DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to VTU, Approved by AICTE & ISO 9001:2008 Certified)
Accredited by National Assessment & Accreditation Council (NAAC) with 'A' grade)

ShavigeMalleshwara Hills, Kumaraswamy Layout, Banglore-560078

Department of Electrical & Electronics Engineering

Internship report on

"HYDRAULICS, PNEUMATICS AND PLC LAB"

Internship report submitted in partial fulfillment of award of the degree of

BE In

ELECTRICAL AND ELECRONICS ENGINEERING

SUBMITTED BY

Aishwarya	**1DS20EE003**
Deeksha Purushotham	**1DS20EE024**
Devika S Kumar	**1DS20EE026**
Shirisha Kumari G A	**1DS20EE066**

SIXTH SEMESTER.

Internship carried out at

Centre of competence for Automation Technologies Rexroth Bosch and Dayananda Sagar University, Kudlu Gate, Bangalore- 560068

rexroth
A Bosch Company

Ms. K. Sudha Deepthi

Assistant Manager &Certified Trainer

Centre of competence for Automation technologies

Rexroth Bosch and DSU

2022-2023

DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to vTU, Approved by AICTE & ISO 9001:2008 Certified Accredited by National Assessment & Accreditation Council (NAAC) with 'A' grade)

ShavigeMalleshwara Hills, Kumaraswamy Layout, Banglore-560078

Department of Electrical & Electronics Engineering

CERTIFICATE

This is to certify that the internship report entitled **"Hydraulics, Pneumatics and PLC lab"**, is carried out at **BOSCH REXROTH-Dayananda Sagar University** by Aishwarya(1DS20EE003), Deeksha Purushotham (1DS20EE024),Devika S Kumar(1DS20EE026) and Shirisha Kumari G A (1DS20EE066) bonafide students of Dayananda Sagar College of Engineering, Banglore, in partial fulfilment for the award of Degree of BE in EEE dept by **VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM** during the academic year of 2022-2023.The Internship report been approved as it satisfies the academic requirements with respect to Internship work prescribed for the said degree.

Signature of the Internal Supervisor
& Co-Ordinator

Signature of the HOD
of EEE dept, DSCE
Dr. P. USHA

Signature of the Principal
Dr. B G Prasad

Internship VIVA-VOCE

Name of the Examiners	**Signature with Date**
1. ____________________	____________________

2.

DAYANANDA SAGAR UNIVERSITY

In collaboration with REXORTH BOSCH

Hosur Main Road, Kudlu Gate, Bengalore, Karnataka, 560068

Department of Electrical & Electronics Engineering

CERTIFICATE

This is to certify that the internship report entitled **"Hydraulics, Pneumatics and PLC lab"**, is carried out at **BOSCH REXROTH-Dayananda Sagar University** by Aishwarya(1DS20EE003),Deeksha Purushotham (1DS20EE024), Devika S Kumar(1DS20EE026) and Shirisha Kumari G A(1DS20EE066) bonafide students of Dayananda Sagar College of Engineering, Banglore, in partial fulfilment for the award of Degree of BE in EEE dept by **VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM** during the academic year of 2022-2023.The Internship report been approved as it satisfies the academic requirements with respect to Internship work prescribed for the said degree.

Signature of the Supervisor

K. SudhaDeepthi
Assistant Manager & Certified trainer
Centre of Competence for Automationtechnologies
REXROTH BOSCH- DSU, Bangalore

ACKNOWLEDGEMENT

I am grateful to **Dr. B G Prasad, principal**, Dayananda Sagar College of Engineering, Bangalore, for his continuous support throughout the completion of this report.

I would also express my thanks to **Dr. P. Usha, HOD**, Department of Electrical and Electronics Engineering, Dayananda Sagar College of Engineering, Bangalore. Her incessant encouragement and valuable technical support have been immense help in realizing this seminar.

Guidance and deadlines play a very important role in successful completion of the internship report on time. We convey our gratitude to our mentor and guide **Ms. K. SudhaDeepthi** Assistant Manager and certified trainer at Centre of competence at Automation Technologies Rexroth BOSCH at Dayananda Sagar University for their support in carrying out the internship work at Rexroth Bosch.

Aishwarya
Devika S Kumar
Shirisha Kumari G A

DECLARATION BY THE STUDENT

We, Aishwarya Devika S Kumar and Shirisha Kumari G A hereby declare that the dissertation entitled, **“Hydraulics, Pneumatics and PLC lab”**, which has been submitted by us as partial fulfillment for the **6th** semester BE degree from Visvesvaraya Technological University, Belgaum, is an authentic record of our own work carried out by us during BE 6th semester at Center of competence at Automation Technologies Rexroth BOSCH at Dayananda Sagar University, under the supervision of my internal guide **Dr. P. Usha,** Dept. EEE, DSCE, Bangalore and external guide **Ms. K. SudhaDeepthi** Assistant Manager and certified trainer at Centre of competence at Automation technologies Rexroth BOSCH at Dayananda Sagar University for their support in carrying out the internship work at Rexroth Bosch **.**

We further undertake that the matter embodied in the dissertation has not been submitted previously for the award of any degree or diploma by us to any institution.

