
WATER INDUSTRY SPECIFICATION

WIS 4-02-03

Issue 2
April 2018
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UK Water Industry

OPERATIONAL REQUIREMENTS: *IN SITU* POLYMERIC LINING OF SERVICE PIPES

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This document has been prepared on behalf of the Water UK Standards Board. Technical queries should be addressed to the Standards Board c/o the Technical Secretary E-mail: mikeshepherd@thamesinternet.com. The latest version of this document can be downloaded from: <http://www.wis-ign.org>

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INTRODUCTION

The structure of this document is such that it covers the currently approved systems for application of polymeric lining material to service pipes. The material storage and delivery/application methods for these systems differ and as a consequence specific generic requirements for each application system have been provided as appendices to this document. These statements provide an outline of the methods adopted and shall be amplified by the detailed method statements to be provided by each specific contractor. The detailed method statements shall follow the format of those given in the Appendices and shall include the specific details required for the lining system.

In addition to a **Method Statement** the **Approved Contractor** shall provide Instructions for Use (IFU) documents for each lining material that will be used that formed part of the submission for Regulation 31 approval of the relevant material, or was subsequently approved as a result of an amendment to that IFU. This document provides details of the required content for an IFU including all details of the individual material properties and application requirements. Compliance with the requirements of this WIS and the IFU shall be a condition for any approval provided under Regulation 31 or its equivalent in other regulatory documentation adopted in UK.

If an existing material IFU, approved under Regulation 31 procedures, predates the introduction of this document then this IFU can remain in force until such time as the material approval is required to be renewed, namely five years from the date of its approval. At that time all documentation submitted for renewal of the material approval under Regulation 31 procedures shall fully conform in every respect with the requirements of this document otherwise no consideration shall be made for its

approval. One exception to the acceptance of such a continuation shall be that the requirement for minimum thickness specified in OR6.9.1 of this document shall supersede any content in the IFU relating to a minimum thickness requirement.

If in the future other service pipe lining systems are approved for use then they shall conform to the same requirements, as detailed in this document. Specific generic requirements will be prepared for the newly approved system and included as an appendix in a revised WIS as required.

Currently, materials used for lining service pipes may be supplied from the manufacturer either as factory proportioned components in prefilled containers or as bulk material which is directly proportioned as part of the application process. The main body of this document has been written to provide a generic specification that is applicable to all polymeric materials for lining service pipes irrespective of their method of application. Specific generic requirements for the application systems currently approved are included as appendices and additional methods will be added when required.

This document has been prepared for the UK Water Industry's Standards Board by NSF International in consultation with the Water Industry.

Information contained in this document is given in good faith. Neither Water UK nor NSF International can accept any responsibility for actions taken by others as a result.

This Issue 2 document has been issued to incorporate amendments required by the Drinking Water Inspectorate.

OR SECTION 1: GENERAL

OR 1.1: Scope

1. These Operational Requirements cover material selection, pipeline cleaning, material application, curing, inspection and return to service requirements needed to provide protective coatings for service pipes constructed of galvanised iron, steel, lead, copper and malleable black iron, or as otherwise limited by the material Instructions for Use (IFU), using polymeric materials

approved for *in situ* lining of service pipes. Application of lining material to plastic pipes will only be allowed if the material has been specifically approved for this purpose and this approval is included in the relevant IFU which is listed in the Approval Confirmation letter for the lining material confirming the Regulation 31 approval.

2. These Operational Requirements currently apply to, but are not limited to, the *in situ* application of polymeric lining material by forced air application technology. Alternative application methods will be considered on their merits and included in the Appendices of this document when required.
3. These polymeric materials are placed *in situ* using **Approved Application Equipment** (as defined in OR 1.3 below) to **Service Pipe Elements** (as defined in OR 1.3 below) of nominal ½ inch up to, but not including 3 inch (12.5 mm but not including 75mm) internal diameter or as limited by the IFU or the **Approved Contractor's** method statement.
4. Compliance with these Operational Requirements is a legal requirement for the *in situ* application of polymeric coatings to service pipes.
5. Material-specific information and advice is presented in the Instructions for Use (IFU) document provided by the coating material manufacturer.
6. It is the responsibility of the Water Undertaker to ensure that all practices conducted on the distribution system pose no risk to the quality of the water supplied. Failure to supply water fit for human consumption can result in the Water Undertaker being prosecuted.

OR 1.2: Implementation

1. These Operational Requirements shall apply from 1st May 2018.
2. Contractors holding a current approval to apply polymeric coatings to service pipes obtained as a result of having met the requirements of this document shall be deemed '**Approved Contractors**' (as

defined in OR 1.3 below), provided that they have:

- provided to all personnel performing lining roles defined in Appendix B a written guide to and awareness training of the Operational Requirements; and
 - satisfactorily demonstrated to a **Nominated Certifying Body** (as defined in OR 1.3 below) that their Quality System and working procedures meet the requirements of this document.
3. Equipment currently approved to apply resin coatings shall be deemed '**Approved Application Equipment**' (as defined in OR 1.3 below), provided that it has been successfully demonstrated to a **Nominated Certifying Body** (as defined in OR 1.3 below) that they comply fully with the requirements of this document.

Arrangements for training and certification of personnel are detailed in OR Sections 4 and 5 below.

OR 1.3: Definitions

For all aspects of *in situ* lining of service pipes the following definitions apply:

Approved Contractor

A contracting company that possesses a valid Contractor Certification as detailed in Appendix A or a contracting company who, in seeking a new certification or renewing an existing certification, has demonstrated its ability to apply a specified **Approved Coating Product** correctly in supervised lining trials (as described in Appendix A), has been certified by a **Nominated Certifying Body**, and is employed by a Water Undertaker to supply trained and appropriately certified personnel (as described in Appendix B) who are registered under the National Water Hygiene Scheme⁽¹¹⁾ or equivalent and uses approved products and equipment to apply polymeric coatings to service pipes in accordance with these Operational Requirements.

The **Approved Contractor** is approved in respect of a stated polymeric material and application equipment combination. A contractor may be approved several times over for various combinations of material and application

equipment (see OR 3.2) and such material/equipment combination approval notified to and entered on the nominated database.

The **Approved Contractor** is responsible for ensuring that all aspects of the rehabilitation process can be monitored and inspected by the **Client Representative**. This includes all components of the cleaning and lining process.

An **Approved Contractor** working as a sub-contractor on behalf of an unapproved contractor as part of a rehabilitation contract is acceptable with the full permission of the appointed person responsible for the Water Undertaker contract.

A list of **Approved Contractors** is held by Energy and Utility Skills Register (EUSR) <http://www.eusr.co.uk>

Approved Coating Product

Any polymeric material that has been approved specifically for the *in situ* lining of service pipes and used in accordance with Regulation 31(4)(a) of the Water Supply (Water Quality) Regulations 2016 in England, Regulation 31 of the Water Supply (Water Quality) Regulations (Wales) 2010, Regulation 33 of the Water Supplies (Water Quality) (Scotland) Regulations (2014) and Regulation 30 of the Water Supply (Water Quality) (Amendment) Regulations (Northern Ireland) 2009⁽¹⁾ and any subsequent amendments.

As yet there are no harmonised European standards concerning fitness for use in contact with drinking water of *in situ* resin lining systems, nor are there any European Technical Approvals or equivalent national standards for these products. In the absence of European or national specifications, coating products shall be approved by the Authorities under the appropriate national regulation.

Approved construction products are listed in the Authorities' List of Approved Products⁽²⁾, which is posted on the appropriate website:

<http://dwi.defra.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf> for the Drinking Water Inspectorate, <http://www.ehсни.gov.uk/environment/drinkWater/regulations.shtml#dwilist> for the Northern Ireland Drinking Water Inspectorate and

<http://www.scotland.gov.uk/Publications> for the Drinking Water Quality Regulator for Scotland.

Approved products shall be used in accordance with their conditions of approval, which are given in the Secretary of State's approval letter referencing the appropriate IFU and in the List of Approved Products⁽²⁾ which states the IFU name, issue number and date, any specific conditions of approval and the product expiry date.

Approved Application Equipment

Equipment or machinery of a design that has been type tested in accordance with Appendix C and subsequently certified by a **Nominated Certifying Body** for cleaning service pipes and the storage, heating, dispensing, mixing, application, curing, inspection and return to service of a specified **Approved Coating Product**.

Service Pipe Elements

Pipework supplying water to domestic or commercial properties, constructed of galvanised iron, steel, lead, copper, malleable black iron or plastic normally of nominal internal diameter nominal ½ inch up to, but not including 3 inch (12.5 mm but not including 75mm). This pipework is normally laid at right angles to the distribution main and in an approximately straight line to the customer's premises to provide potable water directly from the main and is normally subject to the available water pressure from that main. It is usual to consider the complete service pipework as comprising two main elements. For the purposes of this WIS the elements of the service pipe shall be defined as follows:

- **the communication pipe** includes the connection (by tee or ferrule) to the distribution main, the pipe length up to the boundary of the customer's property (or street in which the distribution main is laid) and the statutory boundary control device which takes the form of a stop tap, valve or meter assembly together with its housing. A communication pipe may feed more than one supply pipe. The Water Undertaker is responsible for the installation and maintenance of the communication pipe.

- **the supply pipe** is considered as that part of the service pipework from the outlet of the boundary control device (i.e. the point of delivery) up to and including the mandatory stop valve installed just outside/inside the customer's premises. An existing supply pipe may be shared by more than one customer unit in which case the supply pipe is termed a common (or shared) supply pipe. The customer is responsible for the installation and maintenance of the supply pipe.

Note. Some supply pipes, especially lead, may be coiled. Therefore, estimated lengths from main to property may not be correct.

New Contractor

A contracting company that wishes to undertake the supervised lining trials outlined in Appendix A so as to become an **Approved Contractor** and is required by the **Nominated Certifying Body** to undertake a full assessment procedure.

New Contractors either hold no approvals for application of **Approved Coating Products** or the approvals they hold are for polymeric materials with significantly different properties or with different rehabilitation outcomes, as detailed in A.4, Appendix A of this document.

Nominated Certifying Body

Water UK nominates Certifying Bodies.

