

## **PLUGS AND SOCKETS REPORT**

Generally, an average individual does a lot of research on the electrical and the electronic equipments that he/she wishes to procure. Seldom do they think about the electrical sockets to which these equipments are meant to be connected.

When you build a house, it is invariably the electrician who decides on the type of sockets. The owner often limits his participation to giving his requirement on the number of electrical pin points and the loads for which he requires the sockets and insists that they use a good quality sockets. At the most suggesting a name or two of the popular brand he/she has heard of.

This study aims at the types of sockets and the need for looking into the finer details and the safety aspects to be considered while using them.

Electrical plugs and socket-outlets differ in voltage and current rating, shape, size and type of connectors. The types used in each country are set by national standards.

Generally the plug is the movable connector attached to an electrically operated device's power cord, and the socket-outlet is fixed on equipment or a building structure. The plug has protruding prongs, or pins that fit into matching slots or holes in the socket-outlet. A socket is also called a receptacle, outlet, or power point. It is enclosed in a cover.

Design features of plugs and socket-outlets have gradually developed to reduce the risk of electric shock and fire. Safety measures may include

- Pin and slot dimensions and layout that permit only proper insertion of plug into socket-outlet
- Earth pins longer than power pins so the device becomes earthed before power is connected.
- Electrical insulation of the pin shanks was added as an additional feature to reduce live contact exposure when a plug is partially inserted in a socket-outlet.
- Shutters that open only for the correct plug prevent foreign objects from coming into contact with live slots.

### **Commonly used Electrical Plugs**

The two pin plug is also called the Euro plug. It has two round pins. It can be inserted in either way into the socket.

The three pin plug is rated at 6A / 250V or 16A/ 250 V. It has three round pins in a triangular pattern. The earth terminal is slightly larger and longer than the live and neutral terminals.

### **Socket Outlets**

Socket outlets, or electric receptacles, help provide direct access to an electric power source. They are designed to feed power to most electrically-run equipment from a series of small

boxes that are wired directly to an electrical panel or other power source. Socket outlets are commonplace in most homes and businesses, as they provide both easy and direct access to electrical power from various points. A socket outlet's design may vary depending on the electrical current, the country of origin, and the type of equipment or plug it must accept. Due to these variances, not all electrical outlets and electric-run components are mutually compatible.

### **Hazards of interchange:**

Plugs and socket-outlets are designed as a system to meet standards for safety and reliability. Some types of sockets may accept more than one type of plug; where this is an official, approved intention of the socket design. All the approved combinations will be tested against to the applicable safety standards. Occasionally, plug and socket combinations may allow power to flow but may not meet product standards for mating force, grounding, current capacity, life expectancy, or safety. Improvised or user-modified connectors will not meet the product safety standards.

**Electricity improves our daily lives - but only when used safely. Don't create hazards by overloading sockets, and never ignore warning signs like burning smells, sounds of arcing (buzzing or crackling), fuses blowing or circuit-breakers tripping. Electrical accidents are most likely to happen when equipment is damaged or misused. Failure to correct the problem could have devastating effects. This sounds like common sense, but you would be surprised how many of us fail to follow basic safety guidelines.**

### **For Your Safety:**

#### **Damaged plugs, sockets and flexible cables can cause electric shocks, burns and fires.**

- Check the plug and socket for burn marks, sounds of 'arcing' (buzzing or crackling), fuses blowing, circuit-breakers tripping or whether it feels hot.
- Remove plugs from sockets carefully. Pulling out a plug by the cable puts a strain on it, and could damage the contact between the plug and the socket. This could result in the plug overheating, its wires becoming loose or an electric shock (if the earth wire is disconnected).
- Only use plugs with the ISI mark
- Always replace damaged cables immediately. Touching exposed live wires may give you an electric shock which could result in death.

#### **Mistakes you can avoid:**

- Always unplug an appliance before you try to do any maintenance. You risk injury from electric shock, burns and mechanical movement if you tackle maintenance before appliances are unplugged and have cooled down.

Flexible cables trailing under carpets, rugs or across walkways are not only a major danger in terms of tripping, but also a fire risk.

