



Introduction

Steel tube is commonly used for pipework in sprinkler systems in commercial and industrial premises. Steel is a good material to use because it is readily available in a range of standard sizes, rigid and structurally sound and reliable and well proven in use over many years. There is also a large base of skilled installers that can be called upon, who are familiar with steel tube.

Fire Rating

Steel tube is classified as Class A1 under European Union Construction Products legislation, which means that it will not contribute to the spread of fire and does not need to be tested for reaction to fire (BS EN 10255: 2004 Amd.1: 2007 – Section 8.7).

Steel Tube Grades

As a general guideline, it is recommended that steel tube with a specified minimum yield strength (SMYS) value of 195N/mm² should be employed. Either seamless or welded tube can be used, although welded is normally more readily available. Welded tube is typically manufactured by either the high frequency induction (HFI) or the electric resistance welding (ERW) process. Welded tube made by the continuous weld (CW), or Fretz-Moon, process can also be used although this process is gradually being phased out. CW tube is hot formed whereas ERW and HFI may be either hot finished or cold formed.

Appropriate steel tube grades should be selected either from National (including European) or International Standards or alternatively suitable equivalent proprietary materials from a reputable tube manufacturer may be used.

Steelmaking Process and Manufacturer's Certification

The tubes should be produced from fully killed steel, i.e. steel that is fully deoxidised and which has

additions of suitable nitrogen-binding elements (aluminium plus sometimes others such as titanium, niobium or vanadium) to eliminate any tendency for strain age embrittlement in service. For this reason, rimmed, balanced or semi-killed steels are not suitable and should not be employed.

The tube manufacturer should also operate a quality system in accordance with either BS EN ISO 9001 or BS EN ISO 9002. The tubes should, as a minimum, be subject to non-specific testing and inspection and hence supplied with a Test Report 2.2 in accordance with BS EN 10204 as standard. Typically a 2.2 Test Report will show the chemical composition (ladle analysis) of the steel together with mechanical test results (yield strength, tensile strength and elongation) representative of the tube products supplied. Properly drafted Test Reports in accordance with BS EN 10204 will state on them what class they are (e.g. 2.2).

Recommended dimensions for tubes

The diameter and thickness of the steel tube to be used should be in accordance with the relevant system design standards and in some cases customers may have specific requirements.

Tube Service life

The lifespan of any carbon steel tube is dependent on:

- ◆ The specific service conditions
- ◆ The system being properly designed
- ◆ Correct installation procedures being followed
- ◆ The adoption of a suitable maintenance practice
- ◆ The use of appropriate corrosion protection, inhibitors or other system additives

Steel tube correctly installed and maintained in accordance with best industry practices should have a satisfactory service life. However, it is not possible to declare an actual working life since this will depend on many factors whilst in operation that are beyond the direct control of the steel tube manufacturer.

Corrosion Protection

The combined presence of oxygen and moisture is normally necessary for corrosion of carbon steel to occur. Environmental factors, such as whether the water is soft or hard, the presence of bacteria, the use of corrosion inhibitors and the dissolved oxygen and carbon dioxide contents can all influence the rate of corrosion and the interaction between these various factors is complex.

Galvanized tube can be used, although this is not essential for appropriately designed sprinkler systems. Where tube is supplied hot dip galvanized, a suitable steel composition is preferable. As a general guideline,

Table 1 : Dimensions for tubes to BS EN 12845

Specified Diameter	Nominal Bore			Medium Weight	Heavy Weight
	NB	OD min	OD max	Wall Thickness	Wall Thickness
33.7	25	33.3	34.2	3.2	4.0
42.4	32	42.0	42.9	3.2	4.0
48.3	40	47.9	48.8	3.2	4.0
60.3	50	59.7	60.8	3.6	4.5
76.1	65	75.3	76.6	3.6	4.5
88.9	80	88.0	89.5	4.0	5.0
114.3	100	113.1	115.0	4.5	5.4
139.7	125	138.5	140.8	5.0	5.4
165.1	150	163.9	165.1	5.0	5.4

NOTE: Other diameters and thicknesses may be available depending on supply source.

this means that the silicon content of the steel tube should ideally either be $\leq 0.05\%$ or in the range 0.15 – 0.25%. Hot dip galvanizing is normally carried out either in accordance with BS EN 10240 or BS EN ISO 1461. Galvanized tubes are not suitable for use at temperatures above 60°C and should not be used in contact with copper based alloy tubing, fittings or washers, due to the possibility of a galvanic corrosion reaction.

A range of external coatings may be applied to steel tubes where external corrosion protection is specifically required. It should be noted that the red paint, normally applied to steel tubes for sprinkler systems, is only intended as a temporary/transit protection for the tubes and it should not be assumed to offer any degree of long term protection.

Jointing Systems

It is possible to use a number of jointing methods for steel tubes but the principal methods recommended for sprinkler systems are either butt-welding, grooved couplings or screwed & socketed. Pre-grooved tube is becoming more popular due to the time and cost savings that can be afforded during installation and is typically suitable for use with most commonly available LPCB, FM, UL and VdS approved products.

Tube grades with a SMYS of 195N/mm² are generally considered to be readily weldable in accordance with most standard welding methods. Welding guidelines can be found in BS EN 1011 Parts 1 and 2.

Butt-welded pipework systems operating at ambient temperatures are suitable for operating pressures as set out in the table 2

For steel tubes using grooved couplings, the permissible tube working pressures above are valid, although the type and make of grooved coupling used may determine the maximum operating pressure of the system. Higher operating pressures may be obtained through the use of heavy-duty couplings; tube manufactures can demonstrate tube suitability at these higher pressures via burst strength calculations. Additional technical data can be provided by the relevant coupler or tube manufacturer.

Grooved connections offer the advantage of being simple and quick to install whilst still providing a robust and reliable joint, without having to rely on the skill of the installer. The process complements modular construction and provides a clean installation resulting in reduced flushing and commissioning time.

It is also possible to roll groove on site, providing that suitable equipment is used and appropriate precautions are taken. For example, the tube must be adequately prepared, ensure that the sealing surfaces at the tube ends are free from projections and other indentations and for welded tube it may be necessary to locally remove the internal weld bead.

Although the use of welded or grooved joints is preferred, screwed and socketed connections can also be employed. The standard (taper/parallel) joint specified in BS EN 10255 comprises taper threaded tube (per BS EN 10226) with parallel threaded sockets (per BS EN 10241 or BS EN 10242). Pipework systems with taper/parallel screwed and socketed joints in water service operating at ambient temperatures are suitable for operating pressures as set out in the table 3.

For applications involving exposed pipework in diameters above 50mm NB, the use of taper/parallel joints is not recommended. For such applications, if screwed and socketed joints must be used, then the use of taper threaded tube and taper threaded fittings (taper/taper) would be recommended. Pipework systems with taper/taper screwed and socketed joints

Table 2

		BUTT WELDED PIPEWORK (& GROOVED PIPE*)	
Specified Diameter (mm)	Nominal Bore	Maximum Operating Pressure Water Service (Bar)	
	NB (mm)	Medium Weight	Heavy Weight
33.7	25	50	60
42.4	32	40	50
48.3	40	40	50
60.3	50	28	36
76.1	65	28	36
88.9	80	28	36
114.3	100	25	30
139.7	125	25	30
165.1	150	25	30

*For grooved pipe, the coupling used may determine the maximum pressure of the system

Table 3	PIPEWORK WITH TAPER/PARALLEL SCREWED & SOCKETED CONNECTIONS			PIPEWORK WITH TAPER/TAPER SCREWED & SOCKETED CONNECTIONS	
	Specified Diameter (mm)	Nominal Bore	Maximum Operating Pressure Water Service (Bar)		
			NB (mm)	Medium Weight	Heavy Weight
33.7	25	21	24	35	42
42.4	32	17	21	28	35
48.3	40	17	21	28	35
60.3	50	14	17	24	31
76.1	65	14	17	24	31
88.9	80	14	17	21	28
114.3	100	10	14	17	21
139.7	125	10	14	17	21
165.1	150	9	10	14	17

NOTE: It is not recommended that screwed and socketed connections be used on Light Weight tube.

in water service operating at ambient temperatures are suitable for operating pressures as set out in the table 3.

Other jointing systems may also be employed, such as flanges or compression fittings. Where compression fittings are used, the fitting properties and its installation procedure may determine the maximum operating pressure of the system. Reference should be made to the technical data provided by the fitting manufacturer.

Most types of flange joint can be used but again the particular type of flange used and its installation may determine the maximum operating pressure of the system and so the technical data provided by the flange manufacturer should be consulted.

Malleable Iron Fittings

Due to their long history and tradition malleable iron fittings are the most common pipe fittings and because of their durability and mechanical strength these fittings continuously enjoy great popularity. The material bearing high mechanical stress together with the universal standardised jointing method ensure a safe use of a wide range of applications. Where used, malleable iron fittings should be manufactured in accordance with BS EN 10242.



