



# Tools & Accessories

**ENSOLT  
BOOKS**



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# **Tools and Accessories**





# 1. HAND TOOLS

A hand tool is any tool that is not a power tool, one powered by hand (manual) rather than by an engine.

## SCREW DRIVER

A screwdriver is a tool, manual or powered, for turning (driving or removing) screws. A typical screwdriver has a handle, a shaft, and a tip which is inserted into the head of the screw to turn it. The shaft is usually made of tough steel to resist bending or twisting.



Materials used – steel

Sizes: 100mm, 150mm, 180mm, 200mm, 300mm.

Uses: used for loosening or tightening screws

Precautions: use proper size and shape of screwdrivers tip for particular screws. Don't use screw driver in place of chisel. Avoid greasy or oily handle.

## PLIER

Pliers are a hand tool objects firmly, possibly developed from tongs used to handle hot metal in Bronze Age Europe. They are also useful for bending and compressing a wide range of materials.

### Combination pliers

Material used- steel

Size- 15cm, 20cm, 25cm

Uses- for holding, twisting, or cutting wires.

Precautions- don't cut steel wires, don't hold any hot substance and don't using place of hammer.



### Side cutting pliers

Material used- steel

Size- 20cm

Uses- for cutting wire at narrow places, for removing insulation from cables

Precautions- protect from rust, don't cut steel wires and don't hold hot substance.



## Round nose pliers

Material used- steel

Size- 10cm

Uses- for holding, twisting and joining the wires at narrow places.

Precautions- don't cut steel substance protect from rust.



## CALIPERS

A caliper is a device used to measure the distance between two opposite sides of an object. A caliper can be as simple as a compass with inward or outward facing points.

The inside calipers are used to measure the internal size of an object.

Outside calipers are used to measure the external size of an object.

A hermaphrodite caliper has one leg bent inward and one straight leg ending in a sharp point; this type of caliper is used for scribing lines at a specified distance from a flat or curved surface.



## SPANNERS

Spanner is a tool with a shaped opening or jaws for gripping and turning a nut or bolt

Open end spanner grips only two faces of the nut

Ring spanner grips all corners and faces of the nut



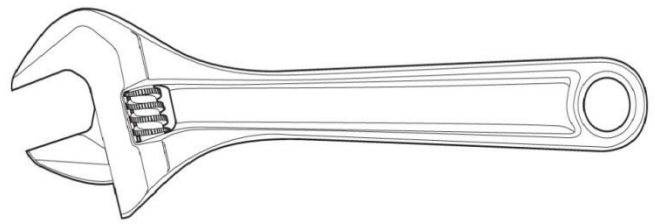
DOUBLE OPEN END



RING



COMBINATION



ADJUSTABLE



BOX

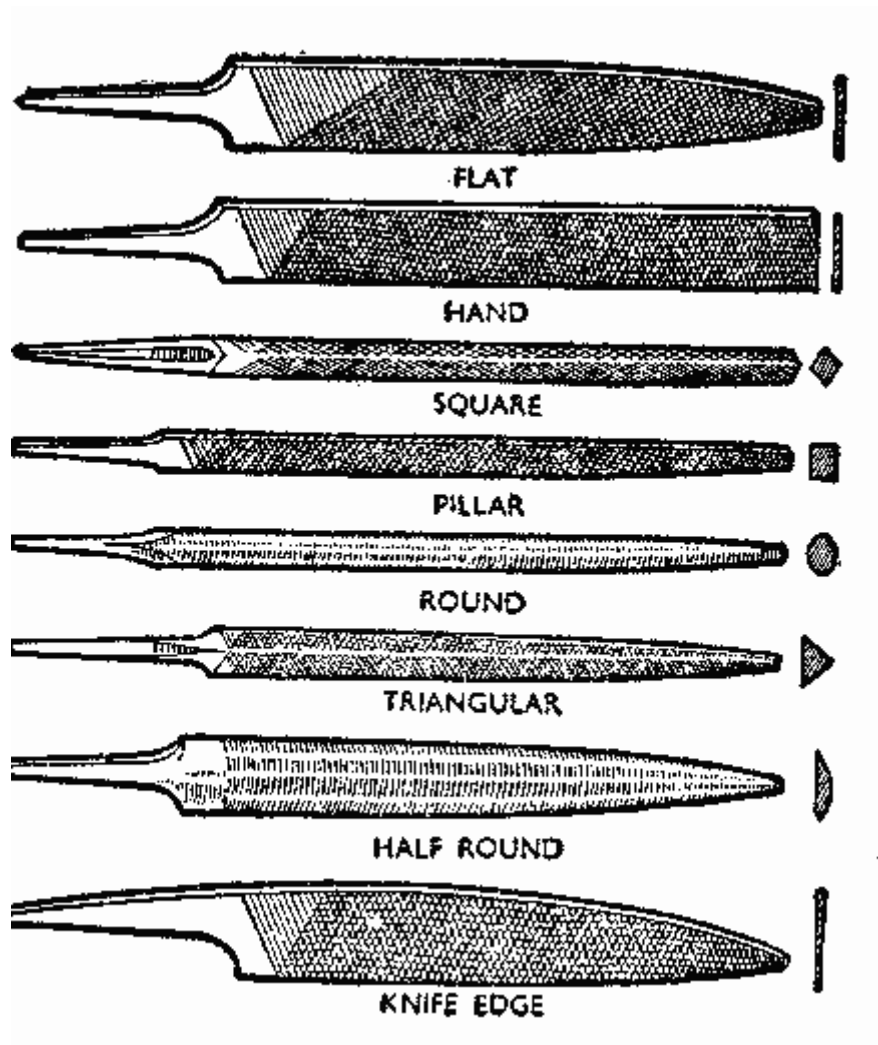
## FILES

A file is a metalworking, woodworking and plastic working tool used to cut fine amounts of material from a work piece. It most commonly refers to the hand tool style, which takes the form of a steel bar with a case hardened surface and a series of sharp, parallel teeth. Most files have a narrow, pointed tang at one end to which a handle can be fitted.

