PERFORM INSTALLATION OF MOTOR CONTROL SYSTEM

NTQF Level II

Learning Guide #20

Unit of Competence: **Perform installation of motor controller system**

Module Title: **Performing installation of motor controller system**

LG Code: EEL EMD2 M02LO1-LG20

TTLM Code: EEL EMD2 M02TTLM 0919v1

LO1: Plan and Prepare for Motor controller Installation

Instruction Sheet	Learning Guide #01

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics–

- Personal protective equipments (PPE)
- Tools and Test Instruments
- Reading industrial installation plan
- Wiring Diagrams and Layouts/shop drawings
- Motor control Components and wiring devices
- Correct size and degree of protection of enclosures
- Reporting complete data of Industrial

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- *Obtain Wiring diagrams* and layout/shop drawings according to job requirements
- read and interpret Drawings in accordance with job requirements
- verify Estimated work schedule with immediate superior
- Identify Correct rating, quantity, sizes and type of control *components and wiring devices* and other materials in line with job requirements
- verify Correct size and degree of protection of enclosures in line with job requirements
- select properly *Tools and testing instruments* in line with job requirements
- Identify and select Correct PPE in line with safety requirements

Submit complete data on inspection report based on job requirements to Immediate superior

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3, Sheet 4, Sheet 5, Sheet 6 and Sheet 7,-" **in page 3-8,10-16, 18-28,30-32,34-42,47-55 and ---** respectively.
4. Accomplish the "Self-check 1, Self-check t 2, Self-check 3 and Self-check 4" **in page 9,17,29,33,43, 56 and ---** respectively
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 " **in page 57-62.**
6. Do the "LAP test" **in page 63**

Information Sheet-1	Personal protective equipments (PPE)

1.1 Introduction to PPE

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations. The Occupational Safety and Health Administration (OSHA) require that employers protect their employees from workplace hazards that can cause injury.

Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, OSHA recommends the use of engineering or work practice controls to manage or eliminate hazards to the greatest extent possible. For example, building a barrier between the hazard and the employees is an engineering control; changing the way in which employees perform their work is a work practice control.

1.2 The Requirement for PPE

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.

1.3 In general, employers are responsible for:

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards.
- Identifying and providing appropriate PPE for employees.
- Training employees in the use and care of the PPE.
- Maintaining PPE, including replacing worn or damaged PPE.
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

Specific requirements for PPE are presented in many different OSHA standards, published in 29 CFR. Some standards require that employers provide PPE at no cost to the employee while others simply state that the employer must provide PPE. Appendix A at page 40 lists those standards that require the employer to provide PPE and those that require the employer to provide PPE at no cost to the employee.

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1.4 Training Employees in the Proper Use of PPE

Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary?
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

1.4.1 Eye and Face Protection

Many occupational eye injuries occur because workers are not wearing any eye protection while others result from wearing improper or poorly fitting eye protection. Employers must be sure that their employees wear appropriate eye and face protection and that the selected form of protection is appropriate to the work being performed and properly fits each worker exposed to the hazard.

1.4.2 Eye Protection for Exposed Workers

OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers and pipefitters, Sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of workers in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment.

Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, the use of power tools or even strong wind forces.
- Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
- Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes.
- Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles).

1.4.3 Types of Eye Protection

Selecting the most suitable eye and face protection for employees should take into consideration the following elements:

- Ability to protect against specific workplace hazards.
- Should fit properly and be reasonably comfortable to wear.
- Should provide unrestricted vision and movement.
- Should be durable and cleanable.

- Should allow unrestricted functioning of any other required PPE.

Some of the most common types of eye and face protection include the following:

- **Safety spectacles.** These protective eyeglasses have safety frames constructed of metal or plastic and impact-resistant lenses. Side shields are available on some models.
- **Goggles.** These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses.
- **Welding shields.** Constructed of vulcanized fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light; they also protect both the eyes and face from flying sparks, metal spatter and slag chips produced during welding, brazing, soldering and cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation.
- **Laser safety goggles.** These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace.
- **Face shields.** These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the employee's head. Some are polarized for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards.

1.4.4 Head Protection

protecting employees from potential head injuries is a key element of any safety program. A head injury can impair an employee for life or it can be fatal. Wearing a safety helmet or hard hat is one of the easiest ways to protect an employee's head from injury. Hard hats can protect employees from impact and penetration hazards as well as from electrical shock and burn hazards.

Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards.

In general, protective helmets or hard hats should do the following:

- Resist penetration by objects.
- Absorb the shock of a blow.
- Be water-resistant and slow burning.
- Have clear instructions explaining proper adjustment and replacement of the suspension and headband.

1.4.5 Foot and Leg Protection

Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Also, employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn. On the other hand, workplace exposure to static electricity may necessitate the use of conductive footwear. Examples of situations in which an employee should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the employee's feet;
  Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
  Exposure to molten metal that might splash on feet or legs;
  Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present.

1.4.5.1 Special Purpose Shoes

1.4.5.1.1 **electrically conductive shoes** provide protection against the buildup of static electricity. Employees working in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear conductive shoes to reduce the risk of static electricity buildup on the body that could produce a spark and cause an explosion or fire. Foot powder should not be used in conjunction with protective conductive footwear because it provides insulation, reducing the conductive ability of the shoes. Silk, wool and nylon socks can produce static electricity and should not be worn with conductive footwear. Conductive shoes must be removed when the task requiring their use is completed. Note: Employees exposed to electrical hazards must never wear conductive shoes.

1.4.5.1.2 **Electrical hazard, safety-toe shoes** are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions and should be used in conjunction with other insulating equipment and additional precautions to reduce the risk of a worker becoming a path for hazardous electrical energy. The insulating protection of electrical hazard, safety-toe shoes may be compromised if the shoes become wet, the soles are worn through, metal particles become embedded in the sole or heel, or workers touch conductive, grounded items. Note: Nonconductive footwear must not be used in explosive or hazardous locations.

1.4.6 Hand and Arm Protection (Glove)

1.4.6 .1 Care of Protective Gloves

Protective gloves should be inspected before each use to ensure that they are not torn, punctured or made ineffective in any way. A visual inspection will help detect cuts or tears but a more thorough inspection by filling the gloves with water and tightly rolling the cuff towards the fingers will help reveal any pinhole leaks. Gloves that are discolored or stiff may also indicate deficiencies caused by excessive use or degradation from chemical exposure.
Any gloves with impaired protective ability should be discarded and replaced. Reuse of chemical-resistant gloves should be evaluated carefully, taking into consideration the absorptive qualities of the gloves. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved and factors such as duration of exposure, storage and temperature.

1.4.7 Body Protection

Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes;
- Hot splashes from molten metals and other hot liquids;
- Potential impacts from tools, machinery and materials;
- Hazardous chemicals

Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

- **Paper-like fiber** used for disposable suits provide protection against dust and splashes.
- **Treated wool and cotton** adapts well to changing temperatures, is comfortable, and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.
- **Duck** is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.
- **Leather** is often used to protect against dry heat and flames.
- **Rubber, rubberized fabrics, neoprene and plastics** protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

1.6 Safety and Health Program Management Guidelines

The guidelines identify four general elements critical to the development of a successful safety and health management program:

- Management leadership and employee involvement.
- Work analysis.
- Hazard prevention and control.
- Safety and health training.

Self-Check 1	Written Test

Part I: Enumeration

Direction: Write on the blank space/List down the following

1. Some common types of eye and face protection equipment's
   a. _____________
   b. _____________
   c. _____________
   d. _____________

2 . List Special Purpose Shoes
   a. _____________
   b. _____________

3. List different types of Protective clothing comes in a variety of materials, each effective against particular hazards
   c. _____________
   d. _____________
   e. _____________
   f. _____________

Answer Sheet

Score = ____________
Rating: _____________

Name: ____________________________ Date: ________________

Information Sheet-2	Tools and Test Instruments

2.1 Testing instrument

TACHOMETERS

There are two types, A.C. and D.C. The A.C. type generates a sinusoidal output. The frequency of the voltage represents the speed of rotation. The frequency must be counted and processed. The D.C. type generates a voltage directly proportional to the speed. Both types must be coupled to the rotating body. very often the tachometer is built into electric motors to measure their speed.

VOLTAGE TESTER

Is often used by the electrician to measure approximate circuit operating voltages. Its rugged construction makes it ideally suited for rough on-the-job handling.

CLIP-ON AMMETER

It is sometimes called "clamp-on" is used to measure current without any direct electrical contact with the circuit.

NEON TEST LIGHT

Is an inexpensive device that can be used by the homeowner to indicate the presence of a voltage.

LOGIC PROBE

Is designed for quick checking and servicing of digital circuits. It visually displays the presence of correct logic levels by illumination of colored readouts.

CONTINUITY TESTER

Is used for checking the continuity of dead circuits. This tester is powered by batteries and used to check for defective switches, broken leads, or to identify wire in multiwire cables. A light signal indicates completed circuits.

MULTI-TESTER

A **multi meter** or a **multi tester**, also known as a **volt/ohm meter** or **VOM**, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multi meter may include features such as the ability to measure voltage, current and resistance. Multi meters may use analog or digital circuits—**analog multi meters** and **digital multi meters** (often abbreviated **DMM** or **DVOM**.) Analog instruments are usually based on a micro ammeter whose pointer moves over a scale calibration for all the different measurements that can be made; digital instruments usually display digits, but may display a bar of a length proportional to the quantity measured.

A multi meter can be a hand-held device useful for basic fault finding and field service work or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems.


Electronic **Multi-Tester** group


Multi Tester Multi Tester


Digital **Multi Tester** DT-830B


Multi Tester


Aquatronica **Multi Teste**

PMUT Presidium **Multi Tester**


YX-360 RNA **MULTI TESTER**


Multi Tester


DIGITAL **MULTI TESTER** METER


ELECTRIC **MULTI TESTER**

Analogue **Multi-tester**


Multi Tester

Picture Of **Multi tester**

Digital **Multi tester**

Presidium **Multi Tester** PMUT

Digital **Multi-Tester** with

MULTI-TESTER GB Electrical

GWS **Multi-Tester** MT-1

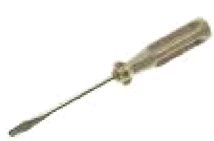
Caravan **Multi-Tester**

2.2 TOOLS

SCREW DRIVERS

A **screwdriver** is a tool for driving screws and rotating other machine elements with the mating drive system. The screwdriver is made up of a head or tip, which engages with a screw, a mechanism to apply torque by rotating the tip, and some way to position and support the screwdriver. A typical hand screwdriver comprises an approximately cylindrical handle of a size and shape to be held by a human hand, and an axial shaft fixed to the handle, the tip of which is shaped to fit a particular type of screw. The handle and shaft allow the screwdriver to be positioned and supported and, when rotated, to apply torque. Screwdrivers are made in a variety of shapes, and the tip can be rotated manually or by an electric motor or other motor. A screw has a head with a contour such that an appropriate screwdriver tip can be engaged in it in such a way that the application of sufficient torque to the screwdriver will cause the screw to rotate.

screwdrivers



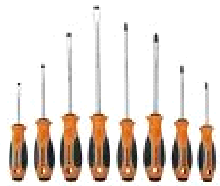
Screwdrivers come

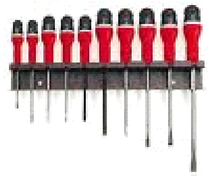
Cushion Grip

Klein **Screwdrivers**

Screwdrivers


Cordless **Screwdrivers**


Screwdrivers have


Screwdrivers

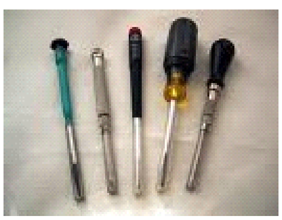

X celite **Screwdrivers**


Find a **Screwdriver** When


screwdrivers


Screwdriver set


all the **screwdrivers I** own


This holds the **screwdriver**


1 - Stubby **Screwdriver** 2


Main Products: **Screwdrivers**


Screwdriver

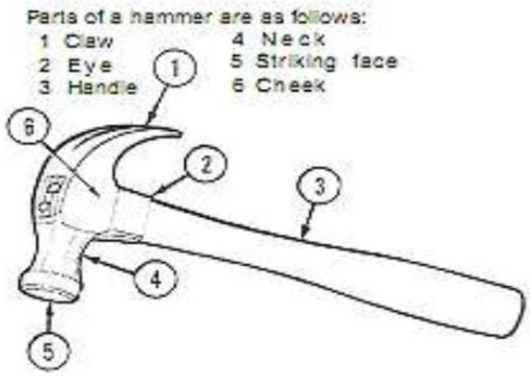

Screwdrivers & Bits


Screwdriver Sets


Screwdriver Review Roundup

HAMMERS

Hammers are produced in a variety of head weights and are an important part of any tool kit.



The carpenter hammer is used for driving and pulling nails and tapping wood chisels. There are two types of claws.

