

Unit 204: Common plumbing processes

Outcome 1

**Procedures for measuring and
bending plumbing tubes**

Measuring and bending tubes

The units of measurement plumbers use are:

Millimetres = mm
(Centimetres = cm)
Metres = m

10mm = 1cm
1,000mm = 1m



Measuring and bending tubes

Rules and tape measures



Steel rule: for accurate pipework measurement and bending



Tape measure: pipework installation or measuring large pipe lengths



Site tape: site measurements or room measurements

Laser distance metre: quick room measurements



Measuring and bending tubes

Material 1

Copper

Measuring and bending tubes

Microbore
hand bender:
R220 soft
coiled copper
6,8,10mm



Scissor type
bender:
R250 half hard
copper 15 and
22mm



Stand bender:
R250 half hard
copper 28 and
32mm



Measuring and bending tubes

Electric tube benders, either hand or stand mounted



Internal and external springs



Measuring and bending tubes

Grades of copper

Sometimes need protection against soils or atmospheres.

Old	New	Type	Diameters (mm)
BS2871	BSEN1057		
Table W	R220	Coiled microbore (heating)	6, 8, 10
Table X	R250	Half hard straight lengths	15-54 domestic 6, 3, 2, 1m lengths
Table Y	R220	Annealed coils for underground	15-22 underground 25m lengths
Table Z	(R290)	Hard thin walled	Not commonly available now

	Water (wholesome)
	Water (other)
	Gas (natural)
	Central heating
	Chrome decorative