A round file is a woodwork device used for removing small amounts of material from a work piece. The round file consists of a long pointed metal body and a square tang for attaching a handle.

A triangular file is a specialized tool for trimming and sharpening edges. Its unique, three-sided design makes it a great tool for sharpening hard-to-reach places such as saw teeth.

Half-round file is made of heat-treated high carbon steel for durability and features a textured PVC and rubber handle for a firm grip.





## CHISELS

A chisel is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving or cutting a hard material such as wood, stone, or metal. The handle and blade of some types of chisel are made of metal or wood with a sharp edge in it.

### Cold chisel

Material used- steel

Size- 10cm, 15cm

Uses- used for chipping, boxing and channeling in walls.

Precautions- should not be oily, avoid flat heat.



### Firmer chisel

Material used- steel

Size- 10cm, 15cm

Uses- used for chipping, scraping and grooving in wood.

Precautions- always strike with mallet, grind it on water stone.



## PIPE WRENCH

The pipe wrench is an adjustable wrench used for turning soft iron pipes and fittings with a rounded surface. The design of the adjustable jaw allows it to rock in the frame, such that any forward pressure on the handle tends to pull the jaws tighter together. Teeth angled in the direction of turn dig into the soft pipe.

Material used- steel

Size- 15cm to 60cm

Uses- used for tightening and opening pipes

Precautions- avoid greasy handle, it should not be used as a hammer.



## CENTER PUNCH

A center punch is used to mark the centre of a point. It is usually used to mark the centre of a hole when drilling holes. A drill has the tendency to "wander" if it does not start in a recess. A centre punch forms a large enough dimple to "guide" the tip of the drill. The Tip of Centre Punch has an angle of 90 Degrees. When drilling larger holes and the web of the drill is wider than the indentation produced by a centre punch, the drilling of a pilot hole is usually needed.

Material used- steel

Size- 100 mm, 150 mm

Uses- used for making guide holes for drilling in metals, walls etc.

Precautions- should not be used on steel materials.



## SCRIBERS

A scribe is a hand tool used in metalworking to mark lines on work pieces, prior to machining. The process of using a scribe is called scribing and is just part of the process of marking out. It is used instead of pencils or ink lines, because the marks are hard to see, easily erased, and inaccurate due to their wide mark; scribe lines are thin and semi-permanent. On non-coated work pieces marking blue is commonly used to increase the contrast of the mark lines.

Material used- steel or carbon steel

Uses –Used for marking lines on surface before cutting



## SNIPERS

Material used- steel

Size -150mm,200mm,250mm

Uses –Used for cutting thin sheets of iron, copper and brass.

Precautions –Keep the sniper well sharpened .Avoid from rust



## WIRE STRIPPER

A wire stripper is a small, hand-held device used to strip the electrical insulation from electric wires.



## SPIRIT LEVEL

Spirit level is a tool used to check the level of a surface. If the level is not corrected, the bubble in the liquid will not be at the center point. We can also measure 450 angle level measurement of the surface using spirit level.



## HACK SAW

A hacksaw is a fine-tooth hand saw with a blade held under tension in a frame, used for cutting materials such as metal or plastics. Hand-held hacksaws consist of a metal arch with a handle, usually a pistol grip, with pins for attaching a narrow disposable blade. A screw or other mechanism is used to put the thin blade under tension. The blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting action on either the push or pull stroke. On the push stroke, the arch will flex slightly, decreasing the tension on the blade, often resulting in an increased tendency of the blade to buckle and crack. Cutting on the pull stroke increases the blade tension and will result in greater control of the cut and longer blade life.



Material Used –Carbon steel.

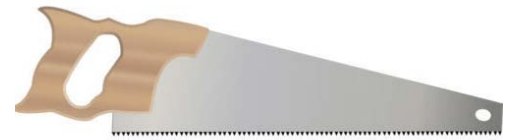
Size -16cm, 20cm, 25cm and 30cm.

Uses –Used for cutting GI pipes.

Precautions – Keep straight the hacksaw while cutting. Apply water on blade while cutting. Keep safe from rust.

## WOOD SAW

A wood saw is a fine-tooth hand saw with a blade held under tension in a frame, used for cutting wood.



## TENNON SAW

A tennon saw is a small rectangular bladed saw used for cutting wood.



## HAMMERS

A hammer is a tool meant to deliver an impact to an object. The most common uses for hammers are to drive nails, fit parts, forge metal and break apart objects. Hammers are often designed for a specific purpose, and vary in their shape and structure.

### Ball peen Hammer

Material Used –Steel.

Size 1/4 kg to 2 kg .

Uses –Used for chipping on teak wood. Beating and reverting in sheet metal.

Precautions – Never use loose handles in hammer. Hammer handle should not be greasy.



### Cross peen hammer

Material Used –Steel.

Size 1/4 kg to 2 kg.

Uses –Used for fixing clip and making holes in wall.

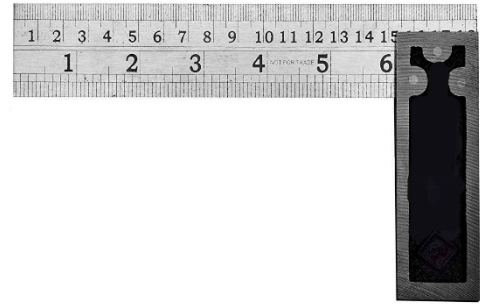
Precautions – Never use loose handles in hammer. Hammer handle should not be greasy.



## TRY SQUARE

A try square is a woodworking or a metal working tool used for marking and measuring a piece of wood.