- BUMPING BODY HAMMER

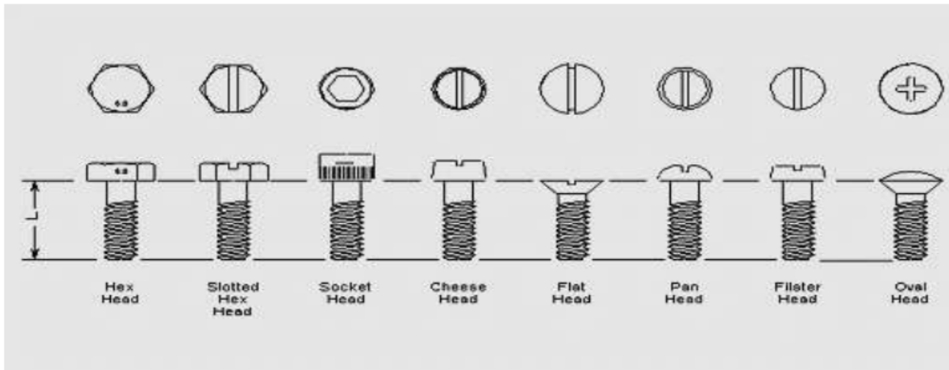
  A bumping body hammer is used to straighten and form metal

ELECTRIC DRILLS

Are used for drilling holes in wood, metal, and concrete. The size of a drill is determined by the chuck size and the power of the motor. The *chuck* is the part of a drill that holds the twist drill bit. A 3/8-inch drill will hold a bit of any size up to 3/8-inch in diameter. Reversible and battery-powered electric drills are also available.

SCREW FASTENER

- MACHINE SCREW BOLT AND NUT UNITS



Are used primarily to join metal to a variety of other materials. They are produced in many thickness and thread pitches, depending on the amount of support strength and compression required. The coarse-thread bolt install faster, since the nut advances along the bolt a greater distance for each complete turn. Fine-threaded units require more turns of the nut to tighten the, but excellent compression is obtained between the surfaces joined.

Self-Check 2	Written Test

Part II: Enumeration

Direction: Write on the blank space/List down the following

____________1. A cutting tools used to removed insulator of wire

____________2. A hand tool used to driving nails and fastener cold chisel.

____________3. A tool used holding wires, gripping, twisting and cutting.

____________4. A driving tool used to driving screws with an X design.

____________5. A driving tool used to loosen tightens screw removing bolts with slotted

____________6. A tool used to measure current without any direct electrical contact.

___________ 7. Measuring devices used to measure voltage current resistance,

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

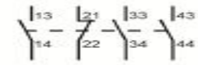
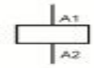
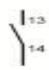
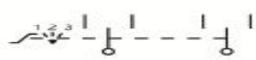
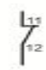
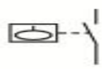
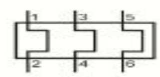
Information Sheet-3	Reading industrial installation plan

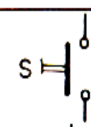
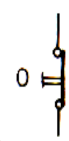
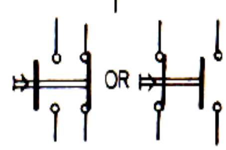
3.1 Reading industrial installation Symbol

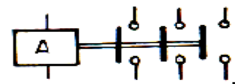
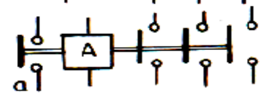
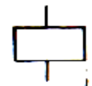
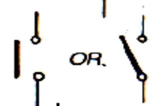
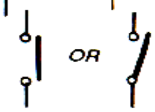
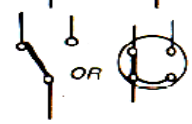
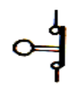
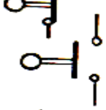
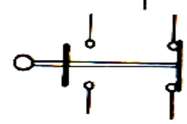
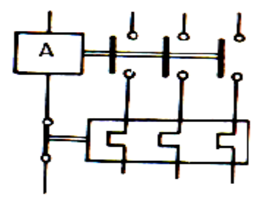
INTRODUCTION

Control symbols

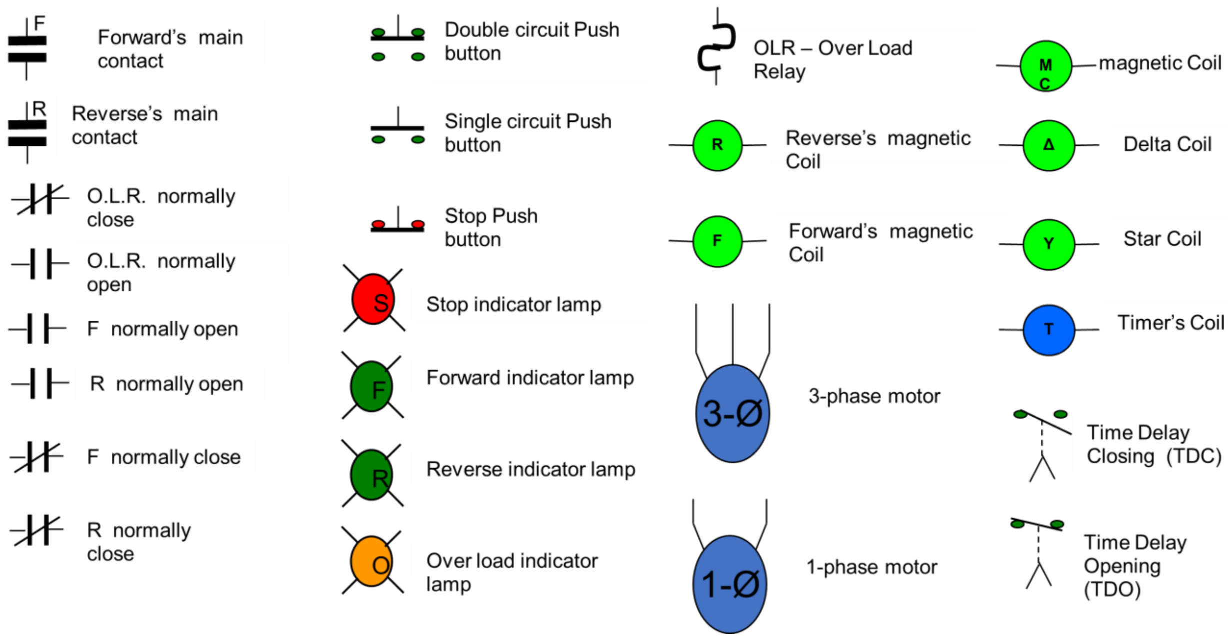
We use drawings to convey the information about piece of equipment in a form which all those Involved
in its production installation and service will understand Tomake this possible standard drawin g **conventions** have been adopted by most companiesn
When you learned to readyou werefirst taught a set ofsymbolsthat represented different soundsTh isset ofsymbols is called the alphabet. Schematics and wiringdiagrams are the written language of motor controls.Before you can learn to properly determine the logicof a control circuit, you must first learn the writtenlanguage Unfortunately there is no actual standardused for mot or control symbols
Different manufacturers and companies often use their own sets of symbolsfor their in house schematicsAlso, schematics drawnin other countries may use entirely different sets ofs ymbols to represent different control components.Although symbols can vary from one manu facturerto another, or from one country to another once youhave learned to interpret circuit logi c it is generally sent by the way they are used in the schematic The
most standardized set of symbols in the United Stateis provided by the National Electrical Manuf acturer'sAssociation, or NEMA. Schematic and wiring diagrams are the written languageof control ci rcuitsMaintenance electriciansmust beable to interpret schematic and wiring diagrams to install co ntrol equipment or troubleshoot existing controlcircuits Schematic diagrams are also known as line di-agrams and ladder diagrams. *Schematic diagrams show componentsin their electrical sequence without regardto physical location.*Schematics are used m ore thananyother type of diagram to connector troubleshoot acontrol circuit.*Wiring diagrams sho w a picture of the controlcomponents with connecting wires.* Wiring diagramsare sometimes used to install new control circuits, butthey are seldom used for troubleshooting existing cir-cuit.

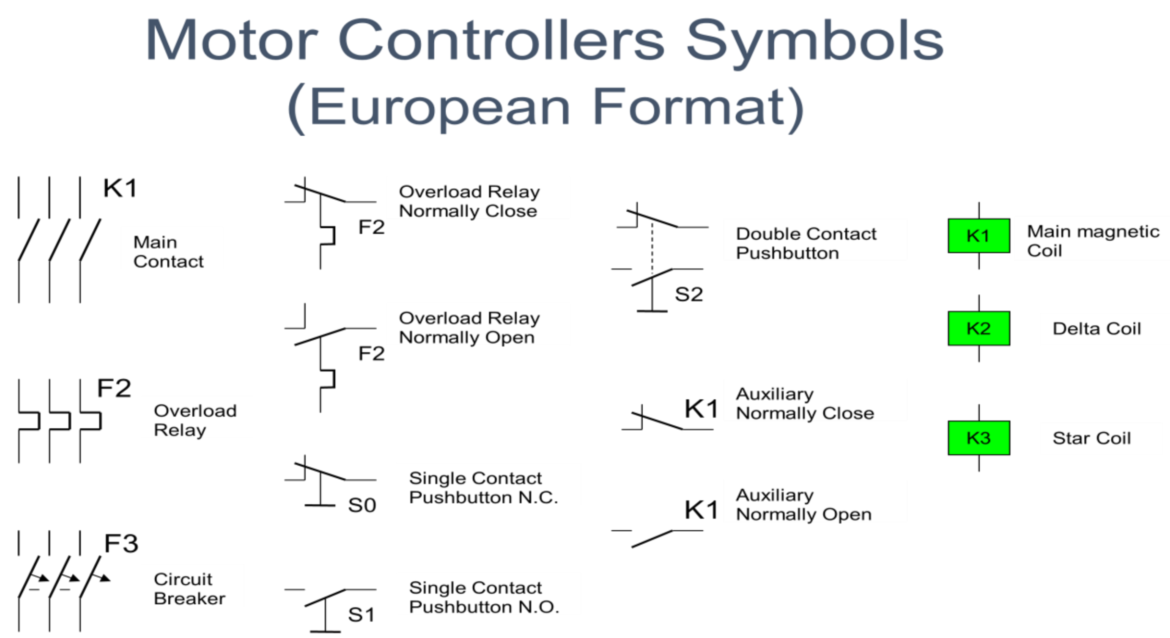
Terminal Strip	11 12 13 14	Neon Lamp	H 
Start Button (spring return)		Relay Contacts	K 
Stop Button (spring return)		Contactor or Relay Coil	K 
Non Automatic Return		Contactor Main Contacts	KM 
Emergency Stop (Mushroom Head) (Latching)		Normal Open Auxillary Contact on KM3	KM3 
Selector Switch 3 Position	S 	Normally Closed Auxillary Contact On KM4	KM4 
Float switch		Resettable Thermal Overload Auxiliary Contacts	
Signal Lamp	H 	Thermal Overload Relay Elements	F 
Incandescent Signal Lamp	H 		

Sl. No.	*Name of Component*	*Electrical Symbols*
1.	Push Button Normally Open NO, S = Start	
	Normally Closed NC. O = Off	
2.	Push Button with one NO and one NC contact operated together (1 NO + 1 NC)	
3.	Three phase induction motor (Squirrel cage)	

Sl. No.	*Name of Component*	*Electrical Symbols*
4.	Slip ring induction motor	
5.	Electrically operated 3-pole contactor with power contacts (three phase supply contacts) or main contacts only	
6.	Electrically operated contactor with main (three phase or power contacts) and auxiliary (control circuit) contacts	
7.	Coil of a electromagnetic relay contactor	
8.	Auxiliary contact Normally Open (NO)	
9.	Auxiliary contact Normally Closed (NC)	
10.	Two-way contactor	
11.	Limit Switch contact Normally Closed	
12.	Limit Switch Contact Normally Open	
13.	NO + NC Limit Switch Operated together	
14.	Signal Lamp	
15.	Contactor with thermal overload relay in all the three poles (phases)	

Motor Controllers Symbols (Western Format)

