Plumbing Code of Practice

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Copper Tubing Africa

Copper Tubing Africa

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COMPANY BACKGROUND

Copper Tubing Africa (Pty) Ltd dates back to 1953 when copper tubing was produced from rolled strip. The copper was blanked and deep-drawn to form tubes from which solder lugs were manufactured.

Today, CTA utilises the most advanced techniques of continuous casting using only high-grade virgin copper to produce drawing billets. Tried and tested methods of cold drawing produces the end product.

The end product is destined not only for the domestic plumbing, refrigeration and medical industry, but is also used extensively in the electrical and industrial markets.

CTA is registered as an *ISO 9001* compliant company with the South African Bureau of Standards. In addition to this the company also holds the SABS mark of approval on its Domestic Plumbing Tubing and Medical Grade range.

"A business succeeds not because it is big or because it has been long established, but because there are men in it who live it, sleep it, dream it, and build great future plans for it."

Author unknown

Copper Tubing Africa

MARKETING AND SALES

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- The Copper Development Association
- SANS 10252-1: 2012

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ANTIMICROBIAL COPPER

The anti-microbial properties of copper have been recognised for centuries. Copper and its alloys can kill harmful bacteria. Laboratory tests have demonstrated that copper is effective against a number of disease-causing bacteria. 99% of MRSA, the hospital acquired "superbug", is killed within minutes when exposed to copper.

Independent studies conducted at the Stellenbosch University, as well as further research undertaken by the Council for Scientific and Industrial research (CSIR) have confirmed these anti-microbial properties. Water systems using copper are decidedly enhanced by this inherent property.

Archaeologists have recovered a portion of a water plumbing system from the pyramid of Cheops in Egypt. The copper tubing used was found in serviceable condition after more than 5000 years!

HEALTH AND DISEASE CONTROL

Copper is biostatic and non-permeable. There is no penetration of liquids and fuels through its walls. Slime build-up does not occur. Depending on the water quality in specific geographical areas, there may be a chemical reaction which will form a green layer on the inside of the tube. This is called "Uniform Superficial Corrosion". The water will still be in contact with the copper and the biostatic properties will still be effective.

* Copper is an important trace element. The recommended daily allowance (RDA) should be 2 – 3 mg.

* Copper is completely UV resistant and will not perish or become brittle over time due to constant sun exposure.

Note: *Do not confuse the build-up of copper carbonates with flux corrosion on the internal or external surfaces. Due to the acid in the flux, the attack generally also appears green in colour, however it will not form an equal layer.*

CHEMICAL COMPOSITION OF CTA TUBE

Typical chemical composition of CTA domestic and industrial plumbing tube:

ELEMENT	SYMBOL	PARTS PER MILLION
Phosphor	***P***	275-350
Silver	***Ag***	5-15
Sulphur	***S***	5-15
Copper	***Cu***	balance

CTA 460/0 EXTRA LIGHT - HARD DRAWN
(5,5m straight lengths)

Identification: Yellow or clear end-caps. Tubing marked "CTA...mm OD SABS 460 class 0 BN....."

Tubing Size (mm)	Nominal Wall Thickness (mm)	Inside Diameter/ Bore size (mm)	Theoretical Mass (kg/m)	Maximum Working Pressure (Mpa)	Recommended usage (all sizes)
15	0.50	14	0.203	4.80	Recommended for above ground use only and should not be bent. Local annealing to produce a bend or offset is not recommended. Tubing is ideally suited for use with soldered capillary fittings.
22	0.60	20.8	0.360	3.93	
28	0.60	26.8	0.460	3.09	
35	0.75	33.5	0.719	3.09	
42	0.90	40.2	1.036	3.09	
54	1.20	51.6	1.774	3.20	
67	1.50	64	2.751	3.22	
76	1.70	72.6	3.537	3.22	
108	2.30	103.4	6.807	3.07	

CTA 460/1 LIGHT - HALF HARD (15mm-42mm) HARD DRAWN (54mm-108mm)
(5,5m straight lengths)

Identification: Orange end-caps. Tubing marked "CTA...mm OD SABS 460 class 1 BN....."

Tubing Size (mm)	Nominal Wall Thickness (mm)	Inside Diameter/ Bore size (mm)	Theoretical Mass (kg/m)	Maximum Working Pressure (Mpa)	Recommended usage (all sizes)
15	0.70	13.6	0.280	5.13	Recommended for above ground use only. Should only be bent with a bending tool having inner and outer formers. Spring bending is not recommended. Tubing is ideally suited for use with compression and/or soldered capillary fittings. Care should be taken when soldering due to the increased wall thickness.
22	0.90	20.2	0.532	4.50	
28	0.90	26.2	0.683	3.54	
35	1.20	32.6	1.136	3.77	
42	1.20	39.6	1.371	3.14	
54	1.20	51.6	1.774	3.20	
67	1.50	64.0	2.751	3.22	
76	1.70	72.6	3.537	3.22	
108	2.30	103.4	6.807	3.07	

CTA 460/2 MEDIUM - HALF HARD (15mm-42mm) HARD DRAWN (54mm-108mm)
(5,5m straight lengths)

Identification: Brown end-caps. Tubing marked "CTA..mm OD SABS 460 class 2 BN...."

Tubing Size (mm)	Nominal Wall Thickness (mm)	Inside Diameter/ Bore size (mm)	Theoretical Mass (kg/m)	Maximum Working Pressure (Mpa)	Recommended usage (all sizes)
15	1.00	13	0.392	7.33	Can be used underground with non-aggressive soil characteristics. Subject to special conditions. Can be bent with either a spring or bending tool and should be lagged correctly when used underground. Tubing is ideally suited for use with DZR compression and/or soldered capillary fittings. Care should be taken when soldering due to the increased wall thickness.
22	1.00	20	0.588	5.00	
28	1.20	25.6	0.900	4.71	
35	1.50	32	1.407	4.71	
42	1.50	39	1.701	3.93	
54	2.00	50	2.912	5.33	
67	2.00	63	3.640	4.30	
76	2.00	72	4.150	3.79	
108	2.50	103	7.385	3.33	

CTA 460/3 HEAVY - HALF HARD (15mm-42mm) HARD DRAWN (54mm-108mm)
(5,5m straight lengths)

Identification: No end-caps. Tubing marked "CTA..mm OD SABS 460 class 3 BN..."

