chapter 2

Hot and cold water supply

OVERVIEW

As a plumber the bulk of the work you will carry out will be covered by Regulations, British Standards and Codes of Practice. These include: Building Regulations, Health and Safety legislation, Gas Safety (Installation and Use) Regulations 1998 and many British Standards and Codes of Practice, particularly BS 6700.

In this chapter you will focus on the requirements of the Water Supply (Water Fittings) Regulations 1999, which in the main cover the requirements of cold and hot water supply installations as they apply to the list below. It will also look in more detail at pumped supplies to showers and private water supplies from wells and boreholes.

- Legislation
- Materials and substances in contact with water
- Water fittings
- Design principles and system installation and commissioning
- Prevention of cross connection to unwholesome water
- Backflow prevention and fluid categories
- Cold-water services
- Hot-water services
- Other appliances (WCs, urinals etc.)
- Water for outside use
The Regulations themselves can be quite hard to follow. While this text refers to the Regulations, it also includes an interpretation of what they mean. This section also covers some of the content of the following technical certificate units:

- Unit 301 Cold-water Systems
- Unit 302 Domestic Hot-water Systems.

**Legislation**

At the end of this section you should be able to:

- state the main legislation relevant to the installation and use of cold and hot water services
- explain the main areas of the Water Regulations that relate to the work of the plumber.

This section looks at the legislation that is relevant to the installation and use of cold- and hot-water services. It includes a brief overview of the current Regulations, the Regulations that are relevant to your job, a discussion of some important issues arising from the Regulations, and the European perspective.


**Background to the legislation**

The control of water-supply installations in England and Wales has been completely revised by the introduction of the Water Supply (Water Fittings) Regulations 1999.

The Secretary of State for the Department of the Environment, Transport and the Regions (DETR) exercised his powers under the Water Industry Act 1991 to enforce Water Regulations that control the installation and use of water fittings, resulting in the making of the Water Supply (Water Fittings) Regulations 1999. The Regulations apply only in England and Wales, but similar requirements have been made by the Scottish Office and Northern Ireland Office.

Previous to the Act, the United Kingdom had a long history of Water Byelaws, which were managed and enforced by local water suppliers. Newly introduced Byelaws expired after ten years, but they would be renewed or updated as necessary. The last renewal of the Water Byelaws was in 1986, before being finally replaced by the new Water Regulations on 1 July 1999.
The Water Regulations are National Regulations made by the Department of the Environment, Food and Rural Affairs (DEFRA). They apply to all installations in England and Wales that are supplied from a public main by a water undertaker. Water undertakers are responsible for the enforcement of the Regulations.

The Regulations have similar aims to the old Byelaws, but are applied differently. They have introduced a significant number of changes in the way water fittings have to be installed and used.

**Relevant legislation**

The principal legislation governing the creation of the Water Regulations is the Water Industry Act 1991, with sections 73, 74, 75, 78 and 213(2) being particularly relevant. Table 2.1 gives an overview of what these sections discuss.

<table>
<thead>
<tr>
<th>Section</th>
<th>Contents of section</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>Offences of contaminating, wasting and misusing water (legal action)</td>
</tr>
<tr>
<td>74</td>
<td>Regulations for preventing contamination, waste etc., with respect to water fittings</td>
</tr>
<tr>
<td>75</td>
<td>Power to prevent damage, taking steps to prevent contamination, waste etc.</td>
</tr>
<tr>
<td>84</td>
<td>Local authority rights of entry etc.</td>
</tr>
<tr>
<td>213(2)</td>
<td>Powers to make Regulations</td>
</tr>
</tbody>
</table>

Table 2.1 Relevant sections of the Water Industry Act 1991, which govern the creation of the Water Supply (Water Fittings) Regulations 1999
An extract from Section 74 is reproduced below:

**74 Regulations for preventing contamination, waste etc. and with respect to water fittings**

(1) The Secretary of State may by Regulations make such provision as he considers appropriate for any of the following purposes, that is to say –

(a) for securing —
   (i) that water in a water main or other pipe of a water undertaker is not contaminated; and
   (ii) that its quality and suitability for particular purposes is not prejudiced, by the return of any substance from any premises to that main or pipe;

(b) for securing that water which is in any pipe connected with any such main or other pipe or which has been supplied to any premises by a water undertaker is not contaminated, and that its quality and suitability for particular purposes is not prejudiced, before it is used;

(c) for preventing the waste, undue consumption and misuse of any water at any time after it has left the pipes of a water undertaker for the purpose of being supplied by that undertaker to any premises; and

(d) for securing that water fittings installed and used by persons to whom water is or is to be supplied by a water undertaker are safe and do not cause or contribute to the erroneous measurement of any water or the reverberation of any pipes.