Measuring and bending tubes

Minibore/microbore: 6, 8, 10mm

Small bore: 12, 15, 22mm

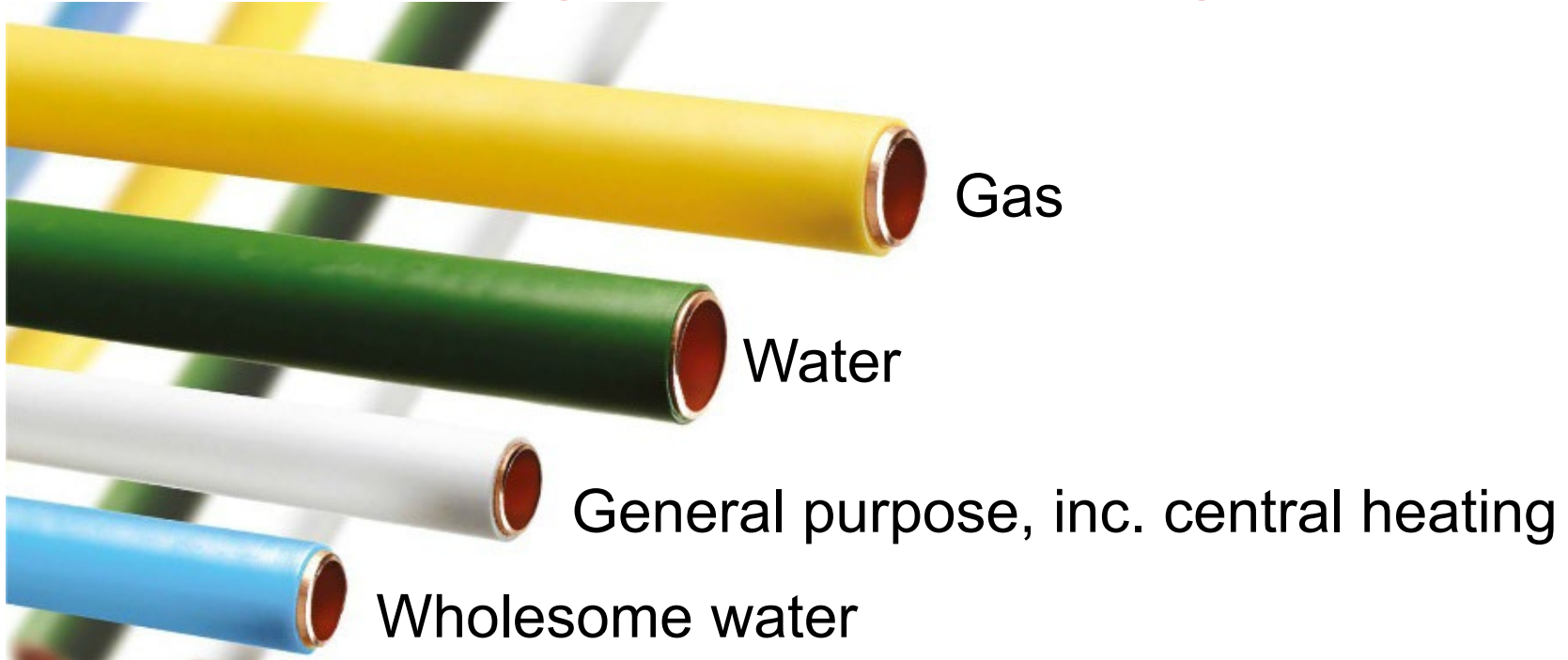
Large bore: 28mm and larger

When copper is purchased, the half hard copper R250 can be bought in 3 or 6m straight lengths. (Table X).

Soft, minibore R220 copper is bought in coils of 10 or 50m.

Protecting copper pipe is important in vulnerable areas – plastic coated, denso tape etc. Copper is most vulnerable when laid in concrete flooring and when it emerges from the floor.

Measuring and bending tubes



Main purpose of coating the pipes is for protection and identification.

The main purpose of chrome-coated copper pipe is for the finish.

Measuring and bending tubes

Bending copper tube

Soft coils (R220 Table Y) and half hard (R250 Table X) copper tube can be bent by using:

- Bending springs (internal or external)
- Hand bender (micro and small bore)
- Machine floor-standing bender (max 42mm)

Advantages of bending pipe, rather than using a fitting:

- Less frictional resistance
- Costs less
- Sections can be prefabricated in one go

Measuring and bending tubes

Bending springs

Internal and external bending springs are not used much today. They are occasionally used by plumbers when trying to bend an existing piece of pipe without creasing it.

