Tests

Before energizing the control panel all necessary tests should be carried out like open, short, earth continuity and earth soundness etc. The supply voltage and frequency are also to be checked.

Control elements

Difference between control panel and switch board

A panel board contains a single panel or a group of panel units as single panel that includes bus-bars, protective devices and control switches, instruments and more starters etc.

In a panel board, the interior are designed to place the accessories and wires in a cabinet or cut out box or partition and accessible only from the front.

A switch board consists of a large single panel or frame or assembly of switch gears, with or without instruments, but the term switch board does not apply to a group of local switches in the final circuit. Unlike panel boards, switch boards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. However the terms, panel board and switch board, are used normally without much discrimination.

For wiring of control panel board the following control elements / components and accessories are required.

They are

- Isolating switch
- Push button switch
- Indicating lamp
- MCB (Miniature Circuit Breaker)
- Contactors
- Electro mechanical relays
- Thermal over load relays
- Time delay relay (timers)
- Rectifiers
- Limit switches
- Control transformers etc.

Control elements for control panel

1 Isolating switch (Fig 7)

Isolating switch (Isolator) is a manually operated mechanical switch which isolates/disconnects the circuit which are connected with it from the supply system as and when required. It should be normally operated at "OFF" load condition.

It is available in different current, voltage rating and size.

Fig 7

ISOLATING SWITCH

ELN4217517

2 Push button switch (Fig 8)

Fig 8

PUSH BUTTON SWITCHES

ELN4217518

Push button is a simple push switch mechanism for making or breaking the circuit as and when required. It is made out of hard plastic or metal. An indicating lamp is incorporated with the push button switch to indicate start or stop is also available.

3 Indicating lamp (Fig 9)

Fig 9

INDICATING LAMP WITH HOLDER

ELN4217519

It is a low voltage, low wattage filament or neon or LED lamps used to indicate the various indication like availability of supply or motor **ON/OFF,** mains/motors fails or trip etc.

It is available in different size, colour and wattage. It should be generally fitted in the front side of the control panel with suitable holder.

4 MCB (Fig 10)

Fig 10

MINIATURE CIRCUIT BREAKER

ELN421751A

Miniature circuit breaker (MCB) is an electro mechanical protective device which protect an electrical circuit from short circuit and over load . It automatically turns off, when the current flowing through it exceeds the maximum allowable limit.

5 Fuses

It is a protective device which is connected is series with the live wire to protect the circuit from short circuit and earth fault.

6 Contactors (Fig 11)

Fig 11

MINIATURE CIRCUIT BREAKER

ELN421751B

A contactor is an electrically controlled double break switch used for switching ON / switching OFF the electrical circuit, similar to a relay with higher current ratings. It is controlled by a circuit which has a much lower power level than the switched circuit.

7 Electro mechanical relays (Fig 12)

Fig 12

ELECTRO MECHANICAL RELAY

ELN421751C

Electromechanical relays are electrically operated switches used to control a high powered circuit accessories using low power signal. When an electric current passes through its coil it produces a magnetic field that activates the armature to make or break a connection.

current passes through its coil it produces a magnetic field that activates the armature to make or break a connection.

8 Thermal overload relays (Fig 13)

Fig 13

THERMAL OVERLOADED RELAYS

ELN421751D

It is a thermally operated electromechanical device that protects motors from over heating and loading.

9 Time delay relay (timers) (Fig 14)

Fig 14

TIMER

ELN421751E

Time delay relays are simply the control relays in - built with a time delay mechanism to control the circuit based an time delay.

In time delay relays its contact will open or close after the pre-determined time delay either on energising or on de-energising its no volt coil. It can be classified into two types as ON delay timer and OFF delay timer.

10 Rectifiers (Fig 15)

Fig 15

RECTIFIER

ELN421751F

A rectifier is a static device consists of one or more diodes that converts alternating current (AC) to direct current (DC). A diode is like a one -way valve that allows an electrical current to flow in only one direction.

11 Limit switches (Fig 16)

Fig 16

LIMIT SWITCHES

ELN421751G

Limit switch is a switch with an actuator which is operated by the motion of a machine part or an object.

When an object or parts comes into contact with actuator, it operates the contacts of the switch to make or break an electrical connection. They are used to control the distance or angles of movement of any machine parts or axis or objects.

12 Control transformer

It is a transformer which is used to supply the power to the control or auxiliary circuit or equipment which does not intend for direct connection to the main supply.

13 Panel meter (voltmeter and ammeter)

They are the measuring instruments used to measure the various electrical parameter of the circuits such as voltage and current etc.

Wiring accessories for control panel wiring

1 PVC channel / Race ways (Fig 17)

Fig 17

PVC CHANNEL

ELN421751H

It is an inspection type PVC enclosed channel which provides a pathway for electrical wiring inside the control panel. It has the opening slots on both sides to facilitate the good ventilation and visual inspection.

It protects the wires from dust, humidity, corrosion, water intrusion, heat, mechanical damage and physical threats.

2 DIN rail (Fig 18)

Fig 18

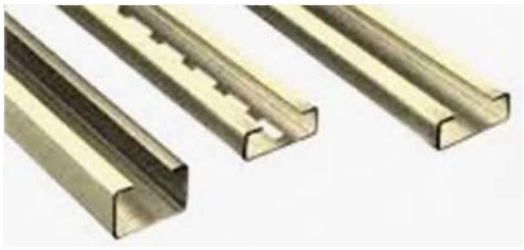
DIN RAILS

ELN421751I

It is a zinc - plated or chromated metal rail which is used for mounting the control accessories like MCB, contactors and OLR etc, with out using screws inside the control panel.

3 G Channel (Fig 19)

Fig 19



'G' CHANNEL

ELN421751J

It is a zinc - coated metal channel which is especially used for mounting the feed through or spring load or double deck terminal connectors without using screw inside the control panel.

4 Terminal connectors (Fig 20)

Fig 20

TERMINAL CONNECTORS

ELN421751K

It is the set of insulated screw terminals at both sides used to connect the accessories of the control panel with external control switches, limit switches, input supply and motor terminals etc.

Terminal connectors with barrier strips and clamping plates provide a tight and electrically sound termination. It is available in various size, current and voltage ratings.

5 Wire ferrules (Fig 21)

Fig 21

WIRE FERRULES

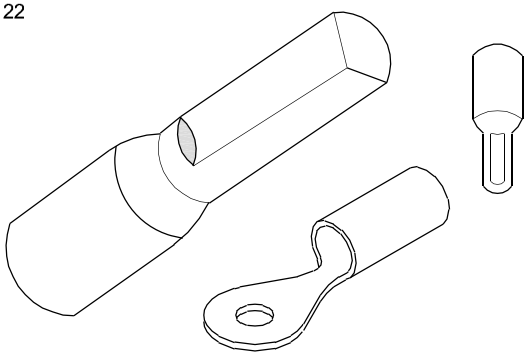
ELN421751L

It is a small circular ring made up of polymer plastics or rubber or fibre, used to easily identify the ends of wires which are to be connected into a particular terminals or accessories. It should be inserted on the both ends of a wire as collar or bracelet.

It is available is different size like 1 sq.mm, 1.5 sq.mm and 2.5 sq.mm etc generally in yellow colour printed with either numerical or alphabet letters on it.

6 Lugs and thimbles (Fig 22)

Fig 22



LUGS AND THIMBLES

ELN421751M

It is a cylindrical barrel along with circular rings or cylindrical rod or U shape or flat surface made up of aluminum or copper or brass, used to ensure the sound electric connection of the cable / wire on to the terminals. It prevent flare out of stripped and stranded cable, increase the conductivity of the connection, support the cable / wire and avoid the loose connection and sparking. Suitable crimping tool has to be used to connects them with cables / wires. It is available in different size like 1 sq.mm, 4 sq.mm, 25 sq.mm, 70 sq.mm, 125 sq.mm and so on.

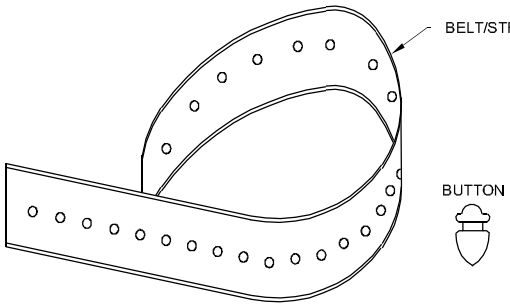
- Thimbles may also be referred as sockets.

7 Cable binding straps and button (Fig 23)

It is made up of PVC or polymer belt with a small holes at regular intervals, used to tie up, bunching, binding and dressing the cable / wires with help of buttons.

It is reusable and good insulator to the heat and electricity. It is generally available 8mm, 10 mm and 12 mm width.

Fig 23

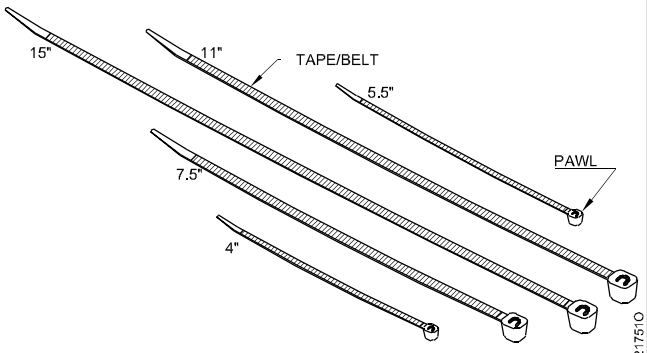


CABLE BINDING STRAPS AND BUTTON

ELN421751N

8 Nylon cable ties (Fig 24)

Fig 24



NYLON CABLE TIES

ELN421751O

- It is a type of fastener used to hold or tie or bunch the wires / cable or group of cables.
- It is made of nylon tape or belt which has teeth that will engage with head of the pawl to form a ratchet and tightens the wires.
- In general the tie can not be loosened, or removed or reused. However some reusable ties are also available.
- it is available in different colour, length and width.
- Because of its low cost and easy to use, it is widely used in general purpose application also.

