Pipes and pipe fittings

Objectives : At the end of this lesson you shall be able to
- **state the uses of pipes**
- **name the common types of pipes**
- **identify the standard pipe fittings and state their uses.**

Various types of pipes and tubes are used for the following purposes.

- Domestic hot and cold water supplies.
- Waste water outlets.
- High pressure steam supplies.
- Hydraulic oil supplies.
- Lubricating oil supplies.
- Special fluid and gases for industrial processes.
- Pneumatic systems.
- Refrigeration systems.
- Fuel oil supplies.

The common types of pipes classified according to material are:

- galvanized iron pipes
- mild steel pipes
- cast iron pipes
- C.I. soil pipes
- copper pipes
- aluminium pipes
- brass pipes
- lead pipes
- P.V.C. pipes
- rubber pipes
- plastic pipes
- stoneware pipes.

Standard pipe fitting

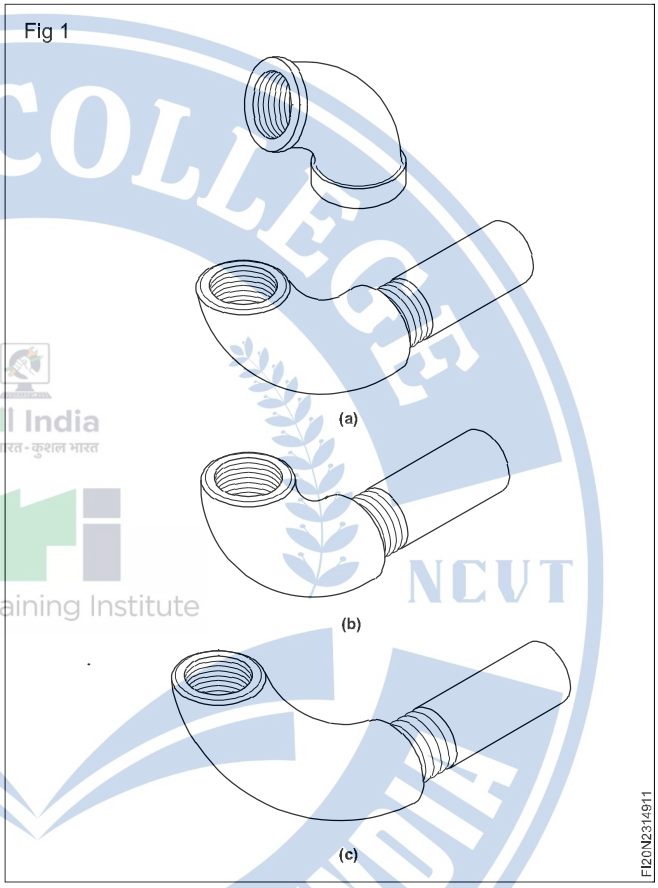
'Pipe fittings' are those fittings that may be attached to water pipes in order to:

- change the direction of the pipe
- connect a branch with a main water supply pipe
- connect two or more pipes of different sizes
- close the pipe ends.

Standard pipe fittings

Elbows (Fig 1)

Fig 1



Elbows and bends provide deviations of 90° and 45° in pipe work systems.

Long radius elbows have a radius equal to 1½ times the bore of the pipe. (Fig 1a)

Short radius elbows have a radius equal to the bore of the pipe.(Fig 1b)

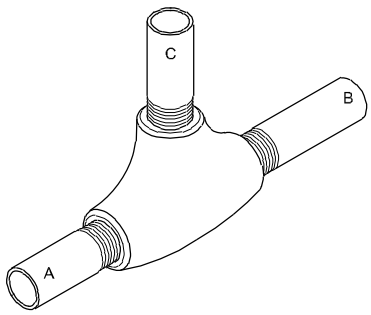
The 45° elbows allow pipe deviation of 45°. (Fig 1c)

Tee branch

A tee joint helps the pipe line to branch off at 90°. The branches may be equal in diameter or there may be one reducing branch.

The dimensions of a branch are always quoted as A x B x C. (Fig 2)

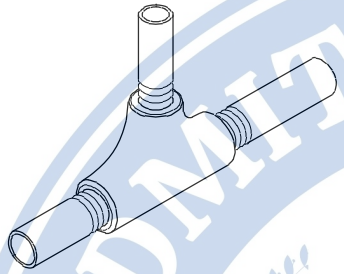
Fig 2



Reducing tee branch

Reducers are fitted where a change in pipe diameter is required.(Fig 3)

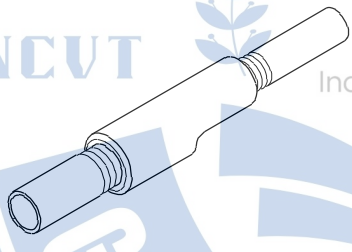
Fig 3



Eccentric reducer

Used mainly in horizontal position.(Fig 4)

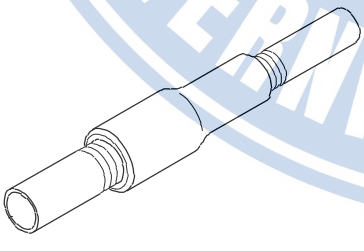
Fig 4



Concentric reducer

Used mainly in vertical position. (Fig 5)

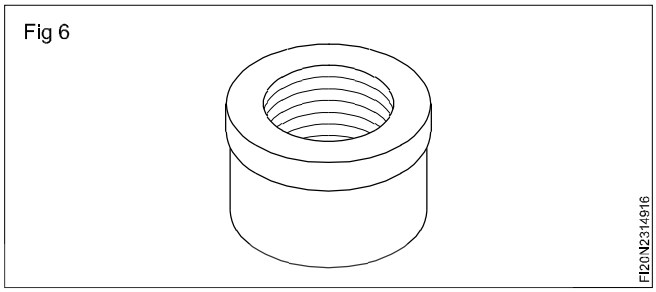
Fig 5



Caps

Caps are used for closing the end of a pipe or fitting which has an external thread. (Fig 6)

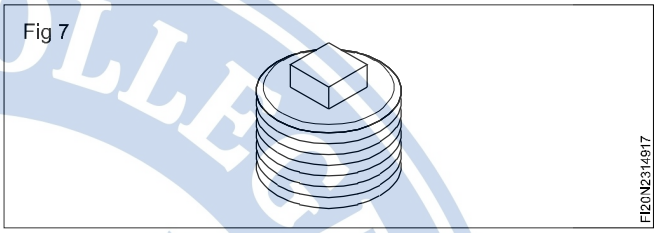
Fig 6



Plug

A plug is used for closing a pipeline which has an internal thread.(Fig 7)

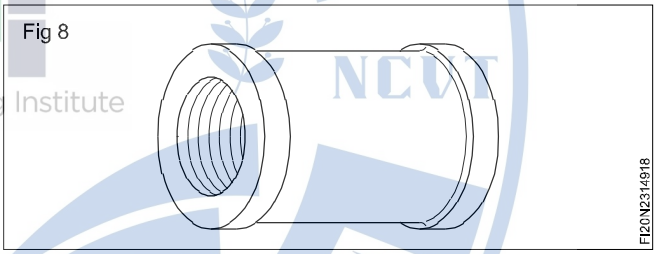
Fig 7



Coupling (Fig 8)

A coupling is used to connect two pipes. Couplings have internal threads at both ends to fit the external threads on pipes.

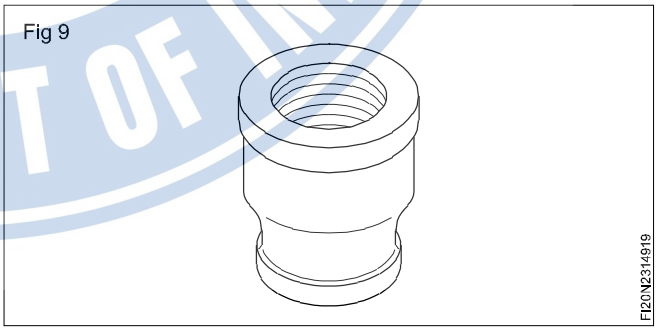
Fig 8



Reducer (Fig 9)

A reducer coupling is used to connect two pipes with different diameters.

Fig 9

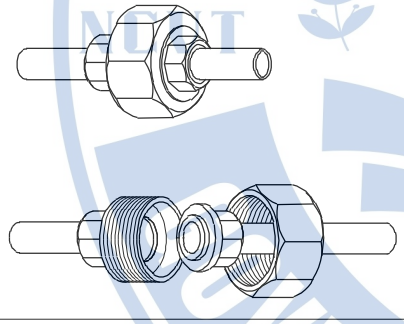


FITTING	SYMBOL
BEND, 90 DEGREES	
BEND, 45 DEGREES	
CROSS	
ELBOW, 90 DEGREES	
ELBOW, 45 DEGREES	
TEE	
REDUCER,CONCENTRIC	
UNION,SCREWED	
PLUG OR CAP	
JOINT/SOCKET	

Union

A device used to connect pipes. Unions are inserted in a pipe-line to permit connections with little change to the position of the pipe. (Fig 10)

Fig 10



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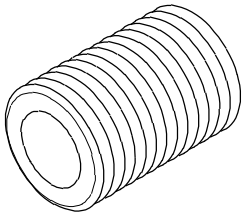
Pipe nipples

Pipe nipples are tubular pipe fittings used to connect two or more pipes of different sizes.

1 Close nipple (Fig 11)

Fig 11



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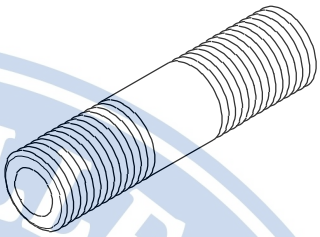
2 Short nipple (Fig 12)

Fig 12



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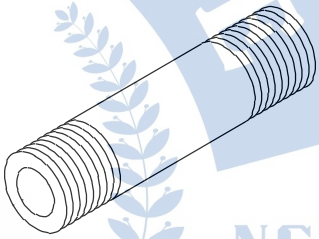
3 Long nipple (Fig 13)

Fig 13



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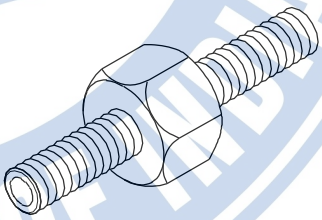
The hexagonal nut

The hexagonal nut in the centre of the nipple is for tightening with a spanner or wrench.(Fig 14)

Fig 14



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British standard pipe threads

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

- **state parallel and taper pipe threads**
- **determine the wall thickness and threads per inch TPI of BSP threads**
- **state the method of sealing pipe joints**
- **determine blank sizes for threading as per B.S 21-1973 and I.S.2643-1964.**

Pipe threads

The standard pipe fittings are threaded to British Standard pipe gauge (BSP). The internal pipe threads have parallel threads whereas the external pipes have tapered threads as shown in Fig 1.

B.S.P. threads

Galvanized iron pipes are available in sizes ranging from 1/2" to 6" in several different wall thicknesses. The table shows outside diameters and threads per inch from $^{1}/_{2}$" to 4". (Fig 2)

Fig 1

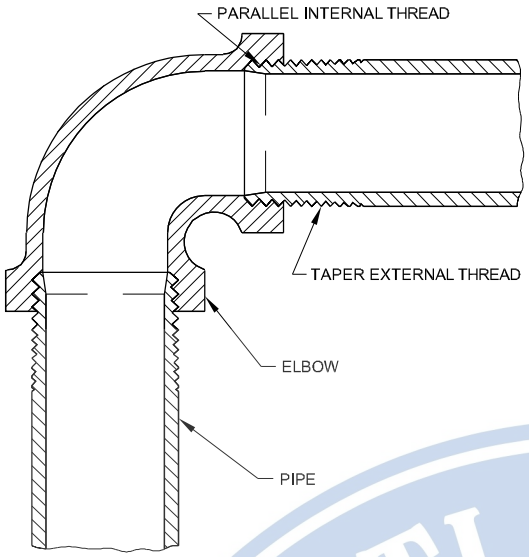
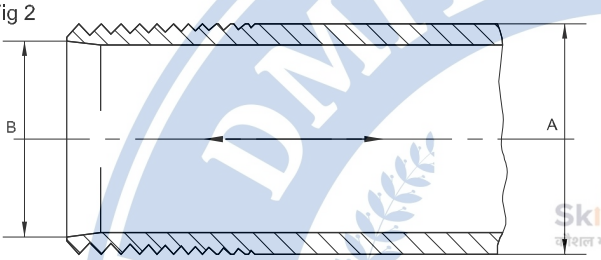


Fig 2



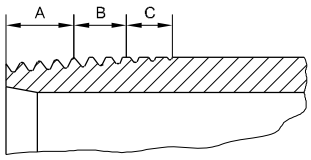
Sealing pipe joint

Fig 3 shows that the pipe has several fully formed threads at the end. (A)

The next two threads have fully formed bottoms but flat tops. (B)

BSP - Pipe sizes or DIN 2999 (inside) (B) +	Threads/ inch	Outside diameter/ mm of the pipe(A)+
1/2”	14	20.955mm
3/4”	14	26.441
1”	11	33.249
11/4”	11	41.910
11/2”	11	47.803
2”	11	59.614
2½”	8	75.184
3”	8	87.884
4”	8	113.030

Fig 3



The last four threads have flat tops and bottoms. (C)

The pipe joint shown in Fig 4 consists of the following.

1 Parallel female thread

2 Tapered male thread

3 Hemp packing

The hemp packing is used to ensure that any small space between two metal threads (male and female threads) is sealed to prevent any leakage.

Fig 4

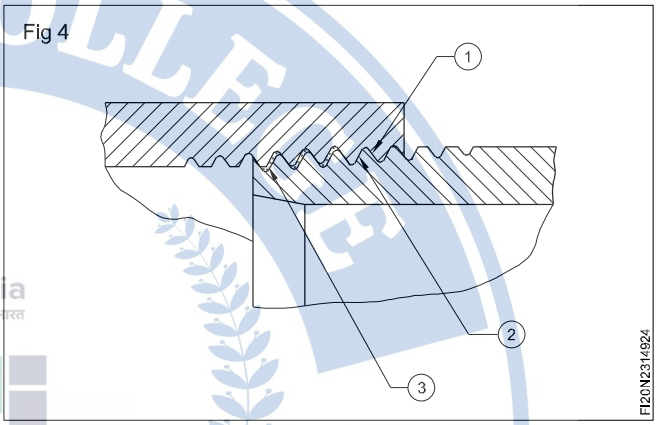


Table-1

Pipe Schedule and Standarad size

Nominal pipe size chart - Nominal pipe dimension in Millimeter (mm)

DN in	OD	5	5s	10	10s	20	30	40	40s	Std	60	80	80s	XS	100	120	140	160	XXS	DN in mm
6	10.3			1.24	1.24			1.73	1.73	1.73		2.41	2.41	2.41						
8	13.7			1.65	1.65			2.24	2.24	2.24		3.02	3.02	3.02						
10	17.1			1.65	1.65		1.85	2.31	2.31	2.31		3.20	3.20	3.20						
15	21.3	1.65	1.65	2.11	2.11		2.41	2.77	2.77	2.77		3.73	3.73	3.73				4.78	7.47	
20	26.7	1.65	1.65	2.11	2.11		2.41	2.87	2.87	2.87		3.91	3.91	3.91				5.56	7.82	
25	33.4	1.65	1.65	2.77	2.77		2.90	3.38	3.38	3.38		4.55	4.55	4.55				6.35	9.09	
32	42.2	1.65	1.65	2.77	2.77		2.97	3.56	3.56	3.56		4.85	4.85	4.85				6.35	9.70	
40	48.3	1.65	1.65	2.77	2.77		3.18	3.68	3.68	3.68		5.08	5.08	5.08				7.14	10.16	
50	60.3	1.65	1.65	2.77	2.77		3.18	3.91	3.91	3.91		5.54	5.54	5.54				8.74	11.07	
65	73	2.11	2.11	3.05	3.05		4.78	5.16	5.16	5.16		7.01	7.01	7.01				9.53	14.02	
80	88.9	2.11	2.11	3.05	3.05		4.78	5.49	5.49	5.49		7.62	7.62	7.62				11.13	15.24	
90	101.6	2.11	2.11	3.05	3.05		4.78	5.74	5.74	5.74		8.08	8.08	8.08					16.15	
100	114.3	2.11	2.11	3.05	3.05		4.78	6.02	6.02	6.02		8.56	8.56	8.56		11.13		13.49	17.12	
125	141.3	2.77	2.77	3.40	3.40			6.55	6.55	6.55		9.53	9.53	9.53		12.70		15.88	19.05	
150	168.3	2.77	2.77	3.40	3.40			7.11	7.11	7.11		10.97	10.97	10.97		14.27		18.26	21.95	
200	219.1	2.77	2.77	3.76	3.76	6.35	7.04	8.18	8.18	8.18	10.31	12.70	12.70	12.70	15.09	18.26	20.62	23.01	22.25	
250	273	3.40	3.40	4.19	4.19	6.35	7.80	9.27	9.27	9.27	12.70	15.09	12.70	12.70	18.26	21.44	25.40	28.58	25.40	
300	323.8	3.96	3.96	4.57	4.57	6.35	8.38	10.31	9.53	9.53	14.27	17.48	12.70	12.70	21.44	25.40	28.58	33.32	25.40	
350	355.6	3.96	3.96	6.35	4.78	7.92	9.53	11.13	9.53	9.53	15.09	19.05	12.70	12.70	23.83	27.79	31.75	35.71		
400	406.4	4.19	4.19	6.35	4.78	7.92	9.53	12.70	9.53	9.53	16.66	21.44	12.70	12.70	26.19	30.96	36.53	40.49		
450	457	4.19	4.19	6.35	4.78	7.92	11.13	14.27	9.53	9.53	19.05	23.83	12.70	12.70	29.36	34.93	39.67	45.24		
500	508	4.78	4.78	6.35	5.54	9.53	12.70	15.09	9.53	9.53	20.62	26.19	12.70	12.70	32.54	38.10	44.45	50.01		
550	559	4.78	4.78	6.35	5.54	9.53	12.70			9.53	22.23	28.58		12.70	34.93	41.28	47.63	53.98		
600	610	5.54	5.54	6.35	6.35	9.53	14.27	17.48	9.53	9.53	24.61	30.96	12.70	12.70	38.89	46.02	52.37	59.54		
650	660			7.92		12.70				9.53				12.70						
700	711			7.92		12.70	15.88			9.53				12.70						
750	762	6.35	6.35	7.92	7.92	12.70	15.88			9.53				12.70						
800	813			7.92		12.70	15.88	17.48		9.53				12.70						
850	864			7.92		12.70	15.88	17.48		9.53				12.70						
900	914			7.92		12.70	15.88	19.05		9.53				12.70						
950	965									9.53				12.70						
1000	1016									9.53				12.70						
1050	1067									9.53				12.70						
1100	1118									9.53				12.70						
1150	1168									9.53				12.70						
1200	1219									9.53				12.70						
DN in mm	OD	5	5s	10	10s	20	30	40	40s	Std	60	80	80s	XS	100	120	140	160	XXS	DN in mm

ASME B36. 10M-2015: Welded and Seamless Wrought Steel Pipe

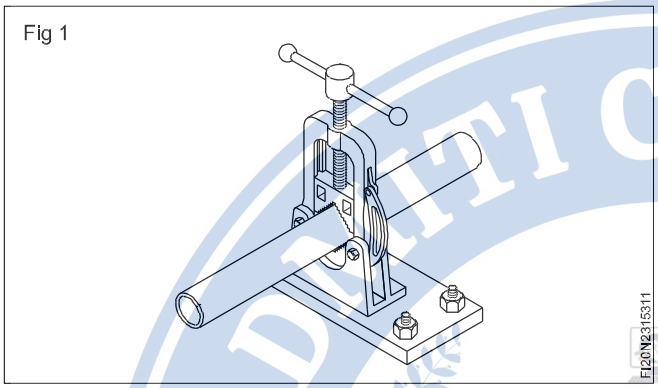
ASME B36. 19M-2004: Stainless Steel Pipe (For 5S, 10S, 40S and 80S)

Uses of pipe fitting tools

Objectives : At the end of this lesson you shall be able to
- **name the different types of pipe vices**
- **state the uses of pipe vices**
- **name the parts of a pipe cutter**
- **compare the constructional features of a pipe cutter and a multi-wheel chain pipe cutter**
- **state the care and maintenance aspects concerning pipe cutters.**

Pipe vice (Fig 1)

Fig 1

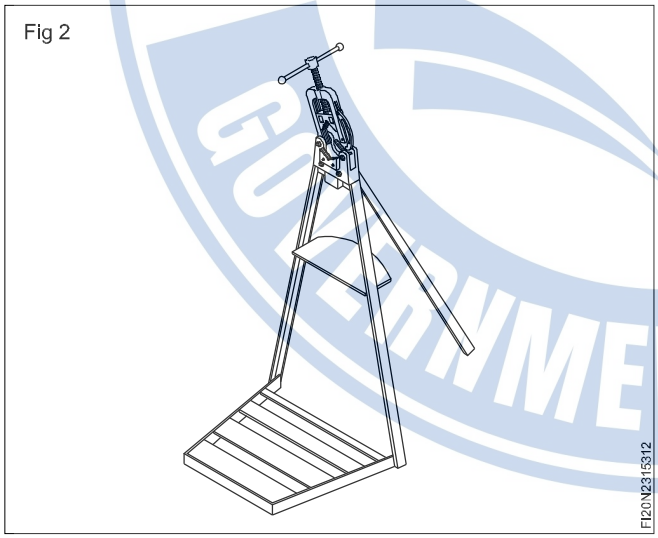


The pipe to be cut/bent/threaded must be held steadily and it must be prevented from rotating by holding it in a pipe vice.

It is a device used for holding and locating pipes. It can be used to hold pipes up to 63mm diameter.

Portable folding pipe vice (Fig 2)

Fig 2

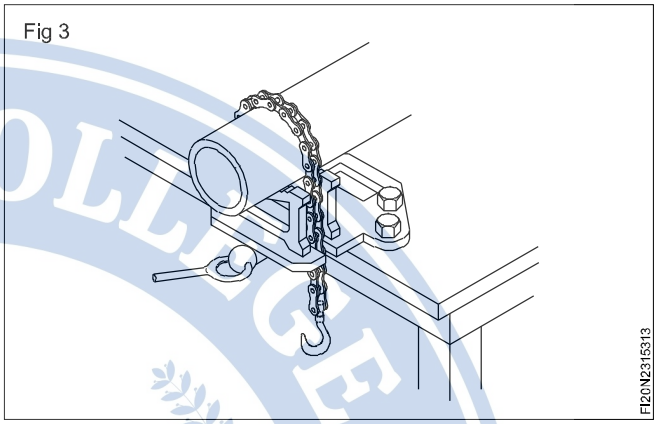


This vice can be folded and carried easily to any working place. This is similar to the quick-releasing type pipe vice.

Chain pipe vice (Fig 3)

This vice is used to hold larger diameter pipes up to 200mm diameter. The pipe is gripped by means of a chain and the serrations provided on the vice jaws.

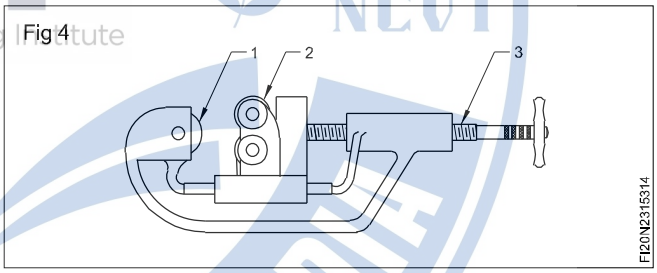
Fig 3



Pipe cutter

The wheel pipe cutter is used to make a square cut on the pipe. It consists of (1) a cutter wheel, (2) two guide rollers and (3) an adjusting screw. (Fig 4)

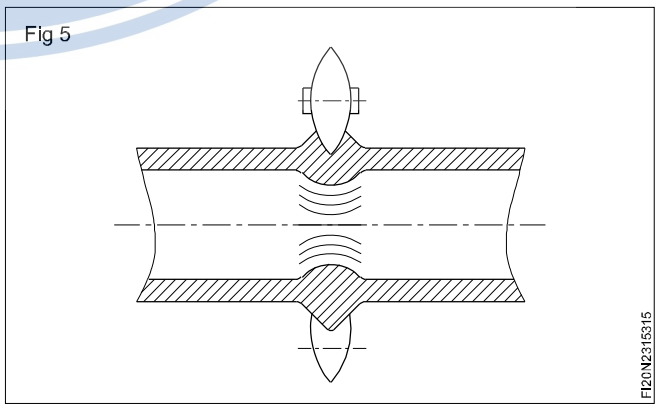
Fig 4



The cutter wheel tends to crush rather than cut the pipe. If it is blunt, it needs replacement.

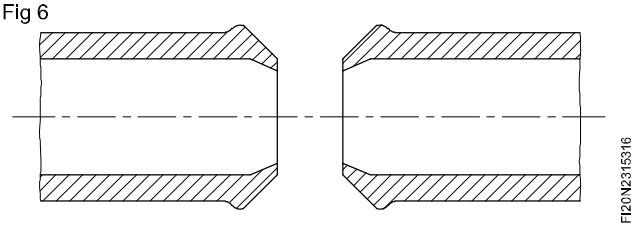
This type of pipe cutter does not remove any materials but the cutter squeezes the metal and forces it ahead of the cutter until the pipe is cut through the wall thickness. (Fig 5)

Fig 5



This type of cutting leaves a large ridge on the inside of the pipe which would obstruct the flow. (Fig 6) The pipe must be deburred or reamed by a pipe reamer.

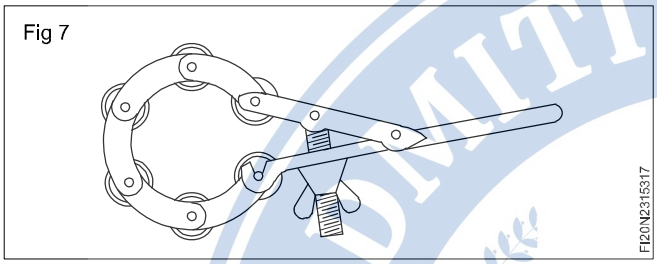
Fig 6



Multi-wheel chain pipe cutter

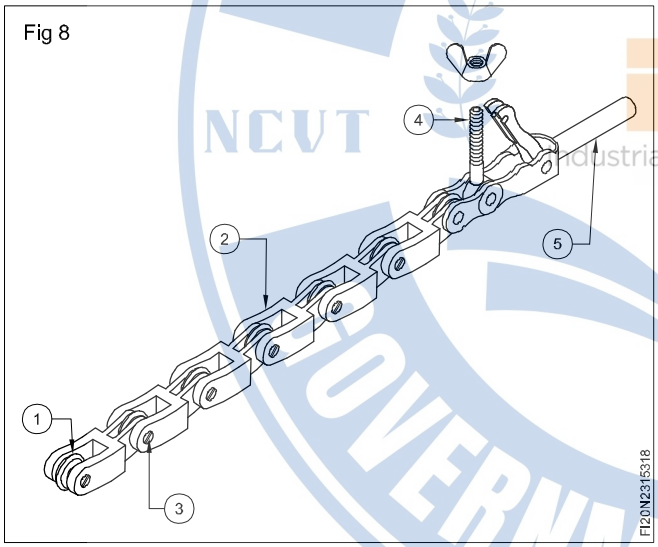
A multi-wheel chain pipe cutter can be adjusted to cut any diameter of pipe by adding on extra wheels and links. (Fig 7) The type and the size of the cutter is selected according to the diameter of pipe to be cut.

Fig 7



It consists of the following parts. (Fig 8)

Fig 8



1 Hardened cutting wheels

2 Links

3 Screw for joining links and wheels

4 Tension adjustment screw

5 Cutter handle

Care and maintenance of pipe cutters

Before using the cutter check the wheels, pins and links for any damage.

Replace the wheels, pins and links if damaged.

As the wheel revolves around the pin, any wear on the pin will cause the wheel to wobble and the cut will not run square to the pipe. This may result in a:

- chipped wheel (Fig 9)
- worn out pin. (Fig 10)

Fig 9

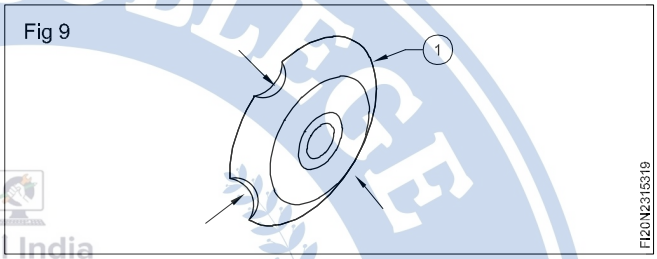
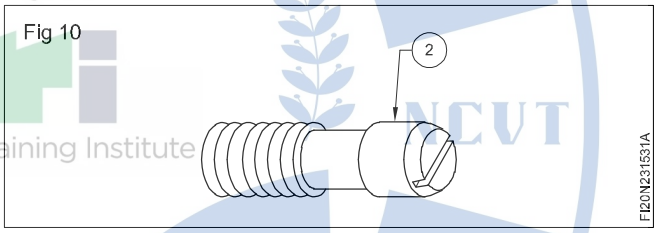


Fig 10



During pipe cutting, small flakes of metal break away and clog up the links and cutting wheels. Clean the links and wheels using a wire brush and soak the cutter in paraffin or kerosene to wash out the small particles of dirt and flakes.

After cleaning, apply a light oil on all moving parts, links and wheels for easy cutting operation and to prevent rust forming on the tool.

Store the cutter and protect the wheels from possible damage when not in use.

Plumbing tools - Pipe wrench and chain pipe wrench

Objectives : At the end of this lesson you shall be able to
- **name the elements of a pipe wrench and chain pipe wrench**
- **state the uses of pipe and chain pipe wrenches**
- **state the care and maintenance of pipe wrenches.**

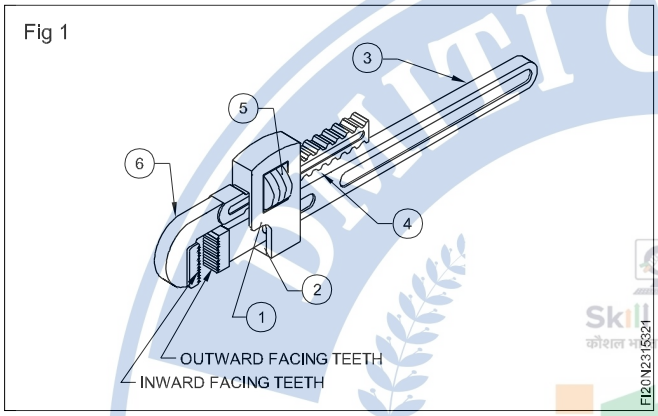
Pipe wrenches

These are adjustable pipe wrenches with different shapes. They are used for:

- holding and gripping pipes
- assembling and dismantling of pipes and fittings.

The Stillson pipe wrench (Fig 1) is designed as a heavy duty tool to withstand rough handling and heavy work. The jaws give an immediate and positive grip.

Fig 1



It may be used for all pipes with 15 mm to 50 mm diameters. Pipe wrenches are selected according to the pipe size.

Parts (Fig 1)

The Stillson pipe wrench consists of the following parts.

1 Pivot
2 Spring
3 Handle or lever
4 Spring
5 Adjusting nut
6 Moveable jaw

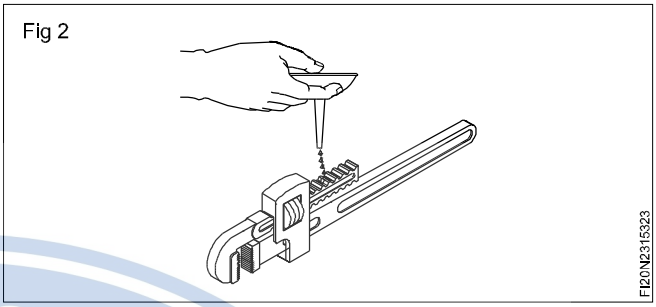
While using this pipe wrench, the jaws must be placed over the workpiece to their full depth and tightened by means of the adjusting nut.

Care and maintenance

The ability of the pipe wrench to grip the pipe is directly related to the condition of the teeth.

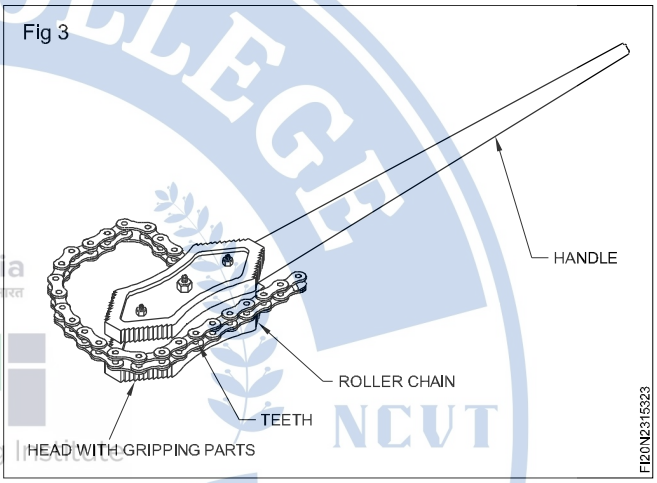
- Cleaning the teeth and sharpening them with a triangular file can restore some wrenches to useful condition.
- Oil should be applied to the adjustment nut periodically to prevent rusting. (Fig 2)

Fig 2



Chain pipe wrench (Fig 3)

Fig 3



Chain pipe wrenches are used for pipes with diameters of 50 mm to 150 mm. They may be used for gripping cylindrical or irregular objects.

Application of chain pipe wrench

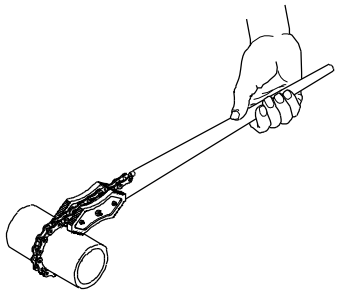
To use a chain pipe wrench, the head is placed on the pipe and the chain pulled round the circumference of the pipe. The chain is then engaged with the large teeth in the centre of the head.

The movement of the lever in the direction indicated by the arrow in the figure causes the serrated edges of the head to wedge firmly against the pipe giving a firm grip. (Fig 4)

The chain pipe wrench is a heavy gripping tool and should not be used for pipes with less than 50 mm diameter.

Apply oil or grease on the cutting edges when not in use.

Fig 4



FI20N2315324

Pipe wrenches

Objectives : At the end of this lesson you shall be able to
- **state the different types of pipe wrenches - strap wrench and foot print wrench**
- **state the uses of each type of wrench.**

Strap wrench (Fig 1)

Strap wrenches are used on finished tubular surfaces to avoid marking or damaging. These wrenches have metallic straps by which the surfaces can be tightly gripped.

Fig 1

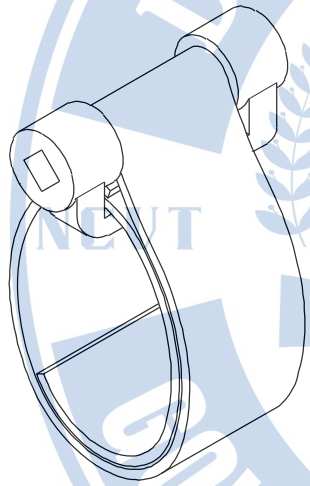


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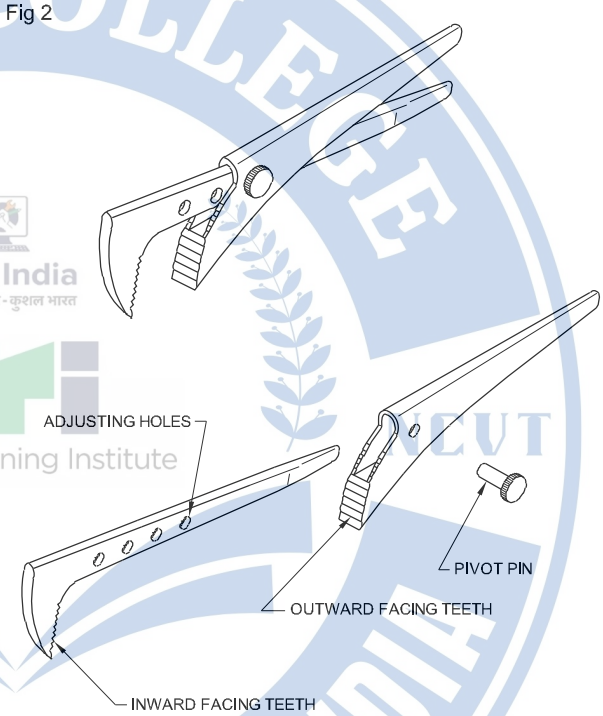
Fig 2



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Footprint wrench (Fig 2)

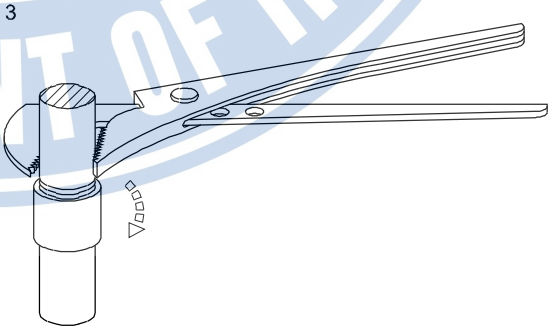
These are used for gripping and turning pipes and round stocks in confined places.