The square refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees); to try a surface is to check its straightness or correspondence to an adjoining surface. A piece of wood that is rectangular, flat, and has all edges (faces, sides, and ends) 90 degrees is called four square. A board is often milled four squares in preparation for using it in building furniture.



## 2. TUBES & TUBE FITTINGS

A tube, or tubing, is a long hollow cylinder used for moving fluids (liquids or gases) or to protect electrical or optical cables and wires. A 1-inch pipe will not actually measure 1 inch in either outside or inside diameter, whereas many types of tubing are specified by actual inside diameter, outside diameter, or wall thickness.

### COPPER TUBE

Copper tubing is most often used for supply of hot and cold tap water, and as refrigerant line in HVAC (heating, ventilation, and air conditioning) systems. There are two basic types of copper tubing, soft copper and rigid copper. Copper tubing is joined using flare connection, compression connection, or solder. Copper offers a high level of resistance to corrosion, but is becoming very costly.

### SOFT COPPER

Soft (or ductile) copper tubing can be bent easily to travel around obstacles in the path of the tubing. While the work hardening of the drawing process used to size the tubing makes the copper hard/rigid, it is carefully annealed to make it soft again; it is therefore more expensive to produce than non-annealed, rigid copper tubing. It can be joined by any of the three methods used for rigid copper, and it is the only type of copper tubing suitable for flare connections. Soft copper is the most popular choice for refrigerant lines in split- system air conditioners and heat pumps.



### RIGID COPPER

Rigid copper is a popular choice for water lines. It is joined using a sweat, compression or crimped/pressed connection. Rigid copper, rigid due to the work hardening of the drawing process, cannot be bent and must use elbow fittings to go around corners or around obstacles. If heated and allowed to slowly cool, called annealing, then rigid copper will become soft and can be bent/formed without cracking. Common wall- thicknesses of copper tubing in the USA are "Type K", "Type L", "Type M", and "Type DWV"

Type K has the thickest wall section of the three types of pressure rated tubing and is commonly used for deep underground burial such as under sidewalks and streets, with a suitable corrosion protection coating or continuous polyethylene sleeve as required by code. In the United States it usually has green colored printing.

Type L has a thinner pipe wall section, and is used in residential and commercial water supply and pressure applications. In the United States it usually has blue colored printing.

Type M has an even thinner pipe wall section, and is used in residential and commercial water supply and pressure applications. In the United States it usually has red colored printing.

Types DWV has the thinnest wall section, and is generally only suitable for unpressurized applications, such as drains, waste and vent (DWV) lines. In the United States it usually has yellow or light orange colored printing, common sizes being 1-¼", 1-½", and 2" copper tube size.

Types K and L are generally available in both hard drawn "sticks" and in rolls of soft annealed tubing, whereas type M and DWV is usually only available in hard drawn "sticks".

Copper Tubing Sizes (CTS) for Plumbing <sup>[1]</sup>				
Nominal size	Outside diameter (OD) [in (mm)]	Inside diameter (ID) [in (mm)]		
		Type K	Type L	Type M
$\frac{3}{8}$	$\frac{1}{2}$ (12.7)	0.402 (10.211)	0.430 (10.922)	0.450 (11.430)
$\frac{1}{2}$	$\frac{5}{8}$ (15.875)	0.528 (13.411)	0.545 (13.843)	0.569 (14.453)
$\frac{5}{8}$	$\frac{3}{4}$ (19.05)	0.652 (16.561)	0.668 (16.967)	0.690 (17.526)
$\frac{3}{4}$	$\frac{7}{8}$ (22.225)	0.745 (18.923)	0.785 (19.939)	0.811 (20.599)
1	1 $\frac{1}{8}$ (28.575)	0.995 (25.273)	1.025 (26.035)	1.055 (26.797)
1 $\frac{1}{4}$	1 $\frac{3}{8}$ (34.925)	1.245 (31.623)	1.265 (32.131)	1.291 (32.791)
1 $\frac{1}{2}$	1 $\frac{5}{8}$ (41.275)	1.481 (37.617)	1.505 (38.227)	1.527 (38.786)
2	2 $\frac{1}{8}$ (53.975)	1.959 (49.759)	1.985 (50.419)	2.009 (51.029)
2 $\frac{1}{2}$	2 $\frac{5}{8}$ (66.675)	2.435 (61.849)	2.465 (62.611)	2.495 (63.373)
3	3 $\frac{1}{8}$ (79.375)	2.907 (73.838)	2.945 (74.803)	2.981 (75.717)

## STAINLESS STEEL TUBE

Stainless steel, also known as inox steel or inox from French "in oxydable", is a steel alloy with a minimum of 10.5% chromium content by mass. Stainless steel does not readily corrode, rust or stain with water as ordinary steel does, but despite the name it is not fully stain-proof, most notably under low-oxygen, high-salinity, or poor-circulation environments. There are different grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel is used where both the properties of steel and resistance to corrosion are required. Stainless steel differs from carbon steel by the amount of chromium present.



Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film (the rust) is active and accelerates corrosion by forming more iron oxide, and due to the greater volume of the iron oxide this tends to flake and fall away. Stainless steels contain sufficient chromium to form a passive film of chromium oxide, which prevents further surface corrosion by blocking oxygen diffusion to the steel surface and blocks corrosion from spreading into the metal's internal structure, and due to the similar size of the steel and oxide ions they bond very strongly and remain attached to the surface.

## PVC TUBING

Poly (vinyl chloride), commonly abbreviated PVC, is the third-most widely produced plastic, after polyethylene and polypropylene. PVC is used in construction because it is more effective than traditional materials such as copper, iron or wood in pipe and profile applications. It can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is also used in plumbing, electrical cable insulation, inflatable products and many applications in which it replaces rubber. Pure poly (vinyl chloride) is a white, brittle solid. It is insoluble in alcohol, but slightly soluble in tetrahydrofuran.