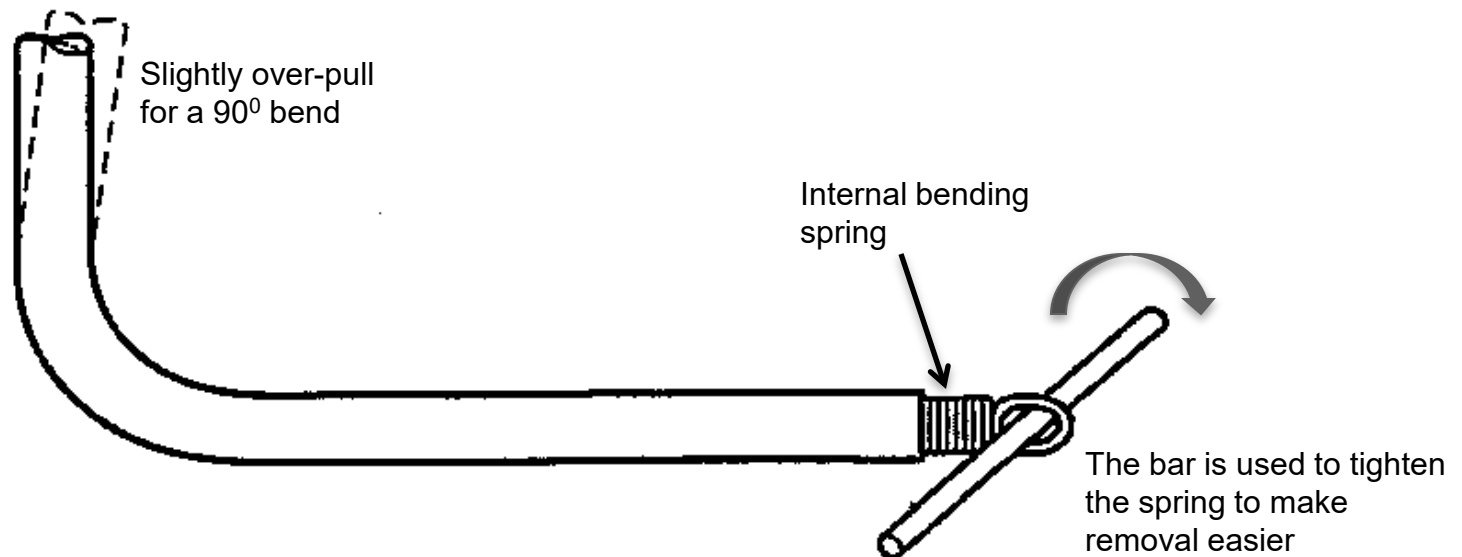


Measuring and bending tubes

Bending springs

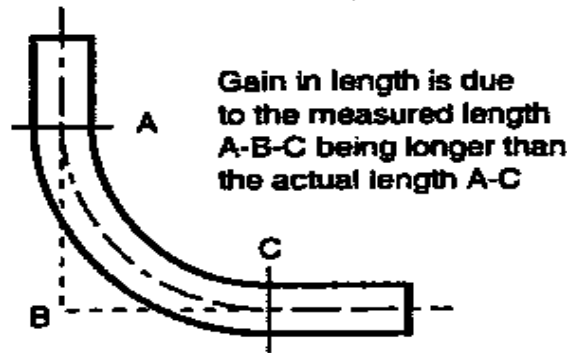
The spring is tightened by twisting a bar through the end of the spring.

The spring bend is normally over-pulled and then eased back to 90° to make spring withdrawal easier.



Measuring and bending tubes

All bends appear to gain material on one side and compress material on the other.



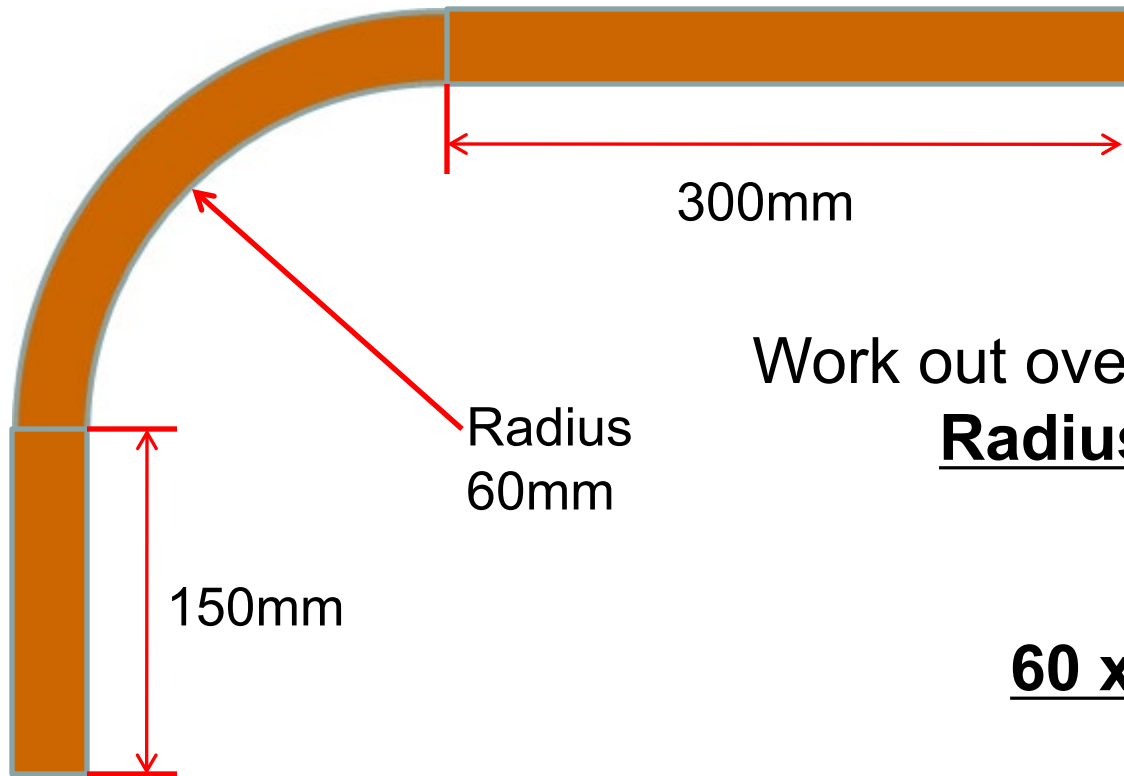
It is possible to accurately work out the length of pipe to be bent, in relation to fixed points, by finding out the length of pipe the bend actually occupies.

