Section KW20

Materials and Workmanship Specification

Spray Applied Waterproofing Membrane System for SCL Works

Document Number: C121-MMD-Z4-RSP-CR001-00003

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12.0	12-08-13	N Tucker	R Diez	M Murray	For Construction

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Contents

KW20 SPRAY APPLIED WATERPROOFING MEMBRANE SYSTEMS FOR SCL WORKS

KW20.1000 FORMAT, SYSTEMS, PERFORMANCE AND MATERIALS

KW20.1100 SPECIFICATION TYPE AND FORMAT

KW20.1101 General

a) This Specification is a section from a suite of documents that detail requirements for the construction of primary and secondary sprayed concrete linings for all underground structures on the Crossrail project. It is part of the Contract Documents and is to be read in conjunction with all other relevant Contract Documents.

b) Unless otherwise stated the *Contractor* shall be responsible for all aspects of the Works described in the Specification.

c) Should the *Contractor* identify an aspect of the Works that is not covered by the set of Contract Documents he shall immediately notify the *Project Manager* in writing.

d) This Specification shall be read in conjunction with the relevant Specification sections shown in Table [KW20-01: Reference specifications] of the Appendix.

e) This Specification shall be read in conjunction with the reference documents shown in Table [KW20-02: Reference documents] of the Appendix.

KW20.1102 Terminology

a) References to 'The Specification' shall be interpreted to mean the set of specification documents listed in Table KW20-01.

b) Acceptance criteria shall be as follows:

i. ‘Accepted without comment' shall mean the work can proceed;

ii. ‘Accepted with comment' shall mean the work can proceed subject to the *Project Manager*'s comments and required changes being incorporated;

iii. ‘Not accepted' shall mean the work cannot proceed and the document shall be resubmitted for acceptance by the *Project Manager.*

KW20.1103 Definitions

a) SCL - Sprayed Concrete Lining.

b) Regulating layer - A finer aggregate sprayed concrete layer used to regulate the substrate surface to receive a waterproofing system or to provide an enhanced surface finish.

c) Spray applied waterproofing membrane - cured in place polymeric lining.

d) Secondary lining - sprayed or cast in-situ concrete lining inside the spray applied waterproofing membrane.

e) Drainage strips - dimpled or ribbed plastic sheet strips fixed to the primary lining to channel and manage rogue seepage ingress.

f) Plant – items intended to be included in the works, such as escalators and air conditioning units (NEC Contract terms).

g) Equipment - items provided and used by the *Contractor* to provide the works. Includes both construction equipment such as cranes, hoists and generators and temporary works materials such as scaffolding or sheet piling (NEC Contract terms).

h) GRP - Glass reinforced plastic.

i) Surveyor Paint - Aerosol paint supplied in cans used for marking temporary information on tunnel walls.

KW20.1200 SYSTEM DESCRIPTIONS

KW20.1201 NOT IN USE

KW20.1300 PERFORMANCE REQUIREMENTS

KW20.1301 Water Resistance Requirements

All SCL tunnels shall incorporate a waterproof membrane in order to achieve the following performance requirements:

a) For running tunnels:

- Above axis level: tunnels containing track shall be free from all leakage, seepage and damp patches and shall comply with the requirements of BS 8102, table 1; grade 3.
- Below axis level: leakage in tunnels containing track shall be limited to damp patches and minor weeping of joints to less than 0.24litres/ day/ m^2 from any separate square metre.

b) Tunnels and shafts accessible to the public including platform tunnels or containing plant and equipment shall be free from all leakage, seepage and damp patches so as to provide a dry environment.

c) For tunnels and shafts not accessible to the public and not containing track, limited damp patches and minor weeping at joints are acceptable where water ingress in any individual location is less than 1litre/ day/ m^2, and the average for the length of the tunnel shall not exceed 0.1litres/ day/ m^2.

