CSI SPECIFICATIONS

WATERPROOF CONCRETE CONSTRUCTION JOINTS

Section 03 15 16

Note to Specifier: *The Krystol Waterstop System is comprised of several products used in a variety of combinations to waterproof construction joints, penetrations, tie holes and control joints in concrete.*

Krystol Waterstop Grout is a crystalline grout used to create an internal or external waterstop at construction joints, pipe penetrations, tie-holes and control joints.

Krystol Waterstop Treatment is a cementitious crystalline slurry that is applied to horizontal and vertical construction joints to provide additional waterproofing protection, and protect rebar from corrosion.

Krytonite Swelling Waterstop is a synthetic rubber waterstop that uses swelling pressure to seal concrete construction joints and penetrations to stop water.

Kryton Crack Inducing Waterstop is used to create crack control joints in cast-in-place concrete and shotcrete walls.

Construction joint detailing should be considered early in design phase as numerous levels of protection are possible depending on the combination of materials and techniques used to treat the joints. Kryton disseminates joint detailing into three categories determined by the risk level mitigated by the waterproofing strategy, as follows:

- *Single Protection: Base level waterproofing of horizontal and vertical joints.*
- *Double Protection: Improved waterproofing performance under more demanding hydrostatic conditions and added reinforcing steel corrosion protection.*
- *Triple Protection: Ultimate waterproofing joint design intended for use on high risk projects.*

Consult the manufacturer for consideration of all waterproofing options related to the Project's jointing requirements, penetration detailing and concrete crack control treatments.

Superior coordination between this technical specification and the drawings is crucial to ensure the waterproofing requirements are clearly conveyed to the Contractor.

Part 1 General

1.1 SECTION INCLUDES

Note to Specifier: In this article, select the components that are intended to be part of the content of this section and will not be included in other sections.

A. [Crystalline waterstop joint system consisting of waterstop grout and treatment for non-moving construction joints.]

B. [Waterproof joint design for non-moving joints in concrete consisting of swelling waterstop and treatment to provide water tightness from a hydrophilic, swelling strip and additional long-term performance from permanent crystalline integral waterproofing.]

C. [Preformed crack inducing device to control and waterproof locations of cracks during concrete curing.]

D. [Predetermined crack control using formed keyways.]

E. [Treatment of penetrations in assemblies.]

F. [Treatment of tie holes in formed concrete assemblies.]

1.2 RELATED SECTIONS

A. [Section 03 05 15 - Crystalline Waterproofing Admixtures.]

B. [Section 03 30 00 - Cast-In-Place Concrete.]

C. [Section 03 37 13 - Shotcrete.]

D. [Section 07 16 16 - Crystalline Waterproofing].

1.3 REFERENCES

A. The following agencies and standards are applicable to this section.

1. American Concrete Institute (ACI)
2. American Society for Testing and Materials (ASTM)
3. British Standard Institution (BSI)
4. German Institute for Standardization (DIN)
5. NSF International

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. A meeting shall be held prior to commencing work of this section with the Contractor, installer, and Owner’s testing agency and the Consultant [and waterproofing manufacturer's representative] in attendance to verify and review the following:
    1. Project requirements for waterproofing as set out in Contract Documents.
    2. Manufacturer's product data.
    3. Applicable application instructions which focuses on this project's specific requirements.
    4. Substrate conditions and procedures for substrate preparation and waterproofing installation.

1.5 SUBMITTALS FOR REVIEW

A. Product Data: Provide technical literature on waterstops materials, including: Technical Data Sheets (TDS) certifying compliance with specified performance requirements.

B. Shop Drawings: Submit drawings showing joints, penetrations and construction assemblies.

C. Independent Test Reports: Provide reports certifying compliance with performance requirements.

1.6 SUBMITTALS FOR INFORMATION

A. Installation Data: Manufacturer's Application Instructions (AI).

B. Qualification Statements:

1. Written notice from installer confirming project experience.

1.7 CLOSEOUT SUBMITTALS

A. Warranty Documents: Manufacturer's warranty documentation executed in the Owner’s name.

1.8 QUALITY ASSURANCE

A. Source Quality Control: Obtain all waterproofing products from a single manufacturer including construction joint details and leak repair products.

B. Manufacturer:

1. Company specializing in manufacturing the Products specified in this section with minimum [twenty-five (25)] years’ experience.

C. Installer:

1. Company specializing in performing the work of this section with minimum [three (3)] years documented experience.

1.9 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials in original undamaged containers, with manufacturer's labels and seals intact.

B. Store materials in dry environment in accordance with manufacturer's instructions.

1.10 SITE CONDITIONS

A. Do not apply below 4^0C (40^0F), or if it is raining or snowing, or if such weather conditions are imminent, unless suitable protective measures are in place.

1.11 WARRANTY

A. Manufacturer's Warranty: Provide warranty limited to waterproofing materials for a period of [ten (10)] years from date of Substantial Performance of the Work.

Part 2 Products

2.1 MANUFACTURERS

A. Manufacturer - Basis of Design:

1. Kryton International Inc.
   Toll Free: 1.800.267.8280
   E-mail: info@kryton.com
   Website: www.kryton.com

B. Substitutions: Not permitted.

2.2 MATERIALS

A. Crystalline Waterstop Grout: Fiber reinforced, non-shrink, non-toxic, fast setting, hydrophilic:

1. Working time at <20 degrees C><<68 degrees F>> and 50% RH: 30 minutes.
2. Hydrostatic head pressure resistance: <140 m><<460 ft>>.
3. Compressive Strength to ASTM C109:
   1. <16 MPa><<2300 psi>> at 1 day.
   2. <38 MPa><<5500 psi>> at 3 days.
   3. <45 MPa><<6500 psi>> at 7 days.
   4. <49 MPa><<7100 psi>> at 28 days.
   5. <52 MPa><<7500 psi>> at 56 days.
4. Pull-off Strength to ASTM C1583: <2.8 MPa><<400 psi>>.
5. Shape of crystal: when observed under 30x magnification, crystalline growth will be long and needle shaped, allowing crystals to grow deeper and fill more space.
6. Certifications: NSF/ANSI Standard 61 certified for use with potable water.
7. Acceptable Product: Krystol Waterstop Grout.

B. Waterproofing Treatment: cementitious, hydrophilic, crack resistant, waterproofing slurry.

1. Working time at <20 degrees C><<68 degrees F>> and 50% RH: 35 minutes.
2. Shape of crystal: when observed under 30x magnification, crystalline growth will be long and needle shaped, allowing crystals to grow deeper and fill more space.

3. Certifications: NSF/ANSI Standard 61 certified for use with potable water.
4. Acceptable Product: Krystol Waterstop Treatment.

C. Swelling Waterstop: Swelling, hydrophilic, synthetic flexible rubber waterstop strip:

Note to Specifier – Krytonite Swelling Waterstop is available in a standard (Yellow) version and a rain protected (Blue RP) version. Specify the yellow version if the joints are exposed to salt water. The blue version is not recommended for salt water exposure, but in all other conditions is may be used interchangeably with the standard yellow version. The blue version has better resistance to rain and allows more time for concrete to be placed over the waterstop. The blue version is recommended if construction will occur during wet weather.

1. Appearance: <Standard Version - Yellow colour> <Rain Protected – Blue Colour>
2. Shape: Trapezoid.
3. Dimensions: <5 mm><<0.20 inch>> x <20 mm><3/4 inch>>.
4. Density: <1.2 - 1.25 g/cm3><< 0.69 - 0.72 oz/in3>>.
5. Hardness (Shore A): Minimum 20 sh A.
6. Tensile Strength: Minimum <2 MPa><<290 psi>>.
7. Swelling Performance in clean water: <Standard Yellow - 1000%> <Blue RP – 500%>
8. Swelling Performance in concrete water: <Standard Yellow - 800%><Blue RP– 400%>
9. Swelling Performance in salt water: <Yellow - 300%>
10. Water Pressure Resistance (Modified DIN 1048-5): 0.8 MPa (8 bar)
11. Acceptable Product: Krytonite Swelling Waterstop

D. Crack Inducing Waterstop: Preformed crack control joint, heat weldable PVC, chemical; resistant:

1. Colour: Yellow
2. Dimensions: <150 mm><<6 inch>> wide x <40 mm><<1-5/8 inch>> thick.
3. Head Pressure Resistance (Water Column): <299 KPa><<100 feet>>.
4. Water absorption to ASTM D5: 0.15% max.
5. Tear resistance to ASTM D624: 5.4 kg/mm (300 lb/in) min.
6. Ultimate elongation to ASTM D638: 350% min.
7. Tensile strength to ASTM D638: 2000 psi min.
8. Low temperature brittleness to ASTM D746: Passes at <-37°C><<-35°F >>.
9. Stiffness in flexure to ASTM D747: <4.83 MPa><<700 psi>> min.
10. Specific gravity to ASTM D792: 1.38 max.
11. Hardness, Shore A to ASTM D2240: 79±3
12. Potable Water Containment: Products of this Section shall be certified to NSF/ANSI Standard 61 for use with potable water.
13. Acceptable Product: Kryton Crack Inducing Waterstop.

Part 3 Execution

3.1 EXAMINATION

A. Verify that adjacent concrete assemblies have been constructed using crystalline waterproofing concrete mix in accordance with Section [03 05 15] [07 16 16].