## TUBE BENDING

Tube bending is the umbrella term for metal forming processes used to permanently form pipes or tubing. Tube bending as a process starts with loading a tube into a pipe bender and clamping it into place between two dies, the clamping block and the forming die. The tube is also loosely held by two other dies, the wiper die and the pressure die. Pipe bending machines are typically human powered, pneumatic powered, hydraulic assisted, hydraulic driven or electric servomotor.



Probably will be the first bending process used on cold pipes and tubing. In this process a die in the shape of the bend is pressed against the pipe forcing the pipe to fit the shape of the bend. Because the pipe is not supported internally there is some deformation of the shape of the pipe giving an ovalar cross section. This process is used where a consistent cross section of the pipe is not required. Although a single die can produce various shapes, it only works for one size tube and radius.

## TUBE CUTTING

A tube cutter is a type of tool used to cut tube. Besides producing a clean cut, the tool is often a faster, cleaner, and more convenient way of cutting tube although this depends on the metal of the tube.





## TUBE CONNECTORS



MALE CONNECTORS



FEMALE CONNECTORS

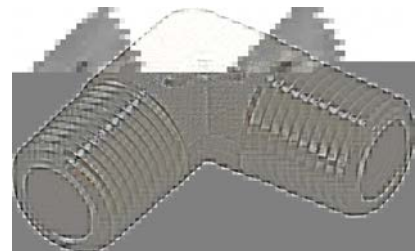


UNION

A union is similar to a coupling, except it is designed to allow quick and convenient disconnection of pipes for maintenance or fixture replacement. While a coupling would require either solvent welding, soldering or being able to rotate with all the pipes adjacent as with a threaded coupling, a union provides simple transition, allowing easy connection or disconnection at any future time. A standard union pipe is made in three parts consisting of a nut, a female end, and a male end. When the female and male ends are joined, the nuts then provide the necessary pressure to seal the joint. Since the mating ends of the union are interchangeable, changing of a valve or other device can be achieved with a minimum loss of time.

## ELBOW

An elbow is a connector installed between two lengths of pipe or tubing to allow a change of direction, usually a 90° or 45° angle, though 22.5° elbows are also made. The ends may be machined for butt welding, threaded (usually female), or socketed, etc. When the two ends differ in size, the fitting is called a reducing elbow or reducer elbow.



## CROSS

Cross connectors are also called 4-way fittings. If a branch line passes completely through a tee, the fitting becomes a cross. A cross has one inlet and three outlets, or vice versa. They often have solvent welded socket ends or female threaded ends. Cross fittings can generate a huge amount of stress on pipe as temperature changes, because they are at the center of four connection

points. A tee is steadier than a cross, as a tee behaves like a three-legged stool, while a cross behaves like a four-legged stool. (Geometrically, "any 3 non-collinear points define a plane" thus 3 legs are inherently stable.) Crosses are common in fire sprinkler systems, but not in plumbing, due to their extra cost as compared to using two tees.



## TEE CONNECTORS

A tee is the most common pipe fitting. It is available with all female thread sockets, all solvent weld sockets, or with opposed solvent weld sockets and a side outlet with female threads. It is used to either combine or split a fluid flow. It is a type of pipe fitting which is T-shaped having two outlets, at 90° to the connection to the main line. It is a short piece of pipe with a lateral outlet. A tee is used for connecting pipes of different diameters or for changing the direction of pipe runs. They are made of various materials and available in various sizes and finishes. They are extensively used in pipeline networks to transport two-phase fluid mixtures.



## REDUCER

A reducer allows for a change in tube size to meet hydraulic flow requirements of the system, or to adapt to existing tubing of a different size. Reducers are usually concentric but eccentric reducers are used when required to maintain the same top- or bottom-of-tube level.



## HOSE CONNECTOR (BARB)

A barb is used to connect flexible hoses to tubes. A barb clamp fitting has a male-threaded end used to mate with the female threads. The other end of the fitting has either a single or multiple barbed tubes having a tapered stub with ridges, which is inserted into the flexible hose to secure it. An adjustable worm drive screw clamp helps to keep the hose from slipping off the barbed tube. Barb fittings can be made of plastic or brass. Brass is used for hot water applications while plastic is used for cold. The barb fitting can be either elbow-shaped or straight.



### 3. PIPE AND PIPE FITTINGS

A pipe is a tubular section or hollow cylinder, usually but not necessarily of circular cross-section, used mainly to convey substances which can flow — liquids and gases (fluids), slurries, powders, masses of small solids. It can also be used for structural applications; hollow pipe is far stiffer per unit weight than solid members.

#### STAINLESS STEEL PIPE

Steel is an alloy of iron, with carbon being the primary alloying element. The carbon content of steel is between 0.002% and 2.1% by weight. Too little carbon content leaves (pure) iron quite soft, ductile, and weak. Carbon contents higher than those of steel make an alloy commonly called pig iron that is brittle and not malleable.

Additional elements may be present in steel: manganese, phosphorus, sulfur, silicon, and traces of oxygen, nitrogen, and aluminums.



#### MILD STEEL PIPE

Mild Steel Casing Pipe, also known as encasement pipe, is most commonly used in underground construction to protect utility lines of various types from getting damaged. Such damage might occur due to the elements of nature or human activity. Mild Steel casing pipe is used in different types of horizontal underground boring, where the pipe is jacked into an augured hole in segments and then connected together by welding or by threaded and coupled ends, or other proprietary pipe connectors. The steel casing pipe can also be set up and welded into a "ribbon" and then directionally pulled through a previously drilled hole under highways, railroads, lakes and rivers.

#### CAST IRON PIPE

Cast iron pipe is a pipe which has had historic use as a pressure pipe for transmission of water, gas and sewage, and as a water drainage pipe during the 19th and 20th centuries. It comprises predominantly a gray cast iron tube and was frequently used uncoated, although later coatings and linings reduced corrosion and improve hydraulics. Cast iron pipe was superseded by ductile iron pipe, which is a direct development, with most existing manufacturing plants transitioning to the new material during the 1970s and 1980s. Little cast iron pipe is currently manufactured.

#### GALVANIZED IRON PIPES (GI)

GI pipes are widely used for conveying raw water & distribution of treated water in majority of rural water supply schemes, where the requirement of water is less. Mostly medium quality GI pipes are used. These pipes are cheap, light in weight and easy to handle & transport & easy to join. Their sizes vary from 15mm to 150mm. These pipes are manufactured conforming to IS-1239 (pt-I) 1990. Generally screwed and socketed pipes are used.

## PIPE SIZE

Nominal Pipe Size (NPS) is a North American set of standard sizes for pipes used for high or low pressures and temperatures.[1] Pipe size is specified with two non-dimensional numbers: a nominal pipe size (NPS) for diameter based on inches, and a schedule (Sched. or Sch.) for wall thickness. NPS is often incorrectly called National Pipe Size, due to confusion with national pipe thread (NPT). The European designation equivalent to NPS is DN (diamètre nominal/nominal diameter/Durchmesser nach Norm), in which sizes are measured in millimetres.[2] The term NB (nominal bore) is also frequently used interchangeably with NPS.

## PIPE FITTING

Pipe fitting is the occupation of installing or repairing piping or tubing systems that convey liquid, gas, and occasionally solid materials. This work involves selecting and preparing pipe or tubing, joining it together by various means, and the location and repair of leaks. Pipe fitting work is done in many different settings: HVAC, manufacturing, hydraulics, refineries, nuclear-powered Super carriers and Fast Attack Submarines computer chip fabrication plants, power plant construction and other steam systems. Pipe fitters (sometimes called simply "fitters") are represented in the USA and Canada by the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada. Fitters work with a variety of pipe and tubing materials including several types of steel, copper, iron, aluminum, and plastic. Pipe fitting is not plumbing; the two are related but separate trades. Pipe fitters that specialize in fire prevention are called Sprinkler fitters, another related, but separate trade. Materials, techniques, and usages vary from country to country as different nations have different standards to install pipe.

## COUPLING

Coupling connects two pipes to each other. If the size of the pipe is not the same, the fitting may be called a reducing coupling or reducer, or an adapter. By convention, the term "expander" is not generally used for a couple that increases pipe size; instead the term "reducer" is used.



## UNION

A union is similar to a coupling, except it is designed to allow quick and convenient disconnection of pipes for maintenance or fixture replacement. While a coupling would require either solvent welding, soldering or being able to rotate with all the pipes adjacent as with a threaded coupling, a union provides a simple transition, allowing easy connection or disconnection at any future time. A standard union pipe is made in three parts consisting of a nut, a female end, and a male end.

When the female and male ends are joined, the nuts then provide the necessary pressure to seal the joint. Since the mating ends of the union are interchangeable, changing of a valve or other device can be achieved with a minimum loss of time. Pipe unions are essentially a type of flange connector.



## REDUCER

A reducer allows for a change in pipe size to meet hydraulic flow requirements of the system, or to adapt to existing piping of a different size. Reducers are usually concentric but eccentric reducers are used when required to maintain the same top- or bottom-of-pipe level.



## TEE

A tee is the most common pipe fitting. It is available with all female thread sockets, all solvent weld sockets, or with opposed solvent weld sockets and a side outlet with female threads. It is used to either combine or split a fluid flow. It is a type of pipe fitting which is T-shaped having two outlets, at 90° to the connection to the main line. It is a short piece of pipe with a lateral outlet. A tee is used for connecting pipes of different diameters or for changing the direction of pipe runs. They are made of various materials and available in various sizes and finishes. They are extensively used in pipeline networks to transport two-phase fluid mixtures.

## ELBOW

An elbow is a pipe fitting installed between two lengths of pipe or tubing to allow a change of direction, usually a 90° or 45° angle, though 22.5° elbows are also made. These ends may be machined for butt welding, threaded (usually female), or socketed etc. When the two ends differ in size, the fitting is called a reducing elbow or reducer elbow.

## CAP

Cap is a type of pipe fitting, usually liquid or gas tight, which covers the end of a pipe. A cap is used like plug, except that the pipes cap screws or attaches on the male thread of a pipe. A cap may have a solvent weld socket end or a female threaded end and the other end closed off. In plumbing systems that use threads, the cap has female threads. Industrial caps can be round, square, rectangular, U-shaped, I-shaped and may have a round hand grip or a flat hand grip.



## PLUG

A plug closes off the end of a pipe. It is similar to a cap but it fits inside the fitting it is mated to. In a threaded iron pipe plumbing system, plugs have male threads.



## BUSHING

Bushing is used to make the diameter of a pipe fitting smaller. They differ from reducers in that they make abrupt changes in diameter and take very little space.

Two examples of galvanized steel bushings are

face bushings, which take the least amount of space, and

Hex bushings which can be tightened with an adjustable wrench.



## ADAPTOR

Adaptors are used to change the end of a non-threaded pipe to male or female threads as needed. Adaptors are commonly used in copper and plastic plumbing jobs. For example adaptors are used to convert from a PVC glue connection to a threaded connection or from a copper soldered connection to a threaded connection. Male adapters and female adapters are both common.

