Rajshahi University of Engineering & Technology

Department of Mechatronics Engineering

LAB REPORTS

Course no: **MTE 3206**
Course Title: **Hydraulic and Pneumatic Control Sessional**

Experiment No: **01**
Name of the Experiment: Study of the components of Hydraulic/Pneumatic control system.

Submitted By:

Abrar Faiyaz Anan Chowdhury
ID: **2008008**
3rd Year, Even Semester
Department of Mechatronics Engineering
Rajshahi University of Engineering & Technology, Rajshahi-6204.

Submitted To:

Md. Faisal Rahman Badal
Assistant Professor
Department of Mechatronics Engineering
Rajshahi University of Engineering & Technology, Rajshahi-6204.

Md. Sakib Hassan Chowdhury
Lecturer
Department of Mechatronics Engineering
Rajshahi University of Engineering & Technology, Rajshahi-6204.

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Experiment No: 01

Name of the Experiment:

Study of the components of Hydraulic/Pneumatic control system.

Objectives:

1. To understand the fundamental principles of hydraulic and pneumatic systems.
2. To identify and study the components of hydraulic and pneumatic systems and their respective applications.
3. To learn the operational mechanisms of these components and their roles in control systems.

Theory:

Hydraulic systems utilize pressurized fluids to transmit power, relying on Pascal's Law, which states that pressure applied to a confined fluid is transmitted equally in all directions. These systems enable significant force multiplication, making them suitable for heavy-duty tasks. Similarly, pneumatic systems operate using compressed air, which is used for automation and industrial processes due to its speed and efficiency.

Key Components of Hydraulic Systems:

- Pump: Converts mechanical energy into hydraulic energy.
- Pressure Regulator: Maintains desired pressure levels.
- Directional Control Valve: Controls the flow direction of the fluid.
- Flow Control Valve: Regulates fluid flow rate.
- Cylinder: Converts hydraulic energy into linear motion.

Key Components of Pneumatic Systems:

- Slide Valve: Directs airflow in the system.
- Magnetic Cylinder: Provides precise linear motion.
- Electro-Pneumatic Valves: Control airflow for actuators.
- Relays and Timers: Enable sequential and time-based control.

Hydraulic trainers simulate real-world hydraulic systems, offering hands-on experience with circuits. Similarly, pneumatic trainers provide educational setups for understanding compressed air-based systems, preparing users for real-world applications in automation and industrial maintenance.

Hydraulic Trainer

A hydraulic trainer is a tool used for educational and training purposes, designed to replicate real-world hydraulic systems. It enables to learn about, design, and test hydraulic circuits within a controlled setting. These trainers come equipped with key components like pumps, actuators, reservoirs, all conveniently mounted on panel for easy access and operation. [1]

Figure 1: A Hydraulic Trainer

Pump

The pump transforms mechanical energy into hydraulic energy by generating fluid flow and pressure. It pulls hydraulic fluid from the reservoir and supplies it to the system.

Figure 2: A Pump

Application:
Pumps are utilized to produce the required pressure to operate actuators in various machinery, including presses, lifts, and industrial robots.

Pump Load Indicator

This device measures and displays the load or pressure the pump is managing, providing real-time insights into the pump's performance.

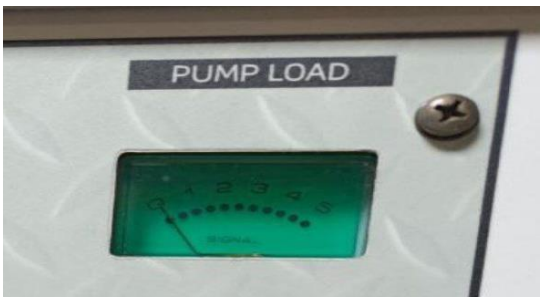

Figure 3: Pump Load Indicator

Application:
It helps monitor the system to prevent pump overloading, ensuring operations remain within safe pressure limits.

Pressure Regulator

Maintains the desired pressure in the hydraulic system by releasing any excess pressure.

Figure 4: Pressure Regulator

Application:

It protects sensitive components and maintains consistent system performance, especially in hydraulic presses and industrial automation systems.

Supply Valve

This valve controls the flow of hydraulic fluid from the pump to the system, allowing it to start, stop, or adjust fluid flow.

Figure 5: Supply Valve

Application:

Widely used to manage the activation of hydraulic circuits in industrial machinery.

Supply Gauge

Displays the pressure level of the hydraulic fluid being supplied to the system.

Figure 6: Supply Gauge

Application:
It is crucial for monitoring system pressure to ensure safe and efficient operation in hydraulic tools and equipment.

Return Line

Routes hydraulic fluid back to the reservoir after it has traveled through the system.

Figure 7: Return Line

Application:
Ensures the continuous recirculation of hydraulic fluid, aiding in cooling and preventing fluid loss.

Flow Control Valve

Regulates the fluid flow rate to control the speed of actuators.

Figure 8: Flow Control Valve

Application:
Used in hydraulic motors and cylinders to manage movement speed in lifting systems and conveyor belts.

Meter and Gauge

Measures and displays parameters such as fluid pressure, flow rate, or overall system performance.

Figure 9: Meter and Gauge

Application:
Provides essential data for diagnosing issues, calibrating systems, and ensuring accurate operation.

Directional Control Valve

Guides the flow of hydraulic fluid to different system parts, determining actuator movement direction.

Figure 10: Directional Control Valve

Application:
Enables forward and reverse movements in hydraulic cylinders, critical for machines like forklifts and excavators.

Check Valve

Ensures fluid flows in one direction only, preventing any backflow.

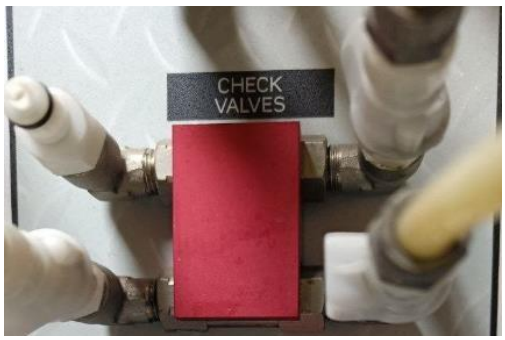

Figure 11: Check Valve

Application:
Protects pumps and components by preventing fluid reversal, commonly used in hydraulic braking and lifting systems.

T Connectors

These connectors distribute hydraulic fluid by linking three flow paths together.

Figure 12: T Connectors

Application:
They enable the branching of hydraulic lines, facilitating complex circuit designs in industrial automation and hydraulic presses.

Cylinder

Transforms hydraulic energy into linear mechanical motion, delivering force to perform various tasks.

Figure 13: Cylinder

Application:
Extensively used for operations such as lifting, pressing, and clamping in construction equipment and manufacturing systems.

In-Line Pressure Gauge

Measures the pressure at specific circuit points directly within the fluid line.

Figure 14: In-Line Pressure Gauge

Application:
Allows real-time system pressure monitoring to detect any pressure drops or surges, ensuring consistent operation.

Flow Meter

Measures the flow rate of hydraulic fluid through the system.

Figure 15: Flow Meter

Application:
Vital for precise flow regulation, commonly used in hydraulic testing and system monitoring.

Pneumatic Trainer

A pneumatic trainer serves as an interactive educational tool designed to demonstrate the principles and applications of pneumatic systems. It replicates real-world pneumatic circuits, allowing learners and professionals to design, assemble, and troubleshoot these systems in a safe and controlled setting. Pneumatic trainers are integral for understanding compressed air behavior in automation and industrial processes, laying a solid foundation in fluid power systems for those pursuing careers in automation, robotics, and industrial maintenance. [2]

Figure 16: Pneumatic Trainer

DL 8110P01
This component includes a slide valve, filter-regulator with a manometer, and a distributor.

Figure 17: DL 8110P01

Application:
It is used to control the direction of airflow in pneumatic circuits.

DL 8110P11
A single-effect (SE) magnetic cylinder equipped with a retracted piston rod and a flow micro-regulator.

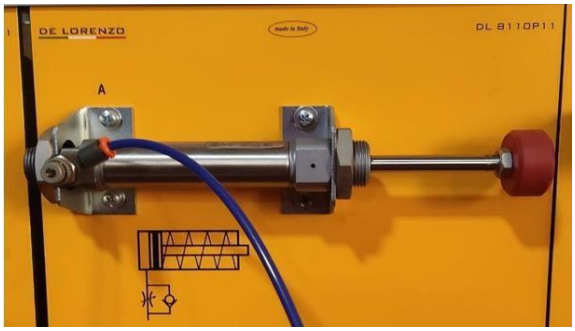

Figure 18: DL 8110P11

Application:
Provides precise linear motion with feedback for position sensing, typically used in automated assembly lines and material handling systems.

DL 8115EP01
Comprises 3/2 electro-pneumatic valves, including one normally closed (NC) and one normally open (NO).

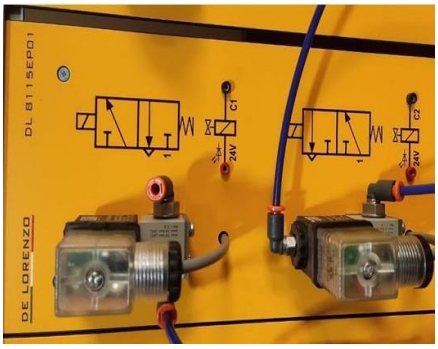

Figure 19: DL 8115EP01

Application:
Used to control the start and stop of airflow to a single-acting cylinder, ideal for operations such as clamping and pressing

DL 8115EP02
Features 5/2 electro-pneumatic valves, both bistable and monostable, with a mechanical spring and filters.

Figure 20: DL 8115EP02

Application:
Guides airflow to double-acting cylinders, controlling both extension and retraction. Commonly used in robotics and conveyor systems.

DL 8115EP03
A double-effect (DE) magnetic cylinder with flow micro-regulators, reed sensors, and a photoelectric sensor.

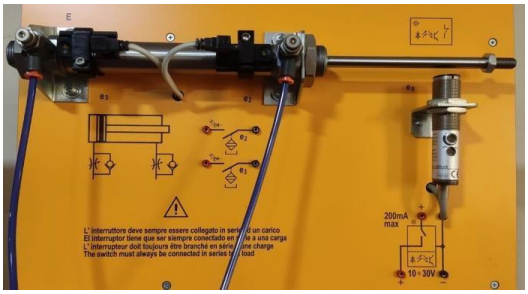

Figure 21: DL 8115EP03

Application:
Provides bidirectional movement with magnetic position sensing.

DL 8115EP04
A double-effect (DE) magnetic cylinder with flow micro-regulators, reed sensors, an inductive sensor, and a capacitive sensor.

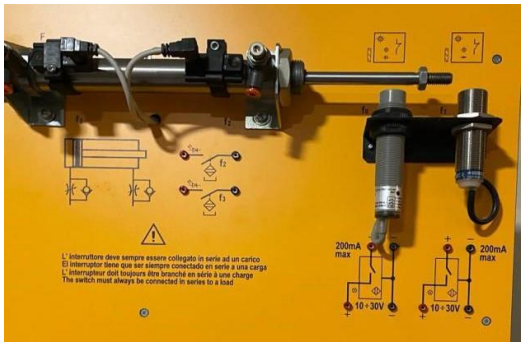

Figure 22: DL 8115EP04

Application:
Ideal for pick-and-place systems and lifting applications.

DL 8115EP05

A stabilized power supply module delivering 24Vdc, 2A.

Figure 23: DL 8115EP05

Application:
Supplies consistent voltage for operating solenoids, relays, and sensors, ensuring the reliable operation of pneumatic control circuits.