B. Verify that waterstop assemblies will not be displaced or damaged during placement of concrete.

Note to Specifier: The following Article describes treatment of formed construction joints in assemblies. Carefully coordinate the requirements of this section with the Drawings. The manufacturer provides detailed Application Instructions for each assembly; the contractor must read these instructions before performing the work.

3.2 CONSTRUCTION JOINTS

A. Single Protection - using swelling waterstop:

1. Provide swelling waterstop to locations indicated on the Drawings.
2. Ensure joints are level and sound. Repair honeycombs or other defects that will prevent a tight seal following the manufacturer's directions.
3. Install in dry conditions only. Installation during heavy rain or in contact with water can result in a premature swelling of the strip, which must be avoided.
4. Install swelling waterstop with adhesive [or mechanical fasteners] recommended by manufacturer.
5. Trim swelling waterstop to fit.

B. Double Protection:

Note to Specifier: The Methods described below should be clearly detailed on the Drawings.

1. Internal Grout Method:
    1. Preparation:
        1. Ensure all surfaces are clean; remove form release agents, dirt or debris.
        2. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
        3. Ensure joints are level and sound. Repair honeycombs or other defects that will prevent a tight seal following the manufacturer's directions.
    2. Install waterstop grout to prepared surfaces in a triangular strip <50 mm><<2 inch>> wide by <30 mm><<1.25 inch>> high with uniformly angled sides, centred in the construction joint.
    3. Apply coating of waterstop treatment to the entire joint area in accordance with manufacturer's written instructions.
    4. Place [concrete] [shotcrete] to Section [03 30 00][03 37 13].
2. Internal Swelling Method:
    1. Preparation:
        1. Ensure all surfaces are clean; remove form release agents, dirt or debris.
        2. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
        3. Ensure joints are level and sound. Repair honeycombs or other defects that will prevent a tight seal following the manufacturer's directions.
    2. Apply coating of waterstop treatment to the entire joint area in accordance with manufacturer's written instructions.
    3. Install swelling waterstop with adhesive [or mechanical fasteners] as recommended by manufacturer.
    4. Trim swelling waterstop to fit.
    5. Place [concrete] [shotcrete] to Section [03 30 00] [03 37 13].
3. External Grout Method:
    1. Preparation: Ensure all surfaces are clean; remove form release agents, dirt or debris.
    2. Ensure joints are level and sound. Repair honeycombs or other defects that will prevent a tight seal following the manufacturer's directions.

3. Apply coating of waterstop treatment to the entire joint area in accordance with manufacturer's written instructions.
4. Keyway Preparation:
    1. Install tapered wooden strips [on the interior of the formwork adjacent to the positive side of the assembly] [to locations indicated on Drawings].
    2. Keyways should be formed <38 mm><<1.5 inch>> deep x <38 mm><<1.5 inch>> wide, tapering to <30 mm><<1.25 inch>> width into the wall.
5. Place [concrete] [shotcrete] to Section [03 30 00] [03 37 13].
6. Ensure that keyway is clean, remove form release agents, dirt or debris.
7. Ensure that keyway is sound, repair honeycombs following manufacturer's instructions.
8. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
9. Tightly pack crystalline waterstop grout into the keyway flush with surface.
10. Cure in accordance with manufacturer's written instructions.

C. Triple Protection:

1. Preparation:
    1. Ensure all surfaces are clean; remove form release agents, dirt or debris.
    2. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
    3. Ensure joints are level and sound. Repair honeycombs or other defects that will prevent a tight seal following the manufacturer's directions.
2. Apply coating of waterstop treatment to the entire joint area in accordance with manufacturer's written instructions.
3. Install swelling waterstop with adhesive [or mechanical fasteners] recommended by manufacturer.
4. Trim swelling waterstop to fit.
5. Keyway Preparation:
    1. Install tapered wooden strips [on the interior of the formwork adjacent to the positive side of the assembly] [to locations indicated on Drawings].
    2. Keyways should be formed <38 mm><<1.5 inch>> deep x <38 mm><<1.5 inch>> wide, tapering to <30 mm><<1.25 inch>> width into the wall.
6. Place [concrete] [shotcrete] to Section [03 30 00] [03 37 13].
7. Ensure that keyway is clean, remove form release agents, dirt or debris.
8. Ensure that keyway is sound, repair honeycombs following manufacturer's instructions.
9. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
10. Tightly pack crystalline waterstop grout into the keyway flush with surface.
11. Cure in accordance with manufacturer's written instructions.

Note to Specifier: The following Article describes treatment of planned crack control joints to contain shrinkage cracks.

3.3 CRACK CONTROL JOINTS

A. External Grout Method for [formed keyways] [and shrinkage crack repair]:

1. Keyway Preparation: Install tapered wooden strips to both sides of concrete forms to ACI 301 and [to spacing indicated on the Drawings.][as follows:]

Note to Specifier: Verify joint spacing is shown on the drawings. Additional joints may be needed in locations where the concrete changes thickness or directions, such and at beams, doors or boxouts. In some cases for lightly reinforced walls,

it is permissible to cut every second horizontal reinforcement bar to help cracks form at the joint - Verify with the Structural Engineer if this is acceptable on this project.

Max Spacing <4 m><13 feet>

Max Distance from Corners: <3m> <10 feet>

1. Keyways should be formed <38 mm><<1.5 inch>> deep x <38 mm><<1.5 inch>> wide, tapering to <30 mm><<1.25 inch>> width into the wall.

2. Place [concrete] [shotcrete] to Section [03 30 00] [03 37 13].
3. Preparation for Crack Repair:
    1. Ensure that [concrete] [shotcrete] drying shrinkage is complete.
    2. Chase the length of cracks. Provide rectangular-shaped chase that is <38 mm><<1.5 inch>> deep x <25 mm><<1 inch>> wide.
4. Ensure that [keyway] [chase] is clean, remove form release agents, dirt or debris.
5. Ensure that keyway is sound, repair honeycombs following manufacturer's instructions.
6. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
7. Tightly pack crystalline waterstop grout into the [keyway] [chase] flush with surface.
8. Cure in accordance with manufacturer's written instructions.

B. Crack Inducing Waterstop Method for blindside formwork applications:

1. Fasten crack inducing waterstop to exterior concrete form at [required control joint location] [at locations shown on Drawings] [and directly opposite formed keyways].
2. Provide crack inducing waterstops [and keyways] to ACI 301 and as recommended by manufacturer:
3. Place [concrete] [shotcrete] to Section [03 30 00] [03 37 13].
4. Keyways should be formed <38 mm><<1.5 inch>> deep x <38 mm><<1.5 inch>> wide, tapering to <30 mm><<1.2 inch>> width into the wall.
5. Ensure that keyway is clean, remove form release agents, dirt or debris.
6. Ensure that keyway is sound, repair honeycombs following manufacturer's instructions.
7. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
8. Tightly pack crystalline waterstop grout into the keyway flush with surface.
9. Cure in accordance with manufacturer's written instructions.

3.4 [PENETRATIONS][AND][FORMWORK TIE HOLES]

A. Preparation:

1. Tie Holes: Remove plastic cones, snap-ties and tapered rods from the concrete to expose tie holes.
2. Penetrations:
    1. Provide <38 mm><<1.5 inch>> deep by <25 mm><<1 inch>> wide chase around all penetrations.
    2. Prepare metal penetrations by mechanically abrading all surfaces in contact with waterproof treatment by sanding or sandblasting; remove all grease, oil, corrosion, and scale.
    3. Prepare plastic penetrations by embedding silica sand into a coating of plastic cement applied to all surfaces in contact with waterproof treatment.]
3. Ensure that all surfaces are clean; remove form release agents, dirt or debris.
4. Saturate surfaces by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.

B. Patch tie holes using crystalline waterstop grout

C. Tightly pack crystalline waterstop grout into the chase flush with surface.

D. Cure in accordance with manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

A. Provide free access to Work and cooperate with appointed firm.

B. Do not conceal installed waterproofing treatment before review by Consultant [and waterproofing manufacturer's representative].

C. Site Tests and Inspections:

1. Following the installation of crystalline waterstop or swelling waterstop, visually inspect the application to verify presence of the waterstop in the correct location and proper dimensions.
2. Following the installation of Treatment, visually inspect the application to verify the presence of the “gold” slurry coat covering the entire contact area of the joint including the previously installed triangle of crystalline waterstop or swelling waterstop.

D. If leaks are discovered, verify with manufacturer whether time period for self-sealing properties of the treated concrete has been exceeded. Make repairs as recommended by the manufacturer and repeat test until no leaks are observed.

3.6 PROTECTION OF FINISHED WORK

A. Protect completed assemblies from damage after application.

B. Wait at least 7 days before filling treated tanks and reservoirs. For reservoirs that will contain drinking water, cure longer if possible, and then rinse with fresh water several times. Initially, the drinking water may need pH adjustment using citric acid or similar water treatment chemicals.

3.7 SCHEDULES

Note to Specifier: The following article will assist in preparing a schedule for waterstop locations for the project. The following schedule includes are EXAMPLES only. Edit the paragraphs below to create a project specific schedule.

A. Provide waterstop assemblies in the following locations:

1. Elevator pits, [sump pits]; Type: [crystalline][swelling].
2. Below Grade Parking: Type: [crystalline][swelling].
3. Tunnels, underground vaults, dry wells, and manholes: Type: [crystalline][swelling].
4. Water tanks, flumes, clarifier tanks, digester sections, reservoirs and wet wells: Type: [crystalline][swelling].
5. Planters and swimming pools: Type: [crystalline][swelling].

END OF SECTION