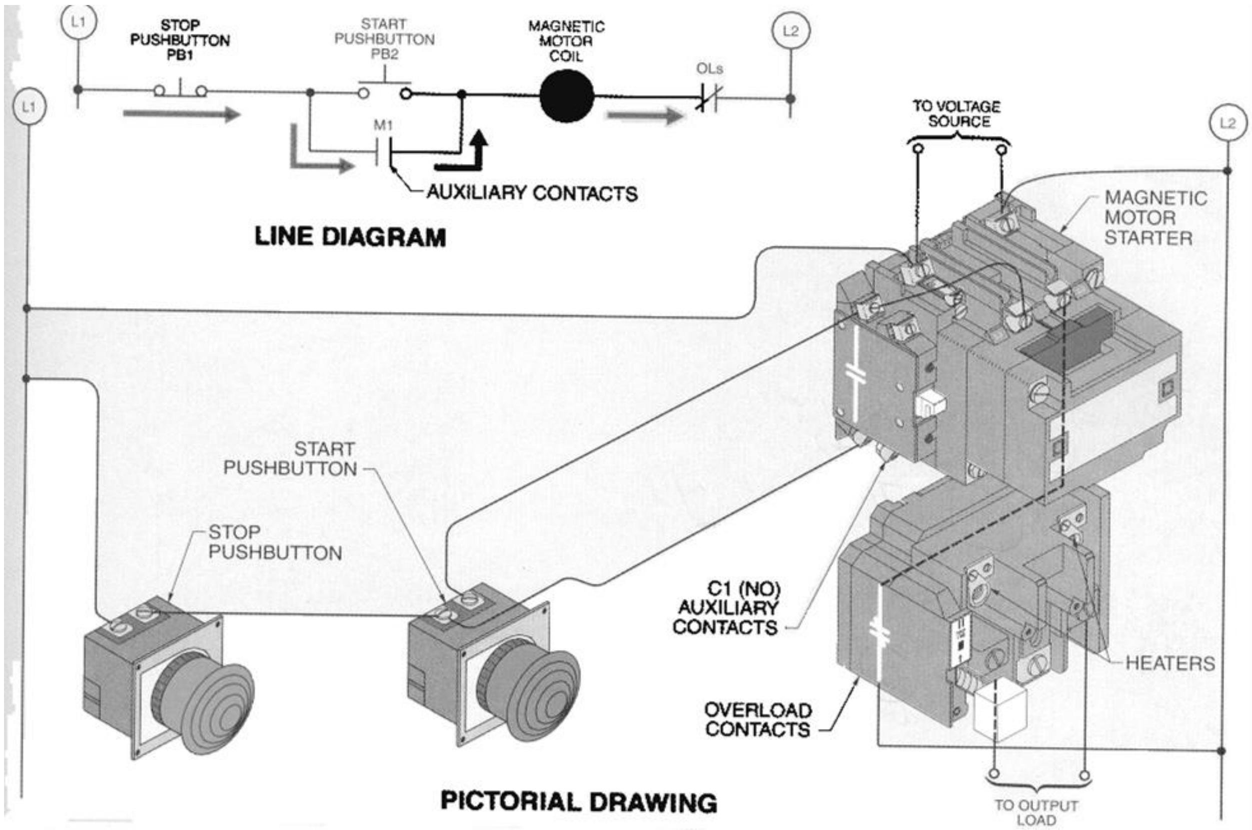




3.2 Magnetic Motor Starters

- A magnetic motor starter is an electrically-operated switch (contactor) that includes motor overload protection.
- Magnetic motor starters are identical to contactors except that they have *overloads* attached to them.
- The overloads have heaters or electronic overloads (located in the power circuit) which sense excessive current flow to the motor.
- The heaters open the NC overload contacts (located in the control circuit) when the overload becomes dangerous to the motor.

Magnetic Starter



Magnetic Motor Starter

L1 (1) - first line in from power source (phase 1 for 3ph / Neutral for 1ph)

L2 (3) - second line in from power source (phase 2 for 3ph / Hot for 1ph* see below for alternate wiring using L2 & L3)
L3 (5) - third line in from power source (phase 3 for 3ph / NC for for 1ph)
COIL
T1 (2) - first line out to motor (phase 1 for 3ph / Hot for 1ph)
T2 (4) - second line out to motor (phase 2 for 3ph / NC for 1ph* see below for alternate wiring)
T3 (6) - third line out to motor (phase 3 for 3ph / Neutral for 1ph)

- **Motor Starter Control Circuit**

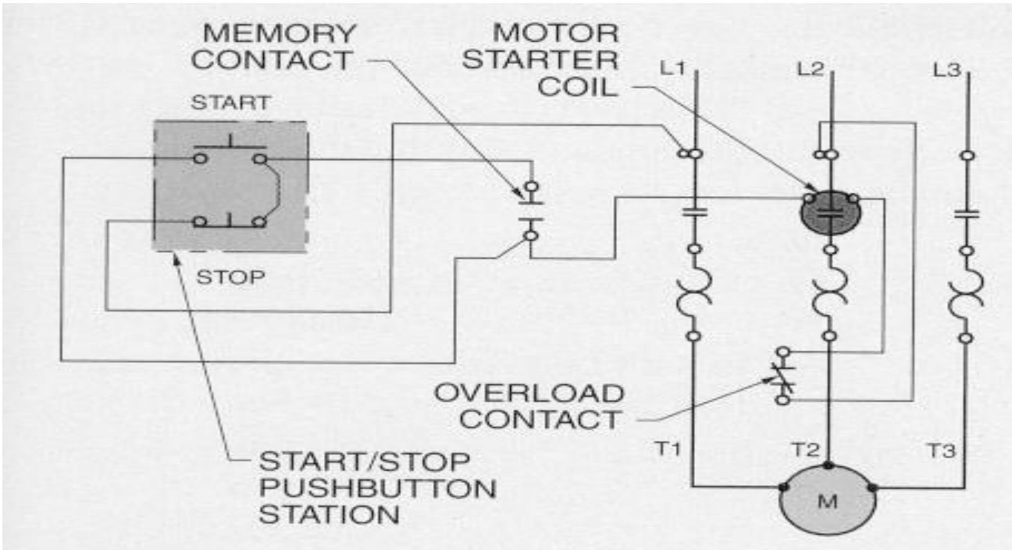


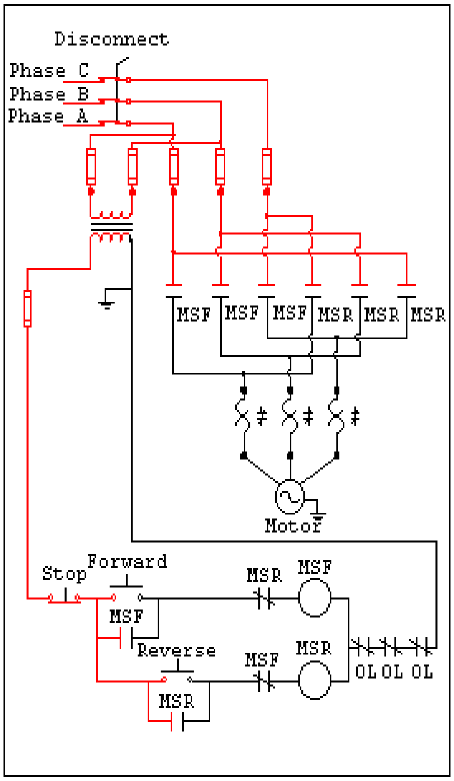
Fig. Alternate method of drawing the electrical circuit

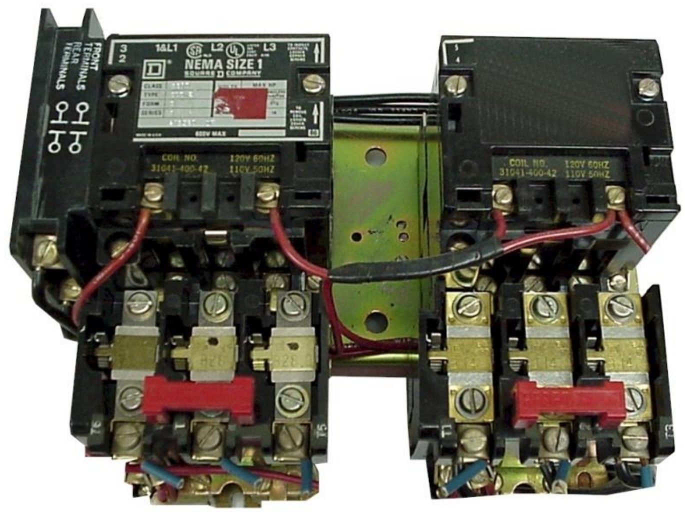
NEMA vs. IEC

If we compare the NEMA magnetic motor starter to the IEC magnetic motor starter, the following differences would be noticed:

- An IEC device is physically smaller than a comparable NEMA device.
- An IEC device is usually less expensive than a comparable NEMA device.
- An IEC device has a life cycle of approximately one million operations while a comparable NEMA device has a life cycle of almost four times that number.
- An IEC device should normally be protected with fast-acting, current-limiting fuses while a NEMA device can be protected with conventional time delay fuses.

Reversing Starter



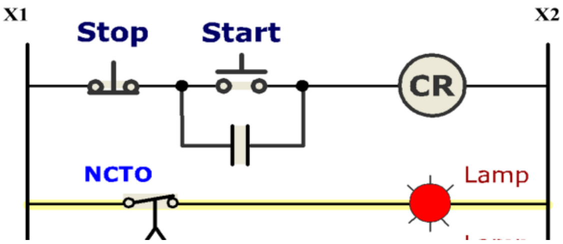


3.3 Relay Timers

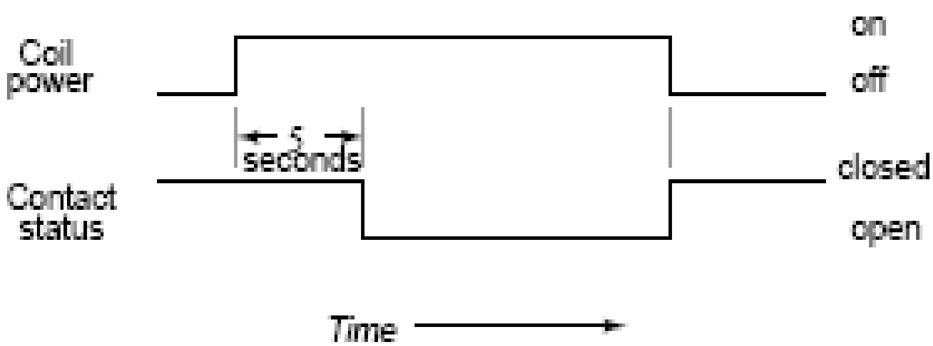
ON Delay

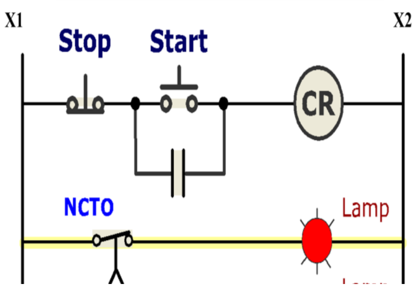
OFF Delay

Wired ON Delay

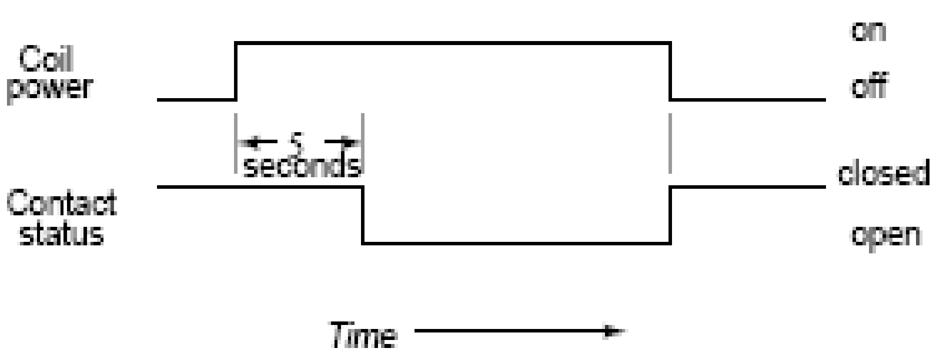


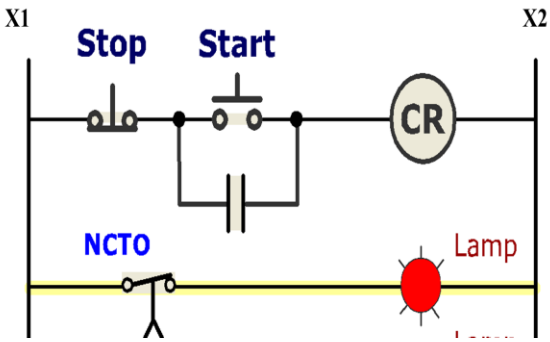
1. Energy applied to power rails





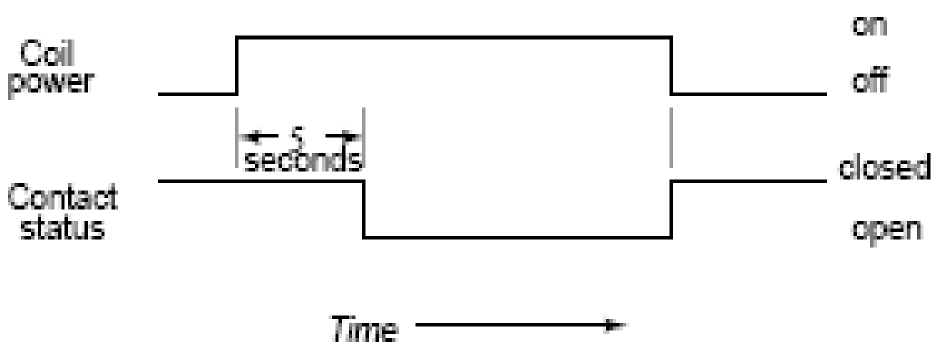
1. Energy applied to power rails
2. **Start PB is pressed**
   - **Coil is energized**
   - **Holding contact close**
   - **Timer contact stays closed, lamp stays on.**
   - **Count begins (5 sec)**





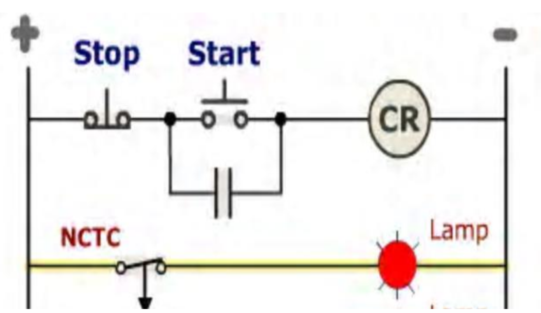
3. **Timer count ends**
   - **Coil is still energized**
   - **Timer contact open**
   - **lamp goes off.**

4. **Timer contacts remain open until the coil is de-energized**

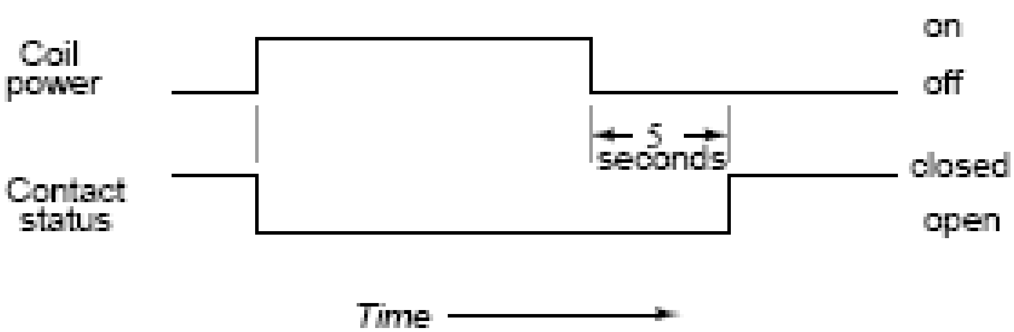


The Normally Closed contact will take 5 seconds To Open when the coil is energized.

