GENERAL SPECIFICATION
FOR
CIVIL ENGINEERING WORKS

SECTION 22
WATER SUPPLY PIPEWORKS
SECTION 22

WATER SUPPLY PIPEWORKS

GENERAL

General requirements

22.01 The works and materials specified in Clauses 22.02 to 22.05 shall comply with the sections stated, unless otherwise stated in this Section.

Drainage works

22.02 Drainage works shall comply with Section 5.

Earthworks

22.03 Earthworks shall comply with Section 6.

Formwork

22.04 Formwork and finishes to concrete shall comply with Section 14.

Concrete

22.05 Concrete shall comply with Section 16.

GLOSSARY OF TERMS

Fitting

22.06 Fitting is a component fitted to a pipe for jointing or connecting or for changing the direction or bore of a pipe.

Flexible joint

22.07 Flexible joint is a connection between pipes and fittings that provides angular deflection or axial movement or a combination of both in service without impairing the efficiency of the connection.

Mechanical joint

22.08 Mechanical joint is a flexible joint in which an elastomeric joint ring is located in the socket and the joint sealed by applying pressure to the joint ring by means of a gland bolted to the socket.

Nominal size

22.09 Nominal size (DN) is a numerical designation of size, which is common to all components in a pipework system. The nominal size is stated as a convenient round number in millimetres and is related to, but not normally the same as, the actual internal diameter of the pipeworks. “dn” designates the nominal size of tees and tapers that are less than DN.

Push-in joint

22.10 Push-in joint is a flexible joint in which an elastomeric joint ring is located in the socket and the joint is effected by entering the spigot through the joint ring into the socket.

Special fitting

22.11 Special fitting is a fitting that is made from a manipulated or fabricated pipe.

Thin-walled pipe

22.12 Thin-walled pipe is a pipe, including pipes of DN 1200 or greater, which has a ratio of nominal size to wall thickness, excluding linings and coatings, exceeding 125.

MATERIALS

Materials for water supply pipeworks

22.13 Materials for water supply pipeworks for potable water shall be non-toxic, shall not promote microbial growth and shall not impart a taste, odour, cloudiness or discoloration to the water after disinfection and washing out of the pipelines as stated in Clause 22.73.
**Steel pipes and fittings** 22.14 (1) Steel pipes and fittings shall comply with the following:

Steel pipes, joints and specials for water and sewage: BS 534

Dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes: BS 3600

Steel pipes and tubes for pressure purposes: carbon steel with specified room temperature properties: BS 3601.

(2) Steel pipes and fittings shall be manufactured by the electric-resistance welded and induction-welded process or by the submerged-arc welded process. The tensile strength of the steel used shall be at least 410 N/mm².

(3) Steel pipes, fittings and specials (including all flanges and blank flanges) shall be coated or lined internally and externally as stated in Table 22.1. Other requirements of using epoxy system shall be in accordance with Appendix 22.2.

(4) Gusseted steel bends and tees shall be fabricated in accordance with BS 534, BS 2633 and BS 4515.

**DI pipes and fittings** 22.15 (1) DI pipes and fittings shall comply with BS 4772. Pipes and fittings other than collars, caps and blank flanges shall be lined internally with cement mortar in accordance with BS 4772, Clause 3.2. Linings shall be made with sulphate-resisting Portland cement complying with BS 4027.

(2) Pipes shall be externally coated with metallic zinc in accordance with BS 4772, Clause 3.1. Fittings shall be externally coated with zinc rich paint in accordance with BS 4772, Clause 3.1.5(b). After zinc coating pipes and fittings shall be externally coated with a finishing coat of one of the following materials as stated in BS 4772, Clause 3.3:

(a) Bitumen based hot applied coating material complying with Clause 22.22 and BS 4147: Type I, Grade C, or

(b) Bitumen based cold applied coating material complying with Clause 22.22 and BS 3416: Type II.
### Table 22.1: Protection to steel pipes and fittings

<table>
<thead>
<tr>
<th>Protection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe External</td>
<td>A Fusion Bonded Epoxy system, complying with latest revision of ANSI/AWWA C213, manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns.</td>
</tr>
<tr>
<td></td>
<td><strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>A chemically-cured Liquid Epoxy system, complying with the latest revision of ANSI/AWWA C210 manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns.</td>
</tr>
<tr>
<td></td>
<td><strong>AND</strong></td>
</tr>
<tr>
<td></td>
<td>For pipes to be installed outdoor under direct sunlight, a topcoat of aliphatic polyurethane at 50 microns shall be applied for extra protection.</td>
</tr>
<tr>
<td>Pipe Internal</td>
<td>A Fusion Bonded Epoxy system, complying with latest revision of ANSI/AWWA C213, manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns.</td>
</tr>
<tr>
<td></td>
<td><strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>A chemically-cured Liquid Epoxy system, complying with the latest revision of ANSI/AWWA C210 manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 750 microns.</td>
</tr>
</tbody>
</table>

#### uPVC pipes and fittings

22.16 uPVC pipes and fittings shall be Class D and shall comply with following:

- uPVC pipe for cold water services: BS 3505
- Joints and fittings for use with uPVC pressure pipes
  - injection moulded uPVC fittings for solvent welding for use with pressure pipes, including potable water supply: BS 4346: Part 1
  - mechanical joints and fittings principally of uPVC: BS 4346: Part 2
  - solvent cement: BS 4346: Part 3
GI pipes and fittings  

22.17 GI pipes and fittings shall comply with the following:

Steel tubes and tubulars suitable for screwing to BS 21 pipe threads: BS 1387, medium grade

Pipe threads for tubes and fittings where pressure-tight joints are made on the threads: BS 21

Wrought steel pipe fittings (screwed BSP thread): BS 1740: Part 1

Flanges  

22.18 (1) Steel flanges shall comply with BS 4504: Section 3.1, and shall be either steel plate for welding type or steel plate blank flange type. The dimensions and drilling of flanges shall comply with BS 4504: Section 3.1, Table 11, as appropriate regardless of the nominal pressure rating.

(2) Steel ring flanges shall be machined in the bore to a diameter of 4 mm ± 1 mm larger than the outside diameter of the pipe to which the flange is to be welded.

(3) Steel puddle flanges shall be separated into 180° segments.

(4) DI flanges shall be cast-on or welded-on standard flanges complying with BS 4772.

Bolts and nuts  

22.19 (1) Bolts and nuts for flanged joints shall comply with BS 4504: Section 3.1, Section 6.

(2) Bolts and nuts shall be compatible with the type of joint and, unless otherwise approved by the Engineer, shall be obtained from the same manufacturer as the joint.

(3) Bolts shall be sufficiently long and shall be suitably threaded for jointing the relevant flanges.

Elastomeric joint rings  

22.20 Elastomeric joint rings shall comply with BS 2494, type W (water). Elastomeric joint rings for DI pipes and fittings shall comply with BS 4772, Clause 2.3.4. The dimensions of rings for use with flanged joints shall comply with BS 4865: Part 1. The rings shall be compatible with the type of joint and, unless otherwise approved by the Engineer, shall be obtained from the same manufacturer as the joint.

Anticorrosion tape  

22.21 (1) Anticorrosion tape shall be of a proprietary type approved by the Engineer. The tape shall either be a petrolatum tape with fabric reinforcement or a bituminous tape with PVC backing. Petrolatum tape shall be used for valves, flanged joints, slip-on type couplings and flange adaptors of all sizes. Bituminous tape shall be used in buried or non-exposed condition for welded joints of steel pipe, repair of steel pipe sheathing and other applications as specified on the Drawings.

(2) Anticorrosion tapes shall have a high resistance to cathodic disbondment, acids and alkalis. Colour of bituminous tape shall be black. Anticorrosion tapes shall have the minimum properties stated in Table 22.2.
(3) Primer and mastic filler for use with anticorrosion tape shall be compatible with the tape and shall be of a type recommended by the manufacturer of the tape and approved by the Engineer. Notwithstanding Clause 22.28(1)(f), primer and mastic filler for use with anticorrosion tape shall be supplied by the Contractor.

(4) Bituminous tapes shall be stored in a cool dry place away from the sun's rays. No dirt or grits shall be allowed to stick on the edge of the tape before applying the tape for pipe protection.

(5) The following particulars of the proposed anticorrosion tape for water supply pipeworks shall be submitted to the Engineer:

(a) Manufacturer’s literature for anticorrosion tape, and

(b) Certificate for anticorrosion tape showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements stated in the Contract and including results of tests in accordance with the Contract.

(6) The particulars, including certificates, shall be submitted to the Engineer at least 14 days before the first delivery of the material to the Site. Certificates shall be submitted for each batch of the material delivered to the Site.

Table 22.2: Properties of anticorrosion tape

<table>
<thead>
<tr>
<th>Properties</th>
<th>Petrolatum tape</th>
<th>Bituminous tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of PVC backing (mm)</td>
<td>-</td>
<td>0.75</td>
</tr>
<tr>
<td>Total thickness (mm)</td>
<td>1.1</td>
<td>1.65</td>
</tr>
<tr>
<td>Mass (kg/m²)</td>
<td>1.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Tensile strength (N/mm)</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Adhesion strength (180° peel) (N/mm)</td>
<td>Self N/A</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Steel N/A</td>
<td>2.5</td>
</tr>
<tr>
<td>Tacky adhesion strength to JIS Z 1902</td>
<td>Self 0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>(N/mm)</td>
<td>Steel 0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>Dielectric strength (2 layers) (kV)</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Elongation (at break) (%)</td>
<td>-</td>
<td>260</td>
</tr>
<tr>
<td>Temperature range(°C)</td>
<td>Wrapping -5 to +45</td>
<td>+5 to +50</td>
</tr>
<tr>
<td></td>
<td>In service -5 to +45</td>
<td>-20 to +75</td>
</tr>
</tbody>
</table>
Bituminous coatings

(1) Bituminous coatings shall comply with the following:

- Bitumen-based hot applied coating material for protecting iron and steel including suitable primers where required: BS 4147, Type I, Grade C

- Black bitumen coating solutions for cold application: BS 3416, Type II.

(2) Bituminous coatings used for repairing joints and coatings shall be compatible with the adjacent coating.

(3) Bituminous coatings shall be made from petroleum or asphaltic bitumen.

Whitewash

Whitewash shall comply with AWWA C 203.

Zinc-based paint

(1) Zinc-based paint shall be a proprietary type approved by the Engineer.

(2) Primers for zinc-based paint shall comply with BS 4652.

(3) Rust inhibitor shall be a chemical agent that is capable of converting rust into iron phosphate.

Joint filler and compressible padding

(1) Joint filler for joints in concrete bed, haunch and surround shall be of a proprietary type approved by the Engineer and shall be a firm, compressible, single thickness, non-rotting filler. The thickness of the filler shall be as stated in Table 22.3.

(2) Compressible padding between pipes and supports shall be bitumen damp-proof sheeting complying with BS 743.

<table>
<thead>
<tr>
<th>Nominal diameter of pipe</th>
<th>Thickness of joint filler (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 450 mm</td>
<td>18</td>
</tr>
<tr>
<td>450 mm - 1200 mm</td>
<td>36</td>
</tr>
<tr>
<td>exceeding 1200 mm</td>
<td>54</td>
</tr>
</tbody>
</table>

Polyethylene sheeting

Polyethylene sheeting shall be impermeable and shall have a nominal thickness of 0.125 mm.

Extension keys

Extension keys, clamps and its associated bolts, nuts and washers for valves shall be Grade 316 stainless steel complying with BS 970: Part 1.
MATERIALS PROVIDED AND EQUIPMENT LOANED BY THE EMPLOYER

Materials provided by the Employer

22.28 (1) The following materials for water supply pipeworks included in Contracts entered into with Water Supplies Department will be provided by the Employer and shall be used in the permanent works:

(a) Full, half and quarter length pipes with plain, flanged and spigot and socket ends,

(b) Ring flanges, puddle flanges, slip-on type couplings, flange adapters, collars, expansion joints, detachable joints, elastomeric joint rings, nuts and bolts,

(c) Blank flanges and caps other than those required for pressure tests,

(d) Bends, tees and tapers,

(e) Steel pipes for the fabrication of gusseted steel bends and tees,

(f) Primer, bitumen based composition and woven glass cloth for repairs to joints in steel pipes with bitumen coating provided by the Employer other than materials for protection of steel flanged joints, slip-on type couplings and flange adapters, and

(g) Gate valves, air relief valves, butterfly valves and non-return valves, including all winding gear, operating motors and control equipment.

(2) The materials shall be obtained from the locations and at the times stated in the Contract.

(3) Water and sterilising chemicals for cleaning, sterilising and testing pipelines as stated in Clauses 22.73 and 22.81 will be provided by the Employer for one set of tests. The water and sterilising chemicals shall be obtained from the locations stated in the Contract or from other locations agreed by the Engineer and shall be mixed by the Contractor.

Equipment loaned by the Employer

22.29 The continuous pressure recorder and purpose made charts for pressure tests on pipelines for water supply pipeworks as stated in Appendix 22.1 will be loaned by the Employer.

INSPECTION OF MANUFACTURE

Inspection of manufacture and testing

22.30 (1) The manufacture and testing of pipes, joints, fitting and valves for water supply pipeworks other than materials provided by the Employer shall be inspected by an independent inspection authority approved by the Engineer.
(2) The inspections shall be carried out at the manufacturer’s works or at other locations stated in the Contract or instructed by the Engineer. The facilities and equipment required for inspections shall be provided by the Contractor.

### SUBMISSIONS

**Particulars of independent inspection authority**

22.31 Particulars of the proposed independent inspection authority for pipes, joints, fittings and valves for water supply pipeworks, including name and address, previous experience, and names of inspectors, shall be submitted to the Engineer at least 28 days before manufacture of the materials starts.

**Particulars of pipes, joints and fittings**

22.32 (1) The following particulars of the proposed pipes, joints and fittings for water supply pipeworks shall be submitted to the Engineer:

(a) Manufacturer’s literature, including details of:
   - Manufacturing process
   - Pressure and temperature ratings
   - Permissible values of straight draws and angular deflection of flexible joints
   - Recommendations for handling, storage, laying, jointing and repair
   - Drilling and tapping equipment for connections to pipes,

(b) A certificate for each material showing the manufacturer’s name, the date and place of manufacture and showing that the material complies with the requirements stated in the Contract and including results of tests required in accordance with the relevant British Standard,

(b) Three copies of drawings showing details of the pipes, joints and fittings, including the materials used and the mass of each item, and

(c) A certificate of inspection of the manufacture and testing signed by the approved independent inspection authority.

(2) The particulars, including certificates other than certificates of inspection, shall be submitted to the Engineer at least 14 days before the first delivery of the material to the Site. Certificates shall be submitted for each batch of the material delivered to the Site.

**Particulars of welding**

22.33 (1) The following particulars of the proposed materials and methods of construction for welding joints in steel pipes for water supply pipeworks shall be submitted to the Engineer:

(a) Details of welders, including names, copies of Hong Kong Identity Cards and details of previous experience,

(b) Details of format of records,

(c) Details of welding procedures, including welding plant, method of welding, materials, manufacturer and size of electrodes, number of runs and current strength,
(d) Procedures for nitrogen gas tests on joints, and

(e) Valid certificate of competency in accordance with BS 2633,
Clause 11 for each welder, issued by an authority approved by
the Engineer.

(2) The particulars shall be submitted to the Engineer at least 14 days
before welding starts.

### Particulars of pressure tests

22.34

(1) The following particulars of the proposed procedures for pressure
tests on pipelines for water supply pipeworks shall be submitted to the
Engineer:

(a) Test equipment and method of setting up the equipment,

(b) Calibration certificates for pressure gauges,

(c) Procedure for carrying out the test, and

(d) Programme for testing.

(2) The particulars shall be submitted to the Engineer at least 14 days
before the test starts.

### TRIALS

#### Welding trials

22.35

(1) Unless otherwise permitted by the Engineer, trials shall be carried out
to demonstrate the competency of each proposed welder who will be
employed to weld joints in steel pipes for water supply pipeworks.

(2) Trials shall be carried out at least 7 days before welding starts.

(3) The Contractor shall inform the Engineer 24 hours, or such shorter
period agreed by the Engineer, before carrying out welding trials.

(4) The trials shall be carried out using the welding procedures submitted
to the Engineer.

(5) Trials shall be carried out under similar conditions as those that will
be encountered on the Site. Each trial shall consist of fillet welding two
steel plates using at least two electrodes to complete one run of weld. The
thickness of the steel plates shall be the same as the thickness of the steel
pipe that will be welded.

(6) A 150 mm length of the plate that contains what in the opinion of the
Engineer is the worst welding shall be cut from the steel plates and broken
in a vice.

(7) The Engineer shall determine the competency or otherwise of each
welder on the basis of the results of the welding trials.

#### Pipe jointing trials

22.36

(1) Trials shall be carried out to demonstrate that the pipes, joints and
fittings for water supply pipeworks fit correctly.
(2) The trials shall be carried out at least 6 weeks, or such shorter period agreed by the Engineer, before the materials are to be incorporated in the permanent work.

(3) The Contractor shall inform the Engineer 24 hours, or such shorter period agreed by Engineer, before carrying out trials.

(4) The Contractor shall immediately inform the Engineer of any pipes, joints or fittings which do not fit correctly. Modifications shall be made to pipes, joints and fittings that do not fit correctly or replacements shall be provided as instructed by the Engineer.

**Trials for drilling and tapping**

22.37

(1) Trials shall be carried out to demonstrate that the proposed equipment and methods of drilling and tapping pipes for water supply pipeworks will produce connections that comply with the specified requirements.

(2) The trials shall be carried out at least 14 days before drilling and tapping starts.

(3) The Contractor shall inform the Engineer 24 hours, or such shorter period agreed by the Engineer, before carrying out trials.

**TRANSPORT, HANDLING AND STORAGE OF MATERIALS**

**Transport, handling and storage of pipes, joints and fittings**

22.38

(1) Pipes, joints and fittings for water supply pipeworks shall be transported, handled and stored in accordance with the manufacturers’ recommendations and in a manner, which will not result in damage or deformation to the pipes, joints and fittings, or in contamination of the pipes, joints and fittings.

