



Engineering Specifications for **SeaShield™ Series 400** Timber Pile Rehabilitation

1.0 Scope

- 1.1 This specification may be used for the materials and application of SeaShield Series 400 Timber Pile Rehabilitation System.
- 1.2 The engineer shall select appropriate sections of the specifications to ensure that the specification is comprehensive for specified work.

2.0 General Requirements

- 2.1 Contractor shall comply with all written recommendations of the manufacturer regarding application of the specified system.
- 2.2 The manufacturer of specified materials shall be Denso, Inc., 9710 Telge Road, Houston, TX 77095, Tel: 281-821-3355 or 90 Ironside Crescent, Unit 12, Toronto, Ontario, Canada M1X1M3 Tel: 416-291-3435. E-mail: info@densona.com
- 2.3 All materials used to comprise the SeaShield Series 400 System must be purchased from the same manufacturer. These include SeaShield Fiber-Form Jackets, C-GRID® 450, SeaShield FX-70TNG Epoxy Adhesive, and either SeaShield 510 UW Grout (Cementitious) or SeaShield 550 Epoxy Grout.

3.0 Materials

- 3.1 Fiberglass Jacket (SeaShield Fiber-Form)
- 3.1.1 The fiberglass jacket thickness shall be a minimum of 1/8 inch (3 mm) constructed of layers of woven roving and mat.
- 3.1.2 The jacket shall be translucent to provide visual inspection during the injection of the grout.
- 3.1.3 The jacket shall have minimum one inch injection ports spaced at intervals not to exceed five feet. To provide even distribution of the grout, the injection ports shall be placed on alternate sides.
- 3.1.4 The jackets shall have adjustable stand-offs inserted through the jacket to maintain the specified annulus between the pile and the jacket. A UV gel

coat shall be applied to the outside of the completed fiberglass jacket.

3.1.5 The fiberglass jackets shall have the following properties:

Ultimate Tensile Strength	ASTM D638	16,000 PSI (110 MPa)
IZOD Impact Strength	ASTM D256	20 ft.-lbf/in. (0.4 J/m)
Barcol Hardness	ASTM D2583	45
Water Absorption	ASTM D570	<1% Max
UV Stability	ASTM G23	500 Hr. Pass

3.1.6 The fiberglass jacket may be manufactured as either a single unit or as two pieces that shall be joined in the field. The jackets can be placed one above the other via bell and spigot.

3.2 Carbon-Fiber Grid

3.2.1 The Carbon-Fiber Reinforcement shall be C-GRID® 450 as provided by Denso, Inc.

3.2.2 Please refer to the C-GRID® 450 data sheet for complete property specifications.

3.2.3 All C-GRID® 450 shall be stored in a sheltered area to prevent degradation of the epoxy resin due to UV exposure.

3.3 Grout

3.3.1 The grout shall consist of either SeaShield 510 UW (Cementitious) Grout or SeaShield 550 Epoxy Grout as manufactured by Denso, Inc. For detailed grout specifications, please refer to the SeaShield 510 UW (Cementitious) Grout or SeaShield 550 Epoxy Grout product data sheets.

3.3.2 All grout shall be stored in a sheltered area away from rain and water.

3.4 Marine Epoxy

3.4.1 The SeaShield FX-70TNG Epoxy Adhesive shall be used to adhere the fiberglass vertical seams. The SeaShield FX-70TNG Epoxy Adhesive may also be used to finish the tops of the encapsulation.

4.0 Equipment

- 4.1 The grout shall be pre-mixed and pumped through a peristaltic pump or other suitable pump. The equipment shall be capable of delivering mixed grout through hoses into the jackets at a rate 1 GPM or greater.
- 4.2 Prior to using the pump, all lines shall be primed by circulating 1 gallon (3.8 liter) of the SeaShield Hose Lubricant.

5.0 Surface Preparation

- 5.1 Prior to application, thoroughly clean and remove marine growth, oil, grease and any other deleterious material which might prevent proper bonding between the pile and grout. Surface preparation shall be accomplished by water blasting to provide a clean surface.

6.0 Installation

6.1 Installation of C-GRID® 450 and Fiberglass Jacket

- 6.1.1 The inside surface of the jacket shall be lightly roughened to remove residue and contamination.
- 6.1.2 Adjustable stand-offs shall be inserted through the jacket at 18" to 48" (450-1200 mm) intervals (depending on diameter size, length and thickness of jacket) along entire length of jacket.
- 6.1.3 All longitudinal and transverse seams shall be sealed with SeaShield FX-70TNG Epoxy Adhesive as described in Section 3.3.1 and fastened with 3/16" (4.7 mm) diameter stainless steel hex screws that shall not exceed 6" (150 mm) spacing.
- 6.1.4 The C-GRID® 450 shall be unrolled and cut using tin snips or other suitable method. The cut width of C-GRID® 450 shall be determined by including enough material to be imbedded within the grout and a 6" (150 mm) overlap along vertical seam. The grid will require a minimum of ¼" (6.35 mm) grout cover.

6.1.5 Locate the C-GRID® 450 between the elevations indicated in the specification and drawings. The C-GRID® 450 shall be wrapped around the timber pile with a minimum 6" (150 mm) overlap along the vertical seam. Use nylon zip ties, plastic clips or other plastic accessories to secure vertical seam and maintain the position of the grid during the pumping of grout. On long length repairs which require more than one panel of grid, the C-GRID® 450 shall be overlapped 6" (150 mm) above or below the first panel of grid.

6.1.6 The fiberglass jacket shall be installed around the pile and C-GRID® 450. The jacket shall be supported by temporary nylon straps or other means to assure that the jacket or C-GRID® 450 will not move or distort during placement of grout.

6.1.7 A foam seal shall be installed at the bottom of each jacket to prevent any grout from leaching out of the bottom of the jacket during installation. A ratcheting strap shall be placed on outside of jacket to compress the foam seal.

6.2 Grout Placement

6.2.1 Jacket is in place, inject grout approximately 6" (150 mm) into the bottom port and allow it to cure before proceeding with subsequent lifts.

6.2.2 Grout injection shall begin at the bottom injection port and proceed upwards. As the jacket is filled to each port, the lower port shall be capped off and repeated until the top of the jacket is reached.

6.2.3 The injection process shall be continuous, except when the injection hose is moved from port to port.

6.3 Completion

6.3.1 After the injection process is completed and the epoxy grout has cured, all temporary supports shall be removed.

6.3.2 Connect grout hose to lower injection port and pump 6" (150 mm) of SeaShield 550 Epoxy Grout as a bottom plug. Let the epoxy grout cure before any additional pumping.

6.3.3 Connect grout to the next injection port, just above the lower injection port, and begin pumping SeaShield 550 Epoxy Grout or SeaShield 510 UW Grout. Move the hose upwards from port to port as needed. Pump continuously until grout reaches within 3" to 4" (75 to 100 mm) of the top of the jacket. Once the grout cures, pour SeaShield 550 Epoxy Grout to the top of the jacket and let cure.

Note: If using SeaShield 550 Epoxy Grout, pumping can continue to the top of the jacket. After cured, mix SeaShield FX-763 with SeaShield Aggregate Part C and trowel around the circumference to create a bevel.

C-GRID® 450 utilized by Denso, Inc. in the SeaShield Series 400 System is protected under the following US and European Patents: 6,263,629; 5836,715; 6,123,879; 6,454,889; 6,632,309; 0861353; 109 4171.



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A Member of Winn & Coales International

Top bevel using
SeaShield FX-763 &
SeaShield Aggregate
Part C

Timber pile

C-GRID® 450

316 SS riverts
or screws on
maximum
6" (150 mm) centers
staggered
right and left

SeaShield 510 UW
Grout or SeaShield
550 Epoxy Grout

Nylon ratchet
strap or equal
on minimum
18" (450 mm) centers
(or as required)
placed over
stand-offs

Tongue and Groove Closure
adhered with SeaShield
FX-70TNG Epoxy Adhesive

Min 1/8" (3 mm)
jacket

Contractor to
install ports
as required

SeaShield FX-70TNG
Epoxy Adhesive



Detail 1

Tongue and Groove Closure

Elevation View

Sheet 1

(Not to Scale)

SeaShield Series 400 Detail Drawing



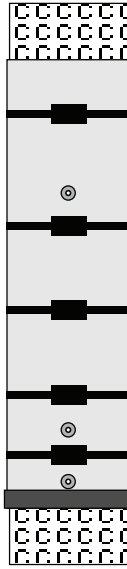
DENSO, INC.



Step 1

Position SeaShield Fiber-Form Jacket around pile/C-GRID® 450 and seal tongue & groove.

C-GRID® 450



Step 2

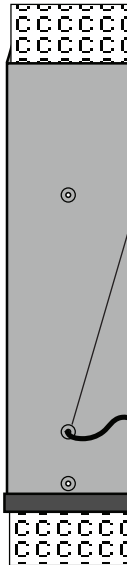
Affix bottom seal with backer rod and install ratchet straps.



Step 3

Connect grout hose to lower injection port and pump 6" (150 mm) of SeaShield 550 Epoxy Grout as a bottom plug. Let the epoxy grout cure before any additional pumping.

6" (150 mm)



Step 4

Connect grout to the next injection port, just above the lower injection port, and begin pumping SeaShield 550 Epoxy Grout or SeaShield 510 UW Grout. Move the hose upwards from port to port as needed. Pump continuously until grout reaches within 3" to 4" (75 to 100 mm) of the top of the jacket. Once the grout cures, pour SeaShield 550 Epoxy Grout to the top of the jacket and let cure.

Note: If using SeaShield 550 Epoxy Grout, pumping can continue to the top of the jacket. After cured, mix SeaShield FX-763 with SeaShield Aggregate Part C and trowel around the circumference to create a level.

Sheet 2
(Not to Scale)

SeaShield Series 400 Grout Placement Sequence

