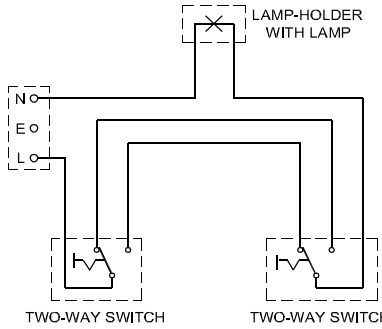
Special wiring circuits - Tunnel, corridor, godown and hostel wiring

Objectives: At the end of this lesson you shall be able to
- **state the difference between godown, tunnel and corridor, bank/hostel wirings**
- **draw the tunnel lighting / corridor / bank / hostel circuits**
- **prepare the mode chart for the above circuits.**

Staircase wiring: In wiring one lamp controlled with one switch in a simple wiring circuit to begin with. However,one lamp controlled with two switches from two different places, known an staircase wiring in the very basic wiring. Fig 1 shows such a wiring where two double pole switches are used to control one lamp individually.

Fig 1



STAIRCASE–WIRING DIAGRAM

ELN227411

In the case of godown wiring we have seen that as you move inside the godown, you can switch on a lamp ahead of you while the light behind you is put off. The same process in the reverse order takes place while moving out of the godown.

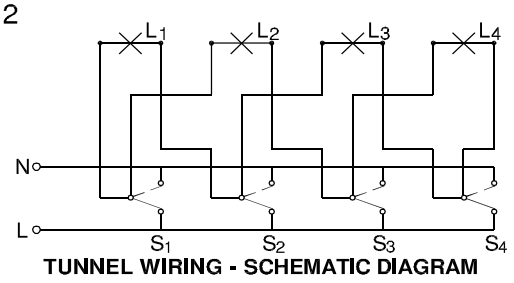
But one light will not be sufficient to give enough illumination in the case of tunnels where darkness is more. Hence, the wiring circuit for a tunnel needs at least two lights to be 'ON' at a time while a person moves inside a tunnel and goes out.

Whereas in the case of corridor wiring the corridor may have a number of rooms occupied by different persons. When one moves toward his room, he needs a forward light to do so. The moment he finds the room and opens it, he may not need the corridor light. Then there should be an arrangement to switch off the light left behind the forward moving person and at the same time there should be a provision to switch off the light in front of his room. Such an arrangement is incorporated in corridor wiring.

On the other hand in bank/jail/hostel, there may be a number of lights having individual controls. There should be a provision for the security staff/warden to switch ON all the lights where they are all OFF. Such a provision is incorporated in the bank / jail / hostel wiring.

Tunnel lighting circuit (Fig 2)

Fig 2



TUNNEL WIRING - SCHEMATIC DIAGRAM

ELN227412

In tunnel wiring a person walking along the tunnel can successively light behind two lamps ahead and put off a lamp behind with one switch.

All switches are two-way switches.

Caution: This circuit is not in accordance with IE rules as the phase and neutral come in the same switch. So care should be taken while connecting the wires.

The mode of operation of the switches and the consequent lighting position are shown below.

Mode chart for tunnel wiring

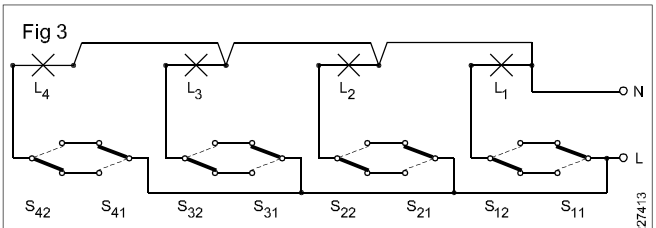
SWITCHES				LIGHTS			
S_1	S_2	S_3	S_4	L_1	L_2	L_3	L_4
✓	✗	✗	✗	✓	✓	✗	✗
✓	✓	✗	✗	✗	✓	✓	✗
✓	✓	✓	✗	✗	✗	✓	✓
✓	✓	✓	✓	✗	✗	✗	✗

MODE CHART FOR TUNNEL WIRING

Corridor wiring (Fig 3)

In this circuit, operating the first switch in one set makes the first light to switch on while operating the 2nd switch in the first set switches off the first light. This sequence goes on as explained in the mode chart.