(2) Pipes, joints and fittings shall be protected from damage and damaged pipes, joints and fittings shall not be used in the permanent work unless permitted by the Engineer. Pipes, joints and fittings shall be securely packed and supported to prevent movement when being transported.

(3) uPVC pipes, joints and fittings shall be protected from exposure to conditions which may affect the material.

(4) Bolts and nuts shall be packed in sealed metal containers.

(5) Elastomeric joint rings shall be packed in bags and lubricant for joints shall be stored in sealed containers marked to identify the contents. The rings and lubricant shall be protected from exposure to conditions that may affect the material.

(6) Boxed or crated materials or those in sealed containers shall remain in their original boxes, crates or containers.

**Handling of pipes and fittings**

22.39

(1) Pipes and fittings other than thin walled pipes shall be handled by manual methods or by using lifting appliances or chains, wire rope or canvas slings of a type recommended by the pipe manufacturer and agreed by the Engineer. Hooks shall not be used.
Storage of pipes

22.40

(1) Pipes other than thin walled pipes shall be stored horizontally at least 75 mm above the ground on wedged timber bearers. The bottom layers and the outer pipes in each layer shall be securely wedged to prevent sideways movement.

(2) Socket and spigot pipes shall be stored with the sockets alternating and in such a manner that loads are not applied to the sockets.

(3) The height of stacks of pipes other than thin walled pipes shall not exceed 2 m unless recommended by the manufacturer and permitted by the Engineer.

(4) Pipes shall not be strung out along the route of the pipeline unless permitted by the Engineer.

Transport of thin walled pipes

22.41

When being transported, thin-walled pipes shall be supported on three rubber-covered saddles shaped such that the pipes are supported over at least one-quarter of the circumference. The pipes shall be securely fixed in position at each saddle by straps tightened by turnbuckles. One saddle shall be placed at the mid-point of the length of the pipe and the other two saddles shall be placed at distances of one-fifth of the length of the pipe from each end of the pipe.

Handling and storage of thin walled pipes

22.42

(1) When being handled and stored, thin walled pipes shall be protected from deformation by means of at least two screw jack cruciform struts with rubber-padded ends shaped to fit the circumference of the pipes. The struts shall be fitted inside the pipes. Any temporary struts fixed by the manufacturer shall be left in position until the cruciform struts have been fixed.

(2) Thin-walled pipes shall be handled by using two reinforced canvas slings at least 300 mm wide. The slings shall be suspended from a lifting beam and shall be placed at a distance of one-fifth of the length of the pipe from each end of the pipe.

(3) Thin-walled pipes shall not be rolled.

(4) Thin-walled pipes shall be stored on timber bearers padded with hessian or straw to provide continuous support over at least one-third of the circumference of the pipe. The pipes shall be securely fixed in position with wedges placed at a distance of one-fifth of the length of the pipe from each end of the pipe.

(5) Thin-walled pipes shall not be stacked on top of each other.

Storage of valves

22.43

Valves, including power operated valves and associated electrical and control equipment, shall be stored in accordance with the manufacturer’s recommendations in a weatherproof store.
ACCESS TO PIPELINES

Access to pipelines 22.44  (1) Rubber wheeled trolleys shall be provided to obtain access inside pipelines exceeding DN 500 for water supply pipework in order to joint pipes, repair joints, coatings and linings and inspect the pipeline. Persons entering pipelines shall wear clean soft-soled footwear.

(2) Mechanical fans shall be provided to ensure that an adequate air supply is available to those entering pipelines for inspection. Engine driven fans shall be fitted with a flexible exhaust or other methods of keeping exhaust fumes clear of the fresh air intake.

SETTING OUT OF PIPELINES

Setting out of pipelines 22.45  (1) Both horizontal and vertical alignment shown on the Drawings are indicative only. The exact alignment shall be determined by the Engineer on site in accordance with the procedure set out in this Clause.

(2) Three weeks before commencing trench excavation of a section of pipeline, the Contractor shall set out on site such section of pipeline based on the indicative information given on the Drawings and shall proceed to conduct the underground utilities survey. When this has been carried out, the Contractor shall prepare his proposal of inspection pits excavation and submit the same to the Engineer for agreement two weeks before commencing trench excavation all in accordance with Clause 1.25(6). The agreed inspection pits excavation shall be completed within one week to provide the remaining one week as float time for the Engineer to inspect and, if found necessary, adjust the indicative alignment to suit topography and obstruction in accordance with sub-clause (3) of this Clause.

(3) The Engineer may order excavation of inspection pits after initial setting out or after the completion of the excavation of inspection pits proposed by the Contractor at locations that may deviate from the proposed indicative alignment to ascertain the final alignment. The inspection pits so ordered shall be payable under the Bills of Quantities. The Contractor shall exercise his best endeavour to complete such inspection pits excavation before the scheduled commencement date for trench excavation.

(4) The method of setting out shall be a centre line peg with suitable offset at every change in horizontal alignment and a slight rail mounted on two posts at 30m maximum or at every change in vertical alignment or any other appropriate methods agreed by the Engineer.

(5) Following the setting out and adjustments, if any, the existing ground levels shall be recorded and agreed.

(6) The chainages shown on the Drawings for mainlaying works are nominal only and should only be used as a means of reference. The measured distance between the chainages assigned to any two points will not necessarily be that given by the difference in those chainages.
LAYING AND BEDDING PIPES

**Laying pipes** 22.46

(1) The Engineer shall be allowed to inspect trenches, bedding, pipes, joints, fittings and valves before pipelaying for water supply pipeworks starts. The Contractor shall inform the Engineer 24 hours, or such shorter period agreed by the Engineer, before pipelaying starts in any part of the permanent work.

(2) The permission of the Engineer shall be obtained before pipelaying starts in any part of the permanent work.

(3) The Contractor shall inspect pipes, joints, fittings and valves, including internal and external coatings, immediately before and after pipelaying. Valves shall be inspected to ensure that they are in working order and are capable of being fully opened and closed. Deleterious material shall be removed and damage shall be repaired immediately before and after pipelaying. Potable water shall be used for washing.

(4) The inside of pipelines shall be kept clean and free from water, dirt, stones, debris and deleterious material. Except when pipes are being jointed, the open ends of pipelines shall be sealed with a wooden plug or stopper or by other methods agreed by the Engineer.

(5) Measures shall be taken to prevent flotation of pipes.

(6) Pipelaying shall follow closely on excavation of the trench. Lengths of trench, which in the opinion of the Engineer are excessive, shall not be left open.

(7) Unless otherwise permitted by the Engineer, pipelines with a gradient steeper than 1 in 20 shall be laid in an uphill direction with sockets facing uphill.

(8) Pipes shall be laid in such a manner that water will not pond in locations with zero and shallow gradients and such that the line and level of pipes will comply with the specified tolerances.

**Laying steel pipes** 22.47

Steel pipes with welded joints for water supply pipeworks shall be spot welded to the adjacent pipe to which they will be jointed immediately after laying. Steel pipes manufactured with longitudinal or spiral welds shall be aligned in such a manner that the welds are staggered from pipe to pipe by at least 15° of arc.

**Laying pipes with flexible joints** 22.48

The degree of the curve of pipes for water supply pipeworks with flexible joints, which are to be laid to a curve, shall be equally distributed over all joints within the curved section. The deflection at a completed joint shall not exceed 3° or three-quarters of the maximum deflection recommended by the manufacturer whichever is less.

**Installation of valves** 22.49

(1) Operating gear and associated fittings shall be installed and fixed at the same time as valves for water supply pipeworks are installed. After installation, valves shall be cleaned inside and outside and left in a closed position.
(2) Extension keys and clamps shall be fixed to valves in valve chambers if the vertical distance between the top of the valve spindle and the finished ground level exceeds 600 mm. The length of extension keys shall be such that the top of the extension key is not more than 300 mm below the finished ground level.

Bedding pipes 22.50

(1) Surfaces on which pipes for water supply pipeworks will be laid shall be cleaned and objects that may damage the pipes shall be removed before pipes are laid.

(2) The bottom of trenches on which pipes will be laid directly shall be shaped to support the pipes uniformly along the length of the barrel. Holes shall be dug to prevent pipes resting on the sockets and to allow the pipes to be jointed.

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CUTTING AND DRILLING PIPES

Cutting pipes 22.51

(1) Pipes for water supply pipeworks shall be cut and the ends shall be prepared in accordance with the manufacturer’s recommendations. Purpose-made equipment recommended by the manufacturer and agreed by the Engineer shall be used for cutting the pipes.

(2) Cut ends of pipes shall be square and even, without damage to the pipe or coating. Cut ends, including cut ends of the piece not immediately required, shall be trimmed and chamfered to suit the type of joint and in such a manner that elastomeric joint rings will not be damaged by the cut end.

(3) Pipes requiring to be cut to form closing lengths shall not be cut until adjacent pipes have been laid and jointed and the length to be cut can be accurately measured.

(4) The permission of the Engineer shall be obtained before pipes provided by the Employer are cut. Only those pipes, which in the opinion of the Engineer are suitable for cutting on Site, shall be cut. All off-cuts shall be used for the permanent work unless in the opinion of the Engineer this is not practicable.

Drilling pipes 22.52

(1) Pipes for water supply pipeworks shall be drilled for small diameter connections using purpose made drilling and tapping equipment.