A **Nominated Certifying Body** must be accredited by **UKAS** or other equivalent European Union accreditation service as a Conformity Assessment Body complying with these Operational Requirements (WIS 4-02-03). Water UK and **UKAS** have each signed an Agreement to this effect.

Nominated Training Certifier

Water UK nominates Training Certifiers.

A **Nominated Training Certifier** that is not already a **Nominated Certifying Body** must be accredited by **UKAS** or other equivalent European Union accreditation service as a Conformity Assessment Body complying with these Operational Requirements (WIS 4-02-03). Water UK and **UKAS** have each signed an Agreement to this effect.

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UKAS (The United Kingdom Accreditation Service)

The sole national accreditation body in the UK recognised by the Department for Business Innovation and Skills, on behalf of Government as a whole, by means of a Memorandum of Understanding dated 1 August 1995.

Client Representative

A person certified by a **Nominated Certifying Body** or a **Nominated Training Certifier** and registered under the National Water Hygiene Scheme or equivalent appointed by the Water Undertaker as their representative.

The **Client Representative** may or may not be a direct employee of the Water Undertaker but shall not be an employee of the **Approved Contractor** or any organisation associated with the **Approved Contractor** (whether parent company, subsidiary company, or affiliated company).

The **Client Representative** is responsible for ensuring all coatings and work undertaken by the **Approved Contractor** are carried out in compliance with and to the quality outlined in these Operational Requirements.

Recognised Fitter

A person formally trained by **Approved Application Equipment** suppliers or manufacturers and who has provided acceptable evidence of their competence, training, and experience to a **Nominated Certifying Body**. Certification will be restricted to the same **Approved Application Equipment**/material combination.

As noted in Appendix B, the **Recognised Fitter** is responsible for ensuring that **Approved Application Equipment** is set up in accordance with the conditions (alarm conditions, set-points, etc.) used when equipment approvals were granted, and can perform in accordance with these Operational Requirements.

Method Statement

A document produced by the **Approved Contractor** which provides a detailed description of all equipment and procedures to be adopted for pipe cleaning, the storage,

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heating, dispensing, mixing, application, curing, inspection and return to service of a specified **Approved Coating Product** used for *in situ* lining of a service pipe.

Uniformity

Uniformity of a lining is considered to be the provision of a lining that has continuous full coverage around the full circumference of the pipe surface and is of the minimum specified thickness requirement. In addition the lining shall have a smooth surface finish with no major surface defects.

OR 1.4: Reference Documents

The following documents or any revisions thereof referred to in this document form an integral part of the specification.

WIS 4-02-01 – Operational Requirements In-situ Resin Lining of Water Mains, Water UK or current edition⁽³⁾

IGN 4-02-02 - Code of Practice: In-situ Resin Lining of Water Mains, Water UK or current edition⁽⁴⁾

BSI - BS EN ISO 9001 Quality Management Systems. Requirements. BSI⁽⁵⁾

BSI - BS6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water⁽⁶⁾

WRAS - Water Fittings and Materials Directory⁽⁷⁾

BSI – BS EN 12873-2 Influence of materials on water intended for human consumption. Test method for non-metallic and non-cementitious site applied materials⁽⁸⁾.

BSI – BS EN 15768 Influence of materials on water intended for human consumption. GC-MS identification of water leachable organic substances⁽⁹⁾

DWI – List of Approved Products⁽²⁾

OR 1.5: Inspection

The **Client Representative** shall, at all times, have access to all parts of the site during the entire course of the cleaning, lining and return to service process.

The **Approved Contractor** shall provide reasonable assistance to the **Client Representative** for the inspection of materials, workmanship, and quality.

OR 1.6: Workmanship

All work shall be performed in a thorough and workmanlike manner by trained and, where required by this document, appropriately certified personnel.

OR SECTION 2: MATERIALS

OR 2.1: General

1. The polymeric material used for *in situ* lining of service pipes shall be:
 - an **Approved Coating Product** approved for that purpose under Regulation 31(4)(a) of the Water Supply (Water Quality) Regulations 2016 in England, Regulation 31(4)(a) of the Water Supply (Water Quality) Regulations (Wales) 2010, Regulation 33 of the Water Supplies (Water Quality) (Scotland) Regulations 2014 and Regulation 30 of the Water Supply (Water Quality)(Amendment) Regulations (Northern Ireland) 2009⁽¹⁾ in Northern Ireland; or any subsequent amendments.
 - Approved under the testing regime as defined by BS6920⁽⁶⁾ and, for non public supply use, listed in the WRAS Water Fittings and Materials Directory⁽⁷⁾
 - supplied with a copy of the coating material manufacturer's Instructions For Use (IFU) documents, which shall be made available in all instances to the **Approved Contractor** and the **Client Representative**.

The IFU, which has been approved as part of the Regulation 31 approval procedure, shall contain all additional product specific information required to allow the **Approved Contractor** to apply the **Approved Coating Product** in accordance with the requirements of these Operational Requirements, and those of the IFU, including:

- Temperature parameters, including any specific lining material application temperatures, for material components, and

any required **Approved Application Equipment** heating system (OR 3.2);

- Listing of pipe materials for which application of the lining material has been approved
- Whether a heated umbilical hose is required for pumped material (OR 3.4);
- The use of factory filled material cartridges that are subsequently heated and mixed on site
- Details of types and lengths of approved in-line mixers suitable for use with the relevant material and application method employed (OR 3.5);
- The correct solvent for cleaning the in-line mixer and injection manifold where applicable (see OR 3.5 and OR 3.6);
- The minimum air/water/heat-cure period before the service pipe can be considered for return to service. (see OR 6.10);
- The minimum flushing period and flow rate before the service pipe can be considered for return to service (see OR 6.13);
- Any need for mechanical mixing of material in storage reservoirs when high viscosity lining material is used.
- Specification of the type of mechanical mixer and type of mixing to be employed where applicable.
- State the maximum concentration of free chlorine permitted that can be used without damaging the lining or affecting its long term durability. Any restrictions on the suitability of a method of disinfection or concentration of chlorine used must be stated;
- Over coating for the reinforcement or renovation of a previously applied coating shall only be carried out if the manufacturer has conducted tests to confirm compatibility between the same material or other specific historically applied coatings which shall be listed in the approved lining IFU document.

- Any necessity to overcoat a lining with the same material within a specific time period shall be specified.
- Mix ratios by weight and by volume.
- Details and types of injection manifold, or other specialised application equipment, for normal application.
- Any necessity for provision of a nitrogen or dry gas blanket in material storage tanks.
- Material shelf life and storage temperature/conditions.
- Typical specific gravity/density and viscosity of material components.

All of the above shall be provided as a Technical Schedule in an Appendix to the IFU

OR 2.2: Manufacture

1. **Approved Coating Product** used for *in situ* lining of **Service Pipes** are required to be moisture tolerant, solvent free systems.
2. It is preferred that base and activator components are manufactured in two clearly distinguishable colours which, when correctly mixed, provide a third distinctive colour, thereby allowing for a visual evaluation of mix efficiency to be conducted.
3. It is preferred that **Approved Coating Product** are manufactured by a company operating a current BS EN ISO 9001 Quality System⁽⁵⁾ and is certified by UKAS (United Kingdom Accreditation Service) or other third party certification body accredited to ISO/IEC 17021 via the International Accreditation Forum (IAF) Multilateral Recognition Agreement (MLA).
4. **Approved Coating Product** shall be supplied in clearly marked containers indicating the following:
 - Mix ratio (by weight and volume)
 - Maximum and minimum heating requirements
 - Batch numbers.

- Date of manufacture
 - Material shelf life or expiry date
 - Storage temperature/conditions
 - Handling instructions
 - Basic health and safety instructions compliant with current legislation
5. Polymeric material lining products shall be supplied with the material manufacturer's certificate of conformity stating: material type, batch code, date of manufacture, specific gravity (SG) and viscosity.

OR SECTION 3: LINING EQUIPMENT

OR 3.1: General

1. The **Approved Application Equipment** to be used for pipe cleaning, the storage, heating, dispensing, mixing, application, curing, inspection and return to service of a specified **Approved Coating Product** to be applied to a **Service Pipe** shall be clearly described in the **Method Statement** provided by the **Approved Contractor** and shall meet the requirements of this document and the generic requirements detailed in the relevant appendix for the method.
2. The only equipment to be used to apply coating materials shall be suitable for pipe cleaning, the material storage, heating, dispensing, mixing, application, curing, inspection and return to service in accordance with the resin manufacturer's Instructions For Use (IFU) and these Operational Requirements.
3. Cleaning and/or lining methods, together with materials used, shall not be deleterious to drinking water quality.
4. Suitable safety equipment to allow high-pressure working and minimise material discharges shall be incorporated into any design.

OR 3.2: Approved Application Equipment

1. The equipment used to line service pipes with polymeric materials shall be certified by a **Nominated Certifying Body**.
2. The **Approved Contractor** shall obtain separate approvals for each generic material/equipment combination that is to be used.

Note: Appendix C details the test procedure and pass criteria for the approval of lining rigs or other types of application equipment.

3. Documentary evidence of these approvals shall be available from the **Approved Contractor**.
4. The equipment shall be designed to permit the operatives to obtain results described in these Operational Requirements.
5. The **Approved Contractor** shall notify the **Nominated Certifying Body** one month prior to the modification of any **Approved Application Equipment** or lining rig modifications relating to the following key functions:
 - Monitoring system (and associated components);
 - Pumping system;
 - Alarms (and associated set points);
 - In-line mixers;
 - Umbilical (hose diameter/configuration);
 - Air blowers.

The **Nominated Certifying Body** shall then consider the need for further formal assessment. Modified equipment shall not be used without prior consent of the **Nominated Certifying Body**.

Failure to comply with the requirement to inform the **Nominated Certifying Body** of equipment modifications or use of alternative designs shall result in the suspension of the contractor's certification until such approvals are obtained.