The radius centre line is normally 4 x the diameter of the pipe (4D).

$$\underline{\text{Radius} \times 2 \times 3.14}$$

Measuring and bending tubes

Example



Work out overall length of pipe

$$\frac{\text{Radius} \times 2 \times 3.14}{4}$$

4

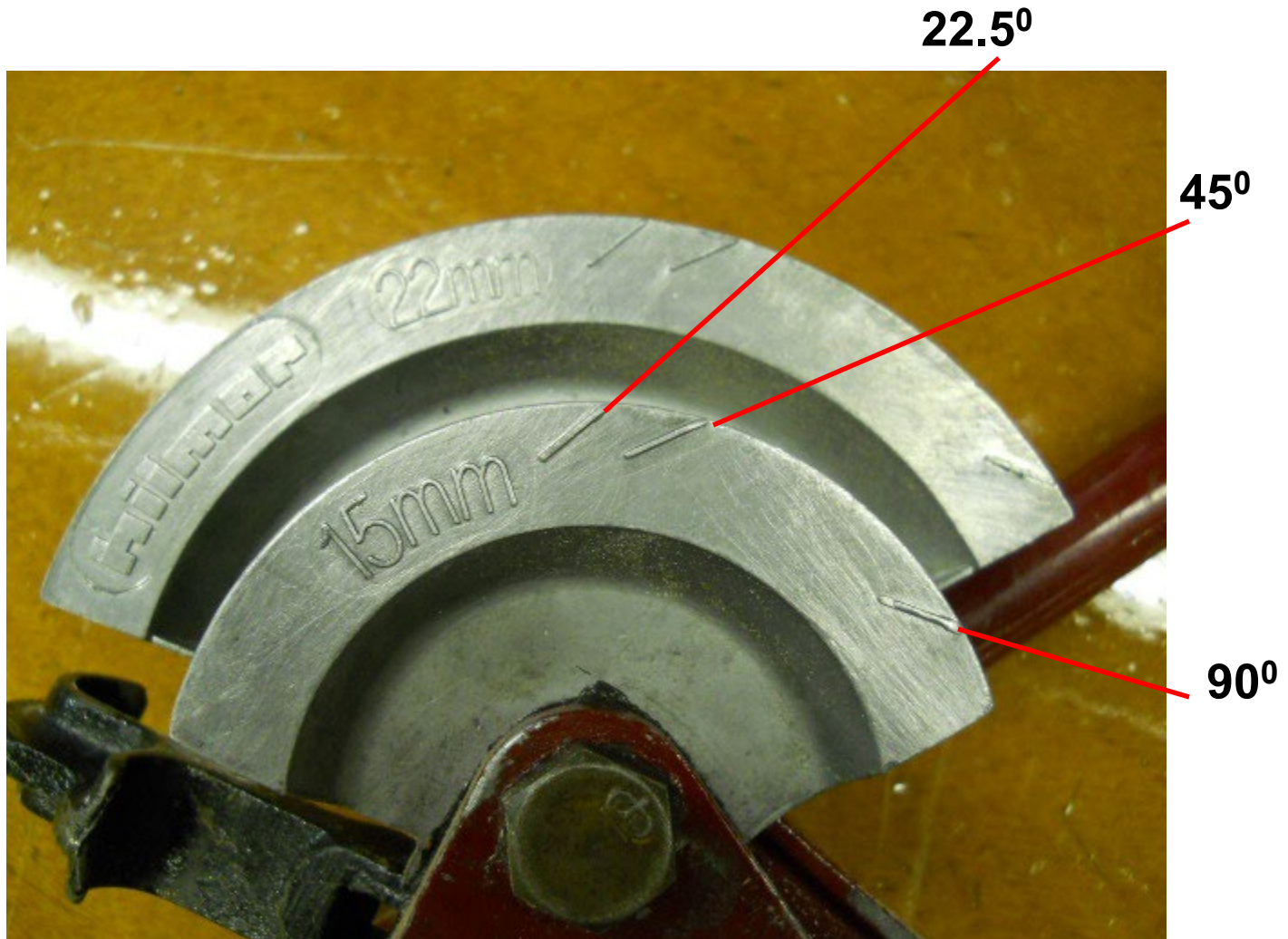
$$\frac{60 \times 2 \times 3.14}{4}$$

4

$$= 94.2\text{mm}$$

$$94 + 300 + 150 = 544\text{mm}$$

Measuring and bending tubes



Measuring and bending tubes

Golden rules

Where possible, work from a **fixed point** to avoid cutting to length.

The fixed, measured point always goes away from you when in the bender – **waste to waist**.

Always mark the throat of the bend.

Measuring and bending tubes

Golden rules

Select the measuring method:

- Back to back
- Centre to centre
- Back to inside
- Inside to back

Measure twice, cut once or bend once.

