

## Information and Guidance Note

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# THE EVALUATION OF NEW PRODUCTS AND PROCESSES DEVELOPED FOR WATER INDUSTRY PIPELINES

## 1. SCOPE AND GENERAL REQUIREMENTS

This document is intended to provide guidance for the development of acceptable products and processes for pipelines for the UK Water Industry. It does not contain details of tests and test limits but identifies the general properties which should be addressed. It is intended that this document can be used as guidance by manufacturers and those involved in the preparation of specifications to ensure that all the important design characteristics of a product or process are considered.

Note that it is not intended to be exhaustive to cover every eventuality and manufacturers are advised to seek further guidance on Water Industry evaluation requirements from the UK Water Industry Materials and Standards Group. Not all test requirements may be available in National Standards. It is expected that many of these performance criteria will have been evaluated by the manufacturer prior to marketing the product within the Water Industry. However, the Materials and Standards Group may require a more detailed performance investigation dependent on the nature of the material, product or process involved before recommending a product or process to the Water Industry.

Research has shown that there is a need to proceed with caution until any limitations of a new product have been identified and understood. Initial recommendations for the use of new products have to be based on technical judgement and previous experience of similar materials, but this may not be entirely reliable. It is only after practical investigation that claimed performance is verified and the strengths and weaknesses are identified. There is an overall need for guidance to be given to suppliers on the Water Industry's requirements for new products or processes and for an evaluation procedure to enable Water Industry specifiers to become aware of the selection choices, performance, quality assurance status and availability of new

products. This evaluation may also include the monitoring of site trials and the agreement on an implementation programme within the Water Industry. During the implementation programme, the quality assurance status of the product may also be considered.

This document considers what may be required both on products themselves and components within products such as elastomeric rings.

## 2. EVALUATION PROCESS

### 2.1 General

The supplier may make contact with the Water Industry through the Materials and Standards Group. Alternatively, the Water Industry may make contact with a supplier and encourage development of a new requirement.

Detailed appraisal requirements may be identified by the Water Industry depending on the technical nature of the submission. Evaluation by the Water Industry does not absolve the supplier from any legal obligations for the product.

### 2.2 Stages

The proposed stages in the new product evaluation process are illustrated in Figure 1.

### 2.3 Funding and contractual issues

If the project involves any funding by the supplier, any evaluation and testing contract must allow the dissemination of information and (if appropriate) the development of a Water Industry Specification.



## 2.4 Appraisal and reporting focus

The formal appraisal and reporting focus will be the Materials and Standards Group which reports to the UK Water Industry Engineering and Operations Committee. The Group may seek technical support as necessary.

The Water Industry will be advised of progress by the Materials and Standards Group and any limitations given for the use of the product or process. Provision should be agreed for an appropriate means of information dissemination, such as a seminar.

## 2.5 Agreed introduction programme

During the introduction phase of a new product, the Materials and Standards Group may agree an introduction programme on behalf of the Water Industry. This may, for example, limit the acceptance of the product on a size or end-use basis depending on the level of confidence available. To help confirm that new product performance and installation meet expectations, the Materials and Standards Group may require site trials to be carried out.

The Materials and Standards Group will be the focus for ongoing technical enquiries concerning the evaluation.

The Water Industry may encourage the attainment of appropriate quality assurance certification for the product. Interim quality audits may be included during the introductory phase to advise on the status of the manufacturing process.

## 3. PRODUCT SPECIFICATIONS AND QUALITY ASSURANCE

### 3.1 Product specifications

#### 3.1.1 General

Pipeline components should be manufactured to an agreed specification which will provide confidence in product capability and allow the operation of appropriate quality assurance procedures. Wherever possible, products should comply with relevant European Standards. Where no relevant European Standard exists, National Standards, Water Industry Specifications or their equivalents should be used, subject to agreement by the Materials and Standards Group as to their applicability to the product. In some instances new test requirements will need to be developed and

agreed with the Materials and Standards Group or their designated technical steering group for the evaluation process.

## 3.2 Quality assurance

### 3.2.1 General

The Water Industry has indicated a preference for third party certified products (in CESWI) where these are available. Where the Water Industry has agreed a programme for the development of quality assurance requirements, the following general guidance will apply.

### 3.2.2 Quality management systems

Where required by the Water Industry, manufacturers should operate a quality system to BS EN 9002 (BS 5750: Part 2) relevant to the product offered for sale.

### 3.2.3 Certification

To ensure that product quality is maintained, and where required by the Water Industry, products should carry a certification mark from an NACCB accredited third party certification scheme. Product assessment certification may be appropriate where the adoption of such schemes has been approved by the Materials and Standards Group, e.g. single supplier submissions.

### 3.2.4 Interim arrangements

In a development situation it is recognised that an agreed product specification may not be available and/or the availability of products meeting the requirements of 3.2.2 and 3.2.3 may be limited and appropriate interim arrangements may be required.

## 4. TYPICAL PROPERTIES AND PERFORMANCE CONSIDERATIONS

### 4.1 Introduction

Consideration of product properties and performance criteria depends on the particular material and/or process involved. The following section is included to provide an example of the range of requirements that might be required. It is included as a guide only and should not be

considered as a complete specification of requirements. These guide requirements are divided into three categories: Performance descriptors, long-term durability and short-term properties.

## 4.2 Performance descriptors

### 4.2.1 Basic requirements

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

- Pressure rating
- Size range, dimensions and tolerances
- Headloss
- Installation and assembly method
- Interaction with other materials
- Effect of the material on water quality
- Product identification
- Compatibility with established systems (if appropriate).

### 4.2.2 Pressure rating

Most pressure pipelines are designed for operation at a particular pressure. In general these pressures range from about 6 bar up to 16 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 uprated.

Pressures above 16 bar may be required but these would be specified as exceptions. Preferred pressure ratings are 6, 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. surge in pumped lines. Products to be used in these environments should be capable of withstanding these effects. For example, if they are not capable of meeting a 50 year design criterion, the lifetime of plastics pipes, expressed as total cycles, should be specified by the manufacturer. Fittings must be capable of performing over the same pressure range as pipes.

### 4.2.3 Dimensions and tolerances

The dimensions and tolerances of pipeline components should define their capacity and may define their connectability. 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 the custom though in general there is a preference for use of the OD.

### 4.2.4 Headloss

It is recognised by the Water Industry that there may be a significant loss of head, or pressure, across fittings (particularly  $\leq 63$ mm diameter). 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 for the industry. As a result it is probable that future specifications, in particular those for service connection fittings  $<63$  mm diameter, will specify a maximum allowable headloss at a specified flow across the fitting.

### 4.2.5 Installation and assembly methods

A principal objective in specifying installation and assembly methods is to ensure sealing efficiency together with speed of installation. Most specifications detail product performance, e.g. for an individual fitting purchased from a manufacturer. However, the integrity of the whole pipeline constructed of individual product components, jointed and installed is the overall requirement and appropriate guidance may need to be developed. Some guidance is already available, e.g. the polyethylene fusion jointing specification WIS 4-32-08, the PVC and PE manuals, but these may not be sufficient for all materials, products and/or processes. 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 associated with pipelines using solvent cement joints.

Consideration should also be given to any site-related health and safety issues and, where appropriate, the availability of repair systems.

### 4.2.6 Interaction with other materials and the environment

This may have to be considered, in particular with respect to the contact, or likely contact between

two different materials or components which may lead to accelerated deterioration of one by the other.

The resistance of the pipeline material to contaminated ground and permeability to gases may need to be considered.

Consideration of resistance to potential extreme conditions and/or external loading might also be required.

#### 4.2.7 Effects of materials on water quality

When used under the conditions for which they are designed, all materials in contact with, or likely to come into contact with, water for public supply shall be introduced in accordance with the requirements of Regulation 25 of the Water Supply (Water Quality) Regulations 1989. (Water Supply (Water Quality) (Scotland) Regulations 1990 in Scotland).

For products not approved under the former voluntary system, and not eligible for use under regulation 25(1)(b) or 25(1)(c), Secretary of State Approval shall be obtained via submission of the product to the "Department of the Environment Committee on Chemicals and Materials of Construction for Use in Public Water Supply and Swimming Pools" for consideration. Non-metallic materials shall comply with the requirements of BS 6920: Part 1: 1990; evidence of compliance shall be submitted to the above committee by the manufacturer.

NOTE 1: A list of approved substances and products is published annually and is available from the Technical Secretary of the Committee at the Drinking Water Inspectorate, Room B 153, 43 Marsham Street, London SW1 3PY.

NOTE 2: Regulation 25 applies only to products used in the treatment and distribution of public water supplies; it does not apply to use of fixtures and fittings on consumers' own premises when approval under the Water Byelaws Scheme and listing in the Water Fittings and Materials Directory is relevant.

#### 4.2.8 Product identification

A product can pass all the tests but may not look right because of blemishes or minor defects that appear on it. Criteria should therefore be established to cover product appearance. This essentially provides the customer with a reasonable and quick means of checking should he have concerns about the product.

To enable positive identification on removal from storage and facilitate site jointing, or matching of

the product in the event of failure, it is essential that products are adequately marked. Marking should normally indicate pressure rating or SDR, dimension, name of the manufacturer, date and time of production, and certification mark where appropriate (see Clause 3).

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 product from another, e.g. yellow for gas pipes, blue for potable water pipes. Sewer pipes should also be colour coded.

Plastic pipes are often difficult to locate underground. Measures to enhance the traceability of these products may be considered desirable.

### 4.3 Long-term durability

#### 4.3.1 Introduction

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. It is not exhaustive and guidance may be required from the Materials and Standards Group which will depend on the particular material, product, process and application concerned.

#### 4.3.2 Pressure performance

The product should meet test criteria that ensure the reliability of the product over the range of conditions and times which it is expected to operate.

For example, the long-term pressure performance of plastic pipes is characterised by a reduction in time to failure with increased pressure and/or temperature. Pipes are designed in such a manner that they will have a pressure capability that is sufficient to ensure satisfactory long-term performance. These design criteria should take into account recognised and acceptable safety factors to accommodate potential influences from ground loading, the environment and installation damages. The validity of shorter-term alternative tests, e.g. such as the 80°C notched hydrostatic pressure test used for PE pipes, may need to be established to represent long-term durability/design requirements, if no long-term tests have been carried out on the actual product. The representative nature of tests carried out on one size of product to others in the range may need to be established.

The sealing performance of elastomeric seals should not significantly deteriorate with time due to compression stress relaxation or microbiological degradation. In general, performance requirements for elastomeric seal components are contained within BS 2494 (or the pending EN) and verification of the conformity to these standards should be sought.

### 4.3.4 Creep

Creep occurs with all plastics but softer plastics, like polyethylene, may exhibit this to a greater extent. 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. These changes need to be considered in the design feasibility investigation of the product.

### 4.3.5 Resistance to corrosion and erosion

Resistance to corrosion is an important factor to be considered for any metal component of the product. Corrosion may significantly affect product life and an assessment of the protection system adopted may be required. The design of fittings should take account of potential erosion forces.

### 4.3.6 Surface weathering

This could potentially affect long-term performance. This factor should therefore be considered particularly when the product is designed for above ground use or expected to be stored outside for an extended period.

## 4.4 Short-term properties

### 4.4.1 Introduction

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 products themselves, parts of the product, or components from within the product. For instance, a whole pipe fitting such as a tee may be tested for its burst strength, whereas only a small "C ring" cut from a plastic pipe may be required to determine the material's fracture toughness; likewise an elastomeric seal ring (a component) within a fitting may have to be tested for hardness.

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. Examples of these requirements are discussed in this section of the Guidance Note.

### 4.4.2 Tensile properties

Tensile tests are typically performed to determine the tensile strength and the strain behaviour of a product. These criteria are normally viewed as performance indices either before or after production.

### 4.4.3 Hardness

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

### 4.4.4 Strength of joints

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

Such products should be tested to determine that this will not be a problem in service. It may be necessary to consider whether this should be a long- or short-term test, as the effects of creep may not become apparent instantaneously. The strength/integrity of continuously jointed pipelines will need to be demonstrated.

### 4.4.5 Stiffness

Under some conditions pipes may be subjected to longitudinal bending which can lead to beam failure. It may be necessary to consider this problem particularly for some rigid pipe products. There may be a need for a longer-term as well as short-term performance assessment, and a consideration of the effect of stiffness/flexibility on the integrity of rubber ring sealed joints.

#### 4.4.6 External pressure resistance

Leakproofness under external pressure may be an important factor where negative pressures occur within a pipeline. Negative pressure, such as that generated under surge, can lead to the ingress of contaminant into a water supply and it is essential that this is prevented. For mechanically-jointed pipeline systems this aspect should receive special consideration.

#### 4.4.7 Resistance to handling and installation damage

During handling or installation, pipes may be subjected to impacts, which can lead directly to failure of the product or to minor cracks which may ultimately lead to premature failure. Impact strength tests of a more quantitative nature are preferred e.g. critical strain energy release rate  $G_c$  (for MDPE) which is a measure of the resistance of the product to failure by impact.

All products should be sufficiently robust that they can be handled on site without impairing their long-term performance. Some objective evidence as to the tolerance to surface damage should be provided. Guidance should be provided on product handling and stacking requirements.

#### 4.4.8 Resistance to slow and rapid 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.

Continuously-jointed pipelines should resist long-line fast fracture or be recommended for use such that long-line fast fracture can be avoided. Guidance on these properties is therefore needed.