The required size is adjusted by placing the pivot pin in the different holes of the solid handle.

The grip is obtained by squeezing both the solid handles together. (Fig 3)

The selection of hole should be such that the handles are not too far as this may result in uncomfortable holding of the handles.

Fig 3



FI20N2315333

Pipe bending machines

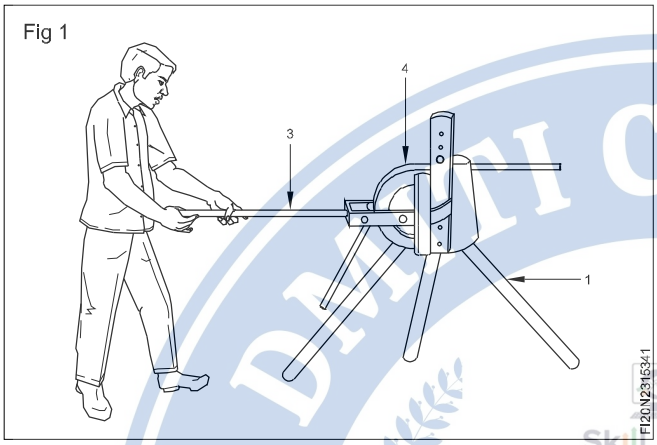
Objectives : At the end of this lesson you shall be able to
- **identify the three most common pipe benders**
- **differentiate their constructional features**
- **name the parts of bending machines**
- **state the uses of bending machines.**

There are some situations in plumbing jobs, where it is preferable to bend a pipe rather than use a pipe fitting.

The most common pipe benders are listed here.

Portable hand operated pipe bender (Fig 1)

Fig 1



The portable hand-operated pipe bender consists of the following parts

1 Tripod stand

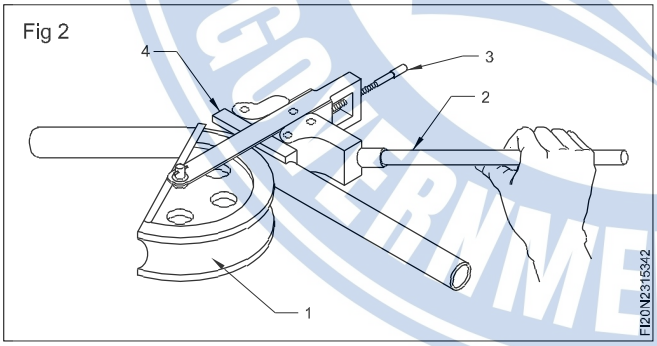
2 Pipe stop lever

3 Handle or lever

4 Inside former

Bench type hand operated pipe bender (Fig 2)

Fig 2



This consists of the following parts. It is used for bending galvanized iron and steel pipes.

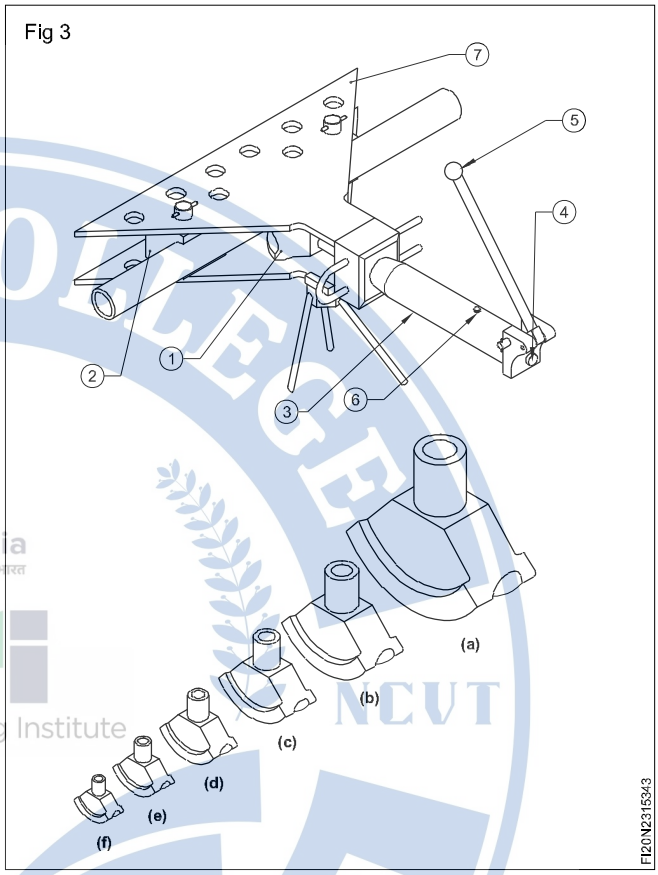
1 Inner former

2 Lever or handle

3 Adjusting screw with lock nut

4 Pipe guide

Fig 3



Hydraulic bending machine (Fig 3)

This machine can be used for bending G.I and M.S.pipes without sand filling to any direction.

It consists of the following the parts.

1 Inner former

2 Back former

3 Hydraulic ram

4 Pressure release valve

5 Operating lever

6 Bleed screw

7 Base plate

Inner formers are interchangeable and are able to bend pipes up to 75 mm diameters. (Figs 3a, b, c, d, e & f)

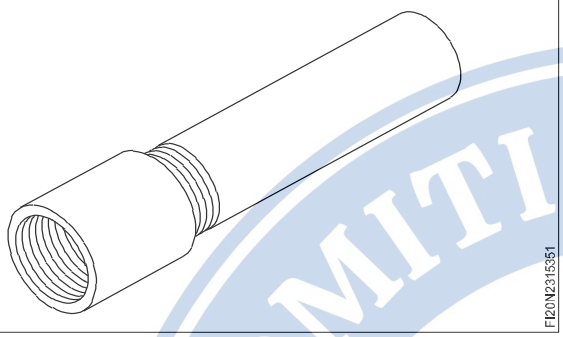
Pipes, dies, die stocks and taps

Objectives : At the end of this lesson you shall be able to
- **identify die sets, die stocks and pipe taps**
- **name the parts of a die stock**
- **state the method of checking pipe threads.**

Pipe dies

Most of the G.I. pipes that plumbers install are threaded at both ends. The pipes are available in lengths of 6 metres and it will be necessary to cut the pipe to the required length and thread it. (Fig 1)

Fig 1



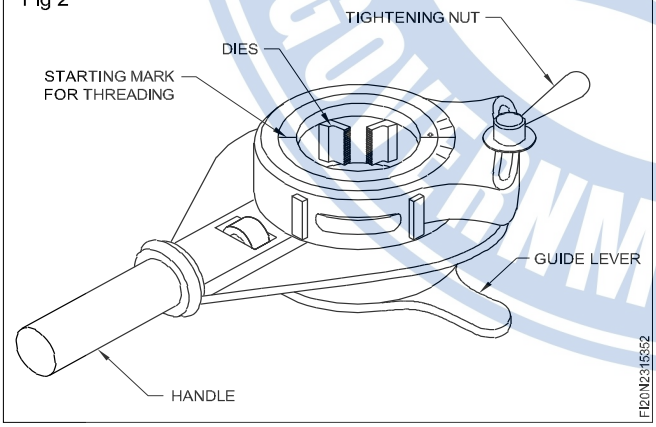
The threads on G.I. pipes and fittings for water supply systems are the standard pipe threads. External pipe threads are cut by pipe dies available in sizes from 1/4" to 4".

The dies must be sharp so that they will cut metal rather than push it around. Dies which push the metal around instead of cutting freely cause threads to break.

Die stocks

Die stocks are required to turn the dies. The ratchet type die stock is preferred because it permits the operator to use his body weight to rotate the die while standing to one side of the pipe. (Fig 2) Die stocks are adjustable.

Fig 2



Die sets

Each die is clearly marked with its type of thread and range of pipe for which it is suitable. Each die has an identification number, that is 1 to 4. Die sets are available in various sizes.