If a section needs two or three bends, ensure the first bend is correctly positioned in the bender before pulling the second.

Measuring and bending tubes

Tools



Scissor type
bender and
slips



Combination
square

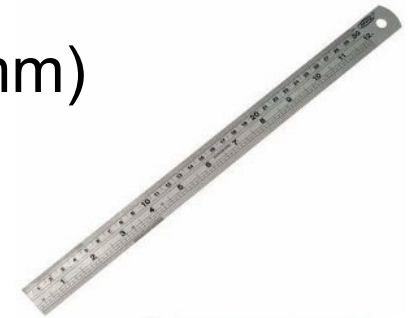


Senior/junior
hacksaw 32tpi

Engineers
square



Steel rule (mm)



Pencil



Measuring and bending tubes

Common bends

- 90⁰, 45⁰
- Offset
- Back to back
- Half pass over (kick over)
- Full pass over

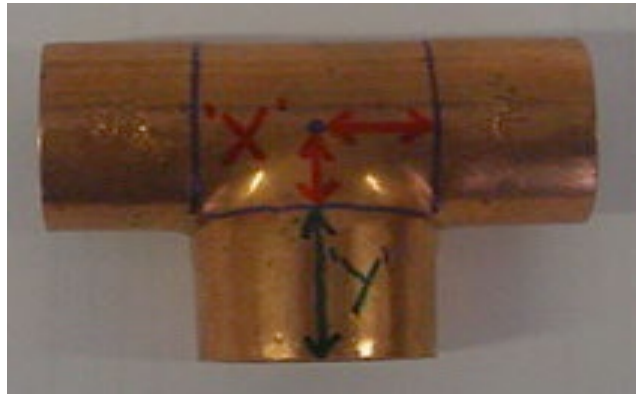
Measuring and bending tubes

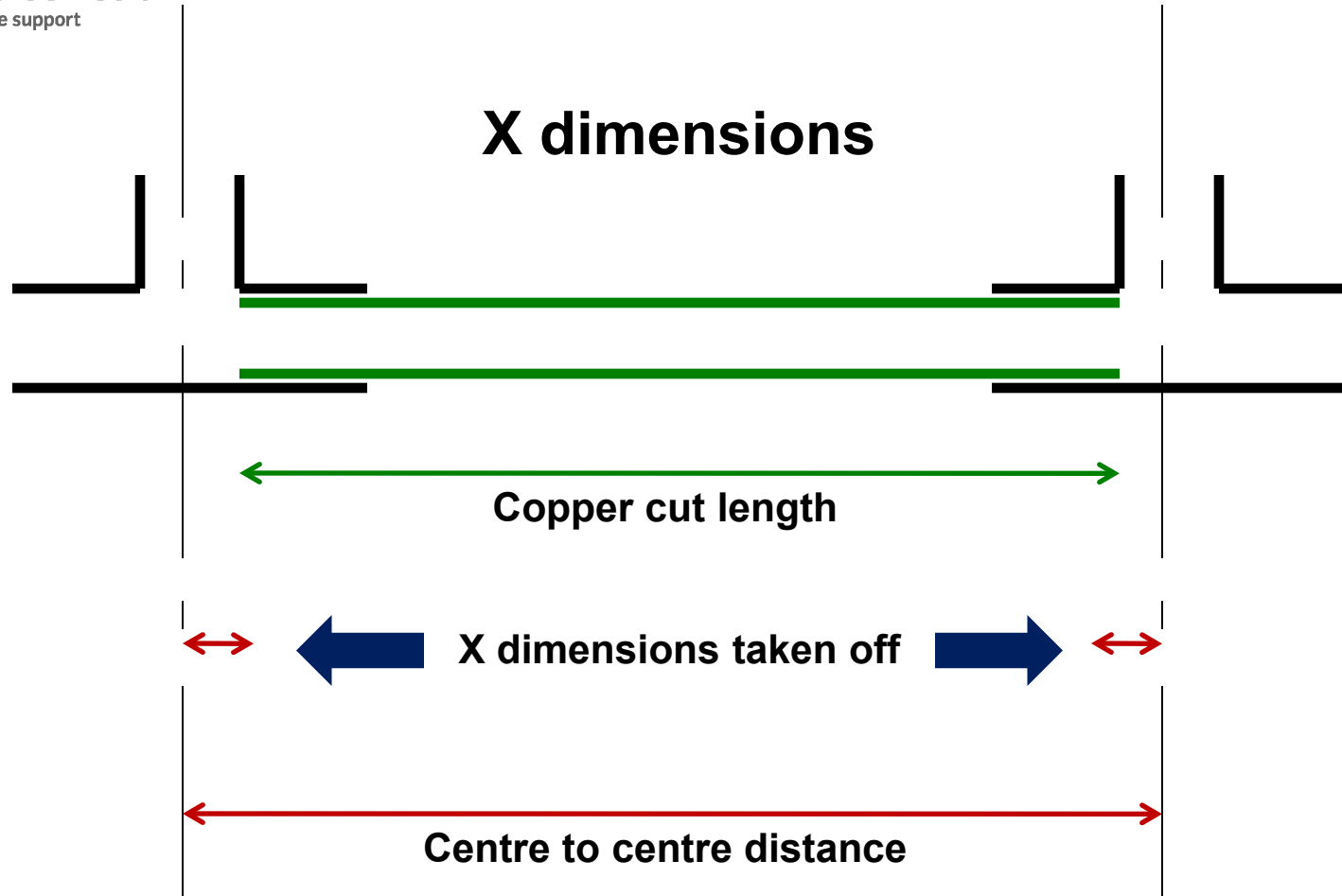
X dimensions

This is a term used by Yorkshire manufacturers to work out how much copper tube is required, providing you know the centre-to-centre measurement.

X dimension = centre of fitting to the engaged length

If you know the type of fittings being used, along with the centre-to-centre distance, taking off 2 x dimensions will give the pipe length.





Measuring and bending tubes

Material 2

Low carbon steel

Measuring and bending tubes

Hydraulic bender



Measuring and bending tubes

Grades

Grade	Colour	Use
Heavy	Red	Steam and fire systems
Medium	Blue	Heating and oil lines
Light	Brown	Gas

When LCS is secured in position, munson rings are commonly used.



Measuring and bending tubes

LCS is made from 99.85% iron and 0.15% carbon.

Manufactured to BS1387 1984 and supplied in:

- Self colour
- Painted black
- Red Oxide paint
- Galvanised