## NIPPLE

A short stub of tubes usually threaded steel, brass, chlorinated polyvinyl chloride (CPVC) or copper; occasionally just bare copper. A nipple is defined as being a short stub of tube which has external male tube threads at each end, for connecting two other fittings. Nipples are commonly used for tubing and hoses, and second as valves for funnels and tubes



## 4. CABLES & CABLE GLANDING

Cable glanding and termination is the process of attaching a cable to equipment using suitable fittings and connect it to the electrical terminals. The main components involved in cable glanding are:

Cable

Cable glands

Lugs

Ferrules

Cable ties.

### CABLES

A cable is most often two or more wires running side by side and bonded, twisted or braided together to form a single assembly, but can also refer to a heavy strong rope. In mechanics, cables otherwise known as wire ropes are used for lifting, hauling, and towing or conveying force through tension. In electrical engineering cables are used to carry electric currents. An optical cable contains one or more optical fibers in a protective jacket that supports the fibers.

Cables can be classified into three classes according to their application:

1. Power cable
2. Control cable
3. Single cable

### POWER CABLE

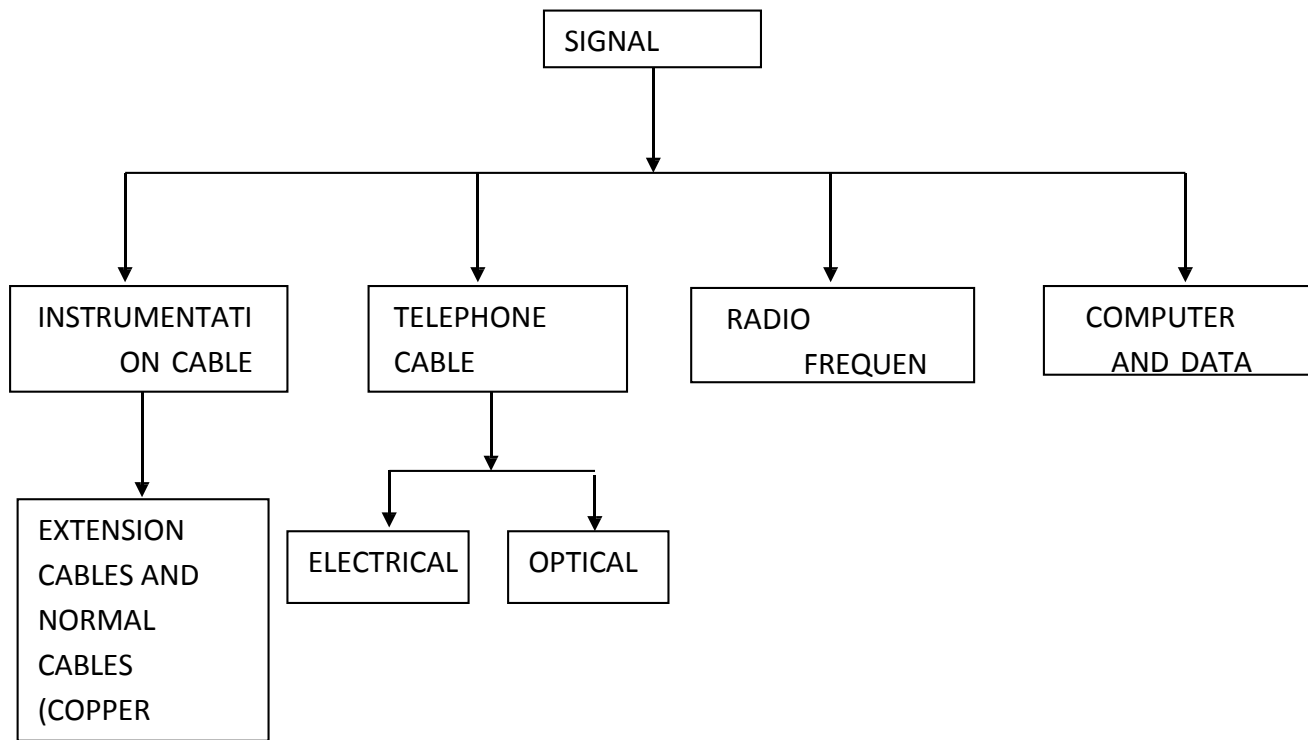
A power cable is an assembly of one or more electrical conductors, usually held together with an overall sheath. The assembly is used for transmission of electrical power. Power cables may be installed as permanent wiring within buildings, buried in the ground, run overhead, or exposed. Flexible power cables are used for portable devices, mobile tools and machinery.

### CONTROL CABLE

These are mainly used for energizing relays, contactors, alarm, control systems and low voltage equipments.

### SIGNAL CABLE

These are mainly used to transmit low voltage and RF signals. Signal cables can be classified as shown below



All the above cables can be further classified as per:

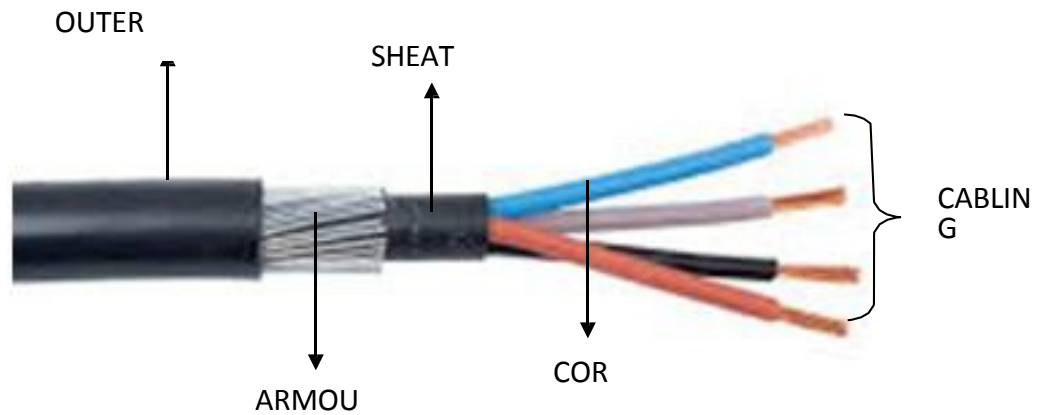
Voltage grade (E.g.:- HV (above 1.1 Kv), LV (up to 1.1 Kv)

Environment (E.g.:- high ambient temperature, chemical resistance etc.)