These dies must always be used and stored as a set. (Fig 3)

Pipe threads are usually cut with threading dies and can be checked by using the pipe ring gauge.(Fig 4)

Fig 3

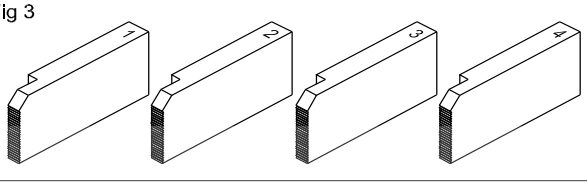
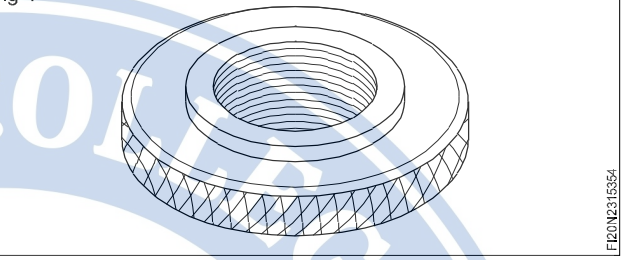


Fig 4

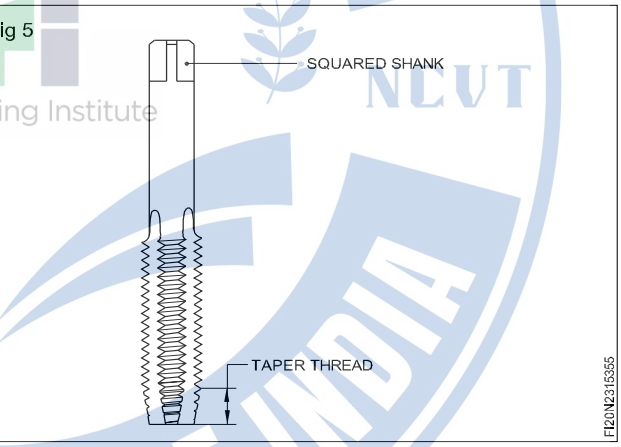


Pipe taps

Internal pipe threads are usually cut with standard taper pipe taps. (Fig 5)

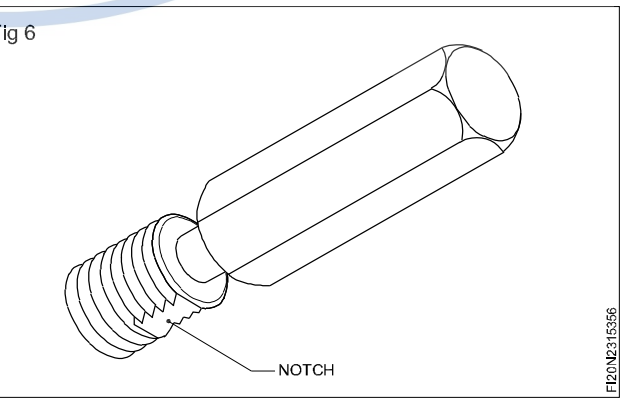
In gauging internal pipe threads, the pipe plug thread gauge

Fig 5



In gauging internal pipe threads, the pipe plug thread gauge should be screwed tight by hand into the pipe until the notch on the gauge is flush with the face. When the thread is chamferred the notch should be flushed with the bottom of the chamfer. (Fig 6)

Fig 6



Standard pipe fitting method

Objectives : At the end of this lesson you shall be able to
- **identify the standard pipe fitting**
- **dismantling the pipe fitting**
- **assemble the pipe fitting**
- **explain the rain water harvesting.**

Standard pipe fitting: 'Pipe fittings' are those fittings that may be attached to pipes in order to:

– change the direction of the pipe

– connect a branch with a main water supply pipe

– connect two or more pipes of different sizes

– close the pipe ends

Long radius elbows have a radius equal to $1^1/_2$ times the bore of the pipe.

Short radius elbows have a radius equal to the bore of the pipe.

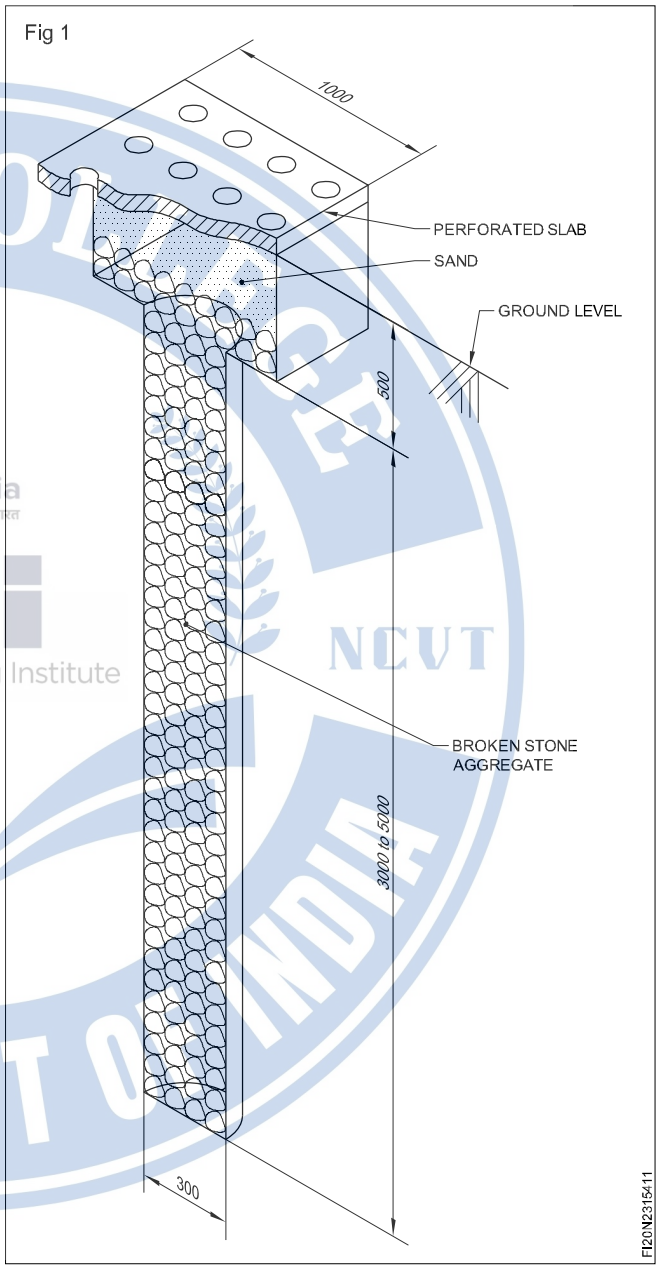
The 45^0 elbows allow pipe deviation of 45^0.

Tee branch: A tee branch helps the pipe line to branch off at 90° . The branches may be equal in diameter or there may be one reducing branch.

Dismantling: The term dismantling implies carefully separating the parts without damage and removing. This may consists of dismantling one or more parts as specified or according to the usage.

Rain water harvesting: Collection of rain water when it rains for use during non monsoon months is called rain water harvesting. When rainfall occurs in heavy during a short spell if it is not collected, it floods the area or run off to sea. It is quite possible to put all the water into soil below with little effort and less expenditure so that rain water is not lost but goes to recharge ground water table. (Fig 1)

Fig 1



Benefits of harvesting

- Ground water table raises.
- Reduce the sainity.
- Avoid flooding.

Method of rainwater harvesting

- Percolators/ soakpit
- Percolation trenches
- Service well cum reckage well method

Maximum plot area to be kept as unpaved so that the rain water can percolate to ground.

The rain water from season 1st rain should normally not to be used for percolation to recharge structures. For such water, suitable arrangement for bypass in pipe system should be introduced.

A suitable provision should be made if possible to allow rain water to percolate to ground water after passing it through settlement tank because such rain water contain silt which is deposited on sand bed reduces the percolation rate.

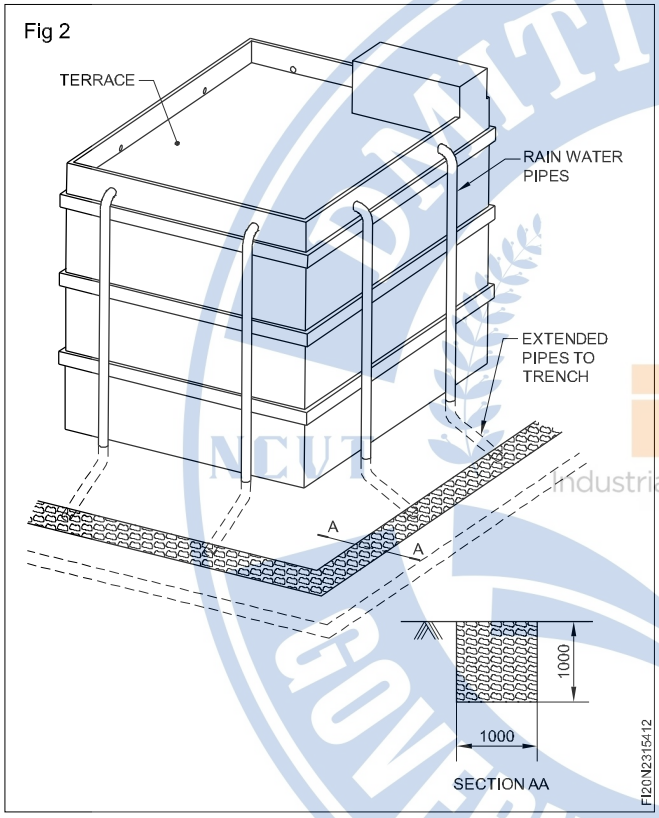
The recharge structure should be made on a plot at the places of lower levels/ elevations so that rain water may flow towards it under normal gravitation flow.