In other words, Section 74 outlines that the Water Regulations have been made to:

- make sure water isn’t contaminated, and that its quality and suitability for a purpose isn’t harmed before or after being supplied to a premise
- prevent waste, undue consumption and misuse of water supplied by the undertaker
- make sure that water fittings are safe and don’t cause or lead to erroneous measurements or vibration and noise in pipes.

These show that the Regulations have been written to protect the water supply and to protect users against their own actions.

**The Water Supply (Water Fittings) Regulations 1999**

The Water Supply (Water Fittings) Regulations 1999 is made up of 14 Regulations. These are divided into three parts and are supported by three Schedules. The Schedules should be treated as part of the Regulations. A brief outline of the Regulations is given in Table 2.2.
<table>
<thead>
<tr>
<th>Regulation</th>
<th>Content of Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
<td>• Gives the date when the Regulations came into force and some interpretations to help understand the Regulations.</td>
</tr>
<tr>
<td></td>
<td>• Makes statements as to how the Regulations should be applied.</td>
</tr>
<tr>
<td>Schedule 1</td>
<td>• Supports Part I.</td>
</tr>
<tr>
<td></td>
<td>• Outlines the fluid risk categories that may occur within and downstream of a water-supply network.</td>
</tr>
<tr>
<td></td>
<td>• Needed for the backflow requirements of Schedule 2.</td>
</tr>
<tr>
<td>Part II</td>
<td>• Defines what is expected of a person(s) installing water fittings.</td>
</tr>
<tr>
<td></td>
<td>• Outlines how water fittings should be installed and used to prevent waste or contamination.</td>
</tr>
<tr>
<td></td>
<td>• Puts conditions on materials and fittings that may be used.</td>
</tr>
<tr>
<td></td>
<td>• Requires contractors to notify the water suppliers of certain installations, and encourages the introduction of Approved Contractors Schemes.</td>
</tr>
<tr>
<td>Schedule 2</td>
<td>• Supports Regulation 4(3) (Requirements for Water Fittings).</td>
</tr>
<tr>
<td></td>
<td>• Has 31 separate requirements.</td>
</tr>
<tr>
<td></td>
<td>• Looks at all aspects of water fittings.</td>
</tr>
<tr>
<td></td>
<td>• Deals with the practical aspects of Part II Regulations.</td>
</tr>
<tr>
<td>Part III</td>
<td>• Deals with the enforcement of the Regulations.</td>
</tr>
<tr>
<td></td>
<td>• Sets out penalties for breaking the Regulations.</td>
</tr>
<tr>
<td></td>
<td>• Sets out disputes procedures.</td>
</tr>
<tr>
<td>Schedule 3</td>
<td>• Supports Regulation 14.</td>
</tr>
<tr>
<td></td>
<td>• Lists Byelaws of various water undertakers which have been replaced with the Water Industry (Water Fittings) Regulations 1999.</td>
</tr>
</tbody>
</table>

*Table 2.2 Summary of the main parts of the Water Supply (Water Fittings) Regulations 1999*
**Important aspects of Part I**

Part I helps with the interpretation of the Regulations by defining terms used in them and explaining what they apply to.

### Regulation 1 definitions

Regulation 1 makes some important definitions:

- **Approved Contractor**
  - a person who has been approved by the water undertaker for the area where a fitting is installed or used
  - a person who has been certified as an approved contractor by an organisation specified in writing by the regulator.

- **The Regulator**
  - In England the Regulator is the Secretary of State. In Wales it is the National Assembly of Wales.

- **Material Change of Use** a change in how premises are being used, so that after they are changed they are used:
  - as a dwelling
  - as an institution
  - as a public building
  - for storage or use of substances that mix with water to make a category 4 or 5 fluid.

- **Supply Pipe** as much of any service pipe that is not vested in the water undertaker.

### The Water Supply (Water Fittings) Regulations 1999

**Do apply to:**

<table>
<thead>
<tr>
<th>Do apply to:</th>
<th>Do not apply to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every water fitting installed or used where the water is supplied by the water undertaker.</td>
<td>Water fittings installed or used for any purpose not related to domestic or food production, so long as:</td>
</tr>
<tr>
<td></td>
<td>• the water is metered</td>
</tr>
<tr>
<td></td>
<td>• the supply does not exceed 1 month (3, with written consent) and</td>
</tr>
<tr>
<td></td>
<td>• no water is returned to any pipe vested in a water undertaker.</td>
</tr>
<tr>
<td></td>
<td>• Water fittings that are not connected to water supplied by a water undertaker.</td>
</tr>
<tr>
<td></td>
<td>• Lawful installations used before 1 July 1999 (these do not have to be replaced).</td>
</tr>
</tbody>
</table>

**Table 2.3** Summary of Regulation 2, which lists the water fittings that are covered by the Water Regulations
**Important aspects of Part II**

Part II of the Regulations contains information about the quality or standard of water fittings and their installation.

The aims of the Water Industry Act, Section 74(1), are given in detail in Regulation 3. Regulation 3 also states that any work on water fittings is to be carried out in a **workmanlike manner**.

Regulation 5 requires a person who proposes to install certain water fittings to notify the water undertaker, and not to commence installation without the undertaker’s consent. The undertaker may withhold consent or grant it on certain conditions.

This requirement does not apply to some fittings that are installed by a contractor who is approved by the undertaker or certified by an organisation specified by the Regulator.

The installation of the following water fittings and systems requires notice to the water undertaker, except those items in bold italics, if carried out by an Approved Contractor:

- the erection of a building or other structure not being a swimming pool or pond
- the extension or alteration of any water system in a building other than a house
- a material change of use of any premises
- the installation of:
  - a bath having a capacity of more than 230 litres
  - a bidet with ascending spray or flexible hose
  - a single shower unit, not being a drench shower for Health and Safety reasons, approved by the Regulator
  - a pump or booster pump drawing more than 12 litres a minute
  - a unit that incorporates reverse osmosis
  - a water treatment unit that uses water for regeneration or cleaning
  - an RPZ valve assembly or other mechanical device for backflow protection from fluid category 4 or 5
  - a garden watering system, unless designed to be operated by hand
  - any water system laid outside a building less than 750 mm or more than 1350 mm underground.

Where an Approved Contractor installs, alters, connects or disconnects a water fitting, they must provide a certificate to the person who commissions the work stating that it complies with the Regulations.
**Important aspects of Part III**

A brief description of the Regulations in Part III is given in Table 2.4.

<table>
<thead>
<tr>
<th>Regulation number</th>
<th>Content of Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 &amp; 8</td>
<td>Provide for a fine not exceeding level 3 on the standard scale for contravening the Regulations. <strong>It is a defence to show that the work on a water fitting was done by or under the direction of an Approved Contractor, and that the contractor certified that it complied with the Regulations.</strong> This defence is extended to the offences of contaminating, wasting and misusing water under section 73 of the Water Industry Act 1991 (reg 8).</td>
</tr>
<tr>
<td>9</td>
<td>Enables water undertakers and local authorities to enter premises to carry out inspections, measurements and tests for the purposes of the Regulations.</td>
</tr>
<tr>
<td>10</td>
<td>Requires the water undertaker to enforce the Regulations (this is done by the Regulator or the Director General of Water Services).</td>
</tr>
<tr>
<td>11</td>
<td>Enables the Regulator to relax the requirements of the Regulations on the application of the water undertaker.</td>
</tr>
<tr>
<td>12</td>
<td>Requires the Regulator to consult water undertakers and organisations representing water users before giving an approval for the purpose of the Regulations, and to publicise approvals.</td>
</tr>
<tr>
<td>13</td>
<td>Provides for disputes arising under the Regulations between a water undertaker and a person who has installed or proposes to install a water fitting to be referred to arbitration.</td>
</tr>
<tr>
<td>14</td>
<td>Revokes the existing Water Byelaws made by water undertakers under section 17 of the Water Act 1945.</td>
</tr>
</tbody>
</table>

**Table 2.4** Summary of regulations covered by Part III of the Water Industry Act 1991

**Schedules**

The Regulations contain three schedules:

- **Schedule 1** on fluid categories defines categories of fluids that may exist both within and downstream of water supply pipework.