Tubing Size (mm)	Nominal Wall Thickness (mm)	Inside Diameter/ Bore size (mm)	Theoretical Mass (kg/m)	Maximum Working Pressure (Mpa)	Recommended usage (all sizes)
15	1.20	12.6	0.464	8.80	Designed for use underground. Subject to special conditions. Can be bent using a bending tool and should be lagged. Spring bending is not recommended. Tube and DZR compression fittings ideally suited for underground use. When used above ground, special care should be taken when soldering due to the thick wall.
22	1.50	19	0.861	7.50	
28	1.50	25	1.113	5.89	
35	2.00	31	1.848	6.29	
42	2.00	38	2.240	5.24	
54	2.50	49	3.605	6.67	
67	2.50	62	4.515	5.34	
76	2.50	71	5.145	4.74	
108	3.20	101.6	9.390	4.27	

CTA 460/BLUE HARD DRAWN
(5,5m straight lengths)

Identification: Blue end-caps. Tubing marked "CTA..mm OD SABS 460 class B BN..."Pressure tested

Tubing Size (mm)	Nominal Wall Thickness (mm)	Inside Diameter/ Bore size (mm)	Theoretical Mass (kg/m)	Maximum Working Pressure (Mpa)
15	0.70	13.6	0.280	6.72
22	0.90	20.2	0.532	5.89
28	0.90	26.2	0.683	4.63
35	1.20	32.6	1.136	4.94
42	1.20	39.6	1.371	4.11
54	1.20	51.6	1.774	3.20
67	1.50	64	2.751	3.22
76	1.70	72.6	3.537	3.22
108	2.30	103.4	6.807	3.07

Recommended usage (all sizes)

BLUE TUBE
clean outside... green inside

Tubing is ideally suited for use with soldered capillary fittings. Care should be taken when soldering due to the increased wall thickness. Designed for above ground use.

Note: *All classes of CTA tube from 54mm to 108mm are hard drawn*

REFRIGERATION TUBE
Hard Drawn Condition

Tubing Size O.D. (mm)	Tubing Size (inches ")	Wall Thickness (mm)	Theoretical Mass (kg/length)	Maximum Working Pressure (Bar)
6.35	1/4"	0.57	0.51	129.26
7.94	5/16"	0.57	0.65	103.38
9.53	3/8"	0.57	0.79	86.13
12.70	1/2"	0.61	1.14	69.17
15.88	5/8"	0.71	1.66	64.38
19.05	3/4"	0.71	2.01	53.67
22.23	7/8"	0.81	2.67	52.47
28.58	1 1/8"	0.91	3.88	45.85
35.93	1 3/8"	1.02	5.33	42.05
41.28	1 5/8"	1.22	7.53	42.56
53.98	2 1/8"	1.42	11.49	37.88

MEDICAL TUBE
Half Hard and Hard Drawn Condition

Tubing Size O.D. (mm)	Tubing Size (inches ")	Wall Thickness (mm)	Theoretical Mass (kg/length)	Maximum Working Pressure (Bar)
6.35 (HH)	1/4"	0.71	0.62	123.0
9.53 (HH)	3/8"	0.71	0.96	81.95
12.70 (HH)	1/2"	0.76	1.4	65.83
15.88 (HH)	5/8"	0.81	1.88	56.11
19.05 (HH)	3/4"	0.89	2.49	51.39
22.23 (HH)	7/8"	1.02	3.33	50.47
28.58 (HD)	1 1/8"	1.02	4.33	51.39
34.93 (HD)	1 3/8"	1.22	6.33	50.30
41.28 (HD)	1 5/8"	1.40	8.6	48.84
53.98 (HD)	2 1/8"	1.65	13.3	44.02

HIGH PRESSURE:
Hard Drawn Condition

Tubing Size O.D. (mm)	Tubing Size (inches ")	Wall Thickness (mm)	Theoretical Mass (kg/length)	Maximum Working Pressure (Bar)
7.94 HP	5/16"	1.60	1.56	290.18
15.88 HP	5/8"	3.25	6.32	294.71
22.23 HP	7/8"	3.25	9.50	210.53
25.40 HP	1"	3.25	11.09	184.25

SPECIFICATIONS FOR COPPER TUBE

SANS 460 Class 0:

A hard drawn thin-walled tube for use *without bending*, and recommended for above ground use only. Hard drawn tubing is *not recommended for underground use* due to its thin wall and lack of flexibility. Any change of direction using SANS 460 Class 0 should be made using capillary fittings.

Local annealing in order to produce a bend, offset or crossover is not recommended. Oxyacetylene brazing of SANS 460 Class 0 using capillary fittings is not recommended.

SPECIFICATIONS FOR COPPER TUBE (cont.)

SANS 460 Class 1:

A half hard thin-walled tube for above ground use only. This tube can be bent using a bending tool with inner and outer formers. Spring bending is not advised due to the spring being too loose in the tube and the walls of the tube collapsing. SABS 460 Class 1 - 28mm to 108mm is ideally suited for the drawing of "T" joints.

SANS 460 Class 2:

A half hard, heavy gauge tube with excellent bending qualities. This class is also used underground under normal conditions i.e. non-aggressive soils. This is the only class that can be bent by using an Internal Bending Spring. Care should be taken when installing tube underground. The tube should be protected against external corrosion using CXP tape. SABS 460 Class 2 - 28mm to 108mm is ideally suited for the drawing of "T" joints.

SANS 460 Class 3:

This class is a heavy, thick walled, half hard copper tube with excellent bending qualities, designed specifically for underground use where soil movement takes place. Care should be taken when installing tube underground and it should be protected against external corrosion using CXP tape.