KW20.1302 Restriction of Groundwater Migration

a) The provision of sufficient bond between the primary lining and the spray applied waterproofing membrane, as per Table KW20-03, shall prevent the movement of groundwater immediately behind the waterproof membrane.

b) The movement of water between the spray applied waterproofing membrane and the secondary lining shall be restricted to ensure leak sealing treatment can be effectively implemented. This shall be provided by a bond, greater than 0.5MPa, between the spray applied membrane and the secondary lining concrete, tested in accordance with BS EN 1542 as per Table KW20-03;

KW20.1303 Regulating Layer

The requirements for the regulating layer are set out in the Materials and Workmanship Specification - Sprayed Concrete Linings, KT20.

KW20.1304 System Life Span

All waterproofing system components shall be designed for the minimum design life of 120 years.

KW20.1400 MATERIALS

KW20.1401 Materials General

a) All material suppliers shall have certification to show compliance with ISO 9001.

b) Following independent review, Crossrail is aware that materials that are not classified as hazardous to human health in accordance with the (Chemicals Hazard Information and Packaging for Supply (CHIP) Regulations 2009 are available for use as spray applied waterproofing membranes. As such, in order to comply with the general requirements of COSHH Regulation 7(2) to avoid the use of materials hazardous to health in the workplace no part of any component of the system shall contain either substances classified as Category 1, 2 or 3 Carcinogens, Mutagens or Teratogens (substances toxic to reproduction) or substances classified as respiratory or skin sensitizers (potential occupational allergens) in accordance with Regulation 4 of the CHIP Regulations. Without prejudice to the above prohibitions, there exists a further requirement to use materials not classified as hazardous according to the CHIP Regulations so far as is reasonably practicable.

c) All waterproofing system products shall be transported and stored in compliance with the Manufacturer's instructions.

KW20.1402 Spray Applied Waterproofing Membrane

a) The spray applied waterproofing membrane product shall be demonstrated to conform to the properties identified in Table [KW20-03: Spray Applied Waterproofing Membrane Properties] of the Appendix. Independent test

certificates to demonstrate conformity shall be submitted to the *Project Manager* a minimum of twenty eight days prior to starting the waterproofing trial, in accordance with the programme indicated in Figure [KW20-02: Programme of waterproofing system acceptance process] of the Appendix.

KW20.1403 Brush Applied Waterproofing membrane

a) The brush applied waterproofing membrane product which may be approved by the *Project Manager* for localised repairs of the spray applied membrane shall be trialled and subject to the same requirements as the Spray Applied Waterproofing Membrane.

KW20.1404 Re-injectable Injection Tube Systems

a) Injection tube systems shall be suitable for acrylic grout and be suitable for flushing and multiple re-injections.

b) The tube systems, including method of installation and fixing, shall be compatible with subsequent application of sprayed and cast in-situ concrete for secondary tunnel linings.

c) The injection tube system shall be complete and shall include tubes, junction boxes, pumps and all other items required for its installation and use.

d) Coloured vent ends, junction boxes, anchor clips, closure plugs and all other accessories shall be as specified and supplied by the injection tube manufacturer.

e) Each injection tube shall be a maximum of 10m long and be tough, flexible and chemically inert. Injection tubes shall be fixed such that there is intimate contact with the substrate along their full length. They shall have a suitable internal diameter to allow flow of proposed injection grout over the length of the tube.

f) For construction joints longer than 10m requiring injection tubes, the joints shall include 10m length of tube with at least 300mm overlap.

g) Terminal boxes shall be heavy duty plastic with water tight feed through connections and shall be a suitable size for housing and protection of the injection tube. Boxes shall be fitted with front covers mounted flush with the surrounding concrete surface and shall be securely fixed during concreting operations.

h) Grout for injection tubes shall be acrylic resin only and shall be compatible with the spray applied membrane.

KW20.1405 Sealants and Hydro Reactive Expansion Sealants

a) Silicon paste sealants shall be of non-corrosive material which is compatible with the membrane (e.g. PVC or Polyolefin).

b) Swelling hydrophilic elastic paste sealants may be used or detailed at junctions with existing structures shall be compatible with materials including spheroid graphite iron, concrete and steel.

c) Sealants shall be compatible with surfaces that are rough, smooth, damp or dry.

d) Sealants shall be gunable and fast curing; tack free in one hour.

e) Sealants shall have an expansion volume of greater than 80% when in contact with fresh water and retain their swelling performance through repeated wet/ dry cycles.

f) Materials and surfaces shall be trialled, installed and prepared in accordance with manufacturer's requirements.

