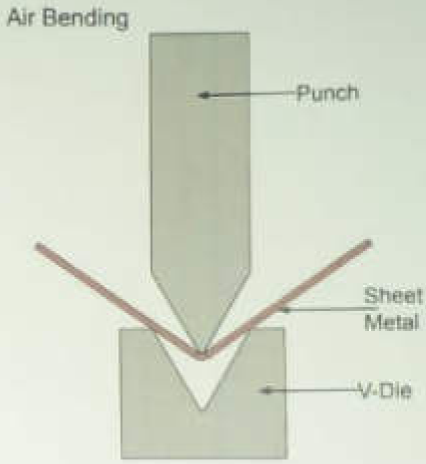


Fig 2.2 bending

Typical products that are made like this are boxes such as electrical enclosures and rectangular ductwork.

A bending machine is a forming machine tool. Its purpose is to assemble a bend on a workpiece. A bend is manufactured by using a bending tool during a linear or rotating move. The detailed classification can be done with the help of the kinematics.

Bending is a flexible process by which many different shapes can be produced. Standard die sets are used to produce a wide variety of shapes.The material is placed on the die, and positioned in place with stops and/or gages. It is held in place with hold-downs. The upper part of the press, the ram with the appropriately shaped punch descends and formsthe V-shaped bend. A press brake is a tool used in order to bend sheet metal and uses a punch and die to do this bending process.

Coating:-

A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. The purpose of applying the coating may be decorative, functional, or both. Coatings may be applied as liquids, gasesor solids e.g. Powder coatings.

A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. The purpose of applying the coating may be decorative, functional, or both. Coatings may be applied as liquids, gasesor solids e.g. Powder coatings.

Fig 2.2 coating processes

Coating processes are aimed at transferring a liquid onto a web. The simplest forms of coating process rely on the viscosity of the liquid to control the thickness and uniformity. Coatings applied at atmospheric pressure have solvents added to reduce the viscosity and so assisting flowand levelling.

A major consideration for most coating processes is that the coating is to be applied at a controlled thickness, and a number of different processesare in use to achieve this control, ranging from a simple brush for painting a wall, to some very expensive machinery applying coatings in the electronics industry application.

A major coating application is to protect metal from corrosion. This use includes preserving machinery, equipment and structures. Most automobiles are made of metal. The body and underbody are typically coated Anticorrosion coatings may use graphene in combination with water-based epoxies.

Milling:-

Milling is the process of machining using rotary cutters to remove material by advancing a cutter into a workpiece. This may be done by varying direction on one or several axes, cutter head speed, and pressure.

Milling is used to produce parts when they cannot be made through a conventional manufacturing process such as metal casting. It is a materialremoval process which uses a milling cutter

Milling covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes for machiningcustom parts to precise tolerances.

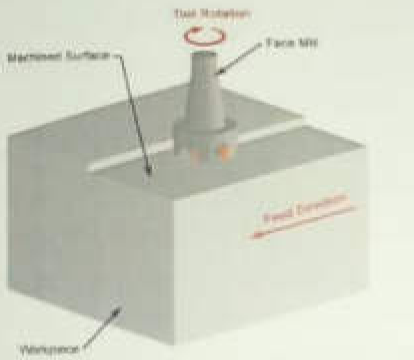


Fig2.2 milling processes

Milling can be done with a wide range of machine tools. The original class of machine tools for milling was the milling machine (often called a mill).After the advent of computer numerical control (CNC).

Milling machines evolved into machining centres milling machines augmented by automatic tool changers, tool magazines or carousels, CNCcapability, coolant systems, and enclosures.

Milling is a cutting process that uses a milling cutter to remove material from the surface of a work piece. The milling cutter is a rotary cutting tool,often with multiple cutting points. As opposed to drilling, where the tool is advanced along its rotation axis, the cutter in milling is usually moved perpendicular to its axis so that cutting occurs on the circumference of the cutter.

2.3 About fabrication processes:-

Fabrication is the process of making something from semi-finished or raw materials rather than from ready-made components the act or process of fabricating; manufacture. Something fabricated, especially an untruthful statement.

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood.

The sheer number of metal fabrication applications boggles the mind, butno matter what product is ultimately being created, the process can be summed up with three basic techniques: cutting, bending, and assembling.

It is the secondary manufacturing processes where raw material are processed through the casting or forming processes. It involves joining pieces either permanently or temporally to perform the necessary action.The joining can be done heat or pressure or both.

Most of the steel structural constructing are first roiled and then joined together by a fabrication processes.

These are fabrication processes used for this company can manufacturing medical and surgical equipment like chair, operation table and motorizedinstrument table (MIT) prepaid for this fabrication processes using to thisoptech medical system.

Fabrication tool are those that are used to fabricate parts or products. They will different tool according to the material being fabricated but can include items such as metal Cutting saws beveling tools angle grinders shears wires cutters drills punches stamps sheet rolling Equipment and more.

Fabrications techniques are the processes that used to shape cut mould materials into items. Common fabrication techniques include cutting forming punching stamping shearing and welding etc.

Types of fabrication processes:-

Gas welding
Electric arc welding
Mig welding (metal inert gas arc welding)
Tig welding (tungsten gas arc welding)
Gas metal arc welding
Arc welding

Gas welding:-

Gas welding allows for the fusing of both nonferrous (not containing iron) and ferrous metals, plus no requirement of electricity to get the welds going. Oxy-acetylene welding uses a combination of oxygen and a fuel gas(typically acetylene) and is used primarily for welding thin metal sections.

Oxyacetylene welding, commonly referred to as gas welding, is a process which relies on combustion of oxygen and acetylene. When mixed together in correct proportions within a hand-held torch or blowpipe, a relatively hot flame is produced with a temperature of about 3,200 deg.

There are two types of cutting torches :

Low pressure cutting torches:-

Low-pressure cutting torches all of which may be used, as required, with oxygen + acetylene or oxygen + propane/LPG by simply fitting the torch with the appropriate cutting nozzle. The cutting nozzles are also selectedaccording to the thickness to be cut the workpiece.

Low-pressure cutting torches are recommended for experienced professionals who will greatly appreciate the heating flame quality.

Low pressure cutting torches

High pressure cutting torches:-

high-pressure cutting torches are specifically recommended for users working under difficult conditions or for relatively inexperienced users. The heating gas is mixed at the cutting nozzle. The mixture is selected in the same way as for the low-pressure cutting torch depending on the gasused, on the one hand, and the thickness to be cut on the other .

High pressure cutting torch

Gas Metal Arc Welding:-

Gas metal arc welding, sometimes referred to by its subtypes metal inertgas and metal active gas is a welding process in which an electric arc forms between a consumable MIG wire electrode and the workpiece metal, which heats the workpiece metal, causing them to fuse.

GMAW was soon applied to steels because it provided faster welding time compared to other welding processes. The cost of inert gas limited its usein steels until several years later, when the use of semi-inert gases such as carbon dioxide became common gas for using industry.

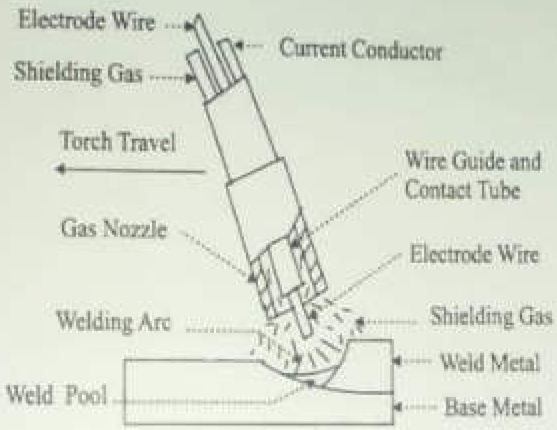
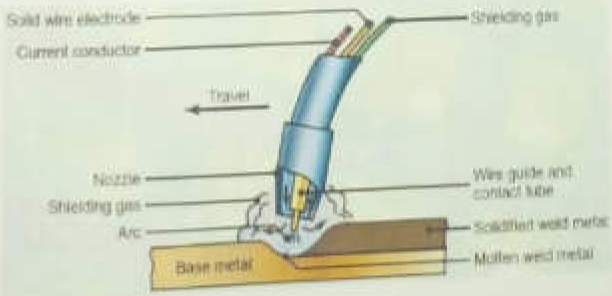


Fig 2.3 gas metal arc welding

The process can be semi-automatic or automatic. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current,can be used.

Along with the wire electrode, a shielding gas feeds through the welding gun, which shields the process from atmospheric content. GMAW is the most common industrial welding process, preferred for its versatility, speed and the relative ease of adapting the process to robotic automation.



Arc welding:-

Arc welding is a fusion welding process used to join metals. An electric arcfrom an AC or DC power supply creates an intense heat of around 6500°F which melts the metal at the join between two work pieces.

Arc welding processes work well for welding aluminum, but some are better than others.

The TIG welding process offers the best aluminum joining method, while the MIG welding process has a speed advantage. Welding aluminum can quickly take a turn for the worse.

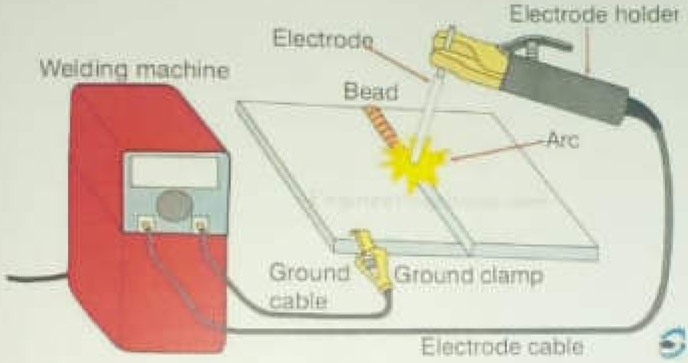
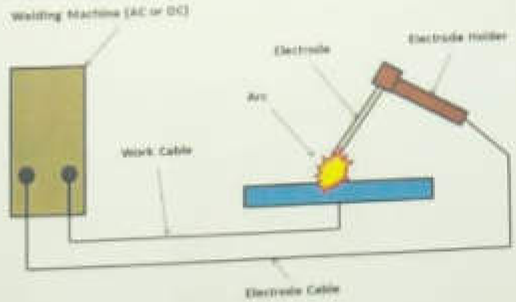


Fig 2.3 Arc welding

Arc welding is welding using the heat of an arc as a heat source. In arc welding, positive voltage is applied to the electrode (welding rod/wire) and negative voltage is applied to the base material. This makes an arc occur from the base material to the electrode.

n a basic arc welding process, the power supply is switched on, and the electrode is brought near the base material. Then, intense heat is generated to produce the electric arc. The heat then melts the base metal, electrode core and flux coating. The flux coating then provides a shieldingenvironment to weld.



Spot welding:-

Spot welding (or resistance spot welding) is a type of electric resistance welding used to weld various sheet metal products, through a process in which contacting metal surface points are joined by the heat obtained from resistance to electric current. The process uses two shaped copper alloy electrodes to concentrate welding current into a small "spot" and to simultaneously clamp the sheets together. Work-pieces are held together under pressure exerted by electrodes. Typically the sheets are in the 0.5 to 3 mm (0.020 to0.118 in) thickness range.

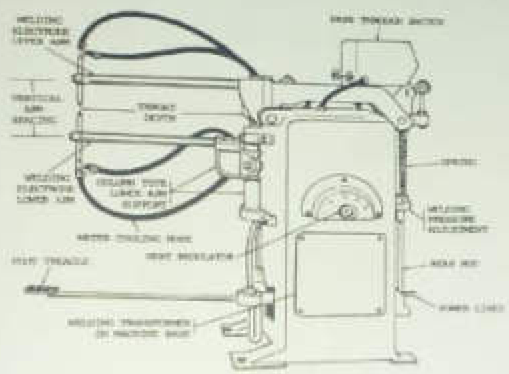


Fig 2.3 spot welding

The attractive feature of spot welding is that a large amount of energy can be delivered to the spot in a very short time (approximately 10–100 milliseconds). The amount of heat (energy) delivered to the spot is determined by the resistance between the electrodes and the magnitude and duration of the current. Spot welding works by applying pressure and heat to the weld area using copper alloy electrodes.The spot welding process uses two copper alloy electrodes to focus the welding current into a small area and hold the sheets together. This process involves pressure and an electric current which creates heat through the current resistive materials like carbons steels.

Mig welding(metal inert gas arc welding):-

MIG welding is an automatic or semi-automatic arc welding process used to join pieces of metals together. It produces high-quality welds withfaster speed. During welding, the welder uses a welding torch to continuously feed a consumable heated wire electrode and shielding gas.

Metal Inert Gas (MIG) welding is an arc welding process that uses a continuous solid wire electrode heated and fed into the weld pool from awelding gun. The two base materials are melted together forming a join. The gun feeds a shielding gas alongside the electrode helping protect theweld pool from airborne contaminants.

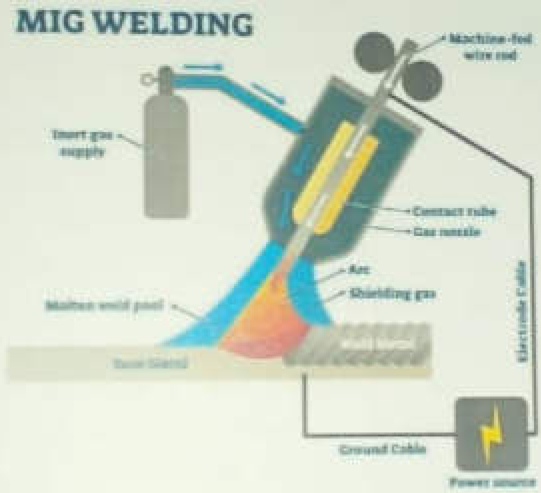
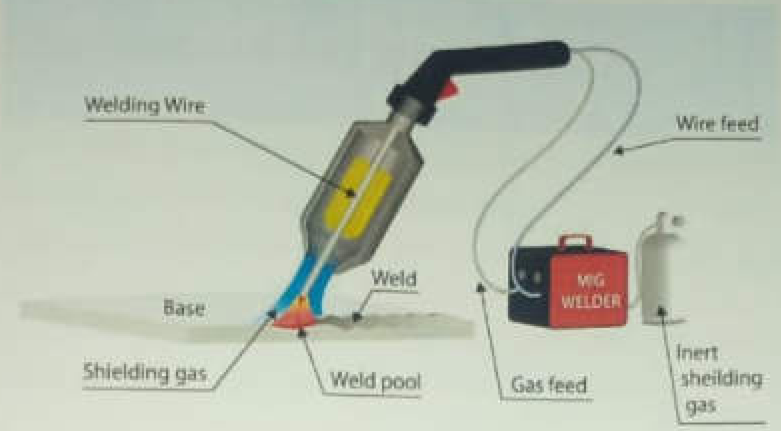


Fig 2.3 MIG welding

MIG/MAG welding is a versatile technique for both thin sheet and thick section components. An arc is struck between the end of a wire electrode and the workpiece, melting both of them to form a weld pool. The wire serves as both heat source (via the arc at the wire tip) and filler metal for the welding joint.

The wire is fed through a copper contact tube (contact tip) which conducts welding current into the wire. The weld pool is protected from the surrounding atmosphere by a shielding gas fed through a nozzle surrounding the wire. Shielding gas selection depends on the material being welded and the application.



Manual MIG/MAG welding is often referred as a semi-automatic process, as the wire feed rate and arc length are controlled by the power source, but the travel speed and wire position are under manual control.

The process can also be mechanised when all the process parameters arenot directly controlled by a welder, but might still require manual adjustment during welding. When no manual intervention is needed during welding, the process can be referred to as automatic.

The process usually operates with the wire positively charged and connected to a power source delivering a constant voltage. Selection of wire diameter (usually between 0.6 and 1.6mm) and wire feed speed determine the welding current, as the burn-off rate of the wire will form an equilibrium with the feed speed.

MIG welding is a versatile process and can be easily used to weld various metals and alloys, including copper, aluminum, nickel, and iron. The process can join dissimilar metals. The shielding gas protects the arc and the metal transfers across the electric arc.

The wire is fed from a reel by a motor drive, and the welder moves the welding torch along the joint line. Wires may be solid (simple drawn wires), or cored (composites formed from a metal sheath with a powdered flux or metal filling).

The processes usually operates with the wire positively charged and connected to a power source delivering a constant voltage. Selection of wire diameter(usually between 0.6 and 1.6 mm) and wire feed speed determine the welding current as the burn off rate of the wire will form an equilibrium with the feed speed.

Tig welding (tungsten inert gas arc welding):-

Tungsten Inert Gas (TIG) welding, also known as Gas Tungsten Arc Welding (GTAW) is an arc welding process that produces the weld with anon-consumable tungsten electrode.
In the TIG welding process the arc is formed between a pointed tungsten electrode and the workpiece in an inert atmosphere of argon or helium. The small intense arc provided by the pointed electrode is ideal for high quality and precision welding.

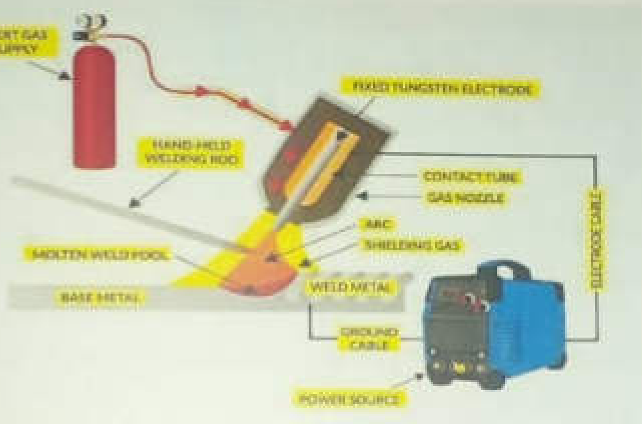
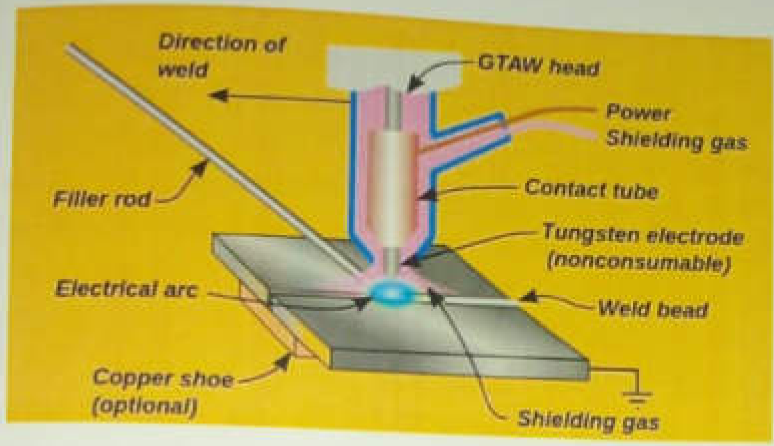


Fig 2.3 Tig welding

Because the electrode is not consumed during welding, the TIG welderdoes not have to balance the heat input from the arc as the metal is deposited from the melting electrode. TIG welding must be operated with a drooping, constant current power source – either DC or AC. A constant current power source is essential to avoid excessively high currents being drawn when the electrode is short-circuited on to the workpiece surface.
This could happen either deliberately during arc starting or inadvertently during welding. If, as in MIG welding, a flat characteristic power source isused, any contact with the workpiece surface would damage the electrode tip or fuse the electrode to the workpiece surface.



The welding arc can be started by scratching the surface, forming a short- circuit. It is only when the short-circuit is broken that the main welding current will flow. However, there is a risk that the electrode may stick to the surface and cause a tungsten inclusion in the weld.
This risk can be minimized using the 'lift arc' technique where the short- circuit is formed at a very low current level.
This risk can be minimized using the 'lift arc' technique where the short- circuit is formed at a very low current level. The most common way of starting the TIG arc is to use HF (High Frequency).
HF consists of high voltage sparks of several thousand volts which last for a few microseconds. The HF sparks will cause the electrode – workpiece gap to break down or ionize. Once an electron/ion cloud is formed, current can flow from the power source.
HF is also important in stabilizing the AC arc; in AC, electrode polarity is reversed at a frequency of about 50 times per second, causing the arc tobe extinguished at each polarity change. To ensure that the arc is reignited at each reversal of polarity, HF sparks are generated across the electrode/workpiece gap to coincide with the beginning of each half-cycle.

Soldering:-

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and this bondsto the metal parts and forms a connection when the solder solidifies. It isdifferent to welding in that the parts being joined are not melted and areusually not the same material as the solder.

Soldering is a common practice for assembling electrical components and wiring. Although it can be used for plumbing, sheet metal fabrication or automotive radiator repair the techniques and materials used are different to those used for electrical work.

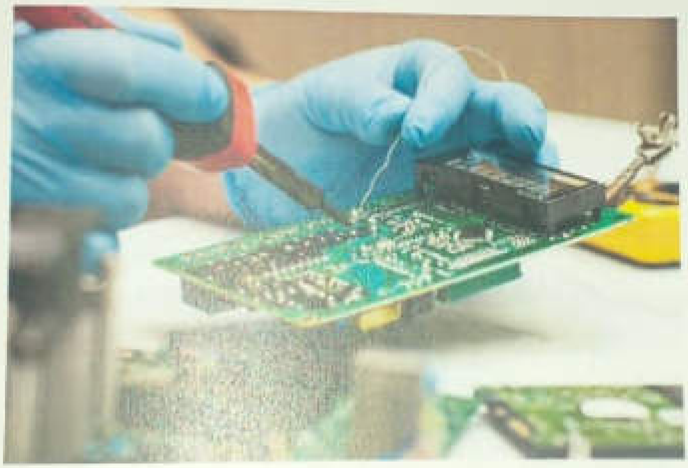


Fig 2.3 soldering

Soldering may be used to join wires or attached components to a printed circuit board (PCB). Wires, component leads and tracks on circuit boards are mostly made of copper. The copper is usually covered with a thin layer of tin to prevent oxidization and to promote better bonding to other partswith solder. When soldering bare copper wires they are often "tinned" byapplying molten solder before making a joint. Printed circuit boards (PCBs) are populated by electronic components and these may be "surface mount" or "through-hole" types. In addition to type of solder used the temperature and method of heating also play a crucial role in soldering processes. Different types of solder require different temperature and heating to workpiece.

Through hole components:-

As the description "through-hole" suggests, the leads of the component are passed through holes in the PCB and then soldered to a "pad" on the reverse side of the PCB. Soldering is accomplished by heating the component lead and PCB pad with a soldering iron and melting solder wire into the joint. This type of construction was common from the 1960's until early 2000's and is still used by hobbyists and in small scale production where manual assembly is preferred.

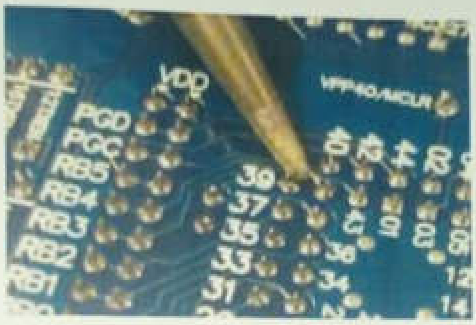


Fig 2.3 through hole components

Surface Mount Components:-

Commercial circuits are mostly of the surface mount type as these are cheaper to make, more compact and easier to automate assembly. For surface mount construction the component's pads are on the same side of the PCB as the component and the component connections sit onto these pads are used for this mount components. Soldering is accomplished by applying solder paste onto component pads on the PCB, placing the component onto the paste and then heating the entire assembly to melt the solder. Commercial assembly uses ovens to heat the boards.

Fig 2.3 surface mount components

Punching:-

Punching is a forming process that uses a punch press to force a tool, called a punch, through the workpiece to create a hole via shearing. Punching is applicable to a wide variety of materials that come in sheet form, including sheet metal, paper, vulcanized fiber and some forms of plastic sheet. The punch often passes through the work into a die. A scrap slug from thehole is deposited into the die in the process. Depending on the material being punched this slug may be recycled and reused or discarded. Punching is often the cheapest method for creating holes in sheet materials in medium to high production volumes. When a specially shaped punch is used to create multiple usable parts from a sheet of material the process is known as blanking.

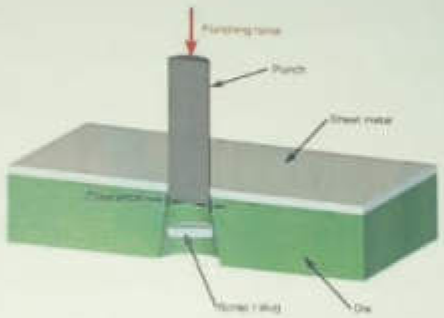


Fig 2.3 punching

Punching is a metal working process that involves creating holes in a metal workpiece Punch tooling (punch and die) is often made of hardened steelor tungsten carbide. A die is located on the opposite side of the workpiece and supports the material around the perimeter of the hole and helps to localize the shearing forces for a cleaner edge. The punch tool creates a recess that helps guide the drill bit into the desired area of the workpiece. Without a center punch tool, the drill bit may veer off as it digs into the workpiece. A variant of the center punch tool is the prick punch tool.

Punch tooling (punch and die) is often made of hardened steel or tungsten carbide. A die is located on the opposite side of the workpiece and supports the material around the perimeter of the hole and helps to localize the shearing forces for a cleaner edge. Punches are used to drive fasteners such as nails and dowels, making a hole, or forming an indentation/impression of the tip on a workpiece. Decorative punches may also be used to create a pattern or even form an image. Punch tools are used to create holes in workpieces by puncturing the surface. Solid punch tools, on the other hand, are used to remove material from workpieces or to drive components pins, rivets, etc.

A punch is a tool used to indent or create a hole through a hard surface. They usually consist of a hard metal rod with a narrow tip at one end anda broad flat "butt" at the other. A center punch tool is a special type of punch tool that's used to create ashallow indention in a workpiece for the purpose of drilling. Prior to drilling a hole in a workpiece, a worker may use a center punch tool to "mark" the area of the workpiece where the drill bit will enter. The punch must be physically pulled back out of the hole while the work is supported from the punch side and this processes is know as stripping.

CHAPTER 3:- INTRODUCTION ABOUT CHEMICAL PROCESSS

Optech medical system its used for this chemical processes is method some changing one or more chemicals or chemical compounds. Such as chemical process can occur by it self or be caused by an outside force andinvolves a chemical reaction of some different part of chair and operationtable.

Chemical processes is a method intended to be used in manufacturing oran industrials scale to change the composition of chemical or metal usually using technology similar or related to that used in chemical plant or chemical industry or manufacturing industry.

In this company are manufacturing for medical and surgical equipment prepaid and four processes are used for this company optical chair series 1 and 2 also prepaid for a operation table and motorized instrument tableand most important processes are chemical processes.

Chemical processes are five basic liquid are used for components of chairand operation table like foot rest, head set, system cover, base for chair, MIT outer and external cover prepaid and this processes are used in partsare good finishing.

3.1 Introduction About Phosphating liquid:-

There are two main liquid are used for this company and this two liquid are phosphating and passivation and other simple liquid are used for thiscompany about this two types liquid details in below.
Phosphating is a chemical method of surface treatment in which a metallic surface reacts with an aqueous phosphate solution. This creates a hardly soluble conversion layer made of metal phosphates. For this purpose, the material is first cleaned with acid and then the phosphate layer is formed.

Fig 3.1 Phosphating liquid

The phosphating process comprises alkaline degreasing, water rinsing, activation, manganese phosphate application, water rinsing again, protective oiling and then drying in that sequence.
Phosphating is a chemical method of surface treatment in which a metallic surface reacts with an phosphate solution its know as phosphating process.
For this purpose the material is first cleaned with acid and then the phosphate layer is formed. This creates a hardly soluble conversion layermade of metal phosphates. The process of Phosphate coating is employed for the purpose of pre- treatment prior to coating or painting, increasing corrosion protection and improving friction properties of sliding components.

Phosphating is a chemical process for treating the surface of steel, where barely soluble metal-phosphate layers are formed on the base material. The layers created are porous, absorbent and suitable as a conversion layer for subsequent powder coating without further treatment. Phosphating is the 7 time processes. And this chemical processes start toend processes in flow diagram in below fig.

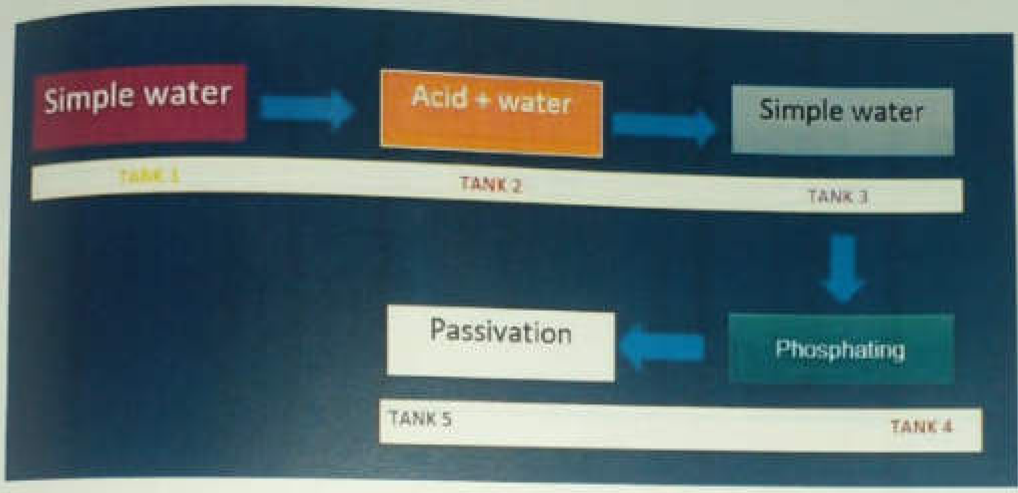


Fig 3.1 chemical processes flow diagram

Phosphating is a chemical electro chemical process in which thin crystalline and water insoluble phosphates are generated on metal surface from phosphoric acid solution in a dipping or spraying procedure.as they are the result of chemical reaction with the base metal phosphate layers are securely anchored in the metal surface and include many cavities and capillaries.

This characteristic gives the phosphate layers an optimum absorption capacity for oils waxes color pigments and lacquers so they have proven their value as corrosion protection and as an adhesive substrate for paint and varnishes. Phosphating used particularly for components made of steel and iron.

Element made of zinc or other non ferrous metals can also be phosphate. The area of application of this processes are corrosion protection reduction of water adhesion promotion and electrical insulation. Since the phosphate layer produced adheres very well, it is often used as a substance for coatings.

3.2 Passivation liquid for chemical processes:-

The passivation process is a method of improving the corrosion resistance of stainless steel parts by removing ferrous contaminants like free iron from their surface, restoring them to their original corrosion specifications. There are three chemicals broadly used for passivating stainless steel; phosphoric acid, nitric acid, and citric acid. Nitric acid is such an oxidizing acid and is always used for passivation treatments. Nitric acid does not corrode stainless steel, does not alter critically dimensioned parts and will not remove heat tint, embedded ironor other embedded surface contamination.

Fig 3.2 passivation for iron

In stainless steel, the passivation process uses nitric acid or citric acid to remove free iron from the surface. The chemical treatment leads to a protective oxide layer, or passivation film, that is less likely to chemically react with air and cause corrosion. Passivated stainless steel resists rust.

In iron phosphating there is an increase in paint adherence and resistance impact while providing protection against oxidation. Iron phosphating is known to offer the least corrosion resistance of the phosphating processes; although due to its low cost it is more often used on indoor equipment and parts that are usually not subjected to high levels of wearand corrosion.

CHAPTER 4:- PRODUCT MANUFACTURING

Optech medical system is prepaid for a medical and surgical equipment and the new product are manufacturing Motorized instrument table (MIT). These product for optical chair series 1 and 2 and compact optical chair, operation table are prepaid for a surgical unit.

In five products are prepaid for this company also include all product aremanufacturing in four processes mechanical, fabrication and most important processes for chemical processes. In these processes are explain in above pages.

Optical chair series 1 and optical chair series 2 some minor changes in design and motion. Optical chair 1 five motion are including up, down, backward, forward and zero position. And optical chair 2 only up and down motion are including.

Basically, iron and mild steel material used for all product manufacturing. Same operation table motion is included in this product up, down, forward, backward and zero position. Motorized instrument table is the side product and its used for a surgical and small eyes cares hospitals to check the eye number.

And also prepaid for a vision box or drum this box is prepaid for a this company to using vision box to check the eyes number for optical shop and optical hospitals. And this vision box are different language like Telegu, Gujrati, Kanad Malayalam etc.

In this company can join in ophthalmic refraction unit in this unit are manufacturing these all product are prepaid for a this unit. Refraction units are at the center of the ophthalmitis room and dictate the comfort of both patient and clinic. The chair has a low seat height for patient mount and dismount the hydraulic height adjustment enables the clinic to alter the position of the seated patient to the desired height before carrying out procedures.

Ophthalmic instrument are used by a variety of individuals are concernedwith the health and performance of the eyes as organs of the body of thepatient as optical system.

4.1 OPTICAL CHAIR 1 MANUFACTURING :-

In this product are used for optical hospitals and small clinic this model are using for a doctor model to easy way check the eyesnumber. To start the manufacturing in optical chair 1 first the design and materialare selected in quality department. Basically iron for using system(electriccircuit ,motor, also PCB are using).

Then design done for the product to start the planning and secluding for this product. There are five motion are including to this chair. Up, down, forward, backward and zero position of chair series 1. Iron and mild steel materialare used for a this chair internal and external cover are used for a MS material this product.

First the prepaid for a system used for a up and down motion of optical chair 1. To start the product are prepaid for all parts are cutting in multiple hacksaw machine using this company. All iron parts are cutting in this machine.

Fig 4.1 hack saw machine

To all parts are cutting go to the fabrication processes and this processesare explain in above pages. Basically grinding and welding both processesmost important in this company. Done the fabrication processes go to machining department to remove the material and finishing parts of thischair. To remove the material are parts lathe and drilling machine are used for this machining department. Multiple lathe machine are used to remove the material and drilling machine are used for a hole of components of optical chair series 1 like head rest, foot rest and system structure.

In chemical processes are using in this company chair parts good finishing and good shining. These processes are done in 48 hours to part are finishing a product . there are five liquid used for this processes like simple water, acid + water, again simple water and now main two liquid are usedfor phosphating and passivation. And the phosphating processes are 7 time processes to part in tank. Now this processes done going to a powder coating department.

This two equipment are power coating processes used. And chemical processes done now all parts are going 1st equipment to part are form in powder form its used for powder gun to spray in part white power are used form chair parts. Now done the parts are powder form going to heating oven. In this heating oven powder are melt form 180 c to set in this penal box. This box can using only heating purpose. Done the all processes parts are going to assembly department. all parts are fixed in steps by steps. Optica lchair series 1 is ready go to packaging and transport the product.

4.2 compact chair:-

In this company are second product are prepaid for compact optical chair in this model are used for a hospitals and optic lens. Different product in optical chair series 1 and compact chair in this chair are using clinic and doctor model. Some chair are different couler like blue, red, Denny blue etc.

To start the manufacturing in compact chair first the design and material are selected in quality department. Basically iron for using system (electriccircuit ,motor, also PCB are using). Then design done for the product to start the planning and secluding for this product.

There are two motion are including to this chair. Up, and down, position of chair series 1. Iron and mild steel material are used for a this chair internal and external cover are used for a MS material this product. First the prepaid for a system used for a up and down motion of optical chair and compact chair.

To start the product are prepaid for all parts are cutting in multiple hacksaw machine using this company. All iron parts are cutting in this machine.

To all parts are cutting go to the fabrication processes and this processes are explain in above pages. Basically grinding and welding both processesmost important in this company. Done the fabrication processes go to machining department to remove the material and finishing parts of this chair.

To remove the material are parts lathe and drilling machine are used for this machining department. Multiple lathe machine are used to remove the material and drilling machine are used for a hole of components of optical chair series 1 like head rest, foot rest and system structure. And now go to chemical and powder coating department. These both processes explain above the pages.

In chemical processes are using in this company chair parts good finishing and good shining. These processes are done in 48 hours to part are finishing a product . there are five liquid used for this processes like simple water, acid + water, again simple water and now main two liquid are usedfor phosphating and passivation. And the phosphating processes are 7 time processes to part in tank. Now this processes done going to a powder coating department.

Fig 4.2 compact chair

This two equipment are power coating processes used. And chemical processes done now all parts are going 1st equipment to part are form in powder form its used for powder gun to spray in part white power are used form chair parts. Now done the parts are powder form going to heating oven. In this heating oven powder are melt form 180 c to set in this penal box. This box can using only heating purpose. Done the all processes parts aregoing to assembly department. all parts are fixed in steps by steps.

Step 1:- Ready to base and fixed the system for using up and downmotion of the chair.
Step 2:- Now done the system to fixed the back rest and foot rest.
Step 3:- now other equipment are fixed like lamp, buttons for motions,regulator fixed to used in plug.
Step 4:- now compact chair is ready to transport.

4.3 Operation Table Manufacturing:-

To start the manufacturing in operation table first the design and material are selected in quality department. Basically iron for using system(electriccircuit ,motor, also PCB are using). Then design done for the product to start the planning and secluding for this product.
First the design is prepaid for using AutoCAD and solid work for operationtable. After done the to planning for OT table design go to the foundry. This operation table can prepaid or manufacturing to parts like bed, system cover, wheel plate, head rest etc. in foundry for Mild Steel material used for this operation table. After done the all selection processes to this company can prepaid for all processes for Operation table.

Fig 4.3 Operation table

Now the first the electric system prepaid for Operation table purpose is the bed is up and down motion in this table .Done the system can move in a wheel plate is prepaid for using in one place to other place can movein OT table. Now move in fabrication department to remove and surface finishing is good for a operation table. To remove the dust practical in grinder cutter used to surface finishing good in Operation table body. Done the all processes to start the assemble all parts in assembly department.

First the wheel plate are fixed and plate material are used for a mild steel(M.S) now next the system and plug holder box are fitted in Operation table. System can run a one motor fixed in middle and close the system in cover is also using the (M.S) material and plug holder box are fixed in OT table. Now to equipment are fixed operation table next the bed and head restis fitted to this table. Next the other equipment are fitted in operation table like tray, bottle heandle and head rest cover fitted. One head press tool are fixed in Operation body this tool can used in bed one slide up and down motion during the operation in eyes care hospitals and surgical hospitals. Mild steel operation table is ready go to packaging department andtransport the one place to other place.

4.4 OPTICAL CHAIR SERIES 2 MANUFACTURING:-

In this product are used for optical hospitals and small clinic this model are using for a doctor model to easy way check the eyesnumber. To start the manufacturing in optical chair 2 first the design and material are selected in quality department. Basically iron for using system (electric circuit ,motor, also PCB are using). Then design done for the product to start the planning and secluding for this product.
There are five motion are including to this chair. Up, and down, position of chair series 2. Iron and mild steel material are used for a this chair internal and external cover are used for a MS material this product. First the prepaid for a system used for a up and down motion of optical chair 2.
To start the product are prepaid for all parts are cutting in multiple hacksaw machine using this company. All iron parts are cutting in this machine.

To all parts are cutting go to the fabrication processes and this processes are explain in above pages. Basically grinding and welding both processesmost important in this company. Done the fabrication processes go to machining department to remove the material and finishing parts of this chair.
To remove the material are parts lathe and drilling machine are used for this machining department. Multiple lathe machine are used to remove the material and drilling machine are used for a hole of components of optical chair 1 like head rest foot rest and system structure.

In chemical processes are using in this company chair parts good finishing and good shining. These processes are done in 48 hours to part are finishing a product . there are five liquid used for this processes like simple water, acid + water, again simple water and now main two liquid are usedfor phosphating and passivation. And the phosphating processes are 7 time processes to part in tank. Now this processes done going to a powder coating department.

Fig 4.4 optical chair 2

This two equipment are power coating processes used. And chemical processes done now all parts are going 1st equipment to part are form in powder form its used for powder gun to spray in part white power are used form chair parts. Now done the parts are powder form going to heating oven.

In this heating oven powder are melt form 180 c to set in this penal box. This box can using only heating purpose. Done the all processes parts are going the assembly department and machine are ready.

CHAPTER 5:- CONCLUSION

It was a great experience in OPTECH MEDICAL SYSTEM . With full knowledge of the Assembly and manufacturing department . Knowledge of measuring instrument to used in a company .I have a learnt about Vernier caliper micro meter, gauges, depth gauges etc. also visited the alldepartment to manufacturing product and show the machining process the friendly all employees to share the experience and given process to machining product.

This employees to share each and every point the process step by step to machining mean while the during internship great learnings to machinesand machining process.

Also seen the how an organization work under the pressure and how to handle the work load and within time to finish work with out any problem and also how to behave in each employees and head of the department.to improved the knowledge to long journey to work in our industry. And solve the problem during the work in our industry.

In this company are manufacturing medical and surgical equipment it was a new concept in this internship. Also this company are new product launch in MIT table its used for a hospitals and small clinic and eyes care hospitals. Many operation table are prepaid and observation during the internship. In this company are join in ophthalmic refraction unit in this unit many company are prepaid or manufacturing in medical and surgical equipment. And this company are join in this unit to few years.

The ophthalmic refraction unit is an essential tool used for optech medical system to this unit manufacturing medical and surgical equipment to this company. This ophthalmic refraction unit to product are using for eyes care hospitals and clinics.

In this company many processes used for prepaid for medical and surgical equipment like optical chair series 1 and 2. Also compact chair and OT table are manufacturing to this company and also new product manufacturing of MIT (motorized instrument tables) this table used for a small dental care hospitals and clinic.

Rumax international company is one more ophthalmic refraction unit connect to prepaid for medical and surgical equipment but this company latest technology using for both product are manufacturing.

CHAPTER 6:- REFERENCES

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https// www.optechmedicalsystems.com

https://www.rumax.co.in

https://www.rumaxinternational.com/

https://m.indiamart.com/rumaxinternational

https://in.linkedin.com/company/rumax

APPENDIX

GUJARAT TECHNOLOGICAL UNIVERSITY
(Established under Gujarat Act No. 20 of 2007)
ગુજરાતટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I - 1
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit Sureshbhai
DIARY OF THE WEEK: DE: 30-1-2023 TO 5-2-2023
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Optech MEDICAL SYSTEM
NAME OF THE PLANT/SECTION/DEPARTMENT: Assembly Department
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week I have work in Assembly Department.
-> This company is manufacturing Dental chair or eye number check and O.T. Table is manufacturing.
-> There are three series of chair
1. optical - 1
2. optical - 2
3. comfort - 1
-> This 1st and 2nd series motion and position are different.
-> comfort - 1 is the new machine.
-> This week S.S [stainless steel] otration table are manufacturing.
-> And other of table are M.S [mild steel] are prepaid.

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TOTAL HOURS: 8 hours

S. S. Patel
SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/1/23

Signature of officer-in-charge of Dept. / Section / Plant

Date: 30-1-2023

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I - 2
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit S

DIARY OF THE WEEK: DT: 19-2-2023 TO 25-2-2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: OPTech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: Fabrication and manufacturing

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhruvul Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week All fabrication process are show in the company.
-> This week Prepaid operation table manufacturing. material are used for stainless steel 304.
-> New of table are Prepaid. motion are 4 include
-> up, down, back, forward etc.
-> welding, finishing, machining, cutting, Powder coating All fabrication process used for M.S. OT chairs etc.
-> This week Prepaid 2 operation table ready All Process are include.
-> first the design Prepaid for O.T table done the design go to the foundary prepaid for structured. All
-> manufacturing the table this company department parts or components joint in Assembly to All parts check in instrument vernier calipar micrometer

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TOTAL HOURS: 16

S.S Patel
SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date: 19/3/23

Date: 19-2-23

- Grading of Work for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I – 3
Enrollment no: 200390119564

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: PATEL SMIT SURESHBHAI

DIARY OF THE WEEK: Dt: 6-2-2023 TO 18-2-2023

DEPARTMENT: MECHNICAl SEM: 8th

NAME OF THE ORGANISATION: OPTECH MEDICAl SYSTEM

NAME OF THE PLANT/SECTION/DEPARTMENT: Manufacturing and Assembly

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week work on manufacturing processes, Assembly and quality department.
-> welding process :- Mig, Arc, Spot
-> finishing process - grinder, painting.
-> machining process - lathe machine, milling machine.
-> components are this process are manufacturing to chair, OT table and MIT (motorized instrument table).
-> Assembly department fitted in All components are this Department
-> Quality department material quality, Accuracy of product, errors can be solved and Also preparing reports.

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TOTAL HOURS: 16

S.S. Patel
SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18 / 3 / 23

Signature of officer-in-charge
of Dept. / Section / Plant

Date: 5 - 2 - 23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Enrolment No.:
200330119804

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit S.

DIARY OF THE WEEK: DT. 27-2-2023 TO 5-3-2023

DEPARTMENT: mechanical SEM: 8th

NAME OF THE ORGANISATION: Oftech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: chemical and powder coating

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Pramod Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> This week I have work to chemical and powder coating Department this Department their part shining and improve the quality of parts.

-> There are 5 [illegible] used for chemical process
(1) simple water (2) [illegible] water (3) Phosphating
(4) simple water (5) Passivation.

-> Powder coating process start in chemical process are done to start this process.

-> Powder coating process used to electrostatic process and [illegible] to either powder to the surface.

-> Two types of Powder coating process
(1) Thermosets
(2) Thermoplastic

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TOTAL HOURS 16

S.S.Patel
SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 25-2-23

Grading of Work for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I - 5
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit S.

DIARY OF THE WEEK: DT: 6-3-23 TO 12-3-23

DEPARTMENT: Mechanical SEM: 6th

NAME OF THE ORGANISATION: Oftech Medical System

NAME OF THE PLANT/SECTION/DEPARTMENT: Assembly Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Ahmad Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> After done the both Process I have work in Assembly department. All parts are making this department.

-> All parts are done in powder coating and finishing.

-> Checked the parts measurement done. After prepare for chair, first the base are ready and now system are fixed in base. Next the electric system are fixed [PCB circuit].

-> Control system are fixed [Buttons, Up/down, back, forward etc.]. Footrest are fixed.

-> Next the other equipment [Lump, Arm, sliding etc.]

-> New chair is ready.

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TOTAL HOURS: 16

S. S. Patel
SIGNATURE OF STUDENT

✪ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 6 - 3 - 23

✪ Grading of Work for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I - 5
Enrollment no: 201190119 504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit Sureshbhai

DIARY OF THE WEEK: Dt: 13-3-23 TO 19-3-23

DEPARTMENT: mechanical SEM: 8th

NAME OF THE ORGANISATION: Oftech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: Design and manufacturing

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dharmraj Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week New Design of chair and manufacturing this chair.
-> Identifying the Problem.
-> Researching in detail.
-> Ideating Possible Solutions.
-> Evaluating and selecting Promising solution.
-> creating a Prototypes.
-> measuring the all Parts.
-> convert the 2D to 3D Parts.
-> measuring all 2D and 3D Part to create inspection report.
-> find the making improvement the final Product.
-> There two software are used for Design AutoCAD and Solid Work.

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TOTAL HOURS: 16

S.S. Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 12-3-23

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Annexure I - A
Enrollment no: [illegible]

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Amit Sureshbhai

DIARY OF THE WEEK: DT: 20-3-23 TO 26-3-23

DEPARTMENT: mechanical

NAME OF THE ORGANISATION: Artech medical System SEM: 8th

NAME OF THE PLANT/SECTION/DEPARTMENT: Assembly Department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> And this week to find and solution of Design of chair and operation table.
-> During the chair and OT table are fixed in parts or components to problem find in system or maker.

-> to solve the problem of design department next time improve the New Design and processes.

-> this Assembly Department parts are fixed OT table, MOT, chair of three series And try to solve in problem.

-> To check quality and measuring All parts to this Department.

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TOTAL HOURS 16

S.S.Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 18-3-23

Grading of Work for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I – 8
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel smit sureshbhai

DIARY OF THE WEEK: DT: 27-3-23 TO 2-4-23

DEPARTMENT: mechanical SEM: 5th

NAME OF THE ORGANISATION: ortech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: chemical department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

->This department used for parts are finishing and shining each and every parts.
->there are five liquid are used for a finishing and good quality of parts.
->simple water ->Acid water ->simple water
->Phosphating ->Passivation.

->Phosphating are most important liquid of the parts. It's a 3 time processes during chemical process are continous.

->And Passivation liquid are used for a different weather condition to effective a their part to check in this department.
->Done to this process All parts going to Powder coating processes start.

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TOTAL HOURS _16_

S. S. Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 26-1-23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I – 9
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit Sureshbhai

DIARY OF THE WEEK: DE: 3-4-23 TO: 9-4-23

DEPARTMENT: mechanical SEM: 8th

NAME OF THE ORGANISATION: Oftech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: Assembly department

NAME OF OFFICER-INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Arvind Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> And this week I have work in Assembly department

-> I have prepaid MIT Table (motorized instrument table.)

-> first the system is prepaid to using this system table is up and down motion.

-> transformer and PCB circuit are fitted in MIT base. And outer cover is fitted in system.

-> drawer are prepaid for small equipment are put in this equipment

-> wheel plate are prepaid and system are prepaid or fitted in this plate.

-> MIT table ready.

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TOTAL HOURS 16

S.S.Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date

Date: 2-4-23

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Annexure I: 10
Enrollment no: 200390119564

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit Sureshbhai
DIARY OF THE WEEK: Dt: 10-4-23 to 16-4-23
DEPARTMENT: Mechanical SEM: 8th
NAME OF THE ORGANISATION: Oftech medical system
NAME OF THE PLANT/SECTION/DEPARTMENT: Fabrication and manufacturing
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: dhruval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> In this week All Fabrication Processes are Show in the company.
-> This week Prepaid operation table manufacturing All material are used for S.S 304.
-> New OT Table are Prepaid. And operation are showing
-> up, down, back, forward etc.
-> This week Prepaid for operation table ready and to used All Processes.
-> All Parts are done form All PROCESSES to check quality and measurement to used manual vernier caliper, micrometer and height gauge.
-> All Parts and equipment are Prepaid for foundary for M.S. and S.S. 304.

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TOTAL HOURS: 16

S.S. Patel
SIGNATURE OF STUDENT

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EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 3-4-23

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Annexure I 17
Enrollment no: 20-39 0119 5-4

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel smit sureshbhai

DIARY OF THE WEEK: DT: 17-4-23 TO 23-4-23

DEPARTMENT: mechanical SEM: 8th

NAME OF THE ORGANISATION: Aptech medical system

NAME OF THE PLANT/SECTION/DEPARTMENT: Assembly department

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

-> I have work in this department to prepaid and manufacturing in MOT table. (Medicine & instrument table).

-> first electric system is prepaid this system used for a machine is up and down motion only. using motor.

-> second wheel plate and drawer is ready simple wooden material used for a drawer.

-> system is ready outer side is cover fitted to M.S. material used.

-> MOT Table is ready. All parts fixed in wheel plate.

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TOTAL HOURS: ___16_______

S. S. Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date: 15-4-23

◘ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

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Annexure I: 12
Enrollment no: 200390119504

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Patel Smit Sureshbhai
DIARY OF THE WEEK: DE: 24-04-23 TO 30-04-23
DEPARTMENT: mechanical SEM: 8th
NAME OF THE ORGANISATION: Oftech medical system
NAME OF THE PLANT/SECTION/DEPARTMENT: chemical department
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Dhaval Patel

DESCRIPTION OF THE WORK DONE IN BRIEF

->In this week new Design of chair and manufacturing this company.
->Identifying the problem
->Researching in depth.
->Ideating possible solutions.
->Evaluating and selecting promising solution.
->creating a prototypes.
->measuring the hare parts.
->convert the 2D to 3D parts.
->measuring all 2D and 3D part to create inspection report
->find the making improvement the final product
->There two software are used for design AutoCAD and Solidwork.

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TOTAL HOURS: 16

S. S. Patel
SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Signature of officer-in-charge of Dept. / Section / Plant

Date:

Date: 03 - 4 - 23

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Annexure 2

Feedback Form by Industry expert

Student Name: Patel smit S

Date: 30-4-2023

Work Supervisor: Dhrumil Patel

Title: Internship

Company/Organization: optech medical system

Enrollment No: 200390119504

Internship Address: Plot No C-1 1263 GIDC estate Phase -1 Naroda-Ahmedabad

Dates of Internship From 30-1-2023 to 30-4-2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives			✓	
Produces high quality work and accepts responsibility		✓		
Uses technical knowledge and expertise			✓	
Analyzes problems effectively		✓		
Communicates well, and works effectively				✓

Overall performance of student intern (Needs improvement/ Satisfactory/ Good/ Excellent):

Additional comments, if any:

Signature of Industry person with name and Stamp:

Signature of the Faculty Mentor:

OPTECH MEDICAL SYSTEM
AHMEDABAD

Internship at LARSEN & TOUBRO LIMITED

(EPSE DEPARTMENT-VADODARA)

AN INTERNSHIP REPORT

Submitted By

JEET POMAL

200390119502

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

Mechanical Engineering

S. P.B. Patel Engineering College, Mehsana

Gujarat Technological University, Ahmedabad

(April 2023)

S.P.B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

GUJARAT TECHNOLOGICAL UNIVERSITY

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad-Mehsana Highway, Linch, Gujarat,384435

CERTIFICATE

This is to certify that the internship report submitted along with the project entitled **Internship at Larsen & Toubro.** has been carried outby Jeet Pomal under my guidance in partial fulfilment for the degree of Bachelor of Engineering in Mechanical Engineering, 8^{th} Semester of Gujarat Technological University, Ahmadabad during the academic year 2022-23.

Prof. Kunalsinh Kathia	Prof Kunalsinh Kathia
Internal Guide	Head of the Department
Mechanical Engineering	Mechanical Engineering

PMMS CERTIFICATE

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : 08 May 2023 (09:57:48)

This is to certify that, ***Jeet Pratapbhai Pomal*** (Enrolment Number - 200390119502) working on project entitled with ***Internship at L&T*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Jeet Pratapbhai Pomal

Name of Guide : Mr. Kunalsinh R. Kathia

Signature of Student : ________________

*Signature of Guide : ________________

Disclaimer :
This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate, Only if all above activities has been Completed.

INDUSTRIAL CERTIFICATE

LARSEN & TOUBRO

Larsen & Toubro Limited
L&T Energy-Power
L&T Knowledge City - Gate No. 1
NH-8, Ajwa-Waghodia Crossing
Vadodara - 390019, Gujarat, INDIA
Tel: +91 265 245 4000 / 4001
www.Lntpower.com

IPT/2022-23/15

29 April 2023

TO WHOM SO EVER IT MAY CONCERN

This is to certify that **Jeet Pomal,** student of **BE - Mechanical, Saffrony Institute of Technology, Mehsana** was with us in **EPSE Department** for Internship from **01/02/2023 to 29/04/2023** as a part of the academic curriculum.

During this period, we observed the student to be hardworking, sincere, well managed and dedicated in all the assignments.

We wish him very best for the future endeavors.

Yours truly,
For L&T Energy - EPC Power

Nishit Bhavsar
AGM – HR

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

GUJARAT TECHNOLOGICAL UNIVERSITY

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad-Mehsana Highway, Linch, Gujarat,384435

DECLARATION

I hereby declare that the Internship report submitted along with the Internship entitled **Internship in Industrial Training & Quality Control** submitted in partial fulfilment of the degree of Bachelor of Engineering in Mechanical to Gujarat Technological University, Ahmedabad, is a bonafide record oforiginal project work carried out by me at Larsen &Toubro under the supervisionof industry guide Mr. Kalpesh Kotak and internal guide Prof. Kunalsinh Kathia and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

ACKNOWLEDGEMENT

I wish to express my appreciation to Prof. Kunalsinh Kathia, Prof.Monil Shah, Prof. Ashutosh Gohel, Prof. Tausif Shaikh for the knowledge imparted during my academic tenure at Saffrony Institute of Technology. A special thanks goes to Prof. Kunalsinh Kathia for making sure I gained sufficient knowledge during my graduate studies and for her encouragement.

First I would like to thank Mr. Nishit Bhavsar, HR, Jt. General Manager Mr. Achintya Gosh & Mr. Chetan Prajapati for giving me the opportunity to do an internship within the organization.

I wish to express our sincere gratitude to our External guide Mr. Kalpesh Kotak for continuously guiding me at the company and answering all my doubts with patience. We would also like to thank our Internal Guide Prof. Kunalsinh Kathia for helping us through our internship by giving us the necessary suggestions and advices along with their valuable co-ordination in completing this internship.

We also thank our parents, friends and all the members of the family for their precious support and encouragement which they had provided in completion of our work. In addition to that, we would also like to mention the company personals who gave us the permission to use and experience the valuable resources required for the internship. I perceive this opportunity as a big milestone in my career development. I will strive to usegained skills and knowledge in the best possible way, and I will continue to work on their improvement, to attain desired career objectives

Thus, in conclusion to the above said, we once again thank the staff members of LARSEN & TOUBRO LIMITED for their valuable support in completion of the Internship.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

ABSTRACT

During my internship at L&D in the Engineering Procurement and Constructions (EPC) department, I had the opportunity to gain practical experience and develop skills in various areas related to project management and construction. Over the course of the internship, I was involved in projects that ranged from site inspections and safety checks to assisting in the coordination of subcontractors and managing project documentation.

Throughout my internship, I worked closely with a team of experienced professionals who provided guidance, support, and feedback on my work. I was able to apply the knowledge and skills I gained in my academic studies to real-world situations, and I also learned new concepts and techniques that will serve me well in my future career.

One of the key projects I worked on during my internship was the construction of a new office building. I was responsible for coordinating with various subcontractors and ensuring that the project was completed on time and within budget. I also had the opportunity to participate in site inspections and safety checks, gaining valuable insights into the importance of safety and compliance in construction projects.

Overall, my internship at L&D in the EPC department was an enriching and rewarding experience that helped me to grow both professionally and personally. The skills and knowledge I gained will be invaluable as I pursue a career in the construction industry.

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CHAPTER 1.0-OVERVIEW OF THE COMPANY

1.1 INTRODUCTION

Larsen & Toubro Ltd, commonly known as L&T, is an Indian multinational conglomerate with a rich history that spans over 80 years, with business interest in engineering, construction, manufacturing, technology, information technology and financial services, headquartered in Mumbai. The company is counted among world's top five construction companies. It was founded by Henning Holck-Larsen and Søren Kristian Toubro, who were two Danish engineers taking refuge in India.

As at March 31, 2022, the L&T Group comprises 93 subsidiaries, 5 associate companies, 27 joint ventures and 35 jointly held operations, operating across basic and heavy engineering, construction, realty, manufacturing of capital goods, information technology, and financial services.

Larsen & Toubro Limited (L&T) is an Indian multinational conglomerate company that is headquartered in Mumbai, Maharashtra. It was founded in 1938 by two Danish engineers, Henning Holck-Larsen and Soren Kristian Toubro. Today, L&T is one of the largest engineering and construction companies in India, with a presence in over 30 countries worldwide.

L&T operates in a variety of sectors, including engineering, construction, information technology, power, defence, and aerospace. The company's engineering and construction division is its largest business segment, accounting for over 70% of its revenue. This division is involved in a range of activities, including building infrastructure such as roads, bridges, and airports, as well as constructing power plants and oil and gas facilities.

L&T's information technology division, L&T Infotech, provides a range of services to clients in industries such as banking, insurance, and healthcare. The company also has a defence division that produces a range of products, including artillery systems and armoured vehicles.

L&T has been recognized for its excellence in engineering and construction, winning numerous awards and accolades over the years. The company has also been recognized for its commitment to sustainability and social responsibility, with a focus on environmental protection and community development.

Overall, L&T is a highly diversified company with a strong presence in a range of sectors. Its commitment to excellence and sustainability has made it a respected player in the Indian business community and beyond.

Fig 1.1 Picture Of L&T Knowledge City

1.2 L&T HISTORY

The company began as a representative of Danish manufacturers of dairy and allied equipment. However, with the start of the Second World War in 1939 and the resulting blockade of trade lines, the partners started a small workshop to undertake jobs and provide service facilities.

In 1946, ECC (Engineering Construction & Contracts) was incorporated by the partners; the company at this time was focused on construction projects L&T began several foreign collaborations. By 1947, the company represented British manufacturers of equipment used to manufacture products such as hydrogenated oils, biscuits, soaps and glass. In 1947, the company signed an agreement with Caterpillar Tractor Company, USA, for marketing earth moving equipment. At the end of the war, large numbers of war-surplus Caterpillar equipment were available at attractive prices, but the finances required were beyond the capacity of the partners. This prompted them to raise additional equity capital, and on 7 February 1946, Larsen & Toubro Private Limited was incorporated.

After India's independence in 1947, the firm set up offices in Calcutta (now Kolkata), Madras (now Chennai) and New Delhi. In 1948, 55 acres of undeveloped marsh and jungle was acquired in Powai, Mumbai. In December 1950, L&T became a public company with a paid-up capital of ₹20 lakh. The sales turnover in that year was ₹1.09 crore. In 1956, a major part of the company's Mumbai office moved to ICI House in Ballard Estate, which would later be purchased by the company and renamed as L&T House, its present headquarters.

In 1965, the firm had been chosen as a partner for building nuclear reactors. Dr. Homi Bhabha, then chairman of the Atomic Energy Commission (AEC) had in fact first approached L&T in the 1950s to fabricate critical components for atomic reactors. He convinced Holck-Larsen, a friend with whom he shared an interest in the arts that the company could do it, indeed must do it. L&T has since contributed significantly to the Indian nuclear program.

During the 1970s, L&T was contracted to work with Indian Space Research Organization (ISRO). Its then chairman, Vikram Sarabhai, chose L&T as manufacturing partner. In 1972, when India launched its space program, the firm was invited to participate.

In 1985, L&T entered into a partnership with Defence Research and Development Organization (DRDO). L&T was not yet allowed by the government to manufacture defence equipment but was permitted to participate in design and development programmes with DRDO. After the design and development was done, the firm had to hand over all the drawings to DRDO. The government would then assign the production work to a public sector defence unit or ordnance factory for manufacture. After a series of successes and positive policy initiatives, the firm today makes a range of weapon and missile systems, command and control systems, engineering systems and submarines through DRDO.

1.3 SCOPE OF LARSEN & TOUBRO:

1] Engineering, Procurement, and Construction (EPC) Services: L&T provides EPC services for various sectors such as infrastructure, power, hydrocarbons, defense, and aerospace. These services include project management, engineering, procurement, construction, and commissioning.

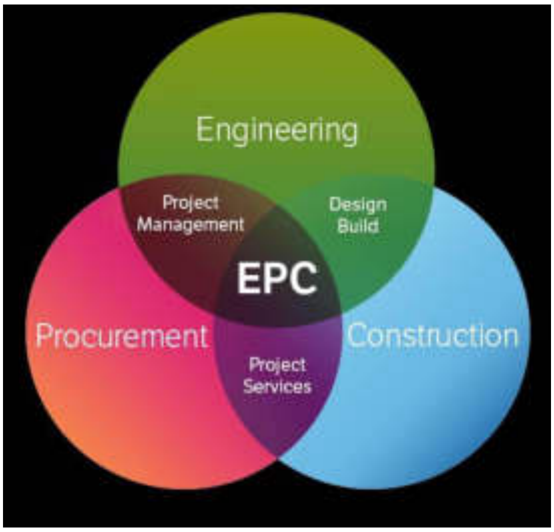


Fig 1.2 Engineering, Procurement, and Construction (EPC) Services

2] Heavy Engineering: L&T manufactures a range of heavy engineering products such as pressure vessels, heat exchangers, reactors, and heavy forgings for industries such as oil and gas, refinery, petrochemical, power, and nuclear.

Fig 1.3 Heavy Engineering

3] Electrical and Automation: L&T provides a range of electrical and automation solutions such as switchgear, electrical systems, industrial automation, and control systems for industries such as power, oil and gas, and manufacturing.

Fig 1.4 Electrical and Automation

4] Information Technology: L&T provides IT services such as application development, maintenance, and support, IT infrastructure management, and consulting services for various industries.

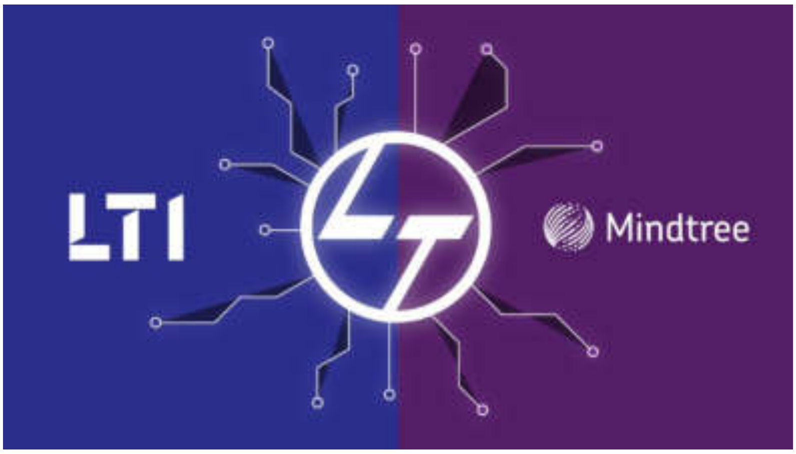


Fig 1.5 Information Technology

5] Financial Services: L&T provides financial services such as mutual fund management, portfolio management, investment banking, and wealth management.

Fig 1.6 Financial Services

6] Construction and Real Estate: L&T is also involved in construction and real estate development. The company builds residential and commercial buildings, infrastructure projects, and airports.

Fig 1.7 Construction and Real Estate

7] Defence: L&T provides defense products and services such as defense electronics, missile systems, and defense aerospace, and naval systems.

Fig 1.8 Defence

8] Shipbuilding: L&T also has a shipbuilding division that builds and repairs ships for the defense and commercial sectors.

Fig 1.9 Shipbuilding

1.4 OBJECTIVES OF LARSEN AND TOUBRO LIMITED

Business growth and profitability: L&T aims to achieve sustainable business growth and profitability by constantly innovating, investing in new technology and processes, and expanding its reach into new markets.

Customer satisfaction: L&T is committed to providing high-quality products and services that meet or exceed customer expectations. The company strives to build long-lasting relationships with its customers by understanding their needs and delivering customized solutions.

Employee development: L&T recognizes that its employees are its most valuable asset and aims to create a work environment that fosters creativity, innovation, and personal growth. The company invests in its employees' development through training, mentoring, and career advancement opportunities.

Corporate social responsibility: L&T is committed to being a responsible corporate citizen by contributing to the social and economic development of the communities in which it operates. The company undertakes various CSR initiatives in the areas of education, healthcare, environment, and rural development.

Sustainable development: L&T recognizes the importance of sustainable development and aims to minimize its environmental impact through the adoption of green technologies and practices. The company is committed to reducing its carbon footprint, conserving natural resources, and promoting sustainable practices across its operations.

Overall, L&T's objectives revolve around sustainable business growth, customer satisfaction, employee development, corporate social responsibility, and sustainable development.

1.5 PURPOSE OF LARSEN AND TOUBRO LIMITED

"L&T" could refer to several things, but assuming you are asking about the purpose of "Learning and Teaching" in the context of education, the purpose of L&T is to facilitate the acquisition of knowledge, skills, and values by learners.

Learning involves the process of gaining new knowledge, developing skills, and changing attitudes, while teaching refers to the process of imparting knowledge, skills, and values to learners. Effective learning and teaching require a supportive and engaging learning environment, appropriate teaching methodologies, and skilled teachers who can cater to the diverse learning needs of students.

The ultimate goal of learning and teaching is to enable learners to develop critical thinking skills, apply knowledge in real-world situations, and become responsible and informed members of society. Additionally, L&T aims to promote personal and social development, encourage lifelong learning, and enhance individual and societal well-being.

Fig 1. 10 Purpose Of Larsen And Toubro Limited

1.6 ORGANIZATIONAL STRUCTURE

The company has a hierarchical organizational structure, which can be described as follows:

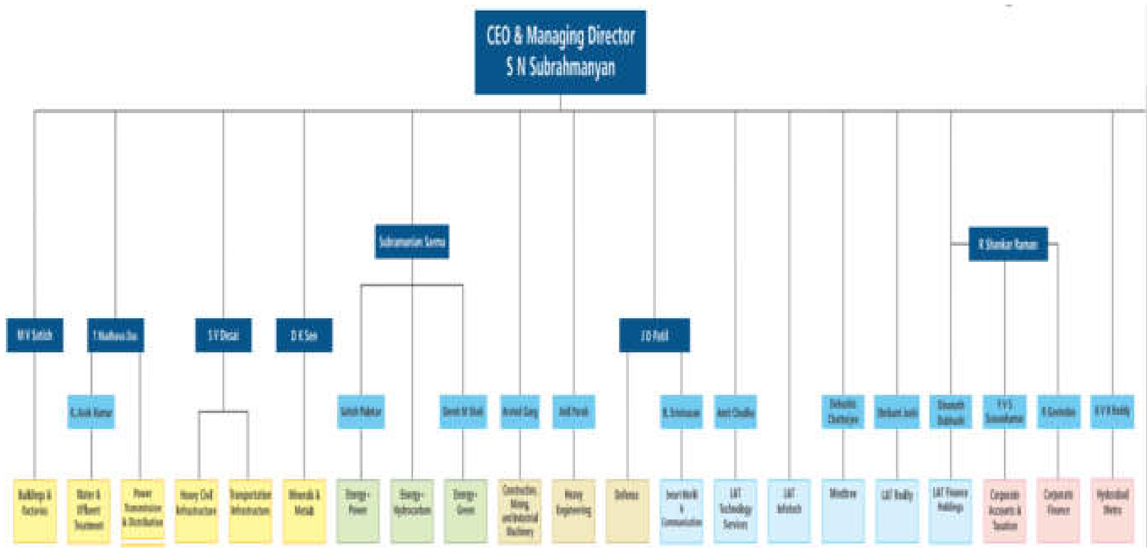


Fig 1.11 ORGANIZATIONAL STRUCTURE

1] **Board of Directors:** The highest level of authority in L&T is its Board of Directors, which is responsible for setting the strategic direction and overseeing the company's operations. The board comprises 14 members, including the Chairman and Managing Director.

2] **Executive Leadership Team:** The Executive Leadership Team is responsible for executing the strategic plans and managing the day-to-day operations of the company. The team comprises the Chairman, Managing Director, and other top executives, including the Chief Financial Officer, Chief Operating Officer, and Chief Human Resources Officer.

3] **Business Units:** L&T operates through various business units, each specializing in a particular sector or function. These units include the Engineering and Construction Division, IT and Technology Services Division, Financial Services Division, and more.

4] **Departments:** Each business unit is further divided into departments, each responsible for a specific function. For example, the Engineering and Construction Division has departments such as Civil and Infrastructure, Power Transmission and Distribution, and Water and Effluent Treatment.

5] **Teams:** Each department is composed of teams responsible for specific projects or tasks. For instance, the Civil and Infrastructure Department may have teams responsible for designing and building roads, bridges, and other infrastructure projects.

1.7 GROUP OF COMPANIES

Three key products/services which L&T is engaged in are: Construction and project-related activity; manufacturing and trading activity; and engineering services. L&T sold L&T Mutual Fund to HSBC on November 26, 2022. L&T IDPL was sold to Edelweiss Alternatives for Rs. 6,000crore. For administrative purposes, the conglomerate has been structured into sixteen subsidiary companies:

- L & T Construction
- L & T Hydrocarbon
- L & T Power
- L & T Mineral & Metals
- L & T Infotech
- L&T Mind tree
- L & T Heavy Engineering
- L & T Defence
- L & T Shipbuilding
- L&T Construction& Mining Machinery
- L & T Valves
- L&T Technology Services
- L & T Metro Rail
- L & T Financial Services
- L & T Realty
- L & T SuFin
- L & T EduTech
- L & T Infotech

1.8 OTHER SUBSIDIARIES AND JOINT VENTURES

As of March 2018, L&T has 93 subsidiaries, 8 associate companies, 34 joint ventures, and 33 joint operation companies.

- L&T Infrastructure Engineering Ltd. is one of India's engineering consulting firms offering technical services in transport infrastructure. The company has experience both in India and Globally, delivering single point 'Concept to Commissioning' consulting services for infrastructure projects like airports, roads, bridges, ports and maritime structure including environment, transport planning and other related services. Established in 1990 as L&T-Ramboll Consulting Engineers Limited, the company became the wholly owned subsidiary of L&T in September 2014. Today, L&T Infra Engineering is an independent corporate entity managed by a board of directors. The company enjoys complete freedom to set and pursue its goals, drawing, as and when required, on the technical and managerial resources of L&T Infrastructure Engineering Limited.
- L&T – Construction Equipment Limited: having its registered office at Mumbai, India and focusing on construction equipment and mining equipment, **L&T-Komatsu Limited** was a joint-venture of Larsen and Toubro, and Komatsu Asia Pacific Pte Limited, Singapore, a wholly owned subsidiary of Komatsu Limited, Japan. Komatsu is the world's second largest manufacturer of hydraulic excavators and has manufacturing and marketing facilities. The plant was started in 1975 by L&T to manufacture hydraulic excavators for the first time in India. In 1998, it became a joint-venture. The Bengaluru works comprise machinery and hydraulics works, with a manufacturing facility for design, manufacture, and servicing of earth moving equipment. The hydraulics works have a precision machine shop, manufacturing high-pressure hydraulic components and systems, and designing, developing, manufacturing and servicing hydraulic pumps, motors, cylinders, turning joints, hose assemblies, valve blocks, hydraulic systems, and power drives as well as allied gearboxes. In April 2013, L&T bought the 50% stake held by Komatsu Asia & Pacific. The company's name was changed to L&T Construction Equipment Limited.

- L&T has a joint venture with Qatari company Al Balagh group as the main contractors for the Al Rayan stadium, the 2022 FIFA World Cup stadium which will host matches up to the quarter-final.
- L&T Finance: Larsen & Toubro financial services is a subsidiary which was incorporated as a non-banking financial company in November 1994. The subsidiary has financial products and services for corporate, construction equipment. This became a division in 2011 after the company declared its restructuring. A partnership between L&T Finance and Sonalika Group farm equipment maker International Tractors Ltd in April 2014 provided credit and financing to customers of Sonalika Group in India.
- L&T Mutual Fund is the mutual fund company of the L&T Group. Its average assets under management (AuM) as of May 2019 is ₹ 73,936.68 crore.
- Larsen & Toubro Infrastructure Finance: this wholly owned subsidiary commenced business in January 2007 upon obtaining Non-Banking Financial Company (NBFC) license from the Reserve Bank of India (RBI). As of 31 March 2008, L&T Infrastructure Finance had approved financing of more than US$1 billion to select projects in the infrastructure sector. It received the status of "Infrastructure Finance Company" from the RBI within the overall classification of "Non-Banking Financial Company".
- L&T Valves markets valves manufactured by L&T's Valve Manufacturing Unit and L&T's joint-venture Larsen & Toubro Valves Manufacturing Unit, Coimbatore as well as allied products other manufacturers. The group's manufacturing unit in Coimbatore manufactures industrial valves for the power industry, along with flow control valves for the oil and gas, refining, petrochemical, chemical and power industries, industrial valves and customised products for refinery, LNG, GTL, petrochemical and power projects. L&T Valves Business Group has offices in the US, South Africa, Dubai, Abu Dhabi, India and China, and alliances with valve distributors and agents in these countries.
- L&T-MHPS Boilers is a joint venture between L&T and Mitsubishi Hitachi Power Systems. The group specialises in engineering, manufacturing, erecting and commissioning of supercritical steam generators used in power plants. It is mainly headquartered in Faridabad with a manufacturing facility in Hazira and an engineering centre in Chennai and Faridabad. Currently, the group is engaged in projects for JVPL, MAHAGENCO, Nabha Power & RRVUNL.

- L&T MHPS Turbine Generators Pvt Ltd: in 2007, Larsen & Toubro and Mitsubishi Heavy Industries set up a joint-venture manufacturing agreement to supply a supercritical steam turbine and generator facility in Hazira. This followed a technology licensing and technical assistance agreement for the manufacture of supercritical turbines and generators between L&T, MHI, and Mitsubishi Electric Corporation (MELCO), headquartered in Tokyo, Japan. In February 2014, MHI and Hitachi Ltd integrated the business centred on thermal power generation systems (gas turbines, steam turbines, coal gasification generating equipment, boilers, thermal power control systems, generators, fuel cells, environmental equipment and so on) and started a new company as Mitsubishi Hitachi Power Systems (MHPS) Ltd, headquartered in Yokohama, Japan.
- L&T Howden Pvt Ltd is a joint venture between L&T and Howden to manufacture axial fans and air pre-heaters in the range of 120-1200 MW to thermal power stations. L&T Howden is an ISO 9001 and ISO 5001 certified organisation, with a plant located in Surat Hazira and a marketing office in Faridabad.
- L&T Special Steels and Heavy Forgings Pvt Ltd. is a joint venture between L&T and NPCIL, headquartered at Hazira. It is the largest integrated steel plant and heavy forging unit in India, capable of producing forgings weighing 120 MT each. LTSSHF currently is engaged in projects from the nuclear, hydrocarbon, power and oil and gas sectors.
- L&T-Sargent & Lundy Limited (L&T-S&L), established in 1995, is an engineering and consultancy firm in the power sector, formed by L&T and Sargent & Lundy L.L.C. - USA, a global consulting firm in the power industry since 189.
- In 2015, the company began developing commercial, retail and office space around the Hyderabad Metro Rail project.
- In June 2019, the company acquired a controlling stake in IT services company Mind tree Ltd.

CHAPTER 2.0-OVERVIEW OF DIFFERENT DEPARTMENT ON MY FLOOR

2.1 LIST OF DIFFERENT TYPE OF DEPARTMENTS IN MY FLOOR

- EPSE - Energy Product & System Engineering
- PIPE DESIGN & PLANT LAYOUT
- CCU – Construction Capability Unit
- PNM - Plant And Machinery
- CMPC –Construction Method And Planning Cell
- CPMCC – Control Planning And Monitoring Competency cell
- HRSG – Heat Recovery Steam Generation
- SCM – Supply Chain Management

2.2. INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF EPSE DEPARTMENT

2.2.1 INTRODUCTION

The Energy Production and Supply Engineering (EPSE) department is a specialized department within the field of engineering that focuses on the production and supply of energy. This department is responsible for designing, developing, and maintaining energy production and supply systems, including power plants, renewable energy systems, and ``

The EPSE department plays a critical role in ensuring that the energy supply is reliable, safe, and efficient. They work on developing new technologies to improve the production and supply of energy, as well as to reduce environmental impact and increase sustainability.

Energy engineers work with a variety of tools and technologies, such as simulation tools, renewable energy sources, and energy storage systems. They also work closely with other engineering disciplines, such as electrical engineering and mechanical engineering, to develop integrated energy systems.

Overall, the Energy Production and Supply Engineering department plays a critical role in addressing the challenges of energy production and supply, including energy security, environmental impact, and sustainability. They work to develop innovative solutions to these challenges, and to ensure that energy is produced and supplied in a way that benefits society and the environment.

The Energy Product & Supply Engineering Department is responsible for the design, development, and production of energy products such as generators, turbines, and other energy-related equipment. The department is also responsible for managing the supply chain of these products, ensuring that they are manufactured and delivered on time and within budget.

The department works closely with other departments within the organization, including Research and Development, Manufacturing, and Sales, to ensure that energy products are designed and produced to meet customer needs while also maintaining cost-effectiveness and sustainability.

- **Research and Development:** The department is responsible for researching and developing new energy products that are innovative, efficient, and cost-effective. This involves conducting market research to identify customer needs, developing product specifications, and testing and validating prototypes.
- **Design and Engineering:** The department designs and engineers energy products, including generators, turbines, and other energy-related equipment. This involves using computer-aided design (CAD) software to create detailed 3D models and technical drawings, as well as conducting simulations and tests to ensure that the products meet performance and safety standards.
- **Manufacturing:** The department oversees the manufacturing of energy products, ensuring that they are manufactured to the highest quality standards and within budget. This involves working closely with manufacturing teams to optimize production processes and reduce costs.
- **Supply Chain Management:** The department manages the supply chain for energy products, ensuring that raw materials and components are sourced from reliable suppliers and that products are delivered on time and within budget.
- **Quality Control:** The department is responsible for ensuring that energy products meet quality standards and are safe to use. This involves conducting rigorous testing and inspections throughout the manufacturing process, as well as implementing quality control measures to prevent defects and ensure customer satisfaction.

- Overall, the Energy Product & Supply Engineering Department plays a critical role in the development and production of energy products, ensuring that they are designed, manufactured, and delivered to meet customer needs while also maintaining cost-effectiveness and sustainability.

The objectives of an Energy Product & Supply Engineering Department can vary depending on the specific goals and mission of the organization or institution it serves. However, some common objectives of this department are:

- **Design and develop energy systems:** The department aims to design and develop energy systems that are efficient, reliable, and sustainable. This can involve the use of renewable energy sources such as solar, wind, hydro, and geothermal energy.

- **Optimize energy efficiency:** The department strives to optimize energy efficiency by developing systems that use energy more efficiently and reduce waste. This can include designing buildings and equipment that require less energy to operate, and implementing energy management strategies.

- **Ensure energy security:** The department aims to ensure energy security by developing systems that can provide reliable and uninterrupted energy supply. This involves designing systems that can withstand natural disasters and other disruptions that may impact energy supply.

- **Promote environmental sustainability:** The department aims to promote environmental sustainability by developing energy systems that have minimal impact on the environment. This can involve reducing greenhouse gas emissions and minimizing the use of fossil fuels.

- **Conduct research and development:** The department aims to conduct research and development to improve energy systems and technologies. This can involve developing new materials, exploring new energy sources, and improving existing technologies.

- **Provide education and training:** The department aims to provide education and training to students, professionals, and the general public on energy systems and technologies. This can include offering courses, workshops, and seminars on energy efficiency, renewable energy, and other related topics.

- Overall, the Energy Product & Supply Engineering Department aims to contribute to a sustainable and reliable energy future by designing and developing energy systems that are efficient, secure, and environmentally sustainable.

Energy Product System Engineering (EPSE) is an interdisciplinary field that combines engineering, science, and management principles to design, analyse, optimize, and manage energy systems and products. The scope of EPSE can include:

- Energy generation systems: EPSE professionals can design and analyse energy generation systems such as solar panels, wind turbines, hydroelectric plants, and nuclear power plants.
- Energy storage systems: EPSE can also involve the design and management of energy storage systems such as batteries, supercapacitors, and pumped hydro storage.
- Energy distribution systems: EPSE professionals can work on the development and optimization of energy distribution systems such as power grids and transmission lines.
- Energy efficiency: EPSE can focus on the improvement of energy efficiency in various products and systems, such as buildings, transportation, and manufacturing processes.
- Renewable energy: EPSE can be applied to the development of renewable energy technologies such as bioenergy, geothermal energy, and tidal energy.
- Overall, the scope of EPSE is broad and encompasses a range of activities related to the design, analysis, optimization, and management of energy products and systems.

2.3 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF PIPE DESIGN AND PLANT LAYOUT DEPARTMENT

The pipe design and plant layout department is an essential division in engineering and construction companies, responsible for designing and developing piping systems and plant layout for various industries. Piping systems are used to transport fluids, such as water, gas, oil, and chemicals, from one location to another. Plant layout refers to the arrangement of equipment and machinery in a facility to optimize the use of space and resources. The department's main objective is to design piping systems and plant layouts that are safe, efficient, and cost-effective.

The pipe design and plant layout department works closely with the project team to determine the specific requirements for the piping system and plant layout. The department then develops a preliminary design concept that outlines the layout of the piping system and plant equipment, including selecting appropriate pipe sizes, fittings, valves, pumps, and other components. Once the design concept has been approved, the department develops a detailed design that includes all the technical specifications, such as the material of construction, pipe thickness, valve ratings, and welding procedures. The department also provides support during the installation and commissioning phase to ensure that the piping system and plant layout are installed correctly and are functioning as per design specifications.

The primary objectives of the pipe design and plant layout department are to design piping systems and plant layout that are safe, reliable, and efficient. The department aims to optimize the use of available space and resources while complying with all applicable codes and regulations. Additionally, the department seeks to ensure that the piping system and plant layout are easy to maintain and operate, with minimal downtime. Finally, the department aims to minimize the overall cost of the project while meeting all the functional requirements. By achieving these objectives, the pipe design and plant layout department contributes to the success of engineering and construction projects across various industries.

The pipe design and plant layout department is responsible for designing and creating the layout of piping systems and industrial plants. The scope of this department can include:

- **Piping design:** This involves designing and creating the layout of piping systems for various industrial applications such as oil and gas, chemical, pharmaceutical, and power plants. The department is responsible for selecting appropriate piping materials, calculating the pressure and flow rate requirements, and designing the piping support systems.

- **Equipment layout:** This involves designing the layout of various equipment such as pumps, compressors, heat exchangers, and tanks within the industrial plant. The department must ensure that the equipment is located in an optimal position that allows for efficient operation, maintenance, and safety.

- **Plant layout:** This involves designing the layout of the entire industrial plant, including the location of piping systems, equipment, and other structures. The department must ensure that the plant layout is efficient, safe, and meets regulatory requirements.
- **Cost estimation:** The department is also responsible for estimating the cost of the piping and plant layout designs, taking into account material and labour costs, equipment costs, and any other relevant expenses.
- Overall, the pipe design and plant layout department plays a crucial role in the design and construction of industrial plants, ensuring that the piping and equipment systems are efficient, safe, and meet regulatory requirements.

2.4 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF CCU DEPARTMENT

The Construction Capability Unit department is a specialized unit within a construction company or organization that focuses on providing a wide range of services related to the construction industry. This department is responsible for managing and delivering construction projects, as well as providing technical expertise and support to other departments within the organization.

The primary role of the Construction Capability Unit is to ensure that construction projects are completed efficiently, safely, and within budget. This includes managing the design, procurement, construction, and commissioning of projects, as well as ensuring compliance with regulatory and safety standards.

The department typically includes professionals with diverse backgrounds, including project managers, engineers, architects, surveyors, and construction supervisors. These professionals work together to provide a comprehensive range of services to clients, including design, engineering, project management, construction, and commissioning.

The Construction Capability Unit department is critical to the success of any construction organization, as it provides the technical expertise and project management skills required to deliver complex construction projects. Its services are essential in ensuring that construction projects are completed on time, within budget, and to the highest standards of quality and safety.

The Construction Capability Unit department works to manage and deliver construction projects efficiently and effectively. This involves a variety of tasks and responsibilities, including:

- Project Planning: The department is responsible for developing project plans, including timelines, budgets, and resource allocation. They ensure that all stakeholders are aware of the project requirements and timelines.
- Design and Engineering: The department provides design and engineering services to develop construction plans that meet client needs and regulatory requirements.
- Procurement: The department manages the procurement of materials, equipment, and services required for construction projects. They identify vendors and suppliers, obtain quotes, negotiate contracts, and ensure timely delivery of materials.
- Construction Management: The department oversees the construction process, ensuring that construction work is carried out to plan, on time, and to the required quality standards.
- Quality Control and Assurance: The department ensures that construction work meets regulatory and quality standards through rigorous quality control and assurance procedures.
- Health and Safety: The department is responsible for managing health and safety on construction sites, ensuring that all workers are trained and equipped to work safely, and that all safety regulations are followed.
- Commissioning: The department oversees the commissioning of construction projects, ensuring that all systems and equipment are tested and operational before the project is handed over to the client.
- The Construction Capability Unit department works closely with other departments within the organization, including finance, legal, and marketing, to ensure that construction projects are completed successfully. They also collaborate with external stakeholders, such as clients, regulatory bodies, and contractors, to deliver high-quality construction projects that meet the needs of all parties involved.

The objectives of the Construction Capability Unit department include:

- Efficient Project Delivery: The department aims to deliver construction projects efficiently, ensuring that projects are completed on time, within budget, and to the required quality standards. This involves effective project planning, design, procurement, construction management, and commissioning.
- Technical Expertise: The department provides technical expertise and support to other departments within the organization, ensuring that the organization has the skills and knowledge required to deliver complex construction projects.
- Compliance: The department ensures that construction projects comply with regulatory and safety standards, minimizing risk and ensuring that all stakeholders are protected.
- Customer Satisfaction: The department aims to meet or exceed customer expectations, ensuring that clients are satisfied with the construction projects delivered.
- Cost Control: The department aims to control costs throughout the construction process, minimizing waste and maximizing the use of resources.
- Innovation: The department aims to drive innovation within the organization, exploring new construction techniques, materials, and technologies to improve construction processes and project outcomes.
- Overall, the Construction Capability Unit department aims to provide a comprehensive range of services to clients, ensuring that construction projects are delivered efficiently, safely, and to the highest standards of quality.

The Construction Capability Unit (CCU) is a department within an organization that focuses on developing and enhancing the organization's construction capabilities. The scope of this department can include:

- **Training and development:** The CCU is responsible for providing training and development programs to employees involved in construction activities. This includes technical training, safety training, and leadership development.
- **Process improvement:** The CCU is responsible for identifying opportunities to improve construction processes and practices within the organization. This includes

identifying inefficiencies and implementing process improvements to increase efficiency, productivity, and quality.

- **Technology adoption:** The CCU is responsible for identifying and adopting new technologies that can improve construction processes and outcomes. This includes implementing new software, hardware, and equipment to increase efficiency and accuracy.
- **Best practices sharing:** The CCU is responsible for sharing best practices and lessons learned with other departments within the organization. This includes developing and implementing standard operating procedures and sharing information on successful construction projects.
- **Performance management:** The CCU is responsible for monitoring and measuring construction performance within the organization. This includes identifying key performance indicators and developing metrics to track performance over time.
- Overall, the scope of the Construction Capability Unit department is to develop and enhance the organization's construction capabilities through training and development, process improvement, technology adoption, best practices sharing, and performance management.

2.5 INTRODUCTION, WORKING OBJECTIVSES, AND SCOPE OF PNM DEPARTMENT

The Plant and Machinery department is a specialized unit within a manufacturing or industrial organization that is responsible for managing the plant and machinery used in the production process. This department is responsible for the procurement, maintenance, repair, and replacement of machinery and equipment used in the manufacturing process.

The Plant and Machinery department works to ensure that the manufacturing process is carried out efficiently and effectively. This involves a variety of tasks and responsibilities, including:

- Procurement: The department is responsible for identifying the machinery and equipment required for the manufacturing process, obtaining quotes, negotiating contracts, and ensuring timely delivery.
- Maintenance: The department is responsible for the routine maintenance of machinery and equipment to ensure that they are in good working condition. This includes preventative maintenance, repairs, and upgrades.
- Replacement: The department is responsible for the replacement of machinery and equipment that has reached the end of its useful life or is no longer suitable for the manufacturing process.
- Training: The department is responsible for providing training to employees on the proper use and maintenance of machinery and equipment.
- Safety: The department is responsible for ensuring that all machinery and equipment are operated safely and in compliance with regulatory standards.

The objectives of the Plant and Machinery department include:

- Efficient Production: The department aims to ensure that machinery and equipment are used efficiently in the manufacturing process, minimizing waste and maximizing productivity.
- Cost Control: The department aims to control costs associated with the procurement, maintenance, and replacement of machinery and equipment.
- Equipment Reliability: The department aims to ensure that machinery and equipment are reliable, reducing the risk of downtime and minimizing disruptions to the manufacturing process.
- Compliance: The department aims to ensure that all machinery and equipment are in compliance with regulatory standards, minimizing risk and ensuring the safety of employees.
- Innovation: The department aims to explore new technologies and techniques that can improve the manufacturing process and increase efficiency.
- Overall, the Plant and Machinery department plays a critical role in the manufacturing process, ensuring that machinery and equipment are used efficiently, safely, and in compliance with regulatory standards.

The Plant & Machinery (P&M) department is responsible for managing the maintenance, repair, and replacement of all plant and machinery within an organization. The scope of this department can include:

- Maintenance management: The P&M department is responsible for developing and implementing a maintenance management program to ensure that all plant and machinery is operating at optimal levels. This includes scheduling maintenance activities, performing inspections, and implementing corrective actions as needed.
- Repair and replacement: The P&M department is responsible for coordinating the repair and replacement of all plant and machinery within the organization. This includes identifying equipment that needs repair or replacement, sourcing replacement parts or equipment, and managing the repair or replacement process.
- Equipment inventory management: The P&M department is responsible for maintaining an accurate inventory of all plant and machinery within the organization. This includes tracking equipment usage, maintenance history, and repair and replacement schedules.
- Budget management: The P&M department is responsible for managing the budget for all plant and machinery-related activities. This includes developing budgets, monitoring expenses, and identifying cost-saving opportunities.
- Safety and regulatory compliance: The P&M department is responsible for ensuring that all plant and machinery within the organization is in compliance with safety and regulatory requirements. This includes implementing safety protocols, conducting safety training, and ensuring that all equipment meets regulatory standards.
- Overall, the Plant & Machinery department plays a critical role in ensuring that all plant and machinery within an organization is well-maintained, repaired, and replaced as needed, and in compliance with safety and regulatory requirements.

2.6 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF CMPC DEPARTMENT

The Construction Method and Planning Cell (CMPC) is a department within a construction company that is responsible for planning and coordinating construction activities, as well as developing and implementing construction methods to ensure the successful completion of projects. The CMPC department typically consists of a team of experienced construction professionals, including project managers, construction engineers, planners, and schedulers. These professionals work together to develop construction plans and schedules, identify potential issues and risks, and provide solutions to ensure that projects are completed on time, within budget, and to the required quality standards.

The working of the CMPC department involves several stages, including project initiation, planning, execution, monitoring, and control. During the project initiation stage, the CMPC team works with the project stakeholders to determine the project requirements, objectives, and constraints. This information is then used to develop a comprehensive construction plan that outlines the project scope, schedule, budget, and quality standards. During the planning stage, the CMPC team develops detailed construction schedules, resource plans, and procurement strategies. They also identify potential risks and develop mitigation plans to minimize their impact on the project. In the execution stage, the CMPC team oversees the construction activities, ensuring that they are completed according to the plan, and any issues are promptly addressed. During the monitoring and control stage, the CMPC team tracks the project progress and compares it to the plan. They identify any deviations and take corrective action to bring the project back on track.

The main objective of the CMPC department is to develop and execute construction plans that are safe, efficient, and cost-effective. This involves analysing the project requirements, determining the best construction methods and materials, and creating detailed schedules and budgets. The CMPC department works closely with other departments such as engineering, procurement, and project management to ensure that all aspects of the construction process are integrated and coordinated. The ultimate goal of the CMPC department is to ensure that construction projects are completed on time, within budget, and to the required quality standards while minimizing risks and maximizing efficiency.

The Construction Method and Planning Cell (CMPC) department plays a crucial role in the successful completion of construction projects. This department is responsible for developing and implementing construction methodologies, planning project timelines, and optimizing resource utilization to ensure timely completion of projects.

The scope of the CMPC department includes the following:

- **Construction Methodology Development:** The CMPC department is responsible for developing and implementing construction methodologies that ensure project quality, safety, and timely completion. This includes identifying the most efficient construction techniques and materials, assessing potential risks, and developing contingency plans.
- **Project Planning:** The CMPC department is responsible for developing project timelines, identifying critical path activities, and optimizing resource utilization. This includes coordinating with various stakeholders, such as contractors, suppliers, and regulatory authorities, to ensure smooth project execution.
- **Cost Estimation:** The CMPC department is responsible for estimating project costs, including material, labour, and equipment costs. This involves assessing the scope of work, identifying potential cost-saving opportunities, and developing accurate cost estimates.
- **Quality Control:** The CMPC department is responsible for implementing quality control procedures to ensure that projects meet specified quality standards. This includes conducting regular inspections, testing materials and equipment, and ensuring that contractors comply with relevant codes and regulations.
- **Safety Management:** The CMPC department is responsible for ensuring that construction sites are safe for workers and the public. This includes developing safety protocols, conducting safety audits, and providing training to workers.
- **Risk Management:** The CMPC department is responsible for identifying potential risks associated with construction projects and developing mitigation strategies. This includes assessing potential risks, developing contingency plans, and monitoring risks throughout the project lifecycle.

In summary, the scope of the CMPC department includes developing and implementing construction methodologies, planning project timelines, estimating project costs, ensuring quality control and safety, and managing project risks. This department plays a crucial role in ensuring the successful completion of construction projects.

2.7 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF CPMCC DEPARTMENT

The Central Planning and Monitoring Competency Cell Department is a department within an organization that is responsible for coordinating and monitoring the planning and execution of various projects and initiatives. The department is typically staffed with experienced project managers who are responsible for developing and implementing project management frameworks and processes, providing guidance and support to project teams, and ensuring that projects are completed on time, within budget, and to the required quality standards.

The department may also be responsible for identifying and resolving any issues or concerns that arise during the course of a project, tracking progress and performance, and providing regular updates and reports to senior management. Additionally, the department may be tasked with identifying opportunities for process improvement and developing best practices for project management that can be applied across the organization.

Overall, the Central Planning and Monitoring Competency Cell Department plays a critical role in ensuring that projects are executed effectively and efficiently, and that the organization is able to achieve its strategic objectives.

The working of the Central Planning and Monitoring Competency Cell Department typically involves several key activities and processes. These may include:

- Developing and implementing project management frameworks and processes: The department is responsible for developing and implementing a standard set of project management frameworks and processes that can be applied across the organization. This may involve defining the roles and responsibilities of project teams, establishing project timelines and budgets, and defining the key milestones and deliverables for each project.

- Providing guidance and support to project teams: The department provides guidance and support to project teams throughout the project lifecycle. This may involve providing training and coaching to team members, helping teams to identify and resolve issues, and ensuring that teams are adhering to the established project management frameworks and processes.
- Monitoring project progress and performance: The department is responsible for monitoring the progress and performance of each project, using tools and techniques such as project dashboards, status reports, and risk assessments. This allows the department to identify any issues or concerns that may arise during the course of a project, and to take corrective action as needed.
- Identifying and resolving issues: When issues or concerns arise during the course of a project, the department is responsible for identifying the root causes of these issues and developing and implementing appropriate solutions. This may involve working with project teams to develop mitigation strategies, or escalating issues to senior management as needed.
- Reporting progress and performance to senior management: The department provides regular updates and reports to senior management on the progress and performance of each project. This allows senior management to stay informed about the status of each project, and to make informed decisions about resource allocation and project priorities.

Overall, the working of the Central Planning and Monitoring Competency Cell Department is focused on ensuring that projects are executed effectively and efficiently, and that the organization is able to achieve its strategic objectives.

The objectives of the Central Planning and Monitoring Competency Cell Department can vary depending on the specific needs and goals of the organization. However, some common objectives of this department may include:

- Improving the efficiency and effectiveness of project management: The department aims to improve the efficiency and effectiveness of project management across the organization by implementing standardized processes and best practices.

- Reducing costs and risks associated with projects: The department aims to reduce the costs and risks associated with projects by identifying potential issues and taking proactive measures to mitigate them.
- Enhancing the quality and impact of project outcomes: The department aims to enhance the quality and impact of project outcomes by ensuring that projects are completed on time, within budget, and to the required quality standards.
- Identifying opportunities for process improvement: The department aims to identify opportunities for process improvement by analysing project performance data and developing best practices that can be applied across the organization.
- Providing guidance and support to project teams: The department aims to provide guidance and support to project teams by offering training, coaching, and other resources that can help teams achieve their objectives.
- Facilitating communication and collaboration across project teams: The department aims to facilitate communication and collaboration across project teams by establishing effective communication channels and encouraging team members to share information and resources.

Overall, the objectives of the Central Planning and Monitoring Competency Cell Department are focused on ensuring that projects are completed successfully and that the organization is able to achieve its strategic objectives.

The scope of the Central Planning and Monitoring Competency Cell department can vary depending on the specific organization and industry it is operating in. However, in general, the department's responsibilities may include:

- Strategic planning: Developing long-term plans for the organization, such as setting goals, identifying potential risks and opportunities, and allocating resources.
- Budgeting: Preparing and managing the organization's budget, ensuring that funds are allocated appropriately and spent efficiently.
- Monitoring and evaluation: Tracking the organization's performance against its goals and objectives, identifying areas for improvement, and making recommendations for changes as needed.

- Data analysis: Collecting and analysing data to inform decision-making, such as identifying trends and patterns, forecasting future needs, and assessing the effectiveness of different strategies.
- Project management: Coordinating the planning, implementation, and evaluation of specific projects or initiatives, ensuring that they are completed on time, within budget, and to a high standard.
- Performance reporting: Providing regular reports to management and stakeholders on the organization's performance, including progress towards goals, financial performance, and key performance indicators.

Overall, the Central Planning and Monitoring Competency Cell department plays a crucial role in helping organizations to achieve their goals and improve their performance over time.

2.8 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF HRSG DEPARTMENT

Heat Recovery Steam Generation (HRSG) is a department within a power plant that is responsible for producing steam using waste heat from the gas turbine or other sources. The HRSG department plays a crucial role in maximizing the efficiency of the power plant by recovering waste heat and converting it into usable energy.

The HRSG department works by utilizing the waste heat produced by the gas turbine or other sources to generate steam. The steam produced is then used to drive a steam turbine that generates additional electricity. The HRSG department also ensures that the steam produced meets the required specifications for use in the steam turbine.

The HRSG department operates under strict safety guidelines and standards to ensure the safe operation of the power plant. It also works closely with other departments within the power plant, such as the gas turbine department and the steam turbine department, to ensure that the power plant operates efficiently.

The primary objectives of the HRSG department include:

- Maximizing efficiency: HRSG department aims to maximize the efficiency of the power plant by recovering waste heat and converting it into usable energy.

- Ensuring safe operation: HRSG department operates under strict safety guidelines and standards to ensure the safe operation of the power plant.
- Meeting steam specifications: HRSG department ensures that the steam produced meets the required specifications for use in the steam turbine.
- Collaborating with other departments: HRSG department works closely with other departments within the power plant, such as the gas turbine department and the steam turbine department, to ensure that the power plant operates efficiently.
- Maintaining equipment: HRSG department is responsible for maintaining and repairing the equipment used in the heat recovery process to ensure that it operates efficiently.
- Continuously improving: HRSG department is continuously looking for ways to improve the efficiency of the heat recovery process and to reduce the environmental impact of the power plant.

Heat recovery steam generation (HRSG) is a critical department in the power generation industry. Its scope encompasses a wide range of activities related to the production of electricity from various sources of fuel, including natural gas, coal, and biomass. The primary function of the HRSG department is to capture the waste heat generated during the combustion of fuel and convert it into useful energy.

The department is responsible for the design, operation, and maintenance of heat recovery steam generators, which are complex systems that require expertise in mechanical, electrical, and control systems engineering. The HRSG department is also responsible for ensuring the safety of the equipment and personnel involved in the operation of these systems.

The scope of the HRSG department includes the following:

- Design and engineering of HRSG systems
- Installation, commissioning, and start-up of HRSG systems
- Operation and maintenance of HRSG systems
- Performance testing and optimization of HRSG systems
- Troubleshooting and problem-solving of HRSG systems
- Safety and regulatory compliance of HRSG systems

The HRSG department plays a crucial role in ensuring the efficient and reliable operation of power plants and is an integral part of the overall energy generation process. With the increasing demand for clean and sustainable energy, the importance of the HRSG department in the power generation industry is only expected to grow.

2.9 INTRODUCTION, WORKING, OBJECTIVSES AND SCOPE OF SCM DEPARTMENT

The Supply Chain Management (SCM) department is responsible for managing the flow of goods and services from suppliers to customers. The SCM department ensures that the right products are delivered to the right place, at the right time, and at the right cost. The department plays a critical role in the success of an organization by optimizing the supply chain and minimizing costs.

The SCM department works by managing the entire supply chain, from sourcing raw materials to delivering finished products to customers. The department collaborates with suppliers, manufacturers, distributors, and retailers to ensure that products are delivered on time and meet customer expectations.

The SCM department also manages inventory levels to ensure that there is enough stock to meet customer demand while minimizing excess inventory. Additionally, the department tracks and analyses supply chain data to identify areas for improvement and to make informed decisions.

- Efficient supply chain management: SCM department aims to manage the supply chain efficiently, from sourcing raw materials to delivering finished products to customers, to ensure that products are delivered on time and at the right cost.

- Minimizing costs: SCM department works to minimize costs throughout the supply chain by negotiating with suppliers, optimizing inventory levels, and reducing transportation costs.

- Enhancing customer satisfaction: SCM department focuses on enhancing customer satisfaction by ensuring that products are delivered on time and meet customer expectations.

- Ensuring supply chain resilience: SCM department aims to ensure supply chain resilience by developing contingency plans to mitigate risks such as natural disasters, supply chain disruptions, and other unforeseen events.

- Continuous improvement: SCM department continuously tracks and analyses supply chain data to identify areas for improvement and make informed decisions to optimize the supply chain.

- Collaboration and partnership: SCM department collaborates with suppliers, manufacturers, distributors, and retailers to build strong partnerships and improve the efficiency of the supply chain.

The scope of supply chain management (SCM) department is broad and covers various activities involved in the production and distribution of goods and services. The department is responsible for managing the flow of goods and information across the supply chain, from the acquisition of raw materials to the delivery of finished products to the end customer. The primary focus of SCM is to ensure that the supply chain operates efficiently, effectively, and sustainably.

The scope of the SCM department includes the following:

- **Procurement:** This involves sourcing raw materials, goods, and services required for the production process.

- **Inventory Management:** This includes managing the inventory levels, tracking the movement of materials and goods, and ensuring that the right products are available in the right quantity at the right time.

- **Logistics and Transportation:** This includes managing the movement of materials and goods, arranging transportation, and optimizing delivery schedules.

- **Production Planning and Scheduling:** This involves planning the production process, scheduling the production activities, and ensuring that the production process is efficient and cost-effective.

- **Quality Management:** This includes monitoring the quality of raw materials and finished products, and ensuring that the products meet the required quality standards.

- **Supplier Management:** This involves managing the relationship with suppliers, assessing their performance, and ensuring that they meet the required quality and delivery standards.
- **Sustainability:** This involves ensuring that the supply chain operates in an environmentally sustainable manner, minimizing waste and reducing the carbon footprint.

The scope of the SCM department is critical to the success of any organization, as it directly impacts the efficiency, cost-effectiveness, and customer satisfaction. Effective supply chain management can lead to increased profitability, improved customer satisfaction, and a competitive advantage in the marketplace.

CHAPTER-3.0 WHY FGD (FLUE GAS DESULFURIZATION) SYSTEM IS USED

The primary reason for using FGD systems in power plants (PP) is to reduce the emissions of sulphur dioxide (SO2) and other pollutants that are released into the atmosphere during the combustion of fossil fuels, such as coal and oil. SO2 emissions can cause acid rain, which is harmful to the environment and human health.

FGD systems are designed to remove the majority of SO2 emissions from the flue gas before it is released into the atmosphere. This is achieved by reacting the SO2 with a sorbent material, such as limestone or lime, to produce a solid or liquid by-product that can be safely disposed of.

In addition to reducing SO2 emissions, FGD systems can also help to remove other pollutants from the flue gas, such as particulate matter, heavy metals, and nitrogen oxides. This can help to improve air quality and protect the health of local communities.

There are also regulatory requirements for power plants to reduce their emissions of pollutants, such as SO2, which can be achieved through the use of FGD systems. Compliance with these regulations can help power plants to avoid fines and other penalties.

Overall, the use of FGD systems in power plants is an important way to reduce the environmental impact of fossil fuel combustion and protect public health.

CHAPTER-3.1 WHAT IS FGD (FLUE GAS DESULFURIZATION) SYSTEM

FGD, or Flue Gas Desulfurization, is a process used to remove sulphur dioxide (SO2) from exhaust flue gases of fossil-fuel power plants, chemical plants, and other industrial processes that emit SO2. This process is designed to reduce the amount of sulphur dioxide emissions released into the atmosphere, which can contribute to acid rain and other environmental problems.

FGD works by using a chemical reaction to convert the sulphur dioxide in flue gas to a solid or liquid compound that can be disposed of safely. The most common method of FGD is wet scrubbing, where a slurry of lime or limestone is sprayed into the flue gas, which reacts with the sulphur dioxide to form calcium sulphite or calcium sulphate. This reaction is typically carried out in a large absorber tower, where the flue gas and slurry are mixed and circulated to ensure maximum contact between the two.

The resulting by-product of this reaction is a wet sludge that must be disposed of properly. The sludge can be processed into a dry powder, which can be used in the manufacture of gypsum products or as a soil amendment. Alternatively, it can be pumped to a disposal pond or landfill.

Other methods of FGD include dry scrubbing, which uses a dry sorbent material such as activated carbon or sodium bicarbonate to absorb the sulphur dioxide, and spray-dry scrubbing, which involves spraying a slurry of sorbent material into the flue gas, which dries and falls to the bottom of the absorber tower.

FGD is an important technology for reducing the environmental impact of industrial processes that emit sulphur dioxide. Its use has become increasingly common in power plants and other industries in recent years, and it is expected to continue to play an important role in reducing emissions and protecting the environment.

CHAPTER -3.2 TYPES OF FGD SYSTEM

FGD (Flue Gas Desulfurization) systems are used to remove sulphur dioxide (SO2) from the flue gases produced by coal-fired power plants and other industrial processes. There are several types of FGD systems available, each with its own advantages and disadvantages. Here is an overview of the different types of FGD systems:

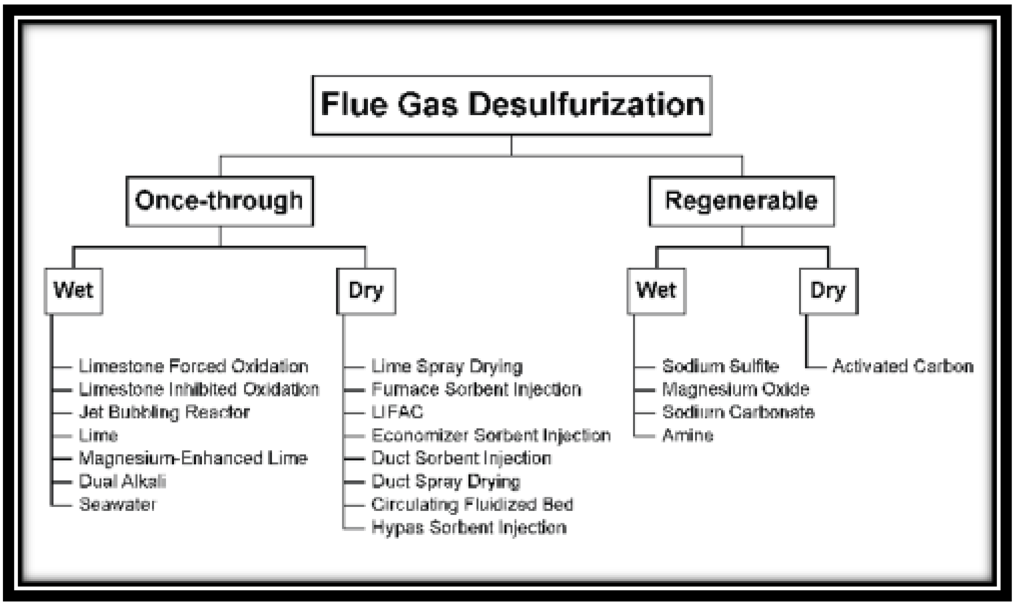


Fig 3.1 Types of Fgd System

- **Wet scrubbers:** Wet scrubbers are the most commonly used type of FGD system. They use a liquid absorbent (usually a slurry of limestone or lime) to react with the sulphur dioxide in the flue gas and convert it into calcium sulphate (gypsum), which can be sold for use in construction or other industries. Wet scrubbers can remove up to 95% of the SO2 from flue gases and are relatively low-cost compared to other FGD systems. However, they require a large amount of water and produce a significant amount of waste water.

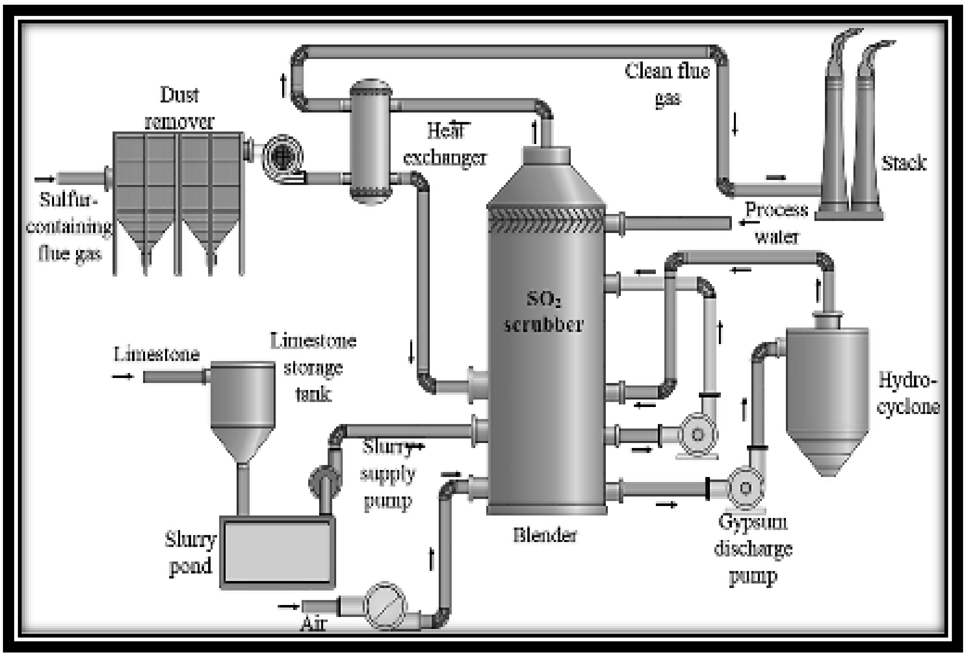


Fig 3.2 Wet scrubbers

- **Dry scrubbers:** Dry scrubbers use a dry absorbent (usually hydrated lime or sodium bicarbonate) to remove sulphur dioxide from the flue gas. Dry scrubbers are typically used in areas where water is scarce or where waste water discharge is restricted. They can remove up to 90% of the SO2 from flue gases but are generally more expensive than wet scrubbers.

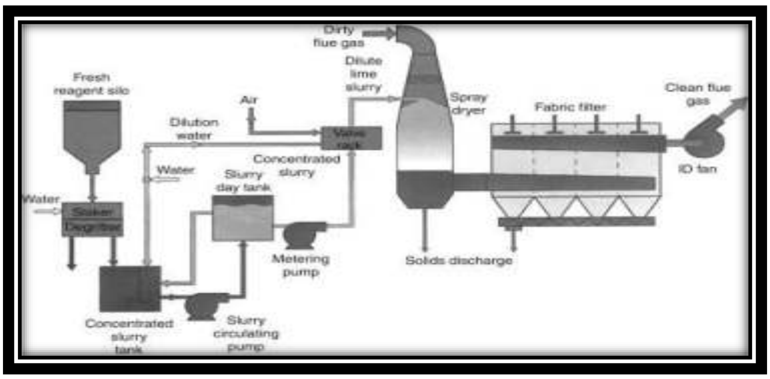


Fig 3.3 Dry Scrubber

- **Spray dryer absorbers:** Spray dryer absorbers are similar to dry scrubbers, but they use a finely atomized spray of slurry to absorb SO2 from the flue gas. They are typically used in smaller power plants or industrial processes and can remove up to 90% of the SO2 from flue gases.

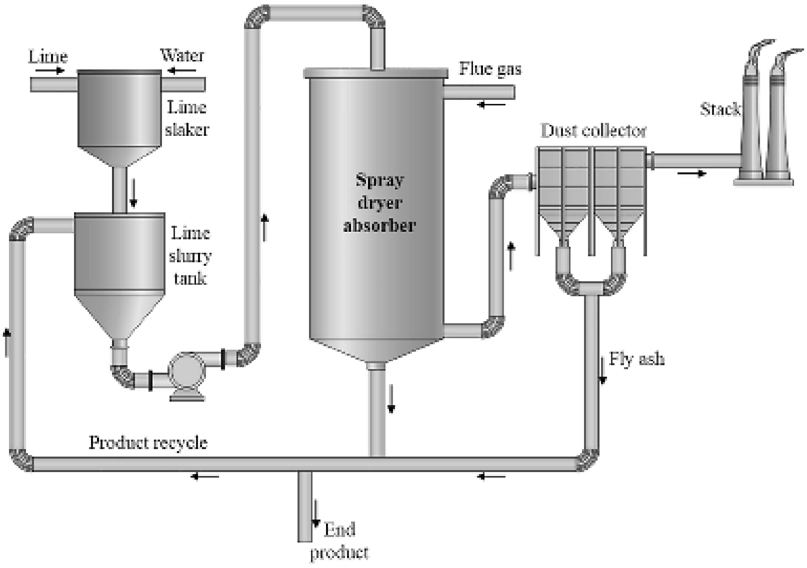


Fig 3.4 Spray dryer absorber

- **Wet dry scrubbers:** Wet dry scrubbers are a hybrid system that combines the benefits of both wet and dry scrubbers. They use a dry absorbent to remove most of the SO2 from the flue gas and then use a wet scrubber to remove any remaining SO2. Wet dry scrubbers are typically more expensive than wet scrubbers but produce less wastewater.
- **Calcium looping:** Calcium looping is an emerging technology that uses calcium oxide (CaO) to absorb SO2 from the flue gas. The CaO is then regenerated by heating it in a separate reactor and reused to absorb more SO2. Calcium looping has the potential to remove up to 99% of the SO2 from flue gases but is still in the early stages of development.

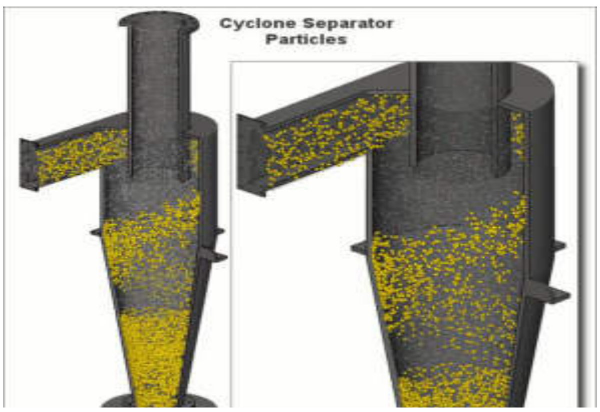


Fig 3.5 Calcium Looping

Each FGD system has its own advantages and disadvantages, and the choice of system will depend on the specific requirements of the power plant or industrial process.

CHAPTER-3.3 TYPES OF WET SCRUBBER

Wet scrubbers are a type of air pollution control equipment that use a liquid to capture and remove pollutants from industrial exhaust streams. There are several types of wet scrubbers, including:

- **Venturi Scrubbers:** These scrubbers use a high-velocity liquid stream to create a pressure drop that atomizes and entrains the pollutants into the liquid stream.

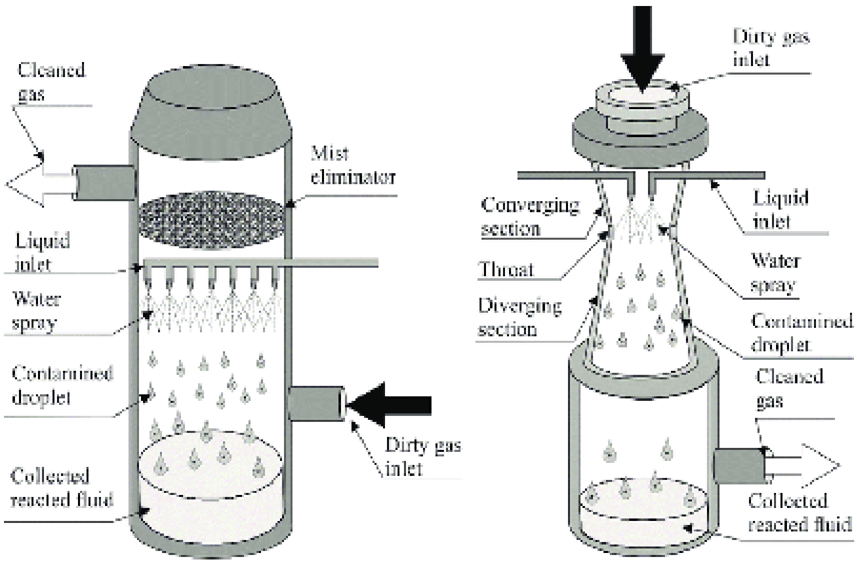


Fig 3.6 Venturi Scrubber

- **Spray Tower Scrubbers:** These scrubbers use a liquid spray to capture pollutants as they pass through the tower.

Fig 3.7 Spray Tower Scrubbers

- **Packed Bed Scrubbers:** These scrubbers use a packed bed of materials (such as plastic or ceramic) to capture pollutants as the exhaust gas flows through it.

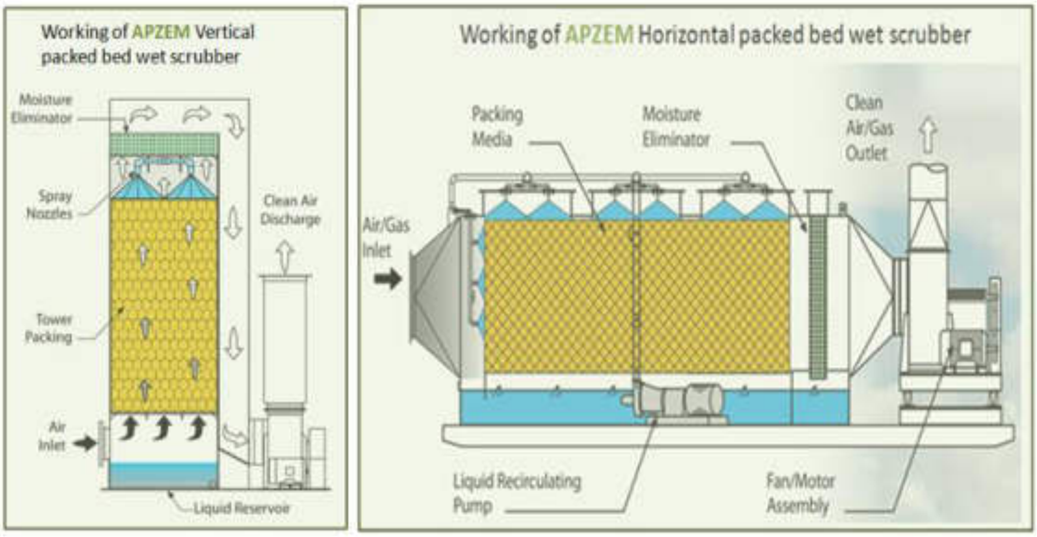


Fig 3.8 Packed Bed Scrubber

- **Fluidized Bed Scrubbers:** These scrubbers use a bed of fluidized particles to capture pollutants.

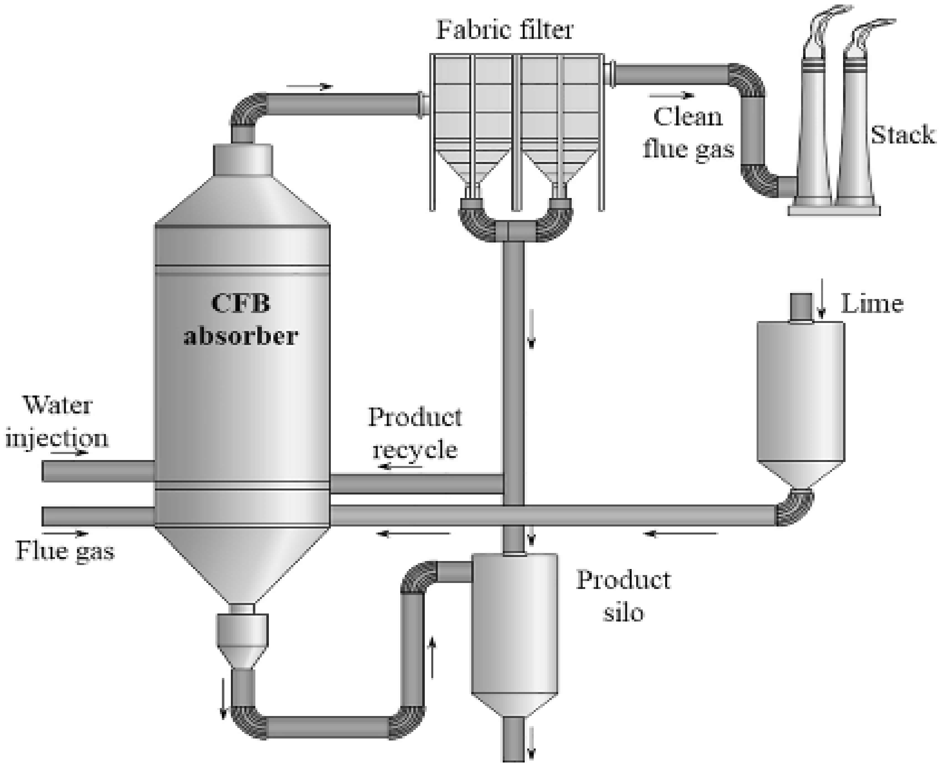


Fig 3.9 Fluidized Bed Scrubber

- **Cyclonic Scrubbers:** These scrubbers use a combination of centrifugal force and liquid spray to remove pollutants.

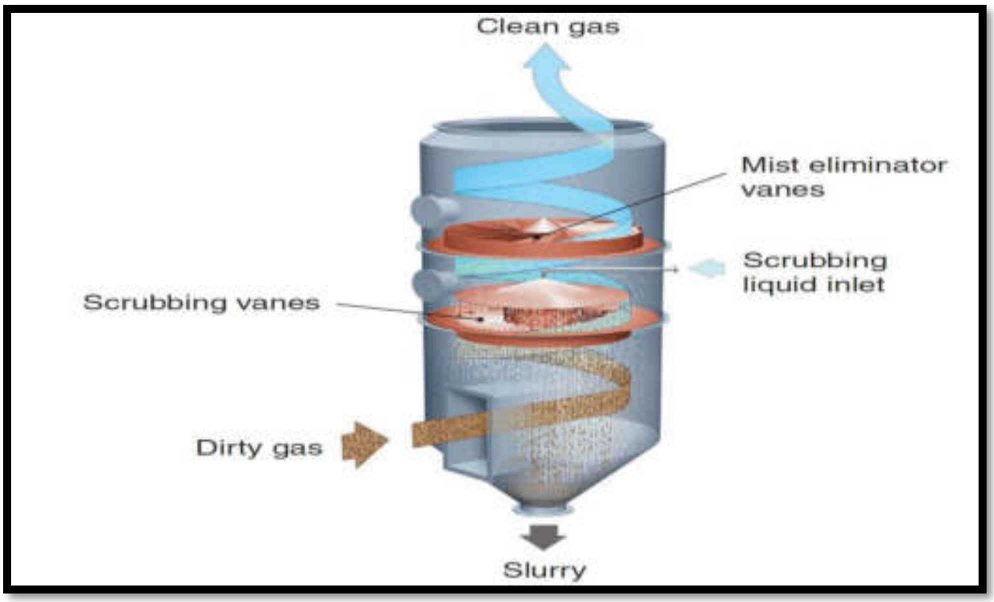


Fig 3.10 Cyclonic Scrubber

- **Impingement Plate Scrubbers:** These scrubbers use a series of plates to create a turbulent flow of liquid that captures pollutants.

- **Bubble Column Scrubbers:** These scrubbers use a bubble column to agitate the liquid and capture pollutants.

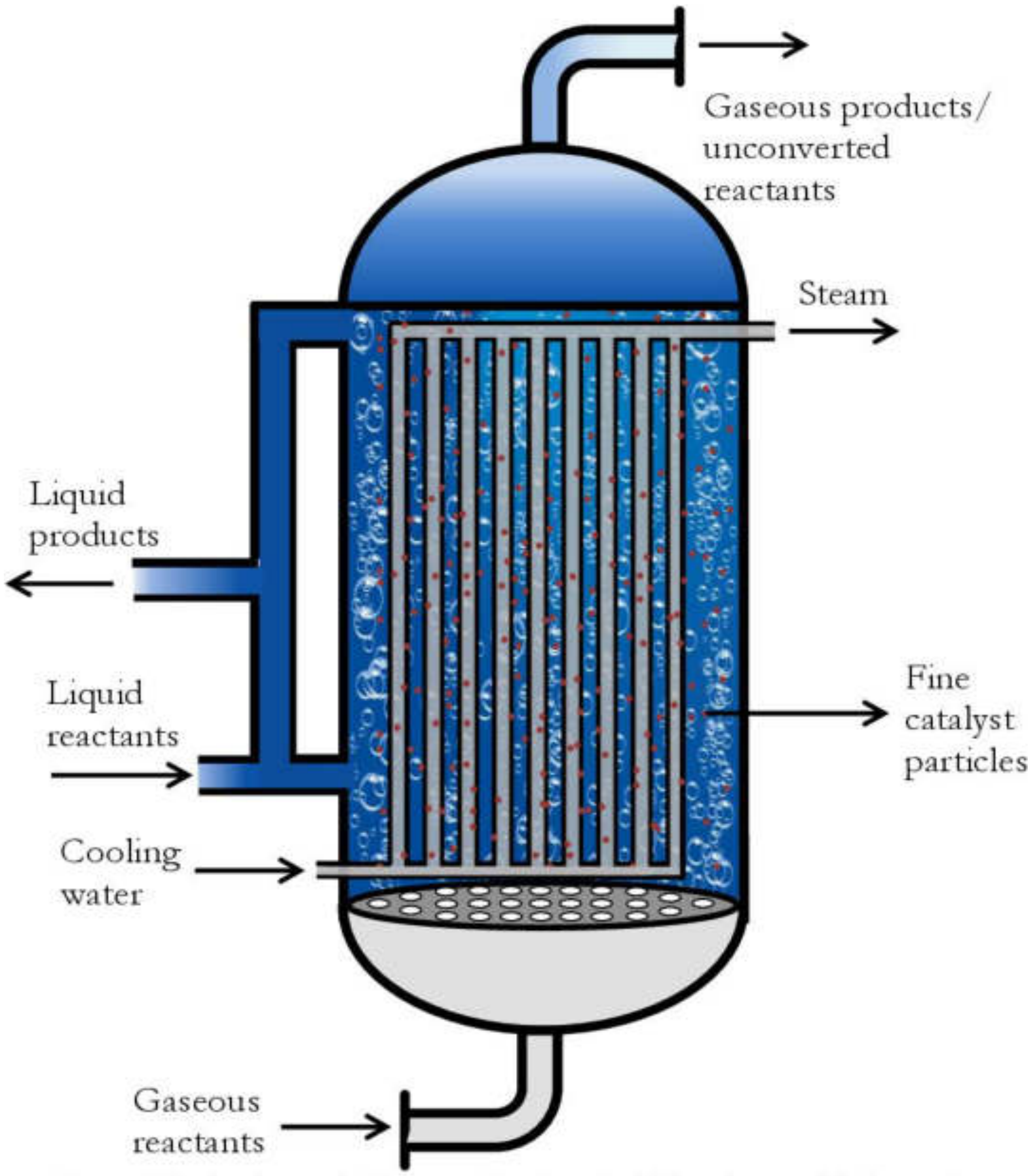


Figure 1.1 - A schematic diagram of a slurry bubble column with internals

Fig 3.11 Bubble Column Scrubber

Each type of wet scrubber has its own advantages and disadvantages and is best suited for certain types of pollutants and operating conditions. The choice of the scrubber depends on the specific requirements of the process and the pollutants to be controlled.

CHAPTER-3.4 L&T POWER USED SCRUBBER SYSTEM IS SPRAY TOWER AND BUBBLE COLUMN SCRUBBERS

SO_2 is an acid gas, and, therefore, the typical sorbent slurries or other materials used to remove the SO_2 from the flue gases are alkaline. The reaction taking place in wet scrubbing using a $CaCO_3$ (limestone) slurry produces calcium sulfite ($CaSO_3$) and may be expressed in the simplified dry form as:

$$CaCO_{3(s)} + SO_{2(g)} \rightarrow CaSO_{3(s)} + CO_{2(g)}$$

When wet scrubbing with a $Ca(OH)_2$ (hydrated lime) slurry, the reaction also produces $CaSO_3$ (calcium sulphite) and may be expressed in the simplified dry form as:

$$Ca(OH)_{2(s)} + SO_{2(g)} \rightarrow CaSO_{3(s)} + H_2O_{(l)}$$

When wet scrubbing with a $Mg(OH)_2$ (magnesium hydroxide) slurry, the reaction produces $MgSO_3$ (magnesium sulphite) and may be expressed in the simplified dry form as:

$$Mg(OH)_{2(s)} + SO_{2(g)} \rightarrow MgSO_{3(s)} + H_2O_{(l)}$$

To partially offset the cost of the FGD installation, some designs, particularly dry sorbent injection systems, further oxidize the $CaSO_3$ (calcium sulphite) to produce marketable $CaSO_4{\cdot}2H_2O$ (gypsum) that can be of high enough quality to use in wallboard and other products. The process by which this synthetic gypsum is created is also known as forced oxidation:

$$CaSO_{3(aq)} + 2\ H_2O_{(l)} + 1/2\ O_{2(g)} \rightarrow CaSO_4{\cdot}2H_2O_{(s)}$$

A natural alkaline usable to absorb SO_2 is seawater. The SO_2 is absorbed in the water, and when oxygen is added reacts to form sulphate ions $SO2-4$ and free H^+. The surplus of H^+ is offset by the carbonates in seawater pushing the carbonate equilibrium to release CO_2 gas:

$$SO_{2(g)} + H_2O_{(l)} + 1/2\ O_{2(g)} \rightarrow SO2-4_{(aq)} + 2\ H^+$$

$$HCO-3 + H^+ \rightarrow H_2O_{(l)} + CO_{2(g)}$$

In industry caustic (NaOH) is often used to scrub SO_2, producing sodium sulphite:

$$2\ NaOH_{(aq)} + SO_{2(g)} \rightarrow Na_2SO_{3(aq)} + H_2O_{(l)}$$

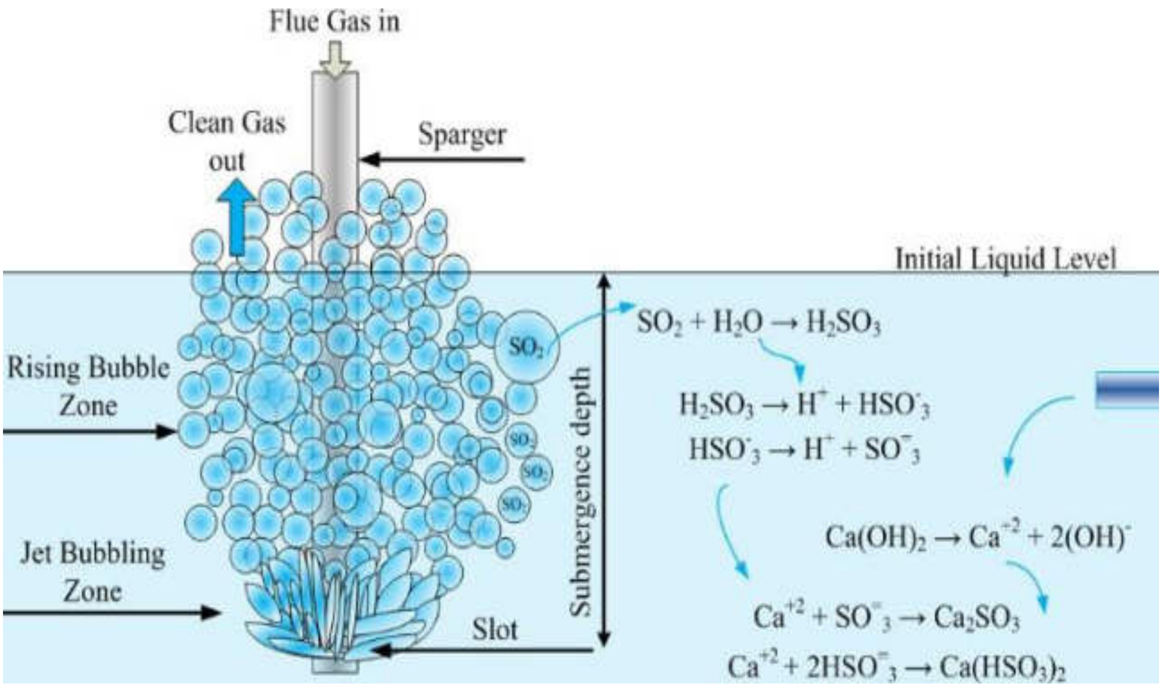


Fig 3.12 Bubble Column Scrubber

The heart of the FGD process is the unique Jet Bubbling Reactor (JBR). All necessary steps for SO_2 absorption, oxidation, neutralization and crystallization occur simultaneously in the JBR. The flue gas is dispersed into the scrubbing liquid through multiple gas sparging tubes, creating small bubbles which are broken by the liquid's motion. Oxidation, neutralization, crystallization occur in the reaction zone, the main area for liquid phase of JBR. Air and limestone are dissolved into the liquid through bubbling and agitation. The gypsum crystals grow to the desired size after sufficient residence times and the gypsum slurry is drawn off. The clean gas passed through JBR and mist eliminator is released to the atmosphere.

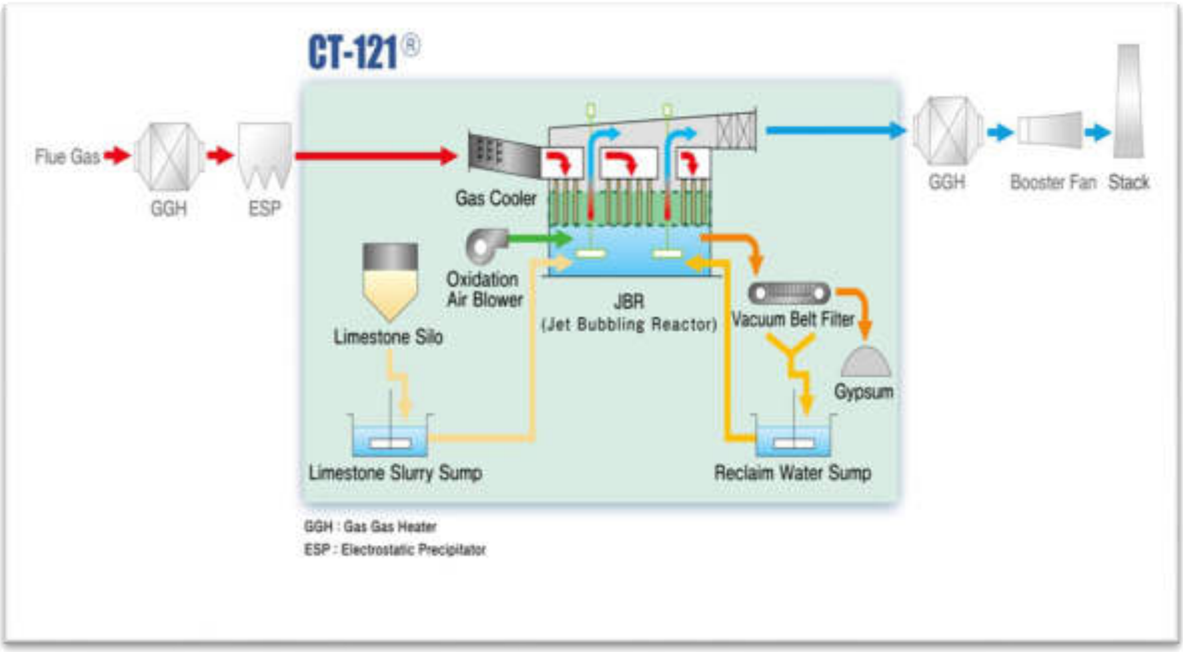


Fig 3.13 Flue Gas Desulfurization system

Capabilities:

- **Low Construction and Maintenance Costs:** Compact design due to low JBR height and simple design without large liquid circulation pumps save construction and maintenance costs.
- **Low Operation Costs:** Low power consumption and easy operation & maintenance due to mechanically simple design result in minimal staffing requirements and low operation costs.
- **High Flexibility:** High SO_2 removal efficiency is achievable at wide inlet SO_2 concentration range, and allow for fuel flexibility consequently.
- **Additional Benefits:** High particulate removal, high Air Toxics removal,

High quality by-product gypsum

Application:

- Flue gas exhausted from coal-fired or oil-fired boiler, non-ferrous industry etc.
- Flue gas pre-treatment for CO_2 Capture and Storage (CCS).

This type of technology can be used for example as a wet scrubber for air pollution control. Counter current flow exposes the outlet gas with the lowest pollutant concentration to the freshest scrubbing liquid. Many nozzles are placed across the tower at different heights to spray all of the gas as it moves up through the tower. The reason for using many nozzles is to maximize the number of fine droplets impacting the pollutant particles and to provide a large surface area for absorbing gas.

Theoretically, the smaller the droplets formed, the higher the collection efficiency achieved for both gaseous and particulate pollutants. However, the liquid droplets must be large enough to not be carried out of the scrubber by the scrubbed outlet gas stream. Therefore, spray towers use nozzles that produce droplets that are usually 500–1000 μm in diameter. Although small in size, these droplets are large compared to those created in venturi scrubbers that are 10–50 μm in size. The gas velocity is kept low, from 0.3 to 1.2 m/s (1–4 ft/s), to prevent excess droplets from being carried out of the tower.

In order to maintain low gas velocities, spray towers must be larger than other scrubbers that handle similar gas stream flow rates. Another problem occurring in spray towers is that after the droplets have fallen a short distance, they tend to agglomerate or hit the walls of the tower. Consequently, the total liquid surface area for contact is reduced, reducing the collection efficiency of the scrubber.

In addition to a counter current-flow configuration, the flow in spray towers can be either a concurrent or crosscurrent in configuration.

In concurrent-flow spray towers, the inlet gas and liquid flow in the same direction. Because the gas stream does not "push" against the liquid sprays, the gas velocities through the vessels are higher than in counter current-flow spray towers. Consequently, concurrent-flow spray towers are smaller than counter current-flow spray towers treating the same amount of exhaust flow. In crosscurrent-flow spray towers, also called horizontal-spray scrubbers, the gas and liquid flow in directions perpendicular to each other.

In this vessel, the gas flows horizontally through a number of spray sections. The amount and quality of liquid sprayed in each section can be varied, usually with the cleanest liquid (if recycled liquid is used) sprayed in the last set of sprays.

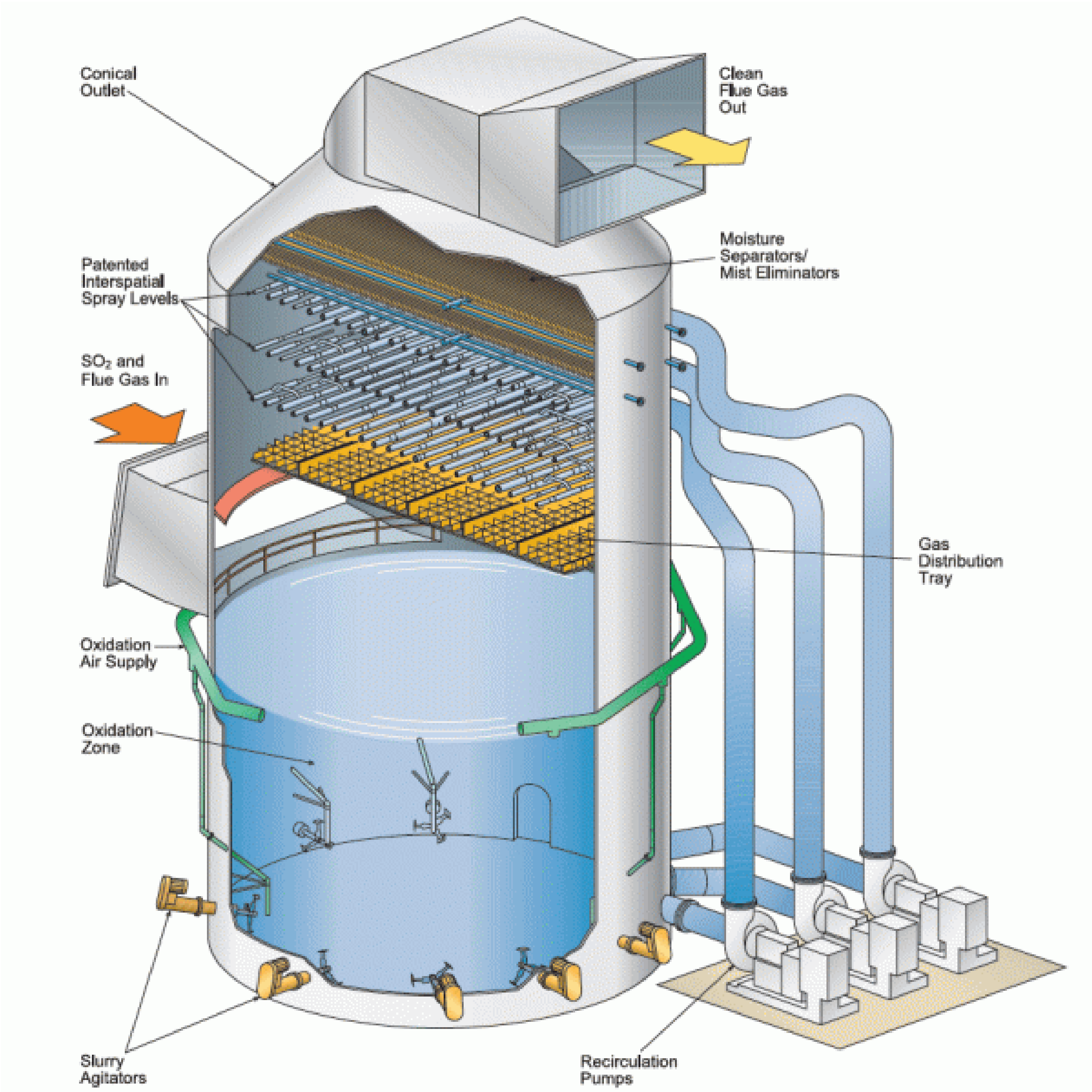


Fig 3.14 Spray tower scrubbers

CHAPTER-3.5 COMPONENTS OF FGD SYSTEM:

A Flue Gas Desulfurization (FGD) system is used to remove sulfur dioxide (SO2) from flue gas emissions produced by industrial processes, such as power generation plants, cement production, and refineries. FGD systems use various components to achieve this goal. Here are the details of the major components of an FGD system:

- **Absorber:** This is the core component of an FGD system. It is a large vessel that contains a scrubbing solution, typically a mixture of water and limestone or lime. The flue gas is directed into the absorber, where it comes into contact with the scrubbing solution. The sulphur dioxide in the flue gas reacts with the calcium in the scrubbing solution to form calcium sulphate or gypsum, which can be collected and used as a construction material.

Fig 3.15 Absorber

- **Mist Eliminator:** This component is located at the top of the absorber and is designed to remove droplets of scrubbing solution from the flue gas before it leaves the absorber. This helps to prevent pollution and corrosion of downstream equipment.

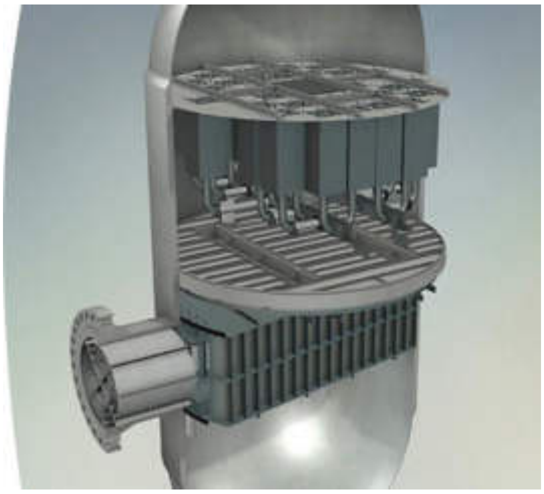


Fig 3.16 Mist Eliminator

Recirculation System: This component is responsible for pumping the scrubbing solution from the absorber to a reagent preparation area where fresh reagent is added, and then back to the absorber. This process is necessary to maintain the required concentration of the scrubbing solution.

- **Limestone Slurry Preparation Area:** This component is where the scrubbing solution is prepared by mixing water with the reagent (limestone or lime). This area may also include a storage area for the reagent and equipment for handling and transporting the reagent.

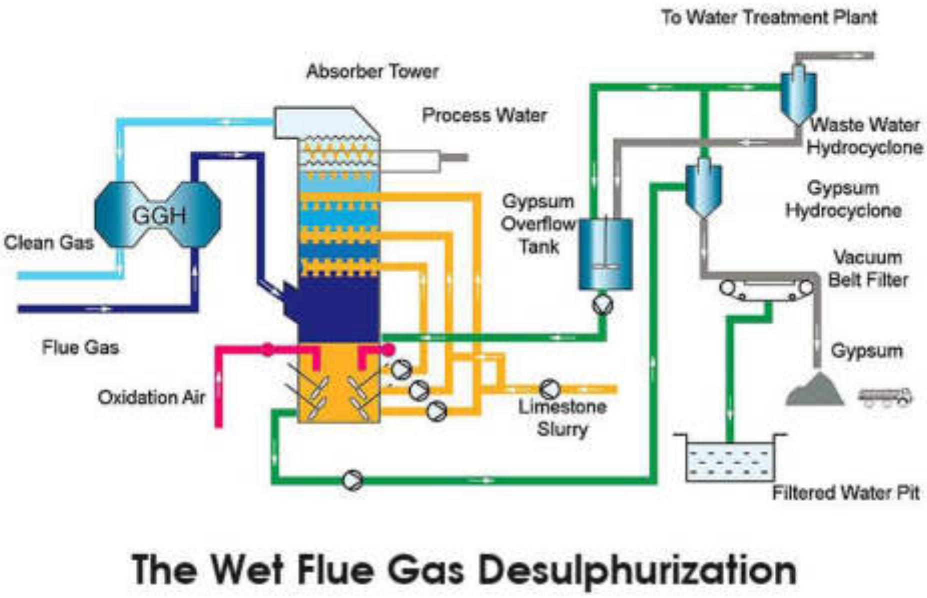


Fig 3.17 Limestone Slurry Preparation Area

- **Slurry Dewatering System (Gypsum Dewatering Building):** This component is used to dewater the gypsum or calcium sulphate produced by the FGD system. The slurry is typically sent to a dewatering system where it is filtered and dried, producing a powder that can be easily handled and transported.

- **Control System (Power House):** The FGD system is controlled by a system that monitors the performance of the various components and adjusts the operation of the system to maintain optimal performance.

Fig 3.18   Control System

Overall, these components work together to remove sulphur dioxide from flue gas emissions, helping to reduce air pollution and improve air quality.

CHAPTER-3.6 TYPES OF ABSORBER

There are several types of absorbers used in Flue Gas Desulfurization (FGD) systems, each with its own advantages and disadvantages. Here are the most common types of absorbers:

- **Spray Tower Absorbers:** This type of absorber uses spray nozzles to distribute the scrubbing solution in the form of fine droplets into the flue gas. The droplets absorb the sulphur dioxide as they pass through the tower. Spray tower absorbers are relatively simple and cost-effective, but they have lower efficiency compared to other types of absorbers.

- **Tray Tower Absorbers:** Tray tower absorbers use a series of trays to distribute the scrubbing solution across the flue gas. The trays provide a large surface area for contact between the flue gas and scrubbing solution, which increases the efficiency of the process. Tray tower absorbers are more complex and expensive than spray tower absorbers but are more efficient.

- **Packed Bed Absorbers:** Packed bed absorbers use a packing material, such as plastic or ceramic rings, to provide a large surface area for contact between the flue gas and scrubbing solution. The packing material is coated with the scrubbing solution, which absorbs the sulphur dioxide as it passes through the bed. Packed bed absorbers are highly efficient, but they are also the most complex and expensive type of absorber.

- **Wet Electrostatic Precipitators (WESPs):** WESPs use an electrostatic field to remove particulate matter and absorb sulphur dioxide from the flue gas. The flue gas passes through a series of electrically charged plates, which attract the particles and absorb the sulphur dioxide. WESPs are highly efficient but are also the most expensive type of absorber.

The choice of absorber type depends on several factors, including the sulfur dioxide concentration in the flue gas, the desired level of removal, the available space and budget, and other specific requirements of the industrial process.

CHAPTER-3.7 COMPONENTS OF ABSORBER

The absorber is a key component of Flue Gas Desulfurization (FGD) systems, which is used to remove sulphur dioxide (SO2) from flue gas. The absorber typically consists of the following components:

- **Absorption Tower:** The absorption tower is a vertical vessel where the scrubbing solution and the flue gas come into contact to remove the SO2. The tower is typically constructed of reinforced concrete or steel, and its size depends on the amount of flue gas that needs to be treated.

- **Spray Nozzles:** Spray nozzles are used to distribute the scrubbing solution into the absorber. The nozzles are typically located near the top of the absorber and spray the solution onto the packing material in the absorber.

- **Packing Material:** Packing material is used to increase the surface area of the absorber and promote contact between the scrubbing solution and the flue gas. The packing material can be made of various materials, such as ceramic, plastic, or metal, and can have different shapes, such as rings or saddles.

- **Demister:** A demister or mist eliminator is used to remove droplets of scrubbing solution from the flue gas before it leaves the absorber. The demister can be of various types, such as chevron blade, fibre bed, mesh pad, or cyclonic separator.

- **Sump:** The sump is a basin located at the bottom of the absorber that collects the scrubbing solution after it has passed through the packing material. The sump typically contains a level control system that maintains a consistent level of scrubbing solution in the absorber.

- **Recirculation System:** The recirculation system is used to recycle a portion of the scrubbing solution back to the absorber to enhance the absorption of SO2. The recirculation system typically includes a pump, a tank, spray nozzles, piping, and a control valve.

The absorber plays a critical role in the FGD system by removing SO2 from flue gas, which reduces emissions and helps to comply with environmental regulations. The design and operation of the absorber depend on several factors, such as the flow rate and composition of the flue gas, the characteristics of the scrubbing solution, and the available space and budget.

CHAPTER-3.8 MIST ELEMINATORS

Mist eliminators are used in Flue Gas Desulfurization (FGD) systems to remove droplets of scrubbing solution from the flue gas before it leaves the absorber. There are several types of mist eliminators that are commonly used, including:

- **Chevron Blade Mist Eliminators:** Chevron blade mist eliminators are the most common type of mist eliminator used in FGD systems. They consist of a series of inclined blades that create a tortuous path for the gas to pass through, which causes the droplets to collide with the blades and coalesce into larger droplets that are heavy enough to fall back into the absorber.

Fig 3.19 Chevron Blade Mist Eliminator

- **Fibre Bed Mist Eliminators:** Fibre bed mist eliminators use a bed of fine fibres, such as glass wool or ceramic fibres, to capture the droplets. The fibres are arranged in a dense mat that creates a large surface area for contact between the gas and the fibres. The droplets are trapped in the fibres and then drained back into the absorber.

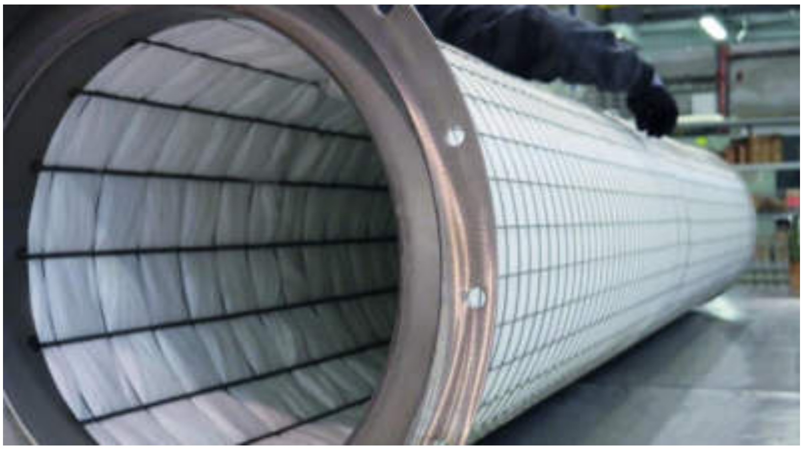


Fig 3.20 Fibre Bed Mist Eliminator

- **Mesh Pad Mist Eliminators:** Mesh pad mist eliminators consist of a series of wire mesh screens that are stacked on top of each other. The droplets are captured on the mesh as the gas passes through, and then drained back into the absorber. Mesh pad mist eliminators are less efficient than chevron blade mist eliminators but are more resistant to corrosion.

Fig 3.21 Mesh Pad Mist Eliminator

- **Cyclonic Separators:** Cyclonic separators use centrifugal force to separate the droplets from the gas. The gas is forced to rotate around a cylindrical or conical chamber, creating a centrifugal force that causes the droplets to be thrown out of the gas stream and collect on the walls of the chamber. Cyclonic separators are less efficient than other types of mist eliminators but can handle high gas velocities.

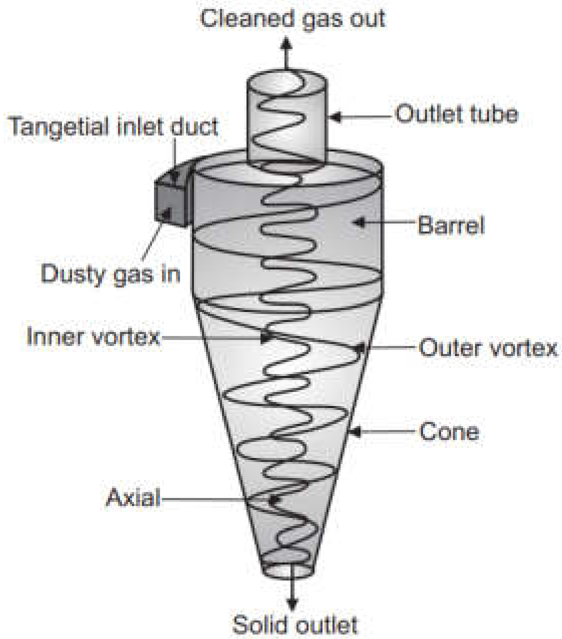


Fig 3.22 Cyclonic Separator

The choice of mist eliminator type depends on several factors, including the gas velocity, the droplet size distribution, the scrubbing solution chemistry, and the available space and budget.

CHAPTER-3.9 COMPONENTS OF RECIRCULATION SYSTEM

In Flue Gas Desulfurization (FGD) systems, recirculation is a process in which a portion of the scrubbing solution is circulated back to the absorber to enhance the absorption of sulphur dioxide (SO2) from the flue gas. The recirculation system typically consists of the following components:

- **Recirculation Pump:** A recirculation pump is used to pump the scrubbing solution from the absorber sump to the recirculation tank. The pump is typically a centrifugal pump that is designed to handle the corrosive nature of the scrubbing solution.

Fig 3.23 Recirculation Pump

- **Recirculation Tank:** The recirculation tank holds the scrubbing solution that is being recirculated back to the absorber. The tank is usually made of fiberglass, plastic, or lined steel to prevent corrosion.

Fig 3.24 Recirculation Tank

- **Recirculation Spray Nozzles:** Recirculation spray nozzles are used to distribute the scrubbing solution back into the absorber. The nozzles are typically located near the top of the absorber and spray the solution onto the packing material or spray nozzles in the absorber.

Fig 3.25 Recirculation Spray Nozzles

- **Recirculation Control Valve:** A recirculation control valve is used to control the flow rate of the recirculated scrubbing solution. The valve is typically a globe valve that is controlled by a signal from a flow meter or a level controller in the absorber sump.

Fig 3.26 Recirculation Control Valve

- **Recirculation Piping:** Recirculation piping connects the recirculation pump, recirculation tank, and spray nozzles. The piping is usually made of plastic, fiberglass, or lined steel to prevent corrosion.

  The recirculation system plays a critical role in the efficiency of the FGD system. By recirculating a portion of the scrubbing solution, the system can maintain a high level of absorption of SO_2, which reduces emissions and helps to comply with environmental regulations.

CHAPTER-3.10 COMPONENTS OF SLURRY PREPARATION AREA

Limestone slurry is a mixture of limestone and water used in various industries such as power generation, environmental protection, and construction. The components of limestone slurry preparation typically include:

- **Limestone -** The main component of the slurry, which is typically ground to a fine powder before being mixed with water. The limestone used in slurry preparation is usually high in calcium carbonate content, which is responsible for its alkaline properties.

Fig 3.27 Limestone

- **Water -** The water used in slurry preparation should be clean and free from impurities, as any contaminants can affect the quality and performance of the slurry.

- **Mixing tank -** A tank where the limestone and water are mixed to form the slurry. The tank should be made of materials that are resistant to corrosion and abrasion, such as stainless steel or plastic.

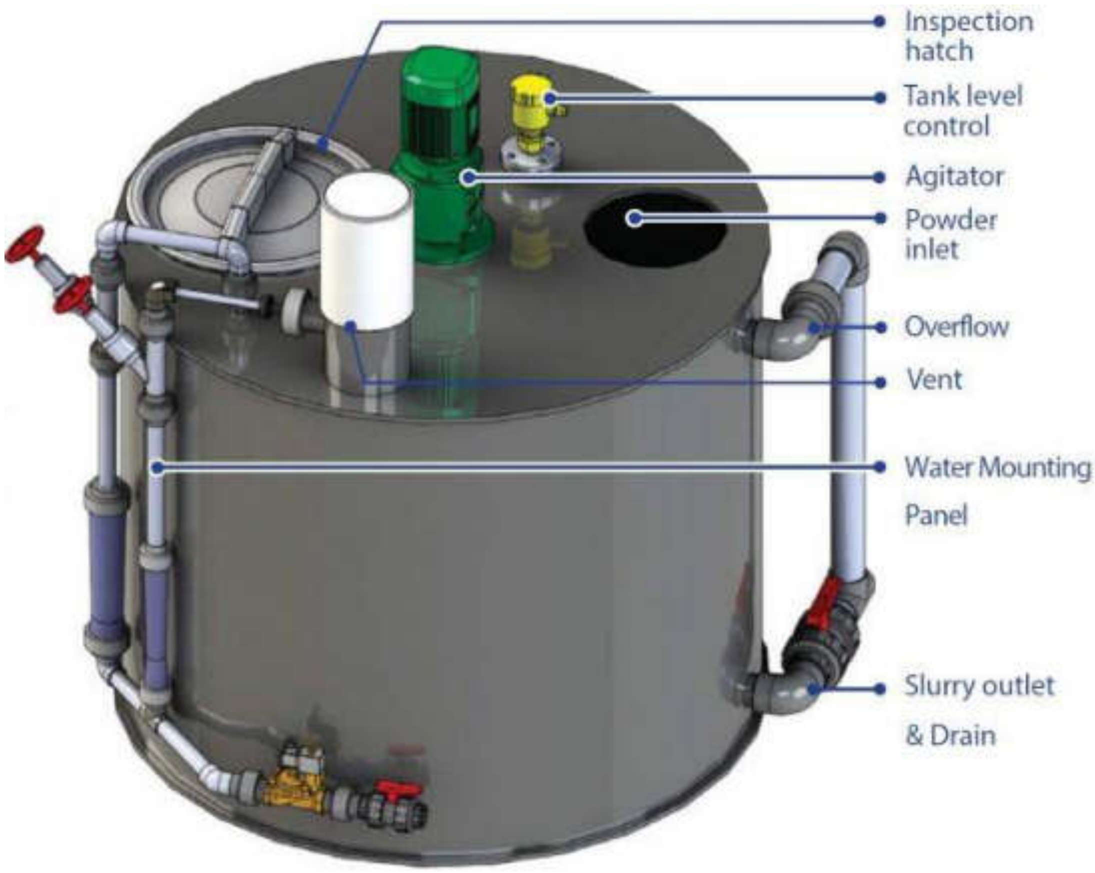


Fig 3.28 Mixing Tank

- **Agitator -** A mechanical device that is used to mix the limestone and water in the mixing tank. The agitator ensures that the limestone particles are evenly distributed throughout the water, resulting in a consistent slurry.

Fig 3.29 Agitator

- **Pump -** A pump is used to transfer the slurry from the mixing tank to the application site. The type of pump used depends on the viscosity and flow rate of the slurry.

- **Control system -** A control system is used to monitor and control the preparation of the limestone slurry. The system may include sensors to measure the pH, temperature, and viscosity of the slurry, as well as software to control the operation of the agitator and pump.

CHAPTER-3.11 COMPONENTS OF GYPSUM DEWATERING AREA

The components of a gypsum dewatering building can vary depending on the specific design and requirements of the facility. However, some common components of such a building may include:

- **Gypsum Storage Silos:** These are large containers used for storing the gypsum produced during the dewatering process.

- **Gypsum Dewatering System:** This is the equipment used for removing moisture from the gypsum slurry. This system can include various components such as thickeners, hydro cyclones, and vacuum filters.

- **Hydro cyclone:** A hydro cyclone is a device used in flue gas desulfurization (FGD) systems to separate solid particles from a liquid suspension, typically limestone slurry in FGD. It works by creating a vortex that separates heavier particles to the outside of the chamber, leaving a particle-free liquid. Hydro cyclones are used in series to efficiently separate particles of different sizes in FGD systems.

- **Vacuum Belt:** A vacuum belt is a type of belt conveyor used in flue gas desulfurization (FGD) systems to transport the slurry, which is a mixture of limestone and water, from the slurry preparation area to the FGD absorber. The vacuum belt system consists of a series of belts that are looped around a series of rollers. The slurry is pumped onto the belts at one end and is carried along the length of the conveyor by the motion of the belts.

- The vacuum belt conveyor operates under negative pressure, which is generated by a vacuum pump, to create a suction effect that helps to reduce the potential for material spillage. The negative pressure also helps to minimize the amount of water that is carried along with the slurry, which can reduce the overall cost of the FGD system.

- **Vacuum Pump:** This is used to create the vacuum required for dewatering the gypsum slurry in the vacuum filters.
- **Belt Conveyors:** These are used to transport the gypsum from the dewatering system to the storage silos.
- **Control Room:** This is the central location where the various components of the building are monitored and controlled.
- **Electrical and Control Equipment:** This includes the electrical panels, wiring, and other control devices required for operating the equipment.
- **Piping and Valves:** These are used for transporting the gypsum slurry and other fluids throughout the building.
- **Structural Steel:** This is the framework of the building, which supports the various components and equipment.
- **Ventilation System:** This is used for controlling the temperature and humidity levels inside the building, and for removing any harmful gases or dust particles generated during the dewatering process.
- **Lighting and Emergency Systems:** These include the lighting fixtures and emergency equipment such as fire alarms, extinguishers, and emergency exits.

CHAPTER-3.12 COMPONENTS OF CONTROL SYSTEM

The components of a control system in FGD (Flue Gas Desulfurization) may vary depending on the specific design and requirements of the facility, but some common components may include:

- **Sensors:** These are used to measure various parameters such as temperature, pressure, pH level, and flow rate.

Fig 3.30 Type of Sensor

- **Programmable Logic Controllers (PLCs):** These are used to monitor and control various processes in the FGD system. PLCs are connected to sensors and actuators and can be programmed to execute different functions based on the input received from the sensors.
- **Human Machine Interface (HMI):** This is the graphical user interface used for monitoring and controlling the FGD system. The HMI displays information such as process variables, alarms, and control settings.
- **Control Valves:** These are used to regulate the flow of fluids in the FGD system. Control valves can be operated manually or automatically through the PLC.
- **Actuators:** These are used to convert the electrical signals from the PLC into mechanical motion to control valves or other equipment.
- **Control Algorithms:** These are mathematical formulas used to determine the control settings for the FGD system based on the input from the sensors.
- **Communication Networks:** These are used to facilitate communication between the various components of the FGD control system, including sensors, PLCs, HMIs, and actuators.

- **Power Supplies:** These are used to provide electrical power to the various components of the control system.
- **Control Room:** This is the central location where the FGD control system is monitored and operated.
- **Alarm Systems:** These are used to alert operators in case of any abnormal conditions or malfunctions in the FGD system.
- Overall, the control system in FGD is essential for maintaining the performance and efficiency of the FGD process and ensuring compliance with environmental regulations.

CHAPTER-4 THE BASICS OF PIPING SYSTEM

A piping system is a network of pipes, fittings, valves, and other components used to transport fluids (liquids, gases, and slurries) from one location to another. Piping systems are essential in many industrial and commercial applications, including oil and gas production, chemical processing, water and wastewater treatment, HVAC systems, and more.

Piping systems are designed to safely and efficiently convey fluids under a range of temperatures, pressures, and flow rates. They can be made from a variety of materials, including steel, copper, plastic, and others, and can be configured in various ways, such as straight runs, elbows, tees, reducers, and more.

One of the key advantages of piping systems is their versatility. They can be used to transport a wide range of fluids, including water, oil, natural gas, steam, chemicals, and more. Additionally, they can be used to convey fluids over long distances, around obstacles, and in hard-to-reach locations.

Some common applications of piping systems include:

- Transporting oil and gas from wells to refineries and distribution centres.
- Moving water and wastewater from treatment plants to homes and businesses.
- Cooling and heating buildings through HVAC systems.
- Conveying chemicals and other fluids in industrial processes.
- Transporting compressed air in manufacturing facilities.

Overall, piping systems play a critical role in many aspects of modern life and are essential in a wide range of industries and applications.

Piping is divided into two main categories:

- Small bore lines
- Large bore lines

As a general practice, those pipe lines with nominal diameters 2” (50mm) and under are classified as small bore and greater than 2” (50mm) NB as large bore. This course is designed to introduce you to the basic concepts of piping engineering, which is all about designing, fabricating and constructing lines for conveying fluids.

ABBREVIATIONS:

- **NPS-**Nominal Pipe Size
- **DN-**Diameter Nominal
- **ID-**Inside Diameter
- **OD-**Outside Diameter
- **SCH-**Schedule (Wall Thickness)
- **STD-**Standard Weight Wall Thickness
- **XS-**Extra Strong Wall Thickness
- **XXS-**Double Extra Strong Wall Thickness

PIPE SIZES

Pipe sizes are designated by two numbers: Diameter and Thickness. In the US, pipe size is designated by two non-dimensional numbers: Nominal Pipe Size (NPS) and schedule (SCH). Let's check some key relationships:

- Nominal pipe size (NPS) is used to describe a pipe by name only. Nominal pipe size (NPS) is generally associated with the inside diameter (ID) for sizes 1/8" to 12". For sizes 14" and beyond, the NPS is equal to the outside diameter (OD) in inches.
- Outside diameter (OD) and inside diameter (ID), as their names imply, refer to pipe by their actual outside and inside measurements. Outside diameter (OD) remains same for a given size irrespective of pipe thickness.
- Schedule refers to the pipe wall thickness. As the schedule number increases, the wall thickness increases, and the inside diameter (ID) is reduced. • Nominal Bore (NB) along with schedule (wall thickness) is used in British standards classification.

Important In process piping, the method of sizing pipe maintains a uniform outside diameter while varying the inside diameter. This method achieves the desired strength necessary for pipe to perform its intended function while operating under various temperatures and pressures. It is also important to maintain certain interchangeability of pipe fittings.

The European designation:

The European designation equivalent to NPS is DN (Diameter Nominal/nominal diameter).

Relationship - NPS and DN pipe sizes

NPS	½	3/4	1	1¼	1½	2	2½	3	3½	4
DN	15	20	25	32	40	50	65	80	90	100

Fig 4.1 Relationship - NPS and DN pipe sizes

The pipe sizes are measured in millimetres.

Note - For NPS of 4 and larger, the DN is equal to the NPS multiplied by 25 (not 25.4)

PIPE SCHEDULES (SCH)

The Schedule of pipe refers to the wall thickness of pipe in the American system. Eleven schedule numbers are available for Carbon Steel Pipes: 5, 10, 20, 30, 40, 60, 80, 100, 120, 140, & 160. The most popular schedule, by far, is 40. Schedules 5, 60, 100, 120, & 140 have rarely been used. Thickness of the pipe increases with the schedule number. This means that:

- Schedule 80 steel pipes will be heavier and stronger than schedule 40 pipe.
- Schedule 80 pipe will provide greater factor of safety allowing it to handle much higher design pressures.
- Schedule 80 pipe will use more material and therefore costlier to make and install.

Stainless steel piping schedules generally match with Carbon Steel piping schedules, but are always identified with Suffix S from 1/8” to 12”. Schedule 40S and 80S are the same as their corresponding schedule 40 and 80 in all sizes except 12” in schedule 40.

How to calculate Schedule?

A simple rule of thumb expression is:

Schedule Number = (1,000) (P/S)

Where,

- P = the internal working pressure, psig

- S = the allowable stress (psi) for the material of construction at the conditions of use.

Example:

Calculate allowable internal pressure P for Schedule 40 mild steel pipe having ultimate tensile strength (S value) of 65,300 psi.

Rearrange the schedule equation:

P = SCH x S/1,000 Therefore,

P = 40 x 65,300/1,000 = 2,612 psi.

This is reasonable, based on a current-day published value of 2,849-psi for 1-inch Schedule 40 steel pipe.

INTERNAL DIAMETER (ID) OF PIPE:

For process engineers, the most important parameter for hydraulic sizing is the pipe Internal Diameter (ID). The ID can then easily be calculated as: ID = OD - 2t

Example

A 4 inches Schedule 40 pipe has an outside diameter of 4.500 inches, a wall thickness of 0.237 inches.

Therefore, Pipe ID = 4.5 inches – 2 x 0.237 inches = 4.026 inches

A 4 inches Schedule 80 pipe has an outside diameter of 4.500 inches, a wall thickness of 0.337 inches.

Therefore, Pipe ID = 4.5 inches – 2 x 0.337 inches = 3.826 inches

PIPING DIMENSIONAL STANDARDS:

Pipe sizes are documented by a number of standards, including API 5L, ANSI/ASME B36.10M in the US, and BS 1600 and BS 1387 in the United Kingdom. Typically, the pipe wall thickness is the controlled variable, and the Inside Diameter (I.D.) is allowed to vary. The pipe wall thickness has a variance of approximately 12.5 percent.

Nominal Pipe Size (NPS)	Pipe Schedule	Outside Diameter	Inside Diameter	Wall Thickness
3"	40	3.5"	3.068"	0.216"
3"	80	3.5"	2.9"	0.3"
3"	160	3.5"	2.804"	0.438"
4"	40	4.5"	4.026"	0.237"
4"	80	4.5"	3.826"	0.337"
4"	160	4.5"	3.438"	0.531"
5"	40	5.563"	5.047"	0.258"
5"	80	5.563"	4.813"	0.375"
5"	160	5.563"	4.313"	0.625"
6"	40	6.625"	6.065"	0.28"
6"	80	6.625"	5.761"	0.432"
6"	160	6.625"	5.187"	0.719"
8"	40	8.625"	7.981"	0.322"
8"	80	8.625"	7.625"	0.5"
8"	160	8.625"	6.813"	0.906"
10"	40	10.75"	10.02"	0.365"
10"	80	10.75"	9.562"	0.594"
10"	160	10.75"	8.5"	1.125"
12"	40	12.75"	11.938"	0.406"
12"	80	12.75"	11.374"	0.688"
12"	160	12.75"	10.126"	1.312"

Fig 4. 2 Standard Carbon Steel Welded and Seamless Pipe size NPS(0.75" to 2.5")

DIMENSIONAL TOLERANCES:

The dimensional tolerances for pipes are provided by ASTM A530 standard that permits following variations in pipe size, pipe lengths and the weight.