OFF Delay - NCTC

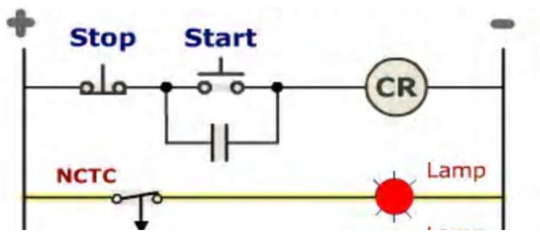


1. Power is applied to rails
2. Coil is off, contacts are closed, lamp is on

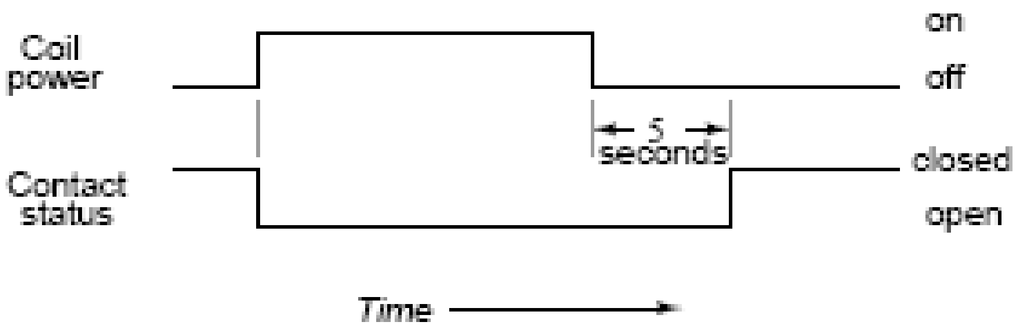


The timer contacts will close 5 seconds after the coil is *de-energized*

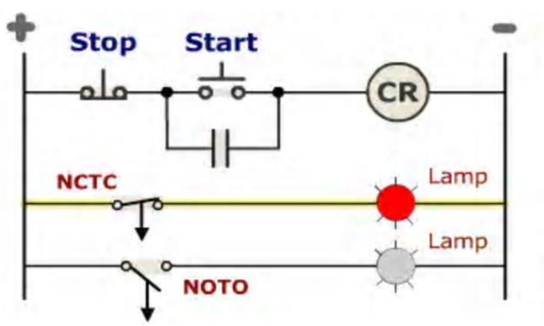
OFF Delay - NCTC



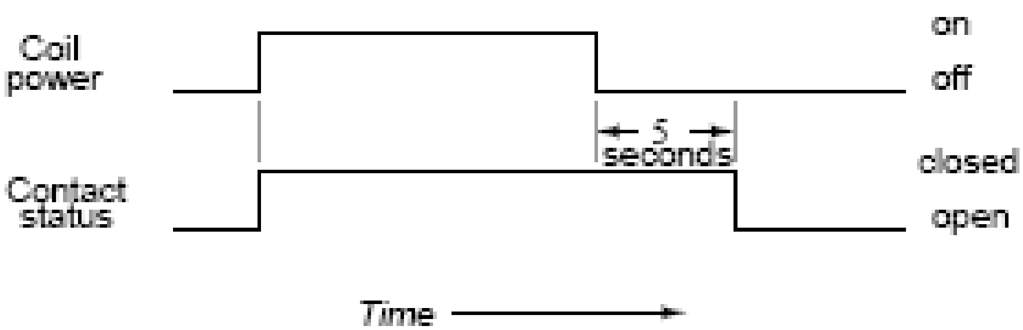
3. Start PB is pressed
4. Timer contacts open
5. Counter will start to count only when coil is de-energized.



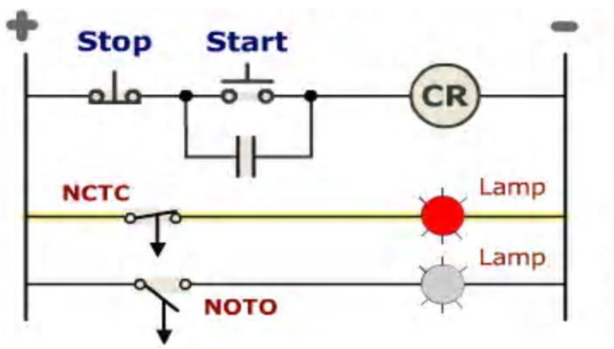
OFF Delay - NOTO



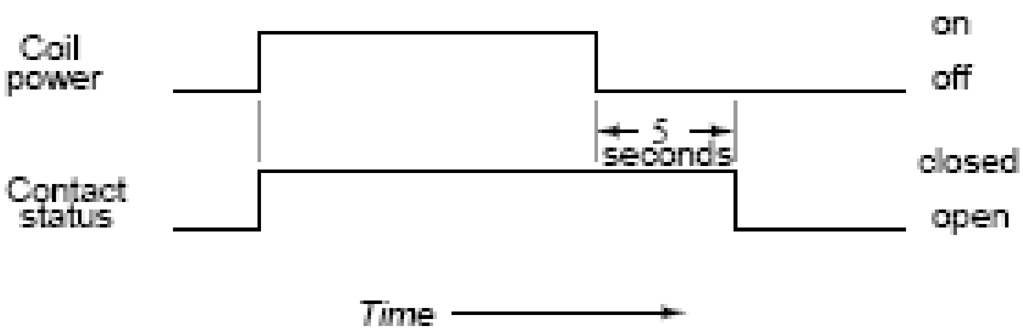
1. Power is applied to rails
2. Coil is off, contacts are closed, lamp is on



OFF Delay - NOTO

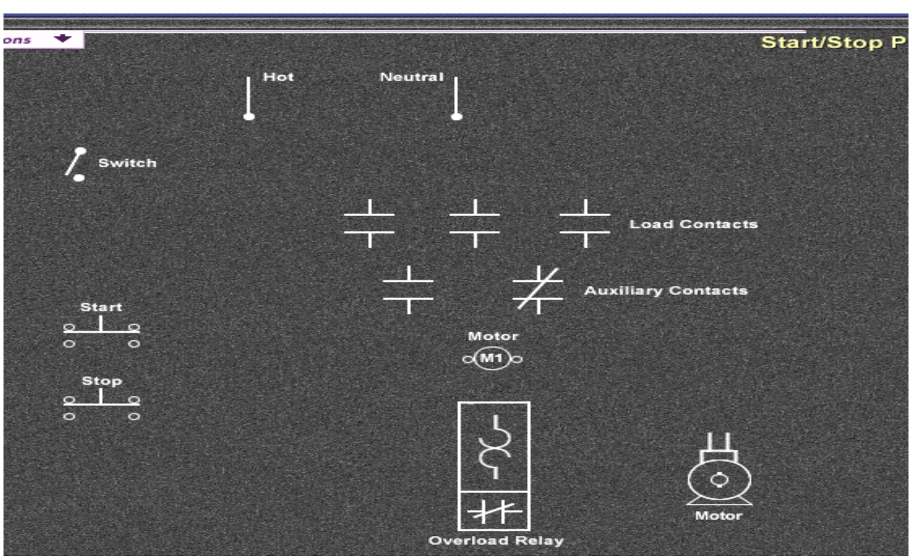


3. Start is pressed.
4. Contacts close, lamp on
5. Counter only starts when coil is de-energize

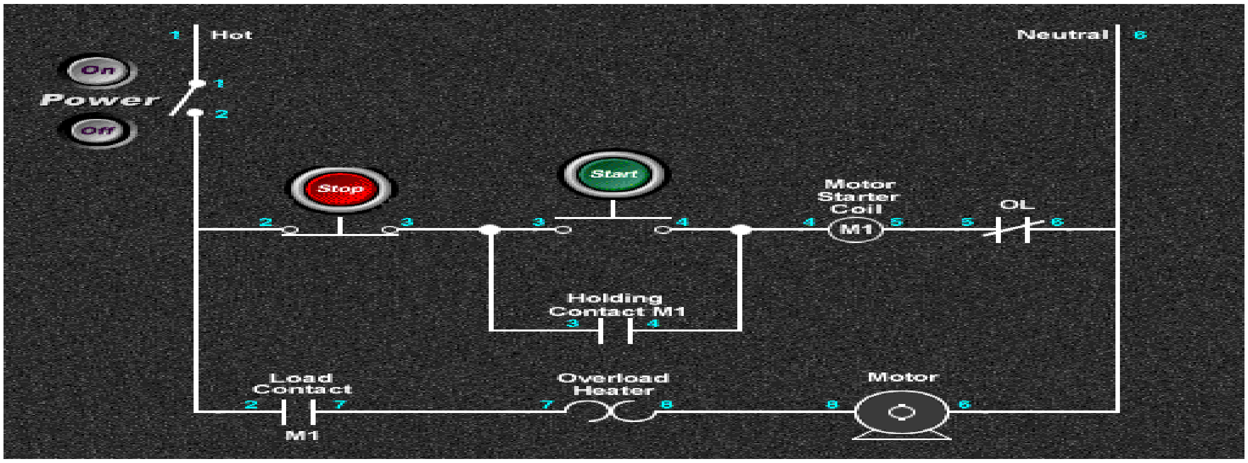


Connection and Schematic diagram of Start/stop push button.

A. Connection diagram of Start/stop push button



B. Schematic diagram of Start/stop push button.



Self-Check 3	Written Test

Part II: Enumeration

Direction: Draw/write on the blank space/List down the following

1. List different Types of electrical Diagram
2. _______________Is an electrically-operated switch (contactor) that includes motor overload protection
3. Draw the Schematic diagram of Start/stop push button

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

Information Sheet-4	Wiring Diagrams and Layouts/shop drawings

4.1 Circuit or schematic Diagram

The circuits drawn for motor control circuits are in two forms :(a) Circuit or schematic diagram
(b) Wiring diagram.

(a) Schematic or Circuit Diagram: While designing a control circuit, the schematic diagram is drawn first as it is easy, simple, clear and easy to follow for implementation in practical wiring diagram. 'The diagram drawn below is a schematic diagram for a simple D.OL starter. The main thing which is to be settled in mind is that practically, the contactor coil and its auxiliary contacts are close to each other but in schematic diagram, they are at different places.

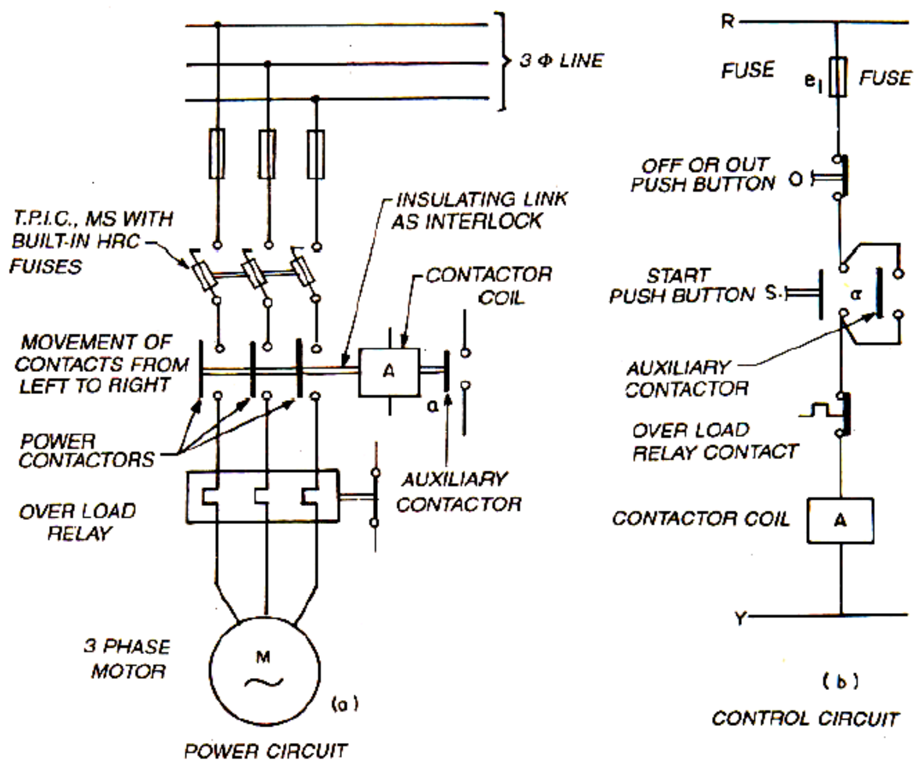


Fig. The contactor coil A and auxiliary contact 'a' are practically close together but in control circuit or schematic diagram, they are at different places. The power contactors, coil and auxiliary contacts are Mounted over a common insulating link.

(b) Wiring Diagram": The wiring diagram is practically implemented design showing connection

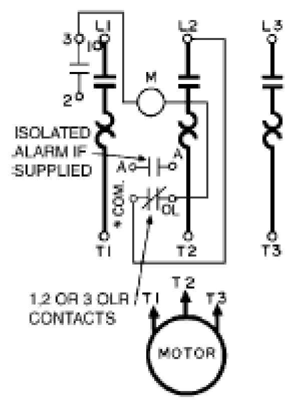
to various components, While designing the control circuit, the schematic diagram is drawn first and then

on the basis of connections shown on schematic diagram, the power circuit wiring diagram is prepared showing layout and connections to component

A wiring diagram shows, as closely as possible, the actual location of all component parts of the device. The open terminals (marked by an open circle) and arrows represent connections made by the user.

Since wiring connections and terminal markings are shown, this type of diagram is helpful when wiring the device or tracing wires when troubleshooting. Bold lines denote the power circuit and thin lines are used to show the control circuit. Black wires are conventionally used in power circuits and red wire in control circuits for AC magnetic equipment.

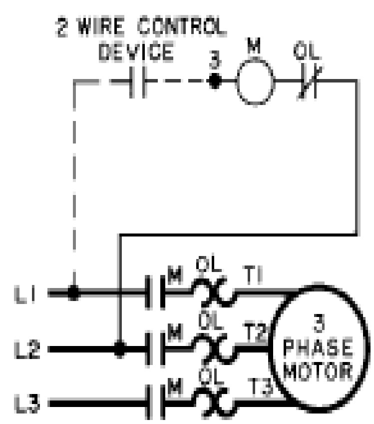
A wiring diagram is limited in its ability to completely convey the controller's sequence of operation. The elementary diagram is used where an illustration of the circuit in its simplest form is desired.



Elementary Diagram

An elementary diagram is a simplified circuit illustration. Devices and components are not shown in their actual positions. All control circuit components are shown as directly as possible, between a pair of vertical lines representing the control power supply. Components are arranged to show the sequence of operation of the devices and how the device operates. The effect of operating various auxiliary contacts and control devices can be readily seen. This helps in troubleshooting, particularly with the more complex controllers.

This form of electrical diagram is sometimes referred to as a "schematic" or "line" diagram.



DESIGN GUIDELINES

1. The supply to relay or contactor coil should commence by pressing start push button.

2. The supply to relay coil should continue through its contactor even if push button is released.

3. The schematic diagram is prepared first.

4. While drawing wiring diagram, mark the layout of components and then make connections purely on the basis of schematic diagram. For example, upper terminal of contactor 'a', lower terminal of off push button and upper terminal of start push button are connected together in the schematic diagram identify the same terminals in wiring diagram wherever they are, and connect them.

5. The 3 phase supply lines are to be shown horizontal while the power circuit lines are to be drawn vertical.

6. The movement of contacts and push buttons to be shown from left to right.

7. The main switches and other switches are to be shown in off position.

8. The contactors and, push buttons are to be drawn in non-actuated position.

9. Crossings of lines in the wiring diagram should be minimized. .

10. If there is sequence of operation, the circuit, which is energized, first should be more to the right.

11. All letters and numerical should be kept clear of the guidelines. Words may be underlined in a drawing where preferred.

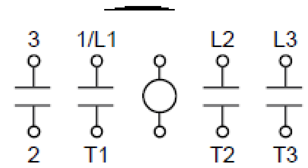
12. Lettering should be done on the drawing in such a way that it may be read when the drawing is viewed from the bottom edge or from bottom and right hand edges.

4.2 Standard Elementary Diagram Symbol

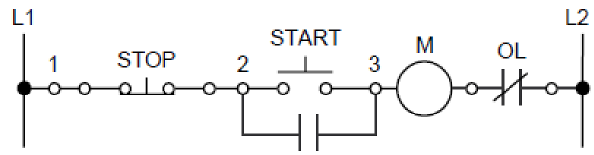
Switch

4.2.1 NEMA and IEC Controller marking and Elementry Diagram

NEMA

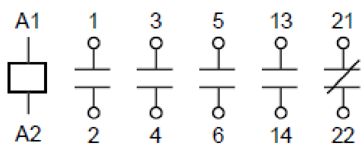


Typical Controller Markings

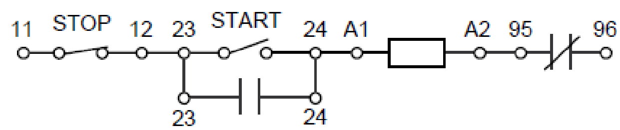


Typical Elementary Diagram

IEC



Typical Controller Markings



Typical Elementary Diagram

Self-Check 4	Written Test

Part II: Enumeration
Direction: Write/List down the following

1. ___________Is practically implemented design showing connection

To various components

2. Draw NEMA and IEC Controller marking and Elementry Diagram

Answer Sheet

Score = ___________

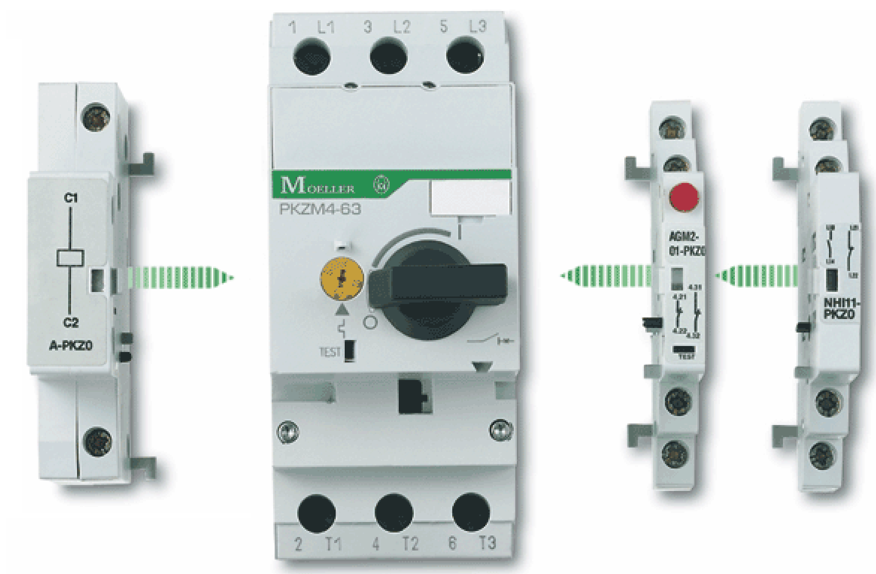
Rating: ____________

Name: _________________________ Date: _______________

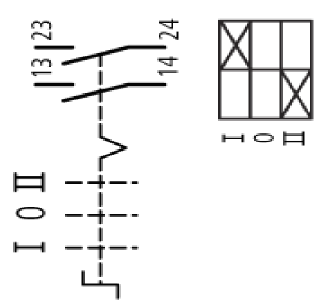
Information Sheet-5	Motor control Components and wiring devices

1. Disconnecting switches: - It isolates the motor from the power sources, selected to carry the nominal full-load current of the motor and to with stand short circuits currents for brief interval.

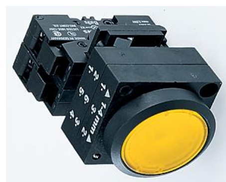
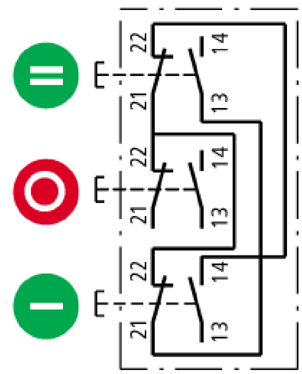
2. Manual circuit breaker: - Opens and closes a circuit like toggle switch. It opens or trips automatically when current exceeds a predetermined limit, after tripping it can be reset manually.



3. Cam switch: - Have a group of fixed contacts and an equal number of moveable contacts. The contacts can be made to open and close in preset sequence by rotating a handle or knob, Used to control the motion and position of hoists, machine and tools.



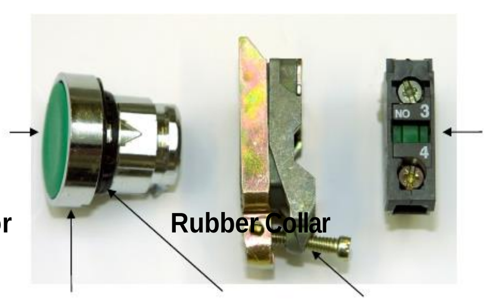
4. Push buttons: - A switch activated by finger pressure, two or more contacts open or close the button is depressed. Usually spring loaded so as to return to their normal position when pressure is removed.

Start Button

A start button consists of a **green** coloured actuator, which when pressed operates a normally **open** contact. On pressing the green actuator the normally open contact will close. These are fitted on the panel door via a mounting collar. The actuator is fitted through a suitable hole in the panel door. A rubber washer is used on the outside to provide ingress protection. The actuator is locked into the collar. The collar is secured to the panel door by a screw. This action compresses the rubber seal on the actuator. Finally the contact block is simply clipped on to the

clor indicato **Mounting Seal**

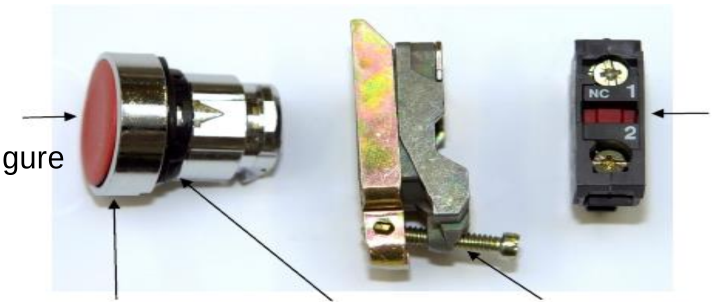


Actuator **Rubber Collar**

Stop Button

A stop button consists of a **red** coloured actuator, which when pressed operates a normally **closed** contact. On pressing the red actuator the normally closed contact will open.

See Figure



clor indicato

Mounting Seal

Actuator

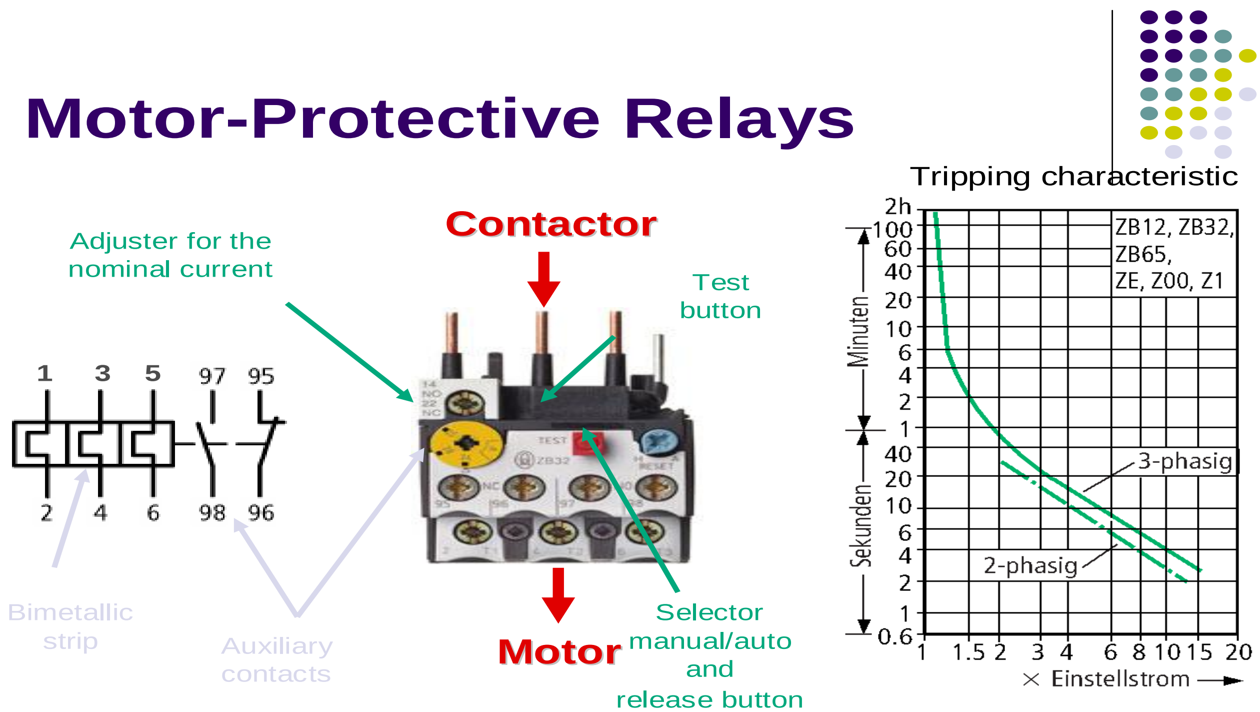
Rubber Collar

Emergency Stop Button

This is an emergency stop button and it differs from a standard stop button as follows:

- It has a large, easy to operate, mushroom shaped actuator.
- This actuator must be mounted on a yellow background.
- When operated, the actuator latches in the “Off “ position.
- The actuator is released by twisting the mushroom shaped head.