6. Except where separate provisions have been made and approvals have been obtained for use of alternative equipment or

procedures as applicable, equipment shall conform with the following requirements:

- i) use equipment to dispense base and activator at the resin manufacturer's specified mix-ratio $\pm 5\%$ at all stages of preparation, delivery and application and use a weight check (as detailed in OR6.4) to ensure that the equipment delivers material components within the specified mix ratio tolerance;
- ii) be provided with calibration records (or copies thereof as long as the copies are certified and controlled in accordance with the requirements of the contractor's quality system) which shall be retained with the equipment for inspection at any time;
- iii) give appropriate audible-alarm and abort responses where applicable if the mix-ratio is out of specification (as detailed in Appendix C);
- iv) where required, store the base and activator separately in suitable reservoirs and maintain material component temperatures throughout the equipment in accordance with the material manufacturer's Instructions for Use (IFU) document. Material storage reservoirs may require a dry gas blanket to prevent atmospheric moisture pre-reacting with an individual component;
- v) where material is supplied in factory filled cartridge dispensers these shall be capable of being preconditioned to the temperature specified in the material manufacturer's Instructions For Use (IFU) document prior to the mixed material being injected into the application equipment;

vi) where applicable provide numerical visual display and a printout, or lining record showing:

- date
- equipment reference
- gang or operator reference
- service pipe location and post code
- service pipe GPS reference
- material batch number
- estimated pipe length
- pipe diameter
- volume of lining material applied
- material component temperatures
- time of start and finish of lining
 - carrier air temperature
 - carrier air speed
 - blow down time

7. Air blowing equipment shall be fitted with filters as detailed in OR 3.7 to provide substantially oil and moisture free air supply at a dew point lower than -20°C .
8. The **Approved Contractor** shall demonstrate to the **Client Representative** on a weekly basis using documentary evidence that any monitoring and alarm systems associated with the **Approved Application Equipment** are operating in accordance with the Operational Requirements and equipment type test conditions. (This can be demonstrated either by explicit testing of the equipment in accordance with Appendix C, or through review of the monitoring system parameters.)
9. Where required durable paper and printing shall be used in any printing device such that the printout is still legible after the required retention period of the paperwork (see OR Section 7).
10. Where applicable the monitoring system shall have the capability of storing data for linings carried out in one day and printing these data at a later time, if required.

OR 3.3: Calibration and Equipment Audits

1. All mechanical, pumping, air blowing and monitoring equipment shall be calibrated in accordance with the equipment manufacturer's instructions or as specified in the **Approved Contractor's** Quality System, at a maximum interval of 12 months, or following replacement of any component that affects its calibration.
2. The equipment manufacturer/supplier or **Recognised Fitter** shall undertake the calibration of **Approved Application Equipment**.
3. Documentary evidence (original or copies thereof as long as the copies are certified and controlled in accordance with the requirements of the contractor's quality system) of maintenance and calibration shall be kept with the equipment and be available for inspection by the **Client Representative** and/or any authorised auditor.
4. Each set of **Approved Application Equipment** shall be shown to be operating in accordance with these Operational Requirements before being used on lining contracts. To demonstrate this, the equipment shall be subjected to a performance audit requested by the **Approved Contractor** and undertaken by a **Nominated Certifying Body** and **Recognised Fitter** in the presence of a **Client Representative**, requiring the application of a coating to pipes laid above ground. A minimum pipe length of 15 metres of 12.5 mm pipe shall be lined.

OR 3.4: Lining Hoses

1. Where lining material is transferred from storage reservoirs or factory filled cartridges by flexible hose suitably rated pressure hoses for the lining equipment/material combination shall be used. These hoses must be in good repair and be chemically resistant to the individual or mixed material components. This is normally achieved by the use of a Teflon or polyethylene lined hose.
2. When specified by the resin material manufacturer in the Instructions For Use

(IFU) document, heated umbilical hoses shall be used.

OR 3.5: In-Line Mixer

1. Mixers for use with the **Approved Coating Product** shall be applicable to the lining material being applied and shall be specified by the material manufacturer in the IFU. Documentary evidence of suitable construction and satisfactory mixing in the in line mixer shall be available from the **Approved Contractor**.
2. Documentary evidence of the approval shall be available.
3. Unless disposable mixers are used, in line mixers shall be solvent cleaned and inspected at the end of each day's operation. The solvent to be used shall be specified by the lining material manufacturer in the IFU. Any fault in the mixer shall be rectified or the mixer replaced. Because of the likely frequency of lining during each working day, there will be no need to clean a mixer after each lining if it is to be reused and simple purging with one material component between linings will be sufficient.

OR 3.6: Lining Injection Head/Manifold

1. A lining injection head or manifold, or any other equipment used to insert material into the pipe to be lined, shall be of a design that places the resin components into the pipe before being dispersed by air. There shall be an even distribution of the air flow such that a coating of the required thickness shall be applied without causing significant pin-holing or ridging. This head/manifold may be disposable after each lining.
2. The lining injection head or manifold, if not disposable, shall be cleaned and inspected after every lining operation by a suitably trained lining operative. Any faults observed shall be rectified or the lining head or manifold replaced.
3. Facilities for cleaning the lining injection head or manifold shall be provided. These shall include the correct solvent as specified by the material manufacturer in the Instructions For Use (IFU) document. Health

and safety precautions shall be implemented.

OR 3.7: Compressed Air

1. Dried air to the minimum quality specified in OR3.2.7 shall be passed through an air filter unit(s) which shall produce filtered air which does not impart a detectable odour or taste. The filter sizes shall be matched to the compressor size and pressure.
2. Filtration units recommended for *in situ* polymeric lining of service pipes consist of three filters, either separate or as a combined filter.
3. The first filter is often a coarse filter with a pore size of 25µm, or it may be a coalescing filter. It shall remove the large dust particles and some of the oil and water and therefore protect the other two filters.
4. The second filter shall be a coalescing filter which shall cause the droplets of oil and water to coalesce and collect in the bowl before the filter. Usually the filter should have an automatic drain to dispose of the collected oil and water. The highest efficiency filters shall be installed.
5. The third filter shall be a carbon filter which contains granulated or powdered activated carbon and is designed to remove oil vapour which has not been removed by the first and second filters. It is essential that filter elements are replaced at regular intervals. Filter manufacturers shall advise on the frequency of replacement.

OR SECTION 4: CLIENT REPRESENTATIVE

OR 4.1: Requirements

1. The **Client Representative** is required to monitor the **Approved Contractor** and take responsibility on behalf of the Water Undertaker for the quality of all linings and that all work is carried out in accordance with the requirements of this document.
2. Such quality control shall only be carried out by personnel who meet the following criteria:

- i) have achieved formal certification from a **Nominated Certifying Body** or a **Nominated Training Certifier** as a result of successfully completing training and certification in accordance with Appendix B;
- ii) resubmit for certification at three yearly intervals; and
- iii) comply with all other requirements specified by the Water Undertaker.

OR 4.2: Implementation Arrangements

1. Certification in full accordance with clause OR 4.1 shall be required.
2. **Client Representatives** who gain formal certification in accordance with Appendix B shall be deemed to be certificated.

OR SECTION 5: CONTRACTOR

OR 5.1: Requirements

1. Polymeric linings shall only be applied by **Approved Contractors** who comply with the following:
 - i) possesses a valid certification, which has been, or is in the process of being notified to and entered on the nominated database;
 - ii) have gained certification in a supervised trial as outlined in Appendix A (separate approvals are required for each **Approved Coating Product/Approved Application Equipment** combination);
 - iii) operate a current BS EN ISO 9001⁽⁵⁾ Quality System that explicitly includes *in situ* polymeric lining of service pipes and is certified by UKAS (United Kingdom Accreditation Service) or other third party certification body accredited to ISO/IEC 17021 via the International Accreditation Forum (IAF) Multilateral Recognition Agreement (MLA). Contractors currently accredited by a third party certification body not recognised by UKAS may continue to use that certification body

provided they submit to an annual BS EN ISO 9001 audit conducted by a Nominated Certifying Body employing a suitably qualified ISO 9000:2000 Lead Auditor. Such Approved Contractors shall be encouraged to become third party certified by an accreditation service recognised by UKAS or other equivalent European Union accreditation service. New Contractors shall only be approved if their third party certification body is recognised by UKAS or other equivalent European Union accreditation service;

- iv) The scope of the Quality System shall cover each *in situ* polymeric lining system for which approval is held where there are significant differences in the **Approved Coating Product** or **Approved Application Equipment** utilised.
- v) resubmit for contractor certification and lining rig assessments and a BS EN ISO 9001⁽⁵⁾ audit at five-yearly intervals. Contractors also certified to meet the requirements of WIS 4-02-01⁽³⁾ may choose to have the audit carried out at the same time for both certifications if appropriate.
- vi) ensure any personnel involved with the actual lining process are direct employees of the certified contracting company or if self-employed can verify continuous employment with the contractor; and
- vii) ensure sufficient personnel have achieved formal certification from a Nominated Certifying Body or a Nominated Training Certifier as set out in Appendix B with renewal every three years. This training requirement is in addition to any specific training provided by individual companies or manufacturers.

OR 5.2: Implementation Arrangements

1. Full certification in full accordance with clause OR 5.1 shall be required.
2. Contractor personnel who gain formal certification in accordance with Appendix B shall be deemed to be certified with details

notified to and entered on the nominated database.

OR 5.3: New Contractors

- A **New Contractor** who operates an appropriate BS EN ISO 9001⁽⁵⁾ Quality System shall submit their draft quality manual, as it pertains to lining with the **Approved Coating Product**/application equipment for which contractor approval is being sought, to the **Nominated Certifying Body** for assessment before the supervised lining trial.
- Following this assessment and any necessary modification to the quality manual, and after successful completion of the supervised lining trial, the **New Contractor** shall apply to a certification body with UKAS accreditation or other equivalent European Union accreditation service accreditation for an extension to the scope of the **New Contractor's** BS EN ISO 9001⁽⁵⁾ Quality System.
- An interim approval shall then be granted conditional to the requirement that within 3 months the *in situ* polymeric lining system for which approval is sought is explicitly included within the scope of the contractor's BS EN ISO 9001⁽⁵⁾ Quality System. Failure to meet this timetable shall result in the withdrawal of the interim approval.
- **New Contractors** that do not operate an appropriate BS EN ISO 9001⁽⁵⁾ Quality System may still gain certification in supervised trials outlined in Appendix A. Following successful completion of the supervised lining trial, an interim approval shall be granted conditional to the requirement that within 18 months the **New Contractor** shall achieve full certification of their Quality System. Failure to meet this timetable shall result in the withdrawal of the interim approval.

OR SECTION 6: APPLICATION PROCESS

OR 6.1: Cleaning

1. All service pipes to be lined shall be disconnected from the mains supply and drained. The point of disconnection may be

at the main if the cleaning/lining is carried out in the direction of the property or may be at the meter box or property boundary if cleaning/lining is carried out in the direction of the main. All water meters and other fittings must be removed prior to cleaning and lining. Any fitting not removed and subsequently damaged as a result of the cleaning/lining shall be replaced by the **Approved Contractor** at his expense. Groundwater levels in all excavations or access chambers must be maintained below the levels of the exposed ends of pipes and fittings during cleaning, lining and reconnection. Pumps should be available, where necessary, to facilitate this.

2. The service pipe shall be suitably cleaned to remove all loose or adhered material resulting from corrosion and mains deterioration processes. Depending on pipe material graphitisation and scale may or may not remain depending on the cleaning process employed.

The quality of cleaning is paramount if coatings are to be applied successfully. The cleaning process shall involve the use of a dry washed aggregate/sand or other acceptable inert material using a system of high velocity pneumatic transport along the length of the pipe. The cleaning material used shall exclude garnet or other glass based materials. The type(s) of material to be used shall be specified in the **Method Statement**.

The spent aggregate and removed deposits shall be collected in an enclosed receptacle at the end of the pipe. The collection receptacle shall have suitable air filtration facilities to ensure that any contaminated dust from the cleaning process is fully contained within it. All waste cleaning materials and deposits shall be disposed of in accordance with the Duty of Care Regulations⁽¹⁰⁾ (See also OR 6.7.2).

3. After cleaning, the pipe bore shall be clean, dry, and free of dust, water and particulate matter. Where the dew point of the air in the pipe for lining is specified by the resin manufacturer in the product IFU, the substrate temperature of the pipe must be a minimum of 3°C above the dew point of the atmosphere within the pipe.

OR 6.2: Pre-Lining Inspection

1. The surface preparation achieved at both ends of the cleaned pipe, where feasible, shall be inspected before lining commences to check the quality of the cleaning and highlight any potential problems that would result in poor lining quality.
2. The **Approved Contractor** or/and the **Client Representative** shall carry out this inspection. The results of this survey shall be recorded on the Service Pipe Record Sheet. (see OR Section 7).
3. Where the service pipe has been cleaned in the direction of the main and the end of the pipe is not accessible for inspection a CCTV survey shall be carried out from within the main to inspect the end of the service pipe for quality of cleaning and to determine if there is any contamination of the main.

OR 6.3: Application Equipment Preparation

1. The batch numbers of material components to be used in linings shall be recorded. Batches shall be used sequentially and in order so that no more than two batches of either component shall be used in any lining
2. Lining cannot commence until the material components have attained the minimum temperature that is within the material manufacturer's specified temperature range for application and there shall be sufficient material components available within the lining rig or factory filled cartridges to complete the lining.
3. All equipment necessary for, or associated with the application of the coating shall be prepared as detailed in the **Method Statement** for that particular application system.

OR 6.4: Weight Checks

1. Weight checks of the base and activator shall be carried out prior to the initial lining of the day and again prior to the last lining of the day to ensure that the mix ratio of the material, performance and material output of the equipment is within the material manufacturer's specification.

2. One weight check shall be carried out on each occasion and each weight check shall be within $\pm 5\%$ (by weight of activator) of the resin manufacturer's specified mix-ratio, calculated as
 $100: ((\text{weight of activator}/\text{weight of base}) \times 100)$.
3. Where possible a minimum of 80g of base component shall be collected for each weight check.
4. Scales used to weigh the samples shall record to ± 1 g, shall be calibrated at a maximum of 12 monthly intervals, and shall be accurate to $\pm 1\%$ full scale deflection
5. The results of the weight check procedure shall be reported on the Service Pipe Record Sheet.
6. An additional weight check shall be carried out and recorded on the Service Pipe Record Sheet if a fault occurs during lining and a Non Conformance Report shall be completed.
7. It is not possible to undertake weight checks on factory prepared cartridges incorporating fixed static mixers. Prior to use, these cartridges shall be checked to ensure that they are:-
 1. Undamaged and have not been tampered with
 2. Are within use by date

OR 6.5: Stabilisation Procedure

1. Where the equipment operates in a manner which involves pumping of the separate material components then the minimum stabilisation time for each combination of **Approved Application Equipment** and **Approved Coating Product** shall be determined at the start of any lining contract, and at least every six months thereafter, or at the request of the **Client Representative**.
2. The procedure for the determination of minimum stabilisation time is given in Appendix D. All stabilisation determination tests shall be carried out in the presence of a **Client Representative**. The results of the stabilisation determination shall be reported on the Stabilisation Determination Record.

OR 6.6: Application Temperatures

1. Polymeric linings shall not be applied when the pipe wall temperature is below 3°C .

OR 6.7: Application of Coating

1. The **Approved Contractor** shall apply the lining to the service pipe fully in accordance with the procedure outlined in the **Method Statement** for that particular application system and shall conform with the generic requirements detailed in the relevant appendix to this document for that system
2. The **Approved Contractor** may clean and/or apply the service pipe lining either from the distribution main in the direction of the property or from the meter box/property boundary to the distribution main. The latter direction provides the option to line to a ferrule tapping that has been removed from the main before cleaning/lining or to clean/line directly into the distribution main with the ferrule tapping still in place. In each of these cases there will be separate, and in the case of cleaning/lining directly into the main different, operations regarding the cleaning and lining procedures. The **Approved Contractor** shall include in his **Method Statement** detailed descriptions of these operations for whichever one or both of the alternatives he wishes to adopt.

Cleaning and lining from a distribution main to a meter box/property boundary or from a meter box/property boundary to a detached ferrule shall require pre lining preparation as detailed in OR6.1.1. Where cleaning/lining is to be carried out directly into the distribution main the **Approved Contractor** shall notify the Undertaker of his intention and shall seek specific approval for this procedure and the method to be adopted to ensure that the work is carried out in an agreed manner. Once agreement has been obtained for work to be carried out in this way the **Approved Contractor's Method Statement** shall be amended if necessary to include the details of the procedure to be adopted and agreed with the Undertaker.

The **Approved Contractor** shall monitor the performance of the **Approved Application**

Equipment throughout the lining paying specific attention to the following:

- pump performance;
 - lining colour;
 - application air/water temperature, pressure and flow rate applicable to any cleaning, preheating, lining or curing procedure.
3. The amount of material dispensed by the application system shall be at least the amount required to apply the minimum required thickness to the straight line measured length plus an additional 10% at least to allow for any pipe deviation. An accurate assessment of the service pipe length and the volume of material delivered shall be recorded on the Service Pipe Record Sheet.
 4. The application air delivery shall be maintained until the lining material has been applied to the pipe wall at the minimum or required thickness and gelled. The gel time will depend on the material used, the pipe diameter and the length being lined.
 5. In the event that the lining material does not reach the end of the pipe the material shall be cured for the minimum time specified by the material manufacturer and the outstanding length shall be completed, or the total length be relined.
 6. Should a fault occur, the **Approved Contractor** can decide to abort the lining at any time as long as acceptable rectification works are carried out after curing of the suspected faulty lining for the period specified by the material manufacturer. Remedial work shall be carried out to the satisfaction of the **Client Representative** prior to restoration of supply to the customer.

OR 6.8: Dip cards

1. Prior to every lining material from the end of the mixer shall be collected and inspected to ensure that the two components have been thoroughly mixed with no colour variations or anomalies evident in the collected material.
2. Under no circumstances shall lining

commence unless it can be confirmed that material has been proportioned and mixed correctly.

OR 6.9: Coating Thickness

1. The minimum lining thickness shall be as specified in the material manufacturer's Instructions for Use document. It is recommended that a lining thickness of at least 0.5mm is applied in order to ensure that applicable in-service performance requirements are satisfied and the Water Undertaker may specify in the Contract Documents a lining thickness in excess of the minimum specification.
2. If there is evidence, or it is suspected that a thin or incomplete coating has been applied, then after curing for the period recommended by the material manufacturer overlining shall be carried out after consideration whether there would be unacceptable restriction of flow after overlining.

OR 6.10: Cure Period: End of Application to Post Cure Inspection

1. The lining shall be cured in accordance with the requirements of the lining material manufacturer's Instructions for Use document and as detailed in the **Method Statement**. The curing period and method employed shall be in accordance with those submitted to the material approval body at the time the current valid approval for lining service pipes was granted to the material.
2. Care must be taken to ensure that the service pipe is neither moved nor bent after completion of the lining as this may result in damage to the lining.
3. During curing records shall be kept of the temperatures and flows of any curing medium(s) utilised in the curing procedure. These shall be determined at the points of inlet and exit from the pipe together with the duration of their application. These shall be recorded on the relevant lining record sheet.

OR 6.11: Post Cure Inspection

1. Upon completion of the specified minimum cure period both ends of the cured pipe shall be inspected for uniformity, quality, thickness and hardness. Where the service pipe has been cleaned and/or lined in the direction of the main and the end of the pipe is not accessible for inspection a CCTV survey of the main shall be carried out to inspect the end of the service pipe for quality and to determine if there is any contamination of the main. Any lining defect shall be recorded on the Service Pipe Record Sheet and a Non Conformance Record produced if necessary.
2. Under no circumstances shall a pipe exhibiting lack of cure, mixing or proportioning be returned to service until it has been rectified to the satisfaction of the **Client Representative**. Such defects shall require the service pipe to be replaced.

OR 6.12: Lining Defects

1. Any lining defects in the service pipe shall be rectified, before return to service, by the **Approved Contractor** and to the satisfaction of the **Client Representative**.
2. Any defect other than lack of cure, mixing or proportioning shall be rectified by over coating the lining after the minimum cure period has elapsed. Over coating shall only be carried out using the same resin material and then only providing that the manufacturer has conducted tests to confirm that this can be done with no detriment to water quality or the performance of the finished lining. A statement to this effect shall be included in the approved lining IFU document. Where any maximum or minimum time period is specified in the IFU, within which over coating must take place, this shall be adhered to.
3. Any pipe lengths contaminated with unmixed material or mix ratio >10% of the resin manufacturer's recommended mix ratio shall be re-laid. Under no circumstances shall any attempt be made to clean and reline such contaminated lengths.