Aishwarya(1DS20EE003)
Devika S Kumar(1DS20EE026)
Shirisha Kumari G A(1DS20EE066)

6th Semester, BE in
EEE dept. DSCE

Place: Bangalore.
Date:

ABSTRACT

Hydraulics is a branch of engineering and science that deals with the study of fluid behaviour , particularly liquids, and their application in various mechanical systems. It encompasses the principles of fluid dynamics, fluid properties, and the transmission of force through confined fluid mediums, such as pipes and channels. The working principle of hydraulics is based on Pascal's law, which states that when a change in pressure is applied to an enclosed fluid in a confined space, that pressure change is transmitted equally in all directions throughout the fluid. In hydraulic systems, this principle is harnessed to transmit force, control motion, and transfer energy.

Pneumatics is a branch of engineering and technology centered on the use of compressed air or gas to transmit power and control mechanical systems. It capitalizes on the fundamental principles of gas behaviour , particularly the compressibility and expansion of air, to generate motion, apply force, and operate various mechanisms. The working principle of pneumatics is based on the use of compressed air or gas to transmit power and control mechanical systems.

Programmable Logic Controllers (PLCs) are indispensable electronic devices in industrial automation and control systems, serving as the nerve center for managing complex processes and machinery. PLCs are designed to execute customized sequences of operations, making them highly adaptable to diverse industrial applications. They operate on the basis of user-programmed logic instructions and input/output (I/O) connections, allowing them to monitor sensors, process data, and issue commands with precision and reliability.

In this report an experiment for Hydraulics, Pneumatics and PLC is discussed and its operation is explained accordingly.

TABLE OF CONTENTS

CHAPTER 1

ORGANIZATION: REXROTH BOSCH-DSU

The internship is carried out at Centre of competence for Automation technologies Rexroth Bosch and Dayananda Sagar University. The brief description about internship organization is given below.

1.1 BOSCH REXROTH

Bosch Rexroth is an engineering firm based in Lohr am Main in Germany. It is the result of a merger on 1 May 2001 between Mannesmann Rexroth AG and the Automation Technology Business Unit of Robert Bosch GmbH, and is a wholly owned subsidiary of Robert Bosch GmbH. Bosch Rexroth's slogan is "The Drive & Control Company". It manufactures products and systems associated with the control and motion of industrial and mobile equipment. The logo of the company is shown below.

Fig.1.1 Rexroth A Bosch Company Logo

The company has its roots in 1795, when the Rexroth family established an iron forge. Economical, precise, safe, and energy efficient: drive and control technology from Bosch Rexroth moves machines and systems of any size. The company bundles global application experience in the market segments of Mobile Applications, Machinery Applications and Engineering, Factory Automation, and Renewable Energies to develop innovative components as well as tailored system solutions and services. Bosch Rexroth offers its customer’s hydraulics, electric drives and controls, pneumatics, gear technology, and linear motion and assembly technology all from one source. At DSU innovation Centre automation lab by Rexroth Bosch is provided. It serves asCentre of competence and skill development. This Centre acts as the regional Centre in automation technologies to train the Faculty and Students of nearby colleges – Vocational institutes, Polytechnics and Engineering in its Region. The technologies dealt in this Centre are Hydraulics, Pneumatics, PLC (Programmable logic controllers), Sensors, AC Servo drives, and CNC Control systems. For the accomplishment of repeated jobs automation is required. Automation can be achieved using Programmable Logic Controllers (PLCs).

1.2 DAYANANDA SAGAR UNIVERSITY

DSU is a proud member of the Dayananda Sagar Institutions family. Founded by Late Sri Dayananda Sagar in the early sixties. Dayananda Sagar University created by an Act of the Karnataka State in 2014, built on this adorable legacy and inspired by its own milestones, meeting the needs of quality higher education in this part of the world. Research, Innovation and Incubation form the core of DSU.It has taken the next logical step: Laying the foundation to transform the entrepreneurial dream of every young
Indian and global citizen into a reality. Enabling this transformation is the active support of industry leaders, industry bodies and a dedicated 4 lakh square feet modern ready-to-move-in infrastructure.