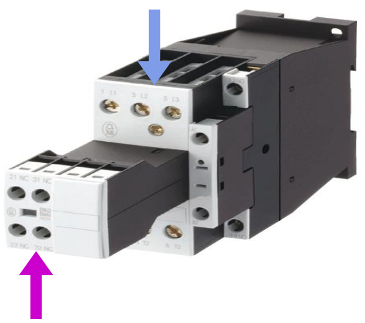
5. Thermal relays or over load relay: - It is a temperature sensitive device whose contacts open or close when the motor currents exceeds a preset limit. The current follows through small calibrated heating elements which raises the temperature of the relay. It is an inherent time delay devices because the temperature cannot follow the instantaneous changes in current.

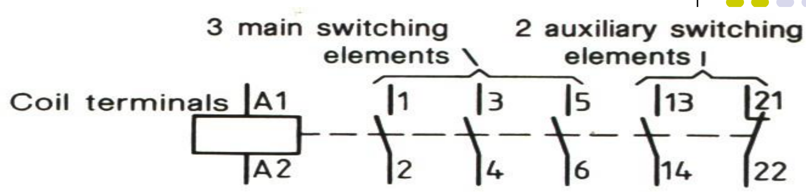


6. Magnetic contactor

It is basically a large control relay designed to open and close a power circuit. It possesses a relay coil and magnetic plungers which carries a set of movable contacts. When the relay coil is energized, it attracts the magnetic plunger, causing it to rise quickly against the force of gravity. The movable contacts come in contacts with a set of fixed contacts there by closing the power circuit. When the relay coil de-energized the plunger falls there by opening and closing the respective contacts, Used to control motors from 0.5hp to several hundred horse power.

Contactors

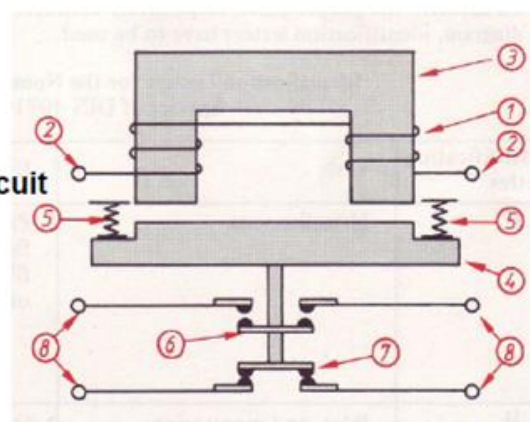




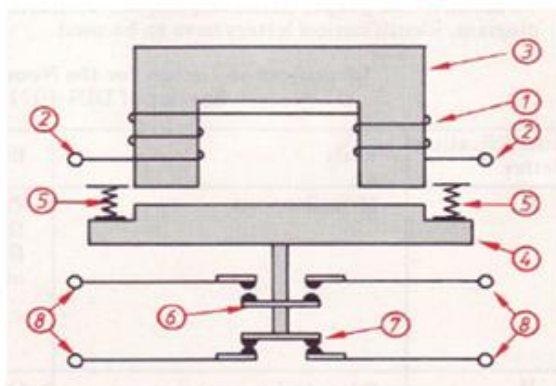
Type of contact	Symbol	Function digit
Normally Open (NO) Make contact	13 / 14	**3** and **4**
Normally Closed (NC) Break contact	21 / 22	**1** and **2**

Structure

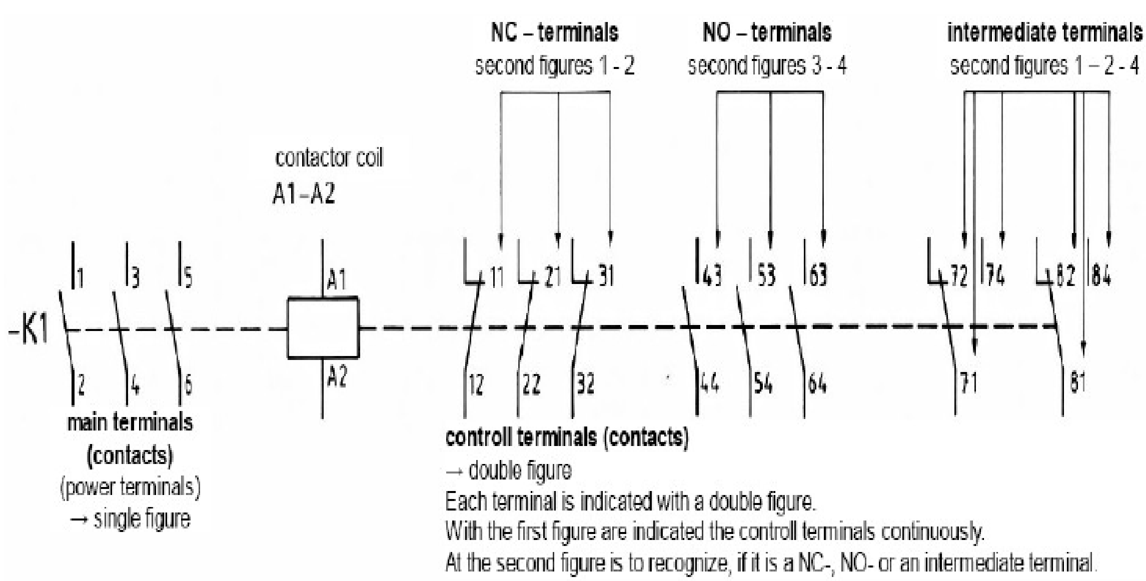
1. coil
2. connection for the control circuit
3. iron core
4. armature
5. armature spring
6. Contacts normally open
7. Contacts normally closed
8. Terminals for the power circuit

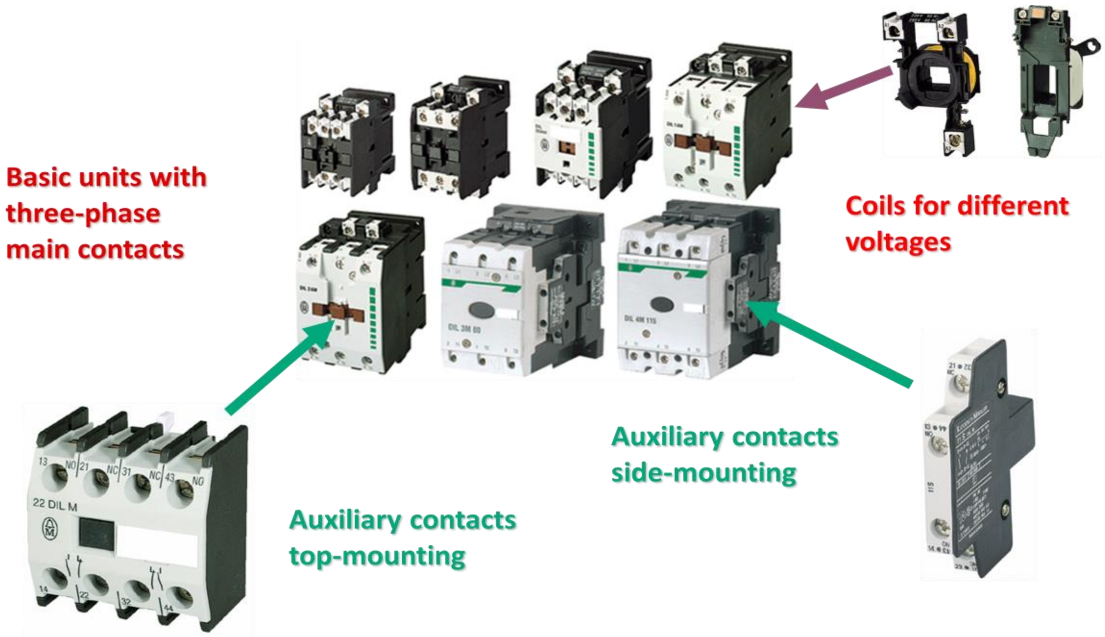


If the coil (1) is energized via the terminals (2) of the control circuit ,
a magnetic field is generated in the core (3).
The armature (4) kept back by springs (5) will be attracted by the core (3).
The attraction of the armature operates the set of contacts (6) (7) (open or close).
By operation of the contacts the operated circuit (8) will be opened or closed.



Contactors may have different arrangements of contacts. One has to differentiate between primary contacts (main contacts) and secondary contacts (auxiliary / control contacts).as shown in the fig.2.1.

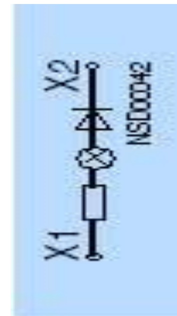




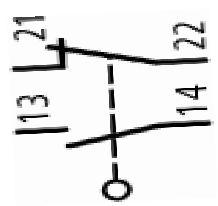
Difference between Contactor and Relay

- Since a contractor is required for a higher load, a relay is always cheaper than a contractor.
- A relay is normally used in appliances below 5KW, while a contactor is preferred when the appliance is heavier.
- A relay is used only in control circuit while a contactor can be used in both control and power circuits.
- In general contactors are little slower than relays
- Contactor is so designed that it can be repaired while it is not normally done in the case of relays.

7. Pilot lights: - It Indicates the ON/OFF states of remote components in control systems.

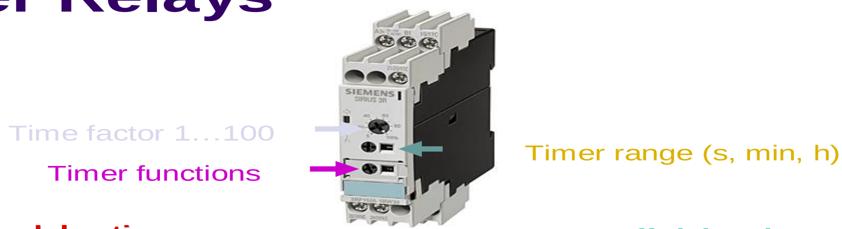


8. Proximity detectors:-Sealed devices that can detect objects without coming in direct contact with them, their service life is independent of the number of operations. They are wire to an external DC source and generate an alternating magnetic field by means of internal oscillators. When a metal objects comes within a few millimeters of the detector, the magnetic field decreases which in turns cause a DC motor current flows.

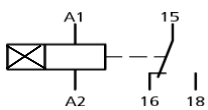


9. Timers

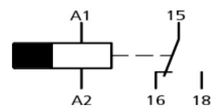
Timer Relays



On-delay timer



Off-delay timer



In automated plants many sequences are controlled time-dependent. In the lower range of performance with conventional contactor controls, delay time relays with different functions are used. Modern timers with digital electronics are often multi-functionally toggleable.

Timer Characteristics

On-delay timer

Off-delay timer

Self-Check 5	Written Test

Part II: Enumeration
Direction: Write/List down the following

1. Write the Difference between Contactor and Relay
2. _________ is a temperature sensitive device whose contacts open or close when the motor currents exceeds a preset limit
3. __________is Sealed devices that can detect objects without coming in direct contact with them, their service life is independent of the number of operations

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

Information Sheet-6	Correct size and degree of protection of enclosures

6.1 Motor Overload Protection

Motors larger than 1 horsepower must be provided separate motor overload protection devices. The most common devices typically used include:

1) Magnetic or thermal overload devices
2) Electronic overload relays
3) Fuses

6.1.1 Magnetic & Thermal Overloads

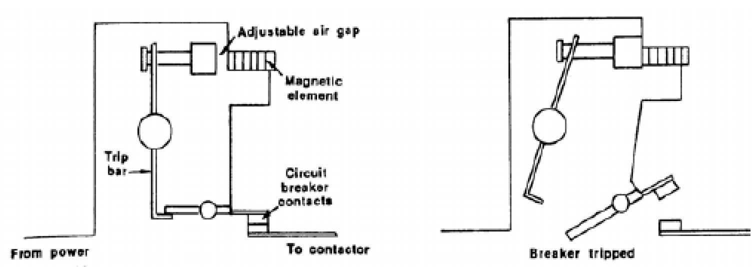
Overload devices are usually located in the motor's starter and connected in series with the motors electrical supply circuit and can be operated by either magnetic or thermal action.

