CSI SPECIFICATIONS

Maintenance of Concrete

Leak Repair, Concrete Repair, Crystalline Waterproofing, Water Repellent Sealer
Division 3, Division 7

***Note to Specifier**: This guide specification includes materials and installation procedures to repair, protect and maintain concrete. Successful installation of these systems will restore water tightness, reduce concrete deterioration, prolong service life and reduce future maintenance expenses. The procedures are suitable for the repair of common concrete deficiencies such as leaking or non-leaking cracks, spalls, honeycombs, and restoration and maintenance of concrete cover. The completed system provides protection from the effects of water, chlorides, corrosion, ASR, aggressive chemicals and organic overgrowth. These products may be used individually or in combination depending on the needs of the project. The guide specification should be adapted to suit the needs and conditions of the project. The content may be included in Division 3 (03 01 00 Maintenance of Concrete) or Division 7 (07 16 16 - crystalline waterproofing or 07 19 00 Water Repellents) as applicable.*

Part 1 General

1.1 Summary

A. This specification is intended to be read as a whole by all parties involved in the project. The general contractor is responsible to make clear to any subcontractors the scope of their work and coordinate work between different trades.

1.2 System Description

A. This specification describes the patching, repair, surface restoration and protection of exterior horizontal and vertical surfaces of portland cement concrete.

B. The system consists of the following products:

1. Krystol Plug - Used to stop active leaks to allow permanent repairs to be completed.
2. Krystol Repair Grout - Used to make permanent, durable and waterproof repairs to concrete (i.e. cracks and honeycombs). Used as a parge coat to resurface damaged concrete cover or rough, irregular surfaces.
3. Krystol T1 - Penetrating Crystalline Surface Treatment - Resurfaces and waterproofs concrete. Used to ensures low permeability and to seals cracks and microcracks. Provides uniform surface and texture to weathered concrete.
4. Hydrostop Sealer (Hydropel Sealer in USA) - Water repellent, rain and chloride screen - Used to greatly reduce water absorption and chloride penetration. Reduces organic growth (moss/algae), resists solvents and mild acids. Concrete remains breathable and does not trap internal moisture.

1.3 Related Sections

A. Section 07 16 16 Crystalline Waterproofing

B. Section 03 61 00 Cementitious Grouting

C. Section 07 19 00 Water Repellents

1.4 References

A. The following standards are applicable to this section:

1. ASTC 39 – Compressive strength
2. ASTM C1583 - Bond Strength by direct tension (Pull-off Method).
3. DIN 1048-5 – Water Permeability
4. USACE CRD C48 – Water Permeability

1.5 Quality Assurance

A. Manufacturing Qualifications: The manufacturer of the specified products shall follow a Factory Production Control system certified by agencies accredited to ISO 7065 - Conformity assessment - Requirements for bodies certifying products, processes and services.

B. Contractor Qualifications: The contractor must be qualified in the field of concrete repair with a successful track record of at least 5 years. The contractor will maintain qualified personal trained by a manufacturer's technical representative.

C. Store and apply materials in accordance with the product label and product SDS, or as required by local, state or federal authorities.

1.6 Delivery, Storage and Handling

A. All materials must be delivered in original, unopened containers with the manufacturer's name, label, and batch numbers. Remove damaged material from the site immediately.

B. Store materials off the ground and protect from rain, freezing or excessive temperature until ready to use.

1.7 Job Conditions

A. Do not apply below 4°C (40 °F), or if it is raining or snowing, or if such weather conditions are imminent.

1.8 Submittals

A. Submit copies of the manufacturer's literature, to include: Technical Data Sheet (TDS), Safety Data Sheet (SDS), Application Instructions (AI).

B. Qualification Statements

1. Written notice from installer confirming experience in similar repair work.
2. Submit letter of contractor training by manufacturer.

1.9 Warranty

A. Manufacturer's warranty: Provide written manufacturer's warranty against defects in materials and manufacturing for a period of 10 Years - Concrete Repair Products, beginning with the date of substantial completion of the work.

Part 2 Products

Note to Specifier: *Hydrostop Sealer is Hydropel in the USA.*

2.1 Manufacturer

A. Basis of Design

Kryton International Inc.
Toll Free: 1.800.268.8280
E-mail: info@kryton.com
Website: www.kryton.com

B. The following products manufactured by Kryton International Inc. conform to the requirements.

1. Krystol T1 (Product Code K-210)
2. Krystol Repair Grout (Product Code K-510)
3. Krystol Plug (Product Code K-620)
4. Hydrostop Sealer <Hydropel Sealer> (Product Code K773)

C. Substitutions: Not permitted.

2.2 General Requirements:

A. The concrete repair products shall be a blend of portland cement, specially graded, non-reactive aggregates, and additives designed to meet the requirements of this specification.

B. The concrete sealer shall be a water based, silane-siloxane penetrating water repellent.

C. All materials shall be non-combustible, both before and after installation.

D. All materials must be supplied as a sealed, factory blended unit.

2.3 Performance Criteria

A. Fiber Reinforced Crystalline Concrete Repair Grout

1. Color - Concrete Grey
2. Working time (20°C / 68°F, 50% RH) - 30 minutes
3. Hardening time (20°C / 68°F, 50% RH) - 1 hour
4. Hydrostatic head resistance - USACE CRD-C48, 140 m (460 feet)
    1. Compressive Strength (ASTM C109)
    2. 16 MPa (2300 psi) @ 1 day
    3. 38 MPa (5500psi) @ 3 days
    4. 45 MPa (6500 psi) @ 7 days
    5. 49 MPa (7100psi) @ 28 days
    6. 52 MPa (7500psi) @ 56 days
5. Pull-off Strength (ASTM C1583) - 2.8 MPa (400 psi)

B. Plug Compound

1. Appearance – dark grey powder
2. Working Time – 1 minutes (20°C/ 68°F, 50% RH)
3. Hardening Time – 2 minutes (20°C/ 68°F, 50% RH
4. Compressive strength (ASTM C109)
    1. > 40 MPa (5800 psi) at 7 days.

Note to Specifier: *Krystol T1 is available in Grey or White.*

C. Crystalline Waterproofing and Protective Coating

1. Appearance <Grey> <White>
2. VOC content – Zero (0 g/L)
3. Working Time – 30 min (20°C / 68°F, 50% RH)
4. Hardening Time – 5 hours (20°C / 68°F, 50% RH)
5. Hydrostatic head resistance – 140 m (460 feet)
6. Crack Sealing – up to 0.5mm (0.02 inches)
7. Pull off strength – (ASTM D4541) – 3.1 MPa (450 psi)
8. Water Permeability – DIN 1048-5 – reduced 75-85%
9. Water Permeability – USACE CRD C48 – reduced 90%
10. Integral Protection:
    1. Crystal growth verified microscopically 100 mm (4 inches) away from the coated surface.
    2. Water penetration - DIN 1048-5 – reduced 51% when tested after removal of the crystalline surface coating.

11. Sulfate Resistance – No loss of strength after 21 cycles in high sulfate solution.
12. Chloride Ion Penetration – reduced 94.6% at a depth of 15 mm (0.5 inches) after 90-day ponding with 10% calcium chloride.
13. Water Absorption – BS 1881: Part 2 – Negligible – "Too impermeable to be sensitive to a longer-term test."
14. Shape of Crystal - Manufacturer must present independent evidence of waterproofing crystals using both optical imaging and scanning electronic microscope (SEM) to verify waterproofing crystals are needle shaped.
15. Potable Water – Certified to CAN/NSF/ANSI No 61.

Note to Specifier: Hydrostop/Hydropel Sealer is a water repellent for above grade use. It does not resist hydrostatic pressure. Do not specify this product for use below grade or for submerged areas.

D. Concrete Water Repellent and Sealer

1. Appearance – milky white liquid (dries clear, non-glossy)
2. pH – 7-8
3. VOC - < 20 g/L
4. Water Absorption – Fed Spec SS-W-110-C - 0.3%
5. Water Absorption Reduction (NCHRp 224, Series II) – 72%
6. Resistance to Wind Driven Rain (ASTM D514) – 89%
7. Chloride Ion Reduction (NCHRP 224, Series II) – 76%
8. Accelerated Weathering, Reduction in Chloride (NCHRP, Series IV) – 90%
9. Coverage: Coverage will vary depending on the porosity of the substrate; confirm coverage with a test patch. Typical coverage:
    1. Dense concrete - 7.5 m^2/L (300 sqft/gal)
    2. Normal concrete – 6.0 m^2/L (240 sqft/gal)
    3. Concrete coated with Krystol T1 – 6.0m^2/L (240 sqft/gal)
    4. Concrete Block – 5.0m^2/L (200 sqft/gal)