- Many electrical appliances, such as heaters, have ventilation slots to prevent overheating. If these slots are covered up, the appliance could overheat and catch fire, or if water drips in, there is a risk of electric shock.
- On an average, You can expect to find around four sockets in a room in a house. Although this is enough for most purposes, an increase in the use of computers, games consoles and other appliances has led to an increase in the number of sockets being needed in an average room. Extension leads and adaptors often provide a quick and easy solution but, in reality, these leads and adaptors are often misused, and can present a very real danger. In extreme cases they can overheat, which can cause a fire.

### Some safe practices

- Ensure the plug is completely inserted into the socket outlet. Failure to do so may cause electric shock and/or excessive heat resulting in a fire.
- Regularly remove any dust, etc from the plugs of the appliances by pulling them from the socket outlets, then wiping them with a dry cloth. Accumulated dust may cause an insulation defect from moisture, etc. resulting in a fire.
- Remove the plug of the appliance from the socket outlet if it emits smoke, an abnormal smell, or makes an unusual noise. These conditions can cause fire or electric shock. Get the wiring and the appliance checked by a competent person.

**Never touch an electric plug with wet hands. There is a danger of electric shock.**

Electric shock can cause Headache, Muscle fatigue or spasms, Temporary unconsciousness, or Temporary breathing difficulty.

Some of the more serious and possibly fatal side effects of electrical shock are

- Severe burns at point of contact and along the electricity's course through the body,
- Vision loss, Hearing loss, Brain damage, Respiratory arrest or failure,
- Cardiac arrest (heart attack), or Death

### Prevention Tips

Plastic outlet caps are a simple solution to keeping fingers and dangerous objects out of socket outlets. But, these aren't perfect, because kids can remove the caps. Another option – that's gaining popularity because of its success – is to install tamper-resistant electrical socket outlets i.e., **with shutters**. Many new homes already come equipped with them, and we can upgrade socket outlets in older homes to these new receptacles.

## **Don't**

- Use adaptors plugged into other adaptors; or
- Overload extension socket outlets, particularly with high-current appliances such as kettles, irons and heaters (Low-current appliances include radios, televisions, computers and hi-fi equipment); this can result in the risk of fire or electric shock.
- Buy cheap, substandard adaptors

**The most sensible action would be to install extra sockets. While you are at it, ask an electrician to install twin sockets rather than single ones.**

## **Safety in the kitchen:**

We all know that water and electricity make a lethal combination. So it's important that electrical equipment is installed correctly, and that you use appliances in your kitchen with care.

- To avoid water coming into contact with electricity, make sure that your sockets or switches are fitted at a safe distance (at least 30 cm horizontally) from the sink.
- If appliances such as fridges, dishwashers and washing machines are fitted under worktops, getting to sockets may be difficult. Ideally, these appliances should be controlled by a switched fuse connection unit mounted above the worktop where you can reach it easily.

## **Don't**

- Touch any electrical equipment or switches with wet hands;
- Wrap flexible cables around any equipment when it is still warm;
- Clean an appliance such as a kettle while it is still plugged in;
- Try to get toast that is stuck out of a toaster while it is plugged in, and especially not with a metal knife –
- Fill a kettle or a steam iron while it is plugged in.

**Take special care when using electrical appliances in the kitchen – the mixture of water, hot surfaces, flexible cables and electricity can be very dangerous. Check that flexible leads and appliances such as kettles and toasters are in good condition.**

## **Bathroom safety**

Water conducts electricity efficiently. When the two mix, the result can kill. Because of this, from an electrical safety point of view, the bathroom is possibly the most dangerous room in the home. The consequences of an electric shock are far more severe in a bathroom or shower room as wet skin reduces the body's resistance. There are special requirements for electrical installations in bathrooms.

### **Sockets**

- Sockets are not allowed in bathrooms or shower rooms (apart from shaver-supply units), unless they can be fitted at least three metres from the bath or shower.
- Shaver-supply units must be at a safe distance from the bath or shower to avoid splashes.

## Don't

Don't use mains-powered portable appliances such as hairdryers, heaters or radios into a bathroom. There is a danger of an electric shock.

## Checking a Plug

- Remove the plug from the socket and check the plug is not damaged.
- Look for signs of overheating, such as discoloured casing or cable.
- Check that the plug is marked ISI 1293
- Check that the cable sheath is firmly clamped in the plug and that no coloured wires are showing.

All modern appliances use the familiar 6 A or 16 A three pin plugs. These plugs are used for handheld appliances such as hairdryers and vacuum cleaners, and appliances like microwave ovens. The plug and cable can suffer damage, particularly if they connect to handheld appliances. Checking a plug and its cable does not need a lot of detailed electrical knowledge and these tips should help..

## Which plugs and sockets should be used:

Most table lamps, standard lamps, televisions, computers, mixers, blenders, power drills, jigsaws, soldering irons will use 700W or less. Larger appliances such as washing machines, dishwashers, microwave ovens, irons, induction tops, and hotplates will use more than 700W. For your convenience these are just standard two plug and socket outlets 6A and 16A. For appliances up to 700W, use a 6A plug and socket outlet. **For those over 700W, use a 16A plug and socket outlet.**

## Frequently Asked Questions:

### Why do the Sockets get heated?? Understanding overheating of socket outlets.

Materials that conduct electricity also oppose its flow to some degree. This phenomenon is known as resistance, and every electrical conductor, no matter how efficient, displays it to some degree. Copper wire is a good conductor with low resistivity, but resistance increases with decreasing wire size, **and one of the byproducts of resistance is heat.**

Remembering the above facts can help us understand why our socket outlets are overheating and what to do about it.

## What thickness of wire is to be used?

**Wiring requirements:** The electrical code is specific about the thickness of wire, also known as the wire gauge that you should use, based on the expected maximum current flow through it. One of the main reasons for the wire size requirements is to prevent overheating of the wires and the resulting damage to equipment and possibility of fire.

## What happens where is miswiring in a socket outlet?

Electricians are required to install socket outlets with the proper gauge wire, but homeowners often modify their circuitry without consulting the codes and make mistakes in the process. One such mistake is to extend the circuit from an existing outlet with a smaller gauge cable than the incoming one. The smaller wire creates a bottleneck for electricity as it passes through the socket outlet on its way along the circuit, and the extra resistance heats up the socket outlet terminals and the socket outlet. In such a case, you may notice the socket outlet getting hot even if you aren't using it.

**High demand appliances:** A socket outlet can heat up for a related reason when you use it to power an appliance that draws more power than the socket outlet is designed to supply. For example, you may be using a socket outlet to supply an appliance or power tool and find that it occasionally draws more than the circuit can handle and trips the circuit breaker. If you attempt to remedy the situation by simply replacing the breaker, the socket outlet will get hot every time the appliance or tool draws more electricity than the socket outlet and the wires attached to them can handle.

## What is the reason for melted socket outlets?

**Loose connections:** Loose connections are responsible for many melted socket outlets and fires. If one of the terminal wires works itself loose from the terminal screw, electricity may arc between the wire and the terminal. Air has a higher resistivity than copper, and more heat is produced when electricity passes through it, which is one reason why lightning strikes often result in fires. A poorly fitting plug or a loose socket outlet can also cause arcing. Heat from loose connections is seldom benign enough to simply warm the socket outlet. It usually results in damage to the socket outlet or plug.

## Are your Sockets Overloaded?

Overloading electric socket outlets is the cause of many house fires and whilst most people have extension leads in their homes, using 4-way bar adaptors (which are recommended over multi plug adapters) to increase the number of appliances that they can plug into a wall socket outlet, it seems many householders are still unclear about what items are safe to plug in.

It is worth noting that different appliances place different demands on an electric socket outlet. Small electrical appliances such as kettles and toasters place a large demand on an extension socket outlet and it is recommended that both of these appliances have their own individual plug and socket outlet.