(2) The threads of screw joints shall be painted before assembly with two coats of bituminous paint and shall be wrapped with three turns of spun yarn or other material approved by the Engineer.
JOINTING PIPES

**Jointing pipes** 22.53

(1) Pipes for water supply pipeworks shall be jointed in accordance with the manufacturer’s recommendations and using jointing equipment and jointing materials recommended by the manufacturer and agreed by the Engineer.

(2) The Contractor shall inspect pipes, joints, fittings and valves, including internal and external coatings, immediately before and after jointing. Deleterious material shall be removed and damage shall be repaired immediately before and after jointing. Potable water shall be used for washing. Surfaces that are to be jointed and jointing materials shall be cleaned immediately before jointing.

(3) All joints in pipelines shall be watertight.

(4) The widths of gaps at joints shall be in accordance with the manufacturer’s recommendations and shall be achieved by marking the outside of the pipe, by using metal feelers or by other methods agreed by the Engineer. The position of elastomeric joint rings shall be checked by using metal feelers after jointing.

(5) Gaps at joints in pipes shall be protected after jointing by methods agreed by the Engineer to prevent dirt, stones or other material entering the joint.

(6) Bolts holes in flanged joints and joints incorporating bolted components shall be correctly orientated before the bolts are tightened. The correct size of bolts and nuts shall be used. Bolt threads shall be lubricated and bolts shall be tightened using the correct size of spanner. Bolts shall be tightened in diametrically opposite pairs working around the bolt circle until all bolts are tightened to the torque recommended by the manufacturer.

(7) Bolt holes in flanged joints shall be orientated symmetrically about the vertical diameter with no bolt-holes on the vertical diameter. Elastomeric joint rings shall be the correct size and shall not protrude into the bore of the pipe. The rings may be temporarily fixed to the face of the flange using a minimum amount of adhesive of a type recommended by the manufacturer. Jointing compound or paste shall not be used.

**DI pipes with push-in joints** 22.54

DI pipes with push-in joints for water supply pipeworks shall be jointed by smearing the spigot end of the pipe with lubricant and placing the elastomeric joint ring in position inside the groove of the socket end of the laid pipe. The spigot end of the pipe shall be placed in the socket end of the laid pipe and pushed home.

**DI pipes with mechanical joints** 22.55

(1) DI pipes with mechanical joints for water supply pipeworks shall be jointed as stated in Clauses 22.55(2) to (4).

(2) The elastomeric joint ring and the ends of the pipe shall be smeared with lubricant over a distance recommended by the manufacturer.

(3) The gland and the elastomeric joint ring shall be placed in position on the spigot end of the pipe.
(4) The spigot end of the pipe shall be placed in the socket end of the laid pipe before the bolts are tightened.

**Welding joints in steel pipes**

22.56

(1) Welding of joints in steel pipes for water supply pipeworks shall be carried out by the metal-arc process in accordance with BS 2633 and BS 4515.

(2) Butt welding shall not be used for jointing plain-ended pipes other than for gusseted bends unless approved by the Engineer. If approved, the ends of the pipes shall be prepared in accordance with BS 534 and BS 2633 and welding shall be carried out in accordance with BS 4515.

(3) Records of welding operations shall be kept by the Contractor on the Site and shall be available for inspection by the Engineer at all times. Records shall contain the following details:

   (a) Date,
   (b) Names of welders,
   (c) Location of welding operation, and
   (d) Electrodes used in making each weld.

**Steel pipes with spigot and socket joints**

22.57

(1) Steel pipes with spigot and socket joints for water supply pipeworks shall be jointed as stated in Clause 22.57(2) to (6).

(2) Pipes not exceeding DN 700 shall be welded externally. Pipes exceeding DN 700 shall be welded internally and shall then be welded externally with a sealing weld.

(3) Loose scale, slag, rust, paint and other deleterious material shall be removed from parts of pipes to be welded by wire brushing or by other methods agreed by the Engineer. The parts shall be kept clean and dry before welding.

(4) A double-run convex fillet weld shall be used for pipes not exceeding DN 900 and a triple-run convex fillet weld shall be used for pipes exceeding DN 900. The leg length of the fillet as deposited shall be at least the same as the full thickness of the pipe wall. The actual throat depth shall not be less than seven-tenths, and shall not exceed nine-tenths, of the minimum leg length as deposited.

(5) Deposition of the weld metal shall be carried out in such a manner that all welds have adequate root fusion and are of good, clean metal, free from cracks, gas holes, slag intrusion and other impurities. The surface of the weld shall have an even contour with a regular finish and shall indicate proper fusion with the parent metal. Slag shall be removed from each weld by light hammering with a chipping hammer and by wire brushing.

(6) Welds that contain cracks or other cavities or defects or in which the weld metal overlaps on to the parent metal without proper fusion shall be cut out and the joints shall be rewelded.
Steel pipes with welded steel collar joints

Steel pipes with welded steel collar joints for water supply pipeworks shall be jointed by leaving a gap not exceeding 75 mm between the ends of the pipes to be jointed. A split steel collar shall be placed centrally around the ends of the pipes. The collar shall be at least the same thickness as the pipe wall and shall be approximately 300 mm long. The end of each pipe shall be fillet welded to the collar as stated in Clause 22.57.

Steel pipes with couplings and flange adapters

(1) Steel pipes with slip-on type couplings and flange adapters for water supply pipeworks shall be jointed as stated in Clause 22.59(2) to (4).

(2) Protective wrappings shall be removed from the ends of plain ended pipes to be jointed and shall be replaced by:

(a) Epoxy or plastics based coating of a proprietary type approved by the Engineer.

(3) The pipe shall be finished to an even, smooth surface free from distortion to allow the components of the coupling or flange adapter to be correctly positioned and jointed.

(4) The coupling or flange adapter shall be placed in position on the plain end before the bolts are tightened.

uPVC pipes with push-in joints

uPVC pipes with push-in joints for water supply pipeworks shall be jointed as stated in Clause 22.54.

uPVC pipes with solvent welded joints

uPVC pipes with solvent welded joints for water supply pipeworks shall be jointed by applying solvent cement to the pipes to be jointed and pushing the pipes home. Excess solvent shall not be applied and surplus solvent shall be removed after jointing. Solvent welded pipes jointed outside the trench shall not be placed in the trench until the solvent setting period recommended by the manufacturer has elapsed.

GI pipe joints

GI pipes for water supply pipeworks shall be screw jointed using a threaded coupler. The surface of the pipe and coupler shall be cleaned and the threads shall be painted with two coats of bituminous paint. The pipe thread shall be wrapped with three turns of spun yarn or other material approved by the Engineer and the joint tightened using purpose made tools. Coal tar compounds or lead-based paint shall not be used. Locking nuts to branch connections shall be tightened. Branch connections shall not protrude inside the pipe.

Making flanged joints

(1) Further to Clause 22.53(6), both pipes and/or fittings to be joined together shall be independently supported and properly aligned. After placing the gasket in position, the bolts shall be tightened in the sequence as shown in Sketch No. 22.1 to avoid severe overstressing of the flange. If it is necessary to dismantle the flanged joint, the bolts shall be slackened in the reverse sequence to that used for tightening.

(2) When flanges other than polyethylene flanges are tightened, the bolts shall be tightened with a torque not exceeding the corresponding value specified in Table 22.4(a), (b) or (c) as appropriate. If the joint is
not sealed after applying the specified torque, then the bolts shall be tightened with the torque increased by 10%. This procedure will be repeated until the joint is sealed. A final tightening shall then be applied with a further 10% increase in torque.

(3) When polyethylene flanges are tightened, the bolt torque shall be in accordance with manufacturer's recommendations or in the absence of such recommendations to the limits as shown in Table 22.4 (d). Bolts shall be tightened by means of a torque wrench.

**PROTECTION TO STEEL FLANGED JOINTS, SLIP-ON TYPE COUPLINGS AND FLANGE ADAPTERS**

22.64 (1) Steel flanged joints, slip-on type couplings and flange adapters in steel pipes for water supply pipeworks shall be protected as stated in Clauses 22.64(2) to (4). Protection shall be carried out after jointing is complete.

(2) The joint, including bolts and nuts, shall be cleaned to remove all moisture, dirt, oil, grease and deleterious material. Bolts and nuts shall be painted with two coats of bituminous paint and the joint shall be coated with primer. Mastic filler shall be applied in such a manner that all depressions, corners and voids between the bolts and nuts are filled and a smooth surface is available on which to apply the anticorrosion tape.

(3) At least two layers of anticorrosion tape shall be applied to all parts of the joint and to the adjacent pipe for at least 200 mm beyond each end of the joint. The tape shall be applied in accordance with the manufacturer’s recommendations and shall be wrapped spirally around the joint and pipe with at least 55% overlap per spiral.

