BSRIA

CODE OF PRACTICE 11/2002

Flexible Hoses

A code of practice for services installers

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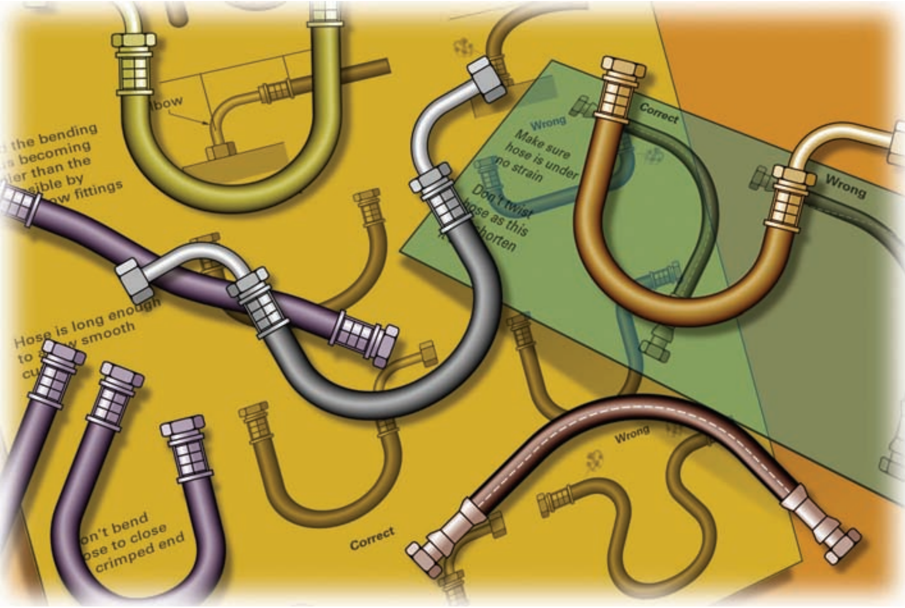

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ACKNOWLEDGEMENTS

This guide was produced by BSRIA on behalf of the Federation of Environmental Trade Associations (FETA) and the Hose Manufacturers and Suppliers Association (HMSA). BSRIA would like to thank the HMSA for sponsoring the production of this code of practice and the forthcoming standard: *Flexible Hose Assemblies for Building Services Applications.*

BSRIA would also like to thank companies in the HMSA which provided additional technical input to the code and the standard.

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CONTENTS

TABLES AND FIGURES

Flexible hoses provide a flexible solution to linking pre-installed or prefabricated pipework to building services components such as fan coils and chilled ceiling modules. Benefits include:

- time saving and productivity during installation
- allowance for minor misalignment of components
- take up of thermal expansion and contraction
- isolation of noise and vibration

Flexible hoses do however have a finite life which is strongly influenced by the quality of manufacturing, the care exercised by the installer and subsequent operating conditions. Hose assemblies, with rubber and plastic hoses, complying with the forthcoming HMSA standard (*Flexible Hose Assemblies for Building Services Applications)* are expected to have a minimum service life of 10 years when appropriately specified and correctly installed. Metal hoses adhering to this standard should have a life of 25 years.

This code of practice has been written to help specifiers, installers and maintenance operatives achieve the benefits that flexible hoses can provide while ensuring long term reliability.

The manufacturers who contributed to this guide can offer applications guidance for specifiers, installers and maintenance companies dealing with flexible hoses.

2.1 APPLICATIONS

The applications considered in this *Code* and in the standard are associated with closed-circuit heating and chilled water systems; that is systems which typically operate at a pressure between 0 and 10 bar_g and a flow temperature of between 10°C (chilled water) and 85°C (heating systems). For safety reasons, the hoses are rated at 10 bar working pressure and up to 110°C for short term temperature excursions.

The majority of hoses sold for these applications are based on Ethlene Propylene Diene Monomer (EPDM) rubber covered with a stainless steel braid. These hoses offer good mechanical flexibility, but gradual thermal degradation of the rubber limits the life of the hose.

Metal hoses may need to be specified where continuous use at high temperature or longer service life is required.

Plastic materials are also used in hose manufacture but are generally less flexible than the braided rubber hose.

2.2 BORE AND LENGTH

Hoses are available in a wide range of bores and lengths and are often custom-manufactured for the application. Usually the bore of the hose is less than the adjoining pipework, but this is not always the case. The cost of the hose assembly increases rapidly with bore so there is a trade-off between the cost and the pressure drop which will influence pump sizing and future operating costs. Where the pressure drop is critical then the designer can refer to manufacturers' data to calculate the pressure drop of the hose assembly including the end fittings.

The length of the hose should be sufficient to ensure that it can be properly installed without undue stress or going below the minimum bend radius. Bear in mind that while the standard specifies the overall length of the hose as being between the mating faces of the fittings, the active length is only the flexible part. Ideally the hose should be installed with a natural bend, in other words there should be minimal bending moment where the hose reaches the ferrule.

Examples of good and bad installation geometry are discussed in Section 3.1

2.3 END FITTINGS

Any kind of end fitting can be specified for a flexible hose including:

- Screwed ISO taper or parallel
- screwed ISO with cone seal
- push-fit connection
- self-sealing, quick-connect coupling
- tube end (bare tube used mainly with compression fittings).

It is important to avoid twisting the hose during installation and this cannot be achieved with, for example, fixed threads at both ends. At least one end of the hose should have a fitting which allows free rotation until tight.

The preferred screwed fitting incorporates a cone (metal to metal) seal, with the female end allowing the rotation. Parallel threaded female fittings with non-metal washers can also be used, but these may be less reliable in the long term. Note that fibre washers should only be used once.

Threaded connections should have a hexagonal section so that spanners may be used during installation.

Push-fit connectors and self-sealing couplings are common and can be very quick to fit. It is preferable to use removable push-fit connectors, as the hose will have to be replaced eventually. Care must be taken to ensure that pipe onto which the connector is pushed has been properly cut with an appropriate tool so that there are no sharp edges, burrs or swarf, which could damage the O-ring.

Quick-release couplings (self-seal or without valve) may also be used in conjunction with other hose end fittings, or directly fitted to the hose assembly by way of a suitable hose tail. They should be manufactured from stress and corrosion-resistant materials and have a mechanism that provides instantaneous shut-off on disconnection. EPDM seals should be used for both valve and main seals.

Push-fit connectors or quick-release couplings can be used as a point of rotation but they must be installed after the fixed end. Neither of these connections should be rotated once fitted.

Bare stubs of copper pipe are supplied where installers want the flexibility to use compression or soldered fittings. There are no problems with compression fittings, which also provide a point of rotation. Soldered fittings should only be used for metal hoses and can be a source of problems, such as flux contamination, unless applied very carefully. Installers should refer to the hose manufacturer for guidance.

Details of minimum bend radii for each hose nominal diameter (ID rated) are provided by the manufacturer.

2.4 WATER TREATMENT CHEMICALS

All modern heating and chilled water systems contain a cocktail of chemicals designed to reduce corrosion, scale and biological growth. Chilled water systems also contain anti-freeze. More chemicals may be added during the flushing and cleaning stages of pre-commissioning, and throughout subsequent maintenance.

All materials used in plumbing have certain chemical incompatibilities, and the ill-considered use of water treatment chemicals can cause problems. For example, neither rubber nor stainless steel hoses will tolerate high concentrations of chlorine.

EPDM is widely used for hoses in the applications referred to this *Code of Practice* and has proven to be suitable for the standard mixture of water treatment chemicals. Alternative materials should display proven resistance and compatibility.

If in doubt about the suitability of chemicals then expert advice and a compatibility guarantee should be sought from the water treatment company.