1.2.1 INNOVATIONS AT DSU:

The main mission of DSU is to achieve objectives in an environment that enhances creativity, innovation and scholarly pursuits while adhering to the vision. There are mainly four innovation labs in DSU they are as follows:

- Automotive systems labs
- VMWARE IT academy
- Design and innovation Centre
- Automation technologies

Today's automotive system is complex with the extensive use of electronics and software. Time to develop the product has reduced significantly and this requires fast development and testing of automotive function. There is a joint initiative of Rexroth Bosch and DSU. It works as an independent Centre serving as Centre of competence and Skill development. This Centre acts as the regional Centre in automation technologies to train the Faculty and Students on latest technologies.

CHAPTER 2

HYDRAULICS

2.1 INTRODUCTION

At its core, the working principle of hydraulics relies on Pascal's law, which asserts that when pressure is applied to an enclosed fluid in a confined space, it is transmitted equally in all directions throughout the fluid. This foundational principle allows hydraulic systems to transmit force, control motion, and transfer energy efficiently and precisely.

A typical hydraulics laboratory comprises several key components and equipment for educational and experimental purposes:

1.Hydraulic Pump: This component pressurizes the hydraulic fluid.

2.Valves: Various valves are used to control the flow and direction of hydraulic fluid within the system.

3.Hydraulic Actuators: These include cylinders or motors that convert pressurized fluid into mechanical work.

4. Pressure Gauges: Pressure gauges are employed to measure the system's hydraulic pressure.

5.Hydraulic Reservoir: A reservoir is used for storing hydraulic fluid and assisting in its cooling.

6.Hoses: A network of hoses is used to transmit the hydraulic fluid throughout the system.

In a hydraulics lab, these components collectively enable students and engineers to conduct experiments and gain practical insights into hydraulic principles, such as pressure transmission, force multiplication, fluid behaviour, and precise control, facilitating hands-on learning and skill development.

2.2 EXPERIMENT

- Experiment name: Extension of cylinder upon operation of a push button

- Aim: A double acting cylinder is to extend and retract. The extending process is controlled by operating a push button. When push button is pressed the cylinder extends and automatically retracts when the push button is released.

- Circuit diagram:

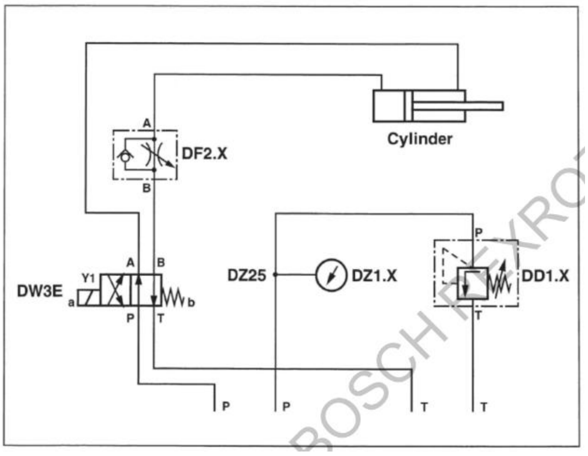


Fig 2.1 Hydraulic circuit

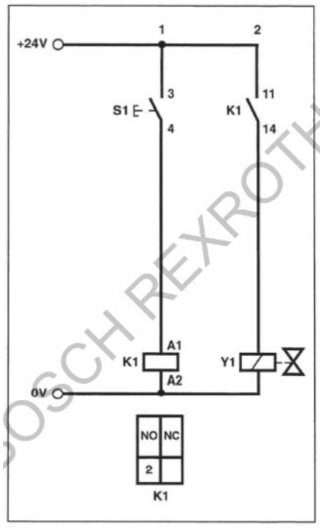


Fig 2.2 Electrical circuit

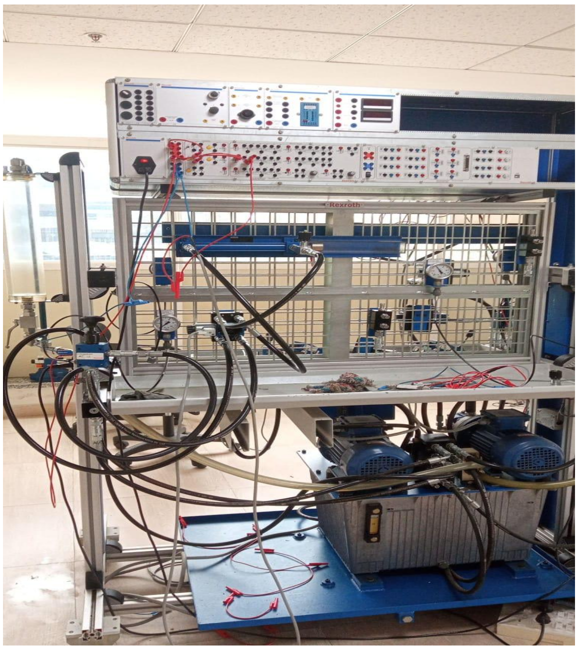


Fig 2.3 A Hydraulic module

1. Procedure: Rig up the connections to the hydraulic unit and other components as shown in the circuit diagram.
2. Switch on supply button to the unit.
3. Once the supply is given to the unit the cylinder extends as operated based on manually operated push button.