(4) The tape shall be moulded manually after application to take up the contours of the parts being protected.
Table 22.4(a): Approximate bolt torques (PN 10 Flanged Joints)

Using rubber, cork, or paper millboard gaskets (3 mm thick only)

<table>
<thead>
<tr>
<th>Nominal Size DN (mm)</th>
<th>Approximate Bolt Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To seal at 5 bar</td>
</tr>
<tr>
<td>80</td>
<td>55</td>
</tr>
<tr>
<td>100</td>
<td>55</td>
</tr>
<tr>
<td>150</td>
<td>90</td>
</tr>
<tr>
<td>200</td>
<td>95</td>
</tr>
<tr>
<td>250</td>
<td>90</td>
</tr>
<tr>
<td>300</td>
<td>95</td>
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<tr>
<td>350</td>
<td>90</td>
</tr>
<tr>
<td>400</td>
<td>125</td>
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<tr>
<td>450</td>
<td>120</td>
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<tr>
<td>500</td>
<td>125</td>
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<td>600</td>
<td>160</td>
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<td>240</td>
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<tr>
<td>1100</td>
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<tr>
<td>1200</td>
<td>290</td>
</tr>
<tr>
<td>1400</td>
<td>335</td>
</tr>
<tr>
<td>1600</td>
<td>425</td>
</tr>
</tbody>
</table>
Table 22.4(b): Approximate bolt torques (PN 16 Flanged Joints (DN 80 - 600))

Using rubber, cork, or paper millboard gaskets (3 mm thick only)

<table>
<thead>
<tr>
<th>Nominal size DN (mm)</th>
<th>Approximate Bolt Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To seal at 5 bar</td>
</tr>
<tr>
<td>80</td>
<td>55</td>
</tr>
<tr>
<td>100</td>
<td>55</td>
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<tr>
<td>150</td>
<td>90</td>
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<tr>
<td>200</td>
<td>85</td>
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<tr>
<td>250</td>
<td>115</td>
</tr>
<tr>
<td>300</td>
<td>120</td>
</tr>
<tr>
<td>350</td>
<td>115</td>
</tr>
<tr>
<td>400</td>
<td>145</td>
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<tr>
<td>450</td>
<td>140</td>
</tr>
<tr>
<td>500</td>
<td>170</td>
</tr>
<tr>
<td>600</td>
<td>215</td>
</tr>
</tbody>
</table>

Table 22.4 (c): Approximate bolt torques (PN 16 Flanged Joints (DN 700 - 1600))

Using rubber, cork, or paper millboard gaskets (thickness up to and including 3 mm)

<table>
<thead>
<tr>
<th>Nominal size DN (mm)</th>
<th>Approximate Bolt Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To seal at 5 bar</td>
</tr>
<tr>
<td>700</td>
<td>235</td>
</tr>
<tr>
<td>800</td>
<td>290</td>
</tr>
<tr>
<td>900</td>
<td>290</td>
</tr>
<tr>
<td>1000</td>
<td>350</td>
</tr>
<tr>
<td>1100</td>
<td>350</td>
</tr>
<tr>
<td>1200</td>
<td>450</td>
</tr>
<tr>
<td>1400</td>
<td>475</td>
</tr>
<tr>
<td>1600</td>
<td>600</td>
</tr>
</tbody>
</table>
Table 22.4 (d): Typical bolt torques for polyethylene flanges

<table>
<thead>
<tr>
<th>Nominal PE Size (mm)</th>
<th>Equivalent Size of Metal Flange (mm)</th>
<th>No. of Bolts</th>
<th>Torque Required (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>50</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>90</td>
<td>80</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>125</td>
<td>100</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>180</td>
<td>150</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>250</td>
<td>250</td>
<td>12</td>
<td>100</td>
</tr>
</tbody>
</table>
For sizes having 12 bolts or more, it is recommended two jointers work simultaneously on diametrically opposite bolts. Each jointer tightens the first nut in the first quadrant then the first nut in the second quadrant, returns to the second nut in the first quadrant and so on.
REPAIRS TO JOINTS, COATINGS AND LININGS

Repairs to joints, coatings and linings 22.65

(1) Joints and damage to coatings and linings of pipes, joints and fittings for water supply pipeworks shall be repaired as stated in Clauses 22.65 to 22.68.

(2) Unless otherwise approved by the Engineer, repairs to joints, coatings and linings shall be carried out using materials of the same type and grade as in the pipe, joint or fitting.

(3) External repairs shall be completed before internal repairs are carried out.

(4) Internal repairs and adjacent areas shall be washed with potable water after the repair is complete.

Repairs to DI pipes with bitumen coatings 22.66

Internal and external repairs to joints and coatings of DI pipes with bitumen coatings shall be carried out using bituminous paint. The area to be repaired shall be cleaned to bare metal and dried. The area to be repaired shall be painted with bituminous paint to the same thickness as the adjacent coating. The paint shall be finished to a smooth uniform surface.

Internal repairs to DI pipes with cement mortar lining 22.67

(1) Internal repairs to joints and linings of DI pipes with cement mortar linings shall be carried out as stated in Clause 22.67(2) to (4).

(2) The area to be repaired shall be cut back to leave clean, bright metal. The area surrounding the area to be repaired shall be wetted.

(3) The cement mortar shall be worked into the area to be repaired and compacted to the same thickness as the adjacent lining. The cement mortar shall be finished to a smooth uniform surface. The repaired area shall be cured with curing compound as stated in Clause 16.11.

(4) The inside of pipe sockets and the faces of flanges shall be kept free from cement mortar.

Repairs to GI pipes 22.68

Internal and external repairs to joints and coatings of GI pipes shall be carried out using zinc-based paint. The area to be repaired shall be cleaned to bare metal and dried. The area to be repaired shall be painted with a rust inhibitor, primer and two coats of zinc-based paint.

THRUST AND ANCHOR BLOCKS

Thrust and anchor blocks 22.69

(1) The bearing face, and other faces stated in the Contract, of concrete thrust and anchor blocks for water supply pipeworks shall be cast directly against undisturbed ground. The faces of excavations shall be trimmed to remove loose material before concreting. Excess excavation and working space shall be filled with concrete of the same Grade as the block.

(2) Internal pressure shall not be applied to the pipeline until thrust and anchor blocks have developed the specified grade strength.
BED, HAUNCH AND SURROUND

Concrete bed, haunch and surround  22.70

(1) Concrete bed, haunch and surround to pipelines for water supply pipeworks shall be constructed as stated in (2) to (5) of this Clause.

(2) Pipes shall be supported at the required level by Grade 20 precast concrete wedges, blocks or cradles or by other methods agreed by the Engineer. One support shall be placed adjacent to each end of each pipe and the spacing between supports shall not exceed 3 m. Compressible sheeting shall be placed between the pipes and supports.

(3) Flexible joints shall be formed in concrete bed, haunch and surround at flexible joints in pipelines. Joint filler shall be placed next to the flexible joint in the pipeline and shall extend for the complete thickness of the bed, haunch and surround.

(4) Polyethylene sheeting shall be placed on the trench bottom before concreting.

(5) Concrete shall be placed evenly over the complete width of the bed and over the complete length of the pipe being concreted up to a level of 25 mm below the underside of the pipe. Concrete shall then be placed on one side of the pipe only and worked under the pipe until the concrete spreads under the pipe. Concrete shall then be placed equally on both sides of the pipe to the specified level.

TOLERANCES

Tolerances : pipelines  22.71

The line and level of pipelines for water supply pipeworks shall be within 25 mm of the specified line and level.

SWABBING

Swabbing of pipelines  22.72

(1) The decision as to whether swabbing should be carried out is subject to the availability of water, which should be agreed with the Distribution Engineer of Water Supplies Department. Swabbing shall not normally be required for new pipes exceeding DN 600 that can be inspected internally to ensure cleanliness.

(2) Swabs shall be of a proprietary brand obtained from an approved manufacturer and used in accordance with the manufacturer's instructions. They shall be of a compressible hard grade polyurethane foam in cylindrical shape and shall have the following diameters:

<table>
<thead>
<tr>
<th>DN of Pipe</th>
<th>Diameter of Swab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 300 mm</td>
<td>Pipe DN + 25%</td>
</tr>
<tr>
<td>Above 300 mm</td>
<td>Pipe DN + 75 mm</td>
</tr>
</tbody>
</table>
Swabs shall be suitable for clearing out new pipelines and removing dirt and materials inadvertently left in the pipeline during construction. It is recommended that swabs be fitted with a signaling device to enable the swab to be located within the pipeline.

(3) Water for swabbing shall be supplied free of charge by the Employer. The Contractor shall be responsible for the conveyance of water to the place where swabbing work is required and if necessary, pressurize the water to a level sufficient for the swabbing work.

(4) Unless otherwise approved by the Engineer, the swab shall be inserted into a short plain-ended pipe at ground level adjacent to the trench and the pipe shall then be fitted, by means of flange adaptors, into position in the pipeline between two gate valves which shall then be opened to allow the swab to pass through the pipeline.

(5) The swab must be fully immersed in water during the entire operation using water as the driving medium. Foam swabs must not be air driven and the water must not drain away from the swab on downhill sections. The velocity of the swab, which shall be controlled by the rate of flow of water downstream of the swab, shall be kept within a range of 300 mm/sec to 1200 mm/sec.

(6) All air valves and valves on tees/branches from the pipeline shall be closed before swabbing work commences.

(7) At least 14 days before the swabbing operation is to be carried out, the Contractor shall submit the following information for the approval of the Engineer:

(a) Name and address of supplier of swab,
(b) Place and name of manufacturer,
(c) Type and grade of swab,
(d) Manufacturer's recommended instructions for use,
(e) Details of previous applications of the proposed type of swab,
(f) Programme and details of swabbing operation, and
(g) Means of recovering swab from pipeline at the end of the swabbing run.