An extension lead can be very useful when a higher number of plug outlets would be required such as to set up a television, DVD player, a SKY box and a Play station. It can be very

inconvenient having to plug these items individually into only one plug socket. An extension lead gives some much needed flexibility. It is worth knowing that to plug in all 4 of these items would use just over 750 watts (3 Amps). It is important to know which pieces of electrical equipments can be safely used on an electrical extension lead. Before an extension lead is used, it is important to know its maximum current rating. The Amps are marked clearly on every extension lead and it is important not to exceed the limit. If the limit is exceeded, it can cause a fire in the wall socket outlet. Although there is space to plug in four appliances, this does not mean it is always safe to do so. Different electrical appliances use different amounts of power.

It is not the biggest appliances though that use the most power. A kettle, for example, would draw more current than a washing machine.

It is important to be aware of the limitations of an extension socket outlet. There are instances where extension sockets have been plugged into extension socket outlets in order to create even more socket outlets without any thought being given to the maximum power available from the one socket outlet. It is a fire risk and is also overloading the extension socket outlet itself.

## COMPARATIVE TESTING

Comparative Testing is a formal process by which products & services of different vendors are tested for Quality; the services are tested for compliance to the regulations laid out by the regulatory authorities. CONCERT has undertaken to do this Comparative Testing for South India under a grant from Department of Consumer Affairs, Government of India. Concert tested 7 products and 3 services in 2012/13 One of the products chosen for testing was electrical plugs and sockets.

### Products chosen for Testing

Socket 6 A	Socket 16A
Million (2 in 1)	Million (15 & 5 Amps)
Kundan (5 in 1)	Kundan (15 & 5 Amps)
Anchor (2 in 1)	Anchor (15 & 5 Amps)
Legrand (3 pin only)	Legrand (15 & 5 Amps)
Havells (2 in 1)	Roopa (15 & 5 Amps)
Fybros (5 in 1)	Fybros (15 & 5 Amps)
Euro (Gemini) (2 in 1)	MK (15 & 5 Amps)
Krans (2 in 1)	Gemini (15 & 5 Amps)
Oswal (2 in 1)	Oswal (15 & 5 Amps)
Priti	Priti (15 & 5 Amps)

( 2 in 1)	
GM (2 in 1)	GM ( 15 & 5 Amps)
Crabtree ( 2 in )	Crabtree (15 & 5 Amps)

Plug 6 A	Plug 16 A	Multi Plugs	Two pin Plugs
Million	Million	Choice ( 5 Amps)	Anchor
Kundan	Kundan	Monic (5 Amps)	Oswin
GM	Oswal	Camy (5 Amps)	Priti
Priti	Priti		Choice

**Plugs are very rarely purchased separately nowadays as all the appliances that we use in our home come with their own Plugs with moulded cables and wired to the appliance. We just have to plug it in a socket and switch the power on.**

## **CRITERIA, PARAMETERS, AND LIST OF TESTS Carried out FOR ELECTRICAL PLUGS AND SOCKET-OUTLETS**

### **1. Packaging and Labelling (for individual Plugs and Socket outlets)**

**The label should contain the following information.**

- Name of the product/Brand Name
- Manufacturer's Name and address
- Date of manufacture
- Net Quantity
- MRP
- Customer Care contact details
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### **2. Ease of use**

**The following exercise was carried out to ascertain the ease of use**

- Fitting the plugs in sockets and removing – interchangeability/without electric connection and without any connected load
- Record any experience of sparks or shocks when the sockets are connected to the electrical supply and the plugs fitted and removed from the socket
- Check temperature rise between plug and socket outlet when different loads are connected in intervals and record the same.

### 3. Overall Quality (for individual Plugs and Socket outlets)

#### Check the following

- Check pin dimensions on Plugs and hole dimensions on sockets with vernier calipers
- Rating as per clause 6 of IS: 1293
- Classification as per clause 7 of IS: 1293
- Marking as per clause 8 a, b, c, d of IS: 1293
- ISI marking on the product
- Check for protection against electric shock/live parts should not be accessible
- Check for provision for earthing
- Check terminals/should be screw type

#### Test Results are as indicated below

##### 1. Packaging and labelling:

The following brands do not carry date of manufacture on the label

(a) 6 A Socket Outlet - Million (2 in 1), Krans (2 in 1)

(b) 16 A Socket Outlet - Million

**2. Ease of Use** - Ease of use of 6A and 16 A Plugs with 16 A Sockets (without any connected load)

The various 6 Amps & 16 Amps plugs were connected to 16 Amps sockets and the observations are as indicated below.

Ease Of use of 6 & 16 A Plugs with 16 A Sockets									
	16 A (Sockets)	Million (6A) PLUG	Kundan (6A) PLUG	GM (6A) PLUG	PRITI (6A) PLUG	Million (16A) PLUG	Kundan (16A) PLUG	Oswal (16A) PLUG	PRITI (16A) PLUG
1	Million	L	L	L	L	L	L	L	L
2	Kundan	G	L	L	L	L	L	L	G
3	Anchor	T	T	T	T	T	G	G	G
4	Legrand	G	G	T	G	G	G	L	L
5	Fybos	L	L	L	L	L	L	L	L
6	Roopa	N	N	N	N	T	G	G	G
7	MK	L	L	L	L	L	L	G	L
8	Gemini	L	G	G	L	L	L	L	G

9	Oswal	G	N	N	N	L	L	L	G
10	Priti	L	L	G	L	G	G	L	G
11	GM	L	L	L	L	G	T	G	T
12	Crabtree	G	G	G	G	G	G	G	L

Legend: L = Loose, G = Correct Fit (Good), T = Too tight, N = Not Fitting.

Ease of use 6 A Plugs with 6 Amps Sockets (without any connected load)

Ease of use 6 A 3 Pin Plugs with 6 Amps Sockets					
	6 A (Sockets)	Million (6A)	Kundan (6A)	GM (6A)	Priti (6A)
		3 Pin Plug	3 Pin Plug	3 Pin Plug	3 Pin Plug
1	Million (2 in 1)	G	L	G	G
2	Kundan (5 in 1)	G	G	G	G
3	Anchor(2 in 1)	L	L	G	L
4	Legrand (3 pin only)	L	L	L	L
5	Havells (2 in 1 + imported Pin)	G	G	G	G
6	Fybro (5 in 1)	L	G	L	G
7	Euro(Gemini) (2 in 1)	N	N	N	N
8	Krans (2 in 1)	N	N	N	N
9	Oswal (2 in 1)	T	T	4	T
10	Priti (2 in 1)	T	G	G	G
11	GM(2 in 1)	L	G	G	L
12	Crabtree (2 in 1)	G	G	G	G

Legend: L = Loose, G = Correct Fit (Good), T = Too tight, N = Not Fitting

#### 1. Ease of use of 2 pin multi plug and 2 pin plugs with 6 Amps socket outlets

- We tested three brands of 2 pin multi plugs and four brands of 2 pin plugs with twelve brands of 6 A socket outlets.
- The fitment of all multi plugs and two pin plugs were found to be good in all the twelve 6 A socket outlets. Anchor brand 2 pin plugs fitted well in 8 out of the 12 6A socket outlets. Monic brand multi plug with 2 pin also had a good fit in 8 out of the 12 6A socket outlets.
- None of the multi plugs or 2 pin plugs fitted well in Euro (Gemini) and Oswal 6A socket outlets.

- Anchor 6A socket outlet had a good fit only with choice 2 pin plug and krans 6 A socket outlet had a good fit only with Monic brand multi plug with 2 pins.

## 2. Ease of use of two brands of 3 Pin Multi plugs namely Choice and Monic with 12 brands 16 A Sockets.

- The fitment of both the multi plugs on Crabtree socket outlet was of Correct Fit (Good)
- Both the multi plugs could not be fitted on Roopa brand of 16 A socket outlet, while the fitment of both on Anchor brand were too tight.
- Choice brand of multi plug had a correct fit (Good) with Crabtree brand of socket outlet and was fitting loose on Million, Kundan, Legrand, Fibros, MK, Gemini, Oswal, Priti, and GM brands of socket outlets.
- Monic brand of multi plug had a correct fit (Good) with Legrand, Oswal, Priti, GM, and Crabtree and was fitting loose on Million, Kundan, Fybros, Mk, and Gemini brands of socket outlets.