Grooved Jointing Systems

Mechanical pipe joining technology was first developed during World War I. Today the grooved pipe jointing system is widely used in many piping systems, including sprinkler systems and wet and dry riser pipework.



Features and Benefits

- Quicker to install than a welded, flanged or threaded system

- Joints can be dismantled and reassembled to facilitate modifications to piping systems, maintenance of pumps etc.
- Minimal equipment investment – only a spanner or socket required for assembly
- Service down time minimised - only 2 bolts required for a 200mm joint, compared to 12 bolts for a PN16 flange
- No Hot Work Permits required
- No X-Ray/Non-Destructive Testing (NDT) required
- Grooved ended pipework is significantly lighter than flanged pipework
- The use of grooved products provides a cleaner system compared to a welded or threaded system.

Anatomy of a grooved joint

A mechanical joint is comprised of four elements: grooved pipe, a gasket, coupling housings, and nuts and bolts. The pipe groove is made by cold forming or machining a groove into the end of a pipe. The elastomeric gasket is stretched over the pipe ends, which applies the initial compression of the gasket. The coupling housings then engage into the groove around the circumference of the pipes and the nuts and bolts are tightened. This encapsulates the gasket, creating a further compressive seal. Finally, pressure within the piping system reinforces the gasket seal.

Grooved connections can be used for a variety of pipe sizes, from 20mm NB to 600mm NB, couplings to suit most pipe material grades and wall thicknesses are available to provide rigid or flexible systems.

Rigid Couplings

Rigid grooved end piping systems provide a mechanical and frictional interlock onto the pipe ends sufficient to result in a rigid joint. The couplings have a unique, angle pad design which constricts the housing keys into the groove around the full circumference to grip the pipe. The housings slide on the angled pads rather than mating squarely. This sliding



adjustment also forces the key sections into opposed contact on the inside and outside groove edges, pushing the joint to its maximum pipe end separation during assembly. These products can be considered to have system behaviour characteristics similar to those of welded or flanged systems, in that all piping remains in strict alignment and is not subject to deflections during operation and electrical continuity is also maintained.

Flexible couplings

Flexible grooved couplings allow a certain amount of controlled pipe movement. Although the majority of sprinkler grooved piping systems are installed with rigid couplings, flexible couplings can be utilised where pipe movement is anticipated, i.e. building movement or settlement, or to create curved pipe runs.



Elastomeric Gaskets

As described above, the elastomeric gasket is fully encapsulated within the coupling, and is pressure responsive. The standard gasket material for sprinkler systems is Ethylene Propylene Diene Monomer (EPDM). Lubrication of the gasket is essential to ensure the gasket is not damaged or pinched during installation, however only a thin coating of lubrication is required. Recent advancements in grooved technology, such as installation-ready couplings, do not require lubrication.

Roll and Cut Grooving

The roll grooving process is performed on standard steel. Roll grooving tools are designed to cold form grooves into the pipe to meet the groove dimensions specified in the manufacturers Groove Specifications for each type and diameter of pipe. It is recommended that the installing contractor sources the roll grooving tool from the grooved coupling manufacturer, and receives certified training from the same manufacturer on the correct and safe use of the tool. Cut grooving can be used on standard weight or heavier walled thickness pipe

Approvals

Component performance requirements for many piping applications are dictated by standard codes relevant to the service. In order to comply with the code requirements, the piping materials must be able to maintain their published performance capabilities while in service. Grooved connections on roll grooved

pipe have consistently met the requirements of various industry codes based on their proven performance capabilities. In relation to the fire protection industry Grooved couplings should meet the stringent testing requirements of the LPCB, FM, UL & VdS approval bodies. These tests include heat exposure, bending moment, corrosion, low and high temperature and accelerated ageing tests.

Electrical Continuity

Electrical continuity has to be considered in the choice of product and system design.

Flanges

Flanges for sprinkler systems should be provided in accordance with the relevant system design standards.



Bending

The bending of steel tube intended for sprinkler use is not recommended since this may reduce the internal bore of the pipe and hence reduce the rate of water delivery.

The recommended bending procedures of BS EN 10255 (BS1387) are as follows:

Self colour/red primer painted tube

The following centre line bend radii should not be less than:

- For hot bending $3D$ (where D = outside diameter).
- For cold bending $5D$

Galvanised tube

Galvanised tube cannot be bent without damaging the coating. For cold bending of galvanising, it is recommended that the radius should not be less than $8D$. It should be noted that there is a risk of disbondment of the zinc coating during bending. To ensure that the service life is not compromised any such disbondment should be repaired by the application of a zinc rich paint (per BS EN ISO 1461(8)).

Presented by:

