

SECTION 3455 - GLASS FIBER REINFORCED CONCRETE (GFRC)

SPECIFICATION FOR GFRC CASTINGS

1.0 MANUFACTURER QUALIFICATIONS: Manufacturer shall have a minimum of five years successful experience in the fabrication of GFRC units of the application and type specified. Fabricator must demonstrate that it has sufficient production capacity to produce the units specified within the time required, so as not to delay other work.

1.1 Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering GFRC castings that may be incorporated in the work include the following:

Arc Limited, 338 Fourteenth St., Ste 150, Ambridge, PA 15003

Tel: (724) 266-1220

Toll Free: 866.940.4732

Forms: Metal, plastic, wood, or other material that is non-reactive with concrete and will produce smooth surface finishes shall be used for form construction. Forms shall be constructed of sufficient strength to withstand pressures of molding operations without deformation. Form work shall be maintained during production to provide completed GFRC units of shapes, lines, and dimensions indicated, within specified fabrication tolerances.

2.0 CASTINGS

2.1 Castings: Castings shall be produced in accordance with the standards set by the Prestressed Concrete Institute (PCI) as published in the manual "Recommended Practice for GFRC Panels", and shall conform to the color and surface appearance of the samples provided. All anchorage attachments shall be supplied by the GFRC fabricator. Castings produced by the alternate pre-mix method using approved AR-Glass fibers shall also be deemed acceptable.

J1.1 Castings may be produced by the premix process, as outlined in PCI Standard Practices Manual or GFRC (Appendix J). The pre-mix material typically has flexural 28-day strength and yield of 700 to 1200 (psi), but Arc's panel design is based on a 900 (psi) yield strength for added safety factor.

3.0 MATERIALS

3.1 Portland Cement: ASTM C 150 Type I

3.2 Aggregate: ASTM C 33 manufactured sand unless otherwise specified.

3.3 Fiberglass Reinforcement: Alkali-resistant (AR) fiberglass filaments shall be continuously introduced by a premix process into the GFRC mix for all backing coats in a manner to produce a continuously dispersed fiberglass mat reinforcement. Insertion of fiberglass mats or scrims shall not be acceptable.

3.4 Water: All water used in mixing shall be potable quality, free from harmful minerals or foreign materials in amounts harmful to concrete.

3.5 Polymer: Polymer compounds shall be added in accordance with the Polymer manufacturer's specifications to increase the strength and durability of the GFRC units

- 3.6 Polymer compounds shall be proven by independent laboratory test analyses to eliminate the need for wet curing of the GFRC castings.
- 3.7 Mold Release Agents: Mold release compounds shall not interfere with the adhesion of sealants or finishes specified under normal preparation requirements.
- 3.8 Curing: All cast GFRC components shall be cured in a controlled environment after release from the mold for a minimum of five days before finishing.
- 3.9 Patching Material: Patching materials of like composition and appearance shall be supplied by the manufacturer to permit field repair of any areas damaged in shipment or handling.

4.0 FABRICATION

- 4.1 Dimensional and Performance Characteristics: Fabrication of GFRC shall be done to achieve the following characteristics when aged 28 days:

Shell Thickness	5/8" +1/8" – 0" (Panels)
Shell Thickness	1" +1/2" – 0" (Terra Cotta Replacement Stones)
Glass Fiber	5 - 6% by weight (Roving - Alkali-Resistant fiber)
Glass Fiber	3 - 4% by weight (Premix - Alkali-Resistant fiber)
Compressive Strength	6,000 psi (cube sample)
Flexural Yield Strength	900 – 1,500 psi (roving method)
Flexural Yield Strength	700 - 1,200 psi (test average - pre-mix method)
Flexural Ult. Strength	2,000 – 3,500 psi (roving method)
Flexural Ult. Strength	1,400 - 1,800 psi (test average - pre-mix method)
Weight	6 – 7 lbs/sq. ft.