OR 6.13: Return to Service

1. The service pipe shall not be considered for return to service until the full cure procedure specified in the **Method Statement** has been completed and the post cure inspection has been carried out.
2. After completion of curing the pipe shall be flushed at a rate and for the period stated in the manufacturer's Instructions For Use (IFU) or as in the **Method Statement**, or specified by the Water Undertaker.
3. All water used for flushing purposes shall be suitably disposed of in accordance with the requirements of the Environment Agency (or equivalent organisation) or any relevant Sewerage Undertaker's requirements.
4. Where disinfection is required/specified it shall be carried out in accordance with the requirements of Principles of Water Supply Hygiene⁽¹²⁾.
5. Any requirement for comparative pressure and/or flow tests to be carried out before and after lining shall be specified by the Water Undertaker if he wishes to determine whether the lining procedure results in an improvement or deterioration in either of the above parameters.

OR SECTION 7: QUALITY ASSURANCE

1. Any **Approved Contractor** carrying out *in situ* lining of service pipes shall operate a BS EN ISO 9001⁽⁵⁾ Quality System that explicitly includes *in situ* polymeric lining of service pipes.
2. The **Approved Contractor** shall make available a Quality Manual which contains appropriate Procedures, Site Process Instructions and Site Documentation for the *in situ* polymeric lining of service pipes.

Note: Example standard documents are contained in Appendix H of this document. No copyright attaches to these forms and they may be freely reproduced.

3. The following data/information shall be provided for every lining:

- i) Service Pipe Record Sheet (SPRS), together with dip cards
4. The following sheets shall be provided when circumstances dictate:
 - i) Non Conformance Record (NCR) – to report any defect experienced during lining;
 - ii) Stabilisation Determination Record (SDR).
 5. The **Approved Contractor** shall make available all documentation used in the lining contract and identified in Appendix H for each lining to the **Client Representative** within 24 hours of completion of the lining.
 6. Record data may be supplied separately in paper (SPRS, NCR or SDR and printout) or in electronic format incorporating all the designated record data which may be transmitted electronically directly to the **Client Representative** or to a remote location designated by the Water Undertaker such that checking and signing etc may be achieved at the earliest time. Such transmitted data must be of legible or viewable quality, as applicable, and there shall be no significant deterioration in quality from the original.
 7. All sheets shall be cross-referenced, signed, and dated by the **Approved Contractor** and the **Client Representative** as being a true and accurate record of each lining and each shall retain a copy.
 8. The Water Undertaker shall retain all paper or electronic lining record data for a minimum of two years from the date of lining or for the period of the lining contract, whichever is the longer.
 9. Dip cards shall be retained for a minimum period of six months from the date of lining or as specified by the Water Undertaker.
 10. All paper, hard copy or electronic record data shall be treated and stored under conditions that will ensure legibility for a minimum of two years from the date of lining or for the period of the lining contract, whichever is the longer.

OR SECTION 8: ADJUDICATION

- If there is any dispute between the **Approved Contractor and the Nominated Certifying Body** concerning a failure to comply with this WIS, such dispute shall be referred to adjudication; either party may give a notice in writing to the other at any time of his intention to do so. The adjudication shall be carried out under the 'The Institution of Civil Engineers Adjudication Procedures (1997)' or any amendment or modification thereof being in force at the time of the notice.
- The adjudicator will be the Chairman of the In-Situ Resin Lining of Water Mains Expert Group as designated by Water UK at the time of the notice.
- The adjudicator shall reach his decision within 28 days of referral or such longer period as is agreed by the parties after the dispute has been referred. The adjudicator may extend the period of 28 days by up to 14 days with the consent of the party by whom the dispute was referred.
- The adjudicator shall act impartially.
- The adjudicator may take the initiative in ascertaining the facts and the law
- The decision of the adjudicator shall be binding until the dispute is finally determined by legal proceedings or by arbitration or by agreement.
- The adjudicator shall not be liable for anything done or omitted in the discharge or purported discharge of his functions as an adjudicator unless the act or omission is in bad faith and any employee or agent of the adjudicator is similarly not liable.

REFERENCES

This document makes reference to the latest edition of the following publications (except where otherwise stated) including all addenda and revisions which should also be consulted.

1. Water Supply (Water Quality) Regulations. HMSO, 2016 in England (2010 Wales) or the Water Supplies (Water Quality) (Scotland)

- Regulations 2014 in Scotland or the Water Supply (Water Quality) (Amendment) Regulations (Northern Ireland) 2009 in Northern Ireland.
2. "List of Approved Products" available at:
 - <http://dwi.defra.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf> for the Drinking Water Inspectorate,
 - <http://www.ehsni.gov.uk/environment/drinkWater/regulations.shtml#dwilist> for the Northern Ireland Drinking Water Inspectorate and
 - <http://www.scotland.gov.uk/Publications> for the Drinking Water Quality Regulator for Scotland.
 3. WIS 4-02-01 Operational Requirements: *In Situ* Resin Lining of Water Mains. Water UK
 4. IGN 4-02-02 Code of Practice: *In Situ* Resin Lining of Water Mains. Water UK
 5. BS EN ISO 9001 Quality Management Systems. Requirements. BSI
 6. BS6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water BSI
 7. Water Fittings and Materials Directory (www.wras.co.uk/approvals/products_and_materials_directory/)
 8. **BSI** – BS EN 12873-2 Influence of materials on water intended for human consumption. Test method for non-metallic and non-cementitious site applied materials.
 9. **BSI** – BS EN 15768 Influence of materials on water intended for human consumption. GC-MS identification of water leachable organic substances
 10. The Controlled Waste (Duty of Care) Regulations HMSO
 11. National Water Hygiene Scheme is a training and registration scheme operated by Engineering and Utility Skills (EU Skills) further information on EU Skills and the scheme is available at (<http://www.euskills.co.uk/water/index.php?pageID=72>).
 12. Principles of Water Supply Hygiene and Technical Guidance Notes. Water UK and RSPH (www.water.org.uk/publications/reports/principles-water-supply-hygiene)

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WIS 4-02-03

APPENDICES

Appendix A – CONTRACTOR CERTIFICATION

PROTOCOL TO BE USED FOR LINING TRIALS REQUIRED FOR CERTIFICATION AND RE-CERTIFICATION OF CONTRACTORS CARRYING OUT *IN SITU* POLYMERIC LINING OF SERVICE PIPES

A.1 Introduction

This protocol has been developed on behalf of Water UK. It relates to the lining trials that contractors are expected to undertake and perform satisfactorily to gain certification to allow them to operate within the UK as **Approved Contractors** for *in situ* polymeric lining of service pipes.

The physical application of the lining and carrying out a Lining Equipment Assessment (Appendix C) shall need to be repeated at 5-year intervals to ensure that **Approved Contractors** are maintaining their standards, are using approved certified equipment and materials, trained and certified personnel and can continue operating.

In order to ensure that high standards of quality are maintained, it is essential that **Approved Contractors** operate a BS EN ISO 9001⁽⁵⁾ quality assurance scheme certified by a third party certification body with UKAS accreditation or other equivalent European Union accreditation service accreditation and this will be audited by a **Nominated Certifying Body** at the initial Contractor Certification and at each 5 year renewal assessment.

New Contractors not operating an ISO 9001⁽⁵⁾ quality assurance scheme shall be allowed an 18-month transition period after successful completion of a lining trial to become so certified.

A.2 Assessment Procedures

Each Contractor shall clean and line one 3m length of 12.5mm diameter lead service pipe and four separate 15m lengths of 12.5, 15, 25 and 32mm clear plastic pipes (other diameters can be used at the discretion of the **Nominated Certifying Body**). The whole lining process shall be witnessed and assessed by the **Nominated Certifying Body**.

For **New Contractors** the service pipes shall be a system specifically constructed for the purposes of the trial and conducted in an appropriate contained area.

On completion of lining the **New/Approved Contractor** shall provide fully completed paperwork as specified in the Operational Requirements for each lined length.

The **Nominated Certifying Body** carrying out the assessment can request as many re-inspections or re-linings as deemed necessary to ensure the **New/Approved Contractor** is suitably proficient in the lining process.

Should any section or complete lining prove to be defective, rectification works shall be carried out as if it was a pipe in service and such rectification would ensure the durability of such a lining is not compromised and there is no adverse impact on water quality. As long as any defects are properly rectified to the satisfaction of the assessing **Nominated Certifying Body**, this shall not necessarily hinder certification.

A. 3 Certification

All contractors approved by a **Nominated Certifying Body** on behalf of Water UK to apply *in situ* polymeric linings to service pipes shall be given a 5-year certificate to that effect. They will be able to describe themselves as 'certified' for application of *in situ* polymeric linings to service pipes and shall appear in a list of **Approved Contractors** maintained by the National Water Hygiene Scheme (EU

Skills)⁽¹¹⁾ on behalf of Water UK. **Approved Contractors** wishing to have full registration or specific certification removed from the EU Skills listing shall make a formal written application to a **Nominated Certifying Body** who will arrange removal with EU Skills and notify all water undertakers via Water UK.

Approved Contractors who do not undertake any *in situ* polymeric lining of service pipes within any 12 month period shall be required to conduct a Lining Equipment Performance Assessment (See C.4) to the satisfaction of a **Nominated Certifying Body** when the **Approved Contractor** begins a new contract.

Approved Contractors who do not undertake any *in situ* polymeric lining of service pipes in the UK within a consecutive three year period will have their certification revoked and shall be required to conduct a Contractor Certification, including a Lining Equipment Assessment, as described in this document, to the satisfaction of a **Nominated Certifying Body** before the **Approved Contractor** shall be allowed to begin a new contract.

Any **Approved Contractor** who undergoes a merger with another company or changes the name of their company shall inform the **Nominated Certifying Body** who originally approved their certification of the change. The **Nominated Certifying Body** would then consider if further certification is required.

A. 4 Certification for Further Materials and/or Rigs

Approved Contractors are limited by each approval to the equipment and the material used for the certification. Should such an **Approved Contractor** wish to use an alternative or modified equipment or a different material, the **Nominated Certifying Body** shall be consulted and full certification trials undertaken.

Re-certification of an **Approved Contractor** for use of a different material and/or lining equipment will in most cases require the auditing of only one lining. However, a full assessment procedure shall be followed where the lining material has significantly different properties to those for which the **Approved Contractor** holds existing approvals.