- The same amount of current passes through the overload relay and the motor.
- If the current or heat through the overload device is higher than the device's rating, it trips and shuts down the electric power to the motor

<u>Magnetic Overload Relays</u>

A magnetic overload relay is an electro-mechanical relay operated by the current flow in a circuit.

- When the level of current in the circuit reaches a preset value, the increased magnetic field opens a set of contacts.
- Electromagnetic overload relays operate on the magnetic action of the load current flowing through a coil.
- When the load current becomes too high, a plunger is pulled up into the coil interrupting the circuit.



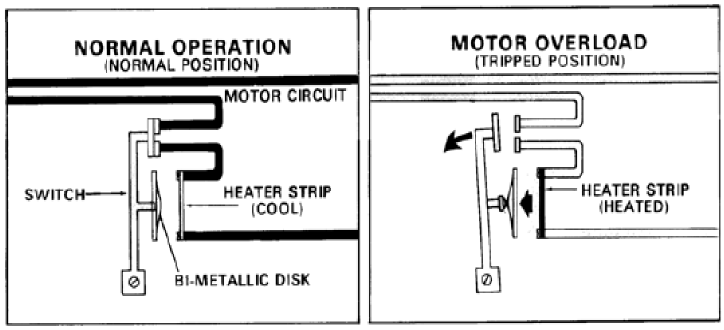
Magnetic Operation

- The tripping current is adjusted by altering the initial position of the plunger with respect to the coil.

Automatic Reset Devices

Automatic reset is an advantage where the starter is inaccessible and the motor is provided three wire control from a magnetic starter.

- This control doesn't allow the motor to restart until the start push button is manually pushed.
- This permits the overload condition to be removed before the motor restarts.



6.1.2 Electronic Overloads

Electronic overloads sense the load current and the heating effect on the motor is computed. If an overload condition exists, the sensing circuit interrupts the power circuit.

- The tripping current can be adjusted to suit the particular application.
- Electronic overloads often perform additional protective functions such as ground fault and phase loss protection.

Fuses

Fuses have limited application as the primary means of overload protection for motors but can be effectively used to provide backup overload protection.

• Single-element fuses are not designed to provide overload protection.

- Their basic function is to protect against short circuits and ground faults.
- If sized to provide overload protection, they would blow when the motor starts due to high motor inrush current.

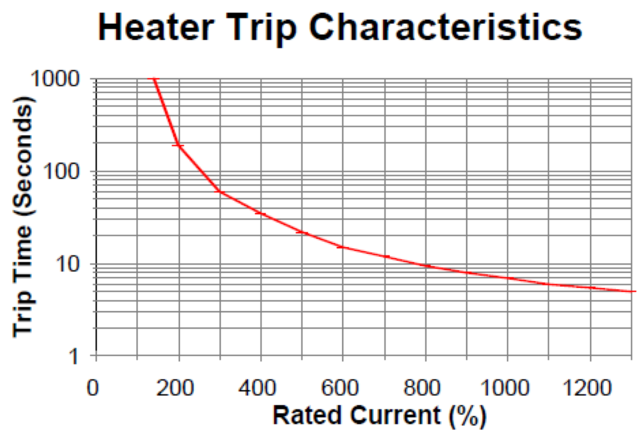
• Dual-element fuses can provide motor overload protection, but they have to be replaced When they blow which can be a disadvantage.

• There is a risk of single-phasing damage to the motor when only one fuse blows unless Single-phase protection is provided.

Overload Trip Time

The time it takes an overload to trip depends on the length of time the overload current exists.

- A Heater Trip Characteristics chart shows the relationship between the time an overload takes to trip and the current flowing in the circuit based on the standard 40•C ambient temperature installation.



- The larger the overload (horizontal axis), the shorter the time required to trip the overload (vertical axis).
- Any change from ambient temperature affects the tripping time of an overload.
  - For temperatures higher than 40•C, the overloads trip at a current rating less than the value of the overload.
- **Example:** At 50•C the overloads trip at 90% of their rated value. For temperatures lower than 40•C, the overloads trip at a current rating greater than the rated value of the overload.

6.2 Sizing Motor Overload Protection

There are several types of devices that can be used to provide overload protection and the sizing procedure can vary depending on the type of device used.

- It is important to keep differences in the procedures separate and understood well so as not to install overloads that do not provide adequate protection to the motor.
- The simplest and most straightforward sizing procedures for motor overload protection are applied when sizing overload relays using the cover of the motor starter, control center, or Manufacturer's catalog.

- The National Electrical Code specifies methods to calculate the maximum size motor overload protection for specific motors if a manufacturers chart is not available. Installations relying on fuses and circuit breakers as back-up overload protection must be calculated using the NEC method.

NEC Calculations

The NEC in general requires the maximum size overload device be set to open at 115% or 125% of the motor's full-load current rating, depending upon the service factor and/or temperature rise of the motor. There are however, exceptions.

• For motors rated 40EC with a Service Factor of 1.15 or greater, 125% of the motors FLA is used to calculate the maximum size device for overload protection.

• For motors rated greater than 40EC or unmarked, 115% of the motors FLA is used to calculate the maximum size device regardless of the motor's Service Factor.

• If use of the previous size rules results in the motor tripping off line during starting, the Device can be increased to a maximum of 140% of the motors FLA.

Example: Find the maximum size overload device to provide overload protection to a 3 phase, 230 Volt, 10 Horsepower motor with FLA of 28 amps if:

Ambient Temp = 40EC, S.F.=1.15: 28 amps X 125% = 35 amps

Ambient Temp = 40EC, S.F.=1.00: 28 amps X 115% = 32.2 amps

Ambient Temp = 50EC, S.F.=1.15 28 amps X 115% = 32.2 amps

Ambient Temp = 50EC, S.F.=1.00 28 amps X 115% = 32.2 amps

If use of the size calculated results in the motor tripping off line when started, the overload device may be increased to a maximum of: Maximum size allowable: 28 amps X 140% = 39.2 amps

Selecting Overloads From Starter Covers or Charts

21 The size overloads required to protect the windings of a motor can be determined by taking the
motor's full-load current rating and selecting the size overloads from the cover of a magnetic starter,
a motor control center, or the manufacturer's catalog.

- The following things should be kept in mind when using manufacturer's charts.
- When the overload size is selected from the cover of a magnetic starter or controller, the nameplate full-load running current of the motor is used. The full-load running current is

NOT increased by 125% when the overloads are selected in this manner.

• The charts are usually based on only the specific manufacturer's equipment.

• Sizes from the charts may be different from those of calculated values from the National Electrical Code.

- Manufacturer s’ charts often provide smaller rated devices than the NEC would allow as a measure of extra protection.

• Manufacturers’ typically list the most common sizes in their charts. Certain sizes may require calculations if the chart is not available from the manufacturer.

• If the motor will operate at/near service factor, the appropriate FLA of the motor at its Service Factor should be used to select the overload size from the manufacturer’s chart

OVERLOAD CHART

AMPERAGE	OVERLOAD UNIT
20.6-23.3	H1042
23.4-26.0	H1043
26.1-30.5	H1044
30.6-33.6	H1045
33.7-37.9	H1046
38.0-42.9	H1047
43.0-48.2	H1048
48.3-54.6	H1049
54.7-61.2	H1050
61.3-67.6	H1051
67.7-75.9	H0152
76.0-87.1	H1054
87.2-97.5	H1055
97.6-109.0	H1056
110.0-112.0	H1057
123.0-135.0	H1058

rating of 39 amps and a Service Factor of 1.00 requires three overload units with catalog number H1047.

Overload units number H1047 are selected because the 39-amp full-load current rating of the motor is between 38.0 and 42.9 amps.

What if the previous motor had a 1.15 Service Factor?

39 amps X 1.15 = 44.85 amps

The motor requires three overload units with catalog number H1048 because the 44.85 amps of the motor at Service Factor is between 43.0 and 48.2 amps.

Example:

A three-phase motor with a full-load current

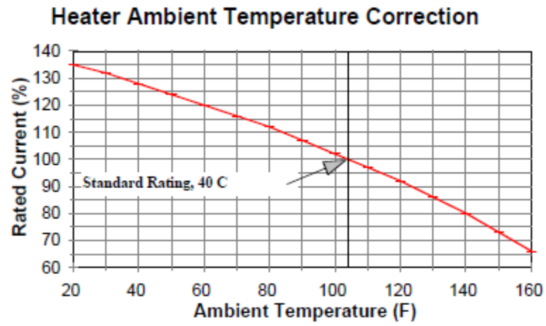
<u>Ambient Temperature Compensation</u>

The ambient temperature in which a starter and motor is located must be considered when selecting overloads because a high ambient temperature reduces overload trip time.

- Reduced overload trip time can lead to nuisance tripping if a motor is located in a cooler ambient temperature than the starter and lead to motor burnout when the motor is located in a hotter ambient temperature than the starter.

- Most thermal overload devices are rated for use at a maximum temperature of 40 degrees C which is about 104 degrees F.

- The overload device trips at less than 100 percent rated current when the ambient temperature exceeds 104 degrees F which can result in "nuisance tripping".



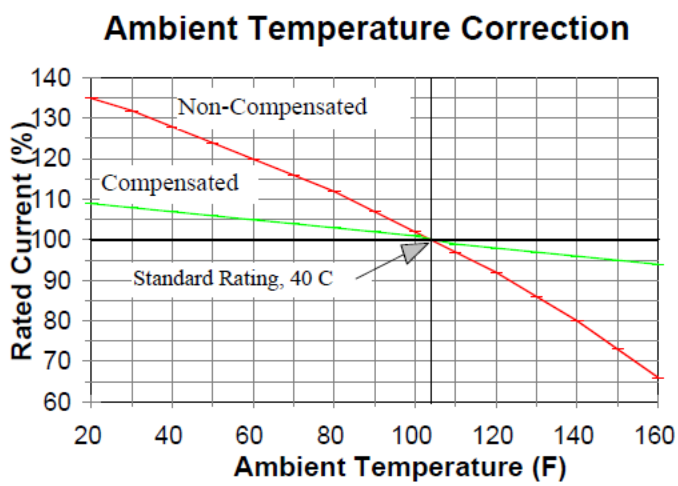
If the temperature is significantly below 104 degrees F, the overload device allows significantly more current through than it is rated for resulting in potential motor overload and failure without the overload tripping the motor off.

- A higher overload heater can be selected when the ambient temperature at the starter is higher than the temperature at the motor and a lower value selected when the ambient temperature at the starter is lower than the temperature at the motor.

- If the temperature varies widely during the year, the motor may not be protected when the temperature swings dramatically the other way unless the original overloads are switched back.

<u>Ambient Compensated Heaters</u>

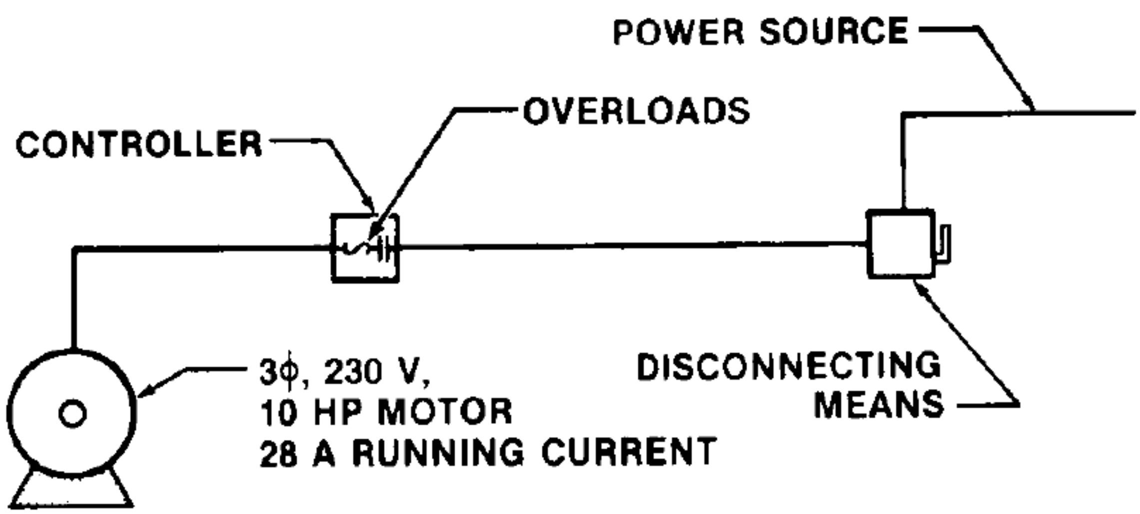
For this reason, special **Ambient Compensated Heaters** which have a much "flatter" temperature response should be used in most outdoor applications and where ambient operating temperatures are significantly different.



Sizing Motor Protection Systems

Given the following motor, size the conductors, motor overcurrent and motor overloads to adequately protect the motor and conductors.