KW20.1406 Drainage Strips

a) Drainage strips shall have sufficient capacity for the encountered inflow of water. They shall be a minimum of 500mm in width and shall have dimples or surface relief features such that water is directed along the strip to a collection point which as temporary work shall be designed by the *Contractor.*

b) Drainage strips shall have a geotextile or plastic mesh backing, to permit bonding with the subsequently applied regulating sprayed concrete layer, as shown on Design Drawings.

KW20 1407 Surveyor Paint

Any surveyor paint used for making markings onto the waterproofing system shall be compatible with the spray applied waterproofing membrane and not impair its performance.

KW20.2000 SUBMITTALS AND TESTING

KW20.2100 SUBMITTALS

a) Certificates of compliance with the relevant European and British Standards and other requirements of the Specification shall be obtained from the producers or suppliers of all materials used and submitted to the *Project Manager* a minimum of twenty eight days prior to starting the waterproofing trial, in accordance with the programme indicated in Figure KW20-02. Any change in materials or supplier shall require new certificates of compliance which shall also be submitted to the *Project Manager* for acceptance.

b) Manufacturer's literature shall be provided to the *Project Manager* a minimum of twenty eight days prior to starting the waterproofing trial, in accordance with the programme indicated in Figure KW20-02. These shall demonstrate the suitability of materials (including membranes, injections tubes, grouts and fixings) for use in an underground environment. Evidence of compatibility with secondary linings of sprayed concrete shall also be provided.

c) The Manufacturer of the spray applied waterproofing membrane shall provide all relevant technical data sheets along with safety data sheets fully compliant with the requirements of Article 31 of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulations 2006 (as

amended). The manufacturer shall also supply independently verified written evidence of compliant risk assessments for the waterproofing membrane in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended), the Confined Spaces Regulations 1997 and the Dangerous Substances and Explosive Atmospheres (DSEAR) Regulations 2002 during all stages of their use: before application, during the spraying process and once installed. This information shall be submitted to the *Project Manager* a minimum of 28 days prior to starting the waterproofing trial, in accordance with the programme indicated in Figure KW20-02.

d) The Manufacturer of all products for the waterproofing works shall provide documentation to demonstrate the products are durable for the given groundwater conditions (refer to the appropriate Geotechnical Sectional Interpretive reports for further details) at each site, for the design life of the project.

e) Leak remediation measures shall be submitted to the *Project Manager* for acceptance. Supporting documentation and evidence shall include:

   i. Grout plan procedure and sample of grouting materials including data sheets and evidence of performance in similar conditions.

   ii. On-site demonstration of injection pressure. The structural capacity of the structure shall not be exceeded.

f) Details of proposed applicators shall be submitted to the *Project Manager* for acceptance a minimum of fourteen days prior to commencement of the waterproofing trial. Details of any changes/ additional applicators shall be submitted to the *Project Manager* for acceptance a minimum of fourteen days before commencing work on site.

g) The *Contractor* shall submit for the acceptance of the *Project Manager*, not less than fourteen days before the commencement of the waterproofing trial, a method statement and quality plan, in accordance with the programme indicated in Figure KW20-02. These documents shall be prepared in conjunction with the applicator and endorsed by the manufacturer of the material, describing the details of the waterproofing works including protective measures, at all stages. If, during trials, adjustments to these documents must be made, these shall be submitted to the *Project Manager* for acceptance before commencement of the full waterproofing works.

h) The *Contractor* shall submit details of the trial sections for the acceptance of the *Project Manager* and shall give at least fourteen days notice to enable the *Project Manager* to be present at the trial, in accordance with the programme indicated in Figure KW20-02.

KW20.2200 KW20.2200 TESTING

KW20.2201 Pre-construction Trials

a) A trial shall be carried out for the proposed membrane type. As part of the trial the *Contractor* shall demonstrate to the satisfaction of the *Project Manager* the temporary water management techniques he wishes to adopt.

b) During trials, the *Contractor* shall demonstrate compliance with material requirements and testing criteria outlined in this Specification.

c) The trial shall be representative of the conditions to be encountered during the full project installation. The spray applied waterproofing membrane and associated items shall be applied to a full profile section (the crown, side walls and invert) at least 5000mm long for tunnel trials. Where required trial sections for shafts shall encompass a full ring a minimum of 2000mm in height.

d) The trial shall be used by the *Contractor* to demonstrate to the *Project Manager* the suitability of the materials, equipment and construction methodology and the competence of operatives. As a minimum the trial shall include the following items:

   i. Installation of water management techniques,

   ii. Application of regulating layer,

   iii. Application (including equipment and skills of the application team) of the spray applied membrane and bond to the substrate,

   iv. Quality control systems and testing methodologies for ensuring coverage and thickness, including the required testing regime,

   v. Repair techniques for the spray applied waterproofing membrane,

   vi. Assessment of water barriers and other items necessary to prevent water migration on the inside of the membrane,

   vii. Demonstration that a sprayed concrete lining can be applied inside the fully cured spray applied waterproofing membrane (including the main tunnel crown) with no observed instability, such as sagging or sprayed concrete fallout.

   viii. Demonstration of repair techniques applied when a leakage is detected after installation of the secondary lining.

e) The spray applied waterproofing membrane product shall be demonstrated to conform to the performance properties shown in Table KW20-03. The tested sections shall be taken from a test panel, 1000mm by 1000mm, 300mm thick with the membrane installed 150mm in from the surface. The type and configuration of materials and their method of application in the construction of the test panel shall be representative of the proposed construction works. Minimum thickness of waterproofing layer to be specified by the supplier.

f) The trial shall form a hold point and additional waterproofing and secondary lining works may not proceed until both the *Contractor* and *Project Manager* are satisfied and the *Project Manager* has accepted all aspects of the trial. If the trial is accepted in can be incorporated into the Works.

KW20.2202 Quality Control Testing during Construction

a) The regulating layer substrate shall be inspected by the applicator with the supervisor to ensure that it is in accordance with section on Substrate Preparation in this Specification KW20, prior to installation of the spray applied membrane.

b) Before a section of secondary lining is installed the relevant section of waterproofing system shall be checked for defects. Installation of the secondary lining can not take place until the section is signed off by an accepted member of the team as identified in the Quality Plan and by the *Project Manager*. This check shall include the waterproofing membrane and all grouting tubes and any items used for compartmentalisation of the lining (refer to section on Restriction of Groundwater Migration in KW20) and shall take place after installation of any reinforcement required in the secondary lining.

c) The spray applied waterproofing membrane shall be tested in accordance with Table [KW20-04: Construction Testing for spray applied waterproofing membranes] of the Appendix.

d) Other waterproofing components shall be tested in accordance with Table [KW20-05: Construction testing for other waterproofing components] of the Appendix.

e) All materials being for inclusion in the works will be installed tested, trialled in accordance with the manufacturer's instructions.

KW20.3000 FABRICATION AND WORKMANSHIP

KW20.3100 KW20.3100 FABRICATION

KW20.3101 Spray Applied Waterproofing Membrane

The spray applied waterproofing membrane shall be mixed in accordance with the manufacturer's instructions, using recommended and *Project Manager* accepted equipment.

KW20.3200 WORKMANSHIP

KW20.3201 Waterproofing System Installation General

a) The spray applied waterproofing membrane system shall be installed only by an application team and equipment accepted by the *Project Manager*.

b) Waterproofing membrane shall be sprayed on primary lining which is dry for at least 24 hours.

c) If the application of the spray applied waterproofing membrane products present fire and COSHH related hazards, then measures shall be identified and put in place to control these hazards. Appropriate measures shall include, but not be limited to:

i. Ventilation requirements and air quality monitoring

ii. Fire detection and suppression

iii. Personal Protective Equipment

iv. Exclusion zones

v. Robotic application, (wherever possible)

vi. Eye wash and first aid facilities

d) Where risk mitigation has been included in the manufacturer's recommended application method, then the product shall be applied strictly in accordance with that method and be included in the *Contractor's* method statement.

e) Waterproofing of the main construction works shall be carried out in accordance with the final method statement applicable to the accepted trial and shall only commence following acceptance of the trial from the *Project Manager*. Waterproofing works may commence immediately *after Project Manager* acceptance of the trial is obtained.