Duty environment( E.g.:- low smoke or burning, fire survival, flame proof etc)



## PARTS OF A CABLE



CORE:- core is an insulated conductor

ELEMENT/ CABLING ELEMENT:- core grouped together form an element

JACKET/ SHEATH:- cover which holds cabling elements together, it also offers some protection

SHIELD/ SCREEN:- metalized tape or metallic bladings used to protect signals from electrical interference

ARMOUR: - metallic (usually galvanized steel wire) wire/ strip used below outer sheath for mechanical protection to cables.

OUTER INSULATION: - outer cover which holds the entire cable parts. Also offer some mechanical strength. (The thickness of outer insulation depends on the required voltage handling capacity).

## SIZE OF CABLE

NO	EXAMPLE	NUMBER OF ELEMENTS	TYPE OF ELEMENT	CROSS SECTIONAL AREA
1	3 C $\times$ 2.5 mm <sup>2</sup>	3	CORE	2.5 mm <sup>2</sup>
2	12 P $\times$ 1.5 mm <sup>2</sup>	12	PAIR	1.5 mm <sup>2</sup>
3	10 T $\times$ 0.5 mm <sup>2</sup>	10	TRIAD	0.5 mm <sup>2</sup>

The current carrying capacity of a cable depends on its conductor cross sectional area and voltage handling capacity depends on its insulation thickness.

Cross sectional area is always the core section of a single conducting path (of one core) and not the sum of all cores. Common area of cross section of instrumentation cables is 1.5 mm<sup>2</sup>.

## CABLE GLANDS

A cable gland (also known as a cable connector or fitting) is a device designed to attach and secure the end of a cable to the equipment. A cable gland provides strain-relief and connects by a means suitable for the type and description of cable for which it is designed—including provision for making electrical connection to the armour or braid and lead or aluminum sheath of the cable, if any. Cable glands may also be used for sealing cables passing through bulkheads or gland plates.

Cable glands are mechanical cable entry devices and can be constructed from metallic or non-metallic materials. They are used throughout a number of industries in conjunction with cable and wiring used in electrical instrumentation and automation systems.

Cable glands may be used on all types of electrical power, control, instrumentation, data and telecommunications cables. They are used as a sealing and termination device to ensure that the characteristics of the enclosure which the cable enters can be maintained adequately.

These are the four main materials from which cable glands are made:

- Plastic

- Brass

- Aluminum

- Stainless steel

## GLAND PARTS

- Outer seal nut

- Outer neoprene ring

- Armor clamping nut

- Armor clamping ring

- Armor clamping core

- Inner neoprene ring

- Gland body

- Check nut

## TYPES OF CABLE GLANDS

- Single compression glands

- Double compression glands

SINGLE COMPRESSION GLAND	DOUBLE COMPRESSION GLAND
<ul style="list-style-type: none"> <li>• It is used for light armored cables</li> <li>• It is also called normal cable gland</li> <li>• As the name suggests, while you tighten the gland , the grip or compression is affected only at one place at the cable armour only</li> <li>• There is no cone and cone ring</li> <li>• The mechanical support for the cable is only neoprene rubber seal, when tightening the cable</li> </ul>	<ul style="list-style-type: none"> <li>• It provide extra support to the heavy armored cables entering or exiting the panel</li> <li>• In this gland the compression happens both at the cable armor as well as at the inner sheath.</li> <li>• There is cone and cone ring</li> <li>• The mechanical support to the cable only cone and cone ring.</li> </ul>