- Operation Steps:

1. System Setup: Ensure that all components are properly connected: the hydraulic cylinder, control valve, hydraulic pump, and reservoir.
2. Initial Position: The single-acting hydraulic cylinder starts in a retracted position.
3. Control Valve Configuration: This involves shifting the valve to the "extend" position.
4. Power On: Start the hydraulic pump to pressurize the hydraulic fluid in the system.
5. Activate Control Mechanism: Depending on setup, manually activate the control mechanism (e.g., by pushing a button or moving a lever) or an automated control system (e.g., PLC).
6. Fluid Flow to Cylinder: When the control mechanism is activated, the directional control valve opens the path for hydraulic fluid to flow from the pump to the single-acting cylinder .The pressurized hydraulic fluid enters the cylinder on the rod end, creating a force that pushes the piston rod outward (extends it).
7. Extension :As hydraulic fluid continues to flow into the cylinder, the piston rod extends linearly from the cylinder body.
8. Controlled Extension :The rate of extension and the distance the piston rod travels can be controlled by adjusting the flow rate and pressure of the hydraulic fluid, which is typically done through the control valve or the hydraulic pump settings.
9. Completion and Retraction: When the desired extension is achieved upon the operation of push button and the cylinder has extended ,the cylinder retracts automatically when the button is released .The hydraulic fluid is redirected, and the piston rod retracts due to the external force (e.g., a spring or gravity), pushing the fluid back into the reservoir.

11.Shutdown:Turn off the hydraulic pump and any control mechanisms.

- Result: Hence the cylinder is extended and expected output is obtained.

2.3 ADVANTAGES:

1.High Power Density: Hydraulics can transmit a high amount of power with relatively small components, making them ideal for applications where space is limited.

2.Precise Control: Hydraulic systems can provide precise control over force and motion, making them suitable for applications requiring accurate positioning and control.

3.Variable Speed: Hydraulic systems can easily change the speed and direction of motion, allowing for flexibility in operation.

4.High Reliability: Well-designed hydraulic systems are known for their durability and reliability, even in harsh environments.

5.Safety: Hydraulic systems can be designed with fail-safes and overload protection, enhancing overall safety in applications like automotive braking systems.

6.Minimal Maintenance: Hydraulic systems typically require less maintenance compared to some other power transmission methods.

2.4 DISADVANTAGES:

1.Fluid Leaks: Hydraulic systems can develop fluid leaks over time, leading to potential environmental concerns and maintenance issues.

2.Limited Efficiency: Hydraulic systems can be less energy-efficient than some other power transmission methods due to fluid friction and heat generation.

3.Fluid Contamination: Contaminants in the hydraulic fluid can lead to system damage and reduced performance, necessitating careful fluid management.

4.Noise and Vibration: Hydraulic systems can generate noise and vibrations, which may require additional damping or isolation in certain applications.

5.Complexity: Designing and maintaining hydraulic systems can be complex, requiring expertise in fluid dynamics and component selection.

6.Weight: The hydraulic fluid and components can add significant weight to a system, which can be a disadvantage in applications where weight is critical.

2.5 APPLICATIONS:

1. Construction Industry:

Excavators: Hydraulic systems power the digging and lifting arms, allowing for precise and powerful excavation.

Bulldozers: Hydraulics control the blade for grading and pushing materials.

Cranes: Hydraulic cranes provide stability and lifting capabilities for heavy loads.

2. Automotive Industry:

Braking Systems: Hydraulic brake systems provide reliable and responsive braking in vehicles.

Suspension Systems: Hydraulics are used in some vehicle suspension systems for ride comfort and stability.

3. Aerospace Industry:

Aircraft Landing Gear: Hydraulic systems retract and extend landing gear for takeoff and landing.

Flight Control Surfaces: Hydraulics control ailerons, elevators, and rudders for aircraft maneuverability.

4. Manufacturing Industry:

Machine Tools: Hydraulic systems power cutting, bending, and forming processes in industrial machinery.

Injection Molding: Hydraulic presses are used for shaping and molding plastic and metal components.

5. Agricultural Industry:

Tractors: Hydraulic systems control implements like plows, loaders, and tillers.

Harvesters: Hydraulics enable the efficient harvesting of crops, such as in combine harvesters.

CHAPTER 3

PNEUMATICS

3.1 INTRODUCTION

Pneumatics is a branch of engineering and technology that deals with the study and application of compressed air or gas to power and control mechanical systems. Derived from the Greek word "pneuma," meaning air or breath, pneumatics utilizes the principles of fluid dynamics to transmit force, motion, and energy. Compressed air, the primary medium in pneumatics, is clean, readily available, and easy to store, making it a versatile choice for a wide range of applications.

A typical pneumatics laboratory consists of the following key components for educational and experimental purposes:

1.Pneumatic Compressor: This component is responsible for compressing air to generate high-pressure compressed air.

2.Valves: Both manually operated and electronically controlled valves are used to manage the flow and direction of compressed air within the system.

3.Pneumatic Cylinders: These cylinders, often equipped with sensors, convert the pressurized air into mechanical motion, allowing students and engineers to study force and motion control.

4.Pressure Gauges and Regulators: These instruments enable the measurement and adjustment of air pressure within the system, ensuring precise control.

5.Air Reservoirs: Reservoirs provide a storage buffer for compressed air, maintaining a stable supply during experiments.

6.Pipes: A network of pipes connects the various components, facilitating the transmission of pneumatic energy throughout the system.

3.2 EXPERIMENT

- Experiment name: Sequential control of two double acting cylinders without overlapping signals.
- Aim: This exercise helps to understand sequential controls and provides practical knowledge of setting up and commissioning a control system with two pneumatic drives.
- Circuit diagram:

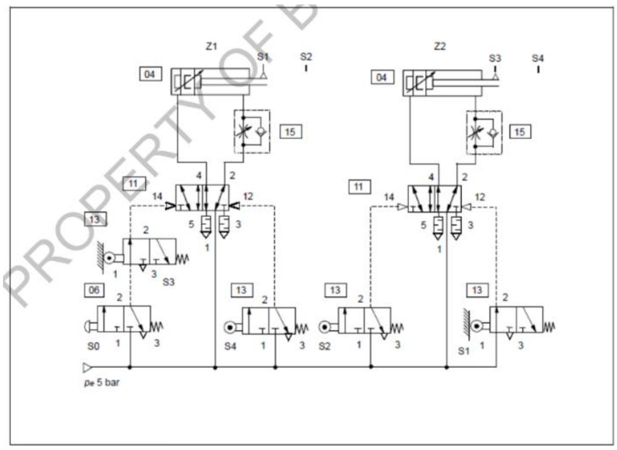


Fig 3.1 Pneumatic circuit diagram

- Procedure:
    1. Rig up the connections to the pneumatic unit and other components as shown in the circuit diagram.
    2. Switch on supply button to the unit.
    3. Once the supply is given to the unit the cylinder extends as operated based on manually operated push button.

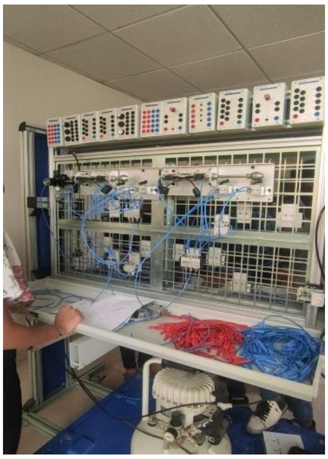


Fig 3.2 A pneumatics module

- Operation steps:

1. Start with the system at rest, with the cylinder in its retracted position.
2. Activate the switch (or timer) that initiates the extending motion of the cylinder (opens the solenoid valve). The solenoid valve directs air to the extend port of the cylinder.
3. If a switch-on delay is configured, wait for the set delay time before the solenoid valve opens, allowing air to flow to the cylinder's extend port. During this delay, no movement should occur.
4. Once the delay is over, the cylinder will start extending, pushing out the piston rod.
5. When the cylinder reaches its fully extended position, the directional control valve should be switched to center position (neutral), which stops the flow of air to the cylinder.
6. Activate the switch (or timer) that initiates the retracting motion of the cylinder (closes the solenoid valve). The solenoid valve directs air to the retract port of the cylinder.
7. The cylinder will start retracting, pulling back the piston rod.
8. When the cylinder reaches its fully retracted position, switch the directional control valve to the center position again to stop the flow of air.
9. This procedure happens in both the cylinders independent of one another.

3.3 ADVANTAGES:

1.Clean and Environmentally Friendly: Pneumatic systems use compressed air, which is clean, readily available, and non-toxic. This makes pneumatics environmentally friendly and suitable for applications where contamination is a concern.

2.Safety: Compressed air systems are intrinsically safe, as there is no risk of electrical sparks or fire, making them suitable for use in hazardous environments.

3.Low Cost: Pneumatic components are often more affordable than their hydraulic or electric counterparts, which can lead to cost-effective system implementations.

4.Easy Maintenance: Pneumatic systems are generally easy to maintain and repair, with fewer complex components compared to some other systems.

5.High Power-to-Weight Ratio: Pneumatic actuators are lightweight compared to hydraulic equivalents, making them suitable for mobile and transport applications.

6.Precise Control: Pneumatic systems can offer precise control of force and motion when properly designed and equipped with control valves and sensors.

3.4 DISADVANTAGES:

1.Limited Energy Efficiency: Pneumatic systems can be less energy-efficient than electric systems, as they may suffer from air leaks and energy losses due to compressibility of air.

2.Noise and Vibration: Pneumatic systems can be noisy, and they may produce vibrations, which can be problematic in some applications without proper damping.

3.Limited Force: Pneumatic systems may not be suitable for high-force applications compared to hydraulic systems.

4.Limited Speed Control: Achieving precise and variable speed control in pneumatic systems can be challenging, particularly at low speeds.

5.Air Quality: Pneumatic systems require clean and dry compressed air to prevent contamination, which may necessitate additional filtration and drying equipment.

6.Limited Position Holding: Pneumatic actuators may not hold a position as accurately as electric or hydraulic systems, which can be a limitation in some applications.

3.5APPLICATIONS:

1. Manufacturing Industry:

Assembly Lines: Pneumatic systems power automated assembly processes, including pick-and-place operations and part positioning.

Pneumatic Tools: Air-powered tools, such as drills, grinders, and nail guns, are commonly used in manufacturing and construction.

2. Automotive Industry:

Robotics: Pneumatic actuators play a crucial role in automotive robots for tasks like welding, painting, and assembly.

Brake Systems: Pneumatic systems are used in some heavy-duty braking applications in commercial vehicles.

3. Packaging Industry:

Conveyor Systems: Pneumatics control conveyor belts and sorting systems in packaging and material handling.

Pneumatic Grippers: Air-driven grippers are employed to pick, place, and manipulate packages and products.

4. Food and Beverage Industry:

Bottle and Can Filling: Pneumatic systems are used for precise control in filling and capping processes.

Packaging and Labeling: Pneumatics aid in packaging, sealing, and labeling food and beverage products.

5. Pharmaceutical Industry:

Automation: Pneumatic systems automate various processes in pharmaceutical manufacturing, including pill counting and packaging.

Clean Room Environments: The cleanliness and non-contaminating nature of pneumatics make them suitable for clean room applications.

CHAPTER 4

PLC(Programmable Logic Controller)

4.1SOFTWARE IMPLEMENTATION

4.1.1 INDIRA WORKS

IndraWorks is the carrier system for integration of the Bosch Rexroth engineering tools. The PLC and its associated software IndraWorks, which is a uniform engineering software, allows to solve all of the tasks with one single software – from project planning and programming to visualization and diagnostics. IndraWorks is universally available in all of the automation systems as integrated engineering software. Profits are fast access to all functions and data of the control components and the increased understand ability of individual's automation solution.The IndraLogic PLCsoftware combines all components from Rexroth to provide integrated solutions with motion and logic control.

Using Indra Motion, one can implement all of the centralized and distributed control designs, customized to the industry-specific requirements. The scalable control, visualization and I/O hardware platforms allow easy, flexible and integrated automation of the applications. Combined with open communication interfaces, these hardware platforms provide automation solutions that are also sustainable in the future and allow factory automation with any degree of freedom.

4.1.2 PROCEDURE TO IMPLEMENT PLC LADDER PROGRAM

Firmware environment: Indra works

Programming language (by Bosch Rexroth): Indra Logic language

1. Project Structure: A project is put into a file named after the project. The first POU (Program Organization Unit) created in a new project will automatically be named PLC_PRG. The process begins here, and other POUs can be accessed from the same point (program function blocks and functions).

2. Project Set Up: Firstly, configure PLC in order to check the accuracy of the addresses used in the project. Then create the POUs needed to solve problem. Now program the POUs in the desired languages. Once the programming is complete, compile the project and remove errors.

3. Project Testing: Once all errors have been removed, activate the simulation, log in to the simulated PLC and "load" project in the PLC in Online mode. Now open the window with PLC Configuration and test project for correct sequence. To do this, input variables are entered manually and outputs are observed.

4. Debugging: In case of a programming error one can set breakpoints. If the process stops at such a breakpoint, the values of all project variables at this point can be examined in time. By working through sequentially (single step) the logical correctness of program is checked.