Part 3 Execution

Note to Specifier: *Detailed installation information is given in Kryton Application Instructions # 5.12 (Leak Repair), 5.22 (general repairs and parge coat), # 2.11 (Krystol T1) and #7.11 (Sealer). The contractor must read those instructions before performing the work.*

3.1 Surface Preparation

A. Concrete surfaces must be clean and free of paint, sealers, form release agents, curing compounds, dirt, laitance or any other contaminates.

B. Concrete Repair Krystol Repair Grout - prepare according to the manufacturer's instructions:

1. Cracks and Joints – Chisel or cut the full length of the crack or joint to provide a rectangular-shaped chase that is 40 mm (1.5 inch) deep x 25 mm (1 inch) wide.
    1. Wall-Slab Joints - Angle the chase so it intersects the joint, removing some concrete from both the wall and the slab.
2. Tie holes, rock-pockets, honeycombs - Chisel out defective areas to sound concrete. Rout out the defect to a uniform depth. Leave edges square, do not featheredge.
3. Where reinforcing is encountered, mechanically clean the steel to remove contaminates and rust.

C. Where concrete will receive Krystol T1 coating or Grout Parge Coat, prepare the surface by high pressure water blasting (minimum 3,000 psi), scarifying, shot blasting or sand blasting to remove loose concrete and surface contaminates.

1. For Krystol T1 Coating, prepare to ICRI CSP <1-3>.
2. For parging with Repair Grout, prepare to ICRI CSP <3-5>

D. Thoroughly rinse all surfaces with water to remove all dust and silt.

3.2 Surface Saturation

A. All concrete surfaces that receive repair materials must be in a Saturated Surface-Dry (SSD) condition. The concrete must be completely saturated with water, but all surface water must be removed before installing repair materials. Rewet the surface as needed to maintain SSD conditions during installation.

3.3 Installation – Concrete Repair - Plug Active Leaks

A. Krystol Plug – Mix to a suitable putty consistency – approximately 4 parts powder to 1 part clean water by volume. Mix only the amount of material that can be installed within one minute.

1. Install 13 mm (0.5 inches) of Krystol Plug and hold in place until it hardens. Do not overfill.
2. Install Krystol Plug along the full length/area of the leaking defect until all leakage has stopped.
3. Wire brush the sides/perimeter of the area to remove excess Plug and rinse with water to expose clean, sound concrete to allow bonding of Krystol Repair Grout.
4. Ensure a minimum depth of 25 mm remains to install Krystol Repair Grout.

3.4 Installation – Concrete Repair – Fill with Grout

A. Krystol Repair Grout - Mix to a non-sag putty consistency (approximately 4.5 parts of powder to 1-part clean water by volume) using a margin trowel or a drill with a grout mixing paddle.

1. Firmly install Krystol Repair Grout into the prepared repair area so that it is flush with the surface. Do not leave any voids.
2. For repairs with minimum width and depth of 50 mm (2 in.) or larger, Krystol Repair Grout may be extended with 10 mm (3/8 in.) pea gravel. Use clean, non-reactive, well-graded gravel complying with ASTM C33. Mix 4 parts grout powder: 2 parts gravel, and up to 1 part water to make a low-slump, cohesive mix. Perform trial batches to confirm workability, as aggregate properties can vary.

3.5 Installation – Resurfacing with Grout Parge Coat:

***Note to Specifier:**. A Parge Coat of Repair Grout is normally only needed for porous surfaces (like concrete block/CMU), or restoring very rough or low concrete cover. If the concrete surface is in acceptable condition, use Krystol T1. When a Grout parge coat is used, Krystol T1 may be still be applied over it if desired.*

A. Krystol Repair Grout

1. Mix approximately 4 parts powder to 1-part clean water by volume using a margin trowel or a drill with a grout mixing paddle.
2. Bonding Slurry for Parge Coat – Mix 3 parts powder to 1-part clean water by volume.

B. Scrub the bonding slurry over the prepared surface to fill voids, then immediately trowel the Parge Coat over the repair area to a thickness of <3 mm (1/8 inch)> <6 mm (1/4 inch)> <specify thickness mm (inch)>

3.6 Installation - Concrete Protection and Waterproofing – Krystol T1:

A. Krystol T1 – Mix to a thick but spreadable consistency (approximately 3.5 parts powder to 1-part clean water by volume) using a margin trowel or a drill with a grout mixing paddle.

1. Verify surface is Saturated Surface Dry (SSD).

2. Brush or spray Krystol T1 evenly over the concrete to achieve a typical coating thickness of 1-1.5 mm <0.04-0.06 inches>. As supplied, the consumption rate of Krystol T1 powder will be <1.2 – 1.6> kg/m^2 (<2.2 – 3.0 lb/yd^2>).
    1. Brush Application - Apply by with a masonry brush using a circular motion to press the coating into low spots. Finish with a lighter pressure to achieve the target coverage and a uniform finish.
    2. Spray Application – Spray evenly over the surface at the specified coverage. Low impact spray equipment will require back brushing to ensure adequate contact between the coating and the concrete. Consult spray equipment manufacturer regarding methods and attachments.

3.7 Protection and Curing

A. Krystol Repair Grout - Protect fresh grout from rapid drying or freezing for at least 24 hours. Cover with tarps or poly if necessary. Protect the fresh grout from rain until it has fully hardened, and do not apply curing water if the grout has not hardened. Begin wet curing once Krystol Repair Grout has hardened (1-2 hours under most conditions). Wet cure by ensuring the grout remains saturated with water by using hoses and sprinklers, saturated coverings or impermeable coverings. Maintain these curing conditions for at least 72 hours or until Krystol T1 is applied.

B. Krystol T1 - Protect the freshly applied Krystol coating with tarps or plastic to prevent water loss due to evaporation while it hardens. Leave an air space between freshly applied coating and the protective covering until the coating has set to the touch. Wet curing should begin as soon as the Krystol coating has hardened and will not be damaged by the curing water, usually 6-24 hours depending on temperature. Keep protective coverings in place during the curing period to retain moisture. Apply more curing water if the coating dries out during the curing period. Wet cure for a minimum of 72 hours.

3.8 Installation - Hydrostop <Hydropel> Sealer

A. Mix the sealer prior to use. Do not dilute.

B. Concrete repairs (Repair Grout of Krystol T1) must be fully cured before applying the sealer.

C. Surfaces must be dry at the time of application. Do not apply sealer to surfaces that have been washed or rained on in the previous 24 hours, or if rain is expected in the next 12 hours.

1. Apply the sealer uniformly by brush, roller or low pressure sprayer. Airless spray equipment must be set at low pressure to prevent atomization of the product during application.

D. Apply only as much sealer as the surface can absorb without material pooling on the surface. A very light “fog coat,” followed immediately by a uniform “flood coat” will usually provide the most even penetration and prevent over application. For vertical surfaces, apply material using overlapping, horizontal passes and allow a 6-8 inch rundown below the spray line.

E. Do not allow material to pool on the surface. Use a sponge, rag or roller to immediately remove excess material that does not soak into the surface.

F. Allow the surface to dry naturally. No special curing procedures are required.

3.9 Clean Up

A. Concrete repair materials - Uncured repair materials can be cleaned from tools with water. Cured repair materials must be removed mechanically.

B. Sealer – clean tools and equipment immediately with soap and water.

C. Leave finished work area in a neat, orderly and clean condition.

3.10 Field Quality Control

Note to Specifier: *Only include this section if special field inspection services are required.*

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. 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.

3.11 Protection of Finished Work

A. Protect completed work from damage after application.

B. Do not backfill for at least thirty six hours (36) after completion of repairs.

C. If backfilling within 7 days, use damp backfill material

3.12 Schedules

Note to Specifier: *Specify products, location and colour to suite project.*

A. Provide crystalline waterproofing repairs and surface sealer in the following locations

Location	**Repair Cracks and Joints**	**Parge Coat, Resurface**	**Krystol T1** <Grey><White>	**Hydrostop Sealer** <Hydropel Sealer>
Elevator pits [sump pits, escalator pits]				
Tunnels, underground vaults, dry wells and manholes				
Water tanks, clarifier tanks, digester sections, reservoirs and wet wells				
Planters, fountains, pools				
Retaining walls, sea walls.				
<specify area>				

END OF SECTION