CLEANING AND STERILISATION OF PIPELINES

Cleaning and sterilisation of pipelines

22.73 (1) Fresh water and potable water pipelines for water supply pipeworks shall be cleaned and flushed through with potable water. Cleaning and flushing shall be carried out after:

(a) The complete pipeline, or parts of the pipelines permitted by the Engineer, has been tested,
(b) Temporary Works required for testing have been removed, and
(c) Parts of the pipeline removed for testing have been reconnected.

(2) The pipeline shall be completely filled with water that has been dosed with a homogeneous solution of sterilising chemicals such that the final concentration of free chlorine in the water is at least 30 ppm. The water shall be left in the pipeline for at least 24 hours.

(3) After the 24-hour period, the pipeline shall be drained down and the sterilising water shall be flushed out using potable water until the concentration of the remaining chlorine is less than 1 ppm.

(4) Unless otherwise permitted by the Engineer, pipelines shall be cleaned and sterilised not more than 7 days before the pipeline is handed over.

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**CONNECTION TO EXISTING WATERMAINS**

*Connection to existing water mains* 22.74

(1) Where connections to existing watermains are specified in the Contract, whether to be done by others or by the Contractor, the Contractor shall excavate inspection pits to determine the locations and levels of the existing watermains as directed by the Engineer. The Engineer may adjust the lines and levels of the proposed watermains to suit the lines and levels of the existing watermains.

(2) Where connections to existing watermains are specified in the Contract to be done by others, the Contractor shall lay and terminate the proposed watermains approximately 2 m from the existing watermains or as directed on Site by the Engineer.

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**IDENTIFICATION TAPES FOR WATERMAINS**

*Identification tapes for water mains* 22.75

(1) Identification tapes for watermains shall be as shown on Drawing No. WSD 1.31 of the standard drawing of Water Supplies Department.

(2) A sample of the proposed identification tape of a minimum length of 1 metre shall be submitted to the Engineer for approval at least 14 days before the relevant work starts.

(3) During the backfilling of pipe trenches, the fill material shall be properly levelled and compacted to prepare for the laying of the identification tapes on a flat surface.

(4) Identification tapes shall be laid continuously along all watermains with the printed pattern facing upward. Wherever lapping is required, a minimum overlapping length of 300 mm shall be provided at each lap position. Identification tapes shall be temporarily secured in position before further backfilling.
Identification tapes shall terminate at the external faces of chambers and pits.

**Detectable Warning Tape for Non-Metallic Watermains**

1. Detectable warning tape for buried non-metallic water mains shall be a polyethylene tape with a continuous aluminium foil inside as shown on Drawing No. WSD 1.37.

2. At the commencement of the Contract, the Contractor shall submit a 1 m (minimum) long sample of proposed detectable warning tape to the Engineer for approval.

3. Detectable warning tapes shall be laid continuously along all new buried non-metallic water mains and be used in conjunction with the identification tapes. Detectable warning tapes shall be placed directly on top of the non-metallic water mains with the printed pattern facing upward and fixed onto the pipe bodies using adhesive tapes at regular intervals of 5 m (approx.). Identification tapes shall then be placed at 300 mm above the crown of the water mains during backfilling.

4. Wherever lapping is required, a minimum overlapping length of 300 mm shall be provided. At the lap, detectable warning tapes shall be joined together by either 2 no. stainless steel crimps or a stainless steel clamp as shown on Drawing No. WSD 1.37. The stainless steel crimps/clamp shall pierce through the plastic covering of the tapes to make direct contact with the aluminium foils.

5. Any change in direction of the detectable warning tape to suit the alignment of the water main shall be achieved by folding the tape and stapling the laps with stainless steel crimp(s) as shown on Drawing No. WSD 1.37. For tee connection of the water main, the tee joint of the detectable warning tape shall be formed by joining two tapes together perpendicularly using a stainless steel clamp as shown on Drawing No. WSD 1.37.

6. Terminal connection points shall be provided at the internal face of valve pits at regular spacing not exceeding 200 m or at locations as indicated on the drawing. The detectable warning tape shall be brought to the surface within such valve pit and mounted to the pit wall to form a terminal connection point as shown on Drawing No. WSD 1.37 by means of a stainless steel clamp and rawl bolts. Further, the tape shall be folded to by-pass the valve in order to avoid interfering the normal open-close operation of the valve.

7. The deposition and compaction of fill material to pipe trenches shall be carried out in such a manner as to enable the detectable warning tapes and identification tapes to be laid properly. During the backfilling of pipe trenches, the fill material shall be properly deposited, leveled and compacted to prepare for the laying of these tapes.
WORK ON ASBESTOS CEMENT PIPES AND DISPOSAL OF ASBESTOS WASTES

22.77 (1) Two copies of the following publications shall be maintained on Site at all times for reference, one copy of which shall be for the sole use of the Engineer:

(a) "Guide to the Factories and Industrial Undertakings (Asbestos) Special Regulations 1986" issued by the Labour Department, Hong Kong.

(b) "Control of Asbestos at Work - Code of Practice" issued by the Labour Department, Hong Kong.

(c) "Code of Practice on the Handling, Transport and Disposal of Asbestos Waste" issued by the Secretary for Health & Welfare, Hong Kong.

(2) Not less than 7 days before disposing of any unwanted Asbestos Cement pipes or fittings, the Contractor shall confirm to the Engineer that the Permit required by Waste Disposal Authority has been obtained.

TESTING: JOINTS IN STEEL PIPES

22.78 (1) Spigot and socket joints in steel pipes exceeding DN 700 for water supply pipeworks shall be tested after welding by the nitrogen gas test.

(2) A tapped hole of approximately 6 mm diameter shall be made in the socket end of each pipe to be tested and a non-return valve shall be fixed in the hole. The nitrogen gas test shall be carried out by pumping nitrogen to a pressure of 400 kPa into the annular space between the spigot and socket. The pump shall be disconnected and the pressure shall be recorded for 30 minutes.

Compliance criteria: joints in steel pipes

22.79 There shall be no drop in pressure in the joint during the 30 minute period of the nitrogen gas test.

Non-compliance: joints in steel pipes

22.80 If the result of any nitrogen gas test does not comply with the specified requirement for the test, the weld at the joint shall be cut out and the joint shall be rewelded and tested.

TESTING: PRESSURE PIPELINES FOR WATER SUPPLY PIPEWORKS

22.81 (1) Pressure pipelines for water supply pipeworks shall be tested as stated in Clause 22.81(2) to (6).

(2) The pipeline shall be tested in sections as stated in the Contract unless otherwise permitted by the Engineer. If testing in sections other than those stated in the Contract is permitted, the section to be tested shall
be as long as practicable provided that the specified test pressure will not be exceeded. Final tests on complete pipelines that have been tested in sections shall not be carried out unless stated in the Contract.

(3) The test pressure shall be as stated in the Contract. If the test pressure is not stated in the Contract, the test pressure shall be:

(a) 1.5 times the maximum working pressure if the maximum working pressure does not exceed 1.5 MPa, or

(b) 1.3 times the maximum working pressure if the maximum working pressure exceeds 1.5 MPa.

(4) Unless otherwise permitted by the Engineer, pressure tests shall not be carried out until the fill material has been deposited and compacted over the complete length of the pipeline to be tested. If permitted, sufficient fill material shall be deposited to restrain the pipeline in position during the test.

(5) Tests shall not be carried out simultaneously on pipelines in the same trench.

(6) The method of testing shall be in accordance with Appendix 22.1.

(7) Unless otherwise permitted by the Engineer, the pipeline shall be left charged with water at a head of at least 15 m after testing and until the pipeline has been sterilised or handed over to the Employer.

**Compliance criteria:**

22.82 The results of tests on pressure pipelines for water supply pipeworks shall comply with the following requirements:

(a) The leakage of water from the pipeline determined by the pressure test shall not exceed the permitted leakage calculated in accordance with Clause 22.1.4 in Appendix 22.1.

(b) There shall be no discernable leakage of water from the pipeline or from any joint during the pressure test.

**Non-compliance:**

22.83 If the result of any test on pressure pipelines for water supply pipeworks does not comply with the specified requirements for the test, the Contractor shall investigate the reason. Remedial or replacement work approved by the Engineer shall be carried out and the pipeline shall be retested.

**TESTING: WATER STERILISATION**

22.84 (1) After the pressure test on fresh water and potable water pipelines for water supply pipelines has been completed, samples of the water in the pipeline will be taken by the Engineer. The number of samples and locations of sampling shall be as instructed by the Engineer. Testing shall be carried out as stated in Clauses 23.36 and 23.37 for water sterilisation of water retaining structures.

(2) The colour, odour, appearance, turbidity, conductivity and pH value of the water samples shall be of a quality comparable with that drawn from the supply point and acceptable for potable water.
APPENDIX 22.1

PRESSURE TESTS ON PIPELINES

Scope 22.1.1 This method covers the determination of the leakage of water from pipelines for water supply pipeworks by means of a pressure test.

Equipment 22.1.2 The following equipment is required:

(a) Blank flanges or caps.

(b) Struts and wedges.

(c) Temporary concrete blocks or other anchors.

(d) Force pump and pump feed tank.