### Ease of use of Mobile chargers with 6A socket outlets

We used mobile chargers of Samsung, Micromax, I-phone, Nokia (3-pin), ERD (Local Brand) and that of Sony camera.

- Fitment on Million socket outlet was found be good except for Sony camera charger.
- Fitment on GM socket outlet was good except the local mobile charger (ERD).
- Nokia (3 pin) charger fitted well on all the socket outlets except on Fybros and Krans brands of socket outlets. Oswal socket outlet fitted well only with Nokia (3 pin) mobile charger and its fitment was loose in all the rest.

### 3. Temperature Rise on the plug and Socket out lets when connected to load.

The temperature rise is high when the fitment is loose. - hair dryers, hot plate, induction top, and immersion heater as connected loads.

**When the fitment of Plug and Socket Outlet is loose, there are always possibilities of sparking and the resultant temperature rises. Continued use of such improper assembly will progressively result in blackening, burning etc leading to fire in extreme cases.**

### 3. Overall Quality

**(i) Ratings as per Clause 6 of IS: 1293:** The Plug and Socket outlet shall preferably have voltage (230, 240, 250 V) and current (6, 10\*, 16 A) ratings.

**All the plugs and socket outlets tested conform to this requirement of the standard.**

\* International practices provide for 10 A socket outlet for all appliances requiring up to and including 10 A, whereas in India, the socket outlet of 6 A is still in use. The manufacturers would develop 10 A socket outlets with the same physical dimensions as of the present 6 A socket outlets. After satisfactory development of 10 A socket outlets, the 6 A socket outlets are to be phased out in future.

**(ii) Classification as per clause 7.2.3 (b) of IS: 1293:** The socket outlets shall be with shutters so that live parts are not accessible without a plug in engagement. The socket outlets shall be so constructed that the live contacts are automatically screened when the plug is withdrawn. (This is an important safety requirement)

## 6 A Socket Outlet

(a) Only Legrand (3 pin) and Crabtree (2 in 1) conform to this requirement of the standard.

(b) Million (2 in 1), Kundan (5 in 1), Anchor (2 in 1), Havells (2 in 1), Fybros (2 in 1), Euro (Gemini) (2 in 1), Krans (2 in 1), Oswal (2 in 1), Proti (2 in 1), and GM (2 in 1) do not conform to this requirement of the standard.

## 16 A Socket Outlet

(a) Million, Anchor, Legrand, Fybros, Roopa, MK, GM, and Crabtree brands conform to this requirement of the standard.

(b) 16 A Socket Outlets – Kundan, Gemini, Oswal, and Priti brands do not conform to this requirement of the standard.

(iii) **Markings as per clause 8 a, b, c, d of IS: 1293:** The plugs and socket outlets shall be marked with Rated current in amperes, Rated voltage in volts, Symbol for nature of supply, Manufacture or responsible vendor's name, trade mark, or identification mark, Type reference, which may be a catalogue reference.

All the plugs and socket outlets tested conform to this requirement of the standard.

(iv) **Check the following:** ISI marking, provision of earthing in 3 pin Plugs and Socket outlets, and check whether the terminals for connecting the wires are of screw type and record.

- **6 A Socket Outlet** - Only Euro (Gemini) (2 in 1) has ISI markings; all the others do not have any ISI marking.
  - **16 A Socket Outlet** – All the brands tested have ISI marking
  - **Plugs** – All the brands of plugs tested have ISI marking
  - All the plugs and socket outlets tested have provisions for earthing and the terminals are of screw type as specified in the standards.
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## BEWARE – PLEASE CONSIDER THE FOLLOWING FOR YOUR SAFETY

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- A smell of hot plastic or burning near an appliance or socket
  - Sparks or smoke coming from a plug or appliance
  - Blackness or scorch marks around a socket, plug or appliance
  - Damaged or frayed leads
  - Coloured wire inside leads showing at the plug or anywhere else on the lead
  - Melted plastic on appliance cases or leads
  - Fuses that blow or lights that trip for no reason
  - If you find you have growing reliance on the use of extension leads in your home, it is worth getting extra sockets outlets installed by an electrician.
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