Fig 3



SCHEMATIC DIAGRAM OF CORRIDOR WIRING

Switch lamps chart

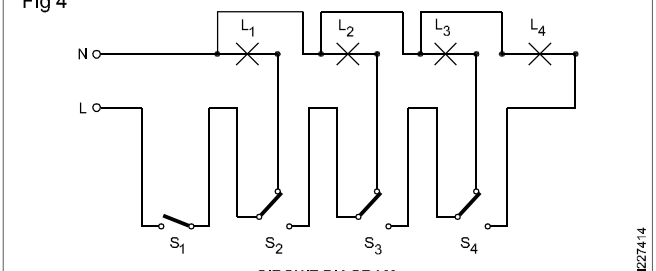
SWITCHES								LAMPS			
1st SET		2nd SET		3rd SET		4th SET		L_1	L_2	L_3	L_4
S_{11}	S_{12}	S_{21}	S_{22}	S_{31}	S_{32}	S_{41}	S_{42}				
ON	–	–	–	–	–	–	–	✓	✗	✗	✗
ON	OFF	–	–	–	–	–	–	✗	✗	✗	✗
ON	OFF	ON	–	–	–	–	–	✗	✓	✗	✗
ON	OFF	ON	OFF	–	–	–	–	✗	✗	✗	✗
ON	OFF	ON	OFF	ON	–	–	–	✗	✗	✓	✗
ON	OFF	ON	OFF	ON	OFF	–	–	✗	✗	✗	✗
ON	OFF	ON	OFF	ON	OFF	ON	–	✗	✗	✗	✓
ON	OFF	ON	OFF	ON	OFF	ON	OFF	✗	✗	✗	✗

MODE CHART FOR CORRIDOR WIRING

Godown lighting circuit

Let us consider a godown lighting circuit (Fig 4) having three lamps L_1, L_2, L_3 and L_4 which are to be controlled such that if one moves in a godown in either direction he can switch ON one light after the other in the forward direction while the lamp which was lighted earlier gets switched OFF. In an arrangement. S_1 is a one way switch, S_2, S_3 and S_4 are two-way switches.

Fig 4



CIRCUIT DIAGRAM

While coming back from the godown when the person switches off the light 4, then the light 3 will be on and give light for his return movement. When he leaves the godown all the lights could be switched 'off' by operating switch S_1.

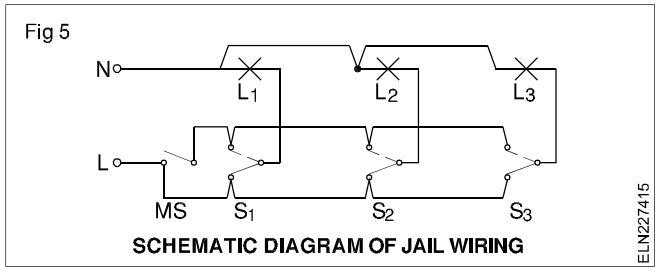
The following chart gives the mode of operation of the switches and lights. Trainees are advised to make the return mode chart.

Mode chart for godown wiring

Switches				Lights			
S_1	S_2	S_3	S_4	L_1	L_2	L_3	L_4
ON	OFF	OFF	OFF	ON	-	-	-
ON	ON	OFF	OFF	-	ON	-	-
ON	ON	ON	OFF	-	-	ON	-
ON	ON	ON	ON	-	-	-	ON

Bank / jail / hostel wiring (Fig 5)

Fig 5



SCHEMATIC DIAGRAM OF JAIL WIRING

The master switch (MS) could be operated by the warden to make all the lights ON when they are all OFF.

Intermediate switch - specification and application in lighting circuit

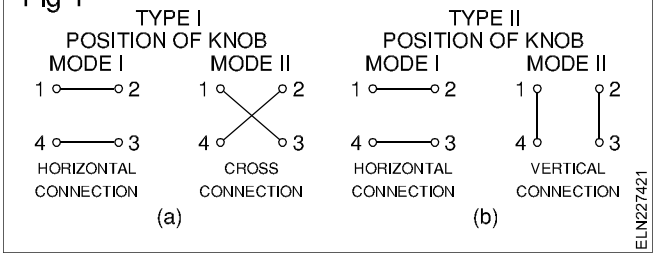
Objectives: At the end of this lesson you shall be able to
- **identify the features and specify an intermediate switch**
- **draw diagrams of a lighting circuit using intermediate switches.**

An intermediate switch is a special type of switch having four terminals for connection. This switch is commonly used to control a lamp or load from three or more positions as encountered in the lighting of staircases, corridors, bedrooms.

Specifications of an intermediate switch

These switches are available in the market with two possible change over types of connections Figs 1a and 1b.

Fig 1



Accordingly the specification should contain the following information.

- Type of mounting
- Voltage rating
- Current rating
- Type of connection

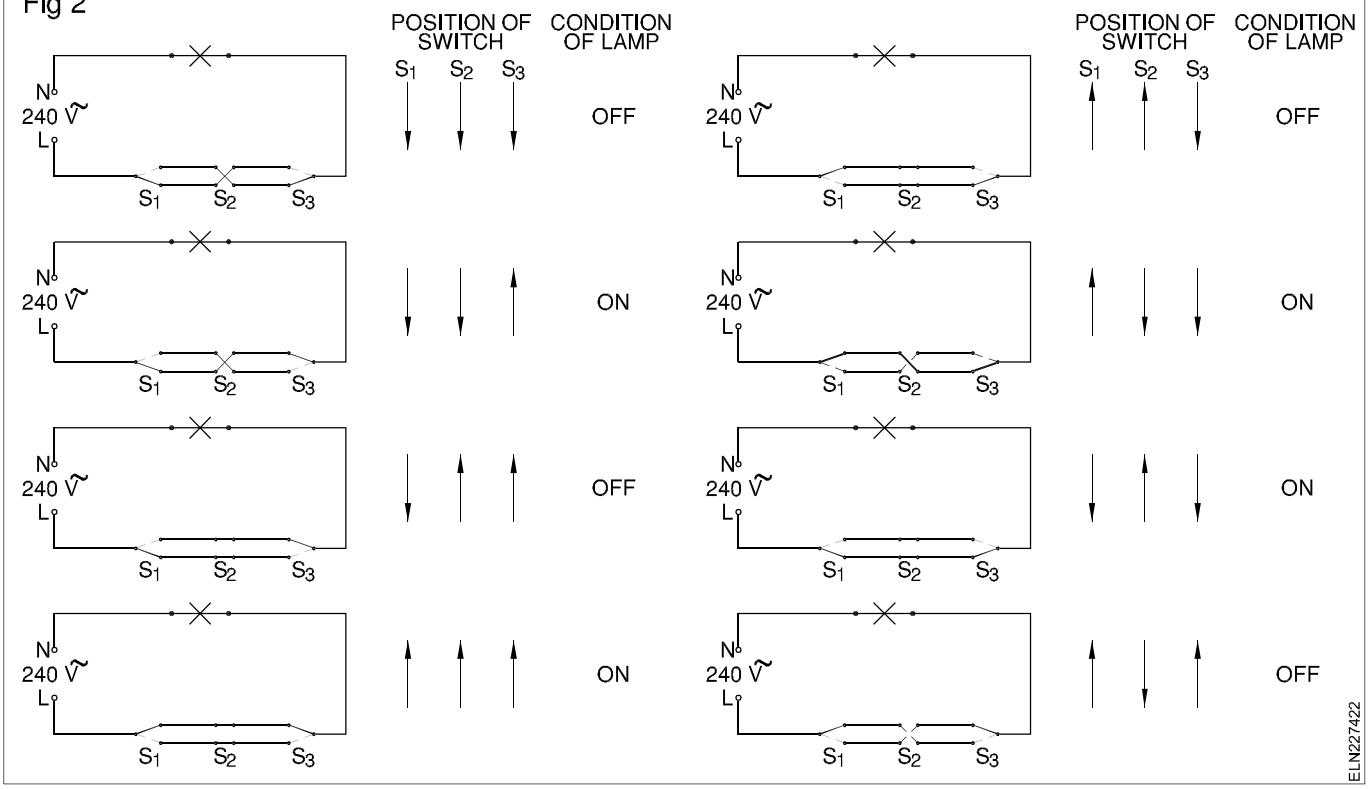
Example

Flush mounting intermediate switch 250 V 6 A horizontal and cross connection.

Circuit connections

For controlling a lamp from three locations, one intermediate switch and 2 two-way switches could be used (Fig 2). Knob positions of the switches and the conditions of the lamp are also given along with Figure 2 for easy understanding.

Fig 2



To control a lamp from three locations, three intermediate switches instead of a two two-way switches can also be used. (But, in practice, they are not used since it is very expensive).

Schematic diagrams (Figs 3 and 4) shows the method of controlling a lamp from three locations using three intermediate switches having horizontal and cross/ vertical connection respectively.

Fig 3

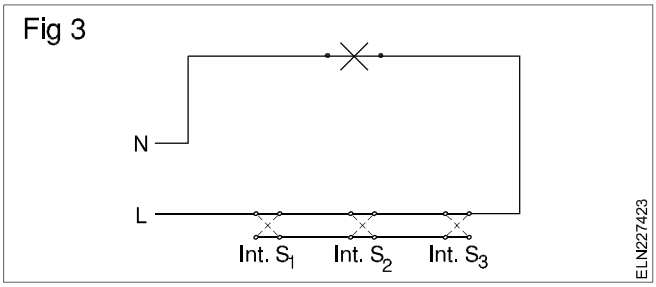
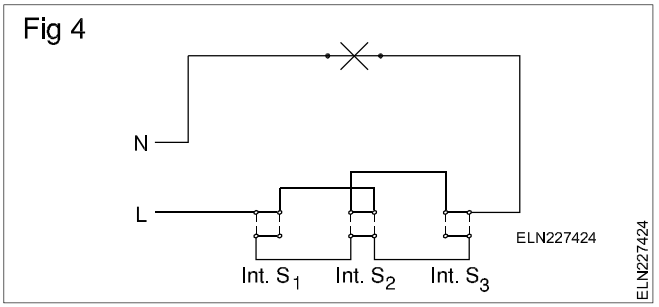


Fig 4



The schematic diagram (Fig 5) is for controlling one lamp from five locations using two two-way switches and three intermediate switches is given below.