Nameplate Info: FLA = 22 Service Factor = 1.00 Ambient = 40 C



STEP 1: Determine the motor's FLA (full load amps)

- Go to the appropriate NEC Table to find the design FLA
- NEC Table 430-150 for 3 phase: For 10 Hp, 230 Volt Motor = 28 amps

STEP 2: Determine the size of branch circuit conductor required.

- NEC 430-22 says the conductor ampacity equals the FLA x 125%
- Conductors supplying a single motor used for a continuous duty load must have a current Carrying capacity of not less than 125% of the motor's full load current (FLA) rating as Given in NEC tables 430-148 or 430-150.
- Conductor Ampacity = 28 amps X 1.25 = 35 amps
- Use NEC Table 310-16 to select the conductor with the required ampacity
- From NEC Table 310-16: #8 AWG Copper
- The NEC procedure requires use of the #8 AWG conductor so it will be large enough for any motor of the same size in the future.

STEP 3: Determine the branch circuit over current device size.

The maximum branch circuit over current device size is calculated based on the type of protective device selected (standard fuse, time-delay fuse, instantaneous breaker, inverse time breaker) and percentage multiplier from NEC Table 430-152.

- Multiply the motors design FLA by the appropriate percentage in NEC Table 430-152.

1. When the value found does not match a standard fuse/breaker size the NEC permits the next higher STANDARD size for a branch circuit over current device.

Standard Fuse	28 X 300% = 84 amps Next Highest: 90 amps
Time-Delay Fuse	28 X 175% = 49 amps Next Highest: 50 amps
Instantaneous Breaker	28 X 800% = 224 amps Next Highest: 225 amps
Inverse Time Delay Breaker	28 X 250% = 70 amps Next Highest: 80 amps

STEP 4: Determine the required size for the motor running overload protection.

1. Use the nameplate FLA directly to find the appropriate overload device heater on the motor Starter cover or from manufacturers tables.
2. Use the nameplate FLA and NEC Section 430-32 to calculate the maximum size for the motor overload protection in amps.

- NEC Section 430-32 specifies the maximum overload protection size for most installations if nameplate amps aren't available. (FLA X 115% or FLA X 125% depending on criteria).

- Since the motor's ambient rating was 40 deg C and the S.F. was 1.0, use 115%.
  For Ambient of 40 deg C and S.F. = 1.0: 22 amps X 115% = 25.3 amps
- NEC Section 430-34 specifies the maximum size if th calculated value in Section 430-32 will not allow the motor to start consistently. (Motor FLA X 140%).
  22 amps X 140% = 30.8 amps MAXIMUM

Self-Check 6	Written Test

1. ______Is have limited application as the primary means of overload protection for motors but can be effectively used to provide backup overload protection.
2. _______Is sense the load current and the heating effect on the motor is computed. If an overload condition exists, the sensing circuit interrupts the power circuit.
3. _________are usually located in the motor's starter and connected in series with the motors electrical supply circuit and can be operated by either magnetic or thermal action.

Information Sheet-7	Reporting complete data of Industrial

Self-Check 7	Written Test

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Operation Sheet 1	
Operation Title:	Using magnetic contactor
Purpose:	To construct and test a circuit using a magnetic contactor in order to understand the operation of a contractor.
Equipment, Tools and Materials:	Magnetic contactor, two push buttons, test lamp, screw driver, pliers, wire
Conditions or Situations for the Operation:	No fuse and overload relay.
Procedures:	

1. **Select the required components and arrange them on the working table.**
2. **Test the components using continuity tester. (Whether NO contacts are open and NC contacts are closed)**
3. **Connects the components as shown on figure 1 below.**

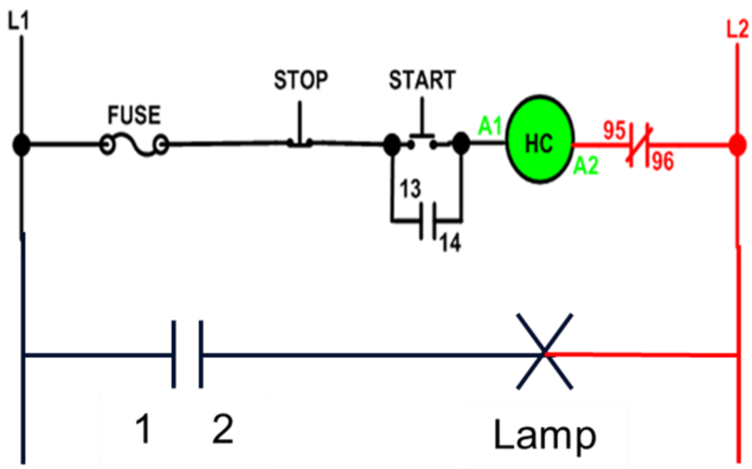


Figure 1

4. **When you have completed the connections of the circuit, check the circuit with continuity tester.**
5. **Connect the circuit to the electrical supply and tests its operation. Write your observation and explain how the circuit is operated briefly in the space below.**

6. **Disconnect the circuit from the supply. Disconnect the contactor contact No 13-14. Test the operation after giving the supply back. Write your observation in the space below.**

7. **What is the purpose of contactor terminal No 13-14 which connected across the START pushbutton. Explain briefly its function in the space below.**

Precaution:	1. **Be sure your hands are dry when you are working with electricity. You may get electrical shock.** 2. **Turn off the power and disconnect the cord before making any adjustment on the circuits.** 3. **Each time you use instrument, be sure to check functions selected and ranges.**
Quality Criterion:	• **Safe work exercise.** • **Neat and clear circuit constructed.**

	• **Circuit operated correctly.**

Operation Sheet-2	
Operation Title:	Thermal Overload Relay(LR2 D type)
Purpose:	To understand the operation of thermal overload relay.
Equipment, Tools and Materials:	Thermal overload relay, lamps (5), pliers, screwdrivers (flat, Philips), wire.
Conditions or Situations for the Operation:	
Procedures:	

Note:

Thermal overload relays are 3 poles. The motor current flows through their bimetals (1 per phase) which are indirectly heated. Under the effect of the heating, the bimetals bend; cause the relay to trip and the position of the auxiliary contacts to change. The relay setting range is graduated in amps. In compliance with international and national standards, the setting current is the motor nominal current and not the tripping current.

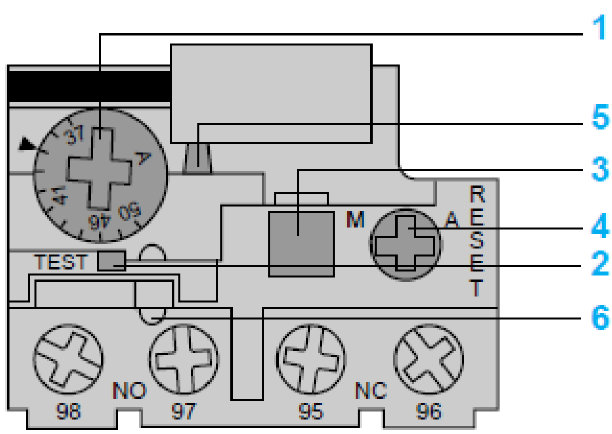
A conventional thermal overload relay protects the motor in the following two cases:

- overload, by monitoring the current drawn by each phase,
- Phase imbalance or failure, by its differential mechanism.

Nevertheless, it has the disadvantage of not taking into account, with sufficient accuracy, the thermal state of the motor.

LR2-D thermal overload relays are used in a circuit of 50/60 Hz, rated insulation voltage of 660V and rated current of 0.1-93A to protect AC circuits and motors against overloads, phase failure, long starting times and prolonged stalling of the motor. They can be plugged in KLC1-D series AC contactors. **LR2-D1321**has18A current rating with scale of current rating from 12A to 18A.

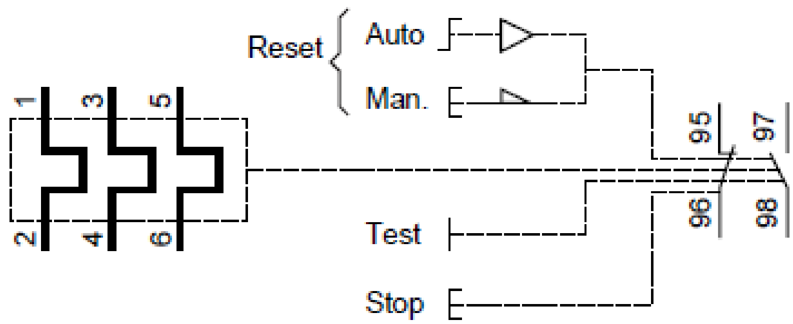
Description(for LRD 3322…4369, LR2 D type relay):



1. Adjustment dials (I_r).
2. Test button.
   Operation of the Test button allows:
   - checking of control circuit wiring,
   - Simulation of relay tripping (actuates both the N/O and N/C contacts).
3. Stop button. Actuates the N/C contact; does not affect the N/O contact.

4. Reset button (manual, automatic).
5. Trip indicator.
6. Setting locked by sealing the cover.

Schematics (for LRD, LR2 D and LR3 D type relay):



Procedures:

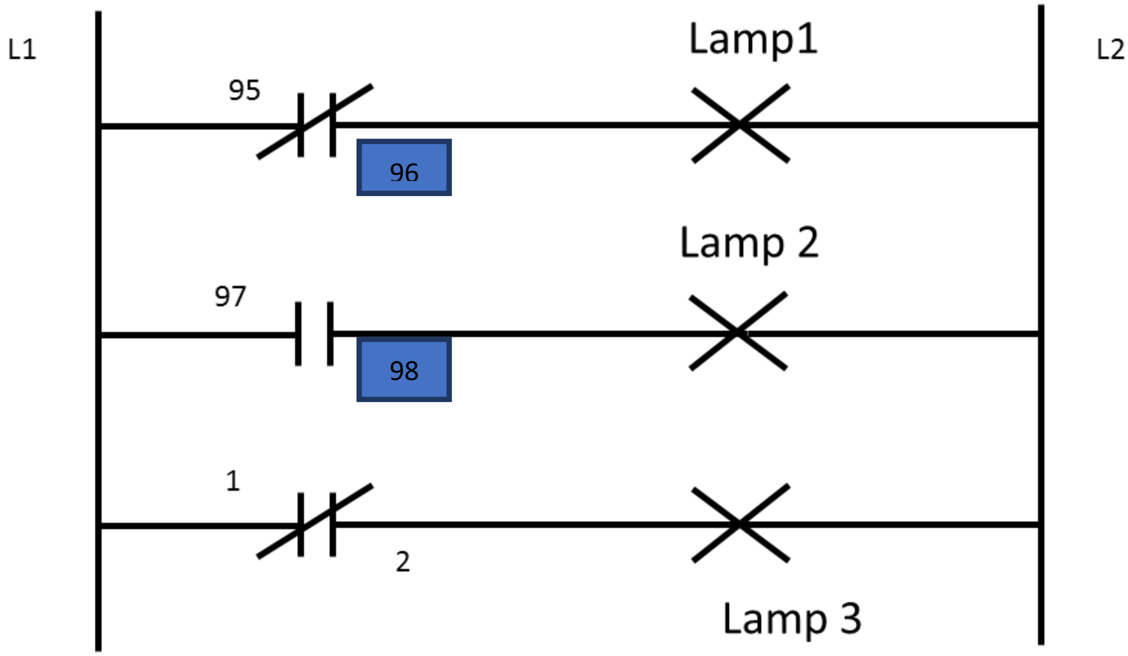
1. Identify the parts of the overload relay given.
2. Fill the ratings of the relay in the table below.

Model No	Frequency (Hz)	Voltage (V)	Current (A)	Current –range (A)

3. Test the tripping contact (95-96) ,signaling contact (97-98) and line contacts using continuity tester and write the result:

   95-96=______________ 97-98=______________1-2/3-4/5-6 =___________________

4. Construct the circuit shown below



5. Fill the table below (Relay not tripped-Automatic reset)

Button operated	Contact	Relay tripped		Relay not tripped	
		Manual reset	Automatic reset	Manual reset	Automatic reset
STOP	95,96 (NC)				
	97,98 (NO)				
	1,2 (NC)				
TEST	95,96 (NC)				
	97,98 (NO)				
	1,2 (NC)				

Precaution:	**2. Be sure your hands are dry when you are working with electricity. You may get electrical shock.** **3. Turn off the power and disconnect the cord before making any adjustment on the circuits.** **4. Each time you use instrument, be sure to check functions selected and ranges.**

Quality Criterion:	• **Safe work exercise.** • **Neat and clear circuit constructed.** • **Circuit operated correctly.**

LAP Test 1	Practical Demonstration

Name: _____________________________ Date: ________________

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1- Install magnetic contactor

LAP Test 2	Practical Demonstration

Name: _____________________________ Date: ________________

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1- Install magnetic contactor

	OTHER REFERENCES	Performing Installation of Motor Controller System

1. Basics of Motor Control Centers..Centers.. series,. Siemens

2. Industrial Motor control Laboratory

3. Cutler-Hammer: LEARNING MODULE 19: STARTERS AND. CONTACTORS