BLUE TUBE
clean outside... green inside

CTA Blue Tube: A hard drawn copper tube for above ground use only. Designed for higher chloride-bearing waters and is used to avoid Type 1 pitting corrosion. Any change of direction using Blue Tube should be made by using fittings. Blue Tube 28mm - 108mm undergoes a pressure test as well as an additional cleaning process before entering the local market.

BENDING OF HALF HARD COPPER TUBE

SANS 460 Class 1, 2 and 3:

CTA SANS 460 Class 1, 2 and 3 tubing has excellent bending qualities. There are various bending machines on the market, but those with inner and outer formers produce excellent results.
SANS 460 1 and 3 tube should only be bent with the above-mentioned bender.

Note: *Damaged and worn bending equipment will result in a failure.*

Hand and spring bending performs satisfactorily with SANS 460 Class 2. Half hard tubing bent by hand should have a radius of at least 6 times the outside diameter of the tubing and machine bent tubes should have a radius of not less than 3 times the outside diameter of the tubing.

Note: *Spring bending 15mm tube using SANS 460 Class 0, 1 and 3 is not recommended.*

SANS 460 Class 1 - spring too loose causing ripples in the tube
SANS 460 Class 3 - spring too tight to be easily removed.

When working with a spring, it is recommended that you overbend the tube by a few degrees past the mark before going back to the marked position. By doing this you will take the tension off the spring and it will be easier to remove.

Note: *SANS 460 Class 0 (Hard Drawn) copper tubing should not be bent.*

FLOW CHARACTERISTICS

The very smooth bore of copper tubing provides long term and excellent flow characteristics when compared with traditional plumbing materials by considerably reducing both the friction losses and the possibility of furring.

HYDRAULIC CHARACTERISTICS

The hydraulic character of piping material, determined by the size and smoothness of its bore, enables it to deliver water at sufficient pressure to overcome head pressures enabling fixtures, appliances and equipment to function correctly as per their design. When comparing smooth bore materials such as copper and most plastic systems, the internal diameter becomes the critical factor in evaluating hydraulic performance.

Copper tube has a thin wall. The internal diameter of copper tube is greater than that of most plastic and multi-composite pipe systems of the same size. Hydraulic performance is influenced by the size of the internal bore.

TABLE 1 Comparison between SANS 460/0 copper tube (Cu) and Polypropylene (PP) showing bore area, percentage difference and comparative flow rates.

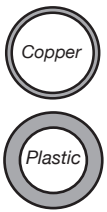
Nominal Tube Size (mm)	Nominal wall thickness (mm)		Bore area mass (mm2)		Copper's greater area (%)	Flow Rate (l/m) at 2.5m/sec (mm2)		Pressure drop in kpa per 10m length	
	PP	Cu	PP	Cu		PP	Cu	PP	Cu
15	1.8	0.5	102	154	50	15.5	23.0	88.0	55.0
22	2.7	0.6	216	346	60	32.5	52.0	56.5	33.5
28	3.4	0.6	35.3	546	59	53.0	84.5	41.0	24.5

HYDRAULIC CHARACTERISTICS (cont.)

TABLE 2 Comparison of flow rate using the same pressure drop values for the same tube size. The values used are those for copper from Table 1.

Nominal Tube Size (mm)	Pressure drop in kpa per 10m length	Flow rate (l/m) at 2.5m/sec (mm2)	
		PP	Cu
15	55.0	11.5	23.0
22	33.5	24.0	52.0
28	24.5	39.0	84.5

Plastic pipes usually have thicker walls than copper tubing. The internal diameter is considerably smaller. According to the specification, a stainless steel insert/sheath should be inserted into the pipe to prevent it from collapsing. This further restricts the flow rate.



The **bore size** of a tube is important when considering volumes, flow rates and velocities - *not the diameter*.

When using plastic it is considered good practice to select a nominal size larger than that specified for copper or steel. This graphic shows that a 22mm copper tube has a 60% greater bore area than the plastic 22mm pipe.

To establish the flow rate for copper tube using 2.5 meters/second as the maximum allowable velocity, the following calculations can be used:

Example:

B.S. × B.S. × 0.1179
= …….. litres per minute

Key: B.S. = bore size

14 × 14 × 0.1179
= 23 litres per minute

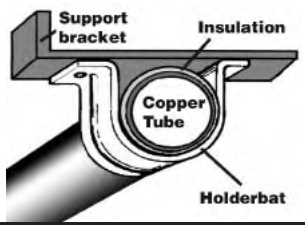
Check technical data on pages 6-8 for nominal bore sizes.

HOLDERBATS, SUPPORTS & FIXINGS

Points to remember when using holderbats to support and affix copper tubing:

- Always ensure a constant air gap is maintained between the tube and wall when using holderbats.
- Never over tighten, especially hot water lines. Allow for expansion.
- In humid atmospheres or in situations where condensation is likely, CTA recommends that the tube be insulated from the galvanized or steel support brackets and holderbats using plastic, rubber or wood.
- Holderbats and support brackets should be fixed at least 100mm away from a fitting or from a change in direction. This will allow free movement of the installation when expansion and contraction occurs.
- The use of steel nails, wire or brick force as a fixing alternative is not recommended as it will lead to eventual failure of the tube through localised corrosion.
- To avoid swaying, when pipes are fixed in a suspended ceiling space by hanging brackets, suitable bracing should be used to fix the installation to the support brackets i.e. Tarzan type holder brackets.

POSITIONING INTERVALS FOR HOLDERBATS		
Tubing Size (mm)	Positioning Vertical Runs (m)	Intervals Horizontal Runs (m)
15	1.9	1.3
22	2.5	1.9
28	2.5	1.9
35	2.8	2.5
42	2.8	2.5
54	3.9	2.8
76	3.9	2.8
108	3.9	2.8

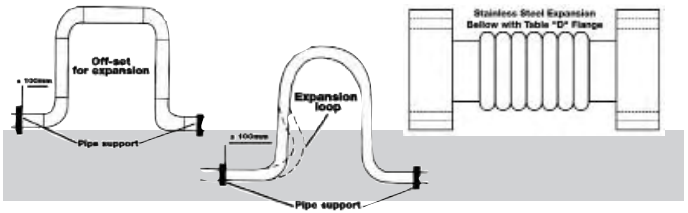


THERMAL EXPANSION OF COPPER TUBING

The co-efficient of linear expansion of copper tubing is:
0.016mm per m between 0° and 100 °C.
For example: **A temperature increase from 0° to 65 °C will cause a linear expansion of 1.04mm per m (i.e. 0.016 X 65 = 1.04 mm expansion per meter.)**

Provision for expansion can include the forming of expansion loops and offsets, as illustrated, and refer to *SANS 10252-1: 2012*. Changing direction can also be used to avoid long straight runs.

Expansion loops and offsets are simple and effective but require space which may not be available.



SANS 460 Class 2 and 3: CTA 460/2 Medium and CTA Heavy – Half Hard is recommended for bending expansion loops and offsets with fittings.

COPPER TUBING IN CHASINGS & CONCRETE

CTA recommends lagging all copper tube in walls.

For more detail regarding the laying of tube in buildings refer to *SANS 10252-1: 2012*.

COPPER UNDERGROUND & EXTERNAL CORROSION .....

Tubing laid in contact with bricks, paving bricks, ash bricks or a cinder backfill in humid and moist environments, together with an electrolyte e.g. water, will cause an electrolytic reaction with the carbons in the bricks and cinders causing localised external corrosion and eventual failure of the tube. Under such circumstances the tube should be insulated with a barrier of CXP tape. Ref: *SANS 10252-1: 2012.*

The rate of external corrosion is influenced by a combination of factors such as:

* Poor drainage
* Humidity and moisture content
* Alkalinity
* Acidity (indicated by the ph value)
* Soils containing organic matter, peat (compost), muck brick or cinder from open fires and backfills.

Combine these factors with aggressive sulphides and chlorides and the action between the carbon in them and copper, and external corrosion will result.

FREEZING .....

It is recommended that copper tubing not be exposed to the elements when installed in a very cold environment. Tubing should be installed under ceiling lagging to insulate and protect it from draughts. (The wind chill factor is the main cause of failure under these conditions.)

Pipes, fittings and components should, when necessary, be protected against freezing using *thermal insulation*. The insulation provided should be appropriate to the minimum temperatures of the geographical area. Ref: *SANS 10252-1: 2012.*

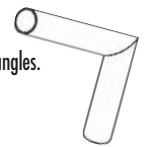
Special care must be taken when plumbing is installed in a Cold Storage area. Tube should not come in contact with the wall and floor areas.

COMPATIBILITY, INSULATION & LAGGING .....

Copper is compatible with all other types of piping. It is accepted practice to join copper tubing to galvanized piping provided the copper tube is downstream from the galvanized pipe. Beware of galvanized fittings downstream! (i.e. galvanized nipples, under wash basins and washing machine outlets.)

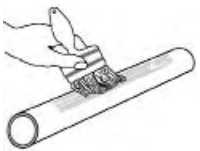
Copper tubing may be used to replace any portion of a failed galvanized system which has been in service for a number of years. Exposed zinc/iron metal is unlikely to be present in the system due to a build up of lime and hardened salts in the bore.

THERMAL INSULATION



1. Using a mitre box offers a more accurate cut, especially 45° and 90° angles.
2. Always use an adhesive to apply insulation and avoid air passages.

3. To prevent loss of insulation and possible freezing, do not have exposed joints or tube.
4. It is recommended that external insulation be painted using an acrylic PVA.



Ref: *SANS 10252-1: 2012 Part 1 See 6.7.5.*

LAGGING OF TUBE

All hot water piping, including pressure relief and overflow drain pipes, restricted in movement through encasement in concrete or plaster, should be lagged throughout the encased length with approved flexible lagging material. Ref: *SANS 10252-1 2012.*

CXP Tape (copper expansion protective tape) is available on request. For information on the product please contact CTA. CTA suggests that both hot and cold tubes installed in walls be lagged.

CAPILLARY FITTINGS

Soldered joints depend on capillary action drawing free-flowing molten solder into the gap between the fitting and the tube. Capillary fittings soldered correctly with 97/3 soft solder have a shear strength of 60 Mpa (600 Bar) and are able to withstand a high degree of vibration, expansion and contraction.

A full range of capillary fittings is readily available in all sizes to fit SANS 460 Classes 0, 1, 2, 3 and *CTA Blue Tube*.

Capillary fittings used with water-based self-cleaning flux with no ammonia and 97/3 solder, make a strong and lasting joint. *(97% Tin/3% Copper)*.

Care should be taken to not use *too much* flux. The cleaning agents in the flux can be harmful to the copper system if not cleaned off properly.

Caution should be taken when choosing fittings:

Oversized: Tolerance between fitting and tube is too great and capillary action will not occur.
Undersized: Tolerance between fitting and tube is too little and solder will not be able to enter the joint.

In both cases the joint will lead to failure.

SOLDERING FLUX

Ref: *SANS 9454-2: 1998 Part 2: Performance Requirements*.

The functions of the soldering flux are:

* To remove residual traces of oxides.
* To promote wetting.
* To protect the surface to be soldered from oxidation during heating.

Standard practice calls for cleaning the tube and fittings by mechanical means. Cleaning by mechanical means is also required if residues of cement, paint or tape gum are found on the surface to be joined. **The use of steel wool is not recommended for cleaning**. Use a CTA cleaning pad or sandpaper.

Soldering flux should only be applied to a clean surface. Lightly coat the surface to be joined. An oxide film may re-form quickly on the copper tube after it has been cleaned, therefore the flux should be applied as soon as possible after cleaning. Any excess flux should be wiped off before soldering.