Nominal pipe size

- Up to 4" = ± 0.79 mm

Fig 4. 3 Standard Carbon Steel Welded and Seamless Pipe size NPS(3" to 12")

- 5 thru 8” = + 1.58 mm / - 0.79 mm
- 10 thru 18” = + 2.37 mm / - 0.79 mm
- 20 thru 24” = + 3.18 mm / - 0.79 mm

Wall Thickness

Most piping standards allow pipe manufacturers a fabrication mill tolerance of 12.5% on the wall thickness.

- All Diameters = - 12.5% (+ tolerance not specified)
- Length = + 6.40 mm / - 0 mm
- Weight = + 10% / - 1.5%

PRESSURE RATINGS:

The pressure rating of the pipe is associated to the maximum allowable working pressure. It is the ability of the pipe material to resist the internal pressure and pressure surges. It is defined by pipe schedule or thickness.

Minimum wall thickness of pipe is calculated by ASME B31.3 code (hoop stress) formula:

$$t = \frac{PD}{2(SE + PY)} + A$$

$$t_m = t + A$$

Fig 4.4 Minimum wall thickness of pipe (hoop stress) formula

Where,

- t = required wall thickness, inches
- tm = minimum required wall thickness, inches
- P = Design pressure, psi
- D = Pipe outside diameter, inches.
- A = Corrosion allowance, inches

- S = Allowable Stress @ Design Temperature, psi (From ASME B31.3, Table A-1)

- E = Longitudinal-joint quality factor (From ASME B31.3, Table A-1B)

Y = Wall thickness correction factor (From ASME B31.3, Table 304.1.1)

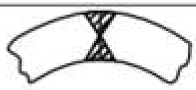
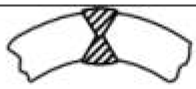
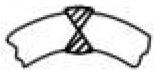
No.	Type of Joint		Type of Seam	Examination	Factor *E*
1	Furnace butt weld, continuous weld		Straight	As required by listed specification	0.60 [Note (1)]
2	Electric resistance weld		Straight or spiral	As required by listed specification	0.85 [Note (1)]
3	Electric fusion weld				
	(a) Single butt weld (without filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.85 1.00 [Note (2)]
	(b) Single butt weld (with filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.80 1.00 [Note (2)]
	(c) Double butt weld (without filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
	(d) Double butt weld (with filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
4	API 5L	Submerged arc weld (SAW) Gas metal arc weld (GMAW) Combined GMAW, SAW 	Straight with one or two seams Spiral	As required by specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]

Fig 4.6 Longitudinal-joint quality factor

Material	Temperature, °F (°C)							
	900 (482) and Below	950 (510)	1,000 (538)	1,050 (566)	1,100 (593)	1,150 (621)	1,200 (649)	1,250 (677) and Above
Ferritic steels	0.4	0.5	0.7	0.7	0.7	0.7	0.7	0.7
Austenitic steels	0.4	0.4	0.4	0.4	0.5	0.7	0.7	0.7
Nickel alloy UNS No. N06690	0.4	0.4	0.4	0.4	0.5	0.7	0.7	...
Nickel alloys UNS Nos. N06617, N08800, N08810, N08825	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.7
Cast iron	0.0	...	...	...	...	...	...	...
Other metals [Note (1)]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Fig 4.5 Wall thickness correction factor

Pressure – Temperature Relationship:

Among other parameters, the pressure rating of the pipe is also influenced by the temperature of the fluid. The hotter the fluid, the lower the pressure it can hold and therefore higher should be the pressure rating. Table below provides pressure ratings of Carbon Steel. Ratings are given for standard seamless pipe sizes at temperatures from 100°F to 750°F. All ratings are in psig and are based on ANSI/ASME B 31.1.

DIFFERENCE BETWEEN PIPE AND TUBE:

Tubing is supplied in sizes up to four inches in diameter but has a wall thickness less than that of either large bore or small bore piping. The essential difference between pipe and tube is that pipe is specified by nominal bore and schedule. Tube is specified by the outside diameter (OD) and a wall thickness. For example: The actual outside diameter of 1¼" pipe is 1.625" – while 1¼" tube has a true 1.25" outside diameter

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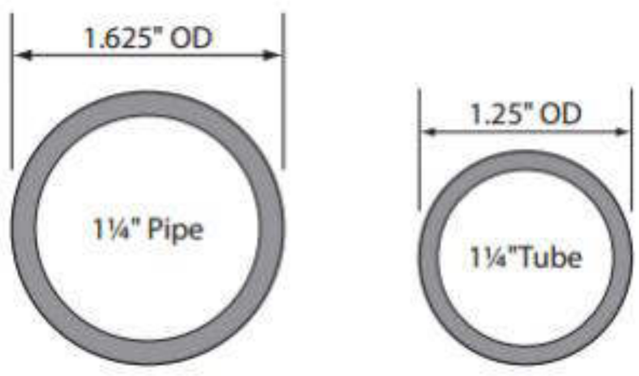


Fig. Difference between Pipe and Tube

FREQUENTLY USED PIPE MATERIALS:

Carbon Steel:

The vast majority of piping is made of Carbon Steel. Carbon steel contains only a tiny amount of carbon; sometimes much less than 1% and is classified as:

- Mild Steels - up to 0.3% Carbon
- Medium Carbon Steels (or simply Carbon Steels) - 0.3 to 0.6 % carbon
- High Carbon Steels - over 0.6% Carbon
- The carbon Percentage influences the mechanical characteristics of the material.
- Material containing carbon more than 0.35 becomes brittle.
- Material containing carbon more than 0.43 are NOT weld able.

Low carbon steel is the most common industrial piping material. The material specifications are governed by ASTM A53 and ASTM A106 standards which defines three Grades A, B and C. The grades refer to the tensile strength of the steel, with Grade C having the highest strength. Grade B permits higher carbon and manganese contents than Grade A. A106 is preferable for more stringent high temperature and high pressure services.

Alloy Steel:

- **Nickel Steels** - These steels contain from 3.5% nickel to 5% nickel. The nickel increases the toughness and improves low temperature properties (up to - 150°F/-100°C). Nickel steel containing more than 5% nickel has an increased resistance to corrosion and scale.
- **Molybdenum -** Molybdenum provides strength at elevated temperatures. It is often used in combination with chromium and nickel. The molybdenum adds toughness to the steel and can be used in place of tungsten to make the cheaper grades of high-speed steel for use in high-pressure tubing. An addition of about 0.5% Molybdenum greatly improves the strength of steel up to 900°F/480°C. Moly is often alloyed to resist corrosion of chlorides (like sea water).
- **Chromium Steels -** Chromium and silicon improve hardness, abrasion resistance and corrosion resistance. An addition of up to 9% Chromium combats the tendency

to oxidize at high temperatures and resists corrosion from sulphur compounds. Stainless Steels contain at least 10.5% Chromium.

- **Chrome Vanadium Steel -** This steel has the maximum amount of strength with the least amount of weight. Steels of this type contain from 0.15% to 0.25% vanadium, 0.6% to 1.5% chromium, and 0.1% to 0.6% carbon.
- **Tungsten Steel -** This is a special alloy that has a characteristic property of red hardness. It has the ability to continue to cut after it becomes red-hot. A good grade of this steel contains from 13% to 19% tungsten, 1% to 2% vanadium, 3% to 5% chromium, and 0.6% to 0.8% carbon.
- **Manganese Steels -** Small amounts of manganese produce strong, free machining steels. Larger amounts (between 2% and 10%) produce somewhat brittle steel, while still larger amounts (11% to 14%) produce steel that is tough and very resistant to wear after proper heat treatment.

Stainless Steel:

Stainless steel pipe and tubing are used for a variety of reasons: to resist corrosion and oxidation, to resist high temperatures, for cleanliness and low maintenance costs, and to maintain the purity of materials which come in contact with stainless.

The ability of stainless steel to resist corrosion is achieved by the addition of a minimum of 12% chromium to the iron alloy. Nickel, molybdenum, titanium and other elements are often alloyed along in varying quantities to produce a wide range of Stainless Steel grades, each with its unique properties.

Stainless steel is classified by the American Iron and Steel Institute (AISI) into two general series named the 200-300 series and 400 series.

Austenitic Steel:

- The 200-300 series of stainless steel is known as Austenitic. There are eighteen different grades of Austenitic steel, of which type SS 304 is the most widely used.

Grade SS304 contains 18% chromium and 8% nickel. It has a maximum carbon content of .08%.

- It is not recommended for use in the temperature range between 400°C and 900°C due to carbide precipitation at the grain boundaries which can result in inter-granular corrosion and early failure under certain conditions
- Type 304L. Is the same as 304 except that a 0.03% maximum carbon content is maintained which precludes carbon precipitation and permits the use of this analysis in welded assemblies under more severe corrosive conditions.
- Grade SS316 contains 16% chromium, 10% nickel and 2% molybdenum. It has high resistance to chemical and salt water corrosion.
- Stainless steel pipe is manufactured in accordance with ASTM A312 when 8” or smaller sizes are needed.
- Large sizes (8” and up) of stainless steel pipe are covered by ASTM A358.
- Extra light wall thickness (schedule 5S) and light wall thickness (schedule 10S) stainless steel pipes are covered by ASTM A409.

400 Series Stainless Steel:

The 400 series of steel is subdivided into two main groups: Ferritic and Martensitic

Ferritic Steel:

These are plain chromium stainless steels with chromium content between 12 and 18% but with low carbon content in ranges of 0.08% to 0.20%. They offer moderate corrosion resistance, not harden able by heat treatment.

- They are magnetic.
- Weldability and formability are poor.
- They are frequently used for a decorative trim with the equipment being subjected to high pressures and temperatures.
- The typical grade is 430.

Martensitic Steel:

Martensitic SS exhibit relatively high carbon content (0.1-1.2%) with 12 to 18% chromium. They were the original commercial SS.

- They are magnetic.
- They offer moderate corrosion resistance and can be heat treated.
- They have high strength but weldability is bad.
- The typical grade is 410.

Duplex Stainless Steel:

Duplex Stainless Steel has high chromium content (between 18 and 28%) and a reasonable amount of nickel (between 4.5 and 8%). These steels exhibit a combination of ferritic and austenitic structure and hence called duplex. Some duplex steels contain molybdenum from 2.5-4%.

- They offer excellent resistance to stress corrosion cracking.
- These have better resistance to chlorides.
- They are better than austenitic and ferritic steels in tensile and yield strength while offering good weldability and formability.
- The typical grade is 2205.

Cast Iron /Ductile Iron:

Cast iron is any iron containing greater than 2% carbon. The high carbon content makes it extremely hard and brittle. Cast iron has a high compressive strength and good wear resistance; however, it lacks ductility, malleability, and impact strength. Two types of cast iron are used, grey cast iron and ductile iron. Both Grey Iron and Ductile Iron are prepared by adding carbon in the hot beds where they are liquefied but ductile iron develops high strength and ductility with the addition of small amounts of magnesium to grey iron.

Galvanized Pipe:

Galvanized iron pipe (GI) is a regular iron pipe that is coated with a thin layer of zinc. The zinc greatly increases the life of the pipe by protecting it from rust and corrosion. GI usually comes in 6-meter (21-foot) lengths, and is joined together by threaded connections.

Titanium:

Titanium has superb corrosion resistance especially for seawater duties in heat exchanger tubes/piping. This material is relatively expensive compared to most other materials; however, if lifetime costing is considered, it would likely be competitive.

Copper, Brass, Copper Nickel Alloys:

Copper tubing is used where ease of fabrication is important. 70%/30% - Cu/Zn brass is a good general purpose material used for a variety of applications, e.g. heat exchanger tubes and closed circuit systems. Brass with 76%/2%/0.04%- Cu/Al/As and Remainder Zn has good resistance to seawater attack and is used for diverse process plants for transferring seawater under turbulent conditions to resist corrosion and impingement attack.

Admiralty brass 70% /1%/29% - Cu/Sn/Zn has slightly improved resistance to polluted water compared to 70/30 brass.

Cupro Nickel Containing 31%/2% - Ni/Fe and “Kunifer" containing 10.5%/1.7% - Ni/Fe are also used for transferring seawater and high good strength at elevated temperatures.

Plastic Piping Systems:

The two most common types of plastic pipe are Polyethylene (PE) and Polyvinyl chloride (PVC).

- Polyethylene pipe (PE) and HDPE are lightweight, flexible pipes that come in large coils 30 meters or more in length. The pipe varies in density and is generally joined by heat fusion. The joint is typically leak free.
- Plastic polyvinyl chloride pipe (PVC) is a rigid pipe, usually white or grey in colour. It comes in 3 or 6 meter lengths and is joined primarily by solvent cement. The pipe varies in density and, when buried is extremely resistant to corrosion.
- Plastic pipes do have limitations on the mechanical and thermal properties.

GRADES

In steel pipe, the word "grade" designates divisions within different types based on carbon content or mechanical properties (tensile and yield strengths).

- Grade A steel pipe has lower tensile and yield strengths than Grade B steel pipe. This is because it has lower carbon content. Grade A is more ductile and is better for cold bending and close coiling applications.

- Grade B steel pipe is better for applications where pressure, structural strength and collapse are factors. It is also easier to machine because of its higher carbon content. It is generally accepted for Grade B welds as well as Grade A.

PIPE CONSTRUCTION METHODS

Electric Resistance Welding (ERW)

Electric Resistance Welding (ERW) is a method used for pipe construction where pipes are created by heating and welding together two edges of a strip of steel. The following is a detailed explanation of the ERW pipe construction method:

- **Coil preparation:** The first step in the ERW pipe construction method is to prepare the steel coils that will be used to make the pipes. The steel coils are unrolled and the edges are trimmed to create straight edges.
- **Forming:** The next step is to form the steel strip into a cylindrical shape. This is done by passing the steel strip through a series of rollers that gradually shape the strip into a circular shape.
- **Welding:** Once the steel strip has been formed into a cylindrical shape, the edges are welded together using an electric current. The two edges of the strip are pressed together and an electric current is applied to heat the edges to their melting point. The edges are then fused together to create a continuous weld.
- **Sizing**: After the welding process, the pipe is then passed through a series of sizing rollers to ensure that it is the correct size and shape. The sizing rollers are used to shape the pipe into its final form and to ensure that it meets the required dimensions.
- **Cutting:** Once the pipe has been sized, it is then cut to the desired length. This is done using a cutting saw or a high-speed rotary cutter.
- **Inspection:** Finally, the ERW pipe is inspected to ensure that it meets the required quality standards. The pipe is checked for defects such as cracks, dents, or other imperfections that could affect its performance.
- In conclusion, Electric Resistance Welding (ERW) is a popular method used for pipe construction due to its ability to create high-quality pipes quickly and

efficiently. The process involves coil preparation, forming, welding, sizing, cutting, and inspection, and produces pipes that are durable, reliable, and cost-effective.

- Electric Resistance Welding (ERW) is a method of pipe construction that offers several advantages, as well as some disadvantages. Here are some of the advantages and disadvantages of the ERW method:
- Advantages:
- High efficiency: The ERW method is a highly efficient method of pipe production, making it a cost-effective option for many applications.
- Versatile: ERW can be used to produce a wide range of pipe sizes and shapes, making it a versatile option for many different applications.
- Strong welds: The electric current used in ERW creates strong, reliable welds that are less likely to fail over time.
- Precise dimensions: The sizing rollers used in the ERW process ensure that the pipes are produced with precise dimensions, which is important for applications where accuracy is critical.
- Reduced material waste: ERW produces very little waste, making it an environmentally friendly option.
- Disadvantages:
- Limited thickness range: ERW is generally used for pipes with a thickness range of 2.375" to 24". Pipes that are thicker or thinner than this range may require a different method of construction.
- Less suitable for high-pressure applications: ERW pipes may not be suitable for applications that require high pressure, as they may not be able to withstand the high pressure over long periods of time.
- Surface finish issues: The welding process used in ERW can cause surface finish issues, which may require additional processing to correct.
- Difficult to repair: If an ERW pipe is damaged or requires repair, it can be difficult to repair without compromising the strength of the weld.

In conclusion, the ERW method of pipe construction has several advantages, including high efficiency, versatility, strong welds, precise dimensions, and reduced material waste. However, it also has some disadvantages, including a limited thickness range, less suitability for high-pressure applications, surface finish issues, and difficulty with repairs.

Submerged Arc Welded (SAW)

Submerged Arc Welded (SAW) pipe construction is a method used to join two metal pieces by heating them with an electric arc, while a granular flux is used to protect the weld zone. This method is commonly used to manufacture large diameter pipes for the transportation of oil, gas, and water.

The process involves the following steps:

- Preparation of the edges of the metal pieces to be welded, ensuring that they are clean and free from any contaminants.
- The pieces are then aligned and clamped in place.
- A wire electrode is fed through a nozzle and positioned close to the joint.
- A granular flux is poured over the electrode and the joint area, which helps to protect the weld zone from contamination and oxidation.
- The electric arc is ignited, melting the electrode and the edges of the metal pieces.
- The molten metal solidifies, forming a strong and durable bond.
- Advantages of SAW pipe construction:
- High production rates: The SAW process can produce large quantities of welded pipes in a relatively short time.
- High quality welds: The use of a granular flux helps to protect the weld zone, resulting in high-quality welds that are strong and durable.
- Efficient: The SAW process is highly efficient, reducing the amount of scrap and minimizing material waste.
- Versatile: The SAW process can be used to weld a wide range of metals, including carbon steel, stainless steel, and alloys.

- Disadvantages of SAW pipe construction:
- Limited mobility: The SAW process requires a fixed position for the metal pieces being welded, which limits its use in certain applications.
- Limited thickness: The SAW process is not suitable for welding very thin metal pieces or plates.
- Expensive equipment: The equipment required for the SAW process is expensive, which can increase the cost of manufacturing.
- Environmental concerns: The use of a granular flux can create environmental concerns due to the release of fumes and dust particles.

Overall, the SAW process is a reliable and efficient method for manufacturing large diameter pipes for various applications. However, it is important to consider the advantages and disadvantages before choosing this method for a specific project.

Seamless (SMLS)

Seamless (SMLS) pipe construction is a method used to manufacture pipes by piercing a solid billet or bar of metal to form a hollow cylinder. This method is commonly used for the production of high-quality pipes for applications such as oil and gas exploration, power generation, and chemical processing.

The process involves the following steps:

- Preparation of the raw material: The raw material, usually a solid billet or bar, is cleaned and inspected for any defects.
- Heating the material: The material is heated to a high temperature to make it malleable and easier to shape.
- Piercing the material: A piercing tool is used to pierce the heated material, forming a hollow cylinder.
- Rolling the cylinder: The hollow cylinder is then rolled to reduce its diameter and increase its length.

- Finishing the pipe: The pipe is then subjected to various finishing processes, such as straightening, heat treatment, and surface treatment, to ensure its quality and performance.
- Advantages of SMLS pipe construction:
- High-quality product: SMLS pipes are manufactured from a single piece of metal, resulting in a product that has no welded seams, making it stronger and more reliable.
- Smooth surface: SMLS pipes have a smooth inner and outer surface, which reduces friction and makes it easier to transport fluids and gases.
- High corrosion resistance: SMLS pipes have a high resistance to corrosion, making them suitable for use in harsh environments.
- Wide range of sizes: SMLS pipes can be manufactured in a wide range of sizes, from small diameter pipes to large diameter pipes, to meet the specific needs of different applications.
- Disadvantages of SMLS pipe construction:
- Limited availability: SMLS pipes are more difficult and expensive to produce than welded pipes, which may limit their availability and increase their cost.
- Limited flexibility: SMLS pipes are limited in their ability to be bent or shaped, which may limit their use in certain applications.
- Longer lead times: SMLS pipes require more time to manufacture and deliver, which may impact project timelines.
- Higher cost: SMLS pipes are generally more expensive than welded pipes due to the higher manufacturing costs.

Overall, SMLS pipe construction is a high-quality method for producing pipes with excellent performance characteristics. However, it is important to consider the advantages and disadvantages before selecting this method for a particular project.

How to Identify Seamless or ERW Stainless Steel pipes?

To identify that a pipe supply is seamless or ERW, simply read the stencil on the side of the pipe

If it is ASTM A53,

- **Type S** means seamless.
- **Type F** is furnace but welded.
- **Type E** is Electrical resistance welded.

That's how it is the easiest way to identify whether pipe is seamless or ERW.

Recommended Guidelines:

- All pipe lines carrying toxic inflammable fluids shall be seamless.
- Utility piping can be ERW or Seam welded.
- Steam pipe lines shall preferably be seamless.

PIPING DESIGN:

The main aim of piping design is to configure and lay equipment, piping and other accessories meeting relevant standards and statutory regulations. The piping design and engineering involves six (6) major steps:

- Selection of pipe materials on the basis of the characteristics of the fluid and operating conditions including maximum pressures and temperatures.
- Finding economical pipe diameter and wall thickness.
- Selection of joints, fittings and components such as flanges, branch connections, extruded tees, nozzle branches etc.
- Developing piping layout and isometrics.
- Performing stress analysis taking into account the potential upset conditions and an allowance for those upset conditions in the design of piping systems.
- Estimating material take-off (MTO) and raising material requisition.

Codes and Standards:

The design basis for any project should state the required design codes for materials and equipment. This is usually set by the client, and the engineer should review the requirements to assure they are complete and not contradictory. Local laws may require special requirements for hurricanes, earthquakes or other public safety issues

The main associations involved in generating piping codes and standards for process industry in US are:

- ASME: American Society of Mechanical Engineers
- ANSI: American National Standardization Institute
- ASTM: American Society of Testing Materials
- API: American Petroleum Institute (primarily for Oil & Gas Industry)

The basic rules for piping engineering are ASME B31 codes. The important codes are:

- ASME B31.1 - Power Piping
- ASME B31.2 - Fuel Gas Piping
- ASME B31.3 - Process Piping
- ASME B31.4 - Liquid Piping
- ASME B31.5 - Refrigeration Piping
- ASME B31.8 - Gas Distribution and Transportation
- ASME B31.9 - Building Service Piping
- ASME B31.11 - Slurry Piping
- ASME Boiler and Pressure Vessel Code applies to boiler supplied piping.
- For pipelines there are Department of Transportation requirements that may apply, such as CFR Part 192.
- For modifications to existing plants, OSHA 1910.119 may apply to Management of Change, Mechanical Integrity and Inspection Requirements.

Each Code provides the typical loading conditions to be considered; allowable stresses; minimum wall thickness calculations; and minimum fabrication, inspection and testing requirements.

B31.1 Power Piping ASME B31.1

Code is typically used for the design and construction of power piping found in Electric Power Generating Stations, Industrial and Institutional Plants, Geothermal Heating Systems, and Central & District Heating and Cooling Systems. The code covers external piping for power boilers and high temperature, high-pressure water boilers in which steam or vapour is generated at a pressure of more than 15 psig and high-temperature water is generated at pressures exceeding 160 psig or temperatures exceeding 250°F.

- B31.1 is intended to be applied to:
- Piping for steam, water, oil, gas, air and other services.
- Metallic and non-metallic piping.
- All pressures.
- All temperatures above -29°C (-20°F).

B31.1 does NOT apply to

- Boilers, pressure vessel heaters and components covered by the ASME Boiler and Pressure Vessel Code (BPVC). Note: A boiler needs pipe, both internally and externally. The internal pipe would come under the rules of Section I and the external piping would come under B31.1.
- Building heating and distribution steam and condensate systems designed for 15 psig or less.
    - Hot water heating systems designed for 30 psig or less.

DEFINITIONS, TERMINOLOGY AND ESSENTIAL VOCABULARY:

CODES AND STANDARDS:

- A code is a set of regulations that tells you when to do something. A code will have requirements specifying the administration and enforcement of the document.
- A standard is a series of requirements that tell you how to do something. A standard tends not to have any enforcement requirements. A standard becomes an enforceable document when it is adopted by reference in a code.

COMMON CODES, STANDARDS AND PRACTICES:

- ANSI (American National Standards Institute)
- API (American Petroleum Institute)
- ASME (American Society of Mechanical Engineers)
- ASTM – American Society of Testing Materials

- AWS (American Welding Society)–
- AWWA (American Water Works Association)
- CFR (Code of Federal Regulations)
- Division of Weights & Measures
- DOT (Department of Transportation)
- FAR (Federal Accounting Regulations)
- IRI (Insurance Regulators Institute)
- Local Permits (Country, State, City, etc.)
- MSS (Manufacturing Standards Society)

ISOMETRIC DRAWINGS

- Isometric drawings are 3D representation of piping showing the bird's eye view of the piping indicating various valves, gages, supports, hangers, anchors and restraints. The drawing is an engineer's language and represents the information in a codified form to the down-stream agencies. The isometric of piping is used for construction and indicates the transportable segments of piping. The isometric drawing contains Bill of Materials (BOM, also known as BOQ). The total weight of all the items covered in a single system is indicated. The isometric, in its final form, is used for field work.
- The isometric diagrams are used for giving inputs to the piping stress analysis computer programs like CAESAR II and CAEPIPE. The outputs of the piping stress analysis are used to up-date the isometrics. As the design is an iterative process (based on trial and error process), the design of the piping is done in several stages.
- The presently used Plant Design Systems (PDS) and Plant Design Management Systems (PDMS) computer programs assist in the preparation of piping isometrics.

SEISMIC ZONE

- A Seismic zone is an area where the rate of seismic activity remains fairly consistent. This may mean that seismic activity is very rare, or that it is very common. Some people often use the term "seismic zone" to talk about an area with an increased risk of seismic activity, while others prefer to talk about "seismic hazard zones" when discussing areas where seismic activity is more common.

PIPE RACK

- The pipe rack is the elevated supporting structure used to convey piping between equipment. This structure is also utilized for cable trays associated with electric-power distribution and for instrument tray.

DESIGN CODES AND STANDARDS:

The manufacture and installation of pressure piping is tightly regulated by the American Society of Mechanical Engineers, ASME "B31" code series such as B31.1 or B31.3. These codes have their basis in the ASME Boiler and Pressure Vessel Codes and are mandatorily applied in Canada and the USA. Europe has an equivalent system of codes.

DIFFERENCE BETWEEN CODES AND STANDARDS:

Design Codes:

The "Codes" define the rules and regulations deemed necessary for safe design and construction. For example, the piping codes address the following design requirements: − Allowable stresses and stress limits

- Allowable dead loads and load limits
- Allowable live loads and load limits
- Materials
- Minimum wall thickness
- Maximum deflection
- Seismic loads and
- Thermal expansion

Note that the piping codes DO NOT include components such as fittings, valves, flanges and meters; rather, they define the design requirements for these components by reference to industry standards.

Design Standards:

The "Standards" provide specific design criteria and rules for individual components or classes of components such as valves, flanges and fittings. Standards apply to both dimensions and performance of system components.

- Dimensional standards provide configuration control parameters for components. The primary objective of dimensional standards is to ensure that similar components manufactured by different suppliers permit interchangeability.
- Pressure-integrity standards provide uniform minimum performance criteria. The main objective is to ensure that the components designed and manufactured to the same standard will function in an equivalent manner. For example, all NPS 10 (DN 250) Class 150 ASTM A105 flanges, which are constructed in accordance with ASME B16.5, Pipe Flanges and Flanged Fittings, have a pressure-temperature rating of 230 psig (1590 kPa gauge) at 300°F (149°C).

ALL ABOUT FIBERGLASS REINFORCED PLASTIC(F.R.P.)

INTRODUCTION

- The full form of FRP is fiberglass-reinforced plastic which is a composite material consisting of a polymer matrix reinforced with fibers.
- So, an FRP pipe is a pipe manufactured of FRP material by contact molding or filament winding method.
- Various types of resins like thermosetting polyester, epoxy, phenolic resin, etc. are used to get specific FRP pipe properties in the final product.
- The most widely used reinforcement is the glass fiber "E-glass". As a corrosion-resistant alternative to metallic piping, the FRP piping system has found worldwide application. By selecting FRP as the pipe material, the need for internal lining, external coating, and cathodic protection can easily be eliminated. FRP piping system is available in a wide range of sizes starting from 1 inch to 144 inches.

Applications of FRP Pipes:

Due to its high durability, corrosion resistance, and moderate strength, the use of FRP pipes is increasing day by day. FRP piping systems are used in various industries like:

- Potable Water and desalination industries
- Chemical, Petrochemical, Oil & Gas industries.
- Ducting and Vent piping

- Irrigation and Sanitary services
- Water distribution and transmission
- Slurry piping
- Power plants, etc.

Properties of FRP Piping:

- Excellent corrosion resistance
- Excellent strength-to-weight ratio. Note that, the strength-to-weight ratio of FRP pipes is higher than steel or other metallic pipes.
- Lightweight which makes it easy for handling and transport.
- Dimensional stability
- Non-toxicity
- Low coefficient of friction (>25% better than steel) that ensures excellent flow characteristics.
- Good abrasion resistance
- Suitable for both aboveground and buried piping
- Resistance to biological attacks like bacteria
- Non-conductive to electricity and
- Low maintenance cost

Typical mechanical properties of the FRP piping system are provided in the Picture below:

Typical mechanical properties of the FRP piping system are provided in the table below:

Mechanical Properties of FRP Pipe	Typical Range
Tensile Strength	14 to 550 Mpa
Tensile Modulus	3.5 to 34.5 Gpa
Flexural Strength	28-480 Mpa
Flexural Modulus	6.9 to 34.5 Gpa
Poisson's ratio	0.3
Thermal Co-efficient	14 to 54 mm/mm/^{0}C
Specific gravity	1.2 to 2.3
Compressive Strength	69-275 Mpa

Fig. Mechanical Properties Of The FRP Piping

Joining of FRP Pipes:

- As the FRP pipe lengths are limited by transportation and handling, they are required to be joined. Also, various FRP Pipe fittings need to be joined as per the requirement. The joining system of the FRP pipe should be such that it does not leak for the intended service condition at the operating pressure. Depending on the specific joint configuration and design conditions, the FRP pipe joints may be restrained or unrestrained.

1. **Unrestrained FRP Pipe Joints:**

- Joints that can withstand the internal pressure but can not withstand the longitudinal tensile loads are known as Unrestrained FRP Pipe joints. Examples of such joints are Coupling joints, bell and spigot joints, mechanical coupling joints with elastomeric seals, flanged joints, butt joints with laminated overlay, etc.

2. **Restrained FRP Pipe joints:**

- Such pipe joints are capable of withstanding both internal pressure and longitudinal tensile loads. For these joints, supplemental restraining elements are added to restrict the longitudinal loads. Threaded joints, bell, and spigot joints with laminated overlay or adhesive bonds are examples of Restrained FRP pipe joints.
- Note that FRP pipe joint tightness must be ensured following ASTM D4161.

Codes and Standards for FRP Pipes:

- ISO 7370
- ANSI/AWWA C950
- AWWA M45
- ISO 14692
- AWWA C590
- ISO 10467
- BS 5480
- ISO 10639
- ASTM D2996, ASTM D2997, ASTM D5421, ASTM D4024, ASTM D5685

Supporting of FRP Piping System:

- FRP piping systems must be supported properly to avoid excessive sagging. Maximum acceptable sagging is the lower of 12.5 mm or 0.5% of span length. The manufacturer's guidelines with respect to the supporting shall be followed. Usually, clamped supports with an elastomeric pad are used for support.

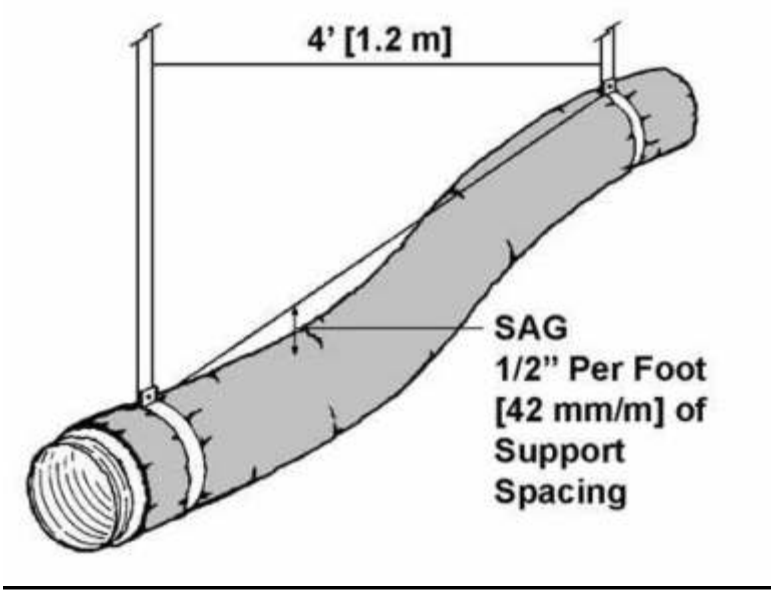


Fig. Sag in FRP Pipe

FRP vs GRP: Difference between FRP and GRP:

FRP stands for fiber-reinforced plastic while GRP stands for Glass reinforced plastic. So, from the name, it is clear that there is a change in the reinforcing fiber. But, both FRP and GRP are normally used to indicate the same plastic piping products.

FRP vs Steel: Differences between FRP and Steel:

- As FRP Pipes have superior corrosion resistance capabilities and over the long term it is economic, Steel pipes are replaced by FRP pipes. So, in this section, it will be great to find the differences between FRP and Steel.
- Steel pipes are isotropic while FRP pipes are anisotropic and the properties change with respect to direction.
- FRP pipes are more flexible than Steel pipes due to the lower modulus of elasticity.
- FRP piping systems are designed considering a higher factor of safety than steel piping. The usual factor of safety in the design of FRP pipes varies in the range of 5 to 10.

Major differences between FRP and Steel pipes are provided in Picture:

Property	FRP	CS	Remarks
Density	1850 kg/cu.m	7800 kg/cu.m	Loads on support are less in the case of FRP pipe as compared to Steel. Handling and transportation of FRP are easier than Steel pipes.
Co-efficient of thermal expansion	27 X 10^{-6} mm/mm °C	11 X 10^{-6} mm/mm °C	Expansion is almost 2.5 times of Carbon Steel Pipe. So more thermal growth in the case of the FRP Piping system.
	* This value may change from vendor to vendor		
Modulus	Axial= 12000 N/sq.mm	Elastic= 211365 N/sq.mm	Considerable difference in the strength of FRP & CS. Anchor loads are less in FRP Pipes as compared to steel pipes.
	Shear= 11400 N/sq.mm		
Tensile Strength	80-135 MPa	456 MPa	Mechanical Strength is higher for Steel material as compared to FRP.
Yield Strength	70-135 MPa	227 MPa	The yield strength of FRP is lesser than that of Steel.
Allowable Stress	4,000 PSI to 20,000 PSI	20,000 PSI	The strength of the GRE varies drastically and hence proper vendor data is a must.
Corrosion resistance	Superior	Inferior	The corrosion resistance of carbon steel is much lower than that of FRP pipes.
Joints	Threaded or glued	Welded	FRP joints are to be checked for higher axial loads and pressure

Fig. Major differences between FRP and Steel pipes

FRP vs HDPE: Differences between FRP and HDPE Pipes:

FRP Pipe	**HDPE pipe**
FRP is Orthotropic composite material	HDPE is isotropic material.
The cost of FRP pipe is very high	The cost of HDPE pipes is considerably lower than FRP Pipes.
Lower thermal expansion coefficient	The thermal expansion coefficients of HDPE pipes are extensively higher as compared to FRP pipes.
FRP pipes have a comparatively higher temperature range than HDPE Pipes	Lowe temperature range
Fabrication time is comparatively longer	Quicker fabrication.
The strength and Elastic modulus for FRP pipes are higher than HDPE	Lower strength and elastic modulus.
Easy installation at the site	Costly complex equipment is required for installation.
Highly skilled professionals are required for site work of FRP piping systems	HDPE pipe works can be done by semi-skilled operators.
Much lighter in weight due to lower all thickness even though the density of FRP is normally higher than HDPE	Heavier due to higher wall thickness.
A fire-retardant version of FRP pipes can be made.	HDPE pipes are highly flammable

Fig. Difference between FRP and HDPE pipe material

CHAPTER-5 THIKNESS CALCULATOR FOR METALLIC PIPE USING EXCEL SHEET

CHAPTER-5.1 INTRODUCTION

Metals are commonly used for the manufacturing of pipes due to their high strength, durability, and resistance to corrosion. However, the selection of the appropriate thickness for metallic pipes is crucial to ensure their safe and efficient operation. The thickness of the pipe must be carefully calculated to prevent failures such as leaks, ruptures, or buckling.

The calculation of metallic pipe thickness depends on several factors, including the pressure inside the pipe, the fluid or gas being transported, the temperature of the fluid or gas, and the material properties of the pipe. This calculation requires knowledge of basic engineering principles and formulae.

In this article, we will discuss the methods for calculating the thickness of metallic pipes, including the design codes and standards used for the calculation. We will also provide examples to illustrate the calculation process and explain the importance of selecting the appropriate thickness for metallic pipes in different applications.

The formula used for calculating the thickness of a metallic pipe is based on the ASME 31.1 formula, which is given by:

$$t = (P * d) / (2 * S * E * W + P*Y)$$

Where:

- t = Thickness of the pipe
- P = Design Pressure
- d = Outside diameter of the pipe
- S = Allowable stress of the material
- E = Quality factor
- W=Weld joint strength reduction factor
- Y= represents the coefficient that adjusts for the effect of longitudinal stress caused by temperature changes

The allowable stress and quality factor are dependent on the type of metal being used for the pipe. The allowable stress is the maximum stress that the material can handle without undergoing plastic deformation, and the quality factor takes into account the manufacturing process and other factors that affect the quality of the pipe.

The Barlow's formula assumes that the pipe is perfectly cylindrical and does not take into account any bends or other deviations in the pipe. Therefore, it is important to add a safety factor to the calculated thickness to account for any potential defects or variations in the pipe.

In summary, the thickness of a metallic pipe is calculated based on the design pressure, design temperature, and material properties of the metal. The Barlow's formula is commonly used for this calculation, which takes into account the outside diameter of the pipe, allowable stress, and quality factor. A safety factor is typically added to the calculated thickness to ensure that the pipe can withstand any potential defects or variations.

CHAPTER-5.2 PICTURE OF EXCEL SHEET

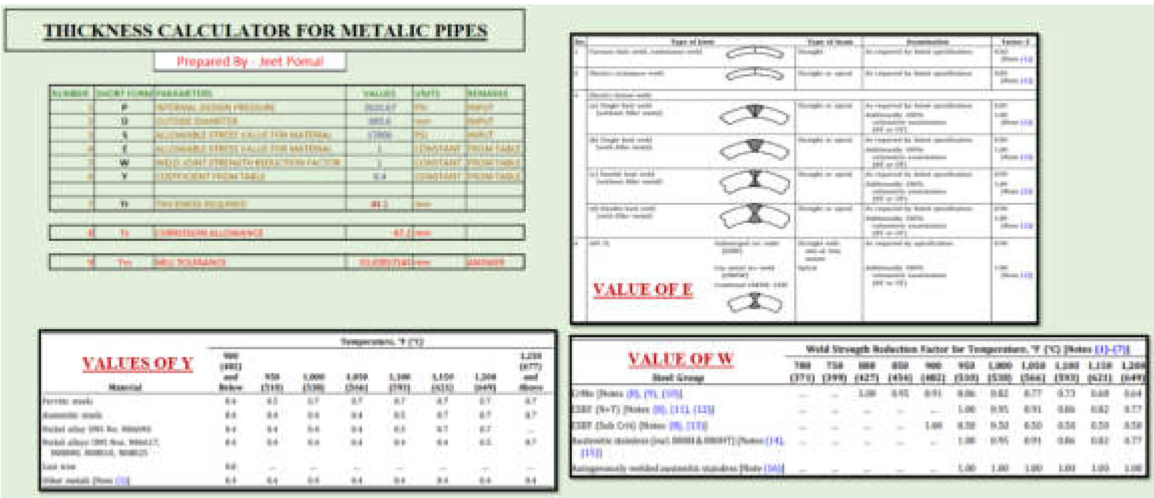


Fig 5.1 thickness Calculator for Metallic Pipes

CHAPTER-5.3 CALCULATION STEPS

THICKNESS CALCULATOR FOR METALIC PIPES

Prepared By - Jeet Pomal

NUMBER	SHORT FORM	PARAMETERS	VALUES	UNITS	REMARKS
1	P	INTERNAL DESIGN PRESSURE	2610.67	PSI	INPUT
2	D	OUTSIDE DIAMETER	609.6	mm	INPUT
3	S	ALLOWABLE STRESS VALUE FOR MATERIAL	17000	PSI	INPUT
4	E	ALLOWABLE STRESS VALUE FOR MATERIAL	1	CONSTANT	FROM TABLE
5	W	WELD JOINT STRENGTH REDUCTION FACTOR	1	CONSTANT	FROM TABLE
6	Y	COEFFICIENT FROM TABLE	0.4	CONSTANT	FROM TABLE
7	Tr	THICKNESS REQUIRED	44.1	mm	
8	Tc	CORROSION ALLOWANCE	47.1	mm	
9	Tm	MILL TOLERANCE	53.82857143	mm	ANSWER

Fig 5.2 Thickness Calculator for Metallic pipe in EXCEL

STEP-1: INPUT VALUES IN VALUES COLUMN

- P-Value of Pressure, in PSI
- D-Value of Outside Diameter, in mm
- S-Allowable Stress Value For Material, in PSI

STEP-2: INPUT VALUES OF CONSTANT IN VALUES COLUMN

VALUE OF W: From Figure

Steel Group	Weld Strength Reduction Factor for Temperature, °F (°C) [Notes (1)–(7)]										
	700 (371)	750 (399)	800 (427)	850 (454)	900 (482)	950 (510)	1,000 (538)	1,050 (566)	1,100 (593)	1,150 (621)	1,200 (649)
CrMo [Notes (8), (9), (10)]	...	...	1.00	0.95	0.91	0.86	0.82	0.77	0.73	0.68	0.64
CSEF (N+T) [Notes (8), (11), (12)]	...	...	...	...	...	1.00	0.95	0.91	0.86	0.82	0.77
CSEF (Sub Crit) [Notes (8), (13)]	...	...	...	...	1.00	0.50	0.50	0.50	0.50	0.50	0.50
Austenitic stainless (incl. 800H & 800HT) [Notes (14), (15)]	...	...	...	...	...	1.00	0.95	0.91	0.86	0.82	0.77
Autogenously welded austenitic stainless [Note (16)]	...	...	...	...	...	1.00	1.00	1.00	1.00	1.00	1.00

Fig 5. 3 Value of W

VALUE OF E: The efficiency factor is a dimensionless factor used to account for the strength reduction in the pipe due to the presence of the weld joint or other joining method. The value of "e" ranges from 0 to 1, where 1 represents a perfect joint with no strength reduction and 0 represents a completely ineffective joint.

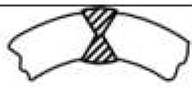
No.	Type of Joint		Type of Seam	Examination	Factor E
1	Furnace butt weld, continuous weld		Straight	As required by listed specification	0.60 [Note (1)]
2	Electric resistance weld		Straight or spiral	As required by listed specification	0.85 [Note (1)]
3	Electric fusion weld				
	(a) Single butt weld (without filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.85 1.00 [Note (2)]
	(b) Single butt weld (with filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.80 1.00 [Note (2)]
	(c) Double butt weld (without filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
	(d) Double butt weld (with filler metal)		Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
4	API 5L	Submerged arc weld (SAW) Gas metal arc weld (GMAW) Combined GMAW, SAW 	Straight with one or two seams Spiral	As required by specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]

Fig 5. 4 Value of E

VALUE OF Y: From Figure

Material	Temperature, °F (°C)							
	900 (482) and Below	950 (510)	1,000 (538)	1,050 (566)	1,100 (593)	1,150 (621)	1,200 (649)	1,250 (677) and Above
Ferritic steels	0.4	0.5	0.7	0.7	0.7	0.7	0.7	0.7
Austenitic steels	0.4	0.4	0.4	0.4	0.5	0.7	0.7	0.7
Nickel alloy UNS No. N06690	0.4	0.4	0.4	0.4	0.5	0.7	0.7	...
Nickel alloys UNS Nos. N06617, N08800, N08810, N08825	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.7
Cast iron	0.0	...	...	...	...	...	...	...
Other metals [Note (1)]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Fig 5.5 Value of Y

STEP-3 CORROSION AND MILL TOLERANCE ALLOWANCES:

Assuming we have a pipe made of a specific material and for a specific application, we can express the corrosion allowance as 3 mm and the mill allowance as 12.5% of the outside diameter.

CHAPTER-5.4 PURPOSE

A metallic thickness calculator is specifically designed to determine the required thickness of metallic materials, such as pipes and pressure vessels, to ensure that they can withstand the intended mechanical stress and pressure while in service. The main purpose of a metallic thickness calculator is to provide a reliable and accurate estimate of the required thickness for a given application.

CHAPTER-5.5 FEATURES

- Input fields for relevant parameters such as operating pressure, temperature, and material properties
- Calculation of the required thickness based on various industry-accepted codes and standards, such as ASME, API, and ASTM
- Option to factor in corrosion and other environmental conditions that may affect the material's lifespan
- Interactive user interface that allows for customization and the ability to save and compare results for different scenarios
- Some calculators may offer additional features such as unit conversions and material property databases

CHAPTER-5.6 BENEFITS

- Accurate determination of the required thickness for a given application, which ensures structural integrity and safe operation

- Compliance with industry-accepted codes and standards, which helps to ensure that the material meets minimum safety requirements
- Time-saving by reducing the need for manual calculations and error-prone estimates
- Cost-effective by reducing the risk of over-engineering and wasted material
- Increased confidence in the design and reliability of the final product
- Enhanced safety by ensuring that the material can withstand the intended mechanical stress and pressure, reducing the risk of accidents and failures
- Improved performance by ensuring that the material is optimized for the intended application, resulting in increased efficiency and reduced downtime

Overall, a metallic thickness calculator is an essential tool for engineers, designers, and other professionals involved in the design and construction of metallic structures that require reliable and accurate estimates of material thickness. It helps ensure that the final product is safe, reliable, and optimized for its intended application.

CHAPTER-6 THIKNESS CALCULATOR FOR F.R.P. PIPE USING EXCEL SHEET

CHAPTER-6.1 INTRODUCTION

FRP (Fibre Reinforced Plastic) thickness calculation is the process of determining the required thickness of a fibre-reinforced plastic composite material to ensure that it can withstand the intended mechanical stress and pressure while in service. FRP is a composite material that is made up of a plastic matrix and reinforcing fibres, such as glass or carbon fibres.

The use of FRP composites in various industrial applications has grown in popularity due to their high strength-to-weight ratio, corrosion resistance, and durability. However, determining the required thickness of an FRP composite can be challenging, as the material properties can vary depending on the manufacturing process and the orientation of the reinforcing fibres.

An FRP thickness calculator is a tool that can help engineers and designers determine the required thickness of an FRP composite material for a given application. The calculator takes into account factors such as the operating pressure, temperature, and mechanical stresses, as well as the material properties and manufacturing process, to provide an accurate estimate of the required thickness.

The use of an FRP thickness calculator can help ensure that the final product is optimized for its intended application, as it helps to ensure that the material is not over-engineered or under-designed. This can result in cost savings and improved performance, as well as increased confidence in the reliability and safety of the final product.

Overall, FRP thickness calculation is a critical step in the design and construction of FRP composite structures, and the use of an FRP thickness calculator can help ensure that the material is optimized for its intended application, resulting in a safe, reliable, and efficient final product.

$t = (PD) / (2S - P)$

Where:

- t = Required thickness of the FRP composite material (inches or millimetres)

- P = Design pressure (psi or MPa)
- D = Inside diameter of the vessel or pipe (inches or millimetres)
- S = Allowable stress of the FRP composite material (psi or MPa)

The formula assumes that the FRP composite material is operating in a cylindrical vessel or pipe with a constant inside diameter. The formula takes into account the hoop stress caused by the pressure and the allowable stress of the FRP composite material.

By inputting the relevant values into the formula, an FRP thickness calculator can provide an accurate estimate of the required thickness of the composite material for a given application.

It is important to note that the values of allowable stress and maximum allowable pressure for an FRP composite material may vary depending on factors such as the type of reinforcement fibres, resin matrix, and manufacturing process. These values should be obtained from the material supplier or determined through testing.

CHAPTER-6.2 PICTURE OF EXCEL SHEET

FRP Pipe Thickness Calculation

Prepared By: Jeet Pomal

Note Inputs entered in green box only

Total thickness calculator for Fiber Reinforced Plastic		
INSIDE PRESSURE	0.98	MPa(N/mm2)
INSIDE DIAMETER	23	mm
ALLOWABLE DESIGN STRESS	10	Mpa
Calculated thickness	1.2	mm
U.V. Strock Fire Resistance	0.3	mm
SiC Coationg thickness	2.5	mm
Total Thickness of FRP pipe	4	mm

NOTE: ALLOWABLE DESIGN STRESS VALUES		
UPTO 40 MM OF THICKNESS	10	MPA
MORETHAN 40 MM OF THICKNESS	29.71	MPA

INCH VALUE TO MILIMITER CALCULATOR		
ENTER VALUE IN INCHES	1	INCH
CALCULATED MILIMETER	25.4	MM

Inputs entered in green box only

Fig 6.1 F.R.P. Pipe Thickness Calculation In Excel Sheet

CHAPTER-6.3 CALCULATION STEPS

STEP-1: INPUT VALUES IN GREEN BOXES:

		Prepared By: Jeet Pomal
Note	Inputs entered in green box only	

Total thickness calculator for Fiber Reinforced Plastic		
INSIDE PRESSURE	0.98	MPa(N/mm2)
INSIDE DIAMETER	23	mm
ALLOWABLE DESIGN STRESS	10	Mpa
Calculated thickness	1.2	mm
U.V. Strock Fire Resistance	0.3	mm
SiC Coationg thickness	2.5	mm
Total Thickness of FRP pipe	4	mm

Fig 6.2 Thickness Calculator for F.R.P. pipe

P-Inside Pressure

I.D-Internal Diameter

S-Allowable Design Stress

STEP-2: CORROSION AND AVERAGE LINEAR THICKNESS ALLOWANCES:

In FRP pipes, corrosion and average linear thickness allowances are not typically applied in the same way as they are in metallic pipes. This is because FRP composite materials do not corrode in the same way as metals.

However, some allowances may still be made for the effects of environmental exposure on the performance of the FRP material. For example, if the pipe will be exposed to UV radiation from sunlight, a protective coating or layer may be added to prevent damage to the FRP material.

In terms of thickness allowances, the design of an FRP pipe will typically take into account factors such as the required strength and stiffness, the intended operating pressure and temperature, and the material properties of the composite material being used. The thickness of the pipe will be designed to ensure that it can withstand the stresses and strains it will experience during normal operation.

Some design standards and codes, such as ASTM D2996 and ASME B31.3, provide guidance on the design and manufacturing of FRP pipes. These standards may include recommendations for minimum wall thicknesses, fibre orientation, and other design parameters.

In general, the design of an FRP pipe will involve a thorough analysis of the expected operating conditions and the properties of the composite material being used, in order to ensure that the pipe will perform reliably and safely over its intended lifespan.

Note: In F.R.P. Pipes Generally in L&T corrosion allowances taken as **0.3mm** and linear thickness is also added **2.5mm** in calculated thickness by Formula.

CHAPTER-6.4 PURPOSE

- The main purpose of an FRP pipe thickness calculator is to help engineers and designers determine the required thickness of an FRP pipe for a given application. This is done by taking into account various design factors and parameters.

CHAPTER-6.5 FEATURES

Some of the key features of an FRP pipe thickness calculator may include:

- **Customizable input fields:** The calculator may allow users to input various design parameters such as operating pressure and temperature, pipe diameter, material properties, and environmental factors.

- **Automatic calculations:** Once the required inputs are entered, the calculator can automatically calculate the required pipe thickness based on the applicable design codes and standards.
- **User-friendly interface:** The calculator may have a user-friendly interface that is easy to navigate and use, making it accessible to a wide range of users.

CHAPTER-6.6 BENEFITS

Some of the key benefits of an FRP pipe thickness calculator include:

- **Time-saving:** Using a calculator can save engineers and designers time by eliminating the need for manual calculations.
- **Accuracy:** By using a well-designed calculator that takes into account the relevant design factors, engineers can obtain accurate estimates of the required thickness for an FRP pipe.
- **Cost-effective:** Designing an FRP pipe with the correct thickness can help prevent over-design and reduce material costs.
- **Compliance with design codes and standards:** Using an FRP pipe thickness calculator can help ensure that the designed pipe meets the relevant design codes and standards, which can help ensure its safe and reliable operation.

CHAPTER-7 REINFORCEMENT PAD CALCULATION FOR BRANCH CONNECTION ACCORDING ASME-31.3

CHAPTER-7.1 INTRODUCTION

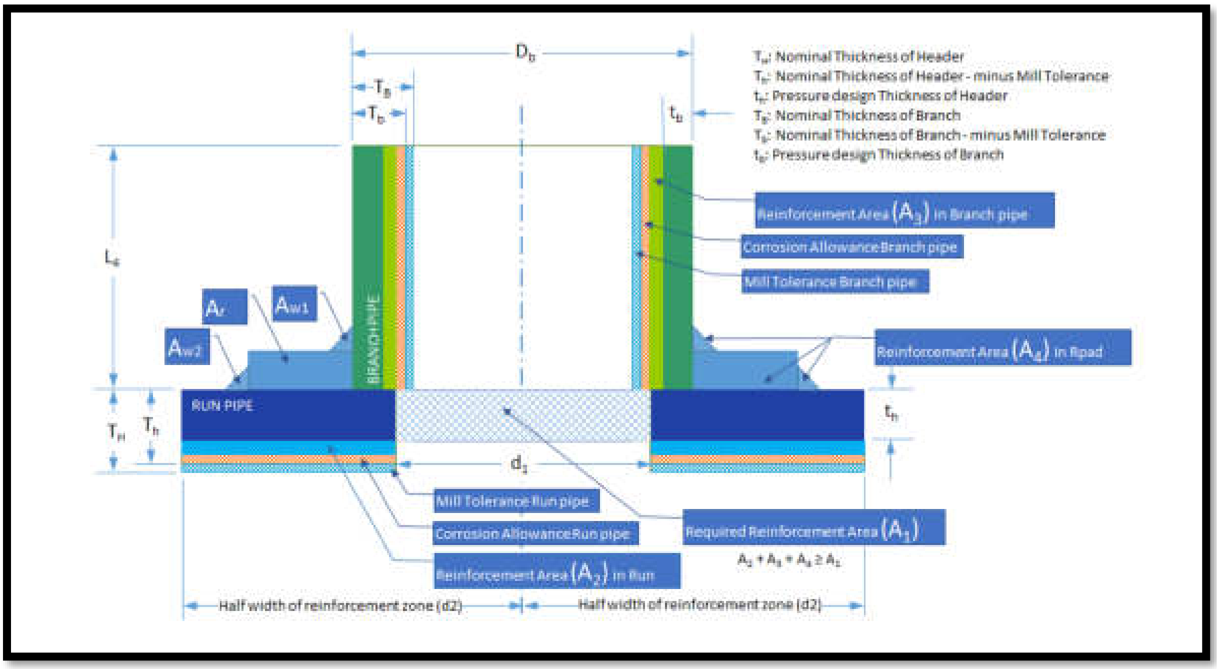


Fig 7.1 Diagram of Reinforcement pad nomenclature

Reinforcement pad calculation is an important aspect in designing branch connections according to ASME B31.3, which is a code for pressure piping systems. The purpose of a reinforcement pad is to strengthen the connection between a branch and a main pipe by redistributing the stress concentration caused by the branch connection.

To calculate the required size of a reinforcement pad, several factors must be considered, including the size and schedule of the main pipe, the size and schedule of the branch pipe, the branch angle, and the material properties of both pipes. The calculations must also take into account the maximum allowable stress and the design factor specified by the code.

ASME B31.3 provides detailed equations and procedures for calculating the required thickness of a reinforcement pad based on these factors. The equations take into account the bending stress and shear stress induced by the branch connection, as well as the pressure load on the main pipe.

It's important to note that these calculations should only be performed by qualified engineers or professionals who have a thorough understanding of the code and its requirements.

A_1 = Area removed from the header or run pipe
A_2 = Extra thickness available in the header pipe
A_3 = Extra thickness available in the branch pipe
A_4 = Area of RF Pad & area of welding

L_4 = Height of the reinforcement zone
β = Angle between axes of the branch and header or run pipe

d_1 = Effective length removed from the run or header pipe
d_2 = Half-width of the reinforcement zone
D_b = Outside diameter of branch pipe
D_h = Outside diameter of run or header pipe

$\bar{T}_h = \bar{T}_b$ = Nominal pipe thickness or ordering thickness of run and branch pipe

Fig 7.2 Nominal Pipe Thickness of Run and Branch pipe

T_h = T_b = Thickness after deducting mill tolerance from nominal pipe thickness or ordering thickness of run and branch pipe respectively

t_h = t_b = Calculated pipe thickness as per the equation of **para. 304.1 of ASME B31.3** for run and branch respectively.