4.1.3FUNCTIONAL BLOCKS USED IN LADDER PROGRAM

The PLC programming is done in Indralogic software. The programming is carried out using ladder diagram. The main functional blocks used in ladder diagram are timers, counters and reset blocks. These provide application in pulse counting, frequency reading, time measurement etc.

- DIFFERENT TYPES OF TIMERS

1) On-Delay Timer (Ton): When input (IN) goes high, output (Q) will go high only after the preset time (PT) has elapsed. When input goes low, output will also go low immediately.

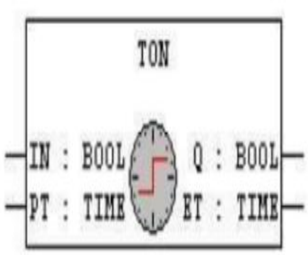
2) Off-Delay Timer (Toff): When input (IN) becomes high, simultaneously output (Q) becomes high. When input becomes low, output becomes low after the preset time (PT) is elapsed.

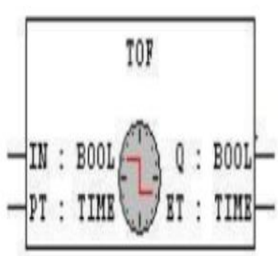
3) Pulse Timer (TP): If input (IN) is low, output (Q) is low. When input goes high, output will remain high till the preset time (PT) & after that it will be reset even if input is high.

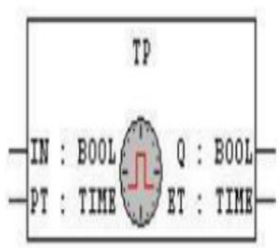
4.2 EXPERIMENT:

- Experiment name: There are 3 mixing devices on a processing line A,B,C.After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5seconds after B. All then remain ON until a master enable switch is turned off. Write PLC ladder diagram, timing diagram and realize the same.
- Program implementation:

```
INPUT:BOOL;
T1: TON;
ET_1: TIME;
MIXER_A: BOOL;
MIXER_B: BOOL;
MIXER_C: BOOL;
T2: TON;
T3: TON;
ET_2: TIME;
ET_3: TIME;
END_VAR
```