In the schematic diagram (Fig 6) is for controlling one lamp from 3 positions with a master control as a security control switch. The lamp is controlled independently from three places by switches S_1, S_2 and S_3. When the master switch

'M' is 'ON' the lamp is permanently 'ON'and cannot be controlled by switches S_1, S_2 and S_3.

Fig 5

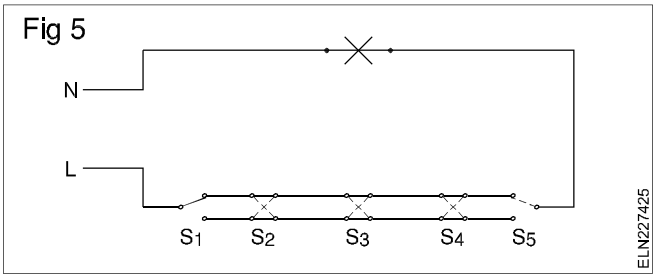
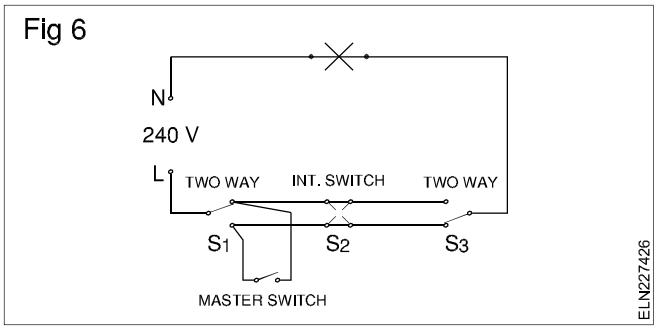
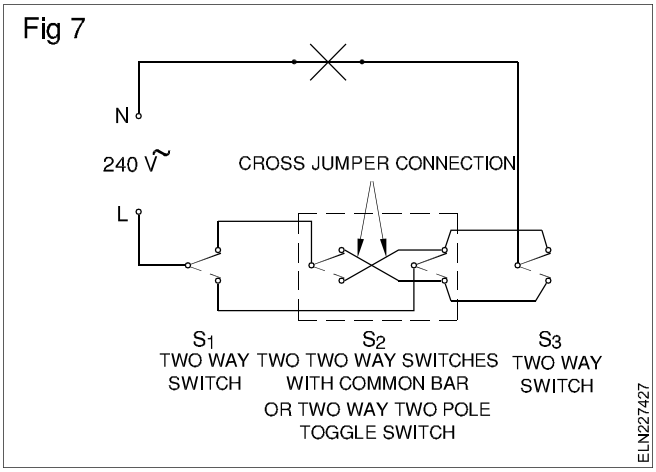


Fig 6



As intermediate switches are costly two numbers of two-way switches can be linked through a common bar and can be used as an intermediate switch (Fig 7). This circuit controls one lamp from 3 places.

Fig 7



IE Regulation for main switch and distribution board

Objectives: At the end of this lesson you will be able to
- **state the I E regulations/ B I S recommendations/ NE Code of practice with regard to the main switch and distribution fuse box.**

Reception and distribution of main supply

There shall be a circuit breaker or a linked switch with fuse in each live conductor of the supply mains at the point of entry.

The neutral wire should not have any break in the form of switch or fuse unit. In the main switch, the neutral conductor should be marked clearly.

The main switchgear shall be located in a place where it is accessible and should be near to the terminating point of the service line.

Main switches and switchboards

Reference BIS 732-1963 and NE code.

All main switches shall be either of metal-clad enclosed pattern or of any insulated enclosed pattern which shall be fixed at close proximity to the point of entry of supply.

Location

Switchboards shall not be erected above gas stoves or sinks, or within 2.5 m of any washing unit in the washing rooms or laundries, or in bathrooms, lavatories, toilets, or kitchens.

In the case of switchboards unavoidably fixed in places likely to be exposed to atmospheric weather, the outer casing shall be weatherproof and shall be provided with glands or bushings or adapted to receive screwed conduit, according to the manner in which the cables are run.

Metal-clad switchgears shall preferably be mounted on any of the following types of boards.

Hinged type metal boards

These shall consist of a box made of sheet metal not less than 2 mm thick and shall be provided with a hinged cover to enable the board to swing open for examination of the wiring at the back.

The joints shall be welded. The board shall be securely fixed to the wall by means of rag bolts, plugs, or wooden gutties and shall be provided with a locking arrangement and an earthing stud. All wires passing through the metal board shall be bushed. Alternatively, hinged type metal boards shall be made of sheet covering mounted on channel or angle iron frames.

