



FIVE STAR PRODUCTS, INC.

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DESIGN-A-SPEC™ GUIDELINES FIVE STAR STRUCTURAL CONCRETE® UNDERWATER HAND PACK

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PART A - GENERAL CONDITIONS - UNDERWATER CONCRETE REPAIR

1.01 SCOPE

The work covered by this document consists of furnishing all equipment, materials, labor and performing all operations required for concrete repairs as directed by the engineer or owner.

1.02 QUALITY ASSURANCE

- A. The manufacturer shall have been in the business of manufacturing similar products for over ten years, maintain a strict quality assurance program, offer technical services and provide a representative at the jobsite for product training, prior to product installation, upon written request.
- B. The contractor shall submit to the engineer, or owner, at least three job references where the contractor has successfully completed similar applications.

1.03 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered to the jobsite in their original, unopened packages, clearly labeled with the manufacturer's identification, printed instructions and batch code.
- B. Store and condition the specified product as per the appropriate product data sheet.
- C. For handling instructions, refer to the Material Safety Data Sheet.

1.04 PROJECT/SITE CONDITIONS

Refer to PART C - PREPARATION, ENVIRONMENTAL CONDITIONS, or contact the manufacturer directly for any physical or environmental limitations required by the product.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement for concrete repairs shall be on a cubic foot/square foot (liter/square meter) basis of material in place.
- B. Payment for concrete repairs shall be at the unit price bid on a cubic foot/square foot (liter/square meter) basis. This payment shall constitute full compensation for all labor, materials, tools, equipment, and other items as necessary to complete the work as described in the contract documents. Progress payments will be made on the percentage of the work satisfactorily completed during each payment period in accordance with the provisions of the contract documents.

PART B - MATERIAL SPECIFICATION - UNDERWATER CONCRETE REPAIR

2.01 MATERIALS

- A. The concrete repair material shall be an underwater hand applied, pre-packaged cement-based mortar suitable for hand placement underwater requiring only the addition of potable water. The material shall not contain any chlorides or lime other than amounts contained within the hydraulic cement composition. The manufacturer shall be ISO 9001 certified and have at least ten years experience in the manufacture of concrete repair materials. The manufacturer shall offer technical services and provide a representative at the jobsite for product training prior to product installation upon five days advance notice.
- B. The concrete repair material shall meet all the following typical performance criteria when cured at 73°F (23°C):

1.	Compressive Strength, ASTM C 109	
	3 Hours	3,000 psi (20.7 MPa)
	1 Day	4,000 psi (27.6 MPa)
	7 Days	5,000 psi (34.5 MPa)
	28 Days	5,500 psi (37.9 MPa)
2.	Underwater Bond Strength, ASTM C 882	
	7 Days	1,150 psi (7.9 MPa)
3.	Length Change, ASTM C 157	
	28 Days Wet	+0.02

The data shown above reflect typical results based on laboratory testing under controlled conditions. Reasonable variations from the data shown above may result in the field. Test methods are modified where applicable.

- C. An acceptable product which meets these criteria is:

Five Star Structural Concrete® Underwater Hand Pack

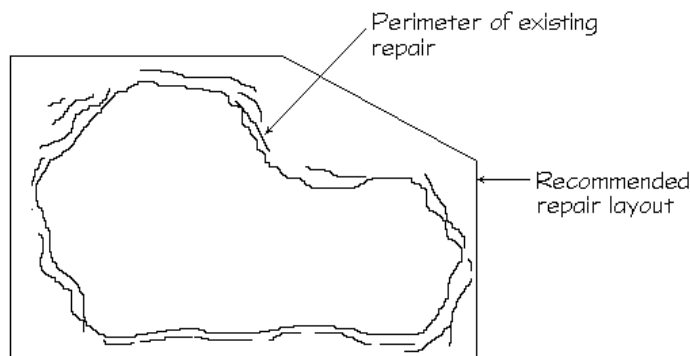
As manufactured by Five Star Products, Inc., Shelton, CT 06484

- D. Subject to meeting the performance criteria stated above, other products may be formally submitted to the engineer for approval up to three days prior to the bid date. All requests for approval shall contain certified test data verifying conformance with this specification. Three references of successfully completed projects of similar nature and scope of the work detailed in this specification shall be provided, as well as a minimum ten year history of use in the industry. The testing laboratory shall certify to any modifications made to the tests performed and provide details of modifications.

PART C – PREPARATION - UNDERWATER CONCRETE REPAIR

3.01 CONCRETE SURFACES

- A. Completely remove all loose, delaminated, and weak concrete, oil, grease, laitance and other contaminants. Prepare concrete using acceptable mechanical means and concrete cleaners and degreasers as necessary to obtain clean, sound, and rough surfaces. Coarse aggregate shall be exposed. Concrete surfaces shall be presoaked for 4 -6 hours in tidal zone applications prior to application.
- B. The edges of the repair shall be vertical and have a rough profile. Avoid abrupt changes in depth.
- C. For vertical and overhead repairs with a depth greater than two inches (50 mm), mechanical anchors may be considered.
- D. The perimeter of the repair shall be kept to a simple shape. Avoid reentrant corners.

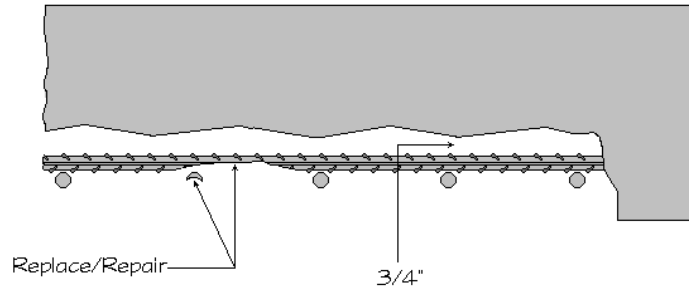


- E. All cracks shall be brought to the attention of the engineer and a determination made of whether the cracks are subject to movement. The cracks shall be repaired as directed prior to application of the repair material.
- F. All existing joints shall be maintained. New joints, if any, shall be installed as detailed on the drawings.

[For more detailed information, refer to the following source: ICRI 310.1R-2008 - "Guide For Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion", Guideline No. 03730, prepared by the Technical Guidelines Committee of ICRI, March 1995.]

3.02 REINFORCEMENT

- A. All reinforcing steel that has lost bond with the concrete or has more than one-half of its circumference exposed shall be undercut by at least 3/4 inch (18 mm) or two times the maximum aggregate size.



- B. All reinforcement shall be rigidly secured and supported.
- C. If more than 20% of the diameter of a reinforcing bar has been deteriorated, the bar will require replacement or will need to be spliced as directed by the engineer.
- D. All exposed reinforcing steel shall be free of all loose scale and rust, and other contaminants.
- E. The minimum cover over reinforcement shall be in accordance with job specifications or 3/4 inch (18 mm), whichever is greater.

3.03 ENVIRONMENTAL CONDITIONS

- A. Condition and maintain all materials and surfaces that contact repair material to between 35°F or 45°F depending on the product and 90°F (2°C or 7°C and 32°C), but optimally between 55°F and 75°F (13°C and 24°C) whenever possible. Shade from direct sunlight as necessary.

[Revise the temperatures range above as appropriate based upon product specified and jobsite conditions. For detailed conditioning procedures refer to Cold Weather or Hot Weather Repairs, PART F – EXTREME WEATHER CONDITIONS.]

3.04 EQUIPMENT AND MATERIALS

- A. All necessary tools, equipment, and materials shall be clean, in good condition and as close as possible to area being repaired.
- B. Appropriate clothing and safety equipment shall be worn to avoid breathing dust and prevent eye and skin contact with both dry and mixed repair materials.
- C. An ample source of potable water shall be available for preconditioning, mixing, cleaning, and curing.

3.05 MIXING

Drill and Paddle Mixer (Single Bag Mixes)

- A. Start by adding the minimum amount of premeasured potable water into pail. While mixing at a slow speed, slowly add repair material and mix to a uniform consistency. Add remaining water to achieve desired consistency. Do not exceed maximum water content as stated on product packaging or an amount that will cause segregation.
- B. Continue to mix thoroughly for approximately 4-5 minutes.
- C. Do not mix more material than can be placed within the working time of the repair material. Do not retemper the mix by adding additional water.

PART D – APPLICATION - UNDERWATER CONCRETE REPAIR

4.01 PLACEMENT PROCEDURES HAND APPLIED

UNDERWATER HAND-PACK

[For small confined areas with limited reinforcement.]

- A. A dry pack consistency is achieved when the mixed material can be squeezed into a ball by hand without crumbling. Only enough water should come to the surface to moisten hands.
- B. Apply material full depth where possible; when placing in layers, combine each layer to the previously placed layer, creating a homogeneous repair without material sagging. Apply material firmly into concrete substrate to promote bond development.
- C. Each placed layer shall be visually inspected for placement uniformity.
- D. Placement shall proceed continuously until area is completely filled.

PART E – FINISHING AND CURING - UNDERWATER CONCRETE REPAIR

5.01 FINISHING

- A. Finish repair material to desired texture when it offers stiff resistance. A wood float, sponge float, brush, or trowel may be used for finishing.

5.02 CURING

- A. Repair material shall be cured as recommended by the manufacturer. Keep wet for a minimum 30 minutes in tidal zones.
- B. Repair material shall be protected from excessive evaporation prior to set, freezing, rain, hydrostatic pressure, vibration and traffic as recommended by the manufacturer.

PART F – EXTREME WEATHER CONDITIONS - UNDERWATER CONCRETE REPAIR

6.01 COLD WEATHER REPAIRS

[Low temperatures delay the set, increase working time and delay the strength development of cement-based products. The procedures below will compensate for these conditions.]

- A. All surfaces shall be preconditioned and maintained between 35°F and 90°F (2°C and 32°C) and materials conditioned to between 35°F and 80°F (2°C and 27°C). Higher substrate and material mix temperatures will result in faster strength development. Due to the mass of palletized material, up to 72 hours of conditioning may be required.
- B. Mix repair material with warm water where applicable.
- C. Where possible, maintain temperature above 35°F (2°C) minimum until material reaches 1000 psi (6.9 MPa) or the minimum required strength.
[Specify minimum required strength.]
- D. Gradually allow temperature of material to cool to ambient temperature to avoid thermal shock.

REFERENCE

ACI 306R-88
"Cold Weather Concreting"

PART F – EXTREME WEATHER CONDITIONS - UNDERWATER CONCRETE REPAIR

6.01 HOT WEATHER REPAIRS

[High temperatures accelerate the set, decrease working time, and accelerate the strength gain of cement-based products. The procedures below will compensate for these conditions.]

- A. Materials shall be conditioned as necessary so that the mixed material is between 50°F and 90°F (10°C and 32°C). Due to the mass of palletized material, up to 72 hours of conditioning may be required.
- B. All surfaces in contact with material should be preconditioned and maintained below 90°F (32°C) where feasible.
- C. Cooling of surfaces, materials and equipment can be accomplished by using iced water for mixing. Do not add ice directly into repair material. Shade area from direct sunlight or pour material when temperatures are decreasing.
- D. Wind breaks shall be provided when necessary to prevent rapid evaporation.
- E. Repair material shall remain protected and curing shall be dependent on specified product. Cure repair material in accordance with manufacturer's recommendations.

REFERENCE

ACI 305R-91
"Hot Weather Concreting"

