

# Industrial Control Devices

## Industrial Electronics

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Lecturer EED.



# Chapter Objectives

- 1. Identify manually operated switches commonly found in motor control circuits and explain their operation.**
- 2. Identify mechanically operated switches commonly found in motor control circuits and explain their operation.**
- 3. Identify different types of sensors and explain how they detect and measure the presence of something.**
- 4. Describe the operating characteristics of a relay, solenoid, solenoid valve, stepper motor, and brushless DC motor.**



# 1. Manually Operated Switches

## Primary and Pilot Control Devices

A control device is a component that governs the power delivered to an electrical load.

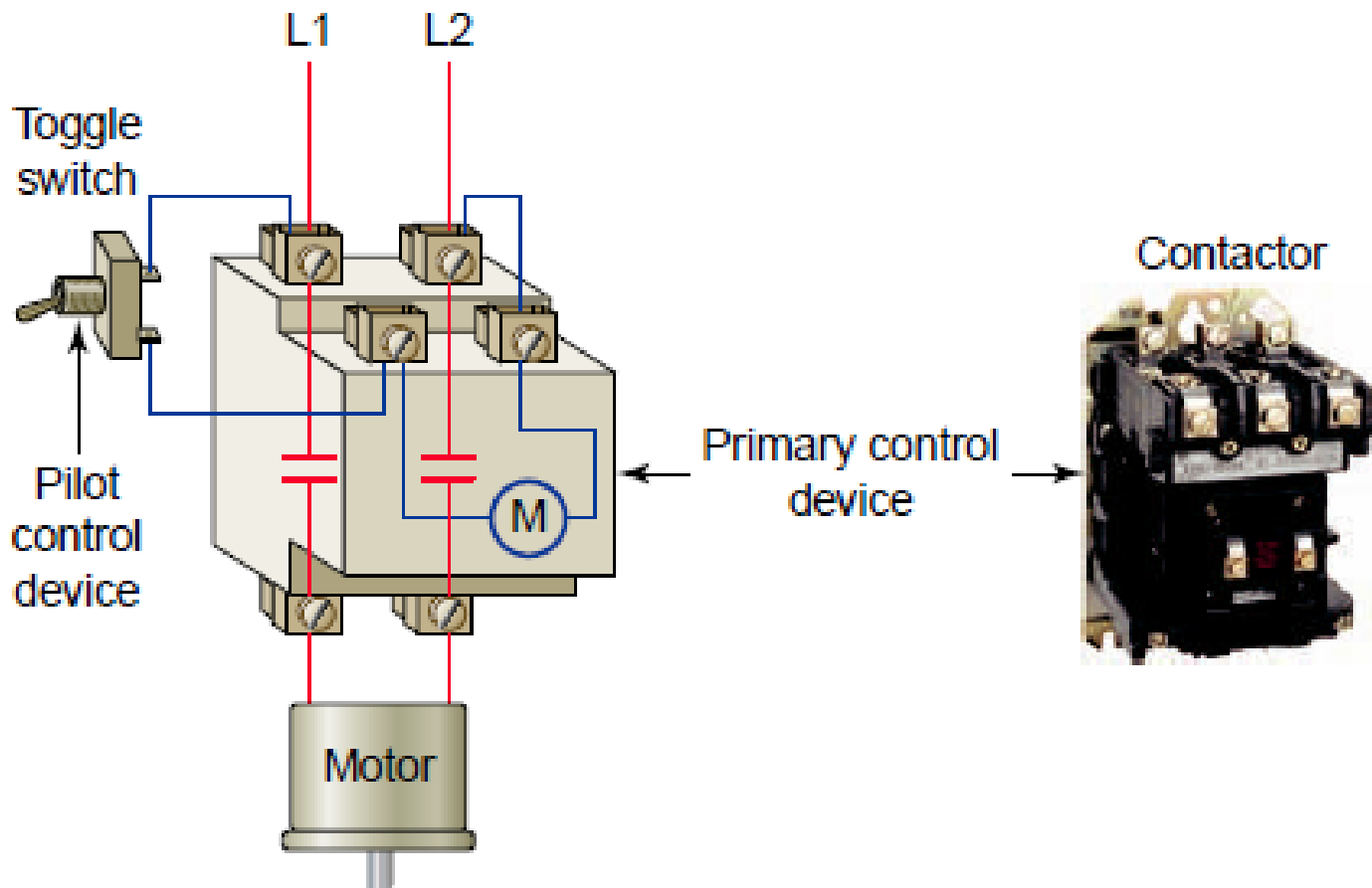
classified as either primary control devices or pilot control devices.



# *Primary control devices Pilot control Devices*

- Connects the load to the line such as Motor contactor, starter, or controller etc. are primary control devices.
- *Pilot control device* , such as a relay or switch contact, is used to activate the primary control device.
- Pilot-duty devices should not be used to switch horsepower loads unless they are specifically rated to do so





# Toggle Switches

- A manually operated switch is one that is controlled by hand.

A toggle switch uses a mechanical lever mechanism to implement a positive snap action for switching of electrical contacts. This type of switching or contact arrangement is specified by the appropriate abbreviation as follows:

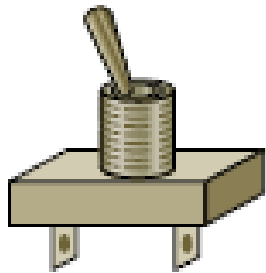
SPST—Single pole, single throw

SPDT—Single pole, double throw

DPST—Double pole, single throw

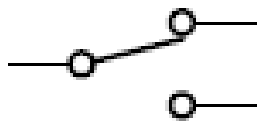
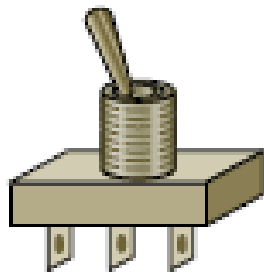
DPDT—Double pole, double throw





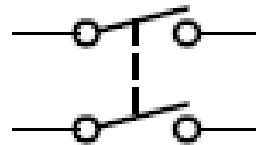
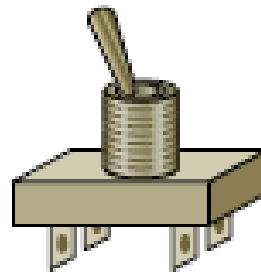
SPST

Single pole,  
single throw



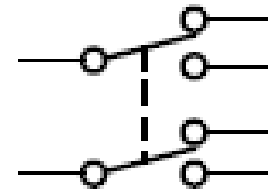
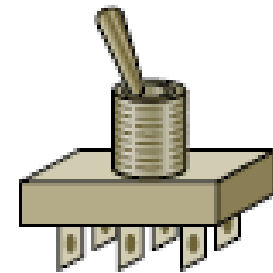
SPDT

Single pole,  
double throw



DPST

Double pole,  
single throw



DPDT

Double pole,  
double throw

# Pushbutton Switches

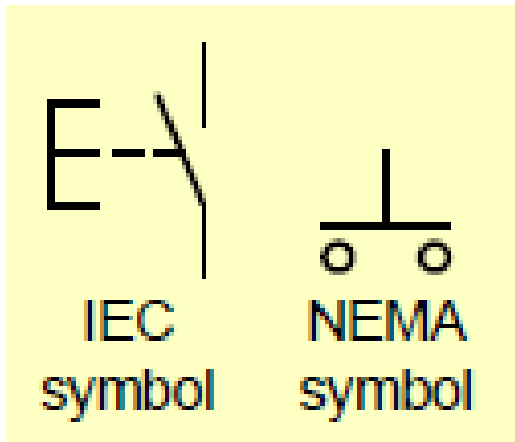
*Pushbutton switches are commonly used in motor control applications to start and stop motors, as well as to control and override process functions.*

A push button operates by pressing a button that opens or closes contacts.

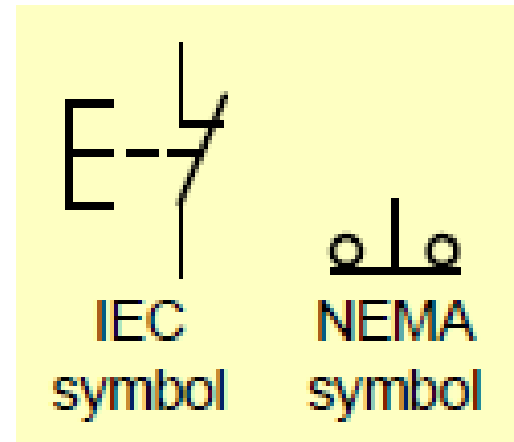
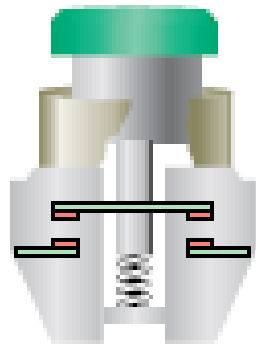
Abbreviations N.O. (normally open) and N.C. (normally closed) represent the state of the switch contacts when the switch is not activated.



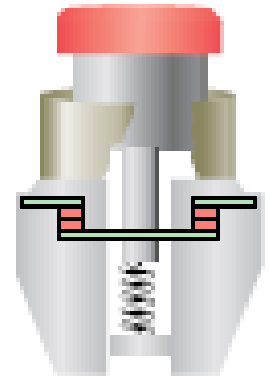




N.O. (normally open)  
pushbutton

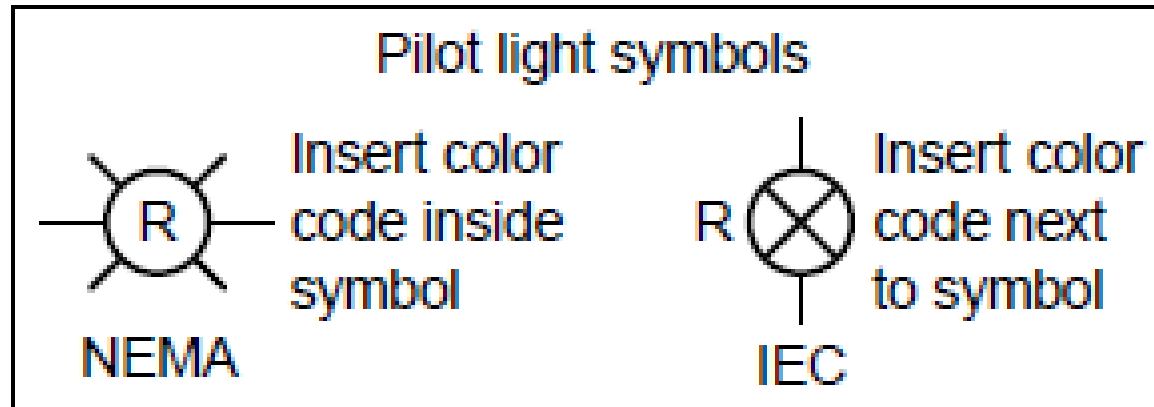


N.C. (normally closed)  
pushbutton



# Pilot Lights

Pilot lights provide visual indication of the status for many motor-controlled processes permitting personnel at remote locations to observe the current state of the operation.



# Selector Switch

A selector switch operator is rotated (instead of pushed) to open and close contacts of the attached contact block.

Switch positions are established by turning the operator knob right or left.

These switches may have two or more selector positions.



Selector switch

# Drum Switch

*A drum switch consists of a set of moving contacts and a set of stationary contacts that open and close as the shaft is rotated.*

Motor connections	
Forward	Reverse
L1-to-T1	L1-to-T3
L3-to-T3	L3-to-T1
L2-to-T2	L2-to-T2



# 2. Mechanically Operated Switches

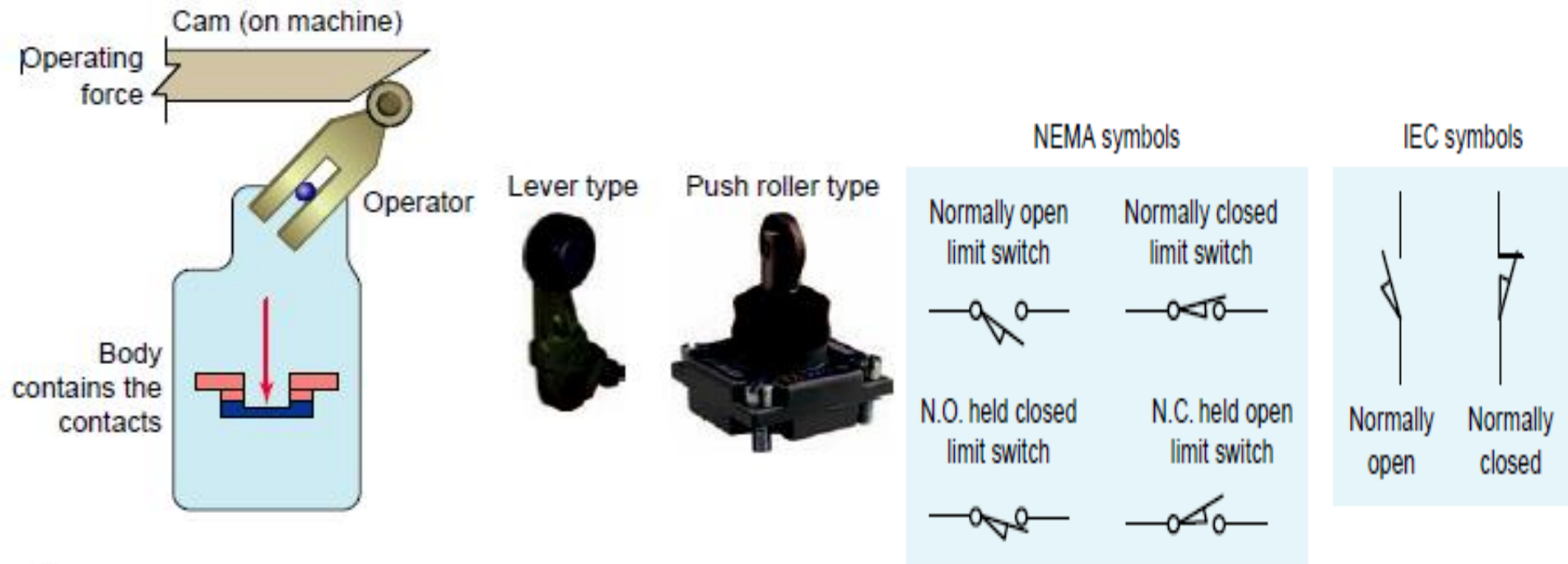
A mechanically operated switch is one that is controlled automatically by factors such as pressure, position, and temperature.

- Limit switch , is a very common type of mechanically operated motor control device.

Limit switches are designed to operate only when a predetermined limit is reached, and they are usually actuated by contact with an object such as a cam.



- Limit switches are constructed of two main parts: the body and the operator head (also called the actuator).



# Temperature Control Devices

- Temperature control devices (also called thermostats, depending on the application) monitor the temperature or changes in temperature for a particular process.
- Temperature control devices are used in heating or cooling applications where temperature must be maintained within preset limits.



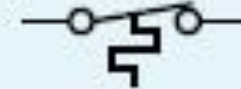
Programmable thermostat



NEMA symbols

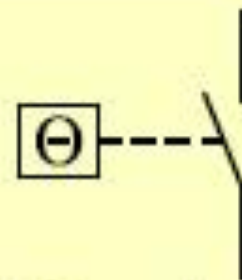


N.O. contact

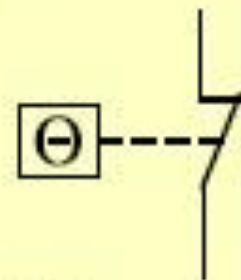


N.C. contact

IEC symbols



N.O. contact



N.C. contact

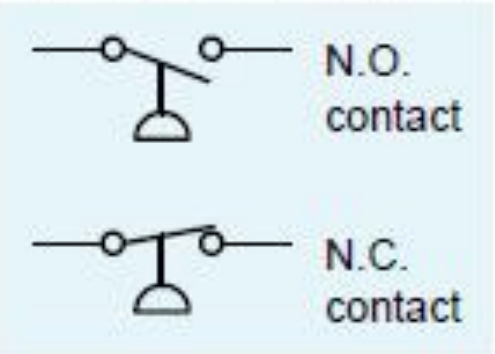


# Pressure Switches

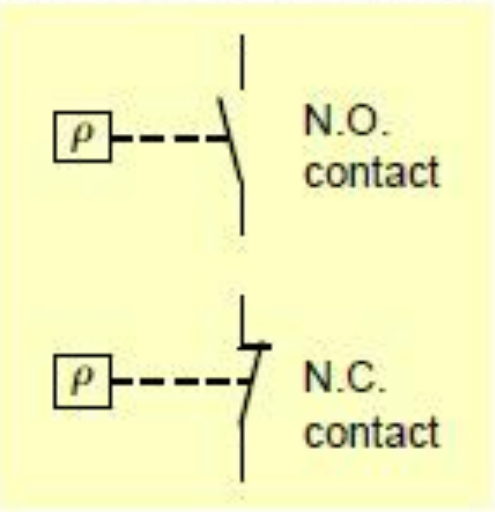
- *Pressure switches are used to monitor and control the* pressure of liquids and gases.
- They are commonly used to monitor a system and, in the event that pressure reaches a dangerous level, open relief valves or shut the system down.



### NEMA symbols for pressure switch contacts



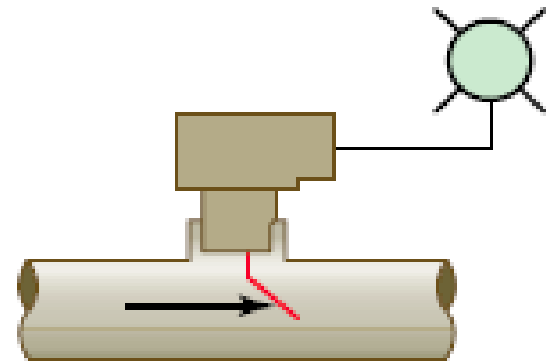
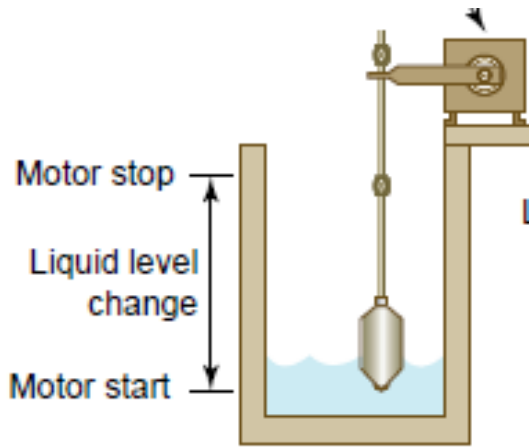
### IEC symbols for pressure switch contacts



# Float and Flow Switches

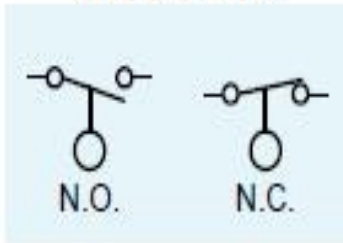
- *A float switch is used to sense the height of a liquid. Float switches provide automatic control for motors that pump liquid from a sump or into a tank.*
- The switch must be installed above the tank or sump, and the float must be in the liquid for the float switch to operate.
- For tank operation, a float operator assembly is attached to the float switch by a rod, chain or cable.



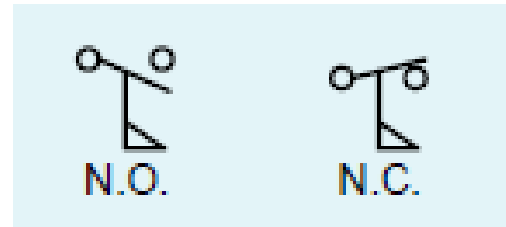


Flow detection

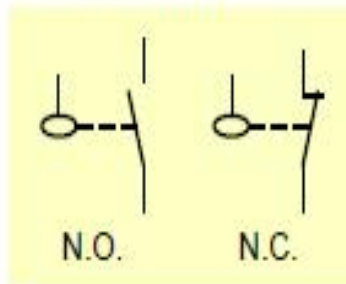
NEMA symbols



NEMA symbols



IEC symbols



IEC symbols