- **Schedule 2** is about the requirements for water fittings and contains most of the detailed information plumbers need to know. We shall be covering these in greater detail later in the section.

- **Schedule 3** covers the Byelaws revoked and consists of a list of water companies whose Byelaws have been revoked. (Schedule 3 is not reproduced in this book.)
Approved (Guidance) Document

The Water Regulations contain little technical detail, so DEFRA has produced a Guidance Document which explains in more detail the expectations of the Regulations.

In addition to the Guidance Document, the Water Regulations Advisory Scheme (WRAS) have produced a Water Regulations Guide. This technical colour guide gives practical advice on compliance with the Regulations and how they can be achieved. It includes a copy of the Regulations, the DEFRA formal guidance and further commentary and guidance on the Regulations.

It’s not compulsory to follow the WRAS Guide, but if you do you will satisfy the requirements of the Regulations. It is up to you to show proof that your installation complies with these requirements. This means that you must be competent in what you do, and that you need to have the qualifications, knowledge and practical experience to carry out your work in a workmanlike manner.

European legislation

Under the conditions of a Directive of the European Commission (EC), Britain must consult with the EC (and with other European countries) for approval before any technical Regulations are made.

This has led to changes in installation methods and the ways in which water is being used (for example, the use of pressure flushing valves for WCs and urinals).

Materials and substances in contact with water

At the end of this section you should be able to:

- list potential hazards to the water supply
- list the materials approved for pipes and fittings
- describe how to identify approved materials
- state which materials are specifically forbidden for use on wholesome water systems
- describe the problems caused by galvanic action
- state the factors to consider when selecting materials for an installation
- define galvanic action and describe its effects
- state the particular problems posed by lead when connected to copper.
Schedule 2 Paragraph 2 of the Regulations makes sure that materials or substances used (alone or in conjunction with any other material) will not cause any contamination that will affect the qualities of drinking water.

Materials that are used in water systems must not contain any substance that could be absorbed into the water, causing the water to become toxic or biologically unhealthy, affecting its colour, taste and smell or making it unfit to drink.

Materials include metallic, non-metallic and plastic substances that are used to make pipes, fittings and appliances, and materials used in jointing and for pipe coatings. Any material or substance in contact with water must not affect its quality.

The Requirements

Below are set out the requirements of Schedule 2, paragraph 2. Remember, this is an extract from the actual Regulations.

2(i) Subject to sub-paragraph (ii) below, no material or substance, either alone or in combination with any other materials or substances, or with the contents of a water fitting of which it forms a part, which causes or is likely to cause contamination of water, shall be used in the construction, installation, renewal, repair or replacement of any water fitting which conveys or receives, or may convey or receive, water supplied for domestic or food production purposes.

(ii) This requirement does not apply to a water fitting downstream of a terminal fitting (tap or valve) supplying wholesome water where:

(a) the use to which the water downstream is put does not require wholesome water; and

(b) a suitable arrangement or device to prevent backflow is installed.

Now take a look at the wording and get an understanding of the requirements.

Paragraph 2 concerns the supply of water for domestic and food production purposes, as well as water fittings that contain wholesome water. ‘Water for domestic purposes’ means wholesome water that is fit for drinking supplied by a water undertaker for general use. Paragraph 2 is also concerned with fittings containing wholesome water, such as a domestic tap, which could become contaminated, for instance by the attachment of a hosepipe, resulting in it no longer complying with the Regulations. Figure 2.1 shows this situation. If the end of the hose were to lie in a pool of contaminated water it could pose two hazards to the water supply:

- contamination
- backflow risk.
Backflow is the water ‘downstream’ in the hosepipe finding its way back through the tap into the water supply ‘upstream’, contaminating the supply. To prevent this, a backflow-prevention device is fitted.

Materials such as hosepipes, overflow pipes, flushing cisterns, feed and expansion cisterns and closed circuits may not be used to supply water for domestic purposes. Because of this, manufacturers don’t have to be so careful when they make them. Therefore, where these pipes or components are connected to a pipe that supplies drinking water, the water supply will need to be protected from any possible contamination that the materials may cause.

**On the job: Connecting a hosepipe**

It has been dry this summer and it looks as if a hosepipe ban is on the cards. Abe is worried about his perfect green lawn and decides it needs a good soaking to try to keep it as green as possible before a ban comes into force. He uses the sprinkler fitting on his hosepipe and attaches it to a cold-water tap.

1. How could this situation lead to contamination of the water?
2. How could this situation be a backflow risk?
3. How must Abe make sure he does not break Regulations with his hosepipe?

**Identifying approved materials**

Before buying or installing materials you should check to see if they comply with either a British or European Standard specification. However, you must note that British Standard specifications are guidance documents only and have no force of law, unless specifically referred to by the Regulations.

Manufacturers will clearly mark the product or packaging to show that the product conforms to relevant recognised quality standards.

If you are unsure about materials you should seek advice from your local water undertaker or from the WRAS. Part of their work has involved producing the *Water Fittings and Materials Directory*, which lists all approved fittings. The directory is a very useful guide to those who aim to comply with or enforce Water Regulations.
Where a connection has to be made onto a lead pipe, it must be done in such a way as not to cause any further contamination, using only fittings that are manufactured and approved for the purpose; the connection must be made in a manner that prevents galvanic action from taking place.

The use of lead pipe is prohibited from use in new installations, and it can’t be used for replacement in any part of an existing water supply installation. There are still many existing installations that contain lead pipes, though.

**Safety tip**

**WRAS approved product**

WBS teardrop symbol still shown on certain products tested before July 1999.

**CE**

The WRAS approved product symbol shows that the product has been tested for approval and is listed in the Fittings and Materials Directory.

**BSI kite mark**

The CE mark indicates that the product has been tested to EN standards and may legally be placed on the market.

The BSI kite mark, along with the BS number, shows that the product has been fully tested under the BSI quality testing scheme.

**Figure 2.3** Common symbols for approved plumbing materials

Look for these symbols on materials. Remember: the symbol may be on the product or packaging.

**Selecting materials**

There are two materials referred to in the guidance documents as health hazards, and which are specifically forbidden for use on wholesome water systems. These are:

- lead and any material or substance containing lead
- any bituminous coatings produced from coal tar.

Lead can be a hazardous material having harmful effects, therefore where a defective length requires replacing, you should advise the customer of the need to remove as much of the pipe as possible, and preferably remove all of it.

All materials must be chosen with care, and consideration must be given to the purpose that they’re intended for.

![Old lead piping must be replaced](Image)
FAQ

What is galvanic action?

Galvanic action is the electrolytic corrosion of dissimilar metals in a damp or wet environment. It can cause severe corrosion of metal pipes and fittings.

For instance, where copper and lead pipes are connected, direct galvanic action takes place, causing the lead to be dissolved and taken into solution, contaminating the water.

Indirect galvanic action occurs where particles of one metal are taken into solution, and the resultant solution attacks the pipe or fitting of a different metal downstream of the pipework system.

The rate at which electrolytic corrosion takes place depends on the materials’ position in the electro-chemical series (see Table 2.6).

Jointing materials

It is very important that you use materials that comply with a relevant British or European Standard specification, in particular those referred to in the Regulations or listed in the Water Fittings and Materials Directory or both (many materials will be covered in both ways).

<table>
<thead>
<tr>
<th>Type</th>
<th>Used for</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft solder</td>
<td>Capillary jointing of copper or copper alloy water fittings, may consist of:</td>
<td>BS EN 29453</td>
</tr>
<tr>
<td></td>
<td>• Type 23 or 24 tin/copper alloy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type 28 or 29 tin/silver alloy</td>
<td></td>
</tr>
<tr>
<td>Silver solder or silver brazing metal</td>
<td>Capillary jointing of copper or copper alloy, may consist of:</td>
<td>BS 1845, Table 2</td>
</tr>
<tr>
<td></td>
<td>• Type AG14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type AG20</td>
<td></td>
</tr>
<tr>
<td>Copper phosphorus brazing filler metals</td>
<td>• Type CP1 to CP6 (all brazing alloys should be free from cadmium)</td>
<td>BS 1845, Table 3</td>
</tr>
<tr>
<td>Jointing compounds</td>
<td>Sealing screwed water fittings (other proprietary compounds and hemp aren’t acceptable as they may promote microbiological growth)</td>
<td>BS 6956, Part 5</td>
</tr>
<tr>
<td>PTFE tape (un-sintered polytetrafluoroethylene tape)</td>
<td>Thread-sealing applications</td>
<td>BS 6974 and BS 6920, Part I</td>
</tr>
</tbody>
</table>

Table 2.5 Jointing materials

Safety tip

Solders used on wholesome water supply installations must indicate that they are ‘lead free’. Hemp or gasket must not be used for any types of joints under any circumstances.
The WRAS guidance document specifies the types of jointing materials that have been given individual approval for use.

The Regulations prohibit the use of solders containing lead for use on domestic hot and cold water pipework, although its use is permitted on central-heating installations where water isn’t drawn off.

**Water fittings**

At the end of this section you should be able to:

- define what is meant by a water fitting
- list jointing materials for use on water fittings
- list the forms of stress supply pipes are subject to
- list appropriate frost-protection measures for a variety of fittings and locations
- state the requirements for underground pipes and fittings, cold surfaces, roof spaces and external situations
- list practical measures to prevent contamination of water-storage cisterns
- describe devices to be used when water-storage cisterns become flooded
- describe ‘permeation’ and its effects on water supplies
- state the specifications for the support of pipes and cisterns.

Water fittings in the Regulations are defined as ‘meters, pipes (other than water mains), taps, cocks, valves, ferrules, cisterns, baths, water closets, soil pans and other similar apparatus used in connection with the supply and use of water’.

It’s important to consider the way in which we use water fittings, so that the contamination or wasting of water will not occur as a result of the fittings installed. You are responsible for the fittings you use in your installation work.

Water meters can help reduce the wasting of water

**The Requirements**

Paragraph 3 states that every water fitting shall:

(a) be immune to or protected from corrosion by galvanic action or by any other process which is likely to result in contamination or waste of water; and

(b) be constructed of materials of such strength and thickness as to resist damage from any external load, vibration, stress or settlement, pressure surges, or temperature fluctuation to which it is likely to be subjected.
Paragraph 4 states that every water fitting shall:

(a) be watertight;
(b) be so constructed and installed as to:
   (i) prevent ingress by contaminants, and
   (ii) inhibit damage by freezing or any other cause;
(c) be so installed as to minimise the risk of permeation by, or deterioration from, contact with any substance which may cause contamination; and
(d) be adequately supported.

Paragraph 5 states that:

Every water fitting shall be capable of withstanding an internal water pressure not less than 1½ times the maximum pressure to which that fitting is designed to be subjected in operation.

Paragraph 6 states:

No water fitting shall be installed, connected or used which is likely to have a detrimental effect on the quality or pressure of water in a water main or other pipe of a water undertaker.

Paragraph 7 states:

(1) No water fitting shall be embedded in any wall or solid floor.
(2) No fitting which is designed to be operated or maintained, whether manually or electronically, or which consists of a joint, shall be a concealed water fitting.
(3) Any concealed water fitting or mechanical backflow prevention device, not being a terminal fitting, shall be made of gunmetal or another material resistant to dezincification.
(4) Any water fitting laid below ground level shall have a depth of cover sufficient to prevent water freezing in the fitting.
(5) In this paragraph ‘concealed water fitting’ means a water fitting which:
   (a) is installed below ground;
   (b) passes through or under any wall, footing or foundation;
   (c) is enclosed in any chase or duct; or
   (d) is in any other position which is inaccessible or renders access difficult.

Water fittings need to be immune to, or protected from, galvanic action.