On a vast and sloppy land patch, the contour bunds preferably of mud with height varying from 15cm to 30cm should be made to store run off temporarily over the katcha land area, thus allowing more time for percolation of water to the ground water and arresting the flow of run off to the drains/ sewers.

For recharge of run off from roads suitable arrangements in the foot path by introducing some katcha area should be made.

In large residential and office complexes the drive ways, pucca path and areas should had some katcha area which may facilitate rain water to percolate to ground water. (Fig 2)

Fig 2



Ideal conditions for rain water harvesting and artificial recharge to ground water. Artificial recharge techniques are adopted where:

- Adequate space for surface storage is not available specially in urban areas.
- Water level is deep enough (more than 8m) and adequate sub- surface storage is available.
- Permeable strata is available at shallow/ moderate depth upto 10 to 15mtr.
- Where adequate quality of surface water is available for recharge to ground water.
- Ground water quality is bad and our aim is to improve it.
- Where there is possibility of intrusion of saline water especially in coastal area.
- Where the evaporation rate is very high from surface water bodies.

The decision whether to store or recharge rain water depends on the rain fall pattern of a particular region.

- If the rainfall period between two spells of the rain is short i.e. two to four months, in such situation a small domestic size water tank for storing rain water for drinking and cooking purpose can be used.
- In other regions where total annual rainfall occurs only during 3 to 4 months of monsoon and the period between two such spells is very large i.e. 7 to 8 months, so it is feasible to use rain water than for storage which means that huge volumes of storage container are required.

Repair and maintenance of household water taps

Objectives : At the end of this lesson you shall be able to
- **name the parts of a water tap**
- **state the functions of each part**
- **state the constructional features of a water tap**
- **state the common defects in water taps, their causes and remedies.**

Repair and maintenance of household water taps

There are many old and new designs of taps in the market. It is advisable to read the manufacturer's instructions when repairing and replacing washers or packing materials.

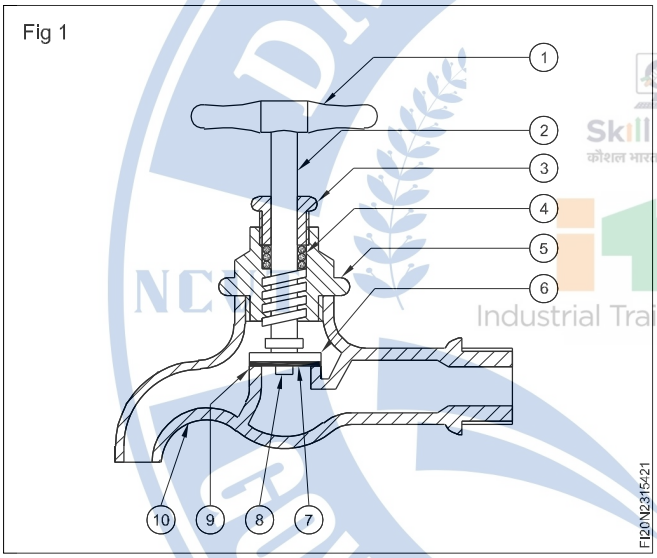
All types of screw-down water taps have two parts which must be maintained.

The packing of the stuffing box for the spindle or shaft.

The washer (rubber,leather or fibre) on the metal disk-holder or valve disk.

Fig 1 shows the inside parts of a screw-down type water tap.

Fig 1



1 Handle

2 Spindle/ shaft

3 Gland nut

4 Stuffing box/ packing

5 Bonnet

6 Metal disk-holder/ valve disk

7 Washer (rubber/ leather/ fibre)

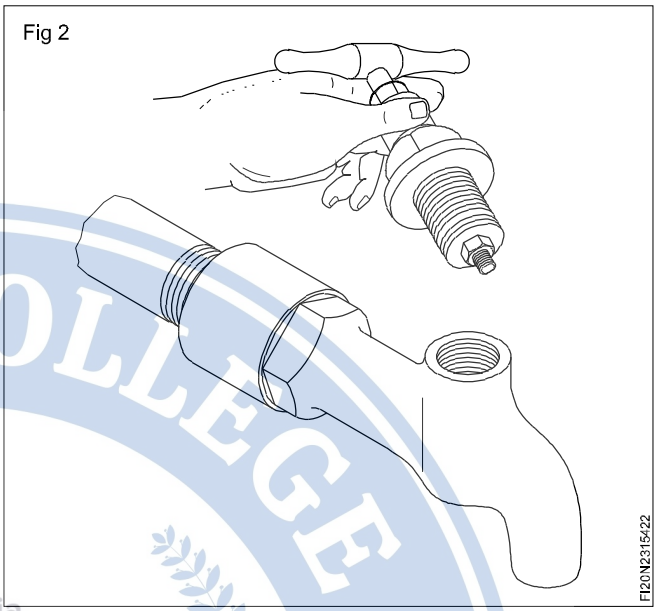
8 Retainer nut/ washer nut

9 Valve seat

10 Body of the tap.

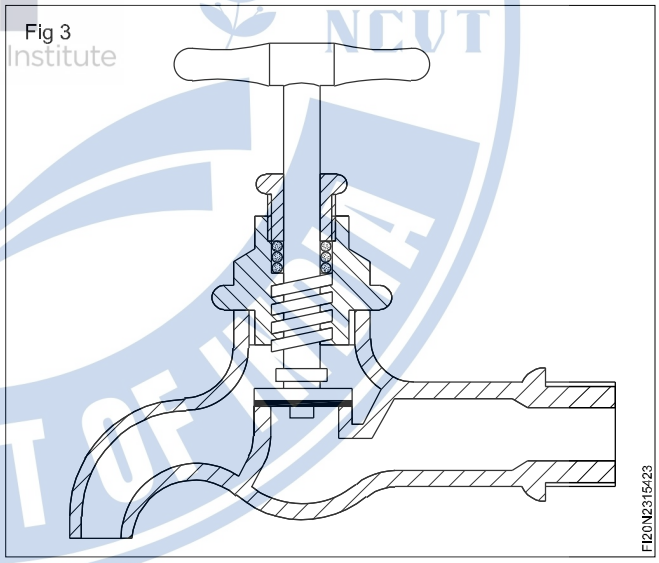
The body of the water tap contains the seat. The bonnet which holds the working parts is screwed on to the body. (Fig 2)

Fig 2



When the water tap is screwed down, the washer is squeezed between the two metal faces and this makes the joint watertight. (Fig 3)

Fig 3



The spindle has a handle at the upper end and a threaded screw at the other end.

Resting in the bottom of the spindle is the metal disk-holder containing the rubber washer which is held in position by a nut underneath.

The stuffing box at the top of the water tap has a soft graphite grease hemp packing. As the stuffing box screw is tightened, this packing is compressed, thus making a watertight joint.

Defects in the working of screw-down water taps

Defects	Causes	Remedy
Water flowing or dripping from the tap even when firmly closed.	Worn out or defective washer. Piece of grit, rust or other foreign matter on the washer. Defective seating.	Replace washer. Remove foreign matter. Reseat tap.
Water flowing from around the spindle or stuffing box screws. screw.	Defective packing in stuffing box. Screw of stuffing box not screwed down tightly.	Replace packing with greased hemp. Tighten stuffing box
Spindle continuously slipping when	Spindle thread worn out.	Replace tap.
turned and tap will not shut off. Tap hard to turn on and off.	Stuffing box packing dry. Spindle bent.	Renew packing with greased hemp of some oil into the stuffing box. Renew tap.
Loud noise in the tap when turned on.	Valve loose on the spindle. Washer loose on valve.	Renew tap. Renew the valve of the washer.

Visual Inspection

Objectives : At the end of this lesson you shall be able to
- **explain visual inspection and its need**
- **state advantages and disadvantages of visual inspection.**

Testing

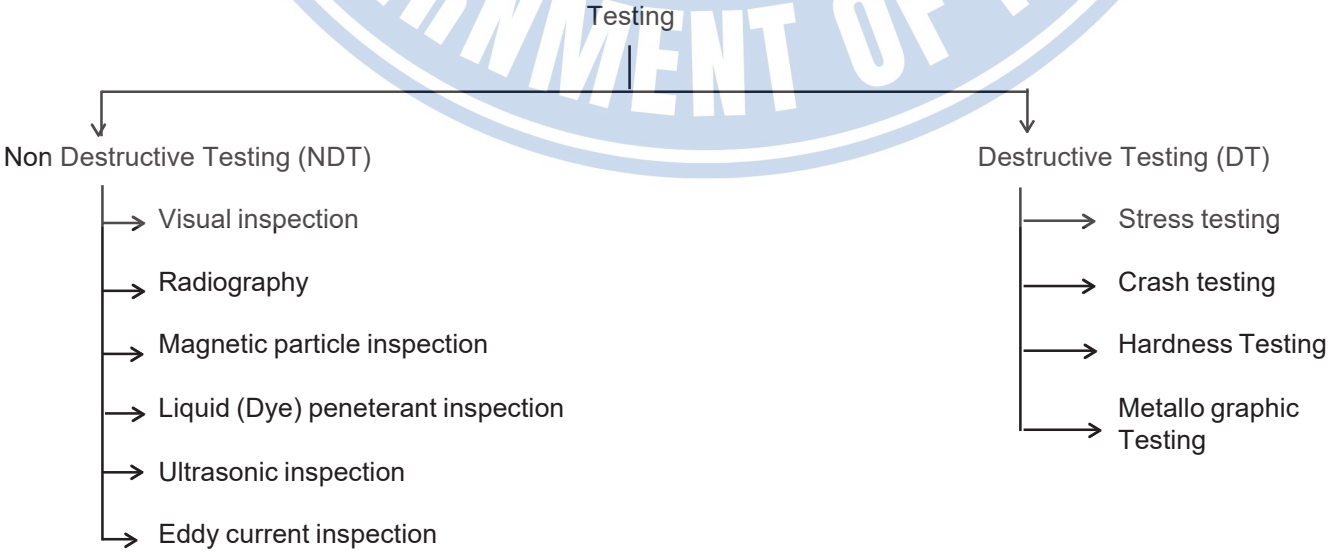
The method by which the presence, quality, genuiness of anything is determined is called testing.

Testing is trial of the quality of something

in our industry or project management testing is done for mechanical properties such as

1 Strengh
2 Ductility
3 Hardness
4 Elasticity
5 Toughness
6 Shape
7 Surface finish
8 Colour etc.

Testing is two types



Visual inspection

Visual inspection is a non destructive testing method used to evaluate the item, by just observation. Visual inspection is used to inspection is used to inspect the

- Surface condition of the item
- Alignment of mating surfaces
- Dimensions and settings as per design

Visual inspection is usually the first method employed for locating defects

Visual inspection is the outlet & most common NDT method

Mechanical and optional aids may be necessary to perform visual inspection such as

Optical AIDS	Mechanical AIDS
Magnifying glass	Vernier calliper
Microscopes	Micrometer
Fibro scopes	Depth gauges
Video cameras	Feeler gauges

Types of visual inspections

a Direct visual testing

b Remote visual testing

c Translucent visual testing

Direct visual testing

It may usually made when access is sufficient to place the eye within 600mm on the surface to be examined and angle between plane of vision & surface shall not be less than 30°.

Translucent visual inspection

It is a supplement of direct visual inspection. The method uses the help of artificial lighting which is contained in illuminator that produces directional lighting. The lighting must be so that there are no surface glares or reflections from surface under examination.

Advantages of visual inspection

1 Does not require any special equipments other than good eyesight.

2 It is very inexpensive from other methods of non destructive testing

3 It provides immediate results.

4 It requires minimum training to the inspector

5 Visual inspection is highly portable as less accessories to inspect are needed.

Disadvantages of visual inspection

1 The accuracy of the visual inspection depends largely on the experience and knowledge of the inspector

2 Only large defects, discontinuities can be detected.

3 Possibility of misinterpretation of scratches as cracks.

4 It may be limited to detection of surface dimensional defects only.

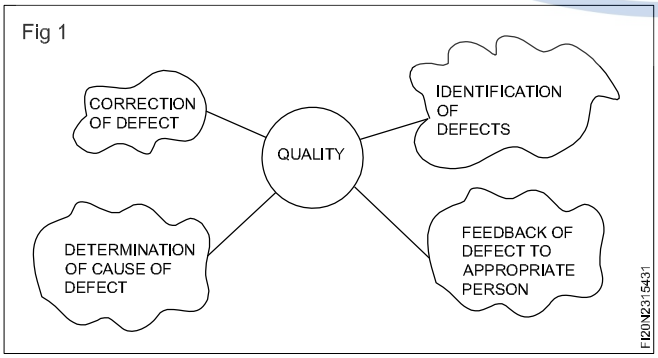
Quality control & inspection

Objectives : At the end of this lesson you shall be able to
- **define inspection, its types**
- **define qualiy and its characteristics**
- **explain quality control and its need**
- **define SPC (statistical process control).**

Inspection and quality control (Fig 1)

An inspection is most generally an organised examination or formal evaluation exercise. which may include measurement, testing, gauging, comparision of materials or items.

Fig 1



An inspection determines if the material or item is in proper quantity and quality

Inspection can be done

1 Individually

2 Lot by lot

Inspection is generally divided into three categories

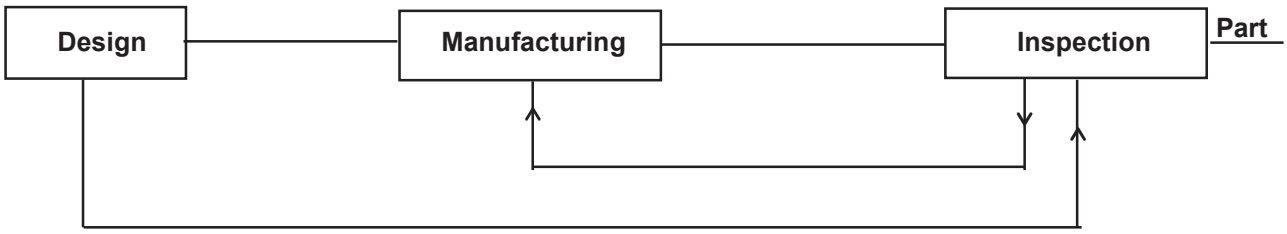
1 Recieving inspection

2 Inprocess inspection

3 Final inspection/ product quality control

Inspection:

Inspection can be termed as the watch dog of manufacturing process



Inspection process is mostly manual

The role of inspection is to verify and validate the VARIANCE DATA and it does not involve separating the good from bad.

PDCA cycle model

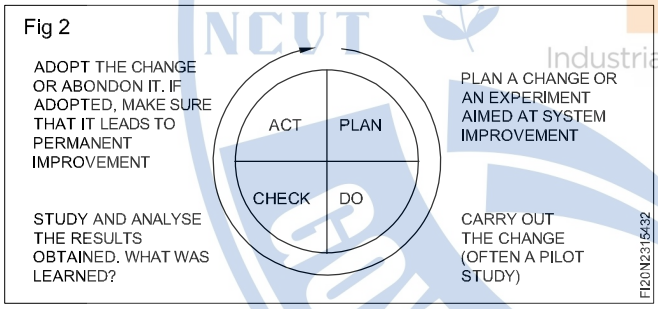
PDCA cycle model is also known as DEMING CYCLE/ STEWHART CYCLE, CONTROL CYCLE.

This model is implement to improve the quality and effectiveness of process with in product life cycle management and project management. (Fig 2)

It contains of 4 steps

- Plan
- DO
- Check
- Act

Fig 2



Objective of inspection

Acess conformity with design specifications

Improve product quantity and reliability

Elements of inspection process

- Interpretation of quality requirements
- Sampling of the material to be inspected.
- Examination of the material from the sample to be inspected.
- Decision and action against the inspection of sample weather to pass or reject.

Quality

- Quality is in conformance to the requirements or specifications
- Quality is fitness for use

The quality of product or service is the fitness of that product or service for meeting or exceeding its intended use as required by the customer.

- Quality of a product or a service defined by one or more elements. These elements are known as quality characteristics
- Quality characteristics can be classified into these categories

1 Structural charcteristics (Length of part, weight of can, strength of beam, viscosity of fluid, etc)

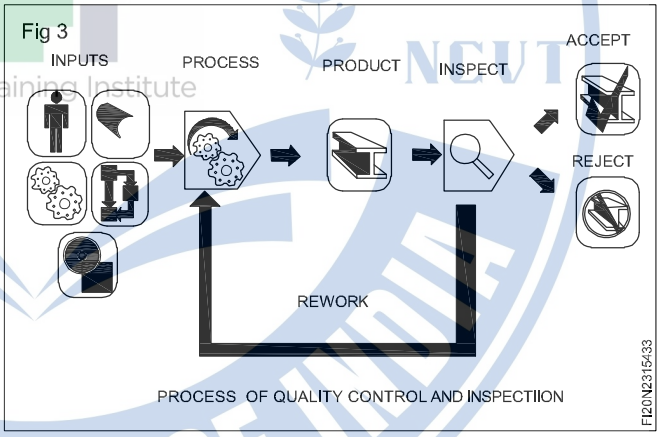
2 Sensory characteristics (taste of good food, beauty of model, smell of fragnance, etc.)

3 Time oriented charcteristics(warrenty, reliability, maintainablity etc.)

4 Ethical charcteristics (Honesty, courtsey, friendliness, etc).

Quality control (Fig 3)

Fig 3



Quality control is a short process by which entities review the quality of all factors involved in production

ISO 9000 design quality control (QC) as:

" A part of quality management focussed on fulfilling quality requirements"

This approach emphasisies on three aspects.

1 Elements such as controls, job management, degined well managed process, performance and integrety. Criteria, identification of records.

2 Competence such as knowledge, skills, experience & qualifications

3 Soft elements such as personnel, integrity, confidence organizational culture, motivation, team spirit & quality relationship.