DL 8115EP06

Module featuring six push buttons, each with one normally open (NO) contact and one normally closed (NC) contact.

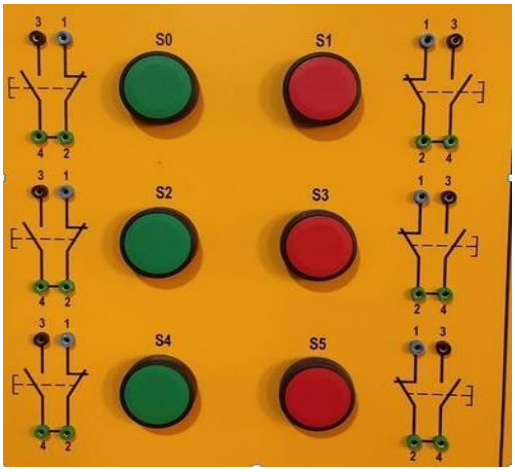

Figure 24: DL 8115EP06

Application:
Manually triggers pneumatic or electric signals, useful for emergency stops and manual system control.

DL 8115EP07

A module containing three relays, each with four normally open (NO) and four normally closed (NC) contacts.

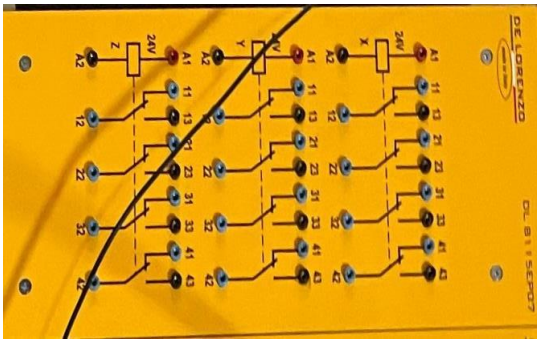

Figure 25: DL 8115EP07

Application:
Used to control multiple pneumatic actuators by switching signals, commonly employed in sequential control applications.

DL 8115EP08

Includes four lamps, two timers, and two switches, each with one NO and one NC contact.

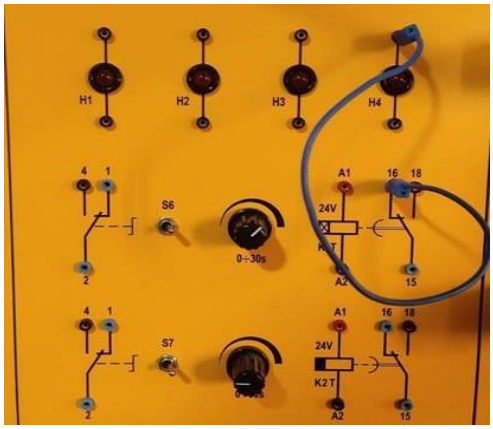

Figure 26: DL 8115EP08

Application:
Provides visual indication and time-based control for pneumatic processes, used for status monitoring and delay operations in automated systems.

Discussion:

The experiment was conducted to investigate hydraulic and pneumatic system components. Each component's function and application were studied in detail. Fluid pressure, flow, and directional control were analyzed under varying conditions, providing insights into the system's behavior. The trainers demonstrated real-world operations, enabling practical understanding of system dynamics and component interactions. The observations confirmed the theoretical principles, emphasizing the importance of precise component selection and integration for system reliability and efficiency.

Conclusion:

The objectives of the experiment were fulfilled by understanding the components of hydraulic and pneumatic systems, their operations, and applications. This experiment enhanced practical knowledge, bridging theoretical concepts with real-world applications. Future scopes include advanced studies on automation using fluid power systems and exploring energy-efficient designs to optimize industrial processes.

References:

1. "Hydraulics / Pneumatics Trainers," *Tech-Labs, 2024*. Available: tech-labs.com
2. "Hydraulics and Pneumatics: Advantages, Types Of, Uses," *IQS Directory*. Available: iqsdirectory.com