The further apart metals are in the electro-chemical series, the more likely it is that corrosion will take place. If two dissimilar metals are placed in contact with each other, the metal at the lower base end of the scale will be the one to corrode.

A typical example of this corrosion can be seen in galvanised steel cisterns that are connected to a copper pipework system. From Table 2.6 you will see that copper and zinc are some distance apart, and zinc is the metal that will corrode.
Another example of galvanic corrosion occurs when connecting copper pipe directly into lead pipe. The lead, being at the lower base end of the scale, will corrode, resulting in it being taken into solution, contaminating the water. The lead will also be weakened by the corrosion, eventually resulting in leakage.

Sometimes **cathodic protection** can provide protection against galvanic action. A **sacrificial anode** can be put inside hot-water vessels, cisterns and tanks, and on pipelines. The anode will corrode instead of the fitting that it protects.

Water fittings are required to resist damage from external load, vibration, stress or settlement pressure surges or temperature fluctuations to which they’re likely to be subjected.

Most water fittings, supply pipes, distributing pipes and discharge pipes are subject to the same forms of stress, whether by expansion and contraction, settlement and vibration or temperature change, e.g. cold and frost. All of these factors can put undue stress on materials, and when in service they must be capable of withstanding the stress, remaining watertight throughout. So, when selecting and installing water fittings you must ensure that any stress is kept to a minimum.
A typical example is where a pipe passes through a wall: it should be sleeved or ducted so as to protect it from stress caused by:

- expansion of the pipe
- movement of the wall.

Water fittings must be watertight and suitable for the working pressure and temperatures likely to be encountered within the installation. Basically, this means ensuring that water fittings are jointed using the proper techniques and remain watertight during service, carrying out all the correct commissioning checks, ensuring that all fittings are sound, and testing in accordance with the required standard.

Also, every water fitting must be capable of withstanding an internal water pressure not less than 1½ times the maximum pressure for which that fitting was designed.

Some of this requirement is the responsibility of the manufacturer of the water fittings, but you as the plumber have a responsibility to see that fittings are used and installed correctly and don’t exceed the limits laid down in the manufacturer’s instructions.

A typical example of the requirement is when installing or replacing copper storage vessels. The vessels are graded to suit various pressure conditions, e.g. a grade 3 copper cylinder to BS 1566 is suitable for a pressure of up to 10 metres head. If the vessel were to be fitted to an installation with a head greater than 10 metres, it would not be adequate for its purpose, invalidating the manufacturer’s guarantee.

**Ingress of contaminants**

Every water fitting must be constructed and installed so as to prevent ingress by contaminants, such as chemicals, vermin, insects or other things. The most vulnerable fittings are those incorporating air gaps, where the water itself is open to the atmosphere. Examples of these include water-storage cisterns.

Water-storage cisterns are required to have rigid, close-fitting and securely fixed covers and to be fitted with screened overflows and vents to prevent insects and dust from entering the cistern.

Water-storage cisterns must not be installed in positions where they’re likely to become flooded by rainwater, ground water or by the cistern overflowing. In instances where a cistern has to be installed in such a location, it must be installed in a watertight enclosure. This could be a concrete chamber or basement that’s watertight. Installations of this type must additionally be fitted with an electric sump pump, to remove any unwanted water that collects at the base of the watertight enclosure. Audible or visual devices must also be fitted to show if the cistern reaches overflowing level, and to warn that water is accumulating at the base of the chamber.

Other components such as cisterns and cylinders should be installed so that they don’t become contaminated by the build-up of sediment; and if necessary, filters should be fitted to prevent sediment passing through the pipework system.
Regular cleansing and maintenance of the installation will help stop sediment accumulating; sediment can provide an ideal environment for bacteriological growth (e.g. legionella), particularly where the water could be warmed up.

Water fittings such as drain valves must not be installed in positions where they’re likely to become submerged in any type of flooding – for example, below ground, below floors, or in sump chambers.

This installation shows drain valves provided for a solid floor duct installation. The valves are sited so that they do not present a contamination risk (i.e. not in the duct). They are just above ground level, so they will not become submerged and are accessible for maintenance activities.