Such types of boards are particularly suitable for small switchboards for mounting metal-clad switchgears connected to supply at low voltages.

Fixed type metal boards

These shall consist of an angle or channel iron frame fixed on the wall or on the floor and supported on the wall at the top, if necessary. There shall be a clear distance of one metre in front of the switchboard.

Such types of boards are particularly suitable for large switchboards for mounting large number of switchgears or higher capacity metal-clad switchgear or both.

Teak wood boards

For small installations connected to a single phase 240 volts supply, teak wood boards may be used as main boards or sub-boards. These shall be of seasoned teak or other durable wood with solid back impregnated with varnish of approved quality with all joints dovetailed.

Thoroughly protected both inside and outside with good insulating varnish conforming to IS:347-1952 and of not less than 6.5 mm thickness, shall be provided at the back for attachment of incoming and outgoing cables. There shall be a clear distance of not less than 2.5 cm between the teak wood board and the cover,

Recessing of boards

Where so specified, the switchboards shall be recessed in the wall. The front shall be fitted with a hinged panel of teak wood or other suitable materials, such as Bakelite, or with unbreakable glass doors in teak wood frames with locking arrangement, the other surface of the doors being flush with the walls. Ample room shall be provided at the back for connection and at the front between the switchgear mountings.

Arrangement of apparatus

Equipment which is on the front of a switchboard shall be so arranged that inadvertent personal contact with live

parts is unlikely during the manipulation of switches, changing of fuses or like operation.

No apparatus shall project beyond any edge of the panel. No fuse body shall be mounted into 2.5 cm of any edge of the panel and no hole other than the holes by means of which the panel is fixed shall be drilled closer than 1.3 cm from any edge of the panel.

In every case in which switches and fuses are fitted on the same pole, these fuses shall be so arranged that the fuses are not live when their respective switches are in the 'off' position.

No fuses other than the fuses in the instrument circuit shall be fixed on the back of or behind a switchboard panel or frame.

Marking of apparatus

Where a board is connected to a voltage higher than 250 volts, all the apparatus mounted on it shall be marked in the following colours to indicate the different poles or phases to which the apparatus or its different terminals may have been connected.

Alternating current

Three phases – red, yellow and blue.

Neutral – black.

Where three-phase, 4-wire wiring is done, the neutral shall be in one colour and the other three wires in another colour.

Where a board has more than one switch, each such switch shall be marked to indicate which section of the installation it controls. The main switch shall be marked as such and where there is more than one main switch in the building, each such switch shall be marked to indicate which section of the installation it controls.

Main and branch distribution boards

The main and branch distribution boards shall be of any type mentioned here.

The main distribution board shall be provided with a switch or circuit-breaker on each pole of each circuit, a fuse on the phase or live conductor and a link on the neutral or earthed conductor of each circuit. The switches shall always be linked.

Branch distribution boards shall be provided with a fuse on the live conductor of each circuit and the earthed neutral conductor shall be connected to a common link and be capable of being disconnected individually for testing purposes. One spare circuit of the same capacity shall be provided on each branch distribution board. Lights and fans may be wired on a common circuit. Such sub-circuit shall not have more than a total of ten points of lights, fans and socket outlets. The load of such circuit shall be restricted to **800 watts**. If a separate fan circuit is adopted, the number of fans in the circuit shall not exceed ten.

Power sub-circuits

The outlet shall be provided according to the load design for these circuits but in no case shall there be more than two outlets on each circuit. The load on each power sub-circuit should be restricted to **3000 watts.**

Installation of distribution boards

- The distribution fuse-boards shall be located as near as possible to the centre of the load they are intended to control.
- Distribution boards shall be fixed at a height not more than 2 metres from the floor level.
- These shall be fixed on suitable stanchion or wall and shall be accessible for replacement of fuses.
- These shall be of either metal-clad type or all-insulated type. But, if exposed to weather or damp situations, they shall be of weatherproof type and, if installed where exposed to explosive dust, vapour or gas, they shall be of flame proof type.
- Where there are two or more distribution fuse-boards in feeding low voltage circuits and fed from a supply at medium voltage, these distribution boards shall be:
  - fixed not less than 2 m apart; or
  - arranged so that it is not possible to open two at a time, namely, they are interlocked and the metal case is marked 'Danger 415 Volts'; or
  - installed in a room or enclosure accessible to only authorized persons.
- All distribution boards shall be marked 'Lighting' or 'Power' as the case may be and also marked with the voltage and number of phases of the supply. Each shall be provided with a circuit list giving details of each circuit with controls, the current rating and its size of fuse-element.

Wiring of distribution boards

In wiring branch distribution board, the total load of the consuming devices shall be divided, as far as possible evenly between branch circuits.

Cables shall be connected to a terminal only by soldered or welded or crimped lugs using suitable sleeve or lugs or ferrules unless the terminal is of such a form that it is possible to securely clamp them without cutting away cable strands.

Fuses

a A fuse carrier shall not be fitted with a fuse element of higher rating than that for which the carrier is designed.

b The current rating of a fuse shall not exceed the current rating of the smallest cable in the circuit protected by the fuse.

c Every fuse shall have in its own case or cover, or in an adjacent conspicuous position, an indelible indication of its appropriate current rating for the protection of the circuit which it controls.

Selection of size of conductor

The size of conductors of circuits shall be so selected that the drop in voltage from the consumer's terminals in a public supply (or from the bus-bars of the main switch-board controlling the various circuits in a private generation plant) to any point on the installation does not exceed 3 per cent of the voltage at the consumer's terminals.

In each circuit or sub-circuit the fuse shall be selected to match the cable rating to ensure the desired production.

All conductors shall be of copper or aluminium. The conductor for final sub-circuit for fan and light wiring shall have a nominal cross-sectional area of not less than 1.00 mm^2 copper and 1.50 mm^2 aluminium. The cross-sectional areas of conductors for power wiring shall be not less than 2.5 mm^2 copper, 4.00 mm^2 aluminium. The minimum cross-sectional area of conductors of flexible cords shall be 0.50 mm^2 copper.

Branch switches

Where the supply is derived from a three-wire or four-wire source and distribution is done on the two wire system, all the branch switches shall be placed in the outer or live conductor of the circuit and no single phase switch or fuse shall be inserted in the middle wire, earth or earthed neutral conductor of the circuit.

Passing through walls and floors

Where conductors pass through walls the conductor shall be carried either in a rigid steel conduit or a rigid non-metallic conduit or in a porcelain tube of such a size which permits easy drawing in. The end of the conduit shall be neatly bushed with porcelain, wood or other suitable material.This steel conduit shall be earthed andsecurely bushed.

Where a wall tube passes outside a building so as to be exposed to the weather, the outer end shall be bell mouthed and turned downwards and properly bushed on the open end.

Fixing to walls and ceilings

Plugs for ordinary walls or ceilings shall be of well seasoned teak or other suitable hardwood not less than 5 cm long and 2.5 cm square on the inner end and 2 cm square on the outer end. They shall be cemented into walls to within 6.5 cm of the surface, the remainder being finished according to the nature of the surface with plaster .

In the case of new buildings, wherever possible, teak wood plugs shall be fixed in the walls before they are plastered. To achieve neatness, plugging of walls or ceilings may be done by a suitable type of asbestos, metallic or fibre fixing plug.

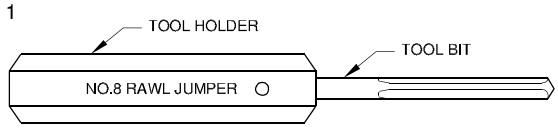
Energy meter board installation

Objectives: At the end of this lesson, you shall be able to
- **state the purpose and method of use of a rawl jumper**
- **state the type of filler materials used for rawl jumper holes**
- **state the shape and use of wooden gutties**
- **describe the method of preparing pipe jumpers**
- **state the precautions while making through holes in the wall.**

Purpose of Rawl jumper

The purpose of the rawl jumper is to make holes in the brick and concrete walls or ceiling for fixing the batten or round blocks. It consists of two parts. Tool bit and tool holder as shown in Fig 1. The tool bit is made of carbon steel whereas the holder is made of mild steel.

Fig 1

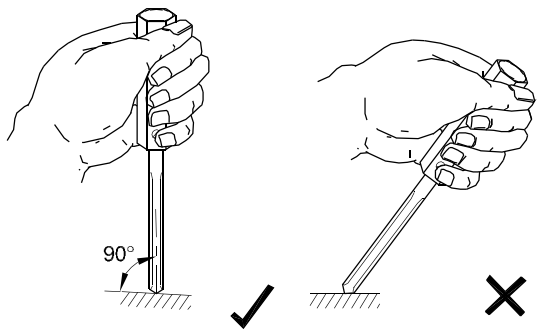


The tool bit is fluted to allow maximum debris clearance and ensure fast penetration. The shank of the tool bit is tapered to fit into the tool holder.