9 Sleeves (Fig 25)

Fig 25

WIRE SLEEVES

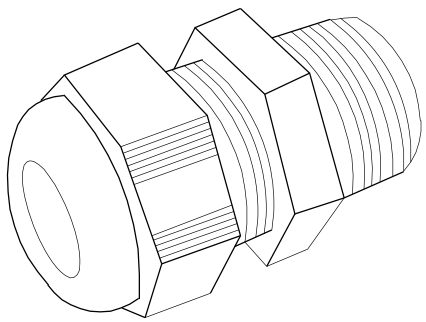
ELN421751P

- It is flexible tubular / cylindrical insulator into which the electric wire or cable or group of cables can be inserted.

- Apart from the electrical insulation and easy identification of wires, it also protect the wires from abrasion, heat, chemical, physical damage and radio interference.
- It is available is different colour, style, materials like carbon fibre, fabrics, Teflon, fibre glass, nylon, poly ethylene (PET) wrap, braided metal and heat shrink sleeves.

10 Grommets (Fig 26)

Fig 26



GROMMETS

ELN421751Q

It is a type of bushing which is used to insulate and hold the cables when they pass through a punched / drilled holes of panels or enclosures. It is generally made of rubber, plastic, plastic coated metal and protect the cable from twist, tug, cut, break, strain, vibration etc and prevent the entry of dirt, dust, water, insects and rats into the panel. It may also called as glands.

11 Wire clips (Fig 27)

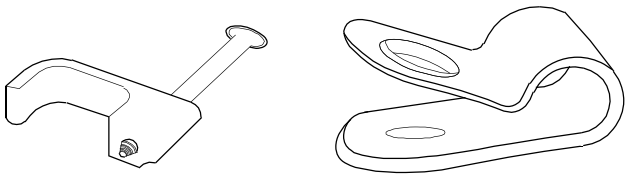
It is a type of fixing or fastening device which is used to fix and hold the cables or punch of cables in a secure manner.

Rotary type switches (Fig 28)

Rotary switches are most commonly used in lathes, milling and drilling machines due to their exact visual position and easiness in operation. These switches are operated by levers or knobs which in turn operate cams inside the switch to contact various terminals in sequence by the internal contact blocks. These cams and blocks are made of hard P.V.C. and are designed to withstand many operations. It is possible to get many circuit combinations by combining various cams and contact blocks. As the contact blocks, terminals and cams are spring-loaded, these switches should not be opened by inexperienced persons for repairs. Fig 28 shows 250V AC 15 Amps 2-pole three position flush mounting coin-slot operator.

Function: This switches can do a number of functions, depending upon the cover and contact block combinations. According they can be used for ON/ OFF switch, manual Forward / Reverse operation, Manual star delta switches, Pole changing switches, Selection switch for meaning instrument etc..

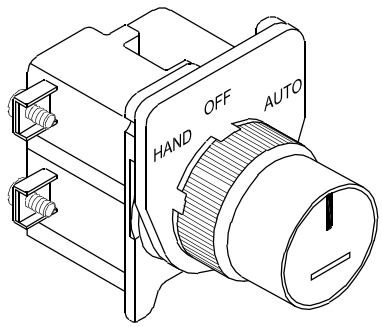
Fig 27



WIRE CLIPS

ELN421751R

Fig 28



ROTARY SWITCH

ELN421751S

Power and control circuits for three phase motors

Objectives: At the end of this lesson you shall be able to

- **state the necessity of starters for a 3-phase induction motor to start and name the types of starters**
- **explain the basic contactor circuit with a single push-button station for start and stop**
- **state the function of DOL starter, semi and fully automatic start - delta strater**
- **explain the function of jogging inching forward and reverse control circuit**
- **explain the remote station control circuit**
- **explain the sequential control of motors.**

Necessity of starter: A squirrel cage induction motor just before starting is similar to a polyphase transformer with a short-circuited secondary. If normal voltage is applied to the stationary motor, then, as in the case of a transformer, a very large initial current, to the tune of 5 to 6 times the normal current, will be drawn by the motor from the mains. This initial excessive current is objectionable, because it will produce large line voltage drop, which in turn will affect the operation of other electrical equipment and lights connected to the same line.

The initial rush of current is controlled by applying a reduced voltage to the stator winding during the starting period, and then the full normal voltage is applied when the