C = Corrosion allowance
T_r = Minimum thickness of reinforcement pad

CHAPTER-7.2 LIST OF FORMULA

$$A_1 = t_h d_1 (2 - \sin \beta)$$

Where,

$$d_1 = [D_b - 2(T_b - c)] / \sin \beta$$

Fig 7.3 Formula for find A1 and d1

$$A_2 = (2d_2 - d_1)(T_h - t_h - c)$$

Fig 7.4 Formula for Find A2

Where,

$$d_2 = \max[d_1, (T_b - c) + (T_h - c) + d_1/2]$$

$$A_3 = 2L_4 (T_b - t_b - c) / \sin \beta$$

Fig 7. 5 Formula For d2 and A3

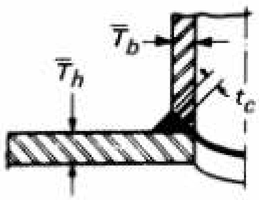
Where,

$$L_4 = \min[2.5(T_h - c),\ 2.5(T_b - c) + Tr]$$

$A_4 = 2t_c^2$ **(Considering without RF Pad)**

Where,

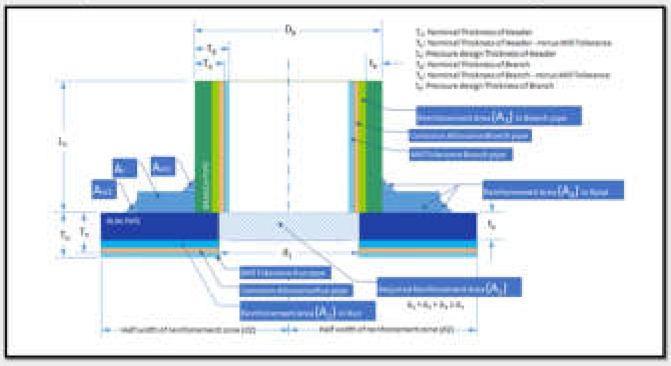
$t_c = \mathrm{Min}[0.7\ \bar{T}_b ; 6\ \mathrm{mm}]$ **(as per para 325.5.4)**



CHAPTER-7.3 PICTURE OF EXCEL SHEET

Reinforcement Pad Calculation for Branch Connection According ASME-31.3

Prepared By - Jeet Pomal

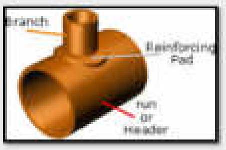


NUMBER	SHORT FORM	PARAMETERS	VALUES	UNIT	REMARKS
1	Th	Nominal thickness of Header pipe	[illegible]	mm	INPUT
2	Tb	Nominal thickness of Branch pipe	[illegible]	mm	INPUT
3	Th	Thickness after reducing mill tolerance from nominal thickness of Header pipe	15.7	mm	
4	Tb	Thickness after reducing mill tolerance from nominal thickness of Branch pipe	[illegible]	mm	
5	th	Calculated pipe thickness of Head	11.85	mm	AS SHEET 4 VALUE
6	tb	Calculated pipe thickness of branch	7.06	mm	AS SHEET 4 VALUE
7	β	Angle between axes of the branch and header or run pipe	45	deg	INPUT
8	C	Corrosion allowance for both header and run pipe	3	mm	CONSTANT
9	Tr	Minimum thickness of reinforcement pad	0	mm	VARIABLE
10	Db	Outside diameter of branch pipe	[illegible]	mm	INPUT
11	Dh	Outside diameter of run or header pipe	[illegible]	mm	INPUT
12	d1	Effective length removed from the run or header pipe	326.7394	mm	
13	d2	Half-width of the reinforcement zone	326.7394	mm	
14	L4	Height of the reinforcement zone	[illegible]	mm	
15	tr	Available thickness of reinforcement pad	0	mm	

1	A1	Area removed from the header or run pipe	4997.456	mm^2	[illegible]	mm
2	A2	Extra thickness available in the header pipe	[illegible]	mm^2	[illegible]	mm
3	A3	Extra thickness available in the branch pipe	228.826	mm^2		
4	A4	Area of RF Pad & area of welding	[illegible]	mm^2		

Part-1 of Excel sheet of R-Pad equation

Now, we can see A1>A2+A3+A4
Therefore, it is clear that we need to provide an RF pad to strengthen the joint.



1	Dr	So, Let's consider RF Pad is taken from the header with the outer diame	711.2	mm
2	Tr=Th	thickness (Tr) = Th	15.7	mm

L4	Height of the reinforcement zone	31.75	mm		
A3	Extra thickness available in the branch pipe	199.63	mm^2	2920.068566	mm^2
A4	Area of RF Pad & area of welding	2436.2	mm^2		
A2	Extra thickness available in the header pipe	284.26	mm^2		

A1	Area removed from the header or run pipe	4997.5	mm^2	4997.45576	mm^2

We can see from the above calculation A1<A2+A3+A4
The above result ensures that a reinforcement pad can be made from the header or run pipe for our case.

Fig. Part-2 of Excel sheet of R-Pad equation

CHAPTER-7.4 CALCULATION STEPS

Step-1 Input Parameters:

NUMBER	SHORT FOR	PARAMETERS	VALUE	UNIT	REMARKS
1	$\bar{T}h$	Nominal thickness of Header pipe	16	mm	INPUT
2	$\bar{T}b$	Nominal thickness of Branch pipe	15.09	mm	INPUT
3	Th	Thickness after reducing mill tolerance from nominal thickness of Head	15.7	mm	
4	Tb	Thickness after reducing mill tolerance from nominal thickness of Branc	13.204	mm	
5	th	Calculated pipe thickness of Head	11.83	mm	AS SHEET 4 VALUE
6	tb	Calculated pipe thickness of branch	7.06	mm	AS SHEET 4 VALUE
7	β	Angle between axes of the branch and header or run pipe	45	deg.	INPUT
8	C	Corrosion allowance for both header and run pipe	3	mm	CONSTANT
9	Tr	Minimum thickness of reinforcement-pad	2	mm	VARIABLE
10	Db	Outside diameter of branch pipe	355.6	mm	INPUT
11	Dh	Outside diameter of run or header pipe	508	mm	INPUT
12	d1	Effective length removed from the run or header pipe	326.74	mm	
13	d2	Half-width of the reinforcement zone	326.74	mm	
14	L4	Height of the reinforcement zone	27.509	mm	
15	tc	Available thickness of reinforcement pad	6	mm	

1	A1	Area removed from the header or run pipe	4997.5	mm^2	4997.45576	mm
2	A2	Extra thickness available in the header pipe	284.26	mm^2	600.873035	mm
3	A3	Extra thickness available in the branch pipe	244.61	mm^2		
4	A4	Area of RF Pad & area of welding	72	mm^2		

Fig. Calculation of R-Pad Equation In Excel Sheet

- Material of Construction of Header Pipe and Branch Pipe.
- Nominal Pipe Size of Header and Branch.
- Standard Pipe Thickness e.g. STD, S40 etc. of Header and Branch.
- Corrosion allowance for header and branch pipe.
- Negative mill tolerance for Header and Branch Pipe.
- Type of Pipe Construction: Seamless, ERW or FBW for both Header and Branch.
- Design Pressure.
- Design Temperature.
- Branch Angle. Maximum angle is 90 Degree. Provide smaller angle.

Step-2 Working of Excel Sheet**:**

Specify minimum R-pad thickness. Start with 0 to check if reinforcement is required. If available reinforcement area $A_2+A_3+A_4$ is less than required reinforcement area, increase size of minimum R-pad thickness gradually. Near exact size can be guessed by trial and error method when available area becomes slightly more than required area.

Then specify actual available plate/pipe thickness just more than minimum required R-pad thickness, to get width of Reinforcement Pad for the branch.

Step-3 Calculation Done In Excel Sheet:

- t : Based on header and branch pipe inputs, pressure design thickness of header and branch pipes is calculated as per ASME B31.3 Section 304.1.1 For more details, see Pipe Thickness Calculation as per ASME B31.3 (‘t_h‘ for header and ‘t_b‘ for branch).
- For explanation of all dimensions in Branch Reinforcement zone, see Figure 304.3.3 from ASME B31.3.
- d_1 = effective length removed from pipe at branch. For branch intersections where the branch opening is a projection of the branch pipe inside diameter (e.g., pipe-to-pipe fabricated
branch), $d_1 = [D_b – 2(T_b – c)]/\sin ß$
- d_2 = “half width” of reinforcement zone = d_1 or $(T_b – c) + (T_h – c) + d_1/2$, whichever is greater, but in any case not more than Dh.
- L_4 = height of reinforcement zone outside of run = $2.5(T_h – c)$ or $2.5(T_b – c) + T_r$ whichever is less.
- T_b = branch pipe thickness (measured or minimum per purchase specification) which excludes mill tolerance.
- T_h = Header pipe thickness (measured or minimum per purchase specification) which excludes mill tolerance.
- T_r = minimum thickness of reinforcing ring or saddle made from pipe. (Use nominal thickness if made from plate.). = O, if there is no reinforcing ring or saddle.
- ß = smaller angle between axes of branch and run.
- A_1: Required Reinforcement Area for branch under internal pressure :

$A_1 = t_h$ X d_1 (2-Sin ß).

- Actual available area is calculated as sum of three parts A_2, A_3 and A_4. It must be more than required reinforcement area A_1. i.e. $A_2+A_3+A_4 >= A_1$.
- Area A_2 is the area resulting from excess thickness in the run pipe wall :

  $A_2 = (2d_2 – d\ 1\ ) (T_h – t_h – C\ )$.

- Area A_3 is the area resulting from excess thickness in the branch pipe wall:

  $A_3 = 2L_4(T_b\text{-}t_b\text{-}c)/\sin ß$.

- Area A_4 : Area A_4 is the area of other metal provided by welds and properly attached reinforcement.

CHAPTER-7.5 PURPOSE

The purpose of performing a reinforcement pad calculation for branch connection according to ASME-31.3 is to ensure the safety and integrity of the piping system. The calculation is used to determine the required size and thickness of the reinforcement pad that is welded to the pipe to support the branch connection.

CHAPTER-7.6 FEATURES

The key features of the reinforcement pad calculation include the determination of the allowable stresses, the analysis of the applied loads, and the calculation of the required pad thickness based on the selected design criteria.

CHAPTER-7.7 BENEFITS

- **Increased safety:** By ensuring that the reinforcement pad is appropriately sized and thick enough to handle the loads applied, the piping system's safety and integrity are improved.
- **Compliance with industry standards:** By following the ASME-31.3 standards, companies can demonstrate that their piping systems meet industry requirements, which can help them avoid legal and financial consequences.
- **Cost savings:** By accurately determining the required pad thickness and avoiding over-design, companies can save money on materials and fabrication costs.

- **Improved performance:** Properly designed and installed reinforcement pads can improve the performance of the branch connection, reducing the risk of leaks and other failures.

CHAPTER-8 PRESSURE DROP CALCULATION IN PIPE LINES

CHAPTER-8.1 INTRODUCTION

The pressure drop equation is used to determine the pressure drop or pressure loss that occurs in a fluid system as the fluid flows through it. This equation is important for understanding how fluid flows through pipes, valves, fittings, and other components of a fluid system.

The pressure drop in a fluid system can be caused by various factors such as friction, turbulence, and changes in direction or elevation. The pressure drop equation takes into account the fluid properties, such as viscosity and density, as well as the geometry of the system, such as the length and diameter of the pipes, and the flow rate of the fluid.

There are several different equations that can be used to calculate pressure drop, depending on the specific conditions of the fluid system. Some of the commonly used equations include the Darcy-Weisbach equation, the Hazen-Williams equation, and the Poiseuille's law.

Understanding the pressure drop equation is important for engineers and designers working with fluid systems, as it can help them optimize the design of the system and select the appropriate components to achieve the desired flow rate and pressure.

CHAPTER-8.2 PICTURE OF EXCEL SHEET

Pressure Drop Calculation In pipe lines

Preapared By - Jeet Pomal

Input Parameters

NO	Short form	Parameters	Values	UNIT	Remark
1	d	Pipe internal diameter:	60.32	mm	input
2	l	Pipe length	800	m	input
3	v	Fluid velocity	100	m/s	input
4	p	Fluid density	844	Kg/m^3	input
5	µ	Fluid viscosity	0.001	pa.s	input
6	r	Pipe roughness	1	mm	input
7	Q	volume flow	10	lit/sec	
8	C	Hazen-Williams coefficient	140	constant	from sheet 2
9	H1	Starting elevation height	2	m	input
10	H2	Ending elevation height	5	m	input
11	P1	starting pressure	500	pa	input
		Reynolds number(Re)=	6032000		

CASE-1	IF, Re<2320 Then fluid flow is laminar
CASE-2	IF, Re>2320 Then fluid flow is

FOR TURBULANT FLOW

NO	Short form	Parameters	Values	UNIT	Remark
1	F.F.1	FRICTION FACTOR head loss in mm of water per 100 m of pipe (mm H20 per 100 m pipe)	19719.355	mm H20 per 100 m pipe	
2	F.F.2	head loss in kPa per 100 m of pipe (kPa per 100 m pipe)	193.447	kPa per 100 m pipe	
3	H.L.1	Head loss (mm H2O)	157754.838	mm	
4	H.L.2	Head loss(kPa)	1547.575	kpa	
5	n1	Number Of Elbows in Pipe line	2		INPUT FROM
6	k1	value of k for Elbow	0.75		INPUT FROM
7	n2	Number Of Tee in Pipe line	2		INPUT FROM
8	k2	value of k for Tee	0.4		INPUT FROM
9	k	value of k fittings	2.3	constant	from sheet 3
10	▲Pf	Pressure loss due to extra elements (fittings)	1.173469388	pa	
11	▲Pe	Pressure drop due to elevation	-24.83892	pa	
	▲P(exit)	total pressure loss at end	-1073.587	pa	

Fig 8. 1 Pressure Drop Equation in Excel Sheet

CHAPTER-8.3 CALCULATION STEPS

Pressure Drop Calculation In pipe lines

Prepared By - Jeet Pomal

Input Parameters					
NO	Short form	Parameters	Values	UNIT	Remark
1	d	Pipe internal diameter:	60.32	mm	input
2	l	Pipe length	800	m	input
3	v	Fluid velocity	100	m/s	input
4	p	Fluid density	844	Kg/m^3	input
5	μ	Fluid viscosity	0.001	pa.s	input
6	r	Pipe roughness	1	mm	input
7	Q	volume flow	10	lit/sec	
8	C	Hazen-Williams coefficient	140	constant	from sheet 2
9	H1	Starting elevation height	2	m	input
10	H2	Ending elevation height	5	m	input
11	P1	starting pressure	500	pa	input
		Reynolds number(Re)=	6032000		

CASE-1	IF, Re<2320 Then fluid flow is laminar
CASE-2	IF, Re>2320 Then fluid flow is turbulant

Fig 8.2 pressure drop calculation in pipe line

STEP-1 CALCULATION OF EQUATION OF PRESSURE DROP

The Hazen-Williams equation is a commonly used empirical equation to calculate the pressure drop or head loss in a pipeline system due to fluid friction. It is applicable to steady, fully developed, incompressible, and turbulent flow of water and other similar fluids.

The equation relates the pressure drop (ΔP) in a pipeline to the flow rate (Q), pipe diameter (D), pipe length (L), and a coefficient (C) that depends on the roughness of the pipe surface.

The Hazen-Williams equation is as follows:

$\Delta P = 1.852 \times (C \times Q^{1.85} / D^{4.87}) \times L$

where:

- ΔP is the pressure drop or head loss in the pipeline (in pounds per square inch, PSI)

- C is the Hazen-Williams coefficient (dimensionless)

Material	Hazen-Williams Coefficient - c -
ABS - Acrylonite Butadiene Styrene	130
Aluminum	130 - 150
Asbestos Cement	140
Asphalt Lining	130 - 140
Brass	130 - 140
Brick sewer	90 - 100
Cast-Iron - new unlined (CIP)	130
Cast-Iron 10 years old	107 - 113
Cast-Iron 20 years old	89 - 100
Cast-Iron, asphalt coated	100
Cast-Iron, cement lined	140
Cast-Iron, bituminous lined	140
Cast-Iron, sea-coated	120
Cast-Iron, wrought plain	100
Cement lining	130 - 140
Concrete	100 - 140
Concrete lined, steel forms	140
Concrete lined, wooden forms	120
Concrete, old	100 - 110
Copper	130 - 140
Corrugated Metal	60
Ductile Iron Pipe (DIP)	140
Ductile Iron, cement lined	120
Fiber	140
Fiber Glass Pipe - FRP	150
Galvanized iron	120
Glass	130
Lead	130 - 140
Metal Pipes - Very to extremely smooth	130 - 140
Plastic	130 - 150
Polyethylene, PE, PEH	140
Polyvinyl chloride, PVC, CPVC	150
Smooth Pipes	140
Steel new unlined	140 - 150
Steel, corrugated	60
Steel, welded and seamless	100
Steel, interior riveted, no projecting rivets	110
Steel, projecting girth and horizontal rivets	100
Steel, vitrified, spiral-riveted	90 - 110
Steel, welded and seamless	100

Fig 8.3 Value of C is the Hazen-Williams coefficient

- Q is the flow rate (in gallons per minute, GPM)
- D is the pipe diameter (in inches)
- L is the pipe length (in feet)

The Hazen-Williams coefficient (C) takes into account the roughness of the pipe surface and is typically determined experimentally based on the material and condition of the pipe.

The higher the value of C, the smoother the pipe surface, and the lower the friction loss in the pipeline.

The Hazen-Williams equation is useful for designing water distribution systems and other similar applications where the fluid properties are well-known and the flow is turbulent. However, it may not be accurate for other types of fluids or for pipes with non-uniform conditions or geometries. In those cases, other equations such as the Darcy-Weisbach equation or the Poiseuille's law may be more appropriate.

Step-2 Pressure Loss Due To elevation and fittings in pipe lines:

Calculating turbulent flow and K factor loss in fittings involves using equations that take

FOR TURBULANT FLOW					
NO	Short form	Parameters	Values	UNIT	Remark
1	F.F.1	FRICTION FACTOR head loss in mm of water per 100 m of pipe (mm H20 per 100 m pipe)	19719.355	mm H20 per 100 m pipe	
2	F.F.2	head loss in kPa per 100 m of pipe (kPa per 100 m pipe)	193.447	kPa per 100 m pipe	
3	H.L.1	Head loss (mm H2O)	157754.838	mm	
4	H.L.2	Head loss(kPa)	1547.575	kpa	
5	n1	Number Of Elbows in Pipe line	2		INPUT FROM SHEET 3
6	k1	value of k for Elbow	0.75		INPUT FROM SHEET 3
7	n2	Number Of Tee in Pipe line	2		INPUT FROM SHEET 3
8	k2	value of k for Tee	0.4		INPUT FROM SHEET 3
9	k	value of k fittings	2.3	constant	from sheet 3
10	▲Pf	Pressure loss due to extra elements (fittings)	1.173469388	pa	
11	▲Pe	Pressure drop due to elevation	-24.83892	pa	
	▲P(exit)	total pressure loss at end	-1073.587	pa	

Fig 8.4 Pressure Loss Due To elevation and fittings in pipe lines

into account various factors, such as the Reynolds number, the geometry of the fitting, and the roughness of the pipe. Here is a brief overview of the calculations involved:

1. Determine the Reynolds number: This number represents the ratio of inertial forces to viscous forces in the fluid flow and is a key parameter in determining whether the flow is laminar or turbulent. The Reynolds number is given by:
2. $Re = (\rho VD)/\mu$

3. Where ρ is the fluid density, V is the velocity, D is the diameter of the pipe or fitting, and μ is the dynamic viscosity of the fluid.

4. Determine the friction factor: The friction factor is a dimensionless quantity that accounts for the energy loss due to friction in the fluid flow. The friction factor can be calculated using various empirical equations, such as the Colebrook-White equation:

5. $1/\sqrt{f} = -2.0 \log(\varepsilon/D/3.7 + 2.51/Re \sqrt{f})$
   where ε is the roughness of the pipe, which affects the friction factor, and f is the friction factor.

6. Calculate the K factor: The K factor is a measure of the energy loss due to flow through a fitting, relative to the energy loss in an equivalent length of straight pipe. The K factor can be calculated using empirical equations, such as the Crane equation:

Fitting	Types	K
45° Elbow	Standard (R/D = 1)	0.35
	Long Radius (R/D = 1.5)	0.2
90° Elbow Curved	Standard (R/D = 1)	0.75
	Long Radius (R/D = 1.5)	0.45
90° Elbow Square or Mitred		1.3
180° Bend	Close Return	1.5
Tee, Run Through	Branch Blanked	0.4
Tee, as Elbow	Entering in run	1
Tee, as Elbow	Entering in branch	1
Tee, Branching Flow		1
Coupling		0.04
Union		0.04
Gate valve	Fully Open	0.17
	3/4 Open	0.9
	1/2 Open	4.5
	1/4 Open	24

   $K = fL/D$

Fig 8.5 K Factor Calculator

   where L is the length of the fitting and D is its diameter.

7. Calculate the pressure drop: The pressure drop across the fitting can be calculated using the K factor and the velocity head, which is given by:

8. $P = K\rho(V^2/2)$

Where P is the pressure drop.

These equations provide a general framework for calculating turbulent flow and K factor loss in fittings, but the specific calculations may vary depending on the particular fitting and the fluid being used. It is important to consult appropriate references and guidelines for accurate calculations.

Pressure loss due to elevation is often referred to as "head loss" and is a result of the gravitational potential energy of a fluid being converted to kinetic energy as it flows through a pipe or conduit. The pressure loss due to elevation can be calculated using the following equation:

$$\Delta P = \rho g h$$

Where ΔP is the pressure loss, ρ is the fluid density, g is the acceleration due to gravity, and h is the change in elevation between two points in the system.

The equation above assumes that the flow is steady and incompressible, and that there is no significant friction or other losses in the system.

It is also important to note that the equation above only applies to situations where the change in elevation is significant relative to the diameter of the pipe or conduit. In situations where the change in elevation is relatively small, such as in a horizontal pipe, the pressure loss due to elevation may be negligible compared to other sources of pressure loss.

CHAPTER-8.4 PURPOSE

The main purpose of a pressure drop equation is to calculate the amount of pressure loss that occurs in a fluid system due to frictional losses or other factors. This information is important for determining the efficiency of the system and ensuring that the desired flow rate is achieved.

CHAPTER-8.5 FEATURES

Some of the key features of a pressure drop equation may include:

- **Customizable input fields:** The equation may allow users to input various design parameters such as pipe diameter, fluid properties, and flow rate.

- **Automatic calculations:** Once the required inputs are entered, the equation can automatically calculate the pressure drop based on the applicable equations and models.
- **User-friendly interface:** The equation may have a user-friendly interface that is easy to navigate and use, making it accessible to a wide range of users.

CHAPTER-8.6 BENEFITS

- Some of the key benefits of a pressure drop equation include:
- **Accuracy:** A well-designed pressure drop equation can provide accurate estimates of the amount of pressure drop that will occur in a fluid system under a given set of conditions.
- **Versatility:** Pressure drop equations can be used for a wide range of applications, from simple pipe systems to more complex fluid flow systems in chemical plants, refineries, and other industrial settings.
- **Efficiency:** By accurately predicting pressure drop, engineers can design more efficient systems that require less energy to operate.
- **Cost-effectiveness:** By designing more efficient systems, operating costs can be reduced, leading to cost savings over time.
- **Compliance with design codes and standards:** Using a pressure drop equation can help ensure that the designed system meets the relevant design codes and standards, which can help ensure its safe and reliable operation.

CHAPTER-9 ALLOWABLE UNSUPPORTED SPAN CALCULATOR

CHAPTER-9.1 INTRODUCTION

An allowable unsupported span calculator is a tool used to determine the maximum unsupported span of a structural member, such as a beam or joist that can safely support a given load. This calculator takes into account various factors such as the material properties of the member, the load to be supported, and the desired safety factor.

The allowable unsupported span is an important parameter to consider when designing a structure, as it helps to ensure the safety and stability of the overall system. If a structural member is too long or not strong enough to support the load it is intended to carry, it can lead to failure or collapse, which can be catastrophic.

By using an allowable unsupported span calculator, engineers and designers can quickly and easily determine the maximum span for a given member, which can then be used in the overall design of the structure. This can help to ensure that the structure is safe, reliable, and efficient, while also minimizing material and construction costs.

Overall, the allowable unsupported span calculator is an important tool for anyone involved in the design or construction of structures, from architects and engineers to contractors and builders. By ensuring that structural members are properly sized and designed, it can help to ensure the safety and reliability of the entire structure, while also minimizing the risk of failure or collapse.

CHAPTER-9.2 PICTURE OF EXCEL SHEET

Allowable Unsupported Pipe Length Calculator

Prepared By - Jeet Pomal

Inputs entered in green box only

Total thickness calculator for Fiber Reinforced Plastic		
INSIDE PRESSURE	0.98	MPa(N/mm2)
INSIDE DIAMETER	25	mm
ALLOWABLE DESIGN STRESS	10	Mpa
Calculated thickness	1.3	mm
U.V. Strock Fire Resistance	0.3	mm
SiC Coationg thickness	2.5	mm
Total Thickness of FRP pipe	4.1	mm
Additional Thickness	0.9	mm
Total Thickness	5	mm
Outer Diameter	35	mm
Inertia Of Pipe	5.451E-08	m^4
Weight Of Pipe Per Meter	8.322	N
Weight Of Liquid Per Meter	5.923	N
Total Weight Of Pipe	14.245	N/m
Allowable Bending Modulus Of Maximum Temperature	8.9	Gpa
Deflection Of Pipe	12.5	mm
Allowable Unsupporated Length	2.3922	M

NOTE: ALLOWABLE DESIGN STRESS VALUES		
UPTO 40 MM OF THICKNESS	10	MPA
MORETHAN 40 MM OF THICKNESS	29.7	MPA

INCH VALUE TO MILIMITER CALCULATOR		
ENTER VALUE IN INCHES	1	INCH
CALCULATED MILIMETER	25.4	MM

Fig 9. 1 Unsupported Span Calculator In Excel Sheet

CHAPTER-9.3 CALCULATION STEPS

Step-1 Input Parameters:

Allowable Unsupported Span Calculator		
Inertia Of Pipe	5.451E-08	m^4
Weight Of Pipe Per Meter	8.322	N/m
Weight Of Liquid Per Meter	5.9237	N/m
Total Weight Of Pipe And Liquid	14.2457	N/m
Axial Bending Modulus At Maximum Tempı	8.9	Gpa
Deflection Of Pipe	12.5	mm
Allowable Unsupportd Length	2.3921319	m

Fig 9.2 Allowable unsupported Calculator

CHAPTER-9.4 FORMULA OF ALLOWABLE UNSUPPORTED LENGTH

Ls = ((dmXEbXIX109)/(13XW))0.25

- D=PIPE OUTSIDE DIAMETER(mm)
- d=PIPE INSIDE DIAMETER (mm)
- dm=DEFLECTION(mm)
- AXIAL BENDING MODULUS AT MAXIMUM TEMP.: Eb = 8.9 Gpa
- I = (π/64)X(OD4 -ID4)X10-12 (m 4)
- TOTAL WEIGHT OF PIPE, W = 14.24601456 N/m
- W = PIPE WEIGHT + LIQUID WEIGHT
- PIPE WEIGHT PER M = 8.3222154 N
- LIQUID WEIGHT PER M = 5.923799156 N

CHAPTER-9.5 PURPOSE

The purpose of an Allowable Unsupported Span Calculator is to help engineers and builders determine the maximum unsupported span for a given beam or structural member based on its properties and the expected loading conditions. This is important because a beam that is too long or not strong enough to support the loads placed upon it can fail or deflect excessively, compromising the safety and stability of the structure.

CHAPTER-9.6 FEATURES

An Allowable Unsupported Span Calculator typically includes input fields for the properties of the beam or structural member, such as its length, width, height, material type, and modulus of elasticity. It also includes input fields for the expected loading conditions, such as the magnitude and distribution of the load, the type of load (e.g., uniform, point, or distributed), and any other relevant factors that may affect the member's ability to support the load. The calculator then uses established engineering principles and equations to calculate the maximum unsupported span that the member can safely withstand.

CHAPTER-9.7 BENEFITS

The benefits of using an Allowable Unsupported Span Calculator include:

- **Improved safety:** By ensuring that beams and other structural members are properly sized and supported, the calculator helps to prevent structural failures that could lead to injury or loss of life.
- **Reduced material costs:** By accurately calculating the maximum unsupported span, the calculator can help to avoid overbuilding and the unnecessary use of materials, resulting in cost savings.
- **Time savings:** Using an Allowable Unsupported Span Calculator can save time compared to manually calculating the maximum unsupported span, especially for complex or non-standard beam configurations.

Overall, an Allowable Unsupported Span Calculator is a valuable tool for anyone involved in the design and construction of buildings and other structures, as it helps to ensure that members are properly sized and supported, resulting in a safe and efficient structure.

CHAPTER-10 RECTANGULAR WEIR CALCULATION

CHAPTER-10.1 INTRODUCTION

A rectangular weir is a type of hydraulic structure commonly used in open-channel flow applications, such as in rivers, canals, and wastewater treatment plants. It consists of a rectangular notch or opening in a wall or barrier that is placed across the channel or conduit. The height of the weir, also known as the "crest height," is adjustable and can be used to control the flow rate of water passing through the channel.

When water flows over a rectangular weir, it creates a sharp, well-defined crest or edge at the top of the notch. The height of the water above the crest is known as the "head," and is directly proportional to the flow rate through the weir. By measuring the head with respect to the crest height, the flow rate can be determined using established equations.

Rectangular weirs are often used in combination with flow measurement devices, such as flumes or flow meters, to accurately measure and control the flow rate of water in open channels. They are relatively simple and inexpensive to construct and maintain, making them a popular choice in many applications. However, their accuracy can be affected by variations in the flow profile and channel geometry, and care must be taken to ensure proper installation and calibration.

CHAPTER-10.2 PICTURE OF EXCEL SHEET

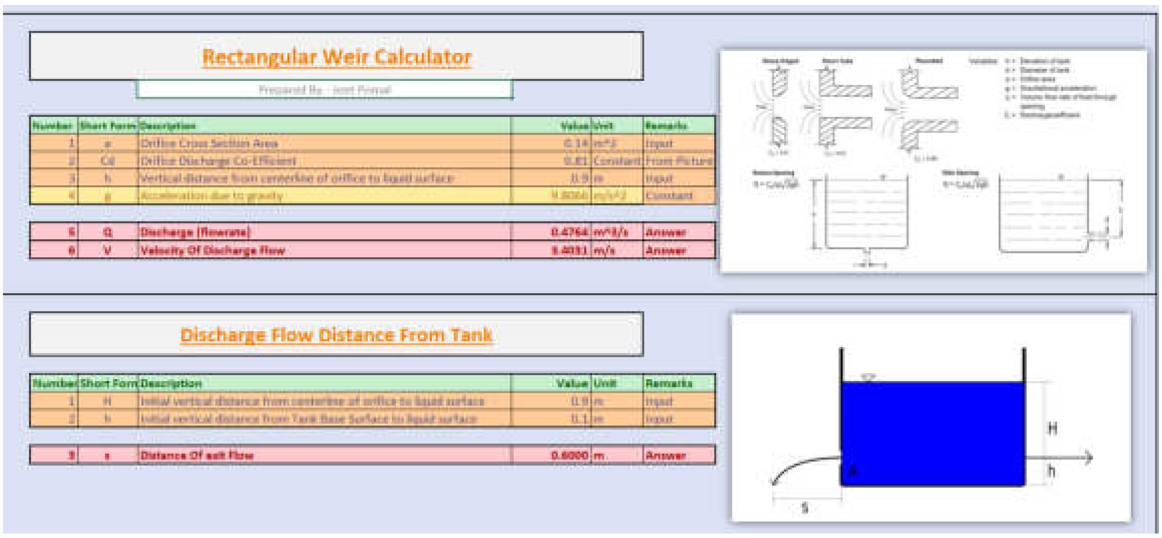


Fig 10.1 Rectangular Weir Calculator in Excel Sheet

CHAPTER-10.3 CALCULATION STEPS

Step-1 Rectangular Weir Calculator:

he liquid **outlet velocity** when draining a tank or a container can be calculated

$$v = C_v (2 g H)^{1/2}$$

Where

v = outlet velocity (m/s)

C_v = velocity coefficient (water 0.97)

g = acceleration of gravity (9.81 m/s^2)

H = height (m)

The liquid **volume flow** can be calculated

$$V = C_d A (2 g H)^{1/2}$$

where

V = volume flow (m^3/s)

A = area of aperture - flow outlet (m^2)

C_d = discharge coefficient

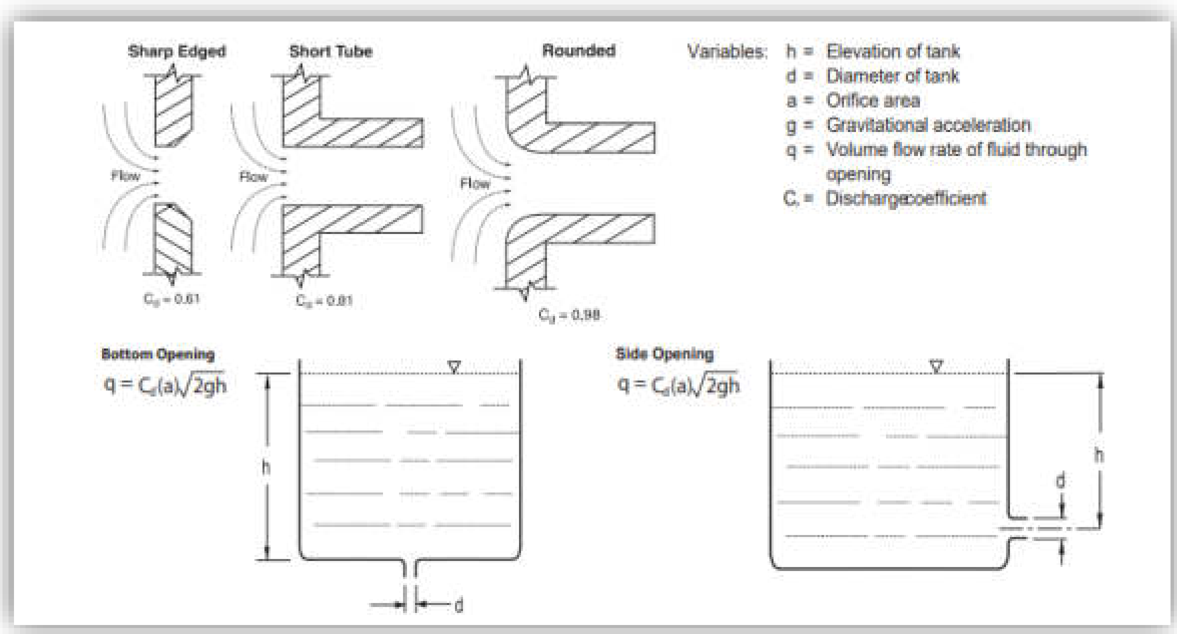


Fig 10.2 Values Of Discharge co-efficient

where

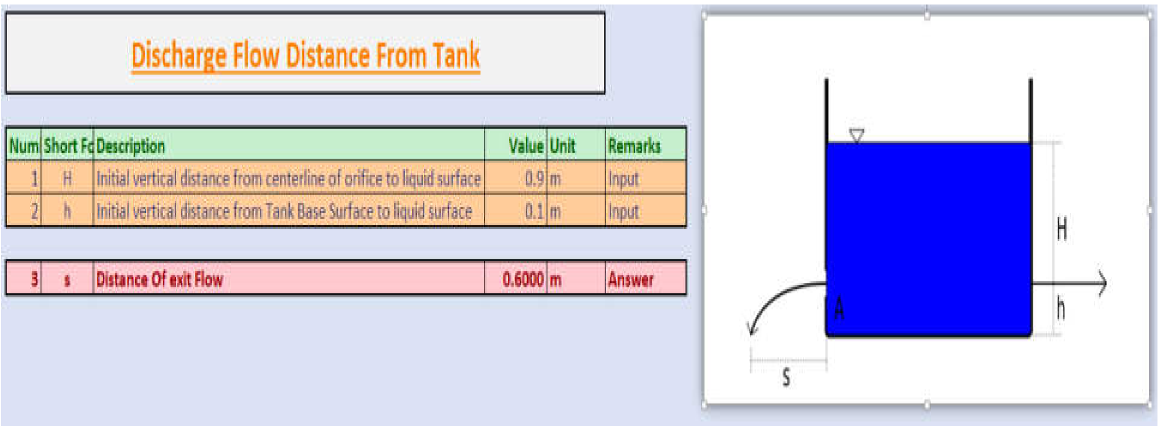
$$C_d = C_c\ C_v$$

where

C_c = contraction coefficient (sharp edge aperture 0.62, well rounded aperture 0.97)

A = area aperture (m^2)

Step-2 Discharge Flow Distance from Tank



Discharge Flow Distance From Tank

Num	Short Fo	Description	Value	Unit	Remarks
1	H	Initial vertical distance from centerline of orifice to liquid surface	0.9	m	Input
2	h	Initial vertical distance from Tank Base Surface to liquid surface	0.1	m	Input
3	s	Distance Of exit Flow	0.6000	m	Answer

Fig 10.3 Discharge Flow Distance from Tank in Excel sheet

Formula:

$$s = 2\ (H\ h)^{1/2}$$

Where:

S=Distance from Tank

H= Initial vertical distance from centreline of orifice to liquid surface

h= Initial vertical distance from Tank Base Surface to liquid surface

CHAPTER-10.4 PURPOSE

The purpose of a Rectangular Weir and Discharge Flow Distance from Tank Calculator is to calculate the flow rate of water over a rectangular weir, and to determine the distance that the water will travel after discharge from a tank or other container. This is important in many engineering and environmental applications, such as water resource management, flood control, and wastewater treatment, where accurate measurement and control of flow rates are critical for safety and efficiency.

CHAPTER-10.5 FEATURES

A Rectangular Weir and Discharge Flow Distance from Tank Calculator typically includes input fields for the dimensions of the rectangular weir, such as its length, height, and crest height, as well as for the properties of the water, such as its density and viscosity. It also includes input fields for the dimensions of the tank or container, such as its height and diameter, and for the discharge rate of the water. The calculator then uses established engineering principles and equations to calculate the flow rate over the weir, and the distance that the water will travel after discharge from the tank.

CHAPTER-10.6 BENEFITS

The benefits of using a Rectangular Weir and Discharge Flow Distance from Tank Calculator include:

- **Accurate flow measurement:** By accurately calculating the flow rate over the weir and the distance of water travel after discharge, the calculator helps to ensure that flow rates are accurately measured and controlled, improving the safety and efficiency of water systems.
- **Cost savings:** By accurately measuring flow rates and controlling them, the calculator can help to reduce waste and optimize the use of water resources, resulting in cost savings.
- **Time savings:** Using a Rectangular Weir and Discharge Flow Distance from Tank Calculator can save time compared to manually calculating flow rates and distances, especially for complex or non-standard configurations.

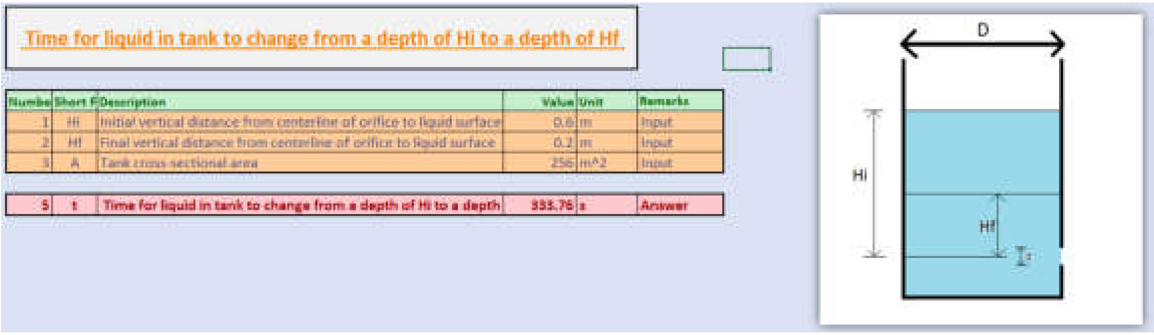
Overall, a Rectangular Weir and Discharge Flow Distance from Tank Calculator is a valuable tool for anyone involved in the management and control of water resources, as it helps to ensure that flow rates are accurately measured and controlled, resulting in a safe and efficient water system.

CHAPTER-11 TIME FOR LIQUID IN TANK TO CHANGE FROM A DEPTH OF HI TO A DEPTH OF HF

CHAPTER-11.1 INTRODUCTION

The time for a liquid in a tank to change from a depth of Hi to a depth of Hf is an important parameter in many engineering and environmental applications where liquid is being stored or processed. This time is calculated using established principles of fluid mechanics and thermodynamics, and depends on factors such as the size and shape of the tank, the flow rate of the liquid into or out of the tank, and the properties of the liquid itself.

CHAPTER-11.2 PICTURE OF EXCEL SHEET



Time for liquid in tank to change from a depth of Hi to a depth of Hf

Numbe	Short F	Description	Value	Unit	Remarks
1	Hi	Initial vertical distance from centerline of orifice to liquid surface	0.6	m	Input
2	Hf	Final vertical distance from centerline of orifice to liquid surface	0.2	m	Input
3	A	Tank cross-sectional area	256	m^2	Input
5	t	Time for liquid in tank to change from a depth of Hi to a depth	333.76	s	Answer

Fig 11.1 Time for liquid in tank to change from a depth of Hi to a depth of Hf

CHAPTER-11.3 CALCULATION STEPS

Step-1 Input Parameters According Formula:

Where:

$$t = \frac{A}{a\ C}\left(\sqrt{H_i} - \sqrt{H_f}\right)\sqrt{\frac{2}{g}}$$

Fig 11.2 Formula for Time for liquid in tank to change from a depth of Hi to a depth of Hf

- A= Tank cross-sectional area
- C= Orifice Discharge Co-Efficient
- A= Tank cross-sectional area
- Hi= Initial vertical distance from centreline of orifice to liquid surface
- Hf= Final vertical distance from centreline of orifice to liquid surface
- g= Acceleration due to gravity

CHAPTER-11.4 PURPOSE

The purpose of calculating the time for a liquid in a tank to change from a depth of Hi to a depth of Hf is to determine how long it will take for the liquid to completely fill or drain from a tank. This is an important parameter in many liquid storage and processing applications, where it is necessary to ensure that liquid is being stored or processed efficiently, and that tanks are not overfilling or draining too quickly.

CHAPTER-11.5 FEATURES

Calculating the time for a liquid in a tank to change from a depth of Hi to a depth of Hf typically involves inputting the dimensions of the tank, the flow rate of the liquid into or out of the tank, and the properties of the liquid itself into established fluid mechanics equations. These equations take into account factors such as the size and shape of the tank, the viscosity and density of the liquid, and the flow rate of the liquid to calculate the time it will take for the liquid to fill or drain to a specific depth.

CHAPTER-11.6 BENEFITS

The benefits of calculating the time for a liquid in a tank to change from a depth of Hi to a depth of Hf include:

- **Efficient liquid storage and processing:** By accurately determining the time it will take for liquid to fill or drain from a tank, it is possible to ensure that liquid is being stored or processed efficiently, reducing waste and optimizing the use of resources.
- **Improved safety:** Accurately calculating the time it will take for a tank to fill or drain can help prevent overfilling or draining too quickly, reducing the risk of spills or other safety hazards.
- **Cost savings:** By accurately measuring the time it takes for liquid to fill or drain from a tank, it is possible to optimize the use of resources and reduce waste, resulting in cost savings.

Overall, calculating the time for a liquid in a tank to change from a depth of Hi to a depth of Hf is an important parameter in many liquid storage and processing applications, helping to ensure efficient and safe operation of liquid systems.

CHAPTER-12 GRAVITY FLOW CALCULATION (BY MANNING EQUATION)

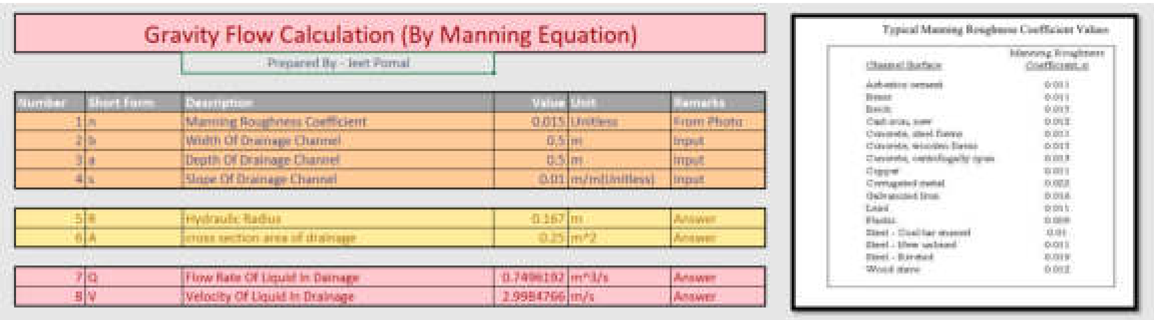
CHAPTER-12.1 INTRODUCTION

Gravity flow calculation using the Manning equation is a method used to determine the flow rate of a liquid through a channel or pipe under the influence of gravity. It is commonly used in hydraulic engineering to design and analyse open channels, such as rivers, streams, and irrigation canals.

The Manning equation, also known as the Manning formula, relates the flow rate to the hydraulic radius, slope of the channel, and Manning roughness coefficient, which is a measure of the resistance to flow. The equation is based on the assumption of steady, uniform flow and is suitable for open channels with a free surface, where the liquid is exposed to the atmosphere.

By using the Manning equation, engineers can determine the flow rate in a channel or pipe, and assess its capacity to carry a given volume of liquid. This information is crucial for designing hydraulic structures, such as dams, culverts, and bridges, and for managing water resources, such as irrigation systems, drainage networks, and flood control measures.

CHAPTER-12.2 PICTURE OF EXCEL SHEET



Gravity Flow Calculation (By Manning Equation)

Prepared By - Jeet Pomal

Number	Short Form	Description	Value	Unit	Remarks
1	n	Manning Roughness Coefficient	0.015	Unitless	From Photo
2	b	Width Of Drainage Channel	0.5	m	Input
3	a	Depth Of Drainage Channel	0.5	m	Input
4	s	Slope Of Drainage Channel	0.01	m/m(Unitless)	Input
5	R	Hydraulic Radius	0.167	m	Answer
6	A	cross section area of drainage	0.25	m^2	Answer
7	Q	Flow Rate Of Liquid In Dainage	0.7496192	m^3/s	Answer
8	V	Velocity Of Liquid In Drainage	2.9984766	m/s	Answer

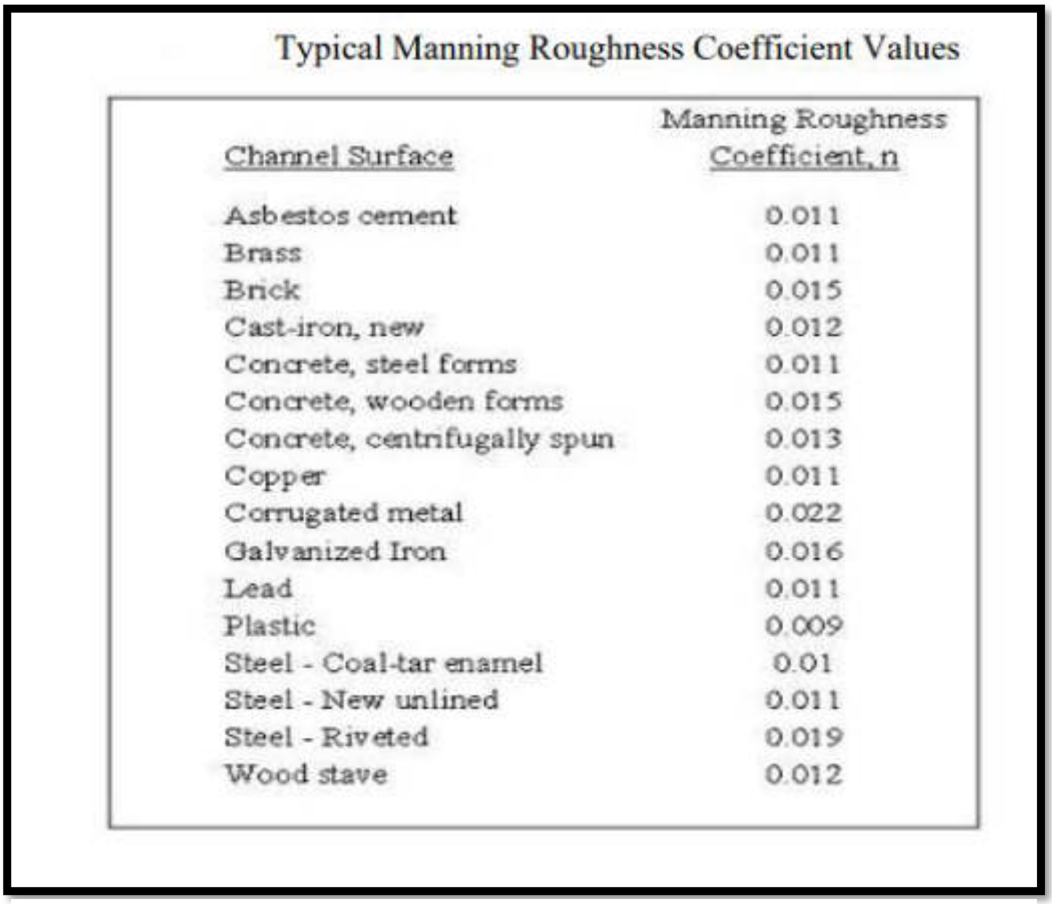
Fig 12.1 Gravity Flow Calculation (By Manning Equation) in Excel Sheet

CHAPTER 12.3 CALCULATION STEPS

Step-1 Formula and input value calculation:

The Manning equation is commonly used to calculate gravity flow in open channels such as rivers, canals, and pipes. The equation relates the flow rate to the slope of the channel, the cross-sectional area of the channel, the hydraulic radius, and the Manning roughness coefficient. Here are the steps to calculate gravity flow using the Manning equation:

- **Determine the channel slope:** The channel slope is the change in elevation per unit of horizontal distance. You can measure the slope using a surveyor's level or by using a topographic map.
- **Calculate the hydraulic radius:** The hydraulic radius is the cross-sectional area of the channel divided by the wetted perimeter (the length of the channel in contact with the fluid).
- **Determine the Manning roughness coefficient:** The Manning roughness coefficient is a measure of the friction between the fluid and the channel surface. It depends on the material and condition of the channel.



Typical Manning Roughness Coefficient Values

Channel Surface	Manning Roughness Coefficient, n
Asbestos cement	0.011
Brass	0.011
Brick	0.015
Cast-iron, new	0.012
Concrete, steel forms	0.011
Concrete, wooden forms	0.015
Concrete, centrifugally spun	0.013
Copper	0.011
Corrugated metal	0.022
Galvanized Iron	0.016
Lead	0.011
Plastic	0.009
Steel - Coal-tar enamel	0.01
Steel - New unlined	0.011
Steel - Riveted	0.019
Wood stave	0.012

Fig 12.2 Manning Roughness Co-efficient Values

Plug the values into the Manning equation: The Manning equation is Q = (1/n) * A * R^(2/3) * S^(1/2), where Q is the flow rate, n is the Manning roughness coefficient, A is the cross-sectional area of the channel, R is the hydraulic radius, and S is the channel slope.

- **Solve for the flow rate:** Rearrange the equation to solve for Q. The flow rate is given by Q = (1/n) * A * R^(2/3) * S^(1/2).

Step-2 Calculation of Hydraulic Radius:

The hydraulic radius is a measure of the efficiency of a channel or pipe to transport fluids, and is defined as the ratio of the cross-sectional area of the flow to the wetted perimeter of the channel. It is denoted by the symbol "R" and is usually expressed in units of length.

To calculate the hydraulic radius, you need to follow these steps:

- **Measure the cross-sectional area of the flow (A):** This can be done by taking measurements of the width and depth of the flow and using the formula A = width x depth.
- **Measure the wetted perimeter (P):** This is the length of the channel or pipe in contact with the fluid. It can be calculated by measuring the length of the channel or pipe along the water surface and the sides in contact with the water.
- **Calculate the hydraulic radius (R):** Divide the cross-sectional area of the flow (A) by the wetted perimeter (P), i.e., R = A/P.

The resulting value of the hydraulic radius (R) will give you an idea of the efficiency of the channel or pipe in transporting fluids. A higher value of R indicates a more efficient channel or pipe, while a lower value indicates a less efficient one.

CHAPTER-12.4 PURPOSE

The main purpose of using the Manning equation to calculate gravity flow is to estimate the amount of liquid or fluid that can be transported through a conduit, such as a pipe or an open channel. This information is vital for designing and maintaining hydraulic systems, including storm water management, irrigation, and wastewater treatment.

CHAPTER-12.5 FEATURES

- The Manning equation is a widely accepted and simple method for estimating flow rate in a variety of applications.

- It takes into account the hydraulic properties of the channel or pipe, including the channel slope, hydraulic radius, and roughness coefficient, to provide an accurate estimate of the flow rate.
- The Manning equation is suitable for both circular and non-circular pipes and open channels with different shapes.

CHAPTER-12.6 BENEFITS

- The Manning equation is a cost-effective method that does not require expensive equipment or specialized software.
- It is a widely accepted method, making it easier for engineers and designers to communicate and share data.
- The Manning equation is versatile and can be used in a variety of hydraulic systems, including storm water management, irrigation, and wastewater treatment.
- The Manning equation provides an accurate estimate of the flow rate, making it a valuable tool for hydraulic system design and maintenance.

CHAPTER-13 MISCELLANEOUS WORK DONE DURING INTERNSHIP

Topic-1 determining the optimal pipe direction for the FGD piping in the plot plan:

CHAPTER-13.1 INTRODUCTION

The Flue Gas Desulfurization (FGD) process is a critical component of modern power plants. The primary purpose of FGD is to remove sulphur dioxide (SO2) from the flue gas generated by power plants, thus reducing the amount of harmful emissions released into the atmosphere. To accomplish this, FGD systems require complex piping networks that must be designed and installed with the utmost precision and care.

At Larsen and Toubro, I was tasked with determining the optimal pipe direction for the FGD piping in the plot plan, as well as estimating the number of elbows and tee fittings necessary for the installation and the overall length of the required piping. In this report, I will detail my calculations and explain how I arrived at my final recommendations.

CHAPTER-13.2 PIPING LAYOUT AND DESIGN CONSIDERATIONS

When designing the FGD piping layout, several critical factors must be taken into account. These factors include pressure drop, fluid flow rate, pipe diameter, and the overall layout of the plot. A well-designed FGD piping system will minimize pressure drop while ensuring optimal fluid flow rates, thereby reducing energy consumption and increasing system efficiency.

To achieve these objectives, I conducted a detailed analysis of the piping layout using advanced software tools. Based on my analysis, I was able to determine the optimal pipe direction for the FGD piping in the plot plan, taking into account the location of other components such as pumps, tanks, and heat exchangers. I also estimated the overall length of the required piping and determined the optimal diameter for each pipe segment.

CHAPTER-13.3 ELBOW AND TEE FITTING CALCULATIONS

One of the most critical aspects of FGD piping design is the calculation of the number of elbows and tee fittings necessary for the installation. Elbows and tees are essential components of any piping system, but excessive use can increase pressure drop and reduce system efficiency. To determine the optimal number of fittings required, I used advanced software tools to simulate the flow of fluids through the piping network.

Based on my calculations, I determined that a total of 34 elbow fittings and 19 tee fittings would be necessary for the FGD piping installation. These fittings were strategically placed to minimize pressure drop while ensuring optimal fluid flow rates. I also recommended the use of long-radius elbows where possible, as these fittings reduce pressure drop and minimize the risk of turbulence-induced pipe failure.

CHAPTER-13.4 OVERALL CONCLUSION

Based on my work at Larsen and Toubro, I have been able to design an optimal FGD piping network that meets all necessary requirements for safety, efficiency, and reliability. By taking into account factors such as pressure drop, fluid flow rate, and the overall layout of the plot, I have been able to ensure that the FGD piping will be designed and installed to the highest standards.

Furthermore, my calculations regarding the number of elbow and tee fittings required will ensure that the piping network is both efficient and reliable, minimizing pressure drop and reducing the risk of pipe failure. In conclusion, I believe that my work at Larsen and Toubro will lead to a safe and efficient FGD piping system that will contribute to the reduction of harmful emissions from power plants.

CHAPTER-14 WEIGHT ESTIMATION FOR A PIPING PROJECT

CHAPTER-14.1 BACKGROUND AND OBJECTIVE

As part of my internship at Larsen and Toubro, I was tasked with calculating the weight estimation for a piping project. The objective was to determine the difference in weight estimation for the same piping project before and after it was tendered, taking into account changes in piping length and other factors.

CHAPTER-14.2 METHODOLOGY

To accomplish this objective, I first obtained information on the length of piping used in a similar project completed by Larsen and Toubro in the past. Using this information, I calculated the weight of the piping based on its material, diameter, and thickness. I then made adjustments to the weight estimation to account for changes in piping length, fittings, and other components.

To make these calculations, I used advanced software tools and Excel spreadsheets to analyse the various factors that affect the weight of the piping, including the density of the material, the wall thickness, and the diameter of the pipe. By making precise calculations based on this data, I was able to arrive at an accurate weight estimation for the piping project.

CHAPTER-14.3 RESULTS

Based on my calculations, I determined that the weight estimation for the piping project before tendering was 4566.3 kg, while the weight estimation after tendering was 4824.7 kg, resulting in a difference of 258.4 kg. This difference can be attributed to the addition of extra piping and fittings required for the project, as well as changes in the design of the piping system.

CHAPTER-14.4 CONCLUSION

Through my work at Larsen and Toubro, I have been able to accurately estimate the weight of a piping project before and after it was tendered, taking into account changes in piping length and other factors. By using advanced software tools and making precise calculations, I was able to arrive at an accurate weight estimation for the project.

This information will be useful for the project team at Larsen and Toubro, as it provides a better understanding of the amount of materials required for the project, as well as the overall weight of the piping system. This information can also be used to make informed decisions about the design and layout of the piping system, helping to ensure that the project is completed on time and within budget.

APPENDIX

GUJARAT TECHNOLOGICAL UNIVERSITY
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ગુજરાતટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure 1

Enrollment no: 200390119502

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Jeet Pradipbhai Panal

DIARY OF THE WEEK: Dt: 01/02/2023 TO 07/02/2023

DEPARTMENT: Mechanical SEM: 8th

NAME OF THE ORGANISATION: L&T Power

NAME OF THE PLANT/SECTION/DEPARTMENT: FGD department - [EPSG]

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Kalpesh Kotak

DESCRIPTION OF THE WORK DONE IN BRIEF

⇒ Week-1 : Key Words

(i) Introducation to the L&T Power FGD department and pipeline design and layout Process.

(ii) Familiarized with team and facilities

- During this week, I was Introduce to the company's FGD department and pipeline design and layout Process. I received an overview of the department team members, and on going projects.
- This helped me understand the company's Expectation and Requirements for Intership.

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

TOTAL HOURS: 37.5 hrs (appr)

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

K Kotak
Signature of officer-in-charge
of Dept. / Section / Plant

Date:

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

1

FEEDBACK FORM

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Annexure 2

Feedback Form by Industry expert

Student Name: Jeet Pomal

Date: 29/04/23

Work Supervisor: Mr. Achintya Ghosh

Title: Internship at L&T Power

Company/Organization: L&T Power

Enrollment No: 200390119502

Internship Address: L&T Knowledge City - Gate No. 1, NH-8, Ajwa-Waghodia Crossing, Vadodara-390019, Gujarat, India

Dates of Internship: From 01/02/23 to 29/04/23

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility				✓
Uses technical knowledge and expertise			✓	
Analyzes problems effectively				✓
Communicates well and writes effectively			✓	

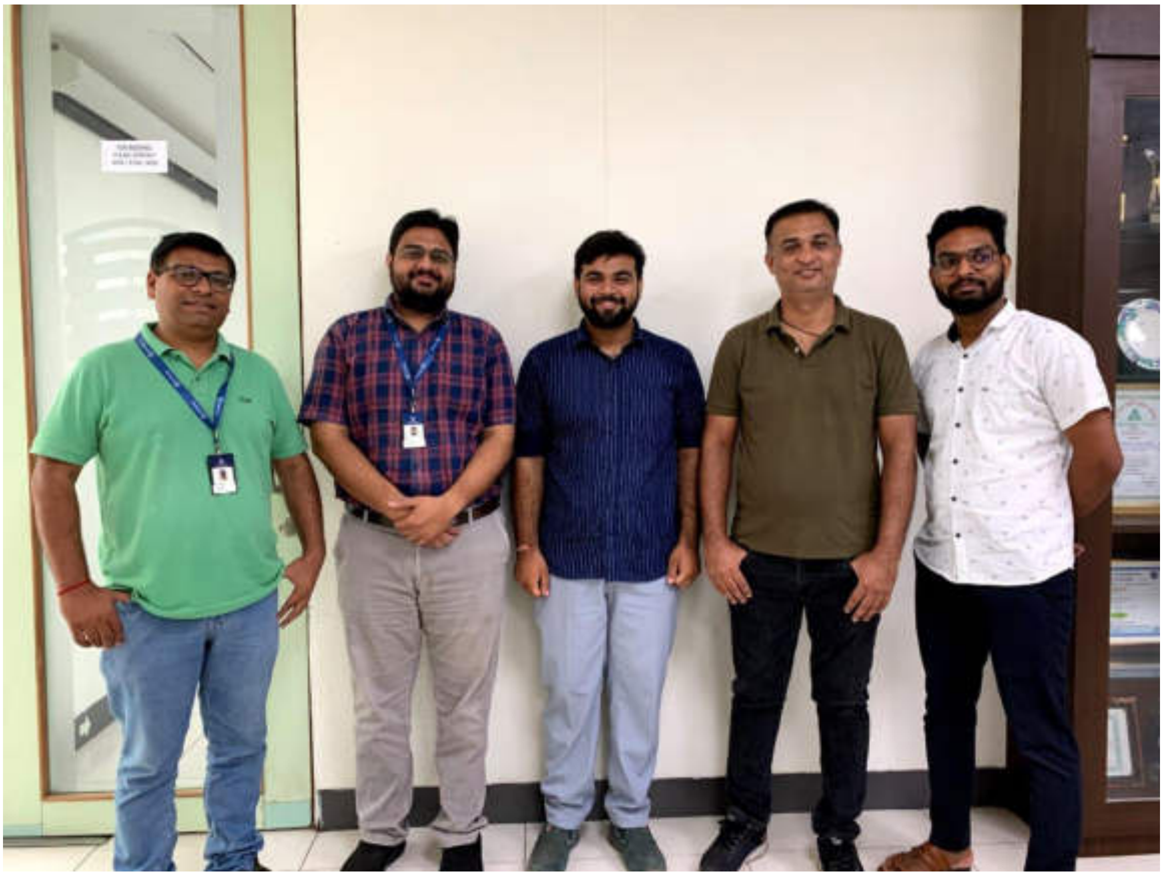
Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent):

Additional comments, if any: Jeet is sincere and having good technical aptitude.

Signature of Industry person with name and Stamp: Achint Gh.
(ACHINTYA GHOSH)

Signature of the Faculty Mentor

LARSEN & TOUBRO LIMITED
L&T Energy Power



INTERNSHIP AT AMMANN INDIA PVT LTD.

AN INTERNSHIP REPORT

Submitted by

Ms. Tithi Navinkumar Sharma

200390119505

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

Mechanical Engineering

S.P.B. Patel Engineering College, Mehsana

Gujarat Technological University, Ahmedabad

May, 2023

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

GUJARAT TECHNOLOGICAL UNIVERSITY

S.P.B. Patel Engineering College

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Internship at Ammann India Private Limited** has been carried out by **Tithi Navinkumar Sharma** my guidance in partial fulfillment for the degree of Bachelor of Engineering in Mechanical Engineering, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2022-23.

Sign	Sign
Prof. Kunalsinh Kathia (Mechanical Engg. Department)	Prof. Kunalsinh Kathia (Mechanical Engg. Department)
Internal Guide	Head of Department

PMMS CERTIFICATE

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE PROJECT PORTAL

B.E. SEMESTER VIII, ACADEMIC YEAR 2022-2023

Date of certificate generation : 09 May 2023 (14:15:34)

This is to certify that, ***Sharma Tithi Navinkumar*** (Enrolment Number - 200390119505) working on project entitled with ***Summer Internship at Ammann India Pvt Ltd.*** from ***Mechanical Engineering*** department of ***S. P. B. PATEL ENGINEERING COLLEGE, MEHSANA*** had submitted following details at online project portal.

Internship Project Report	**Completed**

Name of Student : Sharma Tithi Navinkumar

Name of Guide : Mr. Kunalsinh R. Kathia

Signature of Student : ____________

*Signature of Guide : ____________

Disclaimer :
This is a computer generated copy and does not indicate that your data has been evaluated. This is the receipt that GTU has received a copy of the data that you have uploaded and submitted as your project work.

*Guide has to sign the certificate, Only if all above activities has been Completed.

INTERNSHIP CERTIFICATE

AMMANN

Ammann India Private Limited
(Formerly Ammann Apollo India Private Limited)
Block No. 157, At Ditasan, P.O Jagudan, State Highway, Mehsana, Gujarat - 382710, INDIA
Phone : +91 2762 662200, Email : info.ain@ammann.com
CIN No : U29248GJ1997PTC033432

May 01, 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Tithi Navinkumar Sharma** has successfully completed her Project Internship Training in **Purchase** Department as per her academic regulations during **January 23, 2023 to April 28, 2023 (12 weeks).**

We found her sincere, hardworking, technically sound and result oriented.

We wish her all the best for her future endeavours.

For, Ammann India Private Limited

Ammann India Private Limited
Ditasan

Praful Patel
Senior Manager – Human Resources

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY

GUJARAT TECHNOLOGICAL UNIVERSITY

S.P.B. Patel Engineering College, Mehsana

Near Shanku's Water Park, Ahmedabad – Mehsana Highway, Linch, Gujarat

DECLARATION

We hereby declare that the Internship submitted along with the Internship entitled **Internship at Ammann India Private Limited** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Mechanical Engineering** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me under the supervision of **Prof. Kunalsinh Kathia** & **Mr. Shailesh Zala (External Guide)** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Tithi Navinkumar Sharma ________________________

ACKNOWLEDGEMENT

I would like to express my sincere gratitude and appreciation to everyone who has supported and guided me throughout my internship at Ammann India Pvt Ltd, a global leader in road construction and equipment manufacturing. This experience has been invaluable in shaping my professional growth and providing real-world insights into the industry.

First and foremost, my heartfelt gratitude to **Prof. Kunalsinh Kathia**, whose guidance and support were invaluable throughout my internship. His expertise, patience, and encouragement played a significant role in shaping my learning experience. I am grateful for his mentorship and the valuable insights he shared, which have contributed immensely to my personal and professional growth. I would like to extend my gratitude to **Mr. Shailesh Zala**, **Assistant Manager** at Ammann India Pvt Ltd. His continuous guidance, mentorship, and unwavering support throughout my internship journey have been instrumental in my development.

I am also deeply grateful to **Mr. Anirudh Singh**, **General Manager**, for providing me with this incredible opportunity to be a part of the Ammann India Pvt Ltd team. His trust in my abilities and belief in my potential have been a tremendous motivation.

I would like to extend my gratitude to **Mr. Pawan Sharma**, **Assistant General Manager**, for his valuable insights and guidance. His inputs have played a significant role in broadening my understanding of the industry and refining my skills.

I am thankful to **Mr. Amit Shah**, **Manager**, for his constant encouragement and support. His guidance and expertise have been pivotal in my professional development.

I would also like to express my gratitude to **Mr. Sagar Joshi**, **Deputy Manager**, for his assistance and cooperation throughout my internship. His willingness to share knowledge and provide practical insights have been greatly appreciated.

Additionally, I would like to extend my thanks to all the employees of Ammann India Pvt Ltd who welcomed me warmly and made my internship experience memorable. Their support and willingness to share their expertise have contributed significantly to my learning and growth. Finally, I would like to thank my family and friends for their unwavering support, encouragement, and understanding throughout this internship journey.

I am truly grateful to everyone mentioned above and to all those who have contributed to my internship experience at Ammann India Pvt Ltd. Their guidance and support have been invaluable, and I am fortunate to have had the opportunity to learn from such exceptional professionals in the industry.

ABSTRACT

This report provides an overview of the internship experience at Ammann India Pvt Ltd, a global leader in road construction and equipment manufacturing. The internship focused on various aspects of the company's operations, including supplier communication, technical knowledge acquisition, material tracking, inventory management, SAP software utilization, and learning about the procurement process, sourcing strategies and supply chain.

Technical knowledge played a vital role throughout the internship, as it involved learning about road construction equipment and related components. The experience included studying technical specifications, understanding product functionality, and familiarizing oneself with industry standards. This knowledge acquisition enhanced comprehension of equipment performance, aiding in informed decision-making processes.

Tracking materials and managing inventory efficiently were key responsibilities during the internship. This involved ensuring the availability of necessary materials for production, coordinating with warehouse personnel, and maintaining accurate records. Through this experience, a comprehensive understanding of inventory management principles, such as just-in-time practices and stock optimization, was gained. SAP software was extensively utilized during the internship for various procurement-related tasks. The experience provided opportunities to work with modules like purchase orders, inventory management, and supplier management within the SAP system. This exposure enhanced proficiency in using enterprise resource planning software, a crucial skill in modern procurement practices.

Overall, the internship at Ammann India Pvt Ltd facilitated the development of crucial skills in supplier communication, technical knowledge acquisition, material tracking, inventory management, SAP software utilization, item drawing comprehension, and understanding the procurement process and supply chain. These experiences contribute to a well-rounded understanding of the road construction equipment manufacturing industry and provide a foundation for future professional growth in the field.

List of Figures

List of Tables

List of Abbreviation's

SAP - System Application & Products in Data Processing

T Codes – Transaction Codes

SCM – Supply Chain Management

PO – Purchase Order

PR – Purchase Requisition

RFQ – Request for Quotation

ABC Analysis – Always Better Control Analysis

MM – Material Management

FSN – Fast Moving, Slow Moving & Non-Moving

BOM – Bill of Materials

DP Test – Dye Penetrative Test

P2P – Procure to Pay

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Chapter: 1 General Outline of The Company's History, Products & Services

1.1 About the Ammann Group

Fig 1.1 Ammann Group

Productivity Partnership for a Lifetime ~ Ammann Group

Ammann India is a subsidiary of Ammann Group, a Swiss-based company that specializes in manufacturing construction equipment and machinery for road construction. Ammann India was established in 2011 and has its headquarters in Ahmedabad, Gujarat. The company's product range includes asphalt mixing plants, concrete mixing plants, compactors, and pavers, among others. They also offer a range of after-sales services, including training, spare parts, and technical support.

In 2013, Ammann India established a joint venture with Gujarat Apollo Industries Ltd, now known as Ammann India Private Limited in which they currently hold 100% stake. Innovation has always been a priority for Ammann, as evidenced by their patent for the macadam machine in 1908, which combined an asphalt-mixing plant and a paver to eliminate dust kicked up by automobiles.

Today, Ammann continues to advance their technology to produce machines, plants, and services that help customers find solutions to daily challenges. They also prioritize sustainability to protect the planet and its resources for future generations, by developing equipment that minimizes fuel burn and machine wear, optimizes material usage, and utilizes recycled materials in their asphalt-and concrete-mixing plants.

Ammann remains committed to progress, continuously making exciting advances through product launches, innovations at their Research and Development Centre, and through the experiences of their customers who use their products for construction projects worldwide.

1.1.1 Organization Commitment

In order to enable economic success for our customers, Ammann aspires to maximize customer value and outstanding productivity of the plants and machines. Perpetual service quality and service availability are the foundation of Ammann's efficient, successful and long-term co-operation with all our partners. As a result, their economic success today is reinvested into the further development of our products, services, employees and know-how. This commitment forms the basis of the Ammann Corporate Profile.

1.1.2 Organization Mission

Ammann is a world-leading supplier of mixing plants, machines, and services to the construction industry with core expertise in road building and transportation infrastructure.

1.2 Company Layout

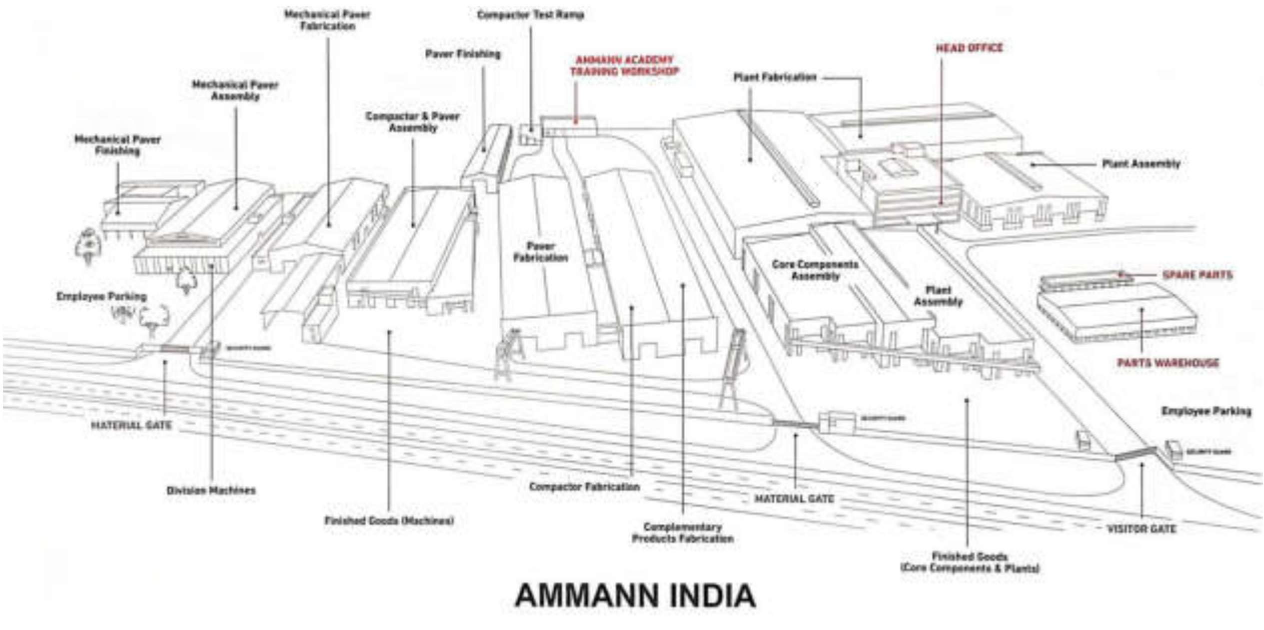


Fig 1.2 Ammann India's Layout

1.3 Production Sites of Ammann Group

1.3.1 Langenthal, Switzerland, Head Office

Fig 1.3 Langenthal, Switzerland, Head Office

- Common research and development.
- Manufacture of core components for asphalt mixing plants.
- Automation/software solution development.

1.3.2 Alfeld, Germany

Fig 1.4 Alfeld, Germany

- Manufacture of asphalt mixing plants.
- Manufacture of control systems.

1.3.3 Ettlingen, Germany

Fig 1.5 Ettlingen, Germany

- Concrete Centre of excellence.

1.3.4 Hennef, Germany

Fig 1.6 Hennef, Germany

- Manufacture of rammers and compaction plates.
- Manufacture of add-on compactors.

1.3.5 Bussolengo/Verona, Italy

Fig 1.7 Bussolengo/Verona, Italy

- Manufacture of asphalt mixing plants.

1.3.6 NOVÉ MĚSTO NAD METUJÍ, CZECH REPUBLIC

Fig 1.8 Nové Město Nad Metují, Czech Republic

- Manufacture of tandem rollers (7 tonnes to 17 tonnes).
- Manufacture of single-drum rollers (7 tonnes to 25 tonnes).
- Manufacture of pneumatic-tyred rollers (9 tonnes to 24 tonnes).
- Manufacture of trench rollers.

1.3.7 Nové Shanghai, China

Fig 1.9 Nové Shanghai, China

- Manufacture of asphalt mixing plants.

1.3.8 Gravataí, Brazil

Fig 1.10 Gravataí, Brazil

- Manufacture of asphalt mixing plants

1.3.9 Mehsana, India

Fig 1.11 Mehsana, India

- Manufacture of Ammann & Apollo asphalt & concrete mixing plants
- Manufacture of Ammann & Apollo asphalt pavers
- Manufacture of Ammann compactors

1.4 Ammann India Products and Services

1.4.1 Plant Division Products

Ammann asphalt plants are used to produce hot mix asphalt for road construction, while Ammann concrete plants are used to produce concrete for a variety of applications, including building construction, infrastructure projects, and more. Ammann asphalt plants are designed for maximum efficiency and reliability, with a range of plant sizes and configurations available to suit different project requirements.

- There are various Asphalt Plants manufactured in Plant Division: -

    - Batch Asphalt Mixing Plants
        - ABC 100 – 260 t/h Valuetec
        - ABC 80 – 160 t/h Ecotec
        - ANP 80–160 t/h
    - Continuous Asphalt Mixing Plants
        - Wet mix 100–250
        - Drum Mix 60–120

Fig 1.12 Asphalt Plants

- There are various Concrete Plants manufactured in Plant Division: -

    - Concrete-Mixing Plants
        - CC 30 – CC 150 ELBA

Fig 1.13 Concrete Plants

1.4.2 Machine Division Products

Ammann India's machine division offers various products, including asphalt and concrete mixing pavers, compactors, and other construction equipment's.

- There are various **Asphalt and Soil and Compactors** manufactured in Machine Division: -

- Soil Compactors
  - ARS 110.1 T3
  - ARS 110.2
  - ARS 121
  - ARS 122
- Asphalt Compactors
  - ARX 90.2
  - ARX 91
  - ARX 32.2

Fig 1.14 Soil Compactors (ARS Series)

Fig 1.15 Asphalt Compactors (ARX Series)

Pavers: Ammann India offers a range of asphalt pavers, including wheeled and tracked pavers, with options for various widths and paving depths. Also, Kerb Pavers are manufactured as well.

- There are various **Asphalt Pavers** manufactured in Machine Division: -
  - Asphalt Pavers
    - AP 550
    - AP 600
    - AP 800
    - AP 1000
    - WM 6 / RM 6
    - AFT 500
    - AFT 950 (Under Development)

Fig 1.16 Asphalt Pavers (AP & AFT Series)

1.4.3 Complementary Products and Retrofits

Complementary products are products or services that enhance or complement the functionality, performance, or user experience of a primary product or service.

Retrofits, on the other hand, refer to upgrades or modifications made to existing equipment or systems in order to improve their performance, efficiency, or compliance with new standards or regulations.

- Various **Complementary Products** are manufactured in Machine Division: -
  - Complementary Products
    - KLM 40 (Curb-casting Machine)
    - KLM 1200 (Curb-casting Machine)
    - ATM BITUMEN SPRAYERS (Bitumen Pressure Distributors)
    - MECHANICAL BROOMS (Surface Preparation Before Asphalt Surfacing)
    - HYDRAULIC BROOMS (Surface Preparation Before Asphalt Surfacing)

Fig 1.17 Complementary Products for Machine Division

- Various Complementary Products are manufactured in Plant Division: -
  - Bitumen Tank
  - Heat Tek

Fig 1.18 Complementary Products for Plant Division

- Various Retrofits Products are manufactured in Plant Division: -
  - Retrofits Products

- Bitumen Tank
- Baghouse
- Noise Reduction
- Burners
- Low Temperature Mixes
- Control System
- Recycling System
- Dryer
- Mixer
- Wear Protection

Fig 1.19 Retrofit Products

1.5 Ammann conservation efforts

Ammann provide technology that helps rollers reach compaction goals in fewer passes, minimising fuel burn and the associated emissions. Ammann promise to the customers and to the world at large is to explore every means possible to reduce the carbon footprint of their products. Its further pledge to continually evaluate manufacturing processes for additional gains and to tirelessly focus on the safety of those who build the products.

The dedication to plants and processes that put sustainability front and centre is not new at Ammann. These efforts include electric vehicles, advanced recycling, and zero-waste technologies. While this progress is significant, Ammann do feel a renewed urgency to accelerate efforts in the interest of global planetary health. Plants and machines have built-in protections that keep operators, and others on the jobsite, safe. It starts with secure machine transport and includes jobsite safeguards such as infrared remote control and a dead man's handle on machines and lower sound levels at asphalt-mixing plants.

1.6 Ammann delivers sustainability with eMission.

This environmentally friendly solution is integrated into new Ammann products. It starts with reduced emissions – and incorporates efficiency, productivity and lower maintenance demands that make jobsites healthier and business owners more profitable.

- emissions reduction – Lowers levels of CO_2 and other particles
- efficiency improvement – Utilises digital technologies to enhance product performance and jobsite management
- electrification – Incorporates alternative power sources, including electricity today and other sources in the future

Ammann India's marketing and sales strategies focus on customer satisfaction, product quality, and timely delivery of products and services. The company's sales team works closely with customers to understand their specific requirements and provide customized solutions that meet their needs.

Ammann India has a strong online presence and uses digital marketing channels to reach out to potential customers. The company's website provides detailed information about its products and services, and customers can request quotes and place orders online. Ammann India also uses social media platforms such as Facebook, LinkedIn, and Twitter to engage with customers and promote its products and services.

The company's sales network includes a team of experienced sales professionals and a network of dealers and service centres across the country. Ammann India provides regular training and support to its sales team and dealers to ensure that they have the knowledge and expertise to provide high-quality service to customers.

Chapter: 2 Overview of various Departments

2.1 Departments at Ammann India Private Limited

Every organization is made up of different department. Each department contributes to the running of the business.

- **Engineering Research and Development (ER&D)** - The function of the Engineering Research and Development (ER&D) is to monitor the new trends developing in the market place and develop new products, Upgrade the design of the existing products, do testing to understand the product functions. The ER&D plays a vital role in keeping the industry products competitive.

- **Manufacturing Systems Engineering (MSE)/ Planning Department** - The team of Manufacturing Systems Engineering (MSE) will be responsible to design the process for the manufacturing. The process that has to be adopted, design of tools and machines that are to be used, Inspection method that has to be practiced in a manufacturing process are decided by the MSE team. The product trails are done and once the product is proved to be capable after capabilities studies the process is handed over to the production team for mass production.

- **New Products Development (NPD)** - The New products Development department are responsible for the development of the product from the market inputs to development of the product and reaching the customers. The lead time in development of the product from idea to a product in real is the challenging task of the NPD team.

- **Purchase Department** - A purchasing department is the division of a company that's responsible for acquiring the goods and services the business requires to operate. Some companies refer to purchasing departments as procurement departments or buying departments. These units are often an important part of helping companies meet their daily needs and their long-term strategic goals. How much responsibility a department has can vary on the size of the company, but they often help monitor the supply chain and help manage vendor contracts to keep the company's operations efficient.

- **Manufacturing Department/ Production Department** - Manufacturing department is involved in the conversion of the raw material to a finished product. The process plan is given by the MSE team and the manufacturing team does the manufacturing, assembly, inspection, packing of the products as per the process plan. Production of parts, assembly, testing and packing of the parts will be covered under the manufacturing Department.

- **Quality Department** - The Quality Department ensures the proper deployment of the Quality management Systems that is in practice to ensure that the quality of the products produced are acceptable by the customer. The Quality Management ensures Quality Planning, Quality assurance, Quality control and Quality improvements are practiced in the organization.

- **Maintenance Department** - The Function of the Maintenance department is to ensure the machines and equipment in the organization are in good working condition. The maintenance department carries out various maintenance activities such as Preventive maintenance, break down maintenance, Time based maintenance etc. to keep the down time minimal in the organization.

- **Marketing Department** - The Function of the Marketing department is to find out the need of the customer and fulfil the need with the products and services of the organization. This involves market research, setting prices, finding distribution channels, advertisements etc.

- **Human Resources Development (HRD)** - The function of the Human resources Development is to ensure the Human resources in the industry are competent to perform the assigned activities. This involves Recruiting right people, training of existing people and motivating the people for the performance to improve their performance.

- **Finance Department** - The Function of the Finance Department is to acquire funds, manage and re distribute the funds based on the budget planned for the financial year. Finance Department is responsible for the documentation of the assets in the organization. Finance departments processes and monitors the revenue spending of the organization and ensure to keep them under the budgeted value.

2.2 Purchase Department in an Organization

Purchasing is the process of buying or acquiring goods and services to make supply chain management more efficient. Goods, materials, and equipment procured in this process play a key role in improving the quality of products/services produced by the organization. Ultimately, the purchasing process impacts the product quality and helps in optimizing costs in the value chain.

The purchasing department of a company is responsible for procuring the goods, raw materials & services required to operate the organization effectively.

Now, every organization has its specific needs when it comes to the sourcing and procurement of equipment, raw materials, and services. These needs define the purchasing process and how its purchasing department functions.

Based on these needs, an organization sets the purchasing department's responsibilities and streamlines its procurement plans to guard against demand-supply hurdles.

2.3 Functional Responsibilities of Purchase Department

The functions and responsibilities of the purchasing department can be broadly outlined as below:

- ✓ To make the materials, supplies and equipment available for the organization at minimal costs, such that it leads to maximum productivity and subsequent profitability of business operations.

- ✓ To make sure that there is continual flow of production with undisrupted supply of raw materials, component parts, supplies, tools, equipment, etc. with repairs and maintenance services.

- ✓ To enhance the asset turnover ratio, such that the investments made in fixed assets as well as inventories are minimal with respect to the corresponding volume of sales. This will also increase the profitability of the organization.

- ✓ To identify alternate sources of supply, increase the bargaining power of the buyer and ensure cost minimization and increased ability to meet the emergencies.

- ✓ To establish good relations with the suppliers, which helps in communicating a favourable image in the business circles, and these are often useful when it comes to changing reasonable prices, preferential material allocation during shortages, intimation about foreseen shortages, details about the newly established substitute, outstanding payments during temporary liquidity crisis, etc.

- ✓ To attain maximum integrity with other organizational departments, including production department or material specs, flow and recommended supplies of certain items, etc., engineering department for purchasing tools, machines and equipment, marketing department for sales forecasts and impact of input quality on output quality, finance department to maintain levels of materials, scheduling investments, etc., and personnel department to man and develop personnel, maintain supplier relationships, etc.

- ✓ To train personnel and develop them and ensure management succession with contented workforce.

- ✓ To ensure efficient recordkeeping and management reporting, such that paper processing is standardized and recordkeeping is maintained.

- ✓ Details about cash discount and quantity discount earned and lost and also about the price trend in the ensuing period and its impact on inventory costs.

- ✓ Planning on material availability and strategy development as planned and Details about new materials and processes that can reduce manufacturing cost.

2.4 Role of Purchase Department

To understand how the purchasing department works, it is important to explore the role it plays in the overall business workflow & P2P cycle. Purchasing departments play two roles in an organization:

- ➢ **Strategic Purchasing:** In this role, the purchasing department plans high-level procurement activities based on the organization's business goals. Strategic purchasing department responsibilities help in sourcing goods strategically (e-sourcing) at economical prices and optimum quality. Decisions such as in-house manufacturing or procurement from external suppliers are taken at the strategic purchasing stage.

- ➢ **Operational Procurement:** This role is also defined as "tactical purchasing", where all the purchase department responsibilities are focused on taking care of business operations and administration. Repeat orders, inventory restocking, and invoice payments are maintained to keep the production line running at its optimal capacity. Operational procurement primarily caters to the long-term needs of the company.

Chapter: 3 SAP MM (Material Management)

3.1 What is SAP?

Fig 3.1 SAP Logo

The name is an initialism of the company's original German name: Systemanalyse Programmentwicklung, which translates to System Analysis Program Development. Today the company's legal corporate name is SAP SE — SE stands for societas Europaea, a public company registered in accordance with the European Union corporate law.

SAP system consists of a number of fully integrated modules, which covers virtually every aspect of business management. SAP is #1 in the ERP market. As of 2010, SAP has more than 140,000 installations worldwide, over 25 industry-specific business solutions and more than 75,000 customers in 120 countries. Other Competitive products of SAP Software in the market are Oracle, Microsoft Dynamics, etc.

3.2 SAP Modules

SAP solutions include various functional modules, which support transactions to execute key business processes, such as –

- Financial Accounting (FI)
- Financial Supply Chain Management (FSCM)
- Controlling (CO)
- Materials Management (MM)
- Sales and Distribution (SD)
- Logistics Execution (LE)
- Production Planning (PP)
- Quality Management (QM)
- Plant Maintenance (PM)
- Project System (PS)
- Human Resources (HR)

Fig 3.2 SAP Modules

3.3 Features of SAP MM

The features of a SAP MM system are as follows −

- ✓ SAP MM is one of the modules of SAP that deals with material management and inventory management.
- ✓ Material Management as a process ensures no shortage of materials or any gaps in the supply chain process of the organization. SAP MM speeds up the procurement and material management activities, making the business run smoothly with complete time and cost efficiency.
- ✓ It deals with managing the materials (products and/or services) and resources of an organization with the aim of accelerating productivity and reducing costs. At the same time, SAP MM is quite versatile to accommodate changes that are frequent in any business environment.
- ✓ It deals with the Procurement Process, Master Data (Material & Vendor Master), Account Determination & Valuation of Material, Inventory Management, Invoice Verification, Material Requirement Planning, etc.

3.4 SAP MM Screen Navigation

3.4.1 Login Screen

Log on to the SAP ERP server. The SAP login screen will prompt you for the User ID and the Password. Provide a valid user ID and password and press enter. The user id and password are provided by the system administrator. The login screen appears as follows: -

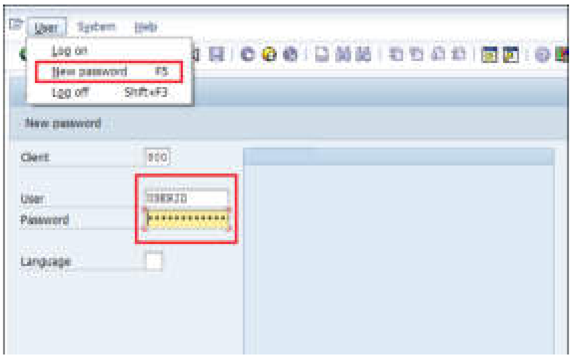


Fig 3.3 SAP MM Screen Navigation

3.4.2 Standard Toolbar Icon

Given below is a brief description of the available toolbars −

- ✓ **Menu Bar** − Menu bar is the top line of the dialog window in the SAP system.

- ✓ **Standard Toolbar** − This toolbar includes standard functions such as save, top of page, end of page, page up, page down, print, etc.

- ✓ **Title Bar** − Title bar displays the name of the application/business process you are currently in.

- ✓ **Application Toolbar** − Application-specific menu options are available on this toolbar.

- ✓ **Command Field** − To start a business application without navigating through menu transactions, some logical codes are assigned to the business processes. Transaction codes are entered in the command field to start an application directly.

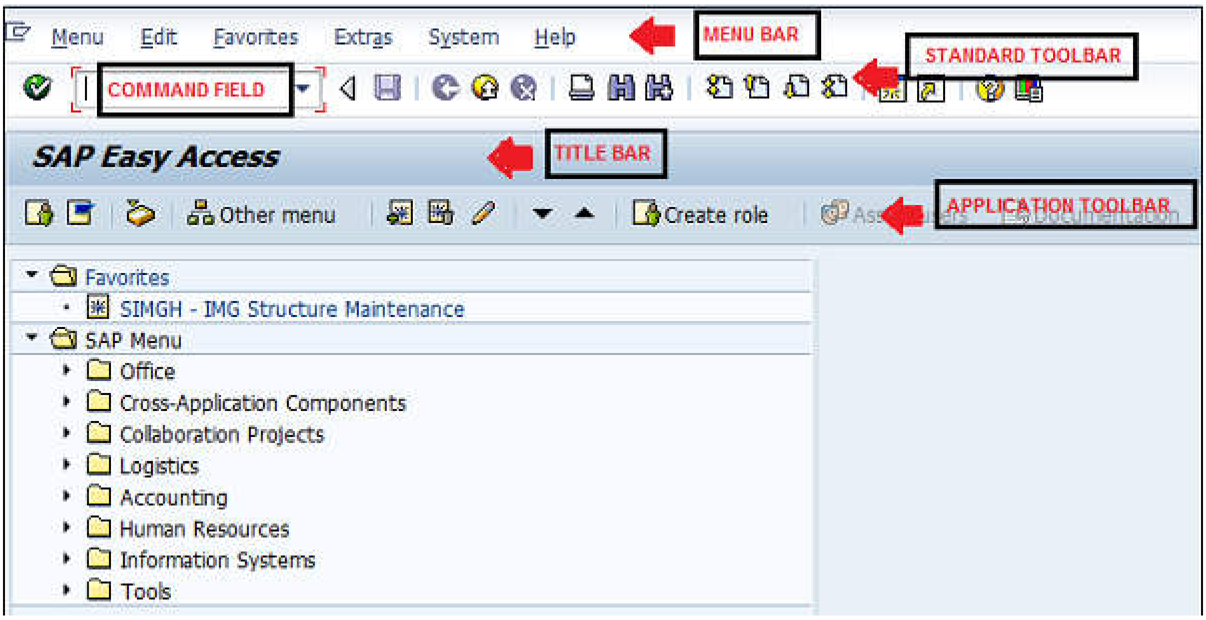


Fig 3.4 SAP MM Standard Toolbar Icon

3.5 SAP MM – Transaction Codes (T-Codes)

T-Code	Function	T-Code	Function	T-Code	Function
ME21N	Create PO	**MIGO**	Post Good Movements	**ME51N**	Create PR
ME22N	Change PO	**MB1C**	Post Other GR	**ME52N**	Change PR
ME23N	Display PO	**MB01**	Post GR for PO	**ME53N**	Display PR
ME29N	Release PO	**OMJJ**	Define New Movement Types	**MMBE**	Stock Overview

MMDE	Delete All Materials	**MRBR**	Release Blocked Invoices	**OX09**	Create Storage Location
ME41	Create RFQ	**ME42**	Change RFQ	**ME43**	Display RFQ
MM01	Create Material	**MM02**	Change Material	**MM03**	Display Material
MB51	Material Document List	**MB52**	List of Warehouse Stocks on Hand	**ME2M**	Purchasing Document List
XK01	Create Vendor	**XK02**	Change Vendor	**XK03**	Display Vendor

Table 3.1 SAP MM T-Codes

Chapter: 4 Inventory Management with SAP

4.1 ABC Analysis

ABC Always Better Control. In materials management, ABC analysis is an inventory categorization technique. ABC analysis divides an inventory into three categories—"A items" with very tight control and accurate records, "B items" with less tightly controlled and good records, and "C items" with the simplest controls possible and minimal records.

The ABC analysis provides a mechanism for identifying items that will have a significant impact on overall inventory cost, while also providing a mechanism for identifying different categories of stock that will require different management and controls.

The ABC analysis suggests that inventories of an organization are not of equal value. Thus, the inventory is grouped into three categories (A, B, and C) in order of their estimated importance. “A” items are very important for an organization. Because of the high value of these 'A' items, frequent value analysis is required. In addition to that, an organization needs to choose an appropriate order pattern (e.g., 'just-in-time') to avoid excess capacity. 'B' items are important, but of course less important than 'A' items and more important than 'C' items. Therefore, 'B' items are intergroup items. 'C' items are marginally important.

Case Study - In the case study we collect data of 10 items mentioned in the table no.4.1 and now we analysis the items according to the ABC Analysis and classify them in the A, B, C category.

Item	Item Name	Part No.	Unit Cost (Rs.)	Annual Usage	Annual Usage Value (Rs.)
1	Oil Filter	245479674	1275	198	252450
2	Water Separator	454278796	395	140	55300
3	Fuel Filter	325796564	270	98	26460
4	Rod Bearing	327856378	1430	46	65780
5	Air Filter	239865478	2135	20	42700
6	Piston Set	642853683	11500	26	299000
7	Piston Ring	532769845	5300	56	296800
8	Head Gasket	258764367	1750	333	582750
9	Main Bearing	467342484	1130	124	140120
10	Bushing	676476538	169	1177	198913

Table 4.1 List of identical items

Items	Unit Cost	Annual Usage	Annual Usage Value Rs.	Cumulative Annual Usage	Cumulative Annual percentage Usage %	% of items	Category
8	1570	333	582750	582750	29.72	10%	A
6	115	26	299000	881750	44.98	20%	A
7	5300	56	296800	1178550	60.12	30%	A
1	1275	198	252450	1431000	73	40%	B
10	169	1177	198913	1629913	83.14	50%	B
9	1130	124	140120	1770033	90.29	60%	B
4	1430	46	65780	1835813	93.65	70%	C
2	395	140	55300	1891113	96.47	80%	C
5	2135	20	42700	1933813	98.65	90%	C
3	270	98	26460	1960273	100	100%	C

Table 4.2 Ranking of items, using ABC Classification

Category	Item Number	Percentage of items	Percentage Of Annual usage	Action
A	325796564 532769845 258764367	30%	60.12%	Close Control
B	245479674 467342484 676476538	30%	30.17%	Regular Review
C	454278796 327856378 239865478 642853683	40%	9.71%	Infrequent Review

Table 4.3 Result of case study

From Table No.4-3, we can conclude that the first three Items No. [325796564, 532769845, 258764367] have need more attention as well As close control of A items for inventory records. The next three items No. [245479674, 467342484, 676476538] have moderate priority of B items and less control as compared to A items and review regularly. The last four items belong to lowest priority of C items. They should review infrequently and it should be ordered in bulk quantity to maintain safety stocks.

4.2 FSN Analysis

FSN analysis, FSN meaning Fast-moving, the slow-moving and non-moving in inventory management. FSN is one of the inventory management techniques and it is about segregating products based on their consumption rate, quantity, and the rate at which the inventory is used.

Fast-moving inventory, as the name suggests, comprises the stock that moves quickly and needs to be replenished very often. Generally, the stock that lies in this category has an inventory turnover ratio of more than 3 and constitutes around 10-15% of the total inventory.

Slow-moving inventory is the inventory that crawls slowly through the supply chain and has an inventory turnover ratio between 1-3. It is generally 30-35% of the total stock. The inventory that rarely moves with the inventory turnover ratio below 1 and makes 60-65% of the total stock is called the Non-moving inventory.

Particulars	F-class item	S-class item	N-class item
Stock	High	Intermediate	low
Control	High	Intermediate	Low
Safety stock	High	Low	Rare

Table 4.4 FSN Analysis

Chapter: 5 Procurement & Supply Chain Management

5.1 What is Procurement?

Procurement encompasses a range of activities involved in obtaining goods or services. What is the purpose of procurement? In general, procurement teams work to obtain competitively priced supplies that deliver the most value. However, not all companies define procurement in the same way. Many companies consider that procurement encompasses all the stages, from gathering business requirements and sourcing suppliers to tracking the receipt of goods and updating payment terms, while others define procurement as a narrower range of activities, such as issuing purchase orders and making payments.

5.2 Types of Procurement

Procurement can be categorized in several ways. It can be classified as direct or indirect procurement, depending on how the company will use the items being procured. It can also be categorized as goods or services procurement depending on the items that are being procured.

- **Direct procurement** refers to obtaining anything that's required to produce an end-product. For a manufacturing company, this includes raw materials and components. For a retailer, it includes any items purchased from a wholesaler for resale to customers.

- **Indirect procurement** typically involves purchases of items that are essential for day-to-day operations but don't directly contribute to the company's bottom line. This can include anything from office supplies and furniture to advertising campaigns, consulting services and equipment maintenance.

- **Goods procurement** largely refers to the procurement of physical items, but it can also include items like software subscriptions. Effective goods procurement generally relies on good supply chain management practices. It may include both direct and indirect procurement.

- **Services procurement** focuses on procuring people-based services. Depending on the company, this may include hiring individual contractors, contingent labour, law firms or on-site security services. It may include both direct and indirect procurement.

	Direct Procurement	Indirect Procurement	Goods Procurement	Services Procurement
What is it?	Any good or service required to produce an end product	All non-production-related goods or services	Physical items typically held as inventory, whether for direct or indirect procurement purposes	All people-based services procured, whether for direct or indirect procurement purposes
Examples	Raw materials, components and parts, machinery, items purchased for resale	Office supplies, marketing services, utilities	Raw materials, wholesale items, office supplies	Law firms, contractors, contingent labour, on-site security services

Table 5.1 Different Procurements with its example

5.3 Steps in the Procurement Process

Procurement processes vary greatly depending on each company's structure and needs, but generally include the following nine core steps:

- **Identify which goods and services the company needs.** First, a business must identify its requirements for a specific item or a service. This may be a new item that the company hasn't previously purchased, a restock of existing goods or a subscription renewal. This step typically involves delving into the nitty-gritty details of what the business needs, such as the precise technical specifications, materials, part numbers or service characteristics. At this stage, it's a good idea to consult all business departments affected by the purchasing decision to ensure the procured items accurately reflect the needs of each department.

- **Submit purchase request.** When an employee or business group needs to procure a significant quantity of new supplies or services, they make a formal purchase request (also known as a purchase requisition). A purchase request notifies the company that a need exists, usually via department managers, purchasing staff or the financial team, as well as specifications such as price, time frame needed, quantity and other important things for the purchasing team to keep in mind. The department overseeing the purchase can then approve or deny the purchase request. If approved, the procurement team can proceed with selecting a vendor and making the purchase.

- **Assess and select vendors.** With a clear list of requirements and an approved purchase request, now is the time to find the best vendor and submit a request for quote (RFQ) – this is what the purchasing team sends to potential suppliers in order to receive a quote – it is important to be as detailed as possible so you can compare apples to apples. Vendor assessment should focus not only on cost but also on reputation, speed, quality and reliability. Many companies consider ethics and social responsibility as well, since procurement is often intertwined with corporate identity. A retailer that prides itself on sustainability would stand to benefit from partnering with environmentally responsible suppliers, for instance.

- **Negotiate price and terms.** A common best practice is to get at least three quotes from suppliers before making a decision. Examine each quote carefully and negotiate where possible. If you need to walk away from a deal, be sure that you have concrete alternative options. Once you've agreed on final terms, be sure to get them in writing.

- **Create a purchase order.** Fill out a purchase order (PO) and send it to the supplier. The PO should be sufficiently detailed to identify the exact services or goods needed and to enable the supplier to fill the order.

- **Receive and inspect the delivered goods.** Carefully examine deliveries for any errors or damage. Make sure everything is delivered as specified in the PO and that the quality meets or exceeds expectations.

- **Conduct three-way matching.** Accounts payable should conduct three-way matching by comparing the purchase order, order receipt or packing list and invoice. The goal is to ensure the goods or services received match the purchase order and to prevent payment for unauthorized or inaccurate invoices. Highlight any discrepancies between the three documents and resolve issues before arranging payment.

- **Approve the invoice and arrange payment.** If the three-way match is accurate, approve and pay the invoice. Businesses should strive to have a consistent invoice payment process through accounts payable that checks that payments match the invoice amount and due date. A standardized process can help make sure invoices are always paid on time, which can prevent late fees and build good relationships with suppliers.

- **Recordkeeping.** It is important to maintain records for the entire procurement process, from purchase requests to price negotiations, invoices, receipts and everything in between. These records may be useful for multiple reasons. They help the company reorder goods at the right price in the future, as well as assist with auditing processes and calculating taxes. Clear, accurate records can also help resolve any potential disputes.

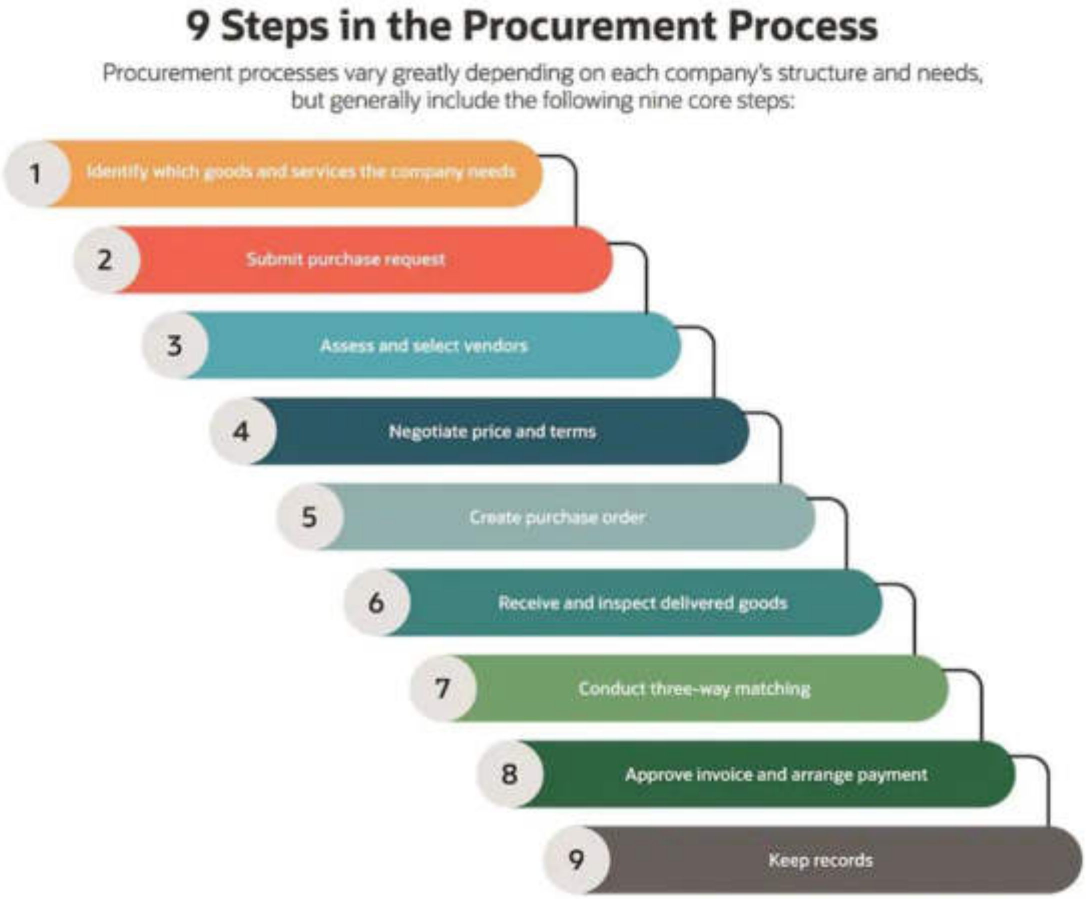


Fig 5.1 Steps in the Procurement Process

5.4 Stages of Procurement

The nine major steps of the procurement process can also be thought of in three distinct stages: the sourcing stage, the purchasing stage, and the receiving stage.

- **Sourcing stage:** This covers the initial steps in which the business identifies its needs, creates a purchase request, and assesses vendors. Even after the initial sourcing steps are complete, it is a good practice to build a strong relationship with suppliers. They can establish grounds for suppliers to learn from partners, improve products and processes and develop trust.

- **Purchasing stage:** This stage includes negotiating terms, creating orders and receiving and inspecting goods and services.

- **Payment stage:** Accounts payable conducts three-way matching to ensure order and invoice accuracy. The invoice can then be approved and the payment is arranged. Records of all invoices, orders and payments should be kept and carefully maintained.

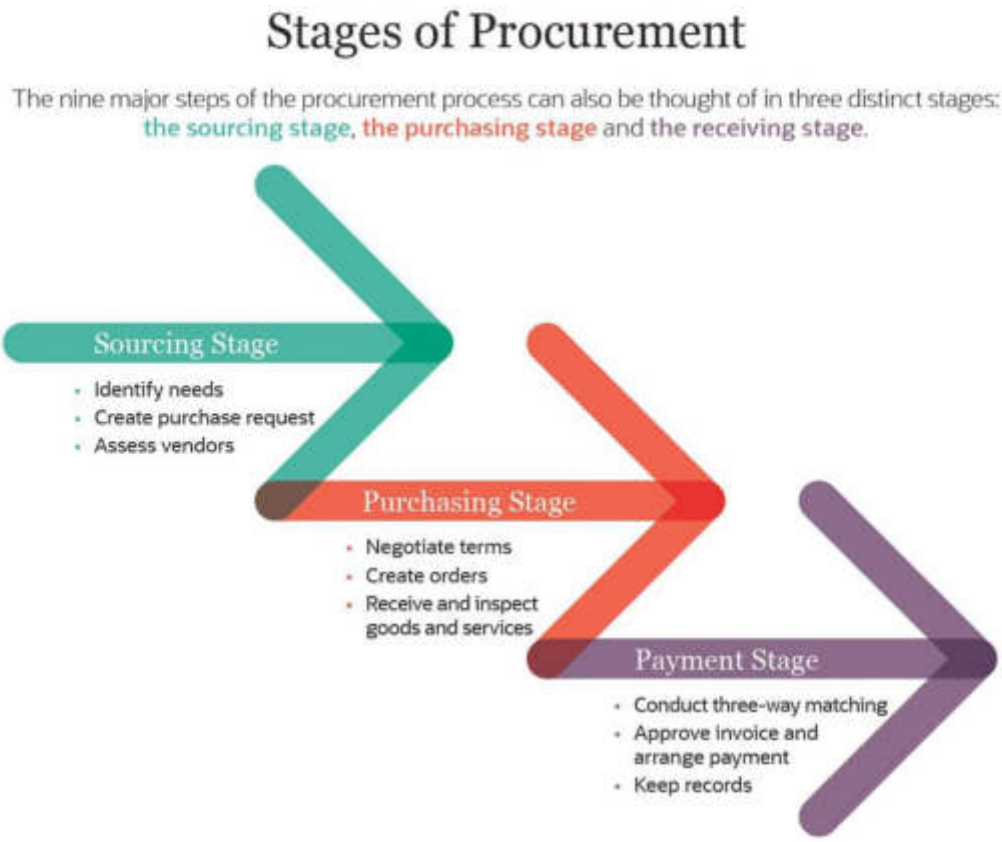


Fig 5.2 Stages of Procurement

5.5 What is Supply Chain?

Fig 5.3 Supply Chain Management

A supply chain is an entire system of producing and delivering a product or service, from the very beginning stage of sourcing the raw materials to the final delivery of the product or service to end-users.

The supply chain lays out all aspects of the production process, including the activities involved at each stage, information that is being communicated, natural resources that are transformed into useful materials, human resources, and other components that go into the finished product or service.

5.6 Generic Supply Chain

The generic supply chain begins with the sourcing and extraction of raw materials. The raw materials are then taken by a logistics provider to a supplier, which acts as the wholesaler. The materials are taken to a manufacturer, or probably to various manufacturers that refine and process them into a finished product.

Afterward, it goes to a distributor that wholesales the finished product, which is next delivered to a retailer. The retailer sells the product in a store to consumers. Once the consumer buys it, this completes the cycle, but it's the demand that then goes back and drives the production of more raw materials, and the cycle continues.

Fig 5.4 Generic Supply Chain Cycle

5.7 Procurement, Purchasing and Supply Chain: What is the Difference?

Fig 5.5 Procurement, Purchasing and Supply Chain

- **Procurement vs. purchasing:** If procurement involves purchasing, you might be wondering: What is the difference between purchasing and procurement? The answer is that purchasing is essentially transactional, focusing on managing specific orders to meet company needs. Procurement is a much broader and more complex set of processes, including establishing and maintaining supplier relationships. Another way to think about the difference between purchasing and procurement is that procurement takes a proactive approach that starts with analysing the company's needs, whereas purchasing is a reactive approach — simply focusing on obtaining what the company has already decided it needs.

- **Procurement vs. supply chain:** Procurement covers one aspect of supply chain management. Procurement includes sourcing, obtaining, and paying for goods and services. Supply chain management also covers the logistics involved in obtaining goods, such as shipping and warehouse management, as well as transforming the procured goods into products and distributing them to customers.

	Procurement	Purchasing	Sourcing	Supply Chain Management
Definition	All activities related to carefully sourcing and obtaining goods and services needed to support business operations	Buying goods & services	Selecting and vetting vendors to provide goods and/or services	Managing the coordinated network of companies, facilities and business activities involved in sourcing, developing, manufacturing, and delivering products

Scope	Includes sourcing, negotiation, purchasing, receiving and recordkeeping	Part of the procurement process	Part of the procurement process	Part of the procurement process
Focus	Ensuring the company gets the most value from goods or services to increase the business's profitability	Usually focuses on getting a good price	Establishing good, long-term relationships with suppliers	Cutting costs while getting goods to the customer as quickly as possible, without sacrificing quality or accuracy

Table 5.2 Procurement, Purchasing & Supply Chain Management

Chapter: 6 Internship Journey at Ammann India

6.1 My Roles and Responsibilities

Fig 6.1 Work at Ammann India Private Limited

- **Follow up with suppliers:** Maintain regular communication with suppliers and buyer to ensure timely delivery of equipment, parts, and materials. Track the status of purchase orders and follow up with suppliers to obtain updates on order progress.

Address any inquiries or issues from suppliers regarding specifications, quantities, or delivery schedules. Maintaining records of supplier communications and update relevant team members accordingly.

- **Sending Item drawings to the supplier for further manufacturing of the bought-out items:** Worked closely with the engineering and design teams to gather relevant drawings and specifications for parts or components. Coordinate with suppliers to transmit the required drawings and specifications for further manufacturing. Ensure timely and accurate delivery of drawings, addressing any questions or clarifications from the suppliers.

- **Cost Analysis:** Assist in conducting cost analysis for evaluating supplier quotes, comparing pricing options, and assessing cost-saving opportunities. Identify the key cost components, including unit prices.

- **Inspection of parts:** Assist in inspecting incoming parts and materials for quality, accuracy, and compliance with specifications. Collaborate with the quality control team to perform visual inspections, measurements, and tests as required.

- **Planning Sheet:** Supported the creation of planning sheets for Bill of material (BOM) that outline the equipment, parts, and materials required for specific projects or production runs.

- **In-warding and Consumption Summary Chart for 2021 to 2023(up to March) for Machine Division:** Generated consumption and in-warding reports and charts based on the in-warding and consumption data from SAP software.

- **Support inventory management:** Assist in maintaining accurate inventory records for materials, parts, and supplies. Conduct regular stock checks and reconcile inventory discrepancies.

- **Collaborate with cross-functional teams:** Worked closely with project managers, engineers, and other departments to understand their functions and supply needs.

6.2 Task Assigned - about Cost Analysis Between targeted and actual price using SAP Software

Sr. No.	Model Name	Description	Target Price	Hydroline ME2M price	Manuli ME2M price	Cost Diff. for Hydroline	Cost Diff. for Manuli
1	ARS 110.2 T1	Hydr Hose 32 1SN 35N90/35N45-1000-0	1633	1,652.00		-19	1633
2	ARS 110.2 T1	Hydr Hose 13 1SN 15N90/15D00-910-0	347	364.61		-17	347
3	ARS 110.2 T1	Hydr Hose 13 2SN 15N00/15N45-750-0	348			348	348
4	ARS 110.2 T1	Hydr Hose 13 2SN 15N00/15N45-1500-0	504			504	504
5	ARS 110.2 T1	Hydr Hose 13 2SN 15N00/15N45-1450-0	493			493	493
6	ARS 110.2 T1	Hydr hose 13 4SP 15N90/15N00-600-0	428			428	428
7	ARS 110.2 T1	Hydr Hose 19 2SN 22N00/22N90-950-0	629			629	629
8	ARS 110.2 T1	Hydr Hose 19 1SN 22N90/22N90-700-180	548	657.00		-109	548
9	ARS 110.2 T1	Hydr Hose 19 1SN 22N00/22N90-550-0	465	550.00		-85	465
10	ARS 110.2 T1	Hydr Hose 25 4SP 25S90M/25P90-1000-0	1393	1,592.00		-199	1393
11	ARS 110.2 T1	Hydr Hose 16 4SP 19S00/20P45-3500-0	1918	2,686.66		-769	1918
12	ARS 110.2 T1	Hydr Hose 16 4SP 19S00/20P45-3300-0	1827	2,549.84		-722	1827
13	ARS 110.2 T1	Hydr hose 19 1SN 18N90/18N90-1050-270	684	959	817.00	-275	-133
14	ARS 110.2 T1	Hydr hose 06 1SN 10N90/10N00-1030-0	230	230	291.00	0	-61
15	ARS 110.2 T1	Hydr hose 06 1SN 10N00/10N90-550-0	192	289	229.00	-97	-37
16	ARS 110.2 T1	Hydr Hose 06 1SN 10N90/BJ14-850-90	236	259.00		-23	236
17	ARS 110.2 T1	Hydr Hose 13 1SN 15N90/15N45-3000-0	708	758.00		-50	708
18	ARS 110.2 T1	Hydr Hose 08 1SN 10N90/10N90-3800-60	588	659.00		-71	588
19	ARS 110.2 T1	Hydr hose 08 1SN 10N90/10N90-800-20	252	353	301.00	-101	-49
20	ARS 110.2 T1	Hydr Hose 10 2SN 12N00/12N90-1200-0	366	386.59		-21	366
21	ARS 110.2 T1	Hydr Hose 10 2SN 12N45/12N90-800-90	299	320.63		-22	299
22	ARS 110.2 T1	Hydr Hose 25 1SN 28N00/28N90-2700-0	1623	1,723.00		-100	1623
23	ARS 110.2 T1	Hydr Hose 25 1SN 28N00/28N00-2100-0	1377	1,372.00		5	1377
24	ARS 110.2 T1	Hydr hose 19 1SN 22N90/22N90-750-15	632	844	755.00	-212	-123
25	ARS 110.2 T1	Hydr hose 16 4SP 19S90M/19S45M-3500-30	2064	3,387.00	2,467.00	-1323	-403
26	ARS 110.2 T1	Hydr hose 13 1SN 15N90/15N00-3200-0	686	1,124.00	820.00	-438	-134
27	ARS 110.2 T1	Hydr hose 19 1SN 22N90/22N90-1200-90	698	1,077.00	924.00	-379	-226
28	ARS 110.2 T1	Hydr hose 04 R1T EFR90/EFR00-350-0	157	169.00	188.00	-12	-31
29	ARS 110.2 T1	Hydr Hose 10 1SN 12N90/12N90-450-0	201	210.00		-9	201
30	ARS 110.2 T1	Hydr Hose 06 1SN 08N90/08N90-600-90	182	198.25		-17	182
31	ARS 110.2 T1	Hydr Hose 06 1SN 08N00/08N90-490-0	160	167.87		-8	160
32	ARS 110.2 T1	Hydr Hose 10 1SN 12N90/without-1400-0	250	252.19		-2	250
33	ARS 110.2 T1	Hydr Hose 10 1SN 12N90/without-200-0	119			119	119
34	ARS 110.2 T1	Hydr Hose 10 1SN 12N90/without-1500-0	297			297	297
35	ARS 110.2 T1	Hydr Hose 10 1SN 12N90/without-1800-0	339	413.69		-75	339
			22871				

Table 6.1 Measure of Cost Analysis between Targeted and Actual

6.3 Task Assigned - Create a RFQ for supplier to receive a Quotation Price List

Sr. No.	Part Code	Description	Unit Price
1	1760924	Fuel Filter AFT500 CEV IV	₹ 2,617.98
2	1760901	Cartridge Lub Oil Filter	₹ 855.58
3	1760927	Filter Diesel Exhaust fluid	₹ 1,511.45
4	1760941	Filter Diesel Exhaust fluid	₹ 2,993.83
5	1518241	Engine Oil CI4 Plus 15W40 20L	
6	1457195	Cooling agent non aminic	
7	1595464	AdBlue Additive AUS32	
8	1652331	Fuel Filter with water seperator	
9	1760905	Gasket Exhaust manifold	₹ 160.55
10	1760906	Gasket Oil Drain	₹ 365.14
11	1760903	Gasket Tubro charger	₹ 68.04

SUDHIR SALES & SERVICES LIMITED 1A:1B, SAFAL PRELUDE, OPP. SPIPA , B/H,ASHWARAJ BUNGLOWS, CORPORATE ROAD, PRAHLADNAGAR, AHMEDABAD , 380015 GUJARAT India Ph : Fax : Email:spc.guj@sudhirgroup.com CIN: GSTIN:24AANCS0891F1Z8 PAN: AANCS0891F	Quotation #:	Quo-SU-AH-2122-003928	Quote Date:	11-02-2022
	Quotation Type:	Quotation	Valid Up To:	
	Revision #:	1	Number of Items:	47 Sales Representative: SANDIP PATEL
	Payment Terms(Days):	45		
	Shipping Warehouse:	Sudhir - Ahmedabad	Freight Terms:	Customer To Pay
	Engine Serial #		Documents To:	
	Engine Model		Service Engineer Name	

Indentor:	Consignee:	Customer Details	
AMMANN INDIA PRIVATE LIMITED BLOCK NO. 157, AT. DITASAN, STATE HIGHWAY| P.O. JAGUDAN-382710 MEHSANA , 382710 GUJARAT 24 India GSTIN:24AACCA0194N1ZO	AMMANN INDIA PRIVATE LIMITED BLOCK NO. 157, AT. DITASAN, STATE HIGHWAY| MEHSANA , 382710 GUJARAT 24 India GSTIN: 24AACCA0194N1ZO	Customer Name:	AMMANN INDIA PRIVATE LIMITED
		Customer ID	1-3PEQ06M
		Customer Vendor Code:	
		Contact First Name:	
		Contact Last Name:	
		Contact Phone #:	
Indentor Site:MEHSANA	Consignee Site:MEHSANA	Remarks:	
Shipping Instructions:			

Sr. No	Item #	Item Description	HSN/SAC	Qty	UoM	Unit Price (Rs.)	Disc %	Disc Amt	Buy Back Disc %	Buy Back Disc Amt	Total Amt	Net Taxable Amt	CGST %	CGST Tax Amt	SGST%	SGST Tax Amt	IGST%	IGST Tax Amt	UTGST%	UTGST Tax Amt	GST Total Amt	Gross Amount(Rs.)
1	3917994	CLAMP, SPRING HOSE	73269099	2	Each	211.46					422.92	422.92	9	38.06	9	38.06	0	0.00	0	0.00	76.13	499.05
2	3937613	CLAMP, HOSE	73269099	6	Each	142.40					854.40	854.40	9	76.90	9	76.90	0	0.00	0	0.00	153.79	1,008.19
3	5316750	CONNECTOR, QCK DISCO	73181600	2	Each	369.00					738.00	738.00	9	66.42	9	66.42	0	0.00	0	0.00	132.84	870.84
4	5266066	GASKET,ACC DRIVE COVER	40169960	2	Each	645.19					1290.38	1,290.38	9	116.13	9	116.13	0	0.00	0	0.00	232.27	1,522.65
5	5525036	ALTERNATOR	85115000	1	Each	9556.29					9556.29	9,556.29	14	1337.88	14	1337.88	0	0.00	0	0.00	2675.76	12,232.05

Table 6.2 Quotation Price List from RFQ

6.4 Task Assigned - provide Specifications for various parts.

Sr. No.	Description	Specification
1	Bulkhead coupling ST XGSV 14 S	Screwed Connection Long (Bulkhead)
		Side 1: M22X1.5 (14PS)
		Side 2: M22X1.5 (14PS)
		FOR fitting catalogue code : A703502/14
		Standard : DIN 3861
2	Bulkhead coupling ST XGSV 22 L	ST XGSV 22 L
3	Screwed Connection FOR A702159/0813	Screwed Fitting M-FS
		Port Side : G-1/4"
		Hose Side : M14X1.5(FS)
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : A702159/0813
4	Screwed Connection FOR A702050/2833	Screwed Fitting
		Port Side :M33x2
		Hose Side : M36x2
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : A702050/2833
5	Screwed connection FOR SA707037/2826	90 Adj elbow
		Port Side : G-3/4"
		Hose Side : M36X2
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : SA707037/2826
6	Screwed Connection FOR A702038/1013	Screwed Fitting
		Port Side : G-1/4"
		Hose Side : M16X1.5
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : A702038/1013
7	Screwed connection FOR A702126/1518	Screwed Fitting M-FS
		Port Side : M18X1.5
		Hose Side : M22X1.5 (FS)
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : A702126/1518
8	Screwed Connection FOR SA702159/1517	Screwed Fitting M-FS
		Port Side : G-3/8"
		Hose Side : M22X1.5 (FS)
		Fitting with O-Ring & Retaining ring
		FOR Catalogue Number : SA702159/1517

Table 6.3 Identification of Part Specification

6.5 Task Assigned - Follow up regarding Articulated Joint Weldment

Part No.: - ABCDEF

- Description: - Articulated Joint Weldment
- Date [14th Feb.]: - PO release to supplier
- Date [15th Feb.]: - Commitment date given by supplier [1st March,2023]
- Date [21th Feb.]: - photos sent by supplier


Fig 6.2 Work in Progress

- Date [23rd Feb.]: - DP test remaining for welding
- Date [25th Feb.]: - DP test done for welding at supplier end
- Date [28th Feb.]: - Inspection done at supplier & found ok.
- Date [1st March]: - Part dispatch from supplier end & inward in Ammann India with 103 & 105 entry.

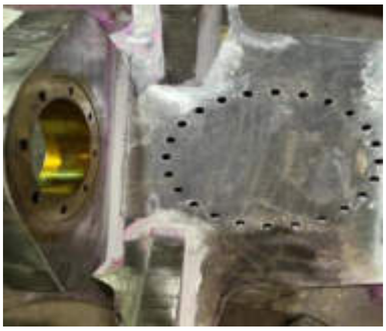
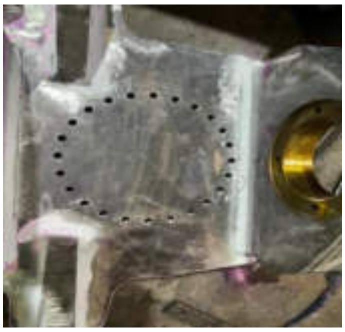




Fig 6.3 DP Test Done



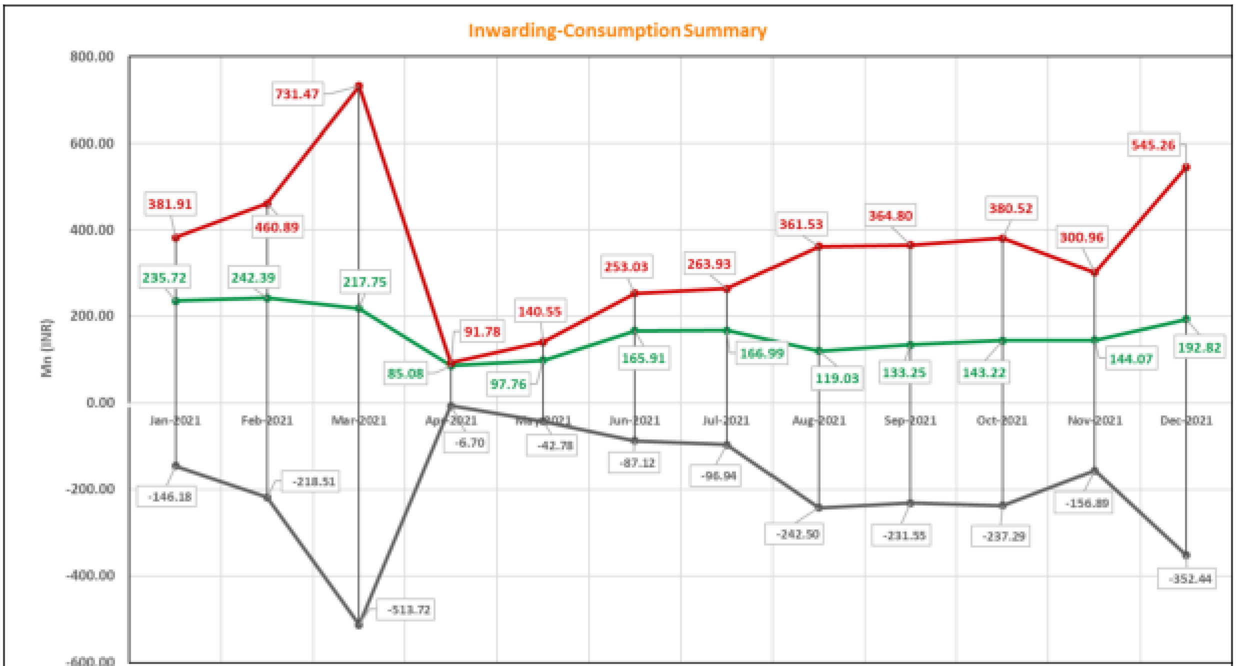




RED TAG
AREA

Fig 6.4 Articulated Joint Weldment

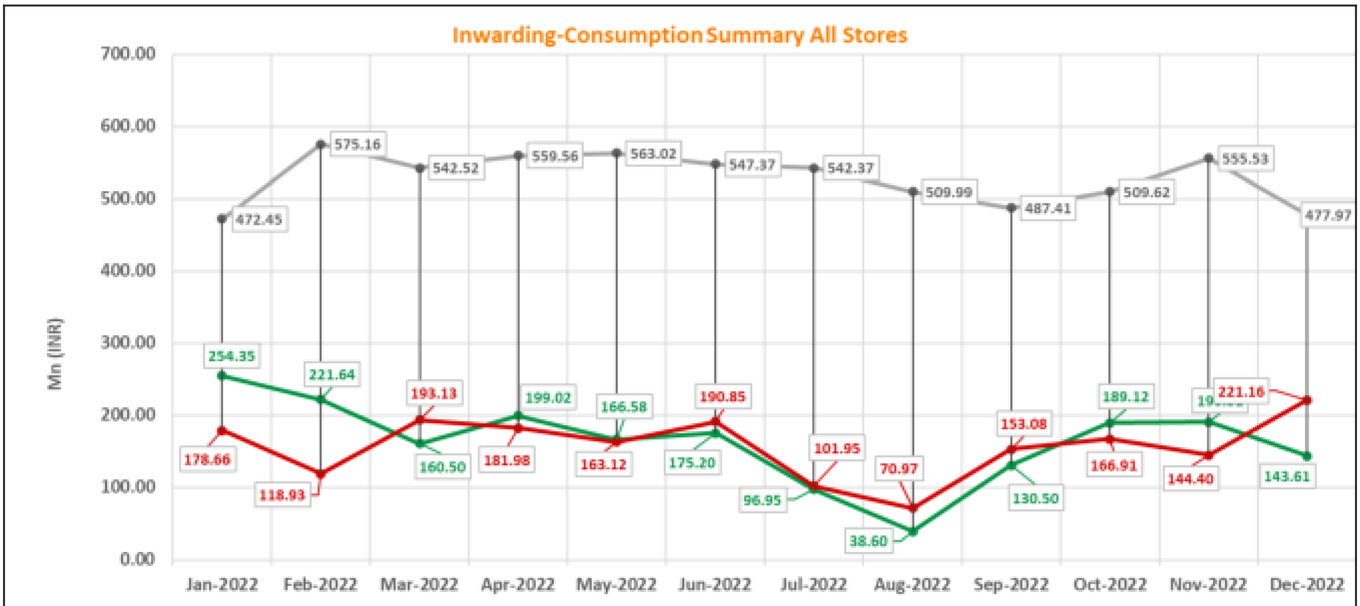
6.6 Task Assigned - In-warding Consumption Summary of Machine Division for 2021



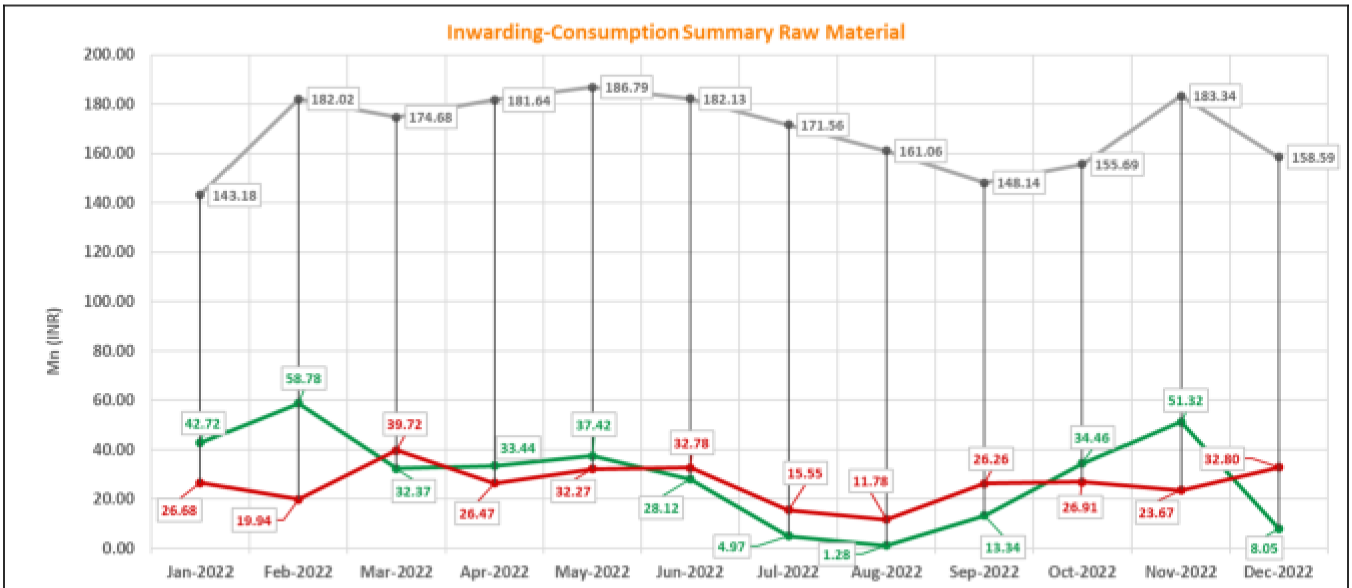
	Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021	Jun-2021	Jul-2021	Aug-2021	Sep-2021	Oct-2021	Nov-2021	Dec-2021
Inwarding	235.72	242.39	217.75	85.08	97.76	165.91	166.99	119.03	133.25	143.22	144.07	192.82
Consumption	381.91	460.89	731.47	91.78	140.55	253.03	263.93	361.53	364.80	380.52	300.96	545.26
Net	-146.18	-218.51	-513.72	-6.70	-42.78	-87.12	-96.94	-242.50	-231.55	-237.29	-156.89	-352.44

Fig 6.5 In-warding Consumption Summary of Machine Division for 2021

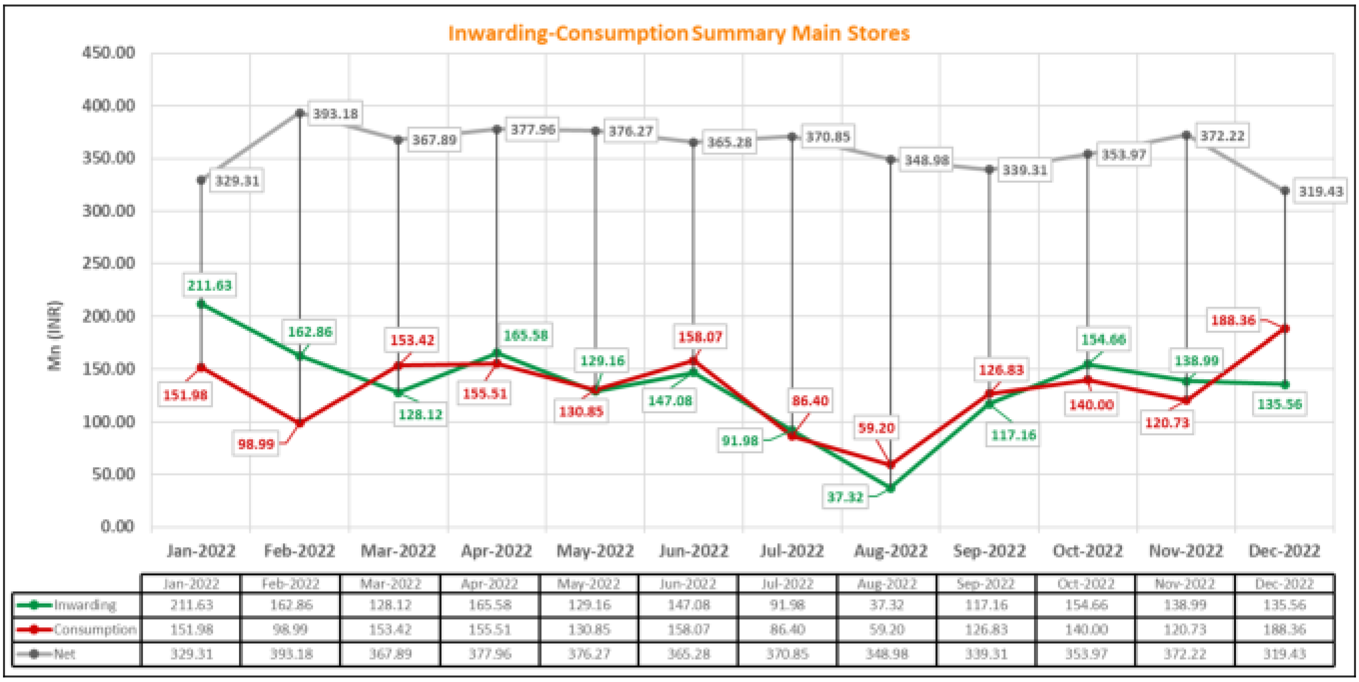
6.7 Task Assigned - In-Warding Consumption Summary of Machine Division for 2022



	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	Dec-2022
Inwarding	254.35	221.64	160.50	199.02	166.58	175.20	96.95	38.60	130.50	189.12	190.31	143.61
Consumption	178.66	118.93	193.13	181.98	163.12	190.85	101.95	70.97	153.08	166.91	144.40	221.16
Net	472.45	575.16	542.52	559.56	563.02	547.37	542.37	509.99	487.41	509.62	555.53	477.97



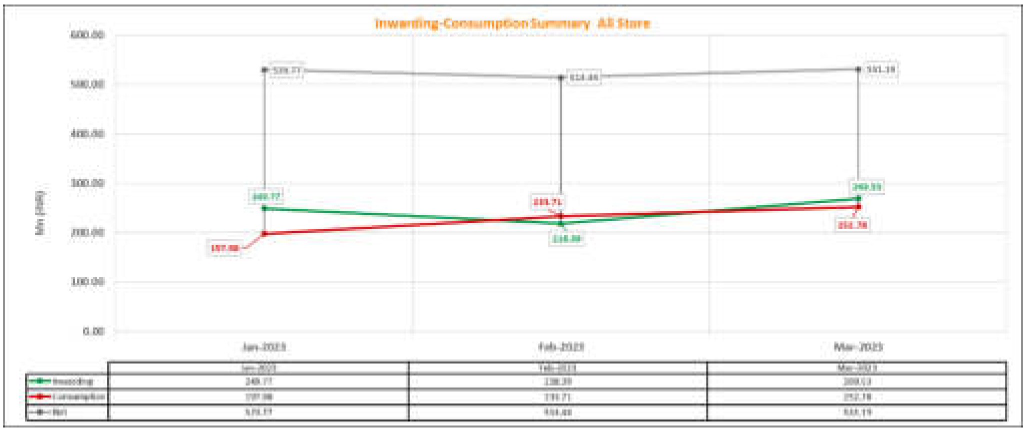
	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	Dec-2022
Inwarding	42.72	58.78	32.37	33.44	37.42	28.12	4.97	1.28	13.34	34.46	51.32	8.05
Consumption	26.68	19.94	39.72	26.47	32.27	32.78	15.55	11.78	26.26	26.91	23.67	32.80
Net	143.18	182.02	174.68	181.64	186.79	182.13	171.56	161.06	148.14	155.69	183.34	158.59

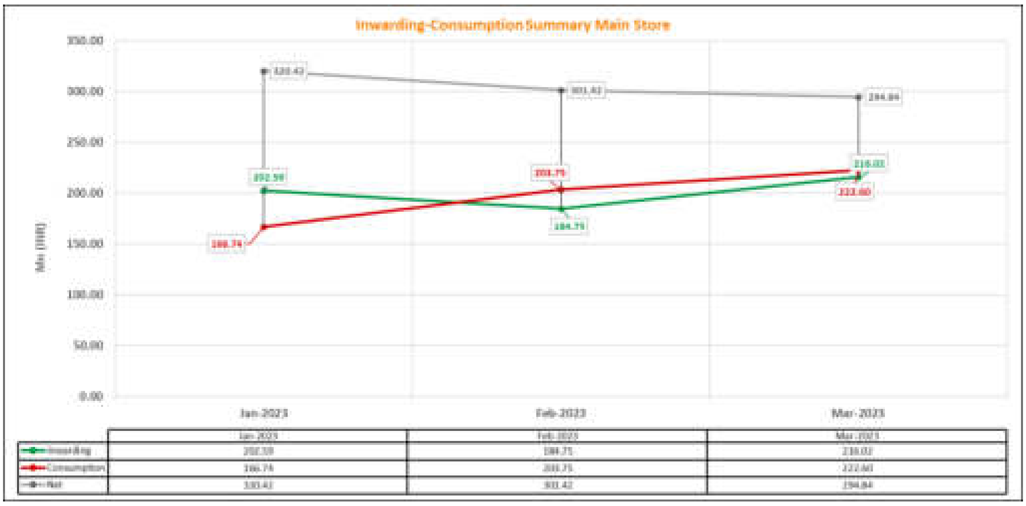


	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	Dec-2022
Inwarding	211.63	162.86	128.12	165.58	129.16	147.08	91.98	37.32	117.16	154.66	138.99	135.56
Consumption	151.98	98.99	153.42	155.51	130.85	158.07	86.40	59.20	126.83	140.00	120.73	188.36
Net	329.31	393.18	367.89	377.96	376.27	365.28	370.85	348.98	339.31	353.97	372.22	319.43

Fig 6.6 In-Warding Consumption Summary of Machine Division for 2022

6.8 Task Assigned - In-warding Consumption Summary of Machine Division for 2023





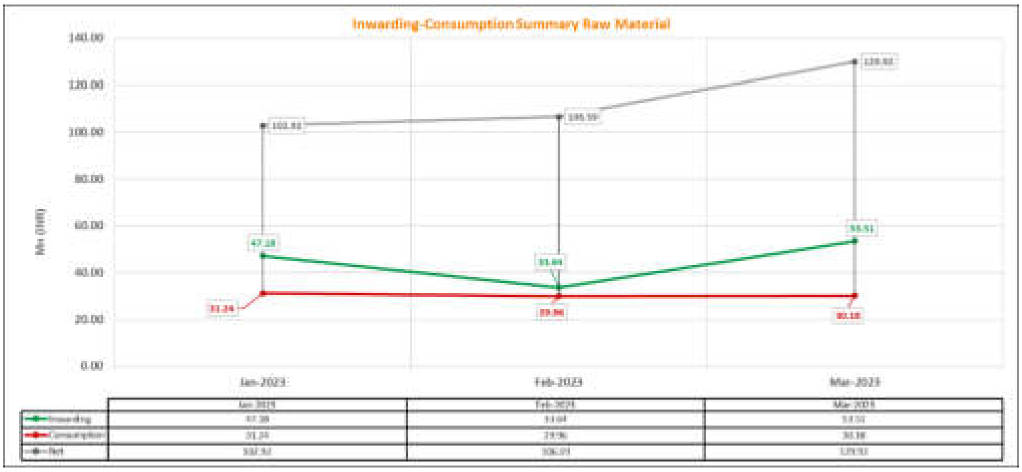


Fig 6.7 In-warding Consumption Summary of Machine Division for 2023

6.9 Task Assigned - Item Drawing Approval from design department & finding respective supplier for production of models

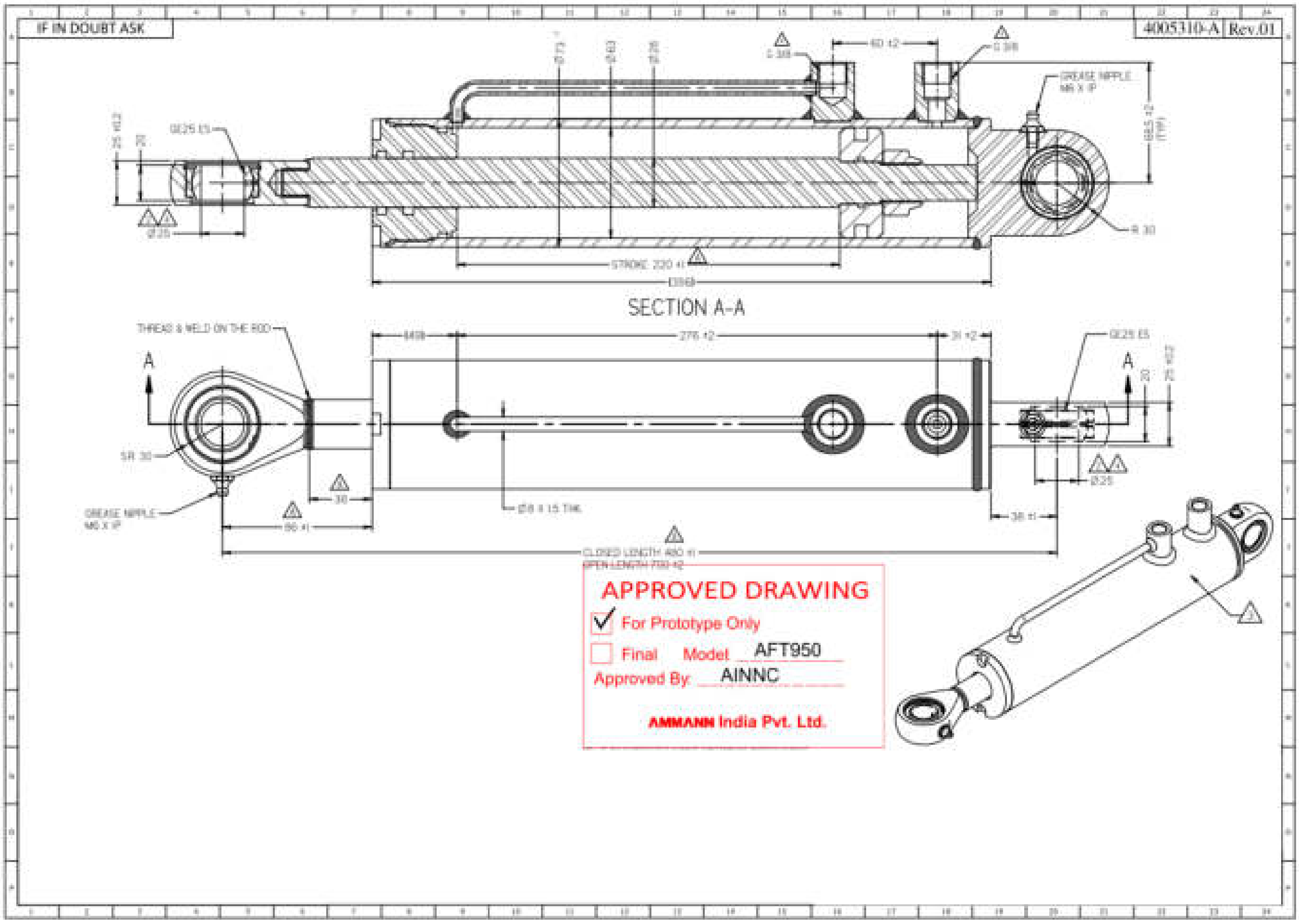


Fig 6.8 Part Drawing Sheet

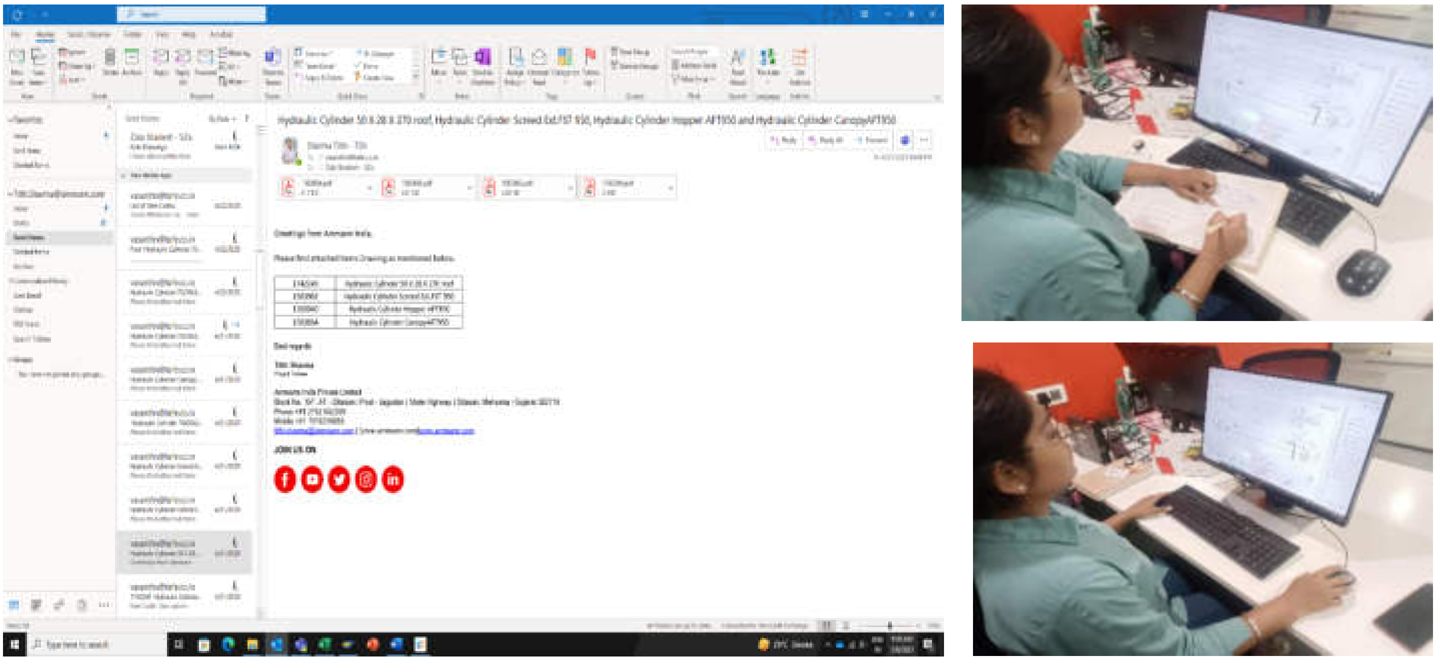


Fig 6.9 Work for the drawing task

6.10 Task Assigned - BOM Planning Sheet for various Models

Part Code	Description	Uom	AP550_BS4 - Soft top	AP550_BS4 - Hard top (Optional)	AP600_BS4 TV4900 - 6M Hard top	AP600_BS4 TV4500 - 6M Hard top	AP550_BS3	AP600_BS3_TV4900	ATM4000	ATM6000	ATM10000	Mech Broomer	Hyd Broomer	AFW500 T3	ARS122_BS3_Base
	Hinge 6x 50x 50 S= 6 li/re schwarz	PCE	4	4	4	4	0	0	0	0	0	0	0	0	0
	Foil Betriebsanleitung	PCE	1	1	2	1	0	1	0	0	0	0	0	2	0
	Isolating pin D=3 L=030 Typ=IS3 Form=A	PCE	4	4	4	4	0	0	0	0	0	0	0	4	0
	Pressure Switch 12bar	PCE	1	1	1	1	0	0	0	0	0	0	0	0	0
	Hexagon nut M4 8 galZn	PCE	2	2	2	2	0	0	0	0	0	0	0	0	0
	Foil <Attention Welding / Wiring>	PCE	1	1	1	1	0	0	0	0	0	0	0	1	0
	Washer R 13/45x4 100HV galZn	PCE	6	6	6	6	0	0	0	0	0	0	0	1	0
	Battery 12 VOLT 150AH [EXIDE MAKE]	PCE	2	2	2	2	0	1	0	0	0	0	0	0	1
	Hose SAE 20R3EC Class D2, 1", 1500mm	PCE	1	1	1	1	0	0	0	0	0	0	0	1	0
	Hose CAC 3"	PCE	1	1	1	1	0	0	0	0	0	0	0	0	0
	TB HOSE CLAMP SPRING LOADED SLTB-44	PCE	1	1	1	1	0	0	0	0	0	0	0	0	1
	WARM DRIVE CLAMP 35A (IS 4762 SIZE: 35)	PCE	2	2	2	2	0	0	0	0	0	0	0	0	0
	Signal Horn WINDTONE 5A, 12V,	PCE	1	1	1	1	0	0	0	0	0	0	0	0	1
	Adhesive Tape 1” (25.4mm) (B/W)	FT	80	80	100	100	24.5	30.5	0	0	0	0	0	0	0
	PRO.SHAFT REAR TEETH BUSH SLOT & WELD	PCE	4	4	0	4	4	0	0	0	0	0	0	0	0
	PROPELLER SHAFT REAR TEETH AXLE OD 50 MM	PCE	3	3	4	3	3	4	0	0	0	0	0	4	0
	STUB BALL HALF YOKE V-GROOVE	PCE	6	6	0	0	6	0	0	0	0	0	0	0	0
	STUB BALL HALF YOKE 1"HOLE & KEY SLOT	PCE	8	8	0	8	8	0	0	0	0	0	0	0	0
	STUB BALL HALF YOKE DIA 50MM	PCE	7	7	4	11	7	4	0	0	0	0	0	2	0
	Driver’s Seat WITH HANDLE (LCV CUSHINOS)	PCE	2	2	2	2	0	2	0	0	0	0	0	0	0
	Safety Belt 2V	SAT	2	2	2	2	2	2	0	0	0	0	0	0	0
	ICATE REFLECTOR RED	PCE	4	4	4	4	4	4	0	0	0	0	0	0	0
	Reflector ROUND AMBER	PCE	6	6	4	4	8	8	0	0	0	0	0	0	0
	Reflector ROUND WHITE	PCE	2	2	2	2	2	2	0	0	0	0	0	0	0
	Hollow screw 1/8" X 1 1/4"	PCE	2	2	2	2	2	2	0	0	0	0	0	0	0
	Washer BANJO 1/8"	PCE	4	4	4	4	4	4	0	0	0	0	0	0	0
	Washer BANJO 14MM (BRASS MAKE)	PCE	10	10	10	10	4	4	2	2	2	0	0	0	5
	Rod TIE END "KAFILA" (KF-3314)	SAT	1	1	1	1	1	1	0	0	0	0	0	0	0

Table 6.4 Creation of BOM Planning Sheet

6.11 Task Assigned - Extract the latest price of hydraulic hose from SAP using ME2M T-code

ARS110.2 CEV st V HOSE SET																
SR. NO.	HOSE ROUTING	PART CODE	PARTCODE DESCRIPTION	STANDARD	HOSE GRADE	HOSE SIZE	END A		END B		HOSE LENGTH	ANGLE OF ROTATION	Hydroline Price	Manuli Price	Hi-Flex Price	Patel Price
1	Hydraulic tank to Steering pump IN port	1521540	Hydr hose 32 1SN 35N90/35N45-1300-270	ISO 17165-1	1SN	32	35N90	M45x2	35N45	M45x2	1300	270				
2	Steering Pump out Port to Tee	1591358	Hydr hose 13 1SN 15N90/15D00-900-0	ISO 17165-1	1SN	13	15N90	M22x1.5	15D00	M22x1.5 Straight Male	900	0				
3	Tee to Steering unit P port	1758049	Hydr Hose 13 2SN 15N00/15N45-750-0	ISO 17165-1	2SN	13	15N00	M22x1.5	15N45	M22x1.5	750	0				
4	Steering unit R port to Tee	1758074	Hydr Hose 13 2SN 15N00/15N45-1500-0	ISO 17165-1	2SN	13	15N00	M22x1.5	15N45	M22x1.5	1500	0				
5	Steering unit L port to Tee	1758071	Hydr Hose 13 2SN 15N00/15N45-1450-0	ISO 17165-1	2SN	13	15N00	M22x1.5	15N45	M22x1.5	1450	0				
6	Tee to steering cylinder RH front port	1474314	Hydr hose 13 4SP 15N90/15N00-600-0	ISO 17165-1	4SP	13	15N90	M22x1.5	15N00	M22x1.5	600	0				
7	Tee to steering cylinder LH front port	1474314	Hydr hose 13 4SP 15N90/15N00-600-0	ISO 17165-1	4SP	13	15N90	M22x1.5	15N00	M22x1.5	600	0				
8	Tee to steering cylinder RH rear port	1474314	Hydr hose 13 4SP 15N90/15N00-600-0	ISO 17165-1	4SP	13	15N90	M22x1.5	15N00	M22x1.5	600	0				
9	Tee to steering cylinder LH rear port	1474314	Hydr hose 13 4SP 15N90/15N00-600-0	ISO 17165-1	4SP	13	15N90	M22x1.5	15N00	M22x1.5	600	0				
10	Steering unit T port to hydraulic filter in	1758061	Hydr Hose 19 2SN 22N00/22N90-950-0	ISO 17165-1	2SN	19	22N00	M30x2	22N90	M30x2	950	0				
11	Hydraulic filter out to Tee	1565754	Hydr hose 19 1SN 18N90/18N00-850-0	ISO 17165-1	1SN	19	18N90	M26x1.5	18N00	M26x1.5	850	0				
12	Travel pump A port to travel motor A port	1565759	Hydr hose 25 4SP 25S90M/19S90M-900-90	ISO 17165-1	4SP	25	25S90M	1"x6000	19S90M	3/4"x6000	900	90				
13	Travel pump B port to travel motor B port	1570279	Hydr hose 25 4SP 25S90M/19S90M-900-270	ISO 17165-1	4SP	25	25S90M	1"x6000	19S90M	3/4"x6000	900	270				
14	Vibration Motor A to Vibration Pump B port	1590455	Hydr hose 16 4SP 19S90M/19S45M-3500-30	ISO 17165-1	4SP	16	19S90M	3/4"x6000	19S45M	3/4"x6000	3500	30				
15	Vibration Motor B to Vibration Pump A port	1590455	Hydr hose 16 4SP 19S90M/19S45M-3500-30	ISO 17165-1	4SP	16	19S90M	3/4"x6000	19S45M	3/4"x6000	3500	30				
16	Travel Pump T1 to Vibration Pump T2 port	1598040	Hydr hose 19 1SN 22N90/22N90-750-15	ISO 17165-1	1SN	19	22N90	M30x2	22N90	M30x2	750	15				
17	Vibration Pump T1 port To Return Manifold	1631839	Hydr Hose 19 1SN 22N00/22N90-950-0	ISO 17165-1	1SN	19	22N00	M30x2	22N90	M30x2	950	0				
18	Vibration Pump G to Brake block P port	1590837	Hydr hose 08 1SN 10N90/10N90-800-20	ISO 17165-1	1SN	8	10N90	M16x1.5	10N90	M16x1.5	800	20				
19	Travel Pump X2 Port to Secondary brake Block	1643629	Hydr hose 06 1SN 08N90/08N90-350-90	ISO 17165-1	*1SN*	6	08N90	M14x1.5	08N90	M14x1.5	350	90				
20	Travel motor T1 port to Return Manifold	1766983	Hydr Hose 19 1SN 18N00/18N90-750-0	ISO 17165-1	1SN	19	18N00	M26x1.5	18N90	M26x1.5	750	0				

Table 6.5 Cost Extraction of hose using SAP MM

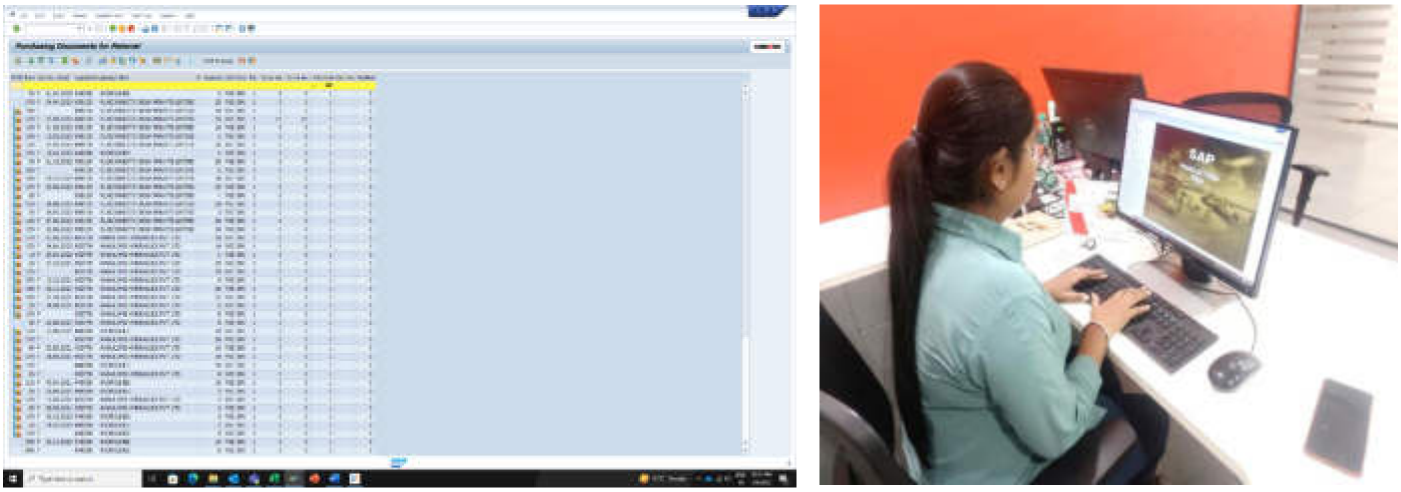


Fig 6.10 Work of Cost Extraction

6.12 Task Assigned - Task is to Inspect the Hydraulic Hose for Model ARS 110.2 (Soil compactor)

Fig 6.11 Inspection of Hydraulic Hose

6.13 Task Assigned - Quality check for the Washer of Apollo Pavers for Reassessing the Supplier

Sr. No	Material Code	Description	Location	Outside Dia.	Inside Dia.	Thickness
1		Washer 10.5/30x2.5 galZn	Y/1/10	31.25 mm	10.30 mm	2.25 mm
2		Spring washer M1/2" (18.5x13.5x2.5)SS3	Y/10/42	21.44 mm	13.15 mm	2.12 mm
3		Washer 22/37x2.5 galZn	Y/10/36	36.56 mm	22.25 mm	2.40 mm
4		Spring washer M20 (ID20.2XOD36.6XTHK4)	Y/10/37	32.40 mm	20.40 mm	3.95 mm
5		Washer PLAIN M4	Y/1/7	11.04 mm	4.46 mm	1.42 mm
6		Washer 6.6/12.5x1.6 galZn	Y/10/24	12.42 mm	6.35 mm	1.42 mm
7		Washer 17/38x2.5 galZn	Y/11/35	38.55 mm	16.85 mm	2.41 mm
8		Spring washer 14 MM	Y/10/33	23.26 mm	14.27 mm	2.96 mm
9		Spring washer 1" MS	Y/10/43	40.65 mm	26.19 mm	4.49 mm
10		Washer 32/63x2.4 galZn	Y/9/44	55.38 mm	33.10 mm	4.01 mm
11		Washer 5.3/15x1.6 galZn	Y/1/8	28.04 mm	8.01 mm	2.10 mm
12		Lock Washer 11.43/19.71x2.77 galZn	Y/8/1	20.28 mm	12.15 mm	2.46 mm
13		Washer PLAIN M18	Y/1/43	38.38 mm	16.93 mm	3.14 mm
14		Washer PLAIN M5	Y/1/46	12.42 mm	5.35 mm	1.48 mm
15		Washer PLAIN M14	Y/9/43	26.83 mm	15.88 mm	2.50 mm
16		Washer 13.5/35x4 galZn	Y/11/11	38.17 mm	12.85 mm	2.55 mm
17		Spring washer 3/8" MS	Y/17/56	17.20 mm	10.22 mm	2.05 mm
18		Washer R 13/45x4 100HV galZn	A/10/8	43.54 mm	13.86 mm	3.55 mm

Table 6.6 Quality Assurance and Control for Apollo Paver and Washer

Fig 6.12 Quality Inspection on-site for Apollo Paver Washer

6.14 Task Assigned - Follow up of various parts and manage the stock material for ease in production

ARX 32 Rops												
				2								
Sr. No.	Part Number	Description	Qty/set	Required Qty	Responsibility	Supplier	PO Release Status	Part Status	Store location	Stock Qty	Receiving Date	Remarks
1	1758523	Spring Cotter single 3 St Zn	2.00	4	Zeel			Pending			30.05.2023	Supplier suggested 1479573
2	1758700	Velcro-Type Closure strap with Buckle	2.00	4	Zeel			Pending			30.05.2023	
3	1758249	Bolt Threaded,pin	2.00	4	Meet	447799 Ambica Industries		Received	2300	10		
4	4-3048700200	Hexagon nut M20 10 galZn	4.00	8	Regular Part				2300	80		
5	1758347	Bolt Threaded,lock	2.00	4	Meet	447799 Ambica Industries		Received	2300	10		
6	1758616	Support Bush	4.00	8	Meet	447799 Ambica Industries		Received	2300	20		
7	4-5535010947	Blind rivet 3.2x10 Al/St	8.00	16	Regular Part				2300	1460		
8	1551626	Identification Plate FOPS 105x45x1	1.00	2	Meet	448976 Rukshmani Metal Process		Received	2300	59		
9	1551625	Identification Plate ROPS 132x70x1	1.00	2	Meet	448976 Rukshmani Metal Process		Received	2300	63		
10	1394065	Lock Washer RIPP LOCK 20 flZn	8.00	16	Regular Part				2300	4762		
11	4-3798408020	Cyl head screw HexSkt M8x20 8.8 galZn	6.00	12	Regular Part				2300	205		
12	1758626	Padlock with extended shackle	2.00	4	Meet	447884 Amit Machine Tools		Received	2300	2		
13	1326108	Hex screw M20x110/46 10.9 galZn	4.00	8	Meet	449469 Vraj Tradelink Pvt. Ltd.		Received	2300	10		
14	4-6531014062	Plate FOPS	2.00	4	Meet	449070 Rukshmani Graphics & Lables		Received	2300 - Project stock 2310 - Project Stock	2 2		
15	4-6120060321	Adhesive LOCTITE 243 50gr BALENÍ	0.13	0.26	Regular Part			Received	2300	2472		

Sr. No.	Material	Description	Total	2300 Stock 04.03.2023	Balance Qty	UOM	Supplier Name	Responsibility	Target Date	Part Status - Tithi	Remarks - Tithi
1	1124785	Reduction ST XGRV 18 15 L	9	0	-9	PCE	448394 HI-FLEX HYDRAULICS PVT.LTD.	JRR	25.04.2023	Pending	
9	1245606	Screwed Connection ST XGEV 25 SR 3/4 WD	6	0	-6	PCE	448394 HI-FLEX HYDRAULICS PVT.LTD.	JRR	15.04.2023	Received	Received 152 nos on 23.03.2023
32	1450957	SILENCER CLAMP	3	37	34	PCE	449017 Rochi Engineers Pvt. Ltd.	MKA		Received	
72	1471838	Weld shocket 1 1/2"BSP, ASC-100	3	78	75	PCE	460179 SMTB Engineering Pvt Ltd	MKA		Received	
77	1472009	Drum W (DD)	3	0	-3	PCE	449011 Royal Steel India	DRV	TBC	Received	
86	1472118	Joint Weldment	3	0	-3	PCE	449011 Royal Steel India	OZA	10.04.2023	Received	
99	1479613	Adhesive LOCTITE-262 50ml	0.75	0	-0.75	PCE	451150 Innovative Engineering Products Pvt	ZAP	01.04.2023	Received	
117	1524421	Gear Pump AZPF-22-025RRR12PB-S0081	3	0	-3	PCE	448024 BOSCH REXROTH INDIA LIMITED	SZA		Received	
123	1546720	Car radio Sony DSXA212UI	1	0	-1	PCE	1380 Ammann Czech Republic a.s.	SJO		Received	
130	1557429	Side Plate 40x560x2180 L	3	0	-3	PCE	447803 Ashapuri Industries	OZA	10.04.2023	Received	
133	1559802	Stiffener	6	0	-6	PCE	447803 Ashapuri Industries	OZA	10.04.2023	Received	
147	1579455	Clamp Hose	3	0	-3	PCE	452780 PRIYANKA ENGIMECH PRIVATE LIMITED	MKA	15.04.2023	Received	
148	1580428	Plate for front weldment	3	0	-3	PCE	447803 Ashapuri Industries	OZA	10.04.2023	Received	
149	1580517	Mounting Plate 36x131x437 L	3	0	-3	PCE	460179 SMTB Engineering Pvt Ltd	MKA	05.04.2023	Received	received 5 nos on 07.04.2023
150	1580538	Mounting Plate 36x131x437 R	3	0	-3	PCE	460179 SMTB Engineering Pvt Ltd	MKA	05.04.2023	Received	received 5 nos on 07.04.2023
151	1580994	Mounting Plate 32x237x400 Rear	6	0	-6	PCE	447803 Ashapuri Industries	OZA	10.04.2023	Received	
166	1590486	Hydr hose 19 1SN 22N90/22N90-1200-90	3	2	-1	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	3 PCE Received on 23.03.2023 & 5 PCE Received on 12.04.2023
167	1590837	Hydr hose 08 1SN 10N90/10N90-800-20	3	2	-1	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	12 No's in Stock
168	1590940	Hydr hose 19 1SN 18N90/18N90-1050-270	3	3	0	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	13 No's in Stock
169	1591180	Hydr hose 06 1SN 10N00/10N90-550-0	3	2	-1	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	12 No's in Stock
173	1598040	Hydr hose 19 1SN 22N90/22N90-750-15	3	3	0	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	13 No's in Stock
186	1624773	Mounting Plate 16x58x132	6	4	-2	PCE	448504 JAY INDUSTRIES	OZA	10.04.2023	Received	received 20 nos on 14.04.2023
204	1659121	Connector XGE 12-PLM-ED	6	0	-6	PCE	448394 HI-FLEX HYDRAULICS PVT.LTD.	JRR	15.04.2023	Received	138 No's in Stock
206	1660492	Plate adapter for engine	3	0	-3	PCE	448680 MAHALAXMI ENGINEERING	OZA	10.04.2023	Received	
207	1660666	Side Plate 30x560x2180 R	3	0	-3	PCE	447803 Ashapuri Industries	OZA	10.04.2023	Received	
208	1660804	Hose Holder R	6	0	-6	PCE	452780 PRIYANKA ENGIMECH PRIVATE LIMITED	AR	30.03.2023	Received	
209	1660821	Clamp plate RH side	6	0	-6	PCE	448504 JAY INDUSTRIES	OZA	10.04.2023	Received	
212	1661863	Hose Holder R AP	3	0	-3	PCE	452780 PRIYANKA ENGIMECH PRIVATE LIMITED	AR	30.03.2023	Received	3 Nos. Recd.
213	1661865	Hose Holder L AP	3	0	-3	PCE	452780 PRIYANKA ENGIMECH PRIVATE LIMITED	AR	30.03.2023	Received	3 Nos. Recd.
214	1661893	Hydr Hose 25 4SP 25S90M/25P90-1000-90	6	0	-6	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 6 nos on 25.03.2023
215	1661912	Hydr Hose 13 1SN 15N90/15N45-3000-0	3	0	-3	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 3 nos on 25.03.2023
216	1661917	Hydr Hose 08 1SN 10N90/10N90-3800-60	3	0	-3	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 3 nos on 25.03.2023
217	1661919	Hydr Hose 19 1SN 22N90/22N90-700-180	3	0	-3	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 3 nos on 25.03.2023
218	1661933	Hydr Hose 19 1SN 22N00/22N90-550-0	3	0	-3	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 3 nos on 25.03.2023
219	1661938	Hydr Hose 32 1SN 35N90/35N45-850-0	3	0	-3	PCE	448358 HYDROLINES	JRR	25.04.2023	Pending	Received 3 nos on 25.03.2023
222	1671561	Rubber 530x230x10	3	0	-3	PCE	448904 PARTH RUBBER TECH PVT LTD	MDD	25.04.2023	Pending	
223	1671563	Rubber 530x50x10	3	0	-3	PCE	448904 PARTH RUBBER TECH PVT LTD	MDD	25.04.2024	Pending	
224	1672939	Moulded Hose Radiator Inlet	3	0	-3	PCE	449502 VINAYAK RUBBER PRODUCTS	MDD	25.04.2025	Pending	
225	1672945	Moulded Hose Air Intake	3	0	-3	PCE	449502 VINAYAK RUBBER PRODUCTS	MDD	25.04.2026	Pending	
226	1674544	Exhaust Pipe	3	0	-3	PCE	449017 Rochi Engineers Pvt. Ltd.	MKA	25.04.2027	Pending	received 1 nos on 11.04.2023
227	1674545	Silencer	3	0	-3	PCE	449017 Rochi Engineers Pvt. Ltd.	MKA	25.04.2028	Pending	

Sr. No.	Material	Description	AF-S-PVT-0001B-001	Total	2300 Stock 27.03.2023	Balance Qty	UOM	Supplier Name	Responsibility	Target Date	Part Status	Remarks
233	1469787	Extendable Pipe	2	10	4	-6	PCE	448927 Pioneer Hydraulics	AR		Received	
379	1474525	Round bar POLISH M.S. 6 MM (1/4")	0.435	2.175	0	-2.175	M	449113 Shree Bhagwati Steel Traders	SZA		Received	RM
560	1515017	Cable harness Canopy AFW500	1	5	5	0	PCE	456695 DHOOT TRANSMISSION PVT LTD	SJO		Received	
591	1530083	Lamp AUX-30 LED 24V white	1	5	0	-5	PCE	448359 Hilux Auto Electric Pvt Ltd	SJO	TBC	Approval drawing pending	We will arrange 2 nos sample from Pacoline. After approval we will arrange series lot. The material with 2 nos will Received on 27.04.2023 from Pacoline.
964	1722024	Battery Cable U2-BLACK-300 DUAL CLAMP	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	10.05.2023	Received	
1006	1735748	Battery Cable U2-RED-2500	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1007	1735749	Battery Cable U2-RED-1400	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1008	1735762	Battery Cable U2-BLACK-2100	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1009	1735764	Battery Cable U2-BLACK-600	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1010	1735773	Battery Cable U8-RED-500	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1011	1735776	Battery Cable U8-BLACK-800	1	5	0	-5	PCE	448091 CONNECT CABLES	SJO	30.04.2023	Received	
1022	1757359	Feather Key 16x10x40 round	2	10	0	-10	PCE	448050 Chevi Industries	SJO		Received	
1023	1757360	Feather Key 22x14x60 round	2	10	0	-10	PCE	448050 Chevi Industries	SJO		Received	
1024	1757361	Feather Key 22x14x55 round	2	10	0	-10	PCE	448050 Chevi Industries	SJO		Received	
1080	5-0050003	Ring 50/38x45	4	20	16	-4	PCE	448927 Pioneer Hydraulics	AR		Received	
1193	5-104007002	Ring 60/50x35	2	10	0	-10	PCE	448927 Pioneer Hydraulics	AR		Received	