KW20.3202 Management of Water Ingress

Where water ingress through the primary lining is such that it may affect the successful installation of the spray applied waterproofing membrane, the *Contractor* shall use water management techniques. This water management shall be maintained throughout the membrane placing process, and shall be so arranged that water pressure behind the membrane cannot develop during construction of the tunnel secondary lining. The system shall provide a suitable dry substrate for 24 hours before the membrane is installed.

KW20.3203 Substrate Preparation

a) A regulating layer at a thickness shown on the Design Drawings and in accordance with the KT20 Sprayed Concrete Specification shall be applied to the primary lining prior to commencement of the waterproofing works.

b) No further waterproofing application stages shall be carried out until the regulating layer has been agreed as satisfactory by the *Project Manager*.

c) Not withstanding the above, the substrate surface shall be prepared in accordance with the membrane manufacturer's instructions. All soil, debris, oils and grease shall be removed and any damaged or spalled surfaces, voids and cracks with depths greater than 25mm, shall be repaired with primary sprayed concrete or regulating concrete.

d) Temporary supports and hangers installed in the primary lining for construction purposes shall be removed and the projecting portion of any support elements shall be cut off and patched so they are flush with the face of the sprayed concrete surface.

e) GRP bars used for the purpose of providing support to secondary lining reinforcement shall be drilled and inserted prior to the application of the waterproofing membrane. There shall be a maximum of two GRP insertions per metre squared of lining. The GRP bars shall be cleaned so as to allow adequate bond with the spray applied waterproofing membrane.

KW20.3204 Spray Applied Waterproofing Membrane

a) The spray applied waterproofing membrane shall be applied in accordance with the manufacturer's recommendations as shall be described in the method statement.

b) When installing the spray applied waterproofing membrane, no other works shall be carried out in the vicinity which may cause personnel or equipment to come into contact with the spray applied waterproofing membrane before it has been protected by installation of the secondary lining. If it is likely that excessive dust may be generated in the vicinity of the works (vehicle movements etc.) then dust suppression measures shall be put in place until the membrane has cured.

c) Adjacent sections of spray applied waterproofing membrane shall overlap by a minimum of 300mm. Spray applied waterproofing membrane shall only overlap an existing section of membrane if the surface is clean of dust and contaminants.

KW20.3205 Re-injectable Injection Tubes

a) Injection tubes shall be installed at construction joints and locations as shown on the Design Drawings.

b) Injection tubes shall be fixed in accordance with the manufacturer's instructions and shall be intimately fixed to the substrate. Clips to attach injection tubes to concrete shall be located at maximum 250mm centres. Adhesive tape to attach tubes to SGI shall be located at maximum 250mm centres.

c) Before pouring/ spraying of the secondary lining the injection tubes shall be tested by flushing with water. Individual injection tubes shall be overlapped by a minimum of 200mm. All ends of tubes shall be identified by means of numbered tags.

d) Injection tubes shall not be compromised by pressure during the concreting works.

e) Injection points shall be located to avoid interference with rebar or embedded objects and permit easy future access and use.

f) Injection shall only take place if water is leaking through the joint. Tubes shall be flushed with water after injection to enable re-injection at a later date, if required.

KW20.3206 Drainage

Drainage strips shall be secured via shot fired nails, with rubber washers/ collars, on either side at minimum 250mm centres.

KW20.3300 DEFECTS AND REPAIRS

KW20.3301 Spray Applied Waterproofing Membrane

a) Areas in which the substrate is still visible, or where the spray applied waterproof membrane's integrity is impaired, shall be marked up with surveyor paint and an additional layer of spray applied waterproofing membrane applied with a minimum lap of 200mm around the area.

b) If, after repairs, any section of spray applied waterproof membrane still does not meet specified requirements shall be removed and replaced. The cause of the problem shall be identified and remedial action taken before placing any further spray applied waterproofing membrane.

KW20.3302 Injection of Leaks

Leaks shall be injected in accordance with the methodology accepted by the *Project Manager*.