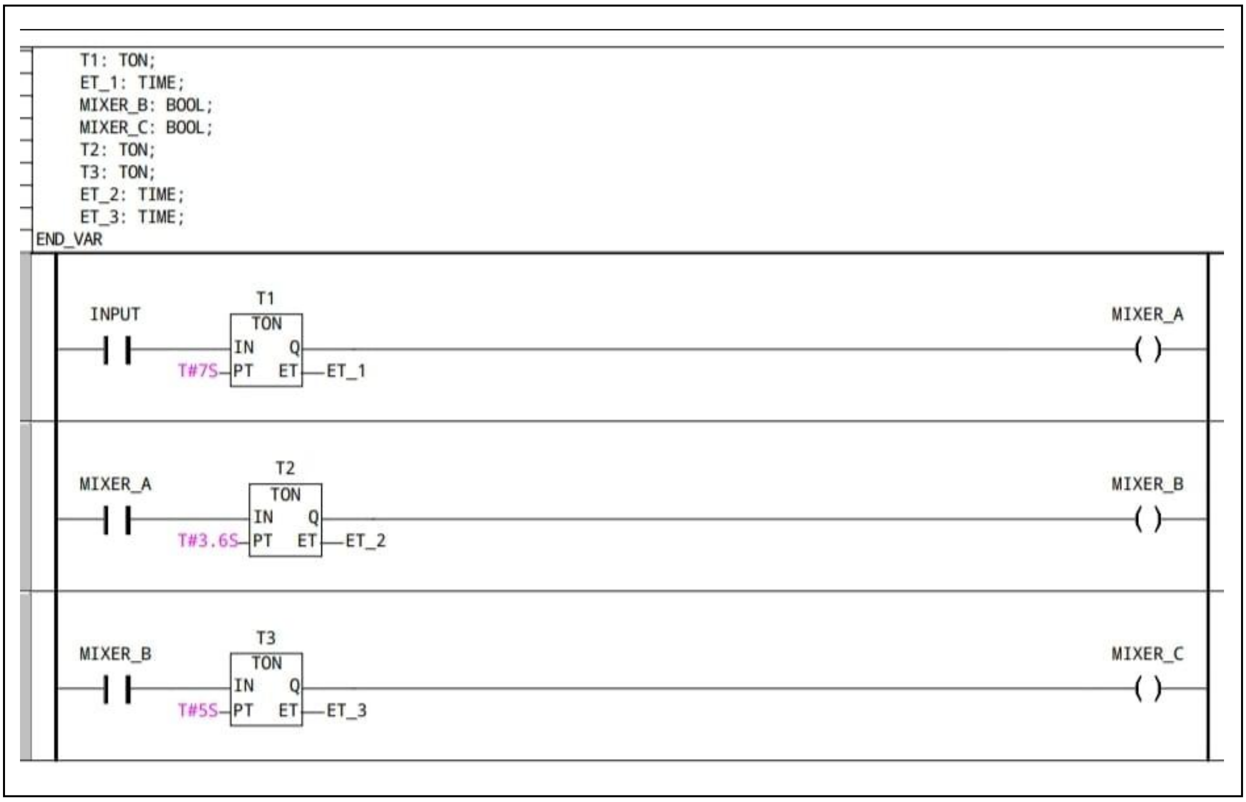


Fig 4.1 Simulation using ladder programming.

4.3ADVANTAGES

1.Flexibility: PLCs are highly flexible and can be easily reprogrammed to accommodate changes in the manufacturing process without significant hardware modifications.

2.Reliability: PLCs are designed for industrial environments and are known for their robustness and reliability. They can operate continuously for extended periods without failure.

3.Ease of Use: PLCs are user-friendly and do not require advanced programming skills. They use ladder logic or other graphical programming languages that are intuitive for technicians and engineers.

4.Scalability: PLC systems can be scaled up or down to suit the complexity and size of a control system. Additional modules and inputs/outputs can be added as needed.

5.Modularity: PLC systems are modular, allowing for easy replacement and expansion of components without affecting the entire system.

6.Remote Monitoring: PLCs can be connected to networks, enabling remote monitoring and control of industrial processes, which can improve maintenance and troubleshooting.

7.Safety Features: Many PLCs come with built-in safety features, including emergency stop functions and redundant programming options to enhance safety in industrial environments.

4.4 DISADVANTAGES

1.Cost: PLCs can be expensive to purchase and program, particularly for smaller-scale applications.

2.Complexity: While they are easier to program than traditional relay-based control systems, PLCs can still be complex for individuals with limited programming experience.

3.Limited Processing Power: PLCs may not be suitable for applications that require high-speed processing or extensive data analysis, as they have limited processing capabilities compared to dedicated computers.

4.Scalability Constraints: While PLCs are scalable to some extent, very large and complex control systems may require multiple PLCs, leading to increased costs and complexity.

5.Compatibility Issues: Integrating PLCs with other control systems or legacy equipment can sometimes be challenging due to differences in communication protocols and hardware.

6.Maintenance: Although generally reliable, PLCs can fail, and diagnosing and replacing faulty components can be time-consuming and cost.

4.5 APPLICATIONS

1.Manufacturing Automation:

PLCs control assembly lines, conveyor systems, and robotic arms in manufacturing plants for tasks such as sorting, packaging, and quality control.

2.Industrial Machinery:

PLCs are used in various industrial machinery, including CNC machines, presses, and injection molding machines, to control and coordinate complex operations.

3.Material Handling:

PLCs automate material handling systems, such as conveyor belts and AGVs (Automated Guided Vehicles), for efficient and precise transportation in warehouses and factories.

4.Process Control:

PLCs monitor and control processes in industries like chemical manufacturing, petrochemical, and food processing, ensuring consistent product quality and safety.

5.HVAC (Heating, Ventilation, and Air Conditioning):

PLCs regulate heating and cooling systems in commercial and residential buildings, optimizing energy efficiency and maintaining comfort.

CONCLUSION

In conclusion, hydraulics, pneumatics, and Programmable Logic Controllers (PLCs) represent three distinct yet interconnected pillars of modern automation and control systems. Hydraulics harness the power of incompressible fluids to transmit force and motion efficiently, finding applications across diverse industries, from construction and manufacturing to aerospace and automotive. Pneumatics, on the other hand, relies on compressed air to achieve precise control and automation, offering advantages such as cleanliness and adaptability, making it indispensable in manufacturing, packaging, and various other sectors. PLCs, as versatile electronic controllers, bridge the gap between hydraulics, pneumatics, and modern control systems, providing flexibility, reliability, and ease of use for automating and monitoring processes across industries.

Together, these technologies have revolutionized industrial automation and control, enhancing productivity, safety, and precision in numerous applications. The choice between hydraulics, pneumatics, or PLCs often depends on specific requirements, environmental factors, and efficiency considerations, highlighting the importance of understanding and integrating these systems effectively. As technology continues to evolve, the synergy between these three pillars remains crucial for powering and controlling the machinery and processes that drive our modern world.

REFERENCES

1. Industrial Hydraulics and Pneumatics reference material , Bosch Rexroth Lab
2. PLC reference material , Bosch Rexroth Lab