(e) Pressure gauge, readable and accurate to 0.01 m head.

(f) Continuous pressure recorder and purpose made charts.

Procedure 22.1.3 The procedure shall be as follows:

(a) Pipes and valves shall be checked for cleanliness and the operation of valves shall be checked.

(b) Blank flanges or caps shall be fixed to the ends of the pipeline, or section of the pipeline, to be tested. Tests shall not be made against valve gates.

(c) The blank flanges and caps shall be secured with struts and wedges against temporary concrete blocks or other anchors. The blocks and anchors shall be completed and shall have hardened sufficiently before testing starts.

(d) Thrust and anchor blocks, pipe straps and other devices required to prevent movement of pipes and fittings shall be completed before testing starts.

(e) The pipeline shall be filled with water and all air shall be removed.

(f) Unless otherwise permitted by the Engineer, the pipeline shall remain filled for 3 days before testing starts to allow absorption to take place and to achieve conditions that are as stable as practicable.

(g) The pressure in the pipeline shall be increased slowly to the specified test pressure by pumping water into the pipeline using a force pump.

(h) The pressure in the pipeline shall be maintained within +0% and -5% of the specified test pressure for a test period of at least 2 hours.
(i) At the beginning and end of the test period and at 30 minute intervals during the test period, readings shall be taken from the pressure gauge and the pressures (p) shall be recorded. The pressure shall be adjusted to the specified test pressure each time a reading is taken.

(j) The pressure shall be adjusted to within the specified tolerances for the test pressure at any time during the test period when the pressure falls outside the specified tolerances.

(k) The pressure shall be monitored during the test by means of a continuous pressure recorder with purpose made charts.

(l) The leakage of water from the pipeline shall be measured as the amount of water required to maintain the specified test pressure in the pipeline. The amount of water shall be determined from the fall in level of water in the pump feed tank.

**Calculation**

22.1.4 (1) The average test pressure (P) shall be calculated as the average of the pressures (p) recorded during the test.

22.1.4 (2) The permitted leakage of water from the pipeline during the pressure test shall be calculated from the equation:

\[
\text{Permitted leakage} = 0.02 \times d \times l \times \frac{t}{24} \times \frac{P}{10} \text{ litre}
\]

where:

- \(d\) is the nominal diameter of the pipe (mm)
- \(l\) is the length of pipeline tested (km)
- \(t\) is the test period (hr)
- \(P\) is the average test pressure (m)

**Reporting of results**

22.1.5 The following shall be reported:

(a) The internal diameter of the pipe to the nearest 1 mm.

(b) The length of pipeline tested to the nearest 1 m.

(c) The test period to the nearest 0.01 hr.

(d) The pressures recorded during the test to the nearest 0.01 m.

(e) The average test pressure to the nearest 0.01 m.

(f) The leakage and permitted leakage of water to the nearest 0.1 litre.

(g) Details of any discernable leakage of water from the pipeline during the test.

(h) Charts obtained from the continuous pressure recorder.

(i) That the test method used was in accordance with this Specification.
GENERAL

22.2.1 (1) Pipes, fittings and specials shall be protected both internally and externally and shall be suitable for use in and transport through the tropics.

(2) The Contractor shall provide full documentation from the pipe manufacturer and/or protection supplier detailing the guaranteed service life of the proposed materials.

(3) The Contractor shall provide certification pursuant to Clause 4.2.2 of AWWA C210-1997 where epoxy system is applied.

(4) For pipes with outside diameter less than 1016 mm, internal protection with sulphate resistant cement mortar lining in accordance with the requirement of BS EN 10298:2005 will also be considered by the Engineer.

(5) Slip-on type couplings and flanges adaptors (including nuts and bolts) shall be protected with Rilsan Nylon 11 or a fusion bonded epoxy, coating (as in the Table 22.2) and shall not require bituminous paint.

(6) Expansion joints shall be protected in accordance with sub-clauses (1) and (2) of this Clause, except stainless steel slides surfaces that require no coating.

(7) All bolts and nuts shall be hot dip galvanized or be coated with an epoxy- or plastic-based corrosion-protection coating.

(8) For pipes, fittings and specials to be jointed together by welding, internal and external protections shall be stopped back at the ends as follows: -

(a) Butt welded joints – 75mm from the ends of pipes to be welded

(b) Sleeve welded joints – for sleeve and spigot sleeve, length plus 75mm

In all cases, priming shall extend to the ends of the pipes.

(9) For pipes, fittings and specials not to be jointed by welding, the external protection shall be stopped back a distance sufficient to permit assembly of the joint and internal protection shall extend to the pipe end.

(10) On-site completion or repair of protection lining shall be carried out in strict accordance with the manufacturer's recommendation. Except for epoxy or plastic based protection coatings, materials for completing and repairing the external and internal protections on site shall be approved by the Engineer. The manufacturer shall submit one set of the maintenance guideline/manual on repair of epoxy coatings to the Engineer.
GENERAL PROTECTION COATING REQUIREMENTS

General  22.2.2 Selection of coating systems and application procedures shall be made with due consideration to environmental conditions during fabrication, installation and service of the installation. All coating application procedures shall be carried out in accordance with ANSI/AWWA C210-97.

Planning and documentation  22.2.3 (1) All painting activities shall be fully incorporated into and regarded as an integral part of the fabrication plan.

(2) Procedures pertaining to overall management, painting facilities, painting equipment, painting application, quality assurance, quality checks, repair and maintenance etc. shall be established and documented in detail and submitted for the approval of the Engineer before commencement of the actual painting work.

Ambient conditions  22.2.4 (1) No final blast cleaning or coating application shall be done if the relative humidity is more than 85%, and if the steel temperature is less than 3 °C above dew point in the ambient. No coating shall be applied or cured at ambient temperatures below 10 °C.

(2) The coating specification and/or product data sheets shall specify the maximum and minimum application and curing temperatures and other relevant requisites regarding application and curing conditions for each product in any coating system.

Coating materials  22.2.5 The coating materials shall be suitable for the intended use and shall meet the following requirements:

(i) In compliance with health, safety and environment protection requirements

(ii) Suitable for raw water, salt water, fresh water and treated effluent

(iii) For fresh water main coating, the material shall be suitable for drinking water uses

Steel materials  22.2.6 Steel used for fabrication, before abrasive blast cleaning, shall as a minimum requirement be in accordance with Rust Grade B according to BS EN ISO 8501-1:2001. Any primer applied by the steel manufacturer shall be regarded as temporary corrosion protection and shall be removed in appropriate manner before application of the coating systems herein.

Pre-qualification of coating, personnel and procedures  22.2.7 Pre-qualification requirements as described in Clauses 22.2.16 to 22.2.19 of this Appendix shall be fulfilled and documented. In the case of equivalent product or alternative to the coating system specified in Clause 22.2.20 is to be proposed, prior written consent from the Engineer shall be obtained before commencement of any work in accordance with this specification.
HEALTH, SAFETY AND ENVIRONMENTAL CONCERNS

Requirements 22.2.8 The following information/documentation shall be properly filed and made available for inspection upon demand.

(a) Product Data Sheet of the coating material
(b) Material Safety Data Sheet of the coating material.
(c) Volatile Organic Compound content (g/l) of the coating material.
(d) Special handling precautions, personal protection, disposal instructions.

SURFACE PREPARATION OF THE SUBSTRATE

Pre-blasting preparation 22.2.9 (1) Sharp edges, blurs, welding seams shall be rounded or smoothened by mechanical grinding before blast cleaning.

(2) Hard surface layers resulting from flame cutting shall be removed by mechanical grinding before blast cleaning.

(3) Welding slag shall be removed by mechanical chipping and/or grinding. Blow-holes and welding imperfections shall be repaired by spot welding or removed by mechanical grinding. All welds shall be inspected and if necessary repaired before final blast cleaning of the area.

(4) Any major surface defects, particularly surface laminations or scabs detrimental to the protective coating system shall be removed by suitable dressing. Where such defects have been revealed during blast cleaning, and dressing has been performed, the dressed area shall be re-blasted to the specified standard.

(5) The surface of the substrate shall be free from any foreign matter such as weld flux, residue, dirt, oil, grease, salt, etc. before blast cleaning.

(6) Any oil and grease contamination shall be cleaned by use of a new rag soaked with a suitable solvent.

Blast cleaning 22.2.10 (1) Blasting abrasives shall be dry, clean and free from contaminants that will be detrimental to the performance of the coating. It shall be in compliance with requirements as specified in BS EN ISO 11124.

(2) Size and shape of abrasive particles for blast cleaning shall be such that the prepared surface profile (anchor pattern profile) is in accordance with the requirements for the applicable coating system. The surface profile will be graded in accordance with BS EN ISO 8503.

(3) The cleanliness of the blast-cleaned surface shall be as referred to for each coating system i.e. Sa 2.5 or Sa 3 in accordance with BS EN ISO 8501-1:2001.
Final surface condition 22.2.11  (1) The substrate surface, after abrasive blast cleaning and before coating, shall be clean, dry, free from oil/grease and have the specified roughness and cleanliness ready for the first coat to be applied.

(2) Dust, residual blast abrasives etc. shall be removed from the surface after blasting such that the surface cleanliness complies with Rating 2 of BS EN ISO 8502-3:2000.