- 4.2 Surface: Units shall be fabricated to provide a smooth surface, free of pockets, sand streaks, honeycomb, finished by blast cleaning and/or acid washing to achieve the specified surface finish.
- 4.3 Piece Identification: Each unit shall be marked with an identifying mark corresponding with shop and/or erection drawings and date cast.
- 4.4 Support Frames and Embedded Support Anchors:
 - 4.4.1.1 Support frames shall be designed by the manufacturer and fabricated of track and stud or steel tubing sections, of sufficient strength and rigidity to support the GFRC units and prevent overstressing of the skin during de-molding and handling, with flexible connections to permit relative movement of the GFRC and the attachment frame.
 - 4.4.1.2 Galvanized steel support track and stud frames shall be of minimum 16 gauge, steel tubing minimum 11 ga., steel attachment plates minimum 16 gauge, and embedded anchors 3/8" diameter.
 - 4.4.1.3 Material specifications shall conform to those listed in PCI MNL-117. Carbon steel tubular frames shall be shop painted one coat of zinc oxide primer and one coat of alkyd enamel.
 - 4.4.1.4 As an alternate to galvanized construction, steel tubing members may be painted with inorganic zinc-rich one-step primer with a minimum zinc content of 80% dry film, with a finish coat of compatible enamel.

- 4.4.1.5 Flexible anchors shall be made of carbon steel bar stock, with corrosion protection by cadmium or zinc electro-plating.
- 4.4.1.6 Where through-bolt attachments are used for suspended pieces, stainless steel washers shall be embedded in the GFRC mix, and a countersunk area shall be provided for the attachment nut, including wrench clearance. Any exposed fasteners shall be recessed and designed to be field patched smooth. Manufacturer must provide test data showing that the proposed attachment has a minimum safety factor of ten. Welded joints shall be protected by a rust-inhibitive coating.
- 4.5 Anchorage: Anchors and fasteners for attachment to the structural steel work shall be provided by the GFRC manufacturer unless otherwise specified.
- 4.6 Control Joints: Fabricator shall design units with adequate control joints for sealing with backer-rod and caulk joints (by others) in the field.

5.0 QUALITY CONTROL: Fabricator shall submit a sample of his quality assurance procedures to architect before beginning fabrication. A test sample from each day's mix shall be retained by manufacturer for a period of one (1) year after fabrication. GFRC units shall closely match the color and finish specified and samples provided.

- 5.1 Testing: Samples shall be analyzed daily for material mix weight, spray rate, and fiberglass content using the washout method. Panel thickness shall be tested with pin gauges during production at a spacing of not more than 24 inches, to verify skin thickness at 5/8" or heavier. Mechanical strength tests and anchor pull-off tests, if required, shall be approved as to type, frequency, and cost by agreement with the Architect/Engineer. In the absence of a specific additional testing requirement, Fabricator's standard quality control procedures shall be deemed acceptable.
- 5.2 Dimensional Control: Fabricator shall be responsible for the shop inspection of each unit to insure that it conforms with the dimensions and tolerances shown on the drawings. Fabrication dimensions shall be held to permit installation within the following tolerances:

Face width of joints:	1/8"
Out of plane (unit to unit)	1/8"
Variation in plumb	1/4" in 10'
Variation in level	1/4" in 10'
- 5.3 Cleaning: Fabricator shall remove all surface contamination prior to shipment, to provide a clean, uniform appearance.
- 5.4 Efflorescence: Efflorescence is a naturally occurring combination of soluble salts, moisture, hydrostatic pressure and evaporation. All masonry and concrete materials are susceptible to efflorescence. The amounts of the deposits vary according to the temperature, humidity and wind. Efflorescence can be cleaned following erection, or allowed to be removed by weathering. Fabricator will not be responsible for such cleaning unless specifically indicated in the contract documents.

6.0 ERECTOR RESPONSIBILITY AND QUALIFICATIONS

- 6.1 ERECTOR RESPONSIBILITY: The erector shall include all labor, materials, equipment, and related services necessary for the erection of the panels as indicated and described by the contract documents. The placement of the connection hardware on the building steel or in the

cast-in-place concrete will be the responsibility of that contractor erecting the panels or placing the cast-in-place concrete.

- 6.2 **ERECTOR QUALIFICATIONS:** Regularly engaged for at least five years in erection of GRFC, terra cotta, or architectural precast concrete panels similar to those required on this project, and the present erection management and staffing capability sufficient to erect the required units without causing delay of project schedules.

7.0 PRODUCT DELIVERY, STORAGE AND HANDLING

- 7.1 GFRC panels are to be shrink wrapped or protected with Visqueen to minimize soiling. Erector shall be responsible for transportation (unless quotation is f.o.b. jobsite) and storage of the GFRC units. Non-staining resilient spacers shall be provided by the fabricator for use to separate units during shipment and storage. All material must be protected on the job-site to keep them clean and prevent damage.

8.0 PRE-INSTALLATION RESPONSIBILITY

- 8.1 **General Contractor Responsibility:** The General Contractor or Architect/ Engineer shall provide building lines, center and grades in sufficient detail to allow installation of the GFRC units, true, level bearing surfaces, and shall provide for the accurate placement and alignment of anchor bolts, plates or dowels on the structure.
- 8.2 **Erector Responsibility** Prior to installation of the units, the erector shall check the jobsite dimensions affecting the work under his contract. Any discrepancies between design dimensions and field dimensions which could adversely affect installation in accordance with the contract documents shall be brought to the attention of the General Contractor and Architect. If discrepancies do exist, installation shall not proceed until they are corrected or until installation requirements are modified and reviewed by the Architect and Engineer.

9.0 ERECTION: The General Contractor shall provide clear, well-drained unloading areas and road access around the building shall be provided and maintained by the General Contractor to a degree that the hauling and erection equipment for the GFRC units are able to operate under their own power.

- 9.1 GFRC units shall be lifted with suitable lifting devices at points provided by the manufacturer, and set level, plumb, square and true within the allowable tolerances. The erector shall provide temporary supports and bracing as required to maintain position, stability and alignment as units are being permanently connected.
- 9.2 GFRC units shall be fastened in place by bolting or welding or both as shown on approved erection drawings. Field welding shall be done by qualified welders using equipment and materials compatible to the base material. GFRC surfaces shall be protected during field welding, and welds shall be field painted to provide corrosion protection with inorganic zinc-rich primer and enamel.
- 9.3 Tolerances for location of GFRC units shall be non-cumulative. For erection tolerances, see PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- 9.4 **PATCHING:** All field patching shall be performed by the erector using materials provided by the GFRC Manufacturer to match color and texture of surrounding materials.
- 9.5 **CLEANING:** Cleaning of the GFRC panels after erection is the sole responsibility of Erector. Cleaning methods shall be approved by fabricator. After installation, Erector shall clean soiled or effloresced area of GFRC surfaces with detergent and water, using fiber brush and sponge, and

rinse thoroughly with clean water. Use extreme care to prevent damage to GFRC surfaces and to adjacent materials. Soiled surface must be thoroughly rinsed with clean water immediately after using cleaner.

9.6 PROTECTION: The erector shall be responsible for any chipping, spalling, cracking or other damage to the units after delivery f.o.b. manufacturer's plant, unless such damage is caused by others during transportation or site storage. After installation is completed, any further damage shall be the responsibility of General Contractor.

10.0 INSPECTION AND ACCEPTANCE: Final inspection and acceptance of erected GFRC panels shall be made by the Architect to verify conformance with plans and specifications.

10.1 Acceptability of Appearance: The finished construction in place shall present a uniform, pleasing appearance when viewed with the naked eye under typical lighting conditions at a distance of 10 feet and shall show no imperfections at a distance of 20 feet.

10.2 Minor spiderweb cracking in the face coat shall be acceptable, providing it does not adversely affect the appearance as noted in section 10.1.