In this case, the full assessment procedure is required so that the **Nominated Certifying Body** can confirm that the **Approved Contractor** has taken into account the difference in the lining material and application process, as specified in the IFU.

A.5 Updates to Regulatory Requirements

It should be noted that specifications and performance requirements for *in situ* polymeric lining of service pipes may be reviewed from time to time and that when requirements change, existing and new contractors shall have to demonstrate compliance. An appropriate transition period shall be negotiated to enable such new requirements to be met.

Appendix B - TRAINING REGIME

PERSONNEL EMPLOYED IN THE *IN SITU* POLYMERIC LINING OF SERVICE PIPES

B.1 Introduction

The training regime for *in situ* polymeric lining of service pipes is designed to ensure that application of such linings is only undertaken and monitored by personnel who have proven competence and possess an understanding of the entire process. Personnel shall also be trained and registered under the National Water Hygiene Scheme⁽¹¹⁾ or equivalent.

A rigorous schedule is set in order to fulfil all the requirements of these Operational Requirements which requires stringent certification criteria that are subject to formal renewal at intervals not exceeding 3 years. Such training can only be carried out by **Nominated Training Certifiers**, as appointed by Water UK, and shall be subject to regular audit by **UKAS** or other equivalent European Union accreditation service to ensure that the high standards specified are maintained.

The description of the content of the training course given here is the minimum that is acceptable. Completion of such training does not preclude either the **Approved Contractor**, material manufacturer or Water Undertaker from carrying out further training on the subject.

The key personnel working for an **Approved Contractor** that require training and certification are defined as:

Agent	The person responsible for the management of a number of lining gangs, providing all lining records to the Water Undertaker and ensuring all work undertaken is in compliance with the Operational Requirements. The Site Agent shall understand all aspects of the lining process, the requirements of the Operational Requirements, health and safety implications and the significance of quality assurance.
Foreman/Ganger	The person responsible for all activities of the lining gang and, whilst he may not regularly operate the lining equipment, he is expected to demonstrate a detailed understanding of that equipment and all aspects of the process and the requirements of the Operational Requirements. He shall also undertake all management responsibility if an Agent is not employed or absent for any other reason.
Application Equipment Operator	The person responsible for the operation of the lining equipment and providing key information for quality assurance records. The Operator shall demonstrate a detailed understanding of equipment operation and maintenance, and all aspects of the lining process and the requirements of the Operational Requirements.
Recognised Fitter	The person responsible for ensuring that the lining equipment is set up in accordance with the conditions (alarm conditions, set-points etc) used when equipment approvals were granted and that lining equipment can perform in accordance with the Operational Requirements

The minimum requirement is for two fully trained personnel for each operating gang excluding the Site Agent throughout the entire rehabilitation process. Failure to maintain this level of qualified staff shall result in suspension of lining operations until such time as sufficient qualified personnel are available.

The key personnel working for a Water Undertaker that require training and certification are defined as:

Client Representative	The person engaged by the Water Undertaker shall understand all aspects of the process to ensure that all lining work fully complies with the Operational Requirements. The Client Representative is ultimately responsible for monitoring the quality of application and validation of all records in accordance with the Operational Requirements.
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B.2 Training Requirements for Key Personnel

Lining operatives shall attend a training course that provides a broad understanding of all aspects of *in situ* polymeric lining of service pipes. The minimum content of the course shall include material handling and performance as well as operation of the lining equipment and procedures for pipe cleaning, the storage, heating, dispensing, mixing, application, curing and return to service of a specified **Approved Coating Product** together with identification and rectification of faults before returning the pipe to service.

Key personnel shall be required to have knowledge of the required content of record paperwork and how to complete this to meet QA requirements and this will also form part of the training.

Key personnel shall be required to successfully complete a written assessment to obtain certification.

Note: Certification is transferable when personnel change employment between the various **Approved Contractors** carrying out *in situ* lining of service pipes using polymeric materials

Training can only be considered transferable to another lining equipment and material type following consultation with a **Nominated Training Certifier** who will make an assessment based on the relevant training requirements. If the nominated body considers that training is not transferable then appropriate training as determined by the nominated body must be completed

B.3 Training Requirements for Client Representatives

The **Client Representative** shall attend a course that gives a broad understanding of all aspects of *in situ* polymeric lining of service pipes. The course content is identical to the Contractor course

A written assessment shall be successfully carried out to gain certification.

Note: Certification is transferable when personnel change employment between the various Utilities.

B.4 Certification

Successful participants in these training schemes shall be issued with a registered identity card, which shall give the following information:

- ID photograph;
- Name;
- Role (Client Rep., Recognised Fitter, Lining Operative);
- Reference number;
- Material;
- Lining System;
- Date of certification;
- Date of expiry;
- Name of certification agent.

The maintenance of the training records and the issue of registered identity cards is conducted by the register of the National Water Hygiene Scheme⁽¹¹⁾.

Appendix C - LINING EQUIPMENT ASSESSMENT SCHEDULE

C.1 Introduction

Lining of service pipes can be carried out using various types of *in situ* lining equipment. One of the alternative procedures involves the use of a service pipe lining rig and this schedule details the standard assessment procedure for determining whether such a resin lining rig complies with the design and performance criteria required to meet the conditions of approval. Other **Approved Application Equipment** may not require such a detailed assessment as required for a lining rig but some of the following may be included or adapted to allow for the critical assessment of alternative types of equipment.

The standard assessment consists of three stages:

- i) A review of the rig/equipment design
- ii) A yard-based assessment of rig/equipment performance;
- iii) An assessment of lining capability;

The assessment procedure shall be carried out for each rig-polymeric lining material and/or monitoring system-material combinations, or other equipment as deemed appropriate by the **Nominated Certifying Body** undertaking the assessment .

Notwithstanding this consideration, the assessment shall be undertaken as a type test; that is, initially a one – off test of rig/equipment design but shall also be re-assessed at 5-year intervals during Contractor Certification or re-certification.

In addition to the type test detailed herein, **Approved Contractors** shall monitor the on-going performance of every lining rig or alternative lining equipment so as to facilitate the early identification of trends that indicate the need for maintenance and/or calibration.

C.2 Output

Upon successful completion of the assessment, the **Nominated Certifying Body** shall issue a certificate as proof that the rig/equipment and monitoring system meet the design and performance requirements for the *in situ* application of the specified polymeric material.

C.3 Review of Lining Rig/Equipment Design

Objective

To review the design of the lining rig/equipment and associated equipment and ensure that it incorporates all required design features.

Method

The **Approved Contractor** shall provide the **Nominated Certifying Body** with a summary of the rig/equipment design and a schematic showing key components of the rig/equipment at least one week prior to the assessment. The relevant key components are as follows:

- Pumps or other material delivery systems;
- Monitoring system including control panel(s);
- Meters or flow regulation/monitoring mechanism
- Temperature sensors;

- Pressure sensors;
- Heating system(s);
- Storage reservoirs;
- Air blower;
- Valving;
- Hoses including heating system and pressure rating;
- Air filtration devices including reception vessel
- Suitable safety systems for high pressure working.

This list is not exhaustive and further information may be required upon examination of the equipment.

The manufacturer shall submit a copy of the rig/equipment operating manual and their indicative calibration and maintenance regime to the **Nominated Certifying Body**, at least one week prior to the assessment.

The **Nominated Certifying Body** shall then inspect a lining rig/equipment to ensure it incorporates accepted design features and components.

It should be appreciated that whilst the rig/equipment generic specification given in the Operational Requirements defines key requirements, this should not limit any further development or inhibit innovation of new types of systems.

Should the rig/equipment manufacturer propose to include any developments that are potentially outside of the specification, full details of such developments shall be submitted at least one month prior to the rig/equipment assessment for consideration of suitability.

The rig/equipment owner should be aware that retrospective fitting of unapproved equipment to any approved rig/equipment design shall contravene the Operational Requirements and will lead to suspension of their certifications.

C.4 Rig/Equipment Performance Assessment Procedure

The procedure for the rig/equipment performance assessment is as follows:

- i) The rig/equipment shall not be preconditioned; i.e. it shall not have been operated on the day of the assessment;
- ii) The rig/equipment shall be started and conditioned as if in use on a lining site under standard operating conditions;
- iii) When the materials are at suitable temperatures (as defined in the manufacturer's IFU), weight checks shall be carried out.
- iv) The basic performance of the rig/equipment shall be monitored during the course of these operations.

When the rig/equipment is performing suitably a number of procedures shall be carried out to confirm monitoring system compliance, where applicable to specific rig/equipment as detailed in C.5.

C.5 Suitability and Accuracy of Monitoring Equipment and Response to Fault Conditions

Objective

To determine if the monitoring/operational systems are suitable and representative of the actual mix ratio output of the rig/equipment

Method

The suitability and accuracy of the monitoring/operational systems shall be assessed in the presence of the **Nominated Certifying Body**.

C.5.1 Response Time of Mix-Ratio Monitoring System

The mix ratio monitoring system is normally tested on a daily and weekly basis and both these tests shall be assessed during the lining rig assessment and is only applicable to a lining rig.

Daily Stall Test

The following tests shall be carried out daily before lining commences to ensure that the displacement pumps and valves are functioning correctly.

Base Stall Test: The assessment is conducted as follows:-

1. Set metering pump to recirculation mode.
2. Close both Base 1 and Base 2 recirculation valves.
3. Increase pump pressure until pressure gauges read approx 30 bar and note direction of pump travel.
4. If rig is operating correctly both gauges should register the same pressure and neither gauge should move in any direction.
5. Open recirculation valve and allow pump to change stroke.
6. Close recirculation valve and allow pump to stall again. The results should be as in step 4. If no movement is detected on either pump stroke the pump and valves are working correctly.
7. Any movement that is detected indicates a faulty pump and no lining shall commence until rectified.

ISO Stall Test: The assessment is conducted as follows:-

1. Repeat the Base Stall Test but in Step 3 only increase pump pressure to approx 15 bar.
2. Open ISO recirculation valve to control pump direction as stated in step 5.
3. If no movement is detected on either pump stroke the pump and valves are working correctly

Once these tests have been successfully completed proceed to the weight check screen and carry out daily weight checks.

In the event that any of the above tests fail to shut the system down correctly the fault shall be investigated and rectified before lining can commence.

C.5.2 Accuracy of Monitoring Equipment

The accuracy of the monitoring/operational system shall be assessed by comparing weight check data, but this will only be completed for directly proportioned material mixed on site and delivered by a metering pump incorporated within the **Approved Application Equipment**.

A total of 30 weight checks shall be carried out in accordance with the standard weight check protocol given below.

Weight checks shall be taken at intervals of at least 1 minute at the maximum attainable flow rate for the rig/equipment in question using the following standard weight check protocol.

- i) Cups of at least 0.3 litre capacity shall be used.
- ii) At least 100 grams of the activator shall be collected for each weight check.
- iii) The checks shall be carried out when the material is at the minimum operating temperature and taken using the provided weight check facilities.
- iv) Balances shall be calibrated at a maximum interval of 12 months and be accurate to $\pm 1\%$. The balance shall record to the nearest gram.
- v) The weight check data shall be recorded on a form showing:
 - date
 - rig identification number
 - operator
 - time of the weight check
 - flow of the base and activator
 - component pressures
 - component temperatures
 - weight of the base
 - weight of the activator
 - calculated mix-ratio (by weight of activator)

The mix-ratios calculated from the weight checks shall be compared with the mix-ratios recorded by the monitoring system or measured directly from the number of complete pump strokes at the time of the weight check. If the mix ratio is taken from the monitoring system the mix-ratio output may be obtained from either the screen display (recorded manually) or the printout, but the **Nominated Certifying Body** shall be satisfied that the screen display and printout are consistent.

The above criterion is for rigs where the mix ratio is measured and displayed directly or there is the possibility to actively monitor pump performance. Where this facility does not exist the mix ratios measured from the physical weight checks shall be compared with the mix ratios calculated using the specific gravities which relate to the batch number(s) of the material used in the weight checks and these specific gravities shall be supplied by the material manufacturer,.

Pass Criteria

The pass criteria for the above tests are given below.

The **Nominated Certifying Body** shall be satisfied that all functions (including any averaging or smoothing functions) and/or constants used to convert meter/transducer/encoder readings for display/recording purposes (including those determined during calibration) are required and do not distort the output of the monitoring system.

When assessed against the mix-ratio given by a calibrated weight check, the monitoring/pumping system mix ratio or calculated mix ratio, using declared SG values, shall give a measure of mix-ratio that is accurate to within $\pm 5\%$. Hence, operational system error/variance shall be less than 5%, with this defined as:

Error variance = (Weight check mix ratio – monitoring system/pump stroke or calculated mix ratio) x100/weight check mix ratio

Note: This calculation requires the “as pumped” specific gravities of the resin components to be known and these shall be supplied by the material manufacturer and be specific to the batch number(s) of the material components used.

Weight check data shall fall within the following tolerance bands:

- 95% of audited weight checks within $\pm 5\%$.
- 100% of audited weight checks within $\pm 10\%$.

Where these criteria are not met, the test may be repeated at the discretion of the **Nominated Certifying Body**.

The suitability of the monitoring system is acceptable when a steady measure of mix ratio is given and displayed clearly on the monitoring system. Mix ratio shall be permanently recorded on the printout; mix ratio faults shall also be registered on the printout.

Any mix ratio reading that exceeds the $\pm 5\%$ allowable tolerance shall produce an audible alarm that would be obvious to the **Approved Contractor** and shall cause the lining to be aborted by shutting the rig down immediately.

C.6 Suitability of Calibration and Maintenance Schedules

Upon completion of the rig assessment, the rig/equipment manufacturer or owner/operator shall conduct a complete rig/equipment calibration exercise. Such a procedure shall be conducted in the presence of the **Nominated Certifying Body**.

A suitable maintenance and calibration schedule, expressed as volume of resin components pumped (or equivalent measure) or explicit time period whichever occurs first shall be determined and incorporated into the **Approved Contractor's** Quality System.

In this context, it is considered good practice that the performance of each lining rig/equipment is assessed on an on-going basis by analysing weight checks together with periodic checking of the mix-ratio data output by the pumping/operational system. The maintenance/calibration schedule may be derived from the results of such on-going performance.

It is recognised that the data required may, in the first instance, be sparse. This shall not be considered a barrier to the operational use of a rig/equipment providing the design is otherwise shown to meet the requirements of the assessment. However, an appropriately cautious provisional volumetric maintenance and calibration schedule shall be adopted until the wear characteristics of rigs/equipment have been fully evaluated.

C.7 Lining Trial

At least one lining shall be assessed under operational conditions to determine compliance with this specification. Key emphasis will be placed on the coating application in terms of:

- i) compatibility of the rig/equipment, including lining application equipment
- ii) overall ability of the rig/equipment to apply a lining of the correct specification to a length of 15m clear plastic pipe of 12.5mm minimum internal diameter
- iii) compliance of the rig/equipment with this specification for the *in situ* application of approved polymeric materials to service pipes.

At the discretion of the **Nominated Certifying Body**, these requirements may be assessed by lining of pipes laid above ground.

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Appendix D - DETERMINATION OF STABILISATION TIME

The stabilisation procedure is designed to identify the time required for a specific rig/material combination to achieve steady state conditions i.e. the transient period of time during which material passing through the static mixer may not be at the correct ratio.

The stabilisation time shall be established for the specific equipment and resin material being applied at the start of the contract and thereafter at 6 month intervals or at the request of the **Client Representative**.

Stabilisation time is determined by discharging material into a suitable clean, empty container and taking a series of dip cards made of PVC, PE or PP. The dip cards are held in the stream of mixed resin coming from the manifold head. A series of dip cards shall be prepared at 10 second intervals covering the period both before and after attainment of colour stability. The first dip card exhibiting colour stability represents the onset of steady state conditions. The minimum stabilisation time for a rig/material combination is determined by adding 10 seconds to the time taken to achieve steady state conditions, the minimum stabilisation time shall not be less than 30 seconds.

The results of the test shall be recorded on a Stabilisation Determination Record Sheet (SDRS).

Appendix E - ALTERNATIVE MONITORING TECHNOLOGIES

E.1 Introduction

Pre-lining weight checks provide confirmation that the rig/equipment has attained a stable output, at the correct mix-ratio. Furthermore, weight checks carried out over consecutive lining processes, in conjunction with rig/equipment calibration and maintenance schedules, show that this stability is being maintained. This level of protection and monitoring can be improved by the use of in-line flow meters, which allow direct monitoring of the mix-ratio during the lining process, and can therefore detect transitory problems. However, because of the nature of the equipment and small volumes of lining material involved the use of in line flow meters is something that is unlikely to be considered so the need for physical checking of mix ratio using weight checks becomes increasingly important.

The assumption that in line flow meters cannot be used is not intended to preclude the use of innovative technologies that afford the same level of monitoring, alarm functionality, and/or protection against inadvertent application of an out-of-ratio lining. The following procedure outlines the arrangements for facilitating the introduction of alternative systems.

E.2 Formal Procedure

The equivalence of the alternative technology shall be demonstrated through the following formal procedure.

Stage 1: The rig/equipment manufacturer shall submit to a **Nominated Certifying Body** a review of the design and operating characteristics of the alternative technology.

Stage 2: The **Nominated Certifying Body** shall formulate a performance-based test schedule and carry out a suitable test programme to assess the equivalence of the alternative technology.

Stage 3: Where the **Nominated Certifying Body** deems the alternative technology appropriate, the results of the assessment shall be reported to a review body designated by Water UK.

Stage 4: The review body will assess the results and stipulate any additional conditions of use, as appropriate.

Should it be shown that the alternative technology complies with both Regulatory and Industry requirements, an approval certificate, together with any conditions of use, will be issued by the **Nominated Certifying Body**.

E.3 Generic Technologies

For the purposes of this document, alternative monitoring technologies will fall into two generic types:

Type 1: Equivalent measure of mix-ratio: Alternative in-line monitors that provide a real time and in-line measure of mix-ratio based on a direct measurement of flow, which is not inferred from other operational parameters such as pressure.

For this type of alternative technology, the performance criteria outlined in the Lining Equipment Assessment Schedule given in Appendix C will be applied. The pass criteria will be that the same level of monitoring and alarm functionality is afforded by the alternative system.

Type 2: Other Systems: Where systems do not give a real time in-line measure of mix-ratio it shall be demonstrated that the design of the rig/equipment is such that inadvertent application of an out-of-ratio lining is not possible when the rig is used under specified operational conditions. Further, the required

operational conditions shall be set through appropriate design features (for example; appropriate control of operating pressure and temperature ranges).

For this type of alternative technology, it shall be demonstrated that the level of protection afforded by the system equals or exceeds that given by a flow meter based or alternative flow measurement system.

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Appendix F

REQUIREMENTS FOR APPLYING DIRECTLY PROPORTIONED MATERIAL MIXED ON SITE AND DELIVERED BY A METERING PUMP INCORPORATED WITHIN THE APPROVED APPLICATION EQUIPMENT

F.1 Introduction

The following statement provides a generic description of *in situ* polymeric lining of service pipes where the resin component materials are separately stored in reservoirs on a lining rig and are transferred to a positive displacement metering pump which proportions the components before delivering them to an appropriate mixer and discharge to an inline injection system. The material injection system incorporates a high velocity air stream which transports the mixed lining material along the length of the service pipe and allows uniform distribution of material onto the pipe wall to provide a continuous lining. Control of air velocity and volume of delivered material allows a lining of the required thickness to be applied throughout the pipe length. This generic statement is amplified by the detailed content of this document together with the **Method Statement** which shall be provided by the **Approved Contractor**.

This statement makes no specific reference to, or any special conditions required, when the cleaning and lining of the service pipe may take place from the boundary stop tap towards the main without physical separation of the service pipe from the main. In such circumstances the Undertaker will be required to give approval to this procedure, as required in OR6.7.2, and the **Approved Contractor's** own **Method Statement** shall provide details of the procedure.

F.2 Cleaning

The service pipe shall be cleaned in accordance with the requirements of OR Section 6 using a combination of substantially oil free dried air and aggregate to achieve a pipe bore that is clean, and free of debris and dust. The pipe may have a blast of water blown through the pipe to ensure complete removal of debris and dust. All standing water shall be removed from the pipe and the pipe shall be left in a dry condition with the pipe wall temperature at least 3°C above the dew point of the atmosphere within the pipe.