Once the joint has been soldered, the flux residue should be removed with a damp cloth. At no time should the soldered joint be shock-cooled with water or a wet rag as this may cause the joint to fracture. *Wipe only with a damp cloth*.

The type of flux required is self-cleaning, water-based, contains NO ammonia and is able to withstand temperatures in excess of 240°C. **Note:** The term *"water-based"* means that the flux is soluble in water and should rinse out of the system once flushed.

CTA recommends water-based self-cleaning flux for use with lead-free solder.

Note: *Joint must be soldered on the same day. If not, flux will harden and capillary action will not occur, causing joint failure.*

SOLDER

Refer: *SANS 24:2008 - Sn 19 Solder wire.*

It is extremely important to use only the recommended solder. Any solder containing lead or having either a resin or acid core should be avoided at all times. Not only is there the obvious health hazard, but there is also the risk of mechanical failure of the joint.

CTA recommends 97/3 (97% tin; 3% copper) lead-free solder.

HEAT SOURCE

A soft non-localised flame such as that produced by LPG/Propane/Butane mix is required. The use of oxy-acetylene is not recommended as the flame is too concentrated and severe. This causes overheating of the tube, leading to burning and drying out of the flux, annealing of the tube and melting of the tube and fitting.

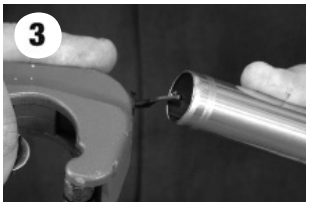
Note: *The selection of gas torches is very important. 35mm-108mm require different size torches.*

15mm to 35mm

Refer: *SANS 1067-2: 2005: Capillary Solder Fittings.*

1. Measure and mark the tube length required before cutting.

2. Cut the tube square so that the tubing will seat flush in the socket of the fitting. Take care not to deform the tube while cutting.



3. Remove all burrs as this could cause water turbulence leading to erosion corrosion. A properly cleaned and reamed tube provides a stronger joint as well as a better flow.

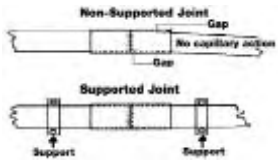
4. The surfaces of both the tube and the fitting to be joined should be cleaned with either a CTA cleaning pad or sandpaper. Care should be taken not to remove too much material from either the tube or fitting as this could interfere with the capillary action taking place during soldering. Mechanical cleaning is recommended on all sizes of tubing and fittings.

Tip: Clean tube end slightly more than fitting cup depth to improve capillary action and ease of jointing.

15mm to 35mm

5. Apply flux to both the tube and the inside of the fitting. Care should be taken not to over-flux. For the best results use a small paint brush to apply the flux. Wipe off excess where possible.

6. Assembly: Ensure the tube end is seated against the base of the fitting. Support the tube and fitting to ensure uniformity of the capillary gap. Excessive joint clearance could lead to an incomplete soldered joint resulting in joint failure.



Warning: Careless workmanship can cause problems after the system has been installed. If excessive amounts of flux are used, the flux residue can cause corrosion and in extreme cases could lead to failure of the tube and fittings.

Remove excess flux from the exterior of the joint where possible. Joints prepared and ready for soldering must be soldered the same day. ***They must not be left overnight.***

7. Bend sufficient length of solder at right angles (measured according to Table 1 Pg 24). This table is a guideline only and shows the amount of solder required for each joint to ensure that sufficient solder is applied without unnecessary wastage.

15mm to 35mm

8. Apply flame to the assembly. Concentrate on the centre of the fitting and not the mouth of the fitting. Slowly move the flame from the fitting to the tube. Remove flame.

9. Apply the solder to the mouth of the fitting to see if it is drawn in. i.e. Keep testing with solder until solder is drawn in.

Note: *It is the heat of the fitting and tube that melts the solder, not the flame.*

Take care not to overheat the assembly. Overheating could burn the flux which will destroy its effectiveness. The solder will not enter the mouth of the joint properly, causing joint failure and unwanted leaks.

Capillary fittings with short sockets i.e. Brazing type, should not be used for soft soldering. Standards laid down by *SANS 1067- 2: 2005*, equivalent to international standards are as follows:

Solder joints depend on capillary action drawing free-flowing molten solder into the narrow clearance between the fitting and the tube. Molten solder is drawn into the joint by capillary action regardless of whether the solder flow is upward, downward or horizontal.

GUIDE TO SOLDERING A CAPILLARY JOINT (cont.)

15mm to 35mm

10. After a short cooling period, wipe the assembly with a damp cloth to remove excess flux. This prevents the assembly from turning green.

Note: *Shock cooling with water will stress the joint.*

It is essential that after completion, the complete system be flushed to remove any excess flux and debris, as per *SANS 10252-1: 2012*.

If a system is to be inoperative for any extended period after installation, it is recommended that it be completely drained after flushing and testing and left empty of water.

TABLE 1: SOLDER LENGTH PER JOINT SIZE

Nominal Tube Size (mm)	Solder Length (2mm dia)	Solder Length (3mm dia)
15	15	-
22	40	-
28	50	25
35	100	50
42	160	75
54	230	105
76	-	195
108	-	455

NB: 3mm dia solder recommended for 35mm upwards

TABLE 2: GUIDE TO SOCKET DEPTH

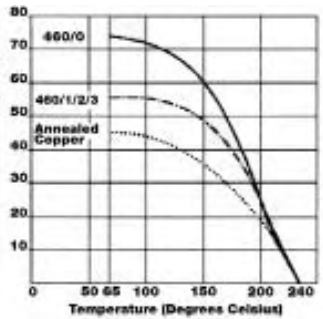
Tubing Size (mm)	Socket Depth	Tolerance ±
15	12	±1.4
22	17	±1.6
28	20	±1.6
35	25	±2.0
42	29	±2.0
54	34	±2.0
76	36	±2.5
108	50	±2.5

PRESSURE TESTING/WORKING PRESSURES

The complete system should always be pressure tested as per *SANS 10252-12: 2012*. An installation should be subjected to a pressure test of at least 1500kPa, but not less than 1.5 times the maximum working pressure of the installation. This test should be maintained for at least an hour.