(3) The maximum content of soluble impurities on the blasted surface as sampled in accordance with BS EN ISO 8502-6:2000 shall not exceed a conductivity corresponding to a NaCl content of 100 mg/M². Equivalent methods may be used.

PAINT APPLICATION

General 22.2.12  (1) Product data sheet for each and every product used in a coating system shall be filed and made available for reference.

(2) The following information for each product used in the coating system shall be clearly specified.

(i) Surface treatment requirements

(ii) Wet film thickness/dry firm thickness (max, min. and specified).

(iii) Maximum and minimum recoating intervals at 10°C gradient from 40°C down to -5°C.

(iv) Information on type of thinner to be used, thinning ratios.

(v) Mixing, handling and application requirements / recommendations.

Application equipment 22.2.13  (1) Roller shall not be used for paint application.

(2) When paints are applied by brush, the brush used shall be of a style and quality acceptable to the coating manufacturer. Brush application shall be done so that a smooth coat in accordance with specified thickness is obtained.

(3) Airless spray equipment is recommended to achieve uniform coating with good penetration. Coating supplier 's recommendation for pressure settings, nozzle sizes and fan angles shall be followed.

Application 22.2.14  (1) Before application of each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, sharp edges of beams and areas not fully reachable by spray, etc. in order to obtain the specified film thickness in these areas.

(2) Edges of existing coating shall be feathered before over-coating and overlapping.
(3) Each coat shall be applied uniformly over the entire surface. Skips, runs, sags and drips shall be avoided. Each coat shall be free from pinholes, blisters and holidays.

(4) Contamination of painted surface between coats shall be avoided. Any contamination shall be removed as per ANSI/AWWA C210 requirements.

**Repair**

22.2.15 All repairs of coating shall be conducted in accordance with the original surface preparation requirements for the substrate and coating application requirements. The Contractor shall submit a method statement for to repair any damage caused to the epoxy coating for the approval of the Engineer.

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**QUALIFICATION OF PERSONNEL, SUPPLIER AND PRODUCT**

**Operators**

22.2.16 (1) Operators for blast cleaning, paint application etc. shall be properly trained and approved by the Engineer with knowledge in areas concerning operational technique, equipment use, product handling, industrial safety, personal health and use of protection equipment, etc.

(2) The personnel involved in carrying out quality inspection or verification such as QC/QA staff shall be qualified in accordance with industrial standard. A relevant qualification in this regard is acceptable if the person has attained the status of Certified Painting Inspector by FROSIO or NACE Painting Inspector - Level 3 or equivalent.

**Supplier**

22.2.17 (1) The Supplier of coating material shall be evaluated and approved by the Engineer.

(2) The Supplier shall demonstrate that it has the resources technically, financially to fulfill its commitments with supply to the Contract. In this regard, Manufacturer's research and development ability to support product advancement, production capacity, quality assurance system, supply logistics, and on-site technical after-sale support shall be evaluated.

**Coating material**

22.2.18 (1) The coating material used for internal lining shall be tested and pass the requirements of BS 6920. A certification issued by Water Research Centre of the UK approving such coating for contact with potable water suitable for human consumption or its equivalent shall be provided.

(2) Coatings used for both internal and external lining shall be demonstrated suitable mechanical properties and anti-corrosion properties for the long-term protection of the substrate. In this regard, the following properties may be used as selection criteria:

(i) Minimum adhesion strength in accordance with ASTM D4541 shall be equal to 19 MPa or in accordance with BS EN ISO 4624:2003 shall be equal to 12 MPa.

(ii) Minimum impact test in accordance with ASTM D2794 shall be 0.136 kg-m.
(iii) Minimum abrasion resistance in accordance with ASTM D4060 (Taber Abraser Wheel CS-17) shall be 200mg/1000 rotations, load 1000 grams.

**Paint working specification (PWS)**

22.2.19 The Supplier of coating material shall provide a working specification sheet giving a summary of the work procedures. This working specification shall be properly filed and made available for reference from time to time to ensure correct procedures are followed.

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**COATING SYSTEM**

**Coating system requirements**

22.2.20 The coating system for carbon steel pipe shall be in accordance with coating system as in Table 22.2.20(a), (b) and (e) as appropriate:

Table 22.2.20(a): System 1 for carbon steel pipe – internal lining

<table>
<thead>
<tr>
<th>SYSTEM 1. For carbon steel pipe – internal lining</th>
<th>Coating Material and Surface Protection Requirements</th>
<th>Minimum Dry Film Thickness (DFT) (Microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Preparation</td>
<td>Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No. 3</td>
<td></td>
</tr>
<tr>
<td>Primer Coat</td>
<td>Solvent free two-component, high build polyamine cured epoxy</td>
<td>250</td>
</tr>
<tr>
<td>Intermediate Coat</td>
<td>Solvent free two-component, high build polyamine cured epoxy</td>
<td>250</td>
</tr>
<tr>
<td>Final Coat</td>
<td>Solvent free two-component, high build polyamine cured epoxy</td>
<td>250</td>
</tr>
<tr>
<td>Total Dry Film Thickness</td>
<td></td>
<td>750</td>
</tr>
</tbody>
</table>
Table 22.2.20(b): System 2 for carbon steel pipe – external lining pipe shielded from direct sunlight (buried underground)

<table>
<thead>
<tr>
<th>SYSTEM 2. For carbon steel Pipe– external lining pipe shielded from direct sunlight (buried underground)</th>
<th>Coating Material and Surface Protection Requirements :</th>
<th>Minimum Dry Film Thickness (DFT) (Microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Preparation</td>
<td>Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No. 3</td>
<td></td>
</tr>
<tr>
<td>Primer Coat</td>
<td>Solvent free two-component, high build polyamine cured epoxy</td>
<td>200</td>
</tr>
<tr>
<td>Final Coat</td>
<td>Solvent free two-component, high build polyamine cured epoxy</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total Dry Film Thickness</strong></td>
<td><strong>400</strong></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. For pipe to be installed outdoor under direct sunlight, a topcoat of aliphatic polyurethane at 50 microns is required for extra protection.

Table 22.2.20(c): System 3 for carbon steel pipe – temporary protection after blasting (approx. 15 cm)

<table>
<thead>
<tr>
<th>SYSTEM 3. For carbon steel pipe end – temporary protection after blasting (approx. 15cm)</th>
<th>Coating Material and Surface Protection Requirements :</th>
<th>Minimum Dry Film Thickness (DFT) (Microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Preparation</td>
<td>Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No. 3</td>
<td></td>
</tr>
<tr>
<td>Blast Primer</td>
<td>2-component amine adduct cured epoxy primer</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total Dry Film Thickness</strong></td>
<td><strong>50</strong></td>
<td></td>
</tr>
</tbody>
</table>

**INSPECTION AND TESTING**

*Testing and inspection* 22.2.21 (1) Testing and inspection shall be carried out in accordance with Table 22.2.21 throughout the application process to ensure overall specification is met.

(2) All epoxy and plastic bond coating shall be tested in accordance with BS 6920 and WIS 4-52-01.
Table 22.2.21: Testing and inspection

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Method</th>
<th>Frequency</th>
<th>Acceptance criteria</th>
<th>Action to take in case of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Conditions</td>
<td>Ambient and steel temperature. Relative humidity Dew point</td>
<td>Before start of each shift + twice per shift evenly timed</td>
<td>(a) Relative Humidity below 85%</td>
<td>No blasting or coating</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(b) Steel surface temp. 3°C above dew point</td>
<td></td>
</tr>
<tr>
<td>Visual examination</td>
<td>Visual for sharp edges. Welding spatter slivers rust grades etc.</td>
<td>100% of all surface</td>
<td>No defect. Ref. Specified requirement</td>
<td>Defects to be repaired</td>
</tr>
<tr>
<td>Cleanliness</td>
<td>BS EN ISO 8501-1:2001</td>
<td>100% visual of all surface</td>
<td>Min Sa2.5</td>
<td>Re-blasting</td>
</tr>
<tr>
<td>De-dust condition</td>
<td>BS EN ISO 8502-3:2000</td>
<td>Spot check</td>
<td>Dust condition Max. quantity and size rating 2</td>
<td>Re-cleaning and retesting until acceptable</td>
</tr>
<tr>
<td>Water soluble salts on steel surface</td>
<td>BS EN ISO 8502-6:2000</td>
<td>Spot check</td>
<td>Max. conductivity Corresponding to 100 mg/ m² NaCl</td>
<td>Re-cleaning and retesting until acceptable</td>
</tr>
<tr>
<td>Surface profile of the blast cleaned surface</td>
<td>BS EN ISO 8503</td>
<td>Spot check</td>
<td>Profile grade “Medium”</td>
<td>Re-blasting</td>
</tr>
<tr>
<td>Film thickness</td>
<td>SSPC-PA 2 Calibration on smooth surface</td>
<td>SSPC-PA2</td>
<td>SSPC-PA2 Apply DS/R 454-80:20 rule</td>
<td>Repair additional coats or re-coating as appropriate</td>
</tr>
<tr>
<td>Adhesion</td>
<td>ASTM D 3359</td>
<td>Spot check</td>
<td>Above level 3</td>
<td>Coating to be rejected</td>
</tr>
</tbody>
</table>

**NOTES:**
All readings should refer to coating system specification.