2.5 LIFE EXPECTANCY

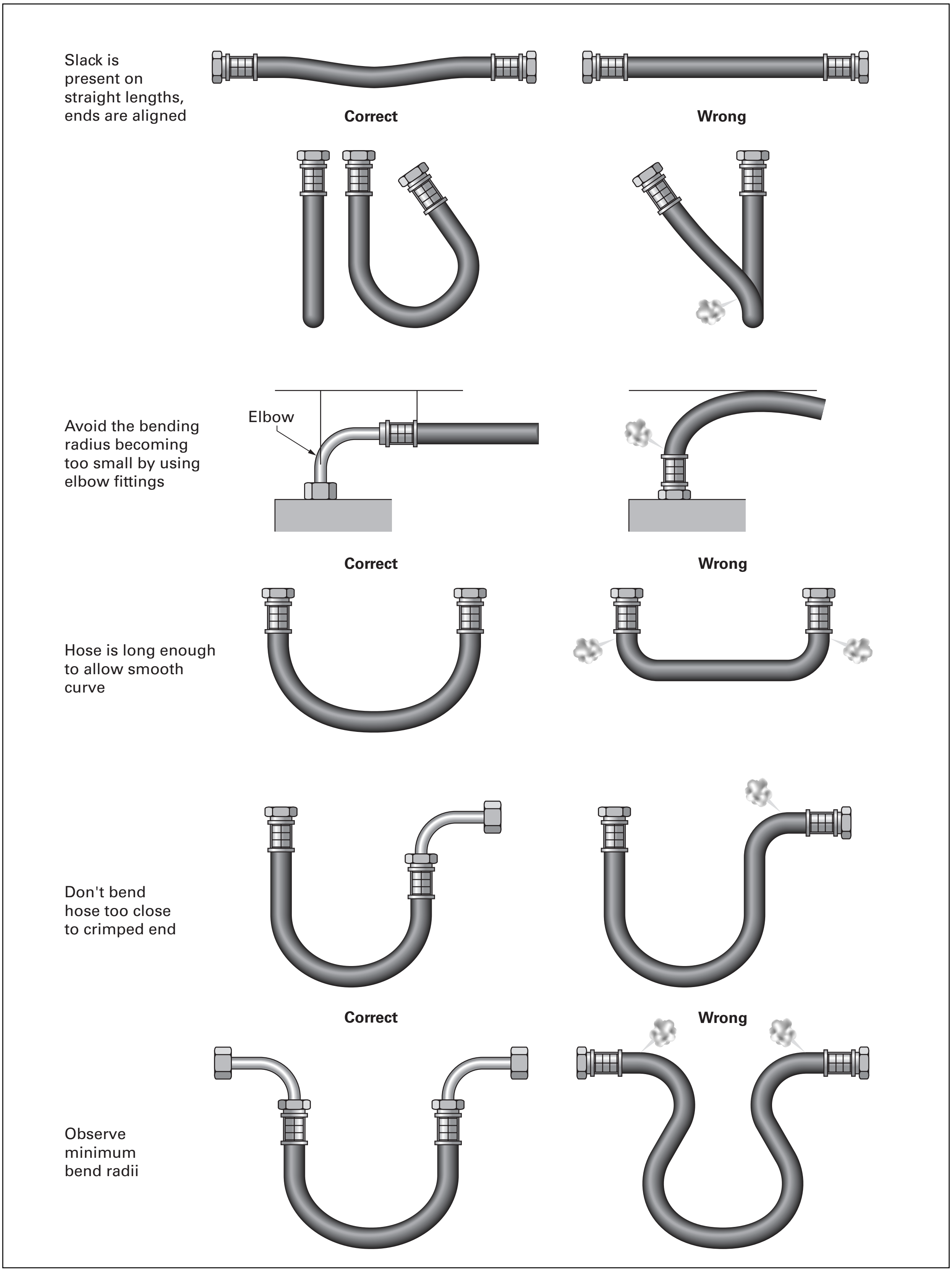
Hoses complying with the flexible hose standard should have a minimum guaranteed life of 10 years, at the maximum temperature and pressure. Hoses not exposed to these extremes are expected to have a longer life. Table 1 lists the factors that can lead to premature failure of a flexible hose.

TABLE 1: Factors which may promote premature failure.

Poor installation	Sharp bends (see Section 3.1) Twisting Tension Acute misalignment Contamination from solder flux
Poor specification	Too short Inappropriate end fittings
Operating conditions	Working temperature limits frequently exceeded Excessive movement External mechanical damage and abrasion High flow rates/dirty water
Poor maintenance	Failure to repair joint leakage Damage to fittings during plant maintenance
Chemical treatment	Aggressive flushing Exposure to chlorine chemicals Incompatible water treatment

3.1 PREFERRED GEOMETRY AND MINIMUM BEND RADIUS

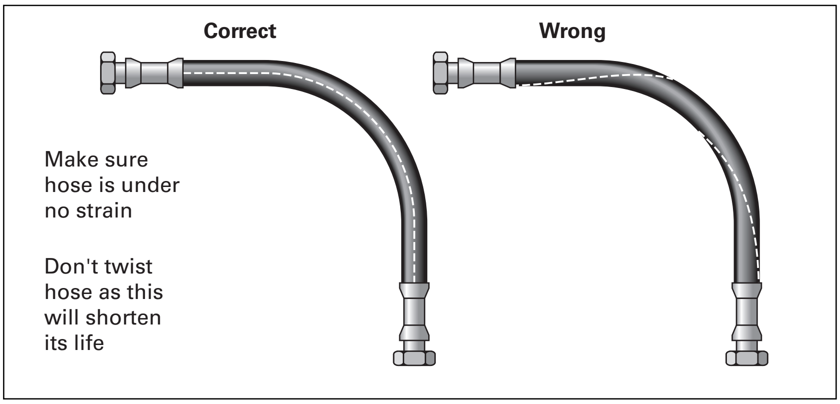
Figure 1: Good and bad installation geometry.



3.2 AVOIDANCE OF TWIST AND STRETCH

Great care should be taken to ensure that the flexible hose will not become twisted (Figure 2) or kinked during installation.

Figure 2: Avoidance of twist.



Rigid fittings, for example BSP taper connectors, are fastened first. Fittings allowing rotation are fastened second. Following the fastening of the second fitting, rigid fittings should not be further tightened, as this may cause twisting and damage.

3.3 CHECKING FOR LEAKS

The flexible hose standard requires a high degree of quality control of materials and manufacturing processes which should ensure that the hose assembly as supplied does not leak. Usually a random selection of rubber/plastic hose assemblies will be pressure tested. However, for critical applications 100% testing should be specified. Metallic hoses are always 100% pressure tested.

It is therefore more likely that any leakage will be where the fitting joins the pipework or hvac component rather than from the hose assembly. This will be detected during normal pre-commissioning pressure testing.

Since the hoses are rated at 10 bar working and 20 bar proof, there are no special precautions required in relation to the hoses during cold pressure testing of the system.

3.4 SYSTEM FLUSHING AND CLEANING

The use of aggressive cleaning and flushing agents should be avoided. Oxidising biocides such as hypochlorite should be avoided for rubber and stainless steel hoses.

If in doubt about the suitability of chemicals then expert advice and a compatibility guarantee should be sought from the company supplying the chemical.

3.5 OTHER ISSUES

Other key issues for the installation of flexible hoses include bacteriological problems and earth continuity

Rubber hoses can potentially act as a benign substrate for the growth of bacteria and biofilm, particularly in chilled water systems. *Pseudonomas* has been implicated in system blockages. Problems are most likely to occur in nutrient-rich (contaminated) systems where there is inadequate biocidal treatment and low flow velocities.

4.1 TYPES OF FAILURE

Leakage may potentially result from:

- Connection failures
- crimp failures
- material (rubber) failures
- corrosion of metal parts.

If the initial connection of the end fitting to the adjoining pipework or component is satisfactory then subsequent failure is very unlikely. The possible exception is where face-seal fittings have been used. Face seals can be subject to creep leading to leakage. There have also been examples where face seals have been replaced with inappropriate materials during disconnection and maintenance of the plant. For this reason, metal to metal sealing such as cone seal fittings are preferred.

Crimp failures have been known to occur due to poor manufacturing quality control but it would be extremely unlikely for hoses assemblies manufactured to the standard and properly installed.

Corrosion failures have been known to occur where end fittings, particularly the barbed portion inside the hose, has been manufactured from carbon steel. The standard requires that end fittings for rubber and plastic hoses are made from a suitable corrosion-resistant material. Carbon-steel fittings may be used on stainless steel hoses, provided they are thick enough to tolerate slight corrosion.

4.2 VISUAL CHECKS

The general condition of the hose should be periodically checked for leakage, external damage and any evidence that it is being subjected to excessive mechanical stresses.

4.3 SAMPLING AND EXAMINATION

In an installation with large numbers of hoses it is recommended to periodically remove a sample hose for detailed inspection and testing as a guide to the condition of the remainder. For rubber hoses the testing should include a proof pressure test and inspection of the rubber. The results can be used in the context of a planned replacement strategy.

In the absence of any other evidence, building owners should consider a planned replacement of rubber/plastic hoses every 10 years. This can be modified according to intermediate sampling and examination.

There will be a need to identify which hoses have been replaced and when. Flexible hoses complying with the standard are date stamped.

The HMSA is a specialist section within the FETA. The HMSA was formed by the leading suppliers of flexible hoses to the building services sector, with the specific aim of protecting customers from inferior products. It achieves this through the third-party, independent testing of HMSA member hoses to a unique standard and by publishing recommended installation practices.

For further information visit www.feta.co.uk

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