KW20.3400 SECONDARY CONCRETE LININGS

KW20.3401 Installation of secondary concrete linings inside the waterproofing

a) Secondary Concrete Linings inside the spray applied waterproofing membrane layer shall be installed in such a way that there is no damage to the integrity of the spray applied waterproofing membrane. If required, protection (as identified in Manufacturer's Information and detailed in the method statement) shall be provided to the spray applied waterproofing membrane against the effect of steel fibre and structural bar reinforcement in the secondary concrete lining.

b) The secondary concrete lining shall be installed as soon as possible following a period of time (as identified in Manufacturer's Information and detailed in the method statement) that allows complete curing of the spray applied waterproofing membrane. The secondary lining shall not be installed without the approval of the *Project Manager*. The spray applied waterproofing membrane shall not be without a secondary concrete lining for a period of time that results in a build up of water pressure behind the membrane.

c) Installation of secondary lining reinforcement shall where practical negate the need for protrusions or penetrations of the waterproofing membrane. The *Contractor* shall demonstrate his proposed methodology for reinforcement installation to the satisfaction of the *Project Manager.*

d) Concreting and other tunnelling activities associated with the secondary lining works shall not result in contamination of the waterproofing works. Where required, protection shall be provided to the spray applied waterproofing membrane when adjacent sections of concrete lining installation are underway.

e) The spray applied waterproofing membrane and other items of the waterproofing system shall be clean from dirt, debris and concrete spill prior to installation of the secondary concrete lining. Any cleaning shall be carried out using compressed air/ water jetting to a maximum of 4bar, such as with a sprayed concrete nozzle.

KW20.3500 RECORDS

KW20.3501 General

a) The *Contractor* shall keep records, during both the pre-construction trials and the main works, of the following items:

i. The inspection of the substrate prior to installing the waterproofing membrane.

ii. The location of any water management measures which are undertaken, such as drainage strips, injection tubes and their terminal units and expansion sealant.

iii. All tests, identifying the section of work to which they relate.

iv. Records of any repairs and retesting carried out.

v. The inspection of the waterproofing system, including membrane, prior to installation of the secondary lining.

b) The delivery tickets for each consignment of each material shall be retained by the Contractor.

KW20.3600 SUPERVISION AND TRAINING

KW20.3601 Supervision of Spray Applied Waterproofing Works

a) The *Contractor* shall have on site a dedicated waterproofing supervisor who shall have at least five years experience of and training in the installation of similar systems. Their CV shall be submitted to the *Project Manager* as part of the Method Statement and Quality Plan submission a minimum of fourteen days before commencement of waterproofing trial.

b) Dedicated waterproofing supervision shall be present on site for all periods of waterproofing application.

KW20.3602 Training of Spray Applied Waterproofing Applicators

a) All waterproofing applicators will have undergone application training accepted by the manufacturer of the membrane and be experienced in the installation and testing of the waterproofing system. Certification of acceptance shall be provided to the *Project Manager* fourteen days in advance of any applicator commencing waterproofing works on site.

End of Section

Section KW20

Materials and Workmanship Specification
Spray Applied Waterproofing Membrane Systems for SCL Works

APPENDIX

Contents

KW20 Spray Applied Waterproofing Membrane Systems for SCL Works

KTW20 TABLES AND FIGURES

TABLE KW20-01: REFERENCE SPECIFICATIONS

Document reference	Title
KT20	Materials and Workmanship Specifications - Sprayed Concrete Linings.
KT21	Materials and Workmanship Specifications - Instrumentation and Monitoring of SCL Works.
KT22	Materials and Workmanship Specifications- Depressurisation for SCL Works.
KT24	Materials and Workmanship Specifications- Fire Testing for SCL Works.
KW21	Materials and Workmanship Specification – Sheet Waterproofing Membrane Systems for SCL Works
KF10	Materials and Workmanship Specification - In-situ concrete