There are different sizes available. Numbers 8, 10, 12, and 14 are used in electrical work. As the number increases the size of the bit as well as the size of the holder decreases

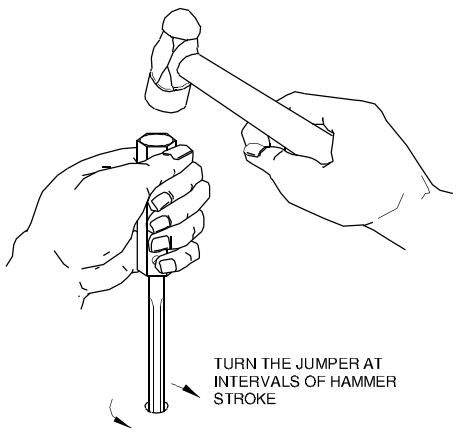
While making holes, the rawl jumper is held at right angles to the wall surface and hit by a hammer. The rawl jumper is turned clockwise and anticlockwise by 90° between hits as shown in Fig 3 to enable removal of debris and to avoid breakage of the tool bit. Care should be taken to see that the mushroom is removed from the tool holder head after every use. (Fig 2)

Fig 2



RAWL BIT SHOULD BE KEPT AT RIGHT ANGLE TO THE WALL SURFACE

Fig 3



CORRECT METHOD OF USING RAWL JUMPER

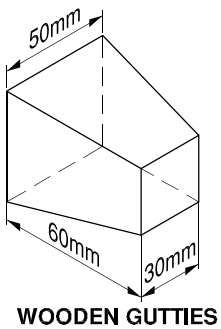
Types of filler materials

Saw dust, fibre, plastic, asbestos, and some times nylon plugs are inserted into the holes. The batten or round block etc are fixed by the screws penetrated into the plug which expands and grips the wall firmly.Rawl plugs are only suitable for rigid walls. But for non-rigid walls, wooden gutties are used.

Shape of the wooden guttie

A wooden guttie is made up of teak wood. The shape of the guttie : Normally, it is 50 mm sq. on one side and gradually tapered to 30 mm sq. at the other side. The length on the side will be 60 mm. The size of the guttie depends upon the load it has to carry. After fixing wooden gutties the cement requires atleast 24 hours of curing before screws could be used on them.(Fig 4)

Fig 4



WOODEN GUTTIES

Method of fixing

A recess hole of a size larger than the size of guttie is made in the wall with a cold chisel and hammer. Then water is sprinkled inside the hole and a small quantity of cement mortar is inserted into the hole. Then the larger area side of the guttie is inserted into the hole and positioned such that the smaller area side is flush with the wall. Fill the hole with cement mortar.

Allow it to set for a day. After 4 hours of fixing, water is sprinkled on the cemented area after every one hour duration for curing. After 24 hours of curing, fix the board or batten or round block with a screw driven into the guttie.

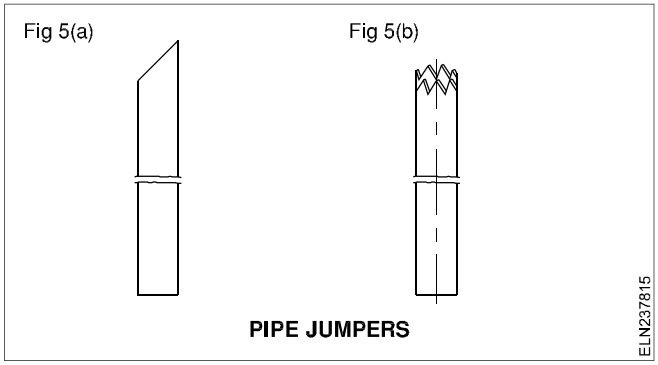
Pipe jumper

A pipe jumper is used along with a hammer to make through holes in walls during wiring. The diameter of the pipe jumper depends upon the diameter of the pipe to be accommodated in the wall and the length depends upon the wall thickness.

Preparing the pipe jumper

One method of making a pipe jumper is to use a GI pipe of suitable size and to have a slant cut by a hacksaw. (Fig 5 a).

The second method of preparing a pipe jumper is to cut the teeth on one end of the pipe Fig 5(b) in the form of a crown.



PIPE JUMPERS

While making through holes in the walls, the following precautions should be observed.

From time to time, between hammer blows, rotate as well as pull out the pipe jumper from the hole to remove the broken masonry pieces. This enables free movement of the pipe jumper.

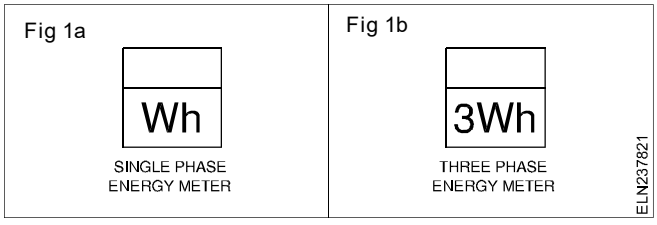
Slow down the hammer strokes when the pipe jumper reaches nearer to the other end of the wall. Otherwise it causes larger sized plaster to fall down from the other side of the wall.

While making a hole on a wall in which concealed wiring exists, ascertain the lay out of the existing wiring on the wall and then make a hole. Otherwise switch off the mains to avoid electrocution.

NE code of practice and IE Rules for energy meter installation

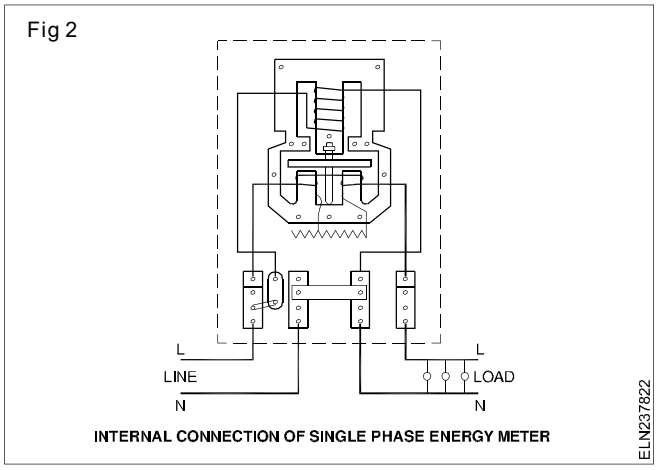
Objectives: At the end of the lesson you shall be able to
- **interpret BIS symbols for single and 3-phase energy meters**
- **state the BIS recommendations pertaining to the mounting of the energy meters.**

The BIS symbols for energy meters are given in Figs 1a and 1b



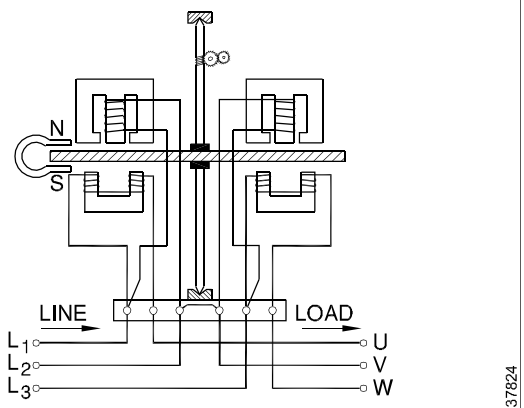
Internal circuit diagrams of single phase and three phase meters are Fig 2 and 3 respectively.

In earlier domestic installations the service mains were brought inside the consumer premises and first connected to the IC cutouts, then to the energy meter and to the consumer main switch (Fig 4a and 4b)



INTERNAL CONNECTION OF SINGLE PHASE ENERGY METER

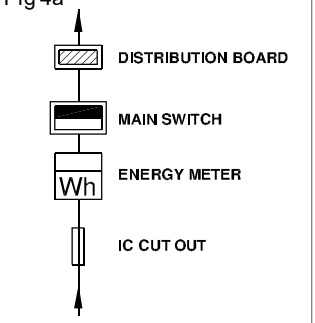
Fig 3



INTERNAL CONNECTIONS OF THREE PHASE ENERGY METER

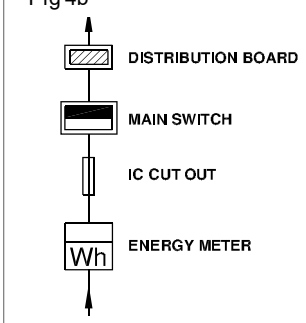
However, to avoid pilferage of electricity, certain electricity boards insist that the service connections should first be connected to the energy meter, then to the I C cutout and then to the consumer main switch. In all the cases the neutral should be directly connected from the outgoing terminals of the energy meter to the consumer main switch.(Fig 4b)

Fig 4a



OLD TYPE OF SERVICE CONNECTION FOR POWER CIRCUIT

Fig 4b



NEW TYPE OF SERVICE CONNECTION FOR POWER CIRCUIT

ELN237824

Precautions while installing energy meters

- Energy meters which are tested and approved by the local electricity board authorities only should be used.
- Energy meters should be used in vertical position only.
- Connections for incoming and outgoing supply should be made according to the manufacturer's instructions/ connection diagram which will be available on the inner side of the terminal plate of the energy meters.

NE code of practice and IE rules for energy meter installation

Energy meters shall be installed at such a place which is readily accessible to both the owner of the building and the authorised representatives of the supply authority.

It should be installed at a height where it is convenient to note the meter reading; it should preferably be not installed below 1 m from the ground. The energy meters should either be provided with a protective covering, enclosing them completely, except the glass window through which the readings are noted or should be mounted inside a completely enclosed panel provided with hinged or sliding doors with arrangement for locking it.

Any meter placed upon the consumer's premises shall be of appropriate capacity and shall be deemed to be correct if its limits of error do not exceed 3% above or below absolute accuracy at all loads in excess of one tenth of full loads and up to full load.

No meter shall register at no load.

General instructions

The body of the energy meter should be earthed to the general mass of earth using a proper size of earth continuity conductor depending upon the current capacity of the installation.

For multi-storeyed buildings which consist of a number of offices or commercial centres or flats occupying various areas, the electrical load for each of them is metered separately. In such cases, all the energy meters are located in a meter room which is normally situated on the ground floor.