#### PARTS OF SINGLE COMPRESSION GLAND

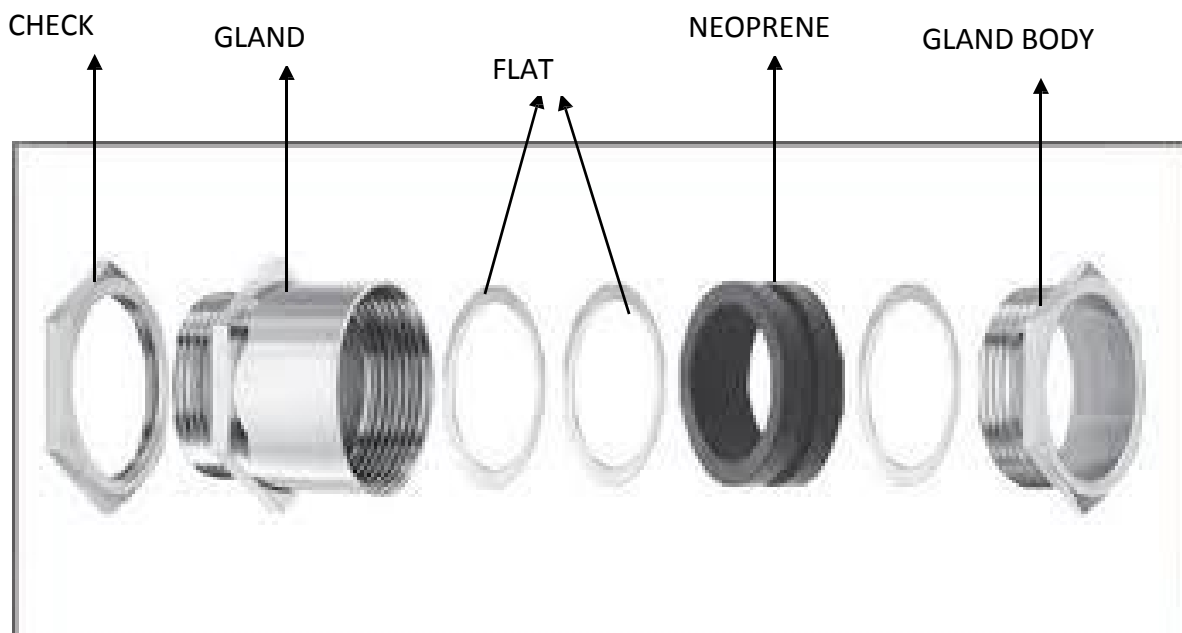
Check nut

Gland body

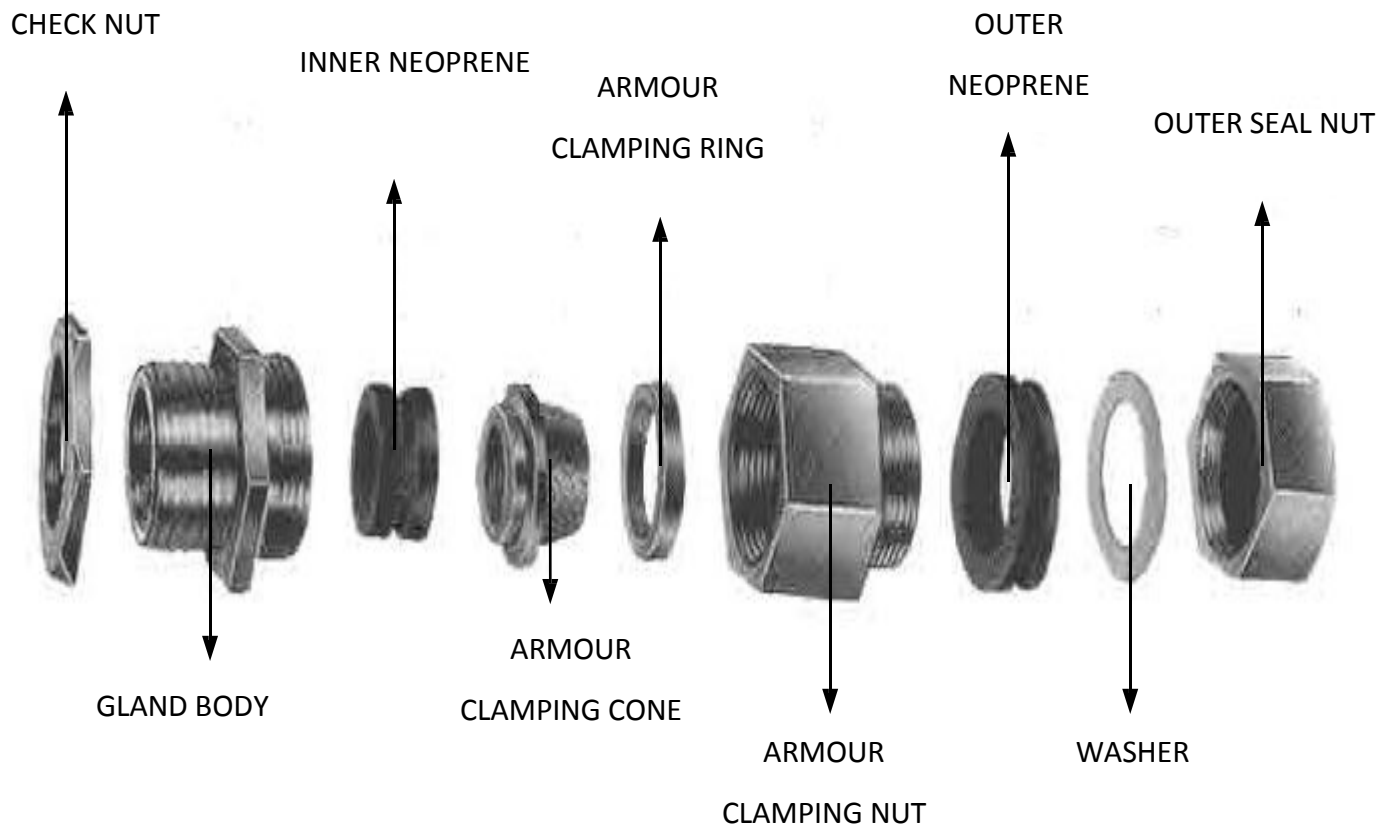
Flat washer

Neoprene seal

Gland body nut



## PARTS OF DOUBLE COMPRESSION GLAND



## GLAND SELECTION

Gland should be selected on following points:

- Type of cable
- Gland size
- Entry type/ thread specification of application
- Ingress protection required
- Material

## CABLE LUGS

These are used to terminate the cable. These are of three types:

Ring type

U type/ fork / y type

Pin type



## CABLE FERRULES

These are used to name the cables



## CABLE TIES

These are used to tie up a set of cables.





## **Engineering Solutions and Training**

### **About the Publication**

ENSOLT is one of the leading design and engineering organization in Chennai. Established in 1991, ENSOLT provides engineering consultancy and EPC services principally focused on the Oil & Gas, Power Plant and Petrochemical industries. The Company has also diversified into sectors like training and project guidance to engineering college students. ENSOLT is committed to quality knowledge transfer and training. The objective of this firm is to provide cost effective solutions to engineering glitches in the field of Electronics, Communication, Electrical and Instrumentation.

ENSOLT brings experts from industry to campus and conducts Guest Lectures and workshops on various topics which relates institutions curriculum with industrial real time application. ENSOLT shares the knowledge of well experienced faculties from reputed Industries to the educational institutions. ENSOLT also provide technical assistance to engineering students to better understand the theory with the real time practical work. ENSOLT conduct customised courses on various engineering discipline.

ENSOLT is privileged to bring this book to the public forum. This book assists student community and employees of the process industry to carry out their mission successfully.