TABLE KW20-02: REFERENCE DOCUMENTS

Document reference	Title
BS 6164: 2001	Code of Practice for Safety in the Tunnelling in the Construction Industry
BS EN 12390-8	Testing hardened concrete Part 8: Depth of penetration of water under pressure
BS 8102:1990	Code of practice for protection of structures against water from the ground
BS EN 1542:1999	Products and systems for the protection and repair of concrete structures. Test methods. Measurement of bond strength by pull-off
BS EN ISO 4624 : 2003	Paints and varnishes. Pull-off test for adhesion
BS EN 1062-7:2004	Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Determination of crack bridging properties
BS EN ISO 11925-2:2002	Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single-flame source test
	Control of Substances Hazardous to Health (COSHH) Regulations 2002
	Chemicals (Hazard Information and Packaging for supply) (CHIP) Regulations 2009
	Dangerous Substances and Explosive Atmospheres (DSEAR) Regulations 2002
	Confined Spaces Regulations 1997

TABLE KW20-03: SPRAY APPLIED WATERPROOFING MEMBRANE PROPERTIES

Property	**Test Method**	**Minimum Requirement**
Bond to substrate	BS EN ISO 4624 : 2003 – Pull off test for adhesion, for resin based materials (using a 50mm dolly) or BS EN 1542:1999 – Pull off test, for all other materials	Failure shown to be in substrate or bond > 0.5MPa.
Permeability	~~BS EN 12390-8:2000~~ ~~(but sealed and tested for twenty eight days with spray applied waterproof membrane located <25mm from tested face of the specimen, within the primary and secondary layers, as shown in Figure KW20-01)~~ ~~or~~ ~~Taywood Testing/similar appropriate where the lining is put to a 10bar test for twenty eight days.~~BS EN 12390-8:2000 (but sealed and tested for twenty eight days with the spray applied waterproof membrane located on the test face and exposed to the water inlet as shown Figure KW20-01) or Taywood Testing/similar appropriate where the lining is put to a 10 bar test for twenty eight days.	Zero penetration of water through membrane.

Property	Test Method	Minimum Requirement
Crack Bridging	BS EN 1062-7: 2004 Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Determination of crack bridging properties Method A: C1 Static Tensile Test	Class A5 (@ 20°C)
Flammability	BS EN ISO 11925-2:2002 Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single-flame source test	Class E (BS 13501-1:2007)

FIGURE KW20-01: BS EN 12390-8:2000 TEST METHOD ALTERED FOR SPRAY APPLIED WATERPROOF MEMBRANES

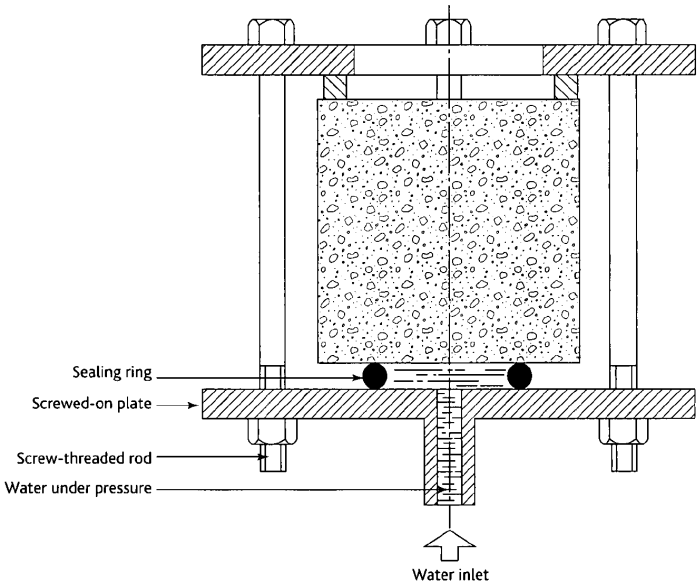
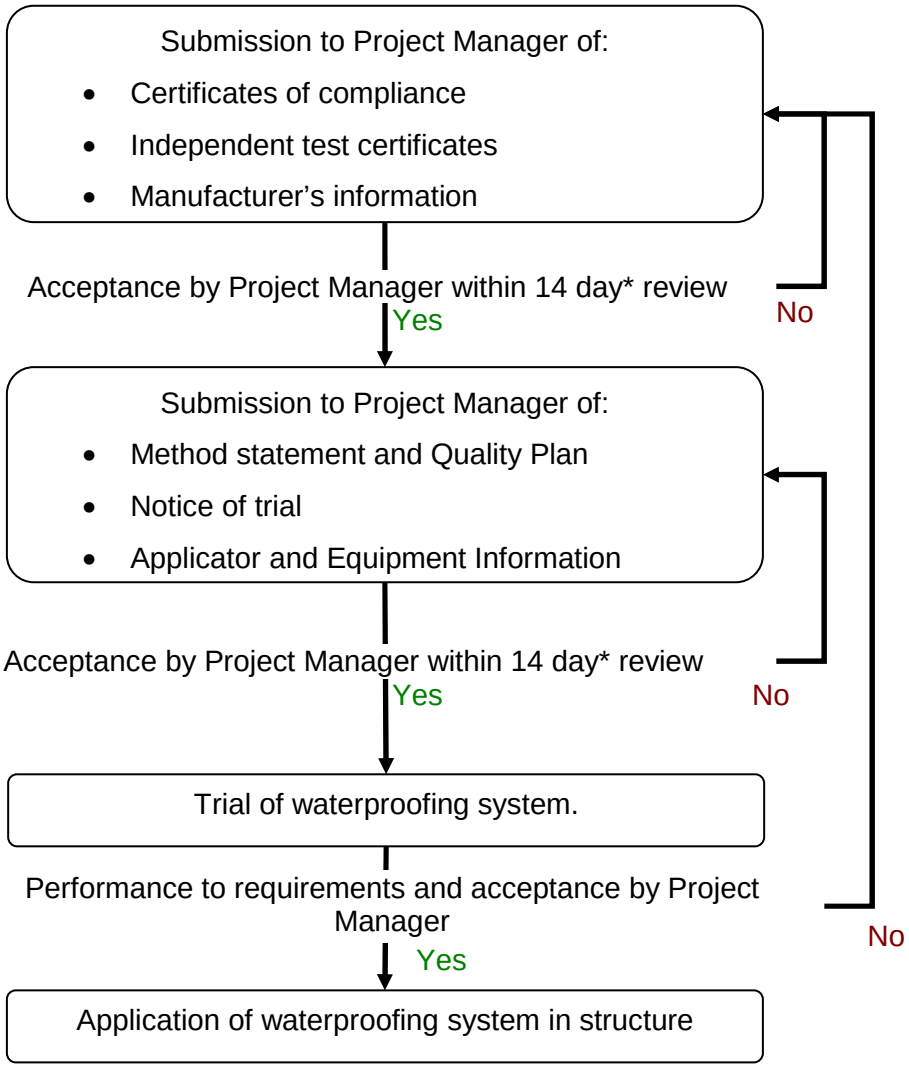


FIGURE KW20-02: PROGRAMME OF WATERPROOFING SYSTEM ACCEPTANCE PROCESS



(* note that allowing for only the minimum time period will run a risk of programme impacts should the materials not prove satisfactory to the Project Manager on first submission/trial)

TABLE KW20-04: CONSTRUCTION TESTING FOR SPRAY APPLIED WATERPROOFING MEMBRANES

Parameter	Test Method	Frequency	Pass/Fail Criteria
Coverage/ continuity	Visual	A visual inspection to be carried out continuously while the membrane is applied and following application.	100% coverage
	In-situ post application non destructive test as identified by manufacturer	All surfaces	100% coverage.
Thickness	Wet film thickness – depth gauge	10 tests per 100m².	Minimum thickness as per manufacturers recommendations achieved in all tests.
	Application quantity measurement	Per bay.	Minimum kg/m^2 to match quantity identified during trials.
	Cured Thickness 50mm by 50mm Patches	As per Project Managers requirements.	Minimum thickness of as per manufacturer's recommendations achieved for all patches.

TABLE KW20-05: CONSTRUCTION TESTING FOR OTHER WATERPROOFING COMPONENTS

Component	Test Method	Frequency	Pass/Fail Criteria
Injection tubes	Water flushing to determine tubes are clear	All tubes, prior to application of secondary linings	Unblocked: replace if necessary
Acrylic Grouts for injection tubes	Small site gel test (cup test)	Before each application of grout	Material must gel as per Manufacturer/Contractor's requirements.