All grades have the same outside diameter – the heavier the grade the smaller the bore.

Diameters are imperial and lengths are metric.

Can be jointed by threading, welding and special compression joints.

Threads are tapered and parallel (BSPT) and are sealed by PTFE, red paste or hemp and paste.

Measuring and bending tubes

Protection

Galvanized

(Inside and outside)

Denso tape

(Wrapped outside only)

Paint

(Outside only)

Chemical

(Inside only)

Measuring and bending tubes



Measuring and bending tubes

Golden rules

When bending, it stretches in **both** directions.

LCS stretches by its nominal bore:

$$\frac{1}{2}\text{in} = 15\text{mm} \quad \frac{3}{4}\text{in} = 20\text{mm}$$

- Level the hydraulic bender when doing multiple bends
- Set stops in correct position
- Use correct size on ram head
- Allow for spring back after pulling a bend – one full pump

Measuring and bending tubes

Tools



Scissor type
bender and
slips



Combination
square

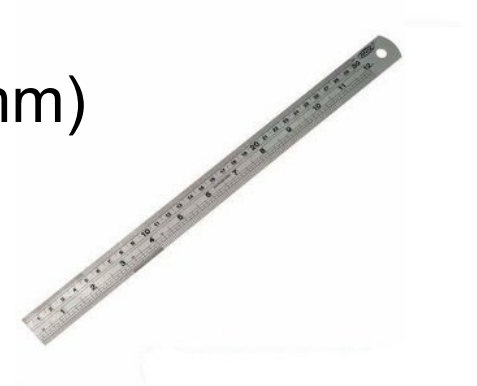


Senior/junior
hacksaw 32tpi

Engineers
square



Steel rule (mm)



Pencil



Measuring and bending tubes

Common bends

- 90⁰, 45⁰
- Off set
- Half pass over (kick over)

Nowadays, commercial LCS is commonly fabricated, using fittings rather than bending.

Measuring and bending tubes

Z dimensions

These are identical to X dimensions in copper, but they are referred to Z dimensions in LCS.

All Z dimensions are referenced from manufacturers' catalogues.

- George Fischer
- Crane

Measuring and bending tubes

Z dimensions



130

Tee, reducing or increasing on the branch, ISO/EN B1

EN		Dim. (1-2) [inch]	Code	a [mm]	b [mm]	z1 [mm]	z2 [mm]
•	B	$\frac{1}{2} - \frac{1}{4}$	770 130 115	23	23	13	13
•	G	$\frac{1}{2} - \frac{1}{4}$	770 130 215	23	23	13	13
•	B	$\frac{1}{2} - \frac{1}{2}$	770 130 116	26	26	16	13
•	G	$\frac{1}{2} - \frac{1}{2}$	770 130 216	26	26	16	13
•	B	$\frac{1}{2} - \frac{3}{4}$	770 130 117	24	24	11	14
•	G	$\frac{1}{2} - \frac{3}{4}$	770 130 217	24	24	11	14
•	B	$\frac{1}{2} - \frac{1}{2}$	770 130 119	26	26	13	16
•	G	$\frac{1}{2} - \frac{1}{2}$	770 130 219	26	26	13	16
•	B	$\frac{1}{2} - \frac{3}{4}$	770 130 121	31	30	18	15
•	G	$\frac{1}{2} - \frac{3}{4}$	770 130 221	31	30	18	15
•	B	$\frac{1}{2} - 1$	770 130 130	34	32	21	15
•	G	$\frac{1}{2} - 1$	770 130 230	34	32	21	15
•	B	$\frac{3}{4} - \frac{1}{4}$	770 130 122	26	27	11	17
•	G	$\frac{3}{4} - \frac{1}{4}$	770 130 222	26	27	11	17
•	B	$\frac{3}{4} - \frac{3}{8}$	770 130 124	28	28	13	18
•	G	$\frac{3}{4} - \frac{3}{8}$	770 130 224	28	28	13	18
•	B	$\frac{3}{4} - \frac{1}{2}$	770 130 127	30	31	15	18
•	G	$\frac{3}{4} - \frac{1}{2}$	770 130 227	30	31	15	18
•	B	$\frac{3}{4} - 1$	770 130 132	36	35	21	18
•	G	$\frac{3}{4} - 1$	770 130 232	36	35	21	18
•	B	$1 - \frac{1}{4}$	770 130 133	28	31	11	21
•	G	$1 - \frac{1}{4}$	770 130 233	28	31	11	21
•	B	$1 - \frac{3}{8}$	770 130 134	30	32	13	22
•	G	$1 - \frac{3}{8}$	770 130 234	30	32	13	22
•	B	$1 - \frac{1}{2}$	770 130 137	32	34	15	21
•	G	$1 - \frac{1}{2}$	770 130 237	32	34	15	21
•	B	$1 - \frac{3}{4}$	770 130 140	35	36	18	21
•	G	$1 - \frac{3}{4}$	770 130 240	35	36	18	21
•	B	$1 - 1 \frac{1}{4}$	770 130 145	42	40	25	21
•	G	$1 - 1 \frac{1}{4}$	770 130 245	42	40	25	21

Measuring and bending tubes

Threading

A common site method used to thread LCS is by using a free-standing threading machine. Training is required before using this type of machine.

The LCS is placed into a chuck which grips the tube. The chuck rotates, allowing the operator to either cut or thread the LCS.



Measuring and bending tubes

Threading

Another method of threading LCS is by using a handheld threader. A clamp is secured onto the LCS.

The handheld threader rotates the dies, allowing the operator to thread the tube, as the threader moves down the clamp arm.



Measuring and bending tubes

Threading

A final method is by using a handheld die. This is a manual operation using a ratchet head and a lever arm to thread the LCS.



Measuring and bending tubes

Threading

With any of the threading methods, a set of four hardened dies with the appropriate thread is used:

1/4in BSP, 1/2in BSP, 3/4in BSP, 1in BSP and 1 1/4in BSP etc.

When cutting the threads, it is important to lubricate the cutting action with oil. Cutting produces burrs that are sharp and care needs to be taken when cleaning the heads.

If any cutting of LSC tube is required, the first job should be to file off any burrs: de-burr.

Measuring and bending tubes

Material 3

Plastic

Measuring and bending tubes

Tools



Hacksaw
32tpi

Ratchet style
cutter for
waste pipe



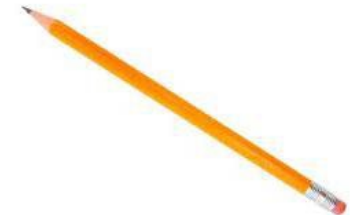
Medium file set
to remove burrs

Steel rule



Pipe cutter for
polybutylene

Pencil



Measuring and bending tubes

Grades

There are many different plastic that plumbers use on a daily basis. They can be used for cold water, hot water, central heating, guttering, above ground drainage and below ground drainage.

Thermoplastic

Made from polymer resin. Can be heated and re-shaped, but when frozen becomes brittle (guttering). These plastics are recyclable.

There are many types which are suitable for different situations.

Measuring and bending tubes

Grades

PVCu	Unplasticised polyvinyl chloride Cold water Soil pipes Waste and overflow pipes Guttering and downpipe	Not suitable for hot water Solvent weld Push fit
MDPE	Medium density polyethylene Underground mains (blue) CWSC	Degrades in sunlight Fusion welded Push fit Compression
HDPE	High density polyethylene Underground mains (black)	Degrades in sunlight Fusion welded Push fit Compression

Measuring and bending tubes

Grades

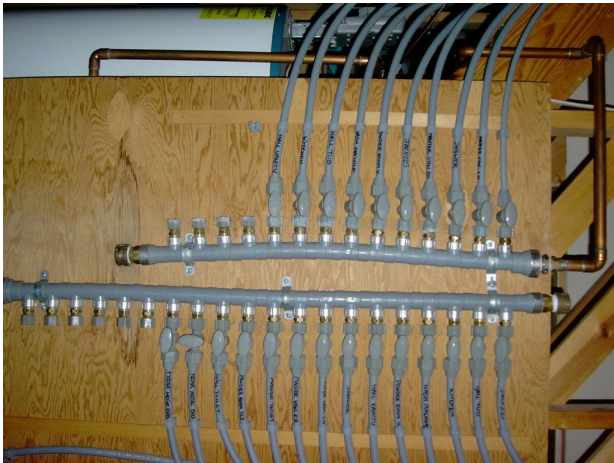
Polypropylene	Waste pipes Overflow CWSC	Degrades in direct sunlight Feels slightly greasy to touch Not solvent welded
Polybutylene	Cold water Hot water Central heating	Push fit Compression Not solvent welded
ABS Acrylonitrile Butadiene Styrene	Commercial water Waste Overflow	Solvent welded Degrades in sunlight

Measuring and bending tubes

Bending

Plastic pipe is usually fabricated using fittings on waste pipes.

Polybutylene (hot, cold and central heating) is flexible and can be laid around corners, if supported.



Measuring and bending tubes

Golden rules

- Allow for expansion and contraction
- Always remove burrs after cutting
- Extra support and clipping required if hot water conveyed
- Ventilation required if solvent welding
- Sunlight degradation due to UV (yellowing on uPVC; pressure pipe disintegrates; soil pipe above (PVCu – grey) and below ground (PVC brown)
- Support sleeves (inserts) for pressure pipe
- Barrier pipe for conveying wholesome water



Measuring and bending tubes

X dimensions

On plastic, the X dimensions are manually measured and worked out.








Some manufacturers now state the X dimensions in their catalogues.

Measuring and bending tubes

Soil and waste plastic

PVCu plastic is used for push fit and solvent welded soil, waste pipes, overflow pipes, guttering and below ground drainage. 110mm, 50mm, 40mm, 32mm and 21.5mm.

90° bends	45° bends	Junctions	Sockets
			
Boss pipes	Strap boss	Access pipes	Boss pipe adapters
			
Cages	Pile clips	Drain adapters	Waste pipe manifolds
			

90° knuckle bends	90° bends	45° bends	Tees
			
Sockets	Reducers	Pipe clips	
			

Measuring and bending tubes

Soil and waste plastic

Modified uPVC is used for solvent welded waste and overflow pipes. It is much more durable than PVCu and performs better than other plastics, especially at high temperatures. 50mm, 40mm, 32mm and 21.5mm.

ABS is used for soil and waste pipes because of its toughness. It degrades when exposed to UV light.

Measuring and bending tubes

Soil and waste plastic

Polyethylene (PE) is used a lot in the plumbing trade.

Medium density polyethylene (MDPE), is hardwearing and is used for water mains (blue) and gas mains (yellow). It degrades when exposed to UV light. 20mm-63mm in coils. The most common is 25mm cold water service pipe.

High density polyethylene (HDPE), was used some years ago and is still found in properties but it was superseded by MDPE.