## 5. REFERENCES

This guidance note makes reference to the latest edition of the following publications (except where otherwise stated) including all addenda and revisions.

### British Standards

- BS 2494 Specification for elastomeric joint rings for pipework and pipelines.
- BS EN 9002 Specification for production, installation and servicing (to be published to replace BS 5750: Part 2).

## Water Industry Specifications

- 4-32-08 Specification for site fusion jointing of MDPE pipe and fittings.

### Other

- WSA/WRc Civil Engineering Specification for the Water Industry. 4th edition. October 1993.

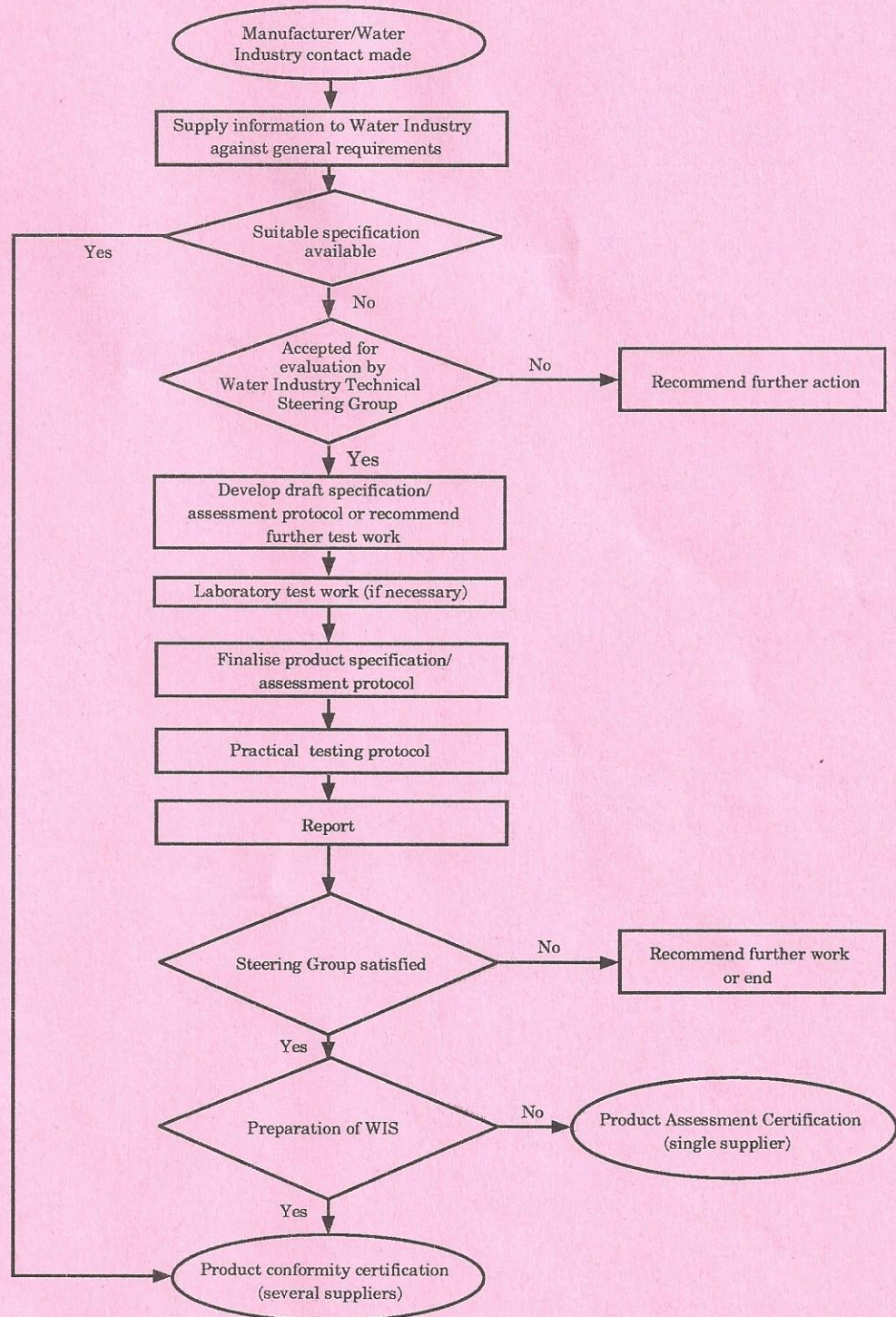


Figure 1 - Suggested product evaluation programme