WORKING PRESSURES:
(As determined from the chart)

460/Hard Drawn = 72 MPa
460/Half Hard = 55MPa



Use the following formula to calculate working pressures for tubes of specific dimensions:

Example:
The safe working stress (f) for a hard drawn tube at 65°C is charted at 72 MPa. For a tube of this quality 15mm O.D. x 0.50mm thick, the safe working pressure is thus:

$$P=\frac{2x72x0.50}{15}=4.8MPa$$

PREPARATION AND JOINTING: 42MM TO 108MM .....

1. Measure and mark the required tube length before cutting.

2. Use a three or four-wheel tube cutter to cut the measured tube. The cut should be square to the run of the tube so that the tube will seat fully in the fitting socket.

3. After cutting, the tube should be deburred with a half-round file. If a tube cutter is used, it is recommended that the rolled burr on the I.D. be removed by filing. Failure to ream the tube may result in system failure due to erosion corrosion adjacent to the unreamed tube ends.

4. Following deburring, the tube should be cleaned with a CTA cleaning pad or sandpaper. Care should be taken not to remove excessive metal from either the tube or fitting. This will interfere with satisfactory capillary action when making the joint.

5. After the surfaces have been thoroughly cleaned, the tube and fittings should be fluxed with a light, even coating of flux applied with a soft brush prior to assembly.

6. Seat the tube fully into the fitting socket. **Note:** When using large diameters, the weight of the fitting hanging on the tube or tube resting on the fitting surface can eliminate capillary space in that portion of the joint. The result: Poor solder distribution and subsequent leakage. (Refer to : *The Solder of a capillary joint, step 6, page 22*)

PREPARATION AND JOINTING: 42MM TO 108MM (cont.) .....

7. After assembly and support of the system, check the tolerance in the joint. *Do not use rattle fit fittings.* Good practice dictates that what is cleaned, fluxed and assembled during the working period should be soldered during that same period. If the joint is allowed to stand overnight without being soldered, it should be taken apart, recleaned and refluxed prior to soldering. (Oxy-acetylene is not recommended for making a joint).

8. Commence by pre-heating the tube to some degree to start conduction of heat into the solder cup. When the flux at the rim of the solder cup begins turning a brown colour, transfer the source onto the fitting and bring the heat up evenly and uniformly around the entire fitting with the residual heat from the torch playing out onto the surface of the tube.

9a. Now bring the torch to the bottom and concentrate the heat on the fitting at the base of the solder cup and check with the solder at about "7 'o clock" position. When the solder begins to melt from the heat of the tube and fitting, push the solder straight into the joint meanwhile pulling the torch back to the base of the fitting on the same line with the solder. *The same technique is used for up or down vertical joints.* Continue this technique across the bottom to the "5 'o clock" position. Now with the solder, check the area previously soldered and make sure that is has solidified and is not still a liquid.The solidified solder has created an effective "dam" that will prevent the solder from running out of the joint as the sides and top are being filled.

A common mistake is to start feeding the solder in at the top of a horizontal joint, relying completely on capillary action. In a horizontal joint, especially in the large diameters, gravity tends to pull the solder down to the bottom of the joint. The procedure described of building a "dam" by applying the solder first at the bottom of the joint prevents solder from being pulled to the bottom of the joint by gravity and allows capillary action to function properly to fill the joint with solder.

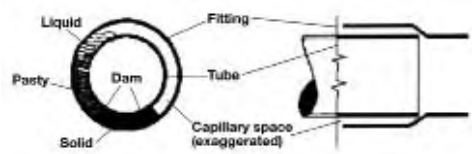
PREPARATION AND JOINTING: 42MM TO 108MM (cont.) . . . . . .

9b. Continuing up from the "5 'o clock" position, the torch is slightly ahead of the solder being applied and small drops will appear behind the point of solder application, indicating the joint is full to that point and will take no more solder.

9c. Continue this technique to the "12 o' clock" position and then move the torch down the opposite side. Apply the solder to the point of beginning, overlapping approximately 20mm, again checking with the solder at the bottom of the joint to assure that the "dam" is still in the solid condition.

9d. Now, move up the side of the joint, using the same technique keeping complete control of the heat and applying the solder slightly behind the source of heat. Continue up to the top of the joint and lap over the top at the "12 o' clock" position.

9e. Remove the heat source and continue applying the solder wire into the joint until it is completely filled and will accept no more solder. Soldering this way ensures a sound joint. At no time is the entire assembly at the melting or liquidus point of the solder. The joint is being made with the solder in the solid, pasty and liquid state in 50mm to 70mm sections of the joint.



10. When the solder has solidified, the joint should be wiped free from excess flux on the exterior of the tube and fitting to leave a neat appearing, workman-like joint.

Note: *Never shock cool the joint with water.*

RECOMMENDED SOLDER TORCHES . . . . . .

Please contact the CTA technical department to discuss the recommended available options.

REPAIRING A NAIL HOLE . . . . . .

- **Cut a slip coupling in half (lengthwise).**
- **Clean off burrs, apply flux and place over hole.**
- **Hold in place with thin wire.**
- **Heat and apply solder, feeding around the full perimeter.**
- **Remove holding wire.**

PRESSURE RATINGS . . . . . .

To calculate MPa to BAR: MPa x 9.67 = BAR pressure
i.e. 15/0 maximum working pressure is 4.80 MPa
4.80 MPa x 9.67 = 46.42 BAR

1 MPa = 1000 KPa
1 BAR = 100 KPa
10 METER. Tank height = 1 BAR

ABBREVIATIONS & TERMINOLOGY

S.A.B.S. South African Bureau of Standards
BSEN British Standard European Norm
BSP British Standard Pipe Thread
C Copper
CxC Copper to copper
F.I. Female iron
M.I. Male iron
MPa Megapascal
kPa Kilopascal
ø Diameter
°C Degree Celsius
mm Millimeter
m Metre
DZR Dezincification Resistant Brass

TERMINOLOGY

Local Annealing:
Applying heat to a specific area only.