Sr. No.	Model	Item	Release date	Description	PR Qty	Supplier	Responsibility	Status	ETA	Purchase Remarks
1	ARS110.2 BS V	10	30.01.2023	Diesel Engine H4 CEV St V 101HP@2200 12V	1	447804 Ashok Leyland Limited	SZA	Pending	20.03.2022	NPD
2	ARS110.2 BS V	20	30.01.2023	Axle Rear CA577401 S	1	452702 CARRARO INDIA PRIVATE LIMITED		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
3	ARS110.2 BS V	60	30.01.2023	Steering Unit 904045009(STI A ON 315 G4)	1	459487 Ognibene India Pvt Ltd		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
4	ARX90.2 BS V	10	30.01.2023	Diesel Engine H4 CEV St V 74HP@2200 12V	1	447804 Ashok Leyland Limited	SZA	Pending	20.03.2022	NPD
5	ARX90.2 BS V	30	30.01.2023	Coupling Flange SAE10", 19TEETH	1	447901 ANUPAM ENTERPRISE		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
6	ARX90.2 BS V	40	30.01.2023	Hydraulic block AP	1	450932 Hydac (India) Private Limited		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
7	ARX90.2 BS V	50	30.01.2023	Water tank AS	1	453892 GMI ZARHAK MOULDERS PVT. LTD		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
8	ARX90.2 BS V	60	30.01.2023	Water pump 8.7L/min 12V	2	447805 Auto & Construction Equipments Corp		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
9	ARX90.2 BS V	70	30.01.2023	Bearing S005_040025 Rev 1	1	448063 Collective Trade Links Pvt Ltd		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
10	ARX90.2 BS V	80	30.01.2023	Steer cylinder 70/36-320	2	448076 Canara Hydraulics Pvt. Ltd.		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
11	ARX90.2 BS V	90	30.01.2023	Steering Unit 904045009(STI A ON 315 G4)	1	459487 Ognibene India Pvt Ltd		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
12	ARX32.2 BS V	10	30.01.2023	Hydraulic pump Travel A10VG28	1	448024 BOSCH REXROTH INDIA LIMITED		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
13	ARX32.2 BS V	30	30.01.2023	Hydraulic block Vibration control	1	448024 BOSCH REXROTH INDIA LIMITED		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
14	ARX32.2 BS V	40	30.01.2023	Gear Motor 008.0cm3/U	2	448024 BOSCH REXROTH INDIA LIMITED		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
15	ARX32.2 BS V	50	30.01.2023	Fluid motor MSE02-2-123-F03-1120-YDGJP	2	448930 Poclain Hydraulics Pvt. Ltd.		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
16	ARX32.2 BS V	60	30.01.2023	Steer Cylinder ARX32.2	5	448175 Dantal Hydraulics Private Limited	SZA	Pending		NPD
17	ARX32.2 BS V	70	30.01.2023	Steering unit VSP 80 ON2	1	448139 Danfoss Power Solutions India Pvt.		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
18	ARX32.2 BS V	80	30.01.2023	Water Pump 4.16L/min 12V	1	447805 Auto & Construction Equipments Corp		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
19	ARX32.2 BS V	90	30.01.2023	Water Tank AP	1	453892 GMI ZARHAK MOULDERS PVT. LTD		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
20	ARX32.2 BS V	100	30.01.2023	Return-suction filter E084-56	1	447854 ARGO-HYTOS PVT LTD		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
21	ARX32.2 BS V	110	30.01.2023	Coupling BoWex 65-10" FLE-PA	1	447901 ANUPAM ENTERPRISE		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
22	ARS110.2 BS V	80	02.02.2023	Cooling Fan 581/7-7/P6ZL/40/PAG/BLEX+3	1	449550 WingFan India Private Limited	SJO	Pending	30.03.2023	NPD
23	ARX90.2 BS V	110	02.02.2023	Cooling Fan 562/9-9/P6ZL/37.5/PAG/BLEX+4	1	449550 WingFan India Private Limited	SJO	Pending	30.03.2023	NPD
24	ARX32.2 BS V	120	02.02.2023	Cooling Fan 400/8-8/S1HL/40/PAG/BLEX+6	1	449550 WingFan India Private Limited	SJO	Pending	30.03.2023	NPD
25	ARS110.2 BS V	90	04.02.2023	Display Unit COBO ECO HE Stage V	2	COBO	SJO	Pending	30.03.2023	NPD
26	ARX90.2 BS V	120	04.02.2023	Display Unit COBO ECO HE Stage V	2	COBO	SJO	Pending	30.03.2023	NPD
27	ARX32.2 BS V	140	04.02.2023	Display Unit COBO ECO HE Stage V	2	COBO	SJO	Pending	30.03.2023	NPD
28	ARS110.2 BS V	100	04.02.2023	Coupling flange BoWex 65-11.5"	1	447901 ANUPAM ENTERPRISE		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
29	ARS110.2 BS V	110	04.02.2023	Coupling Monolastic 32 76/84.7	1	447901 ANUPAM ENTERPRISE		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
30	ARS110.2 BS V	120	04.02.2023	Hydraulic brake block	1	450932 Hydac (India) Private Limited		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
31	ARX90.2 BS V	130	04.02.2023	Hydraulic Pump Tandem H1T053R	1	449081 Danfoss Power Solutions Gmbh & Co.		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
32	ARX90.2 BS V	140	04.02.2023	Gear motor	1	448139 Danfoss Power Solutions India Pvt.		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
33	ARX90.2 BS V	150	04.02.2023	Controller	1	448024 BOSCH REXROTH INDIA LIMITED		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
34	ARX32.2 BS V	150	04.02.2023	Hydraulic brake block	1	450932 Hydac (India) Private Limited		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
35	ARX32.2 BS V	130	04.02.2023	Hydraulic Pump Vibration AZPF11-16	1	448024 BOSCH REXROTH INDIA LIMITED	SZA	Pending	30.04.2023	NPD
36	ARS110.2 BS V	130	15.02.2023	Platform ROPS Assembly ARS110.2	2	SANDHAR	MKA	Pending	30.04.2023	NPD
37	ARX90.2 BS V	160	16.02.2023	Control lever kompl ARX	1	455226 Meflex GmbH		In Stock		No Need to Place Separate PO, It will be transferred from Regular Purchase on WBS and delete PR
38	ARS110.2 BS V	270	27.02.2023	Radiator Outlet Hose	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
39	ARS110.2 BS V	280	27.02.2023	Radiator Outlet Elbow	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
40	ARS110.2 BS V	290	27.02.2023	Radiator Inlet Hose	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
41	ARS110.2 BS V	300	27.02.2023	Hose for air suction	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
42	ARS110.2 BS V	310	27.02.2023	Reducer Ø64-Ø57.5	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
43	ARS110.2 BS V	320	27.02.2023	Charge Air Cooler Elbow 90°	1	449502 VINAYAK RUBBER PRODUCTS	SJO	Pending	25.03.2023	
44	ARS110.2 BS V	390	28.02.2023	Exhaust Pipe Tail	1	Rochi Engineers Pvt. Ltd.	MKA	Pending	30.04.2023	
45	ARS110.2 BS V	400	28.02.2023	Exhaust Pipe Engine to DOC	1	Rochi Engineers Pvt. Ltd.	MKA	Pending	30.04.2023	
46	ARS110.2 BS V	410	28.02.2023	Charge Air Cooler inlet pipe	1	Rochi Engineers Pvt. Ltd.	MKA	Pending	30.04.2023	
47	ARS110.2 BS V	420	28.02.2023	Charge Air Cooler outlet pipe	1	Rochi Engineers Pvt. Ltd.	MKA	Pending	30.04.2023	
48	ARS110.2 BS V	430	28.02.2023	Radiator outlet pipe AW	1	Rochi Engineers Pvt. Ltd.	MKA	Pending	30.04.2023	
49	ARS110.2 BS V	440	28.02.2023	PMP Vibration motor	1	459519 PMP Drive Systems India Pvt Ltd	SZA	Pending	-	PO will be generated by 3rd of March 2023

Table 6.7 Material Follow up to Control Inventory Level

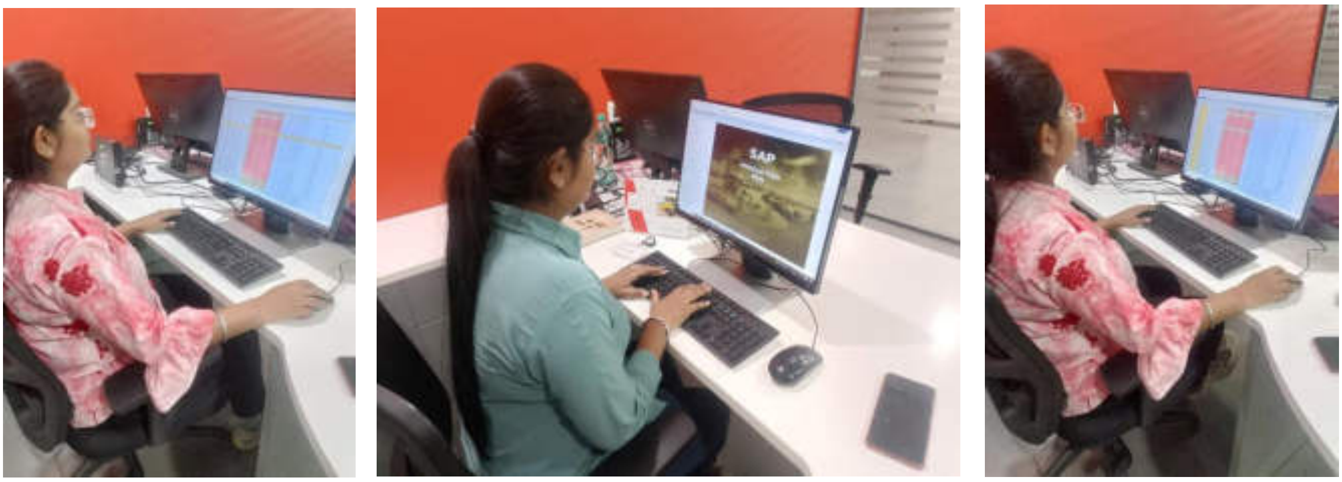
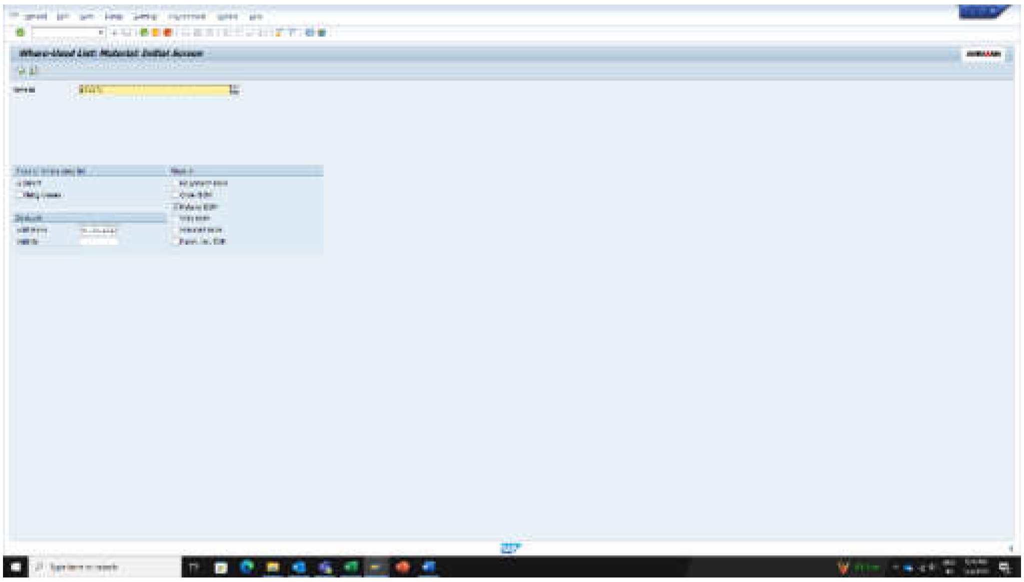


Fig 6.13 Work of Follow up to Manage Inventory Level

6.15 Task Assigned - Tracking of Last In-warding and Consumption

Sr No	Part No	Material Description	Qty	Amount	Last Inward	Last Inward Qty	Supplier	Last Issue	Last Issue Qty	M/C Model where Use	PO No.	PO Creator	Remarks
1		Hydraulic block	53		25.04.2018	34	447854 ARGO-HYTOS PVT LTD	26.03.2018	4	ARS 121 BS3		Ankit Patel	
2		Hydraulic pump propel Aux_mou CEV4	2		N.A	N.A	N.A	22.04.2022	1	AFT 500 CEV St IV		N.A	PO not found & No inwarding found
3		Leveling System matic 1G (ROTS)+1S(DIGI)	1		11.01.2019	1	448715 Moba Mobile Automation Pvt Ltd	28.01.2019	1	AFT 500 CEV St IV		Karan Patel	
4		Indicator Lamp SWF 511 502	810		26.03.2019	490	1380 Ammann Czech Republic a.s.	30.01.2019	5	ARS 122 BS3		Vishal Joshi	
5		Water tank ARX4 SESTAVA	3		16.12.2022	5	1380 Ammann Czech Republic a.s.	29.03.2023	1			Sagar Joshi	
6		Wheel Gp D533x305x430	1		N.A	N.A	N.A	07.03.2019	1			N.A	PO not found & No inwarding found
7		Fuel gauge 94-1Ohm 12V D=52mm	35		25.03.2019	2	448561 KUSAUTO INTERNATIONAL LTD.	30.01.2019	1	ARS 121 BS3 (Cummins)		Ankit Patel	
8		Roof SESTAVA	1		27.06.2022	2	1380 Ammann Czech Republic a.s.	N.A	N.A	ARS 110.2 CEV St V		Manish Kumar	No Consumption found
9		Wheel	1		N.A	N.A	N.A	21.11.2018	3	AFW500 (Converted)		N.A	PO not found
10		Pinion shaft 50 TEETH GEAR - DLC	25		20.04.2023	15		25.04.2023	6	WM6 CEV St IV		N.A	PO not found
11		Valve STEERING ARX91	10		05.03.2019	28	449314 Danfoss Power Solutions (Nordborg)	07.10.2020	1	ARX 91 BS3 (Cummins)		Vishal Joshi	
12		Proximity Sensor BES-M12MI-PSC20B-S04G	129		17.07.2020	100	1380 Ammann Czech Republic a.s.	11.10.2019	2	ARX 91 BS3 (Cummins)		Durgesh Vyas	
13		Float	24		04.09.2019	30	1100 Ammann Schweiz AG	06.12.2021	1	AFW 500 T3		Vishal Joshi	
14		Switch SWF 511 019	175		02.02.2019	10	1380 Ammann Czech Republic a.s.	30.01.2019	1	ARS122 BSIII		Ankit Patel	
15		Fan SPAL Typ 010-A70-74D 12V	8		12.02.2020	6	453828 Pee Aar Exim Pvt. Ltd.	27.11.2020	1	ARS122 BSIII		Ankit Patel	
16		Resistance 82 OHM TR600 10W	252		18.12.2018	150	1380 Ammann Czech Republic a.s.	22.01.2019	2	ARX91		Ankit Patel	
17		Battery cable +ve clamp to lug R-70-3000	43		25.01.2022	15	448091 CONNECT CABLES	27.12.2021	1	AP 600 CEV St IV		Akshay patel	
18		Lamp obrys.zadní LED24V 2SB008405-~	38		14.12.2022	38	1380 Ammann Czech Republic a.s.	08.09.2022	2	ARS110.1_T3		Durgesh Vyas	
19		Acceleration Sensor 04-21-20700-A01	3		22.04.2022	1	448715 Moba Mobile Automation (I) Pvt Ltd	04.08.2022	8	ARS 110.2 HX CEV St IV		Durgesh Vyas	
20		Valve MANIFOLD, 600-1-140528-BHIN-01	14		15.06.2021	20	447985 Bucher Hydraulics Pvt. Ltd.	24.08.2021	1	ARX91 BSIII		Anirudha Patel	
21		Covering hood ARX 4 Ammann	1		24.02.2023	1	456621 SR FIBRE GLASS AUTO PVT LTD	N.A	N.A			Durgesh Vyas	No Consumption found
22		Fluid Motor A2FM16	4		23.08.2022	8	1380 - Ammann Czech Republic a.s.	13.01.2023	1	AFT 950 BS4		Vijay Prajapati	
23		Pillar VOLANTU ÚPRAVA SUBD.	17		02.12.2018	3		12.10.2019	2	ARX91 BSIII		N.A	PO not found
24		Hose Set TV4900 DIN	5		05.09.2022	6	459135 FLUICONNECTO INDIA PRIVATE LIMITED	24.03.2023	1	AP 600 CEV St IV		Jignesh Raychura	
25		Controller Gp AFT	28		21.02.2018	28	1100 - Ammann Schweiz AG	N.A	N.A			Vikram Solanki	No Consumption found
26		Hand-Held Transmitter Emergency AFT501	10		14.06.2019	1	448715 Moba Mobile Automation (I) Pvt Ltd	09.08.2018	1			Vishal Joshi	
27		Switch SWF 511 007	307		26.03.2019	200	1380 Ammann Czech Republic a.s.	30.01.2019	2	ARS121-CUMMINS		Vishal Joshi	
28		Tank Sensor typ GW7-4016	19		26.12.2017	18	6120 Ammann India Private Limited	N.A	N.A			Ankit Patel	No Consumption found
29		Pinion shaft FOR 16/39 TEETH GEAR	32		25.04.2023	30		25.04.2023	6	WM6 CEV St IV		N.A	PO not found
30		Inert Gas ARGON + CO2 GAS	1197	81,396	26.04.2023	350	455899 SPECIALITY GASES PVT LTD	18.11.2021	119		N.A	N.A	No Consumption found

Table 6.8 Tracking of Last In-warding and Consumption



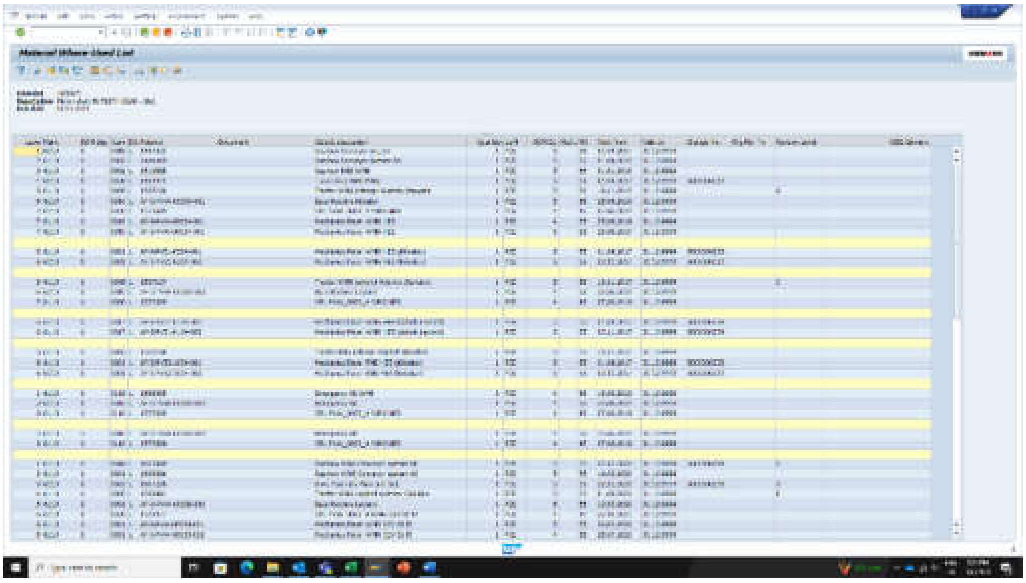


Fig 6.14 SAP view

6.16 Task Assigned - Nesting for upcoming model for optimum sheet utilization

Date	Wed Mar 15 16:15:40 2023

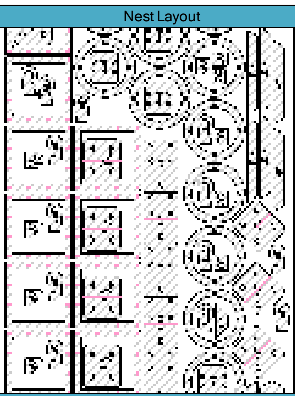
Nest Overview Report

Plan information

Project Name	AP550BSV8MM	Number of nests	1	Number of sheets	1
Machine	2: Trumpf TruLaser 3060 Sinumerik 840D	Strategy	Oxygen/Standard/7.5 In Lens	Programmer	AINSYP

MS, 8mm

Nest Layout



Production Information

Nest Name	P3 AP550BSIV10MM	Weight	172.70 Kg	Cutting length/Sheet	73.50 Mt.
Sheet Size	1100X2000 MM	Cutting Time	00:49:22	Total Cut Length	73.50 Mt.
Quantity	1 Sheet	Net Utilization	91.17%	Total Piercing	297
Material	MS, 8mm	No of Sheet Run	1	Rapid Move Length	40.94 Mt.

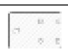
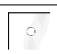
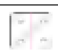
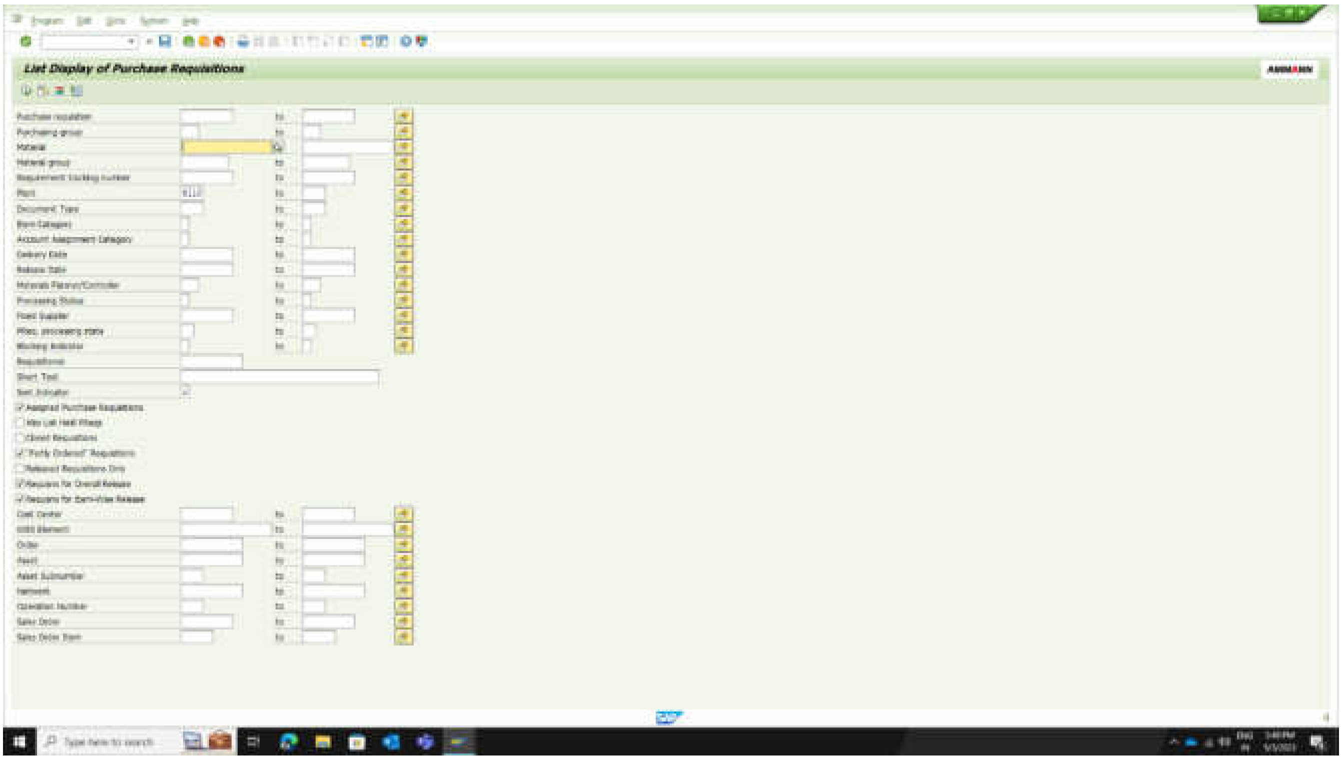
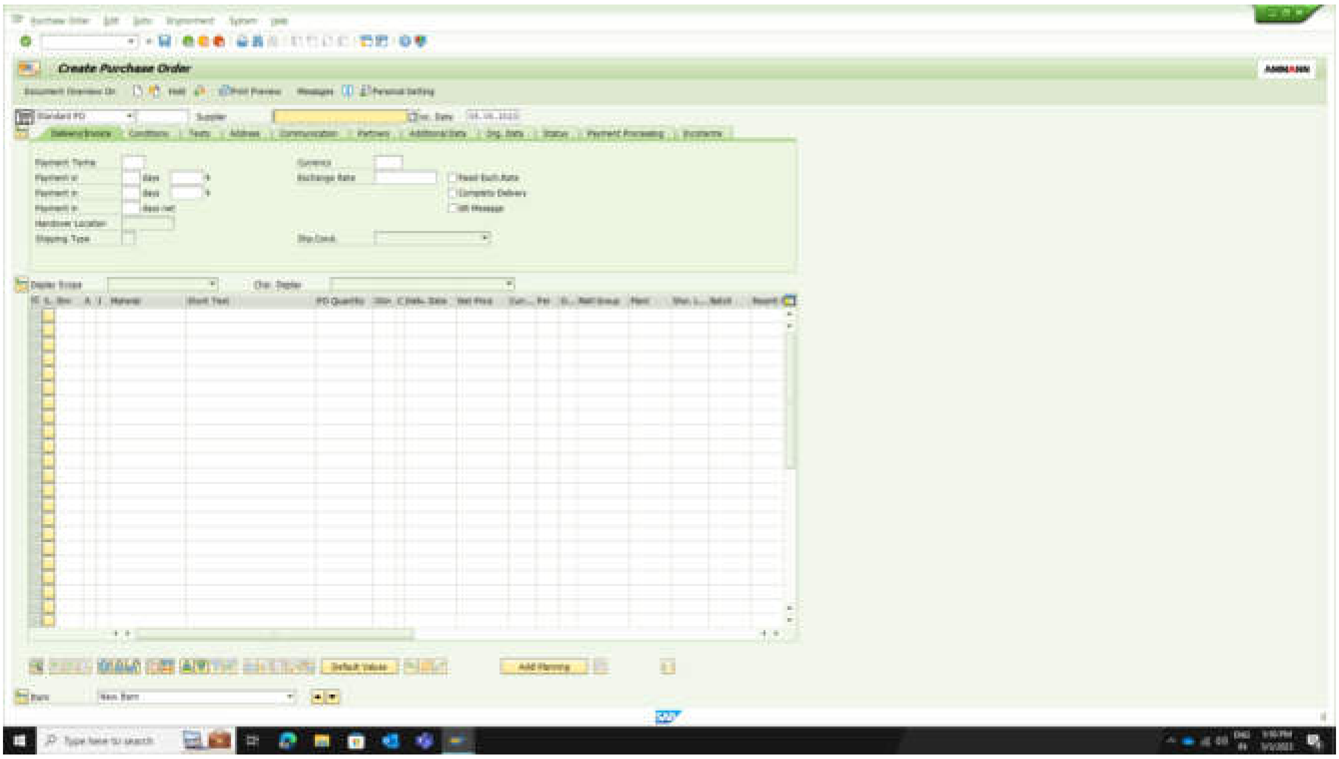
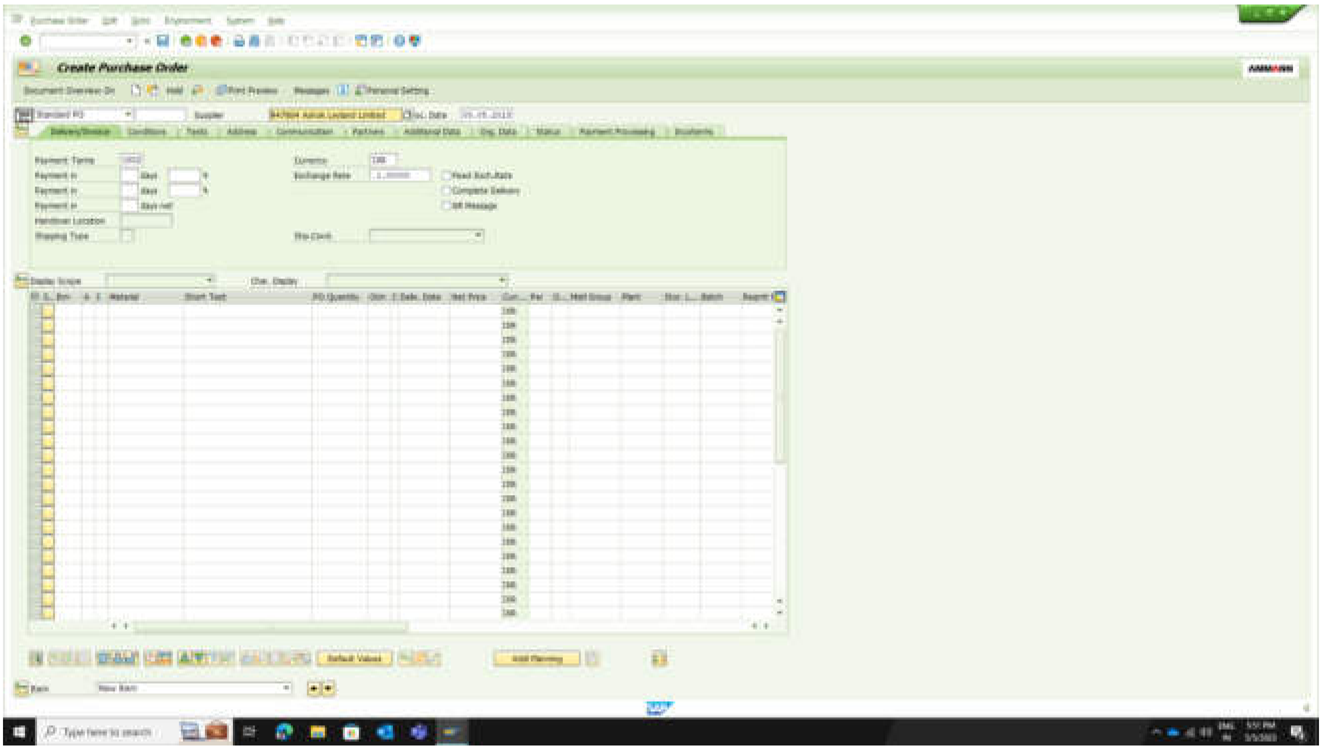
ID	Part Image	Part Name	Per Sheet	Nested	Part Wt.	Part X	Part Y
1		1484829-10-2-E250	12	12	1.36	228.60	228.60
2		1485412-10mm-2-E250	12	12	1.77	250.00	250.00
3		1486568-10mm-12-E250	19	19	0.38	60.00	110.00
4		1488274-10mm-2-E250	10	10	0.92	320.00	40.00
5		1580107-10mm-1-E250	6	6	1.97	197.62	132.00
6		1580110-10mm-2-E250	1	1	0.32	95.00	95.00
7		1580128-10mm-2-E250	6	6	0.95	122.00	106.25
8		1626312-10-02-E250	13	13	0.23	60.00	50.00
9		1671439-10mm-2-E250	12	12	1.68	161.99	140.00

Fig 6.15 Sheet Metal Nesting for Optimum Utilization

6.17 Task Assigned - PO Creation







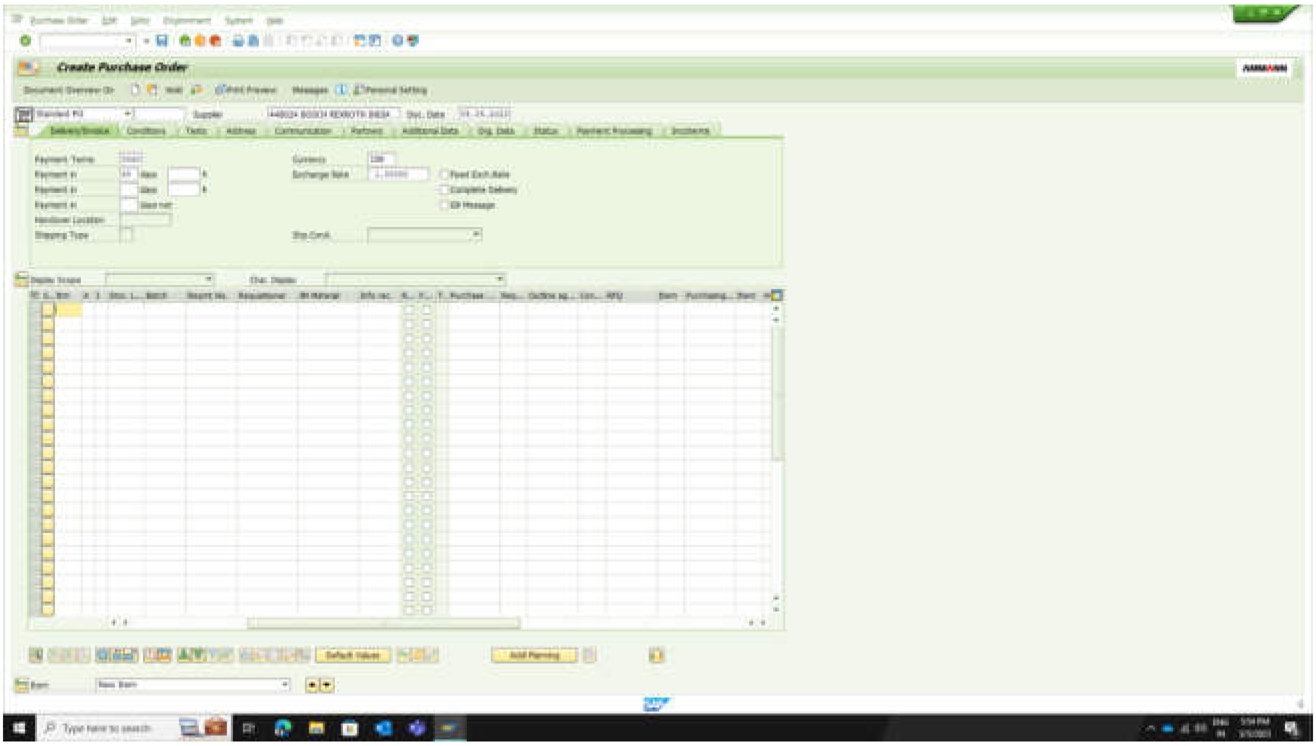


Fig 6.16 SAP view for PO Creation

Chapter: 7 My learnings from the Internship

During my internship at a global leader in road construction and equipment manufacturing, I had the opportunity to work in the purchase department. This experience provided me with a comprehensive understanding of the procurement process and its integration within the broader supply chain. I immersed myself in various aspects of procurement, including supplier relationship management, technical knowledge acquisition, material tracking, inventory management, utilization of procurement software, and understanding the procurement process and supply chain dynamics.

I actively engaged with suppliers, effectively communicating and negotiating terms to ensure smooth procurement processes. This experience highlighted the importance of building strong supplier relationships and the significance of timely and accurate information exchange. Technical knowledge played a vital role as I studied product specifications, engineering drawings, and industry standards. This knowledge enhanced my decision-making abilities and facilitated effective communication with internal stakeholders.

I actively participated in material tracking and inventory management, ensuring the availability of materials for production. This hands-on experience sharpened my organizational and logistical skills, emphasizing the importance of efficient inventory management.

Utilizing procurement software, such as SAP, I gained proficiency in creating purchase orders, managing supplier databases, and generating reports. This exposure to advanced procurement technology emphasized the role of digital tools in streamlining processes.

Overall, in my internship, I gained a holistic understanding of the procurement process and its impact on overall organizational performance. Actively participating in requisition management, supplier evaluation and selection, purchase order processing, and delivery coordination provided invaluable insights into the interconnectedness of procurement activities within the supply chain. This experience has laid a solid foundation for my professional growth in the field.

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Appendices

A. NOC Letter

SAFFRONY INSTITUTE OF TECHNOLOGY
S.P.B. PATEL ENGINEERING COLLEGE

AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY (YEAR 2008)
APPROVED BY ALL INDIA COUNCIL FOR TECHNICAL EDUCATION (AICTE) (YEAR 2006)

SIT/SPBPEC/S2023/NOC/ 30

Date: 20th January 2023

To,
Ammann India Pvt Ltd
Plot No. 2, 80, Ditasan,
Ahmedabad - Patan Highway Rd, Jagudan,
Gujarat 384460

Subject: NOC for Industrial Internship of our student at your organization.

Dear Sir/Ma'am,

Greetings of the day!

S.P.B. Patel Engineering College, Mehsana is one of the leading Engineering Institutions in the North Gujarat. At present, we offer seven engineering branches – Mechanical, Automobile, Civil, Electronics and Communication, Electrical, Information Technology and Computer Engineering as well as three post graduate programs – Masters in Production Engineering, Computer Science and Electronics & Communication.

We wish to send our final year 8th Semester Mechanical Engineering students for **Industrial Internship of 12 weeks tentatively** starting from **January 2023** at a reputed organization like yours.

The objective is to give students practical exposure to real life working environment & current technologies in addition to theoretical knowledge. In this regard, we request you to provide Industrial Internship in your esteemed organization for the following student:

Sr. No.	Name of Student	Enrolment No.	Mobile No.
1	Tithi Navinkumar Sharma	200390119505	7016316855

We request you to give our student an opportunity for practical learning at your organization.

We also request you to provide a internship certificate/letter after successful completion of the internship.

Yours sincerely,

S.P.B. Patel Engineering College Linch

Prof. Tausif Shaikh
Department Placement Coordinator
Assistant Professor, Mechanical Engineering Department
S.P.B. Patel Engineering College, Linch
Email: tausif.shaikh@saffrony.ac.in
Mobile No: 8200754891

Near Shanku's Waterpark, Ahmedabad-Mehsana Highway,
At & Post : Linch, Dist. : Mehsana, Gujarat-384 435. Phone / Fax (02762) 285721
www.saffrony.ac.in • E-mail : info@saffrony.ac.in

B. Annexure-I

Week 1

GUJARAT TECHNOLOGICAL UNIVERSITY
(Established under Gujarat Act No. 20 of 2007)
ગુજરાતટેકનોલોજીકલ યુનિવર્સિટી
(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Jithi Navinkumar
DIARY OF THE WEEK: Dt: 23/01/2023 TO 27/01/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department (M/c Division)
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

• My first week as intern was extremely exciting and enlightening. I had the opportunity to work in "purchase department". Mr. Anirudh Singh, purchase head given me task to observe the whole process area of plant & machine division. In the first week, I was introduced to the company's profile, product, process, equipment and software, which gave me a better understanding of the company. I have learnt about plant division, they are making Asphalt plant, drum mix plant, concrete mixture plants etc. I learnt about different components of asphalt mixing plant like feeder, dryer, Burner, Bag House, Hot elevator, vibrating screen, mixer, Bitumen tank, Hot mix silo, control system etc. from its cutting to dispatching. There are different machines used in the plant like welding m/c, sheet metal bending, drilling m/c, overhead cranes etc. I observed that 98% Mig welding is used and 2% arc welding is used. Arc welding is used for fabricate the naked part of the component. Metal sheet used from 2mm to 30mm and bending is done according to the design of various components. I observed that Ammann's acceptable quality level is 99.5% and quality performance is 99.38%.

→ I took observation of the screen body which is the component of Asphalt plant, where I are noticed various defects while fabrication of screen body assembly ANP 1500 / 200 such as support bracket found bend, weld distortion in the month of April. For the screen body VA-2050-5 in the month of May, I observed that poor plasma / laser cutting & spot not be cutted by M/C.

→ I observed the fabrication process of the components of the asphalt plant. Additionally I observed tank leakage test, which is used to detect any kind of leakage in the drum part. I found that by providing air supply in the drum and pouring or spraying water on the welded part can help in detecting leakage. Leakage can be sealed by arc welding. I observed that various colour code of gas cylinders like ① Blue - argon, ② Red - hydrogen etc. I observed how buckets are made in different sizes according to the application.

→ I got to know various components of CC30 plant (concrete mixing plant) which consist of aggregate frame, extension plates, skiptrack, weighing unit, mixer frame, M/C support, foundation bracket, Bucket feeder etc.

→ Additionally, I learnt how quality checking of the components are done. Air leakage test (4kg), oil test (4kg), Dimension test are the mandatory test for maintaining the quality of the components.

→ I observed whole floor area of plant division which is 25,670 sqm. It includes various hall like Hall No. 17, Hall No. 19 C, Hall No. 20 etc. for fabrication shop, assembly shop for various components of Asphalt as well as concrete mixing plant.

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TOTAL HOURS: 29

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer-in-charge of Dept. / Section / Firm

Date: 17/02/23.

DITASAN

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 2

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Annexure I
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Naminkumar

DIARY OF THE WEEK: Dt: 30/01/2023 TO 03/02/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase department (M/C Division)

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

• During the duration of this week, I had the opportunity to learn various aspects in the "MACHINE DIVISION" which was truly eye-opener. I observed and learn fabrication and assembly of various types of road construction machines, including sensor pavers, mechanical pavers and compactors. I was able to observe and assist with the various stages of the assembly process, from the assembly of individual components to final inspection and testing of the finished made. I observed especially making of AP550 sensor paver where AP is apolla paver from it cutting of metal sheet to the final inspection and testing. I learn various parameters of the fabrication of the chassis which is the heart of the machines.

→ I saw MIG welding is used to fabricate the components where I got to know how to assemble to components, which equipments are used.

→ I observed that CNZ tapper roller bearing are used in the assembly of hub of the wheel of the paver. I observered how workers are assembling the components with high level of precision and I got to know detailed view of the each and every part. I interact with the incharge head and technicians, who work in the M/C division, and I was able to learn from their extensive experience and knowledge.

→ I observered that disc brake is used in the head shaft assembly of the gear box, which is connected with the master cylinder. Length of the conveyor chain is 9 meter, which is used to transport the asphalt towards the screed. I saw the fitting of the chain which is Boughtout item on the top part of the M/C. I observe how pipes are connected in the paver, for fuel supply, grease supply etc. BS4 engine is used in mechanical as well as slipper paver. I observe the assembly of screed and auger part.

→ In the mechanical paver assembly, I observed how gear box is made and learnt how gears are made using CNC lathe M/C based on siemens, which makes programming a bit easier. I saw various M/Cs used in making parts of paver, which includes Broching M/C, Grinding, drilling, gear hobbing, milling etc. I observe the flow of making the paver. I learn each and every aspect during the fabrication of the mechanical paver. Even I observe how compactor assembly is done. I saw testing of compactor paver. I even observing the control panel of the sensor paver. At the end of the week, I gained valuable experience in the field.

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TOTAL HOURS: 37

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

AMMANN INDIA PVT. LTD. DITASAN

Signature of Faculty Mentor

Date: 18/03/2023

Signature of Officer-in-Charge of Dept. / Section / Plant

27/2/23.

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 3

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Naninkumar
DIARY OF THE WEEK: Dt: 13/02/2023 TO 17/02/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Dept. (Machine Division)
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala.

DESCRIPTION OF THE WORK DONE IN BRIEF

- During the duration of this week, I learn many new aspects regarding the Purchase process and NPD (New Product development) models. I observed even the fabrication parts of compactors like front frame, rear frame, Bonnet etc.
- I observed that purchase Dept. is connected with the various dept. like Design, production, Quality, Accounts, Assembly. I observed the NPD model ARX 32.2 (BS-III) which completed it's homologation test.
- I Explored many advantages of ammann compactor over competitor compactor.
  - → High compaction output
  - → No rear axle concept
  - → Multiple vibration frequencies.
- I observed various component of ARX 90.2 which is Double drum roller, and observe the stepwise assembly procedure of compactor.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

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Signature of Faculty Mentor

Date: 18/03/2023

Signature of Officer-in-charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITASAN

Date:

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 4

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Navinkumar

DIARY OF THE WEEK: Dt: 20/02/2023 TO 24/02/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Dept. (Machine Division)

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I had given a task to explore about hydraulic circuits, motor and pump by my guide Mr. Shailesh Zala. I learn about different components used in the hydraulic circuits like pump, valves, Reservoir, DCV, actuators, Hoses & fitting etc. I explore various ~~of~~ symbols used in hydraulic circuits. I explored various parameters in the compactors and pavers. I observed the PDI (Pre-Dispatching Inspection) of ARS 110.1 T3 where, I got to know that actual speed of the machine is less than desired speed. Even I made calculation for the same. I observe the drum anomaly of the compactor.

→ I observed the pre-inspection test of ARX 90.2 which contains, inspection of hydraulic oil level, coolant level, functioning of electrical system, engine speed, acceptance criteria, etc.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer-in-charge of Dept. / Section / Plant

DITASANI

Date: 24/3/23

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 5

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Annexure I

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Navinkumar

DIARY OF THE WEEK: Dt: 27/02/2023 TO 4/03/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department (MK Division)

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I learnt various aspects about procurement Dept. I observed how lubrication and maintenance of ARS 122 needed to be carried out. I acquire a knowledge of various measuring instruments in the quality dept. such as vernier caliper (Digital one), micrometer, Bore gauge, Rockwell hardness test etc.

→ Expert session conducted by Mr. Sagar Joshi on various manufacturing process such as casting, forging, sheet metal fabrication etc. I became proficient in casting process and its aspects.

→ I recieved a task to communicate with the vendor regarding their purchase order and Expected time arrival for various parts in pavers and compactors. I used the SAP software & Excel to execute the task. I Even taken the follow up from all the responsible authorities regarding part supplier. I acquire knowledge of various technicality about the components used.

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TOTAL HOURS: 50

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer-in-charge of Dept / Section / Plant

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 6

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Annexure 1
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Jithi Navinkumar
DIARY OF THE WEEK: Dt: 6/03/2023 TO 10/03/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Dept. (Machine Division)
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I gain knowledge of various specification of fluids, viscosity classification.
→ I took the follow up regarding the steer cylinder ARX 32.2 from Pawtal hydraulics Pvt. Ltd. I completed the task by communicating with the vendor on call and update about the component arrival in the Ammann store.
→ I even completed the task of measuring 30+ different washers, including its outer dia., Inner dia., and thickness using digital vernier caliper, which help me to know various applications for the same.
→ completed the task of checking the gas hose pipe for upcoming paver production.

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TOTAL HOURS: 35

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of officer in charge of Dept/Section/Plant

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 7

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure 1

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Jithi Maninkumar

DIARY OF THE WEEK: Dt: 13/03/2023 TO 17/03/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department-Machine Division

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala.

DESCRIPTION OF THE WORK DONE IN BRIEF

• During the duration of this week, I gain extensive knowledge in the department, where, I learnt tracking of parts for pre series model like ARS 110 T1, ARX 32 ROPS, ARX 90.2 ROPS.

→ I learnt how AMMANN sustainability works that is generally based on emission, such as emissions reduction, efficiency improvement, electrification.

→ Observation was done on chassis of compactor ARS 122, includes, front frame, boom, articulated joint, bonnet, steering pump, canopy etc.

→ Exported the item drawing using SAP such as male Tee 1/2", nipple 9/16" etc. and shared with the supplier.

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TOTAL HOURS: 46

SIGNATURE OF STUDENT

- The above entries are correct and the grading of work done by Trainee is EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 18/03/2023

Signature of official in-charge of Section / Plant

AMRAAN INDIA PVT. LTD. DITASAN

Date: 21/3/23

- Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 8

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Navinkumar
DIARY OF THE WEEK: Dt: 20/03/2023 TO 24/03/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department - Machine Division
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

- During the duration of this week, I majorly focused on the task about making the sheet based on monthly inwarding and monthly consumption for plant division and machine Division from Jan 21 - Dec 21, Jan 22 - Dec 22, Jan 23 - Feb 23.

→ Exporting the item drawing with its specification using SAP, such as hydraulic cylinder 50X28X270 mof, steel cylinder, etc.

→ Gain knowledge of operations of maintenance such as replacing suction line filter catridg, checking the oil temperature sensor, Refilling the hydraulic circuit. Observed the do's and don't's regarding the coolant change.

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TOTAL HOURS: 47

SIGNATURE OF STUDENT

○ The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 10/05/2023

Signature of officer-in-charge
of Dept. / Section / Plant

AMMANN INDIA PVT. LTD.
DITASAN

Date: 31/03/2023

○ Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 9

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I
Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Navinkumar
DIARY OF THE WEEK: Dt: 27/03/2023 TO 31/03/2023
DEPARTMENT: Mechanical Engineering SEM: 8th
NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.
NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department - M/C Division
NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Chailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I gain extensive knowledge and importance of strategic sourcing process, which includes analyze internal needs and market, identify potential suppliers, develop a strategic sourcing strategy, negotiate with suppliers, implement the strategy and Review performance and implement for continuous improvement.

→ I learnt how to manage the data. I received a task of tracking and need to take follow-up of parts of APS 100.2, ARX 90.2, ARX 32 etc. My duty is to take follow up of all necessary parts and provide solutions if required for ease in receiving.

→ Learn how to make the purchase order (PO) Exporting Items drawing from SAP.

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TOTAL HOURS: 47

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 10/05/2023

Signature of officer-in-charge
of Dept. / Section / Plant

Date:

AMMANN INDIA PVT. LTD.
DITASAN

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 10

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure I

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Navinkumar

DIARY OF THE WEEK: Dt: 3/04/2023 TO 7/04/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department - M/C Division

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I learnt about the P2P process, which is procure to pay, which include. Requirement identification, Purchase requisition (PR), Budgeting, supplier selection, negotiation, purchase order (PO), Goods or services receipt, Invoice receipt, Invoice processing, payment, and Record keeping.

→ Even learnt about the SAP MM (material management) T codes (Transcation codes), which are the shortcut codes that take us directly to the screen desired. Example (MM03 - Display material), ME41 - create RFQ quotation.

→ I had to update, previous inwarding - consumption summary, for some specific stores of machine division for the year 2022 and 2023.

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

TOTAL HOURS: 45

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 10/05/2023

Signature of officer-in-charge
of Dept. / Section / Plant

AMMANN INDIA PVT. LTD.
DITASAN

Date:

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 11

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Annexure I

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Jithi Navinkumar

DIARY OF THE WEEK: Dt: 10/04/2023 TO 14/04/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department-(M/C Division)

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala

DESCRIPTION OF THE WORK DONE IN BRIEF

→ during this week of internship, I gain the knowledge of SAP MM (material management). I learnt the process of supply chain management, learnt to make the purchase order, using T code ME21N, learnt to make Goods Receipt, posting invoice etc.

→ I was assigned for task to prepare the sheet of LL2 supplier which meant to analyze the low cost rate of supplier. Input was given to me in terms of an excel sheet listed with material code, supplier code, JOB, etc.

→ The purpose behind the task was to analyze the low cost supplier for material among all the available supplier. Learnt the material and inventory management.

→ I was given a task to prepare planning sheet for upcoming models and prepared the BOM quantity.

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TOTAL HOURS: 45

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 10/05/2023

Signature of officer in-charge of Dept. / Section / Plant

AMMANN INDIA PVT. LTD. DITASAN

Date: 28/4/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

Week 12

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure 1

Enrollment no: 200390119505

STUDENT'S WEEKLY RECORD OF INTERNSHIP

NAME OF STUDENT: Sharma Tithi Mavinkumar

DIARY OF THE WEEK: Dt: 17/04/2023 TO 21/04/2023

DEPARTMENT: Mechanical Engineering SEM: 8th

NAME OF THE ORGANISATION: Ammann India Pvt. Ltd.

NAME OF THE PLANT/SECTION/DEPARTMENT: Purchase Department-(M/C Division)

NAME OF OFFICER INCHARGE OF THE PLANT/SECTION/DEPARTMENT: Mr. Shailesh Zala.

DESCRIPTION OF THE WORK DONE IN BRIEF

→ During the duration of this week, I managed the data sheet for upcoming model AFT500 for production. Perform various analysis task such as cost analysis between two company for their price for the purpose of further purchase of hydraulic hose. Taking follow-up with the supplier to for ease in production process.

→ Even learn the whole procedure of purchase using SAP and its translation code. completed the task of inwarding and consumption given by the General Manager Mr. Anirudh Singh.

→ Learnt the various T codes used in SAP modules. I was given a task to communicate with the supplier regarding manufacturing of the hydraulic cylinder with revised dimension. Learnt the manufacturing process and communication etiquette with the supplier.

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(ગુજરાત અધિનિયમ ક્રમાંક: ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

TOTAL HOURS: 47

SIGNATURE OF STUDENT

The above entries are correct and the grading of work done by Trainee is
EXCELLENT / VERY GOOD / GOOD / FAIR / BELOW AVERAGE / POOR

Signature of Faculty Mentor

Date: 10/05/2023

Signature of Officer-in-charge of Dept. / Section / Plant

AHMANN INDIA PVT. LTD.
DITASAN

Date: 28/4/2023

Grading of Work, for trainee may be given depending upon your judgement about his Punctuality, Regularity, Sincerity, Interest taken, Work done etc.

C. Annexure-II

GUJARAT TECHNOLOGICAL UNIVERSITY
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Annexure 2

Feedback Form by Industry expert

Student Name: Tithi N. Sharma Date: 28/04/2023

Work Supervisor: Mr. Shailesh Zala (Asst. Manager) Title: Internship at Ammann India.

Company/Organization: Ammann India Pvt. Ltd.

Enrollment No: 200390119505

Internship Address: Plot No. 2, 80, Ditasan, Ahmedabad-Patan Highway, Jagudan Gujarat 384460

Dates of Internship: From 23/01/2023 to 28/04/2023

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Excellent
Shows interest in work and his/her initiatives				✓
Produces high quality work and accepts responsibility			✓	
Uses technical knowledge and expertise				✓
Analyzes problems effectively				✓
Communicates well and writes effectively				✓

Overall performance of student intern: (Needs improvement/ Satisfactory/Good/Excellent):

Additional comments, if any:
Good in handling multiple data at a time. Showing interest in technical areas, and work effectively.

Signature of Industry person with name and stamp:
AMMANN INDIA PVT. LTD. DITASAN
Shailesh 28/04/23 (A.M)

Signature of the Faculty Mentor

D. ID CARD

E. Attendance Sheet

AMMANN

Student Visit for Project Work

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
1	23/1/23	8:56 AM	6:03 PM	03		
2	24/1/23	8:47AM	6:15 PM	03		
3	25/1/23	9:03 AM	6:07 PM	03		
4	27/1/23	8:58 AM	6:00 PM	03		
5	30/1/23	8:40 AM	5:57 PM	03		
6	31/1/23	8:38AM	6:06 PM	03		
7	1/2/23	8:42 AM	6:02 PM	03		
8	2/2/23	8:50AM	5:49 PM	03		
9	3/2/23	8:38 AM	6:15 PM	03		
10	13/2/23	8:36 AM	6:05 PM	03		
11	14/2/23	8:42AM	6:10 PM	03		
12	15/2/23	8:38AM	6:04PM	03		
13	16/2/23	8:40AM	6:10 PM	03		
14	17/2/23	8:43AM	6:18 PM	03		
15	20/2/23	8:40AM	6:03PM	03		
16	21/2/23	8:46AM	6:05PM	03		
17	22/2/23	8:50 AM	6:02PM	03		
18	23/2/23	8:44AM	6:04 PM	03		
19	24/2/23	8:57AM	6:05PM	03		
20	27/2/23	8:50AM	6:02PM	03		
21	28/2/23	8:48AM	6:03 PM	03		
22	1/3/23	8:42AM	6:05PM	03		
23	2/3/23	9:03 AM	6:02 PM	03		
24	3/3/23	8:48AM	6:08 PM	03		
25	4/3/23	8:46 AM	6:05 PM	03		
26	6/3/23	8:43AM	6:03PM	03		
27	7/3/23	8:50AM	6:02 PM	03		
28	9/3/23	8:43AM	6:00 PM	03		
29	10/3/23	8:50 AM	6:05 PM	03		

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Student Visit for Project Work

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
29	13/3/23	8:50AM	6:02PM	03		
30	14/3/23	8:48AM	6:05PM	03		
31	15/3/23	9:03 AM	6:03 PM	03		
32	16/3/23	8:53 AM	6:10 PM	03		
33	17/3/23	8:45AM	6:05 PM	03		
34	20/3/23	8:50 AM	6:02PM	03		
35	21/3/23	8:48AM	6:02 PM	03		
36	22/3/23	8:45AM	6:05PM	03		
37	24/3/23	8:50 AM	6:08 PM	03		
38	27/3/23	8:43AM	6:05 PM	03		
39	28/3/23	8:56 AM	6:10 PM	03		
40	29/3/23	8:58 AM	6:05 PM	03		
41	30/3/23	8:50 AM	6:03PM	03		
42	31/3/23	8:56 AM	6:05PM	03		
43	3/04/23	8:50AM	6:06PM	03		
44	4/04/23	8:48AM	6:10 PM	03		
45	5/04/23	8:50 AM	6:05PM	03		
46	6/04/23	8:58 AM	6:03 PM	03		
47	7/04/23	8:50 AM	6:05 PM	03		
48	10/04/23	8:51 AM	6:05 PM	03		

1. Video Shooting and Photography are strictly prohibited.
2. Student must carry Identity Card issued by College during the factory visit and to be worn when in the premises.
3. Student wearing Chappal & Sandal will not be allowed to enter the premises. In the interest of their Health and Safety, we prefer student's wear Safety shoes.

Signature of College Instructor: ______________________

Signature of Human Resources: ______________________

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Student Visit for Project Work

Sr. No.	Date	In Time	Out Time	Gate Pass No.	Signature of Supervisor	Signature of Security.
1	11/4/23	8:50 AM	6:02 PM	03		
2	12/4/23	8:42 AM	6:05PM	03		
3	13/4/23	8:43AM	6:00 PM	03		
4	14/4/23	8:45 AM	6:05 PM	03		
5	17/4/23	8:50AM	6:06 PM	03		
6	18/4/23	8:48AM	6:05 PM	63		
7	19/4/23	8:50AM	6:10 PM	03		
8	20/4/23	8:59 AM	5:57 PM	03		
9	21/4/23	8:53 AM	6:05 PM	03		
10	24/4/23	8:50 AM	6:10 PM	03		
11	25/4/23	8:57 AM	6:05 PM	03		
12	26/4/23	8:50 AM	6:10 PM	03		
13	27/4/23	9:03 AM	6:11 PM	03		
14	28/4/23	8:50 AM	6:05PM	03		
15	02/5/23	8:52 AM	6:02PM	03		
16	03/5/23	8:56 AM	5:58 PM	03		
17	04/5/23	8:50 AM	6:04 PM	03		
18	05/5/23	9:10 AM	6:05PM	03		
19	06/5/23	8:55AM	6:02PM	03		
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