

Information and Guidance Note

INFORMATION AND GUIDANCE FOR THE DEVELOPMENT OF SPECIFICATIONS FOR WATER SUPPLY PIPELINE SYSTEMS COMPONENTS

CONTENTS

- 1 General Scope and Objectives
- 2 General Properties and Performance Criteria
- 3 Product Quality Assurance

1. GENERAL SCOPE AND OBJECTIVES

This document is intended to form the basis for the development of harmonised standards for drinking water pressure pipeline components. It does not contain details of tests and test limits but identifies the properties which should be addressed in appropriate National Standards. It is intended that this document can be used by those involved in the preparation of specifications to ensure that all the important design characteristics of a product are considered. Note that some tests are already available in National Standards.

It covers pipes and simple fittings such as tees and bends but does not include valves. This document considers tests that may be required both on products themselves and components within products such as elastomeric rings.

2. PERFORMANCE CRITERIA AND QUALITY CONTROL

2.1 Introduction

Product and performance quality control criteria are summarised in this document. The tests are divided into three categories: Performance descriptors, long and short term mechanical properties. A further section details product appearance requirements and product marking.

2.2 Performance descriptions

2.2.1 Basic requirements

These are the basic requirements by which engineers might specify a product and include:-

- Pressure rating
- Size range, dimensions and tolerances
- Head loss
- Installation and assembly properties

Interaction with other materials
Effect of the material on water quality.

Although all these factors may not be specified often they are implicit in specifications.

2.2.2 Pressure rating

Most pipes are designed for operation at a particular pressure. In general these pressures range from about 6 bar up to 15 bar. It is unlikely that products with a pressure rating below 6 bar would be required by the Water Industry, because systems may have to be upgraded.

Pressures above 16 bar may be required but these would be specified as exceptions. Preferred pressure ratings are 6, 8, 10, 12 and 16 bar.

Fatigue conditions sometimes apply within water networks and products may have to be designed for this condition. All products should be capable of withstanding the effects of diurnal pressure variations.

In some instances there may be a significant and frequent fatigue loading, e.g. pumped lines. Products to be used in these environments should be capable of withstanding these effects. If they are not capable of lasting 50 years their lifetime, expressed as total cycles, should be specified by the manufacturer. Fittings must be capable of performing over the same pressure range as pipes. Under fatigue loading, for some products, the peak pressure should not exceed the maximum rated working pressure of the product.

2.2.3 Dimensions and tolerances

The dimensions and tolerances of pipes and fittings should define their capacity and may define their connectivity. The Water Industry's preference is for ISO and CEN dimensions given in millimetres. Pipes are specified on the outside or inside diameter (OD or ID) depending on custom though in general there is a preference for use of the OD.

2.2.4 Headloss

It has been realised by the Water Industry that there may be a significant loss of head, or pressure, across fittings. This is aggravated by the use of more complex



fittings such as water meter boxes and check valves, etc. This loss of head could affect the capability to meet standards of service and therefore have significant cost implications to the industry. As a result it is probable that future specifications, in particular those for fittings, mainly service connections <63mm, will specify a maximum allowable head loss at a specified flow across the fitting.

2.2.5 Installation and assembly properties

A principal objective in specifying installation and assembly properties is to ensure sealing efficiency together with speed of installation. Most specifications detail product performance; a product may be an individual fitting purchased from a manufacturer or it may be a whole pipeline which is installed by a contractor. Some specifications, e.g. the polyethylene welding spec. WIS No. 4-32-08, therefore specify the methods of installation. Sometimes the industry specifies a type of joint, e.g. PVC-U pipes are joined using elastomeric rings because of previous problems with long line fracture of solvent cement joints.

2.2.6 Interaction with other materials

This may have to be considered, in particular with respect to the contact, or likely contact, between two different metals, as this may lead to corrosion. In some instances coatings, linings or wrappings may be specified for some products e.g. ductile iron pipes.

The resistance of the pipe material to contaminated ground and permeability to gases should be considered.

2.2.7 Effects of materials on water quality

It is essential that pipes and fittings do not contaminate the water that they carry. Specifications should clearly refer to appropriate standards, e.g. BS 6920, which in turn refers to the DoE CCM Committee which appraises materials for use in potable water supply systems. These specifications/review systems, cover factors such as toxicity, carcinogenicity, and susceptibility to biodegradation. Reference should be made to existing water supply regulations where these are relevant.

2.3 Long term tests of mechanical properties

2.3.1 The probable performance of some products can be characterised by tests which can be accomplished over a relatively short period. Other tests, for instance weathering tests, can take much longer. This section discusses those tests which may have to be undertaken to establish long term properties.

2.3.2 Stress rupture performance

Specifications should contain tests that ensure the reliability of the product over the range of conditions and times under which it is expected to operate.

The long term performance of plastic pipes is characterised by a reduction in time to failure with increased pressure. Pipes are designed in such a manner that they will have a pressure capability that is

sufficient to ensure satisfactory performance for well in excess of 50 years. For example, a plastic pipe designed to operate at 10 bar for in excess of, say, 50 years may be only capable of withstanding 30 bar for a short time. Tests may be carried out on notched or unnotched pipes.

2.3.3 Compression set

The performance of elastomeric seals may deteriorate with time due to compression set. This is a reduction in the resilience of the material which affects the ability of the seal to spring back into place.

2.3.4 Creep

A similar phenomenon to compression set may occur with the softer plastics, like polyethylene, which exhibit creep. Creep of polyethylene may mean that jointing performance of compression fittings may change with time. This phenomenon has already been identified as a problem with fittings which rely on correct tightening of a number of bolts.

2.3.5 Resistance to corrosion

Resistance to corrosion is an important factor to be considered for a number of products made from metals. Corrosion may significantly affect product life. To reduce the risk of corrosion, valves and fittings may be protected with a surface coating or lining. Other products e.g. ductile iron pipes may be protected by sleeving. A specification may therefore have to make reference to a coating or lining specification.

2.3.6 Surface weathering

Some products, e.g. plastics pipes and elastomeric sealing rings may suffer weathering or surface oxidation when subjected to sunlight. This could potentially affect their long-term performance. This factor should therefore be considered in the development of some specifications, particularly when the product is designed for above-ground use.

2.4 Short term tests of mechanical properties

2.4.1 The aim of most short term tests is to provide routine quality control monitoring of products during the production cycle. Tests may be carried out on the products themselves, parts of the product, or components from within the product. For instance, a whole pipe fitting such as a 'T' may be tested for its burst strength, whereas only a small C ring cut from a pipe may be required to determine its fracture toughness; likewise an elastomeric ring seal (a component) within a fitting may have to be tested for hardness.

The short term test requirements are very much dependent on the nature of a particular product. However, the UK Water Industry has found from experience that certain short term tests are of importance in providing reliable products. The nature of

these tests is discussed in this section of the Guidance Note.

2.4.2 Tensile tests

Tensile tests are typically performed in two ways. Firstly to determine the tensile strength of the product, secondly to determine the strain behaviour of a product e.g. elongation at break testing. Both tests are aimed at determining materials' quality either before or after production.

2.4.3 Hardness testing

For some products such as elastomeric rings, the hardness is an important property which will affect the ability of a ring to make a good seal.

2.4.4 Shear at joints

Pipelines which are jointed by mechanical joints such as elastomeric O rings may be susceptible to the effects of shear at those joints.

Specifications should determine that this will not be a problem. It is interesting to consider whether this should be a long or short term test, as the effects of creep may not become apparent instantaneously.

2.4.5 Beam bending

Under some conditions pipes may be subjected to longitudinal bending which can lead to beam failure. It may be necessary to consider this problem for some rigid pipe materials but not for others like polyethylene.

2.4.6 External pressure

Leakproofness under external pressure may be an important factor where negative pressures occur within a pipeline. Negative pressures, such as those generated under surge, can lead to the ingress of contaminants into a water supply and it is essential that this is prevented.

2.4.7 Impact strength

During handling, pipes may be subjected to impacts, these can lead directly to failure of the product or to minor cracks which will ultimately lead to premature failure. Such tests may be of a qualitative nature or may be more quantitative e.g. critical strain energy release rate G_c (for MDPE) which is a measure of the resistance of the product to failure by fast fracture.

2.4.8 Tolerance to handling

All products should be sufficiently robust that they can be easily handled on site without impairing their long term performance. Where appropriate, guidance should be given on product handling and stacking.

2.4.9 Resistance to slow crack growth

It may be important to show that a product will resist growth of cracks due to point loads or inherent defects. An example of this is the fracture toughness test required for PVC-U pipes.

2.5 Product appearance and marking

2.5.1 Appearance

A product can pass all the tests but may not look right because of blemishes or minor defects that appear on it. Most specifications include a clause covering product appearance. This essentially provides the customer with a reasonable indicator should he have concerns about a product.

2.5.2 Marking

To enable positive identification on removal from storage and site jointing, or after exhumation in the event of a product failure, it is essential that products are adequately marked. Marking will normally indicate pressure rating or SDR, dimension, name of the manufacturer and data and time of production. A certification mark on the product indicates that the product has the advantage of having been produced under a third party quality assurance scheme.

2.5.3 Colours

Colour may be specified for the identification of the use of certain products for health and safety reasons. The colour coding helps to distinguish one utility's products from another, e.g. yellow for gas pipes, blue (or blue and black striped) for potable water pipes. Sewer pipes should also be colour coded.

2.6 Traceability underground

2.6.1 Traceability

Plastic pipes are often difficult to locate underground. If possible, measures should be taken to enhance the traceability of these products.

3. PRODUCT QUALITY ASSURANCE

3.1 Specifications

3.1.1 Wherever possible, products should comply with relevant European Standards. Where none are available National Standards or their equivalents should be used.

3.2 Certification

3.2.1 Manufacturers should operate a quality system to EN 29002 (BS5750: Part 2) for each product they produce for sale to the Water Industry.

3.2.2 Where possible products should carry a certification mark from an independent third party scheme. This ensures that product quality is maintained.

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