Erosion Corrosion:
Where surface metal has been gradually destroyed by the flow of water.

Furring:
A deposit build-up e.g. lime, in the bore of the tube.

B.S.P. TO MM - NOMINAL EQUIVALENTS

B.S.P.	Copper Tube
1/2”	15mm
3/4”	22mm
1”	28mm
1 1/4”	35mm
1 1/2”	42mm
2”	54mm
2 1/2”	67mm
3”	76mm
4”	108mm

COMPRESSION FITTINGS

Compression fittings are available in sizes from 15mm to 54mm, complying with *SANS 1067-1: 2005*.
Imported fittings should comply with *BS EN 1254 part 2-3-4 of 1998*, which has replaced *BS 864*.

Note: *Soldering, the use of putty, hemp, P.T.F.E. tape, silicone, stag, liquid Teflon and other sealants is not recommended and is bad practice.*

Note: *Use of compression fittings with brass rings/olives is not recommended for Class 0 tube. Over-tightening of the capnut causes the brass ring to bite into the copper resulting in stress of the joint and the possibility of failure.*

TABLE 1
Indicative traction for compression fittings:

Diameter	Traction Turns
8mm	1.1/4 turn
10mm	1.1/4 turn
12mm	1 turn
15mm	1 turn
18mm	1 turn
22mm	1 turn
28mm	1 turn
35mm	3/4 turn
42mm	3/4 turn
54mm	3/4 turn

TABLE 2
Maximum working temperatures and pressures

°C	BAR
30	16
65	10
110	6
120	5

WORKING WITH COMPRESSION FITTINGS

STEP 1
Carefully measure and mark the tube to the required length.

STEP 2
Cut tube ends square using a tube cutter or hacksaw (32TPI fine tooth blade is best). Do not use too much pressure.

STEP 3
De-burr and clean tube ends using a reamer or file as well as a CTA cleaning pad.

STEP 4
With the fitting disassembled, first place the nut and then the ring onto the tube.

STEP 5
Push tube with ring and nut into the fittings body right up to the fittings inner shoulder.

STEP 6
Hand fasten the nut ensuring that the tube stays firmly against the inner shoulder of the fitting.

STEP 7
After fastening the nut by hand, use a suitable spanner to fasten the fitting till the tube cannot move. Turn the nut another half turn to make it seal. Tighten the nut as per recommended traction turns : (Table 1 on page 31.)

DZR COMPRESSION FITTINGS

CTA suggests the use of Dezincification Brass (DZR) in South Africa and neighbouring countries, due to the water quality. DZR brass has added chemicals to prevent the zinc from being leached from the fitting or valve.

CC
Straight Coupler
Copper to Copper

15mm; 22mm; 28mm; 35mm; 42mm; 54mm.

CCMI
Straight Coupler
Copper to Male Iron

15mm x 1/2; 22mm x 3/4; 28mm x 1;
35mm x 1 1/4; 42mm x 1 1/2; 54mm x 2.

CCFI
Straight Coupler
Copper to Female Iron

15mm x 1/2; 22mm x 3/4; 28mm x 1;
35mm x 1 1/4; 42mm x 1 1/2; 54mm x 2.

CCR
Reducing Straight Coupler
Copper to Copper

22mm x 15mm; 28mm x 22mm.

CCMIR
Reducing Straight Coupler
Copper to Male Iron

15mm x 3/4" 22mm x 1".

CCFIR
Reducing Straight Coupler
Copper to Female Iron

15mm x 3/4"; 15mm x 1"; 22mm x 1".

CCE
Elbow 90º
Copper to Copper

15mm; 22mm; 28mm; 35mm; 42mm; 54mm.

CCMIE
Elbow 90º
Copper to Male Iron

15mm x 1/2"; 22mm x 3/4"; 28mm x 1";
35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2".

CCFIE
Elbow 90º
Copper to Female Iron

15mm x 1/2"; 22mm x 3/4"; 28mm x 1";
35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2".

CCRE
Reducing Elbow 90º
Copper to Copper

22mm x 15mm.

CCMIRE
Reducing Elbow 90º
Copper to Male Iron

15mm x 3/4".

CCFIRE
Reducing Elbow 90º
Copper to Female Iron
15mm x 3/4".

CCT
Equal Tee
Copper to Copper to Copper

15mm ; 22mm ; 28mm; 35mm; 42mm; 54mm.

CCFIT
Tee
Copper to Copper to Female Iron

Note: All unequal ends of tees are sized according to the numbers featured on the pictures

15mm x 15mm x 1/2" ; 22mm x 22mm x 3/4".

CCTR
Reducing Tee
Copper to Copper to Copper

Note: All unequal ends of tees are sized according to the numbers featured on the picture

15mm x 15mm x 22mm; 22mm x 15mm x 15mm;
22mm x 15mm x 22mm; 22mm x 22mm x 15mm;
22mm x 22mm x 28mm; 28mm x 28mm x 22mm;
28mm x 28mm x 15mm; 28mm x 22mm x 28mm.

CCFIWPE
Wallplate elbow 90º
Copper to Female Iron

15mm x 1/2"; 22mm x 3/4".

CPTA
Pillartap Adaptor
Copper to Female Iron

15mm x 1/2"; 22mm x 3/4".

CCSE
Stop end
15mm; 22mm; 28mm.

CRS1P
Single Step Reducer
(for adapting a fitting)
22mm x 15mm; 28mm x 15mm;
28mm x 22mm.

CCFISE
Swivel elbow 90º
Copper to Female Iron
15mm x 1/2"; 22mm x 3/4".

HB Holderbats
Brass plated
15mm; 22mm.
CFW Fibre washer
15mm; 22mm.

CIVWH
Isolating valve with handle
Nickel plated
15mm.

CIV
Isolating valve
Nickel plated
15mm; 22mm.

CVSS
Valve swivel straight
Nickel plated
15mm.

CVSA
Valve swivel angle
Nickel plated
15mm.

CN
Spare capnut
10mm; 15mm; 22mm; 28mm; 35mm; 42mm; 54mm.

CR
Spare ring
10mm; 15mm; 22mm; 28mm; 35mm; 42mm; 54mm.

CWMTA
Washing machine tap angle
Nickel plated
15mm x 3/4".

CWMTS
Washing machine tap straight
Nickel plated
15mm x 3/4.

SSL
Slip Coupler
Copper to Copper
15mm; 22mm; 28mm.

SSC
Straight Coupler
Copper to Copper
15mm; 22mm; 28mm; 35mm; 42mm; 54mm; 76mm; 108mm.

SCMI
Straight Coupler
Male Iron to Copper
15mm x 1/2"; 22mm x 3/4"; 28mm x 1"; 35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2"; 76mm x 3"; 108mm x 4".

SCFI
Straight coupler
Female Iron to Copper
15mm x 1/2"; 22mm x 3/4"; 28mm x 1"; 35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2"; 76mm x 3"; 108mm x 4".

SRSCF
Pipe reducer
Copper to Copper
22mm x 15mm; 28mm x 15mm; 28mm x 22mm; 35mm x 28mm; 42mm x 35mm; 54mm x 42mm; 76mm x 35mm; 76mm x 42mm; 76mm x 54mm.

SCMIR
Reducing straight coupler
Male Iron to Copper
15mm x 3/4".

SCFIR
Reducing straight coupler
Female Iron to Copper
15mm x 3/4".

SCE
Elbow 90º
Copper to Copper
15mm; 22mm; 28mm; 35mm; 42mm; 54mm; 76mm; 108mm.

SCE45
Elbow 45º
Copper to Copper
15mm; 22mm; 28mm; 35mm; 42mm; 54mm; 76mm; 108mm.

SFRM
Fitting reducer
Male Copper to Copper
22mm x 15mm; 28mm x 15mm; 28mm x 22mm; 35mm x 15mm; 35mm x 22mm; 35mm x 28mm; 42mm x 15mm; 42mm x 22mm; 42mm x 28mm; 42mm x 35mm; 54mm x 15mm; 54mm x 22mm; 54mm x 28mm; 54mm x 35mm; 54mm x 42mm; 76mm x 35mm; 76mm x 42mm; 76mm x 54mm; 108mm x 54mm; 108mm x 76mm.

SCMIE
Elbow 90º
Male Iron to Copper
15mm x 1/2"; 22mm x 3/4"; 28mm x 1"; 35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2".

SCFIE
Elbow 90º
Female Iron to Copper
15mm x 1/2"; 22mm x 3/4"; 28mm x 1"; 35mm x 1 1/4"; 42mm x 1 1/2"; 54mm x 2".

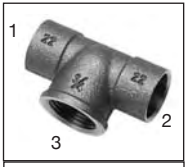
SCMIRE
Reducing Elbow 90º
Male Iron to Copper
15mm x 3/4".

SCFIRE
Reducing Elbow 90º
Female Iron to Copper
15mm x 3/4".

SFC
Full crossover
Copper to Copper
15mm; 22mm.

SCWPE
Wallplate elbow
Female Iron to Copper
15mm x 1/2"; 22mm X 3/4".

SCT
Equal Tee
Copper to Copper to Copper
15mm; 22mm; 28mm; 35mm; 42mm; 54mm; 76mm; 108mm.



SCFIT
Tee
Copper to Copper to Female Iron
Note: All unequal ends of tees are sized according to the numbers featured on the pictures
15mm x 15mm x 1/2"; 22mm x 22mm x 3/4".

SCRT
Reducing Tee
Copper to Copper to Copper
15mm x 15mm x 22mm; 22mm x 15mm x 15mm; 22mm x 15mm x 22mm; 22mm x 22mm x 15mm; 22mm x 22mm x 28mm; 28mm x 22mm x 22mm; 28mm x 22mm x 28mm; 28mm x 28mm x 15mm; 28mm x 28mm x 22mm; 35mm x 35mm x 15mm; 35mm x 35mm x 22mm; 35mm x 35mm x 28mm; 42mm x 42mm x 15mm; 42mm x 42mm x 22mm; 42mm x 42mm x 28mm; 42mm x 42mm x 35mm; 54mm x 54mm x 22mm; 54mm x 54mm x 28mm; 54mm x 54mm x 35mm; 54mm x 54mm x 42mm; 76mm x 76mm x 22mm; 76mm x 76mm x 35mm; 76mm x 76mm x 42mm; 76mm x 76mm x 54mm.

STEC
Tube end cap
15mm; 22mm; 28mm; 35mm; 42mm; 54mm.

SCCU
Union coupler
Copper to Copper
15mm; 22mm.

SCMIU
Union coupler
Copper to Male Iron
15mm x 1/2"; 22mm x 3/4".

CAPILLARY FITTINGS (cont.)

STC
Straight tap connector
Copper to Female Iron
15mm x 1/2"; 15mm x 3/4"; 22mm x 3/4".

TS
Tube strap
Copper
15mm; 22mm.

SUNDRIES

FLUX / FB
Water soluble flux / flux brush
75g; 200g; 500g.

SOLD
CTA soft solder
97% tin; 3% copper
2mm x 250g; 2mm x 500g; 3mm x 500g

CXP TAPE
Flexible lagging and insulation tape
200m x 70mm.

SUNDRIES (cont.)

CLEANING PADS
CTA pads
abrasive pads for cleaning tube

PLUMBERS' RULE
16cm aluminium ruler
Easy-measure solder lengths; socket depth table

PLUMBERS' POUCH
Handy pouch
Belt loops; zip

PLUMBERS' KIT
Pouch; rule; flux brush; Code of Practice; cleaning pad

NOTES