The debris removed from the pipe shall be collected in an enclosed receptacle or hopper which will not allow discharge to the atmosphere of any potentially contaminated material. Excess air shall be suitably filtered before discharge to waste and waste retained in the receptacle shall be considered and disposed of as a hazardous waste.

F.3 Lining

The lining rig shall be suitably positioned adjacent to the service pipe to be lined and the material heated and circulated to ensure the minimum temperature within the material manufacturer's specified temperature range for application has been achieved throughout the storage and delivery system.

A weight check shall be carried out before the first lining of any particular day and also before the last lining of any day to confirm that the metering pump is operating correctly and the mix ratio of the material is within the specified tolerance limits.

Air is introduced into the pipe via the injection system to create steady flow conditions and so allow the lining material to be introduced into the delivery manifold with its subsequent displacement into the pipe. Once it has been established that the material has stabilised and is thoroughly mixed with no colour variations a dip card shall be taken before the introduction of material into the pipe.

Once the calculated amount of resin has been delivered and excess resin has appeared at the end of the service pipe the material flow can be stopped. The airflow shall be maintained for a period of time to ensure even distribution of lining material and apply a finish to the material surface.

On completion of lining the pipe ends shall be inspected to ensure that the lining is of the required quality and thickness.

F.4 Curing and Return to Service

The material shall be cured in accordance with the requirements of the material manufacturer's Instructions for Use document and as detailed in the ***Method Statement*** and this will be likely to require air cure for a specified period of time at a specific minimum ambient temperature. Any other method of curing employed such as the use of hot air and/or hot water shall be specified and detailed in both of the above documents.

On completion of the curing procedure the pipe ends shall be inspected for uniformity, quality, thickness and hardness and any defect recorded, and rectified as necessary. If lining is carried out from the boundary stop tap towards the main without separation of the service pipe then the final inspection shall include a CCTV survey of the end of the service pipe carried out from within the main.

The pipe shall be flushed prior to return to service. This will require a minimum flow of water to be passed through the pipe for a minimum period of time, both shall be specified in the material manufacturer's Instructions for Use document and detailed in the ***Method Statement***

F.5 Quality Assurance

The ***Approved Contractor*** shall complete and supply all documentation as specified in OR 7.3 and 7.4 for each lining within 24 hours of completion of that lining. If lining is carried out from the boundary stop tap towards the main without separation of the service pipe then this shall also include a copy of the CCTV survey.

Appendix G

REQUIREMENTS FOR APPLYING MATERIAL MANUFACTURED AND SUPPLIED AT THE CORRECT PROPORTIONS IN PREFILLED CONTAINERS AND DELIVERED BY **APPROVED APPLICATION EQUIPMENT**

G.1 Introduction

The following statement provides a generic description of *in situ* polymeric lining of service pipes where the resin component materials are separately stored in containers, such as prefilled cartridges, from which the components are transferred at the correct mix ratio, without further modification or intervention, to an appropriate mixer with discharge to the **Approved Application Equipment**.

The **Approved Application Equipment** incorporates a high velocity air stream which transports the mixed lining material into the service pipe and allows uniform distribution of material onto the pipe wall to provide a continuous lining. Control of air velocity and volume of delivered material allows a lining of the required thickness to be applied throughout the pipe length. This generic statement is amplified by the detailed content of this document together with the **Method Statement** which shall be provided by the **Approved Contractor**.

This statement makes no specific reference to, or any special conditions required, where the cleaning and lining of the service pipe may take place from the boundary stop tap towards the main without physical separation of the service pipe from the main. In such circumstances the Undertaker will be required to give approval to this procedure, as required in OR6.7.2, and the **Approved Contractor's** own **Method Statement** shall provide details of the procedure.

G.2 Cleaning

The service pipe shall be cleaned in accordance with the requirements of OR Section 6 using a combination of substantially oil free, dried air and aggregate to achieve a pipe bore that is clean, and free of debris and dust. The pipe may have a blast of water blown through the pipe to ensure complete removal of debris and dust. All standing water shall be removed from the pipe and the pipe shall be left in a dry condition with the pipe wall temperature at least 3°C above the dew point of the atmosphere within the pipe. If specified in the **Method Statement** that the pipe wall is required to be at a higher temperature then additional heating must be employed before lining commences.

The debris removed from the pipe shall be collected in an enclosed receptacle or hopper which will not allow discharge to the atmosphere of any potentially contaminated material. Excess air shall be suitably filtered before discharge to waste and waste retained in the receptacle shall be considered and disposed of as a hazardous waste.

G.3 Lining

The lining material in the prefilled containers or cartridges shall be heated to ensure the minimum temperature is within the material manufacturer's specified temperature range for application and that this has been achieved throughout the storage and delivery system, including the pipe wall. The stored resin components shall be connected to the specified mixer tube and loaded into the injection system.

Before the material is discharged into the service pipe or shot tube a weight check shall be carried out before the first lining of any particular day and also before the last lining of any day to confirm that the mix ratio of the material is within the specified tolerance limits.

Air is introduced into the shot tube/pipe via the injection system to create steady flow conditions and so allow the lining material to be introduced into the air stream and displacement into the pipe. When it has

been established that the material has stabilised and is thoroughly mixed with no colour variations, a dip card shall be taken before every lining application.

Once the calculated amount of resin has been delivered and excess resin has appeared at the end of the service pipe the material flow can be stopped. The airflow may be maintained for a period of time to ensure even distribution of lining material and apply a finish to the material surface.

On completion of lining the pipe ends shall be inspected to ensure that the lining is of the required quality and thickness.

G.4 Curing and Return to Service

The material shall be cured in accordance with the requirements of the material manufacturer's Instructions for Use document and as detailed in the **Method Statement**. This shall require curing for a specified minimum period of time at a specific minimum temperature using hot air and/or hot water. When air is used to cure the lining the temperature shall be measured and controlled at the point of exit of the circulated air from the service pipe. When air curing is followed by a water curing stage involving the circulation of water at a specific minimum temperature for a specified minimum period of time then temperature regulation shall also be measured at the exit of the circulated water from the service pipe. The rates of flow of air and water shall be specified in the **Method Statement**. Any other method of curing employed such as ambient air cure shall be specified and detailed in both of the above documents.

On completion of the curing procedure the pipe ends shall be inspected for uniformity, quality, thickness and hardness and any defect recorded, and rectified as necessary. If lining is carried out from the boundary stop tap towards the main without separation of the service pipe then the final inspection shall include a CCTV survey of the end of the service pipe carried out from within the main.

The pipe shall be flushed prior to return to service. This will require a minimum flow of water to be passed through the pipe for a minimum period of time. Both shall be specified in the material manufacturer's Instructions for Use document and detailed in the **Method Statement**.

G.5 Quality Assurance

The **Approved Contractor** shall complete and supply all documentation as specified in OR 7.3 and 7.4 for each lining within 24 hours of completion of that lining. If lining is carried out from the boundary stop tap towards the main without separation of the service pipe then this shall also include a copy of the CCTV survey.

Appendix H – QUALITY ASSURANCE DOCUMENTATION

IN-SITU LINING OF SERVICE PIPES

SERVICE PIPE RECORD SHEET

Serial Number

Scheme/ Location

Post Code
House Number
Contract
Contractor Supervisor
Gang Ref

Date
Resin Material
Pipe Diameter
Pipe Material
Length Lined

Lining Rig Number
Application Head Number
Activator batch number:
Base batch numbers:

	Quantity	
	Quantity	
Cleaned: visual checks OK	Yes	No
		Cleaned by

Ambient temperature
Base temperature
Activator temperature

Spin-up time
Lining: time start
Lining: time complete

Pre weight check			
Test No.	Weight of base (B)	Weight of activator (A)	Mix-ratio = (A/B)x100
1			
Time of Test			

Completion weight check			
Test No.	Weight of base (B)	Weight of activator (A)	Mix-ratio = (A/B)x100
1			
Time of Test			

Weight check 1	Yes	No
Tab test OK?	Yes	No

Weight check 1	Yes	No
Tab test OK?	Yes	No

Back Pressure Start		Back Pressure Clean		Back Pressure lined	
---------------------	--	---------------------	--	---------------------	--

PRE - INSPECTION

Uniformity OK?	Yes	No
Quality OK?	Yes	No
Thickness OK?	Yes	No
Hardness OK?	Yes	No

POST - INSPECTION

Uniformity OK?	Yes	No
Quality OK?	Yes	No
Thickness OK?	Yes	No
Hardness OK?	Yes	No

Curing time: start

Curing time: finish

Duration of cure

Tack free

Disinfectant concentration

Dechlorinated?

Reconnection Time

Reconnection date

Non-conformance record no

Non-Conformance Record No comments: (If required)

For Client

Signature	
Print name	
Position	
Date	

For Contractor

Signature	
Print name	
Position	
Date	

IN-SITU LINING OF SERVICE PIPES

NON CONFORMANCE RECORD

Serial Number

Scheme/ Location

House Number

Post Code

Gang Ref.

Pipe Size

Pipe Material

Date

Length Lined

Nature of defect

Reason for defect

Action taken

Action taken to prevent recurrence

Comments

For Client

Signature

Print name

Position

Date

For Contractor

Signature

Print name

Position

Date

IN-SITU LINING OF SERVICE PIPES

SPIN-UP DETERMINATION RECORD

Serial Number

Scheme/ Location

Gen# Ref.

Contract Supervisor

Date

Resin Material
 Rig Type
 Rig Number

Ambient Temperature
 Activator Temperature
 Base Temperature

Total Flow Rate

Elapsed Time	Colour Correct		Assessment of Cure
10s	YES	NO	
20s	YES	NO	
30s	YES	NO	
40s	YES	NO	
50s	YES	NO	
60s	YES	NO	
70s	YES	NO	
80s	YES	NO	
90s	YES	NO	
100s	YES	NO	
110s	YES	NO	
120s	YES	NO	

Tab cure time

Date tested

Min Acceptable Spin up time

Note: This is the time of the tab having the correct colour and cure plus 30 seconds. Minimum allowable Time: 1 Min

Test carried out by

Signature

Print name

Position

Date

Witness by Client

Signature

Print name

Position

Date