INDUSTRIAL FIBERGLASS RAILING SYSTEM

SAF RAIL™

INDUSTRIAL FIBERGLASS RAILING SYSTEM

STRONGWELL®

EXCLUSIVELY MADE IN THE USA
SAFRAIL™ Industrial Fiberglass Railing Systems

What is SAFRAIL™?
SAFRAIL™ industrial fiberglass railing systems are made exclusively in the U.S.A. for use as stair rails, platform/walkway handrails and guardrails. SAFRAIL™ systems are fabricated from pultruded fiberglass components produced by Strongwell and compression molded FRP connectors. The railing systems are particularly well-suited to corrosive environments like those found in industrial, chemical and wastewater treatment plants, as well as commercial structures with urban and salt air corrosion.

Why Use SAFRAIL™?
SAFRAIL™ systems can be used like traditional metal railing systems but offer the inherent benefits of pultruded fiberglass. In addition, SAFRAIL™ systems have been optimized to offer the following advantages:

• **Ease of Assembly** — lightweight standard sections can be prefabricated in large sections and shipped to the jobsite or fabricated and installed on site with simple carpenter tools.

• **Internal Connection System** — construction of continuous handrail systems is simplified, even around circular tanks, without special fittings.

• **Safety Features** — SAFRAIL™ systems come standard in a “safety yellow color”, feature low electrical conductivity and exhibit high strength. Systems meet federal OSHA standards with a 2:1 factor of safety with a 6-foot (1830mm) maximum post spacing. SAFRAIL™ systems also comply with international standard AFNOR NF E 85-101. In addition, the long-term durability of SAFRAIL™ components virtually eliminates maintenance requirements.*

• **Cost Effective** — Corrosion resistant, pigmented fiberglass will outlast aluminum or steel systems with virtually no maintenance. The systems’ easy-to-assemble designs provide savings on installation time and labor. The light weight of the systems saves on freight costs and minimizes the need for special installation equipment.

SAFRAIL™ can be used in guardrail applications where railing is needed to protect the open side of an elevated walkway. SAFRAIL™ systems meet OSHA 1910.29 standards for a height of 42” (1067mm) from the top of walkway to the top of the guardrail with a 2:1 factor of safety.

Features
SAFRAIL™ fiberglass handrail systems are:

• Corrosion Resistant
• Structurally Strong
• Impact Resistant
• Lightweight
• Easy to Field Fabricate
• Low Thermal and Electrical Conductivity

Materials of Construction
SAFRAIL™ is an engineered composite consisting of:

• Continuous glass fibers
• Two continuous strand glass mats
• A synthetic surfacing veil
• Fire-retardant polyester resin (other resin systems are available upon request)

This unique combination provides the ultimate in strength, stiffness and long-term corrosion and UV protection.*

*Strongwell recommends a coating to reduce color fade for outdoor applications. If a coating is not applied, components may fade rapidly.
SAFRAIL™ Mechanical Properties

Square Post or Rail

Round Post or Rail

Channel Top Rail

Section Properties

<table>
<thead>
<tr>
<th>SHAPE</th>
<th>WEIGHT LB/LIN. FT (KG/M)</th>
<th>A IN² (MM²)</th>
<th>S IN³ (MM³)</th>
<th>I IN⁴ (MM⁴)</th>
<th>E* PSI (N/MM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td>0.95 (1.41)</td>
<td>1.15 (742.5)</td>
<td>0.657 (1.077 x 10⁴)</td>
<td>0.657 (2.735 x 10⁶)</td>
<td>3.7 x 10⁶ (25,500)</td>
</tr>
<tr>
<td>Round</td>
<td>0.86 (1.28)</td>
<td>1.05 (677.4)</td>
<td>0.405 (6.637 x 10⁴)</td>
<td>0.385 (1.602 x 10⁶)</td>
<td>4.5 x 10⁶ (31,000)</td>
</tr>
<tr>
<td>Channel Top</td>
<td>0.99 (1.47)</td>
<td>1.21 (780.6)</td>
<td>Sₓ = 0.962 (1.576 x 10⁴)</td>
<td>Iₓ = 0.717 (2.984 x 10⁴)</td>
<td>3.0 x 10⁶ (20,700)</td>
</tr>
</tbody>
</table>

* Where E = Full Section Modulus

Material Properties (Typical)

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>SQUARE RAIL</th>
<th>ROUND RAIL</th>
<th>CHANNEL TOP RAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Flexural Stress (Full Section)</td>
<td>N/A</td>
<td>psi</td>
<td>36,000</td>
<td>60,000</td>
<td>30,000</td>
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<tr>
<td></td>
<td></td>
<td>N/mm²</td>
<td>248</td>
<td>414</td>
<td>207</td>
</tr>
<tr>
<td>Full Section Modulus (non-phenolic)</td>
<td>N/A</td>
<td>psi</td>
<td>3.7 x 10⁶</td>
<td>4.5 x 10⁶</td>
<td>3.0 x 10⁶</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/mm²</td>
<td>25,500</td>
<td>31,000</td>
<td>20,700</td>
</tr>
<tr>
<td>Full Section Modulus (phenolic)</td>
<td>N/A</td>
<td>psi</td>
<td>6.0 x 10⁶</td>
<td>6.0 x 10⁶</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/mm²</td>
<td>41,400</td>
<td>41,400</td>
<td>N/A</td>
</tr>
<tr>
<td>Density</td>
<td>ASTM D792</td>
<td>lbs/in³ g/cc</td>
<td>0.065 - 0.075</td>
<td>0.065 - 0.075</td>
<td>0.065 - 0.075</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.80 - 2.08</td>
<td>1.80 - 2.08</td>
<td>1.80 - 2.08</td>
</tr>
<tr>
<td>24 hr. Water Absorption (non-phenolic)</td>
<td>ASTM D570</td>
<td>% max by wt.</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>24 hr. Water Absorption (phenolic)</td>
<td>ASTM D570</td>
<td>% max by wt.</td>
<td>2.0</td>
<td>2.0</td>
<td>N/A</td>
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<tr>
<td>Coefficient of Thermal Expansion, lengthwise</td>
<td>ASTM D696</td>
<td>in/in/°F mm/mm/°C</td>
<td>7 x 10⁸</td>
<td>7 x 10⁸</td>
<td>7 x 10⁸</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.0 x 10⁸</td>
<td>2.0 x 10⁸</td>
<td>2.0 x 10⁸</td>
</tr>
</tbody>
</table>

HOW TO SPECIFY SAFRAIL™

Fiberglass railing shall be SAFRAIL™ as manufactured by Strongwell. Railing shall be pultruded and assembled in the U.S.A. Resin shall be fire retardant (polyester) (vinyl ester) (phenolic) meeting the requirements of a Class 1 rating of 25 or less per ASTM E-84 and the self-extinguishing requirements of ASTM D-635. Color shall be (gray) (yellow). Resin shall be UV inhibited and the composite shall include a veil on all exposed surfaces (unless phenolic). The visual quality of the pultruded shapes shall conform to ASTM D-4385.

Note: If special options are required that are not stated in the above specification, fill in your special requirement in the appropriate section.

CUSTOM RAILING SYSTEMS

SAFRAIL™ systems are cost effective standard systems designed to fit a wide variety of applications. Custom guard and fence systems are also available from Strongwell to suit specific needs. Examples include vertical pickets, multi-color, architectural features, heavy duty systems as well as NSF-61 certified materials.

For more custom handrail options, see Strongwell’s STRONGRAIL® Architectural Handrail and Fencing Systems.
STANDARD SQUARE HANDRAIL CONSTRUCTION

Connection Details
All components secured with epoxy.

A RAIL SPLICE
- STRAIGHT
  - 6" (152mm) Square Plug
- ANGLE
  - Adjustable Corner Assembly

B END POST TO RAIL
- 90° Corner
  - 4" (102mm) Split Tube Connector

C LINE POST TO RAIL
- 4" (102mm) Split Tube Connector
- 8" (203mm) Split Tube Connector

D STAIR RAIL RETURN
- (2) Adjustable Corner Assemblies

E POST MOUNTED RAIL
- 1.90" (48.3mm) O.D. TUBE
- 2" (51mm) SQUARE HANDRAIL POST
- 0.8" x 1.3/4" (20.3mm x 31.75mm) SHCS SELF-DRILLING SCREWS (2x) (FIELD ATTACHED)
- 0.8" x 7/8" (22.2mm x 22.2mm) HHCS SS 316

F WALL MOUNTED RAIL
- 3-1/4" (82.55mm)
- 1.90" (48.3mm) O.D. TUBE
- 1/4" x 1-1/4" (6.4mm x 31.75mm) SHCS SELF-DRILLING SCREWS (2x) (FIELD ATTACHED)
- SS 316 WALL BRACKET 60° (1524MM) ON CENTER MAX. (FIELD ATTACHED)
- 3/8" (9.53mm) CONCRETE ANCHOR (SUPPLIED BY OTHERS)

ALTERNATIVE POST DESIGN

Refer to OSHA 1910.25, Table D-2 for stairway handrail requirements.
# Recommended Square Post and Kick Plate Installation

## Posts with FRP Base Plate

<table>
<thead>
<tr>
<th>Fastening to Structural Steel or Fiberglass</th>
<th>Fastening to Concrete</th>
<th>Removable Posts</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Beam with spacers</td>
<td>Square plug</td>
<td>Kickplate to Post</td>
</tr>
<tr>
<td>Perpendicular plate</td>
<td>Embedded in concrete</td>
<td>Kickplate Corner</td>
</tr>
<tr>
<td>Parallel plate</td>
<td></td>
<td>Kickplate Splice</td>
</tr>
<tr>
<td>Channel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 1/8” x 1/2” (3.2mm x 12.7mm) SS POP rivets |

### Kickplate to Post

- **1/8” x 1/2” (3.2mm x 12.7mm)** SS POP Rivets
- **CUT 1-1/2” x 1-1/2” x 4” (38mm x 38mm x 102mm) ANGLE FROM 2” x 2” (51mm x 51mm) TUBE**

### Kickplate Corner

- **1/8” x 1/2” (3.2mm x 12.7mm)** SS POP Rivets
- **CUT (2) 3/4” x 3” (20mm x 76mm) STRIPS FROM 2” x 2” (51mm x 51mm) TUBE OR KICKPLATE**

### Kickplate Splice

### Kickplate Splice

### SQUARE HANDRAIL COMPONENTS

<table>
<thead>
<tr>
<th>POST OR RAIL</th>
<th>SQUARE PLUG</th>
<th>SPLIT TUBE CONNECTOR</th>
<th>KICKPLATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2” x 2” (50.8mm x 50.8mm)</td>
<td>1.68” (42.7mm) SQUARE</td>
<td>1/8” (3.2mm) WALL</td>
<td>4” or 6” (101.6mm or 152.4mm)</td>
</tr>
</tbody>
</table>

### 90° Corner

- 2” (50.8mm) CUBE
- 2.5” (63.5mm) LEGS
- 1.68” (42.7mm) SQUARE

### Adjustable Corner Assembly

- 1/4” (6.4mm) PIN
- 4.9” (124.5mm) SQUARE
- 30° MIN.
- 1.68” (42.7mm) SQUARE

### Post Base (Mounted To Post)

- 1” (25mm)
- 4” (102mm)
- 9/16” (14mm)
- 6” (152mm)
- 0.75” (19mm)

### End Cap

- 1/8” (3.2mm)
- 3/4” (19.1mm)
- 2” SQUARE (50.8mm)

### Note:

- For Capping Tubes (Special Construction)
STANDARD ROUND Handrail CONSTRUCTION

Connection Details
All components secured with epoxy.

A RAIL SPLICES
STRAIGHT
8" (204mm) Round Plug

ANGLE
Adjustable Corner Assembly

B END POST TO RAIL
90° Corner

Intermediate Connector

4" (102mm) Split Tube Connector

C LINE POST TO RAIL
4" (102mm) Split Tube Connector

Intermediate Connector

D STAIR RAIL RETURN
(2) Adjustable Corner Assemblies

E POST MOUNTED RAIL
1.9" (48.3mm) O.D. Tube

Handrail Bracket
(Field Attached)

1/4" x 1-1/4" (6.4mm x 31.75mm)
SHCS Self-Drilling Screws (2x)
(Field Attached)

F WALL MOUNTED RAIL
1.9" (48.3mm)

1/4" x 1-1/4" (6.4mm x 31.75mm)
SHCS SELF-DRILLING SCREWS (2x)
(FIELD ATTACHED)

SS 316 WALL BRACKET 60° (152mm) ON CENTER
MAX. (FIELD ATTACHED)

3/8" (9.53mm) CONCRETE ANCHOR
(SUPPLIED BY OTHERS)

Refer to OSHA 1910.25, Table D-2 for stairway handrail requirements.
### Recommended Round Post and Kick Plate Installation

#### Posts with FRP Base Plate

- **S.S. Kickplate Bracket**
- Ø 1/4" (6.4mm) BOLTS

#### Fastening to Structural Steel or Fiberglass

<table>
<thead>
<tr>
<th>I Beam with Spacers</th>
<th>Perpendicular Plate</th>
<th>Parallel Plate</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; MIN. (51mm)</td>
<td>2&quot; MIN. (51mm)</td>
<td>2&quot; MIN. (51mm)</td>
<td></td>
</tr>
<tr>
<td>WELD (STEEL)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Fastening to Concrete

- 2" MIN. (51mm)
- 4" MIN. (102mm)
- WELD

#### Removable Posts

- 2" MIN. (51mm)
- 4" MIN. (102mm)
- WELD

#### Kickplate to Post

- 1/8" x 1/2" (3.2mm x 12.7mm) SS POP RIVETS

### Round Handrail Components

#### Intermediate Connector

- 1.90" (48.3mm) OD.
- 1.51" (38.3mm) ID.

#### Round Plug

- 1.5" (38mm) OD.
- 1.25" (32mm) ID.

#### Split Tube Connector

- 1.5" (38mm) OD.
- 3/4" (19mm) ID.

#### Kickplate

- 4" or 6" (101.6mm or 152.4mm)
- 5/8" (16.0mm) WALL
- 4" (101.6mm)
- 3/4" (19.1mm)
- 1" (25.4mm)
- 5/8" (15.9mm)

#### 90° Corner

- 2.5" (63.5mm) LEGS

#### Adjustable Corner Assembly

- 1 1/4" (6.4mm) PIN
- 1 1/2" (38mm) MIN.
- 5.7" (145mm)

#### Post Base (Mounted To Post)

- 3/4" (19mm)
- 4" (102mm)

#### End Cap

- Note: For Capping Tubes (Special Construction)
- 1.9" (48.3mm)
- 3/4" (19mm)
SAFRAIL™ channel top industrial fiberglass handrail is an economical commercial railing system designed for long runs on platforms and walkways. The railing system is designed for fabrication efficiency and is not particularly well-suited for stair rails with twists and turns. SAFRAIL™ channel top can be used in combination with round and square SAFRAIL™.

### Advantages

The benefits of designing a SAFRAIL™ channel top fiberglass handrail system are:
- Economical installation of long, straight runs
- Fewer components, reduced freight cost
- No epoxy required
- All riveted connections

### Safety

The channel top handrail system meets OSHA strength requirements. It has been independently tested and meets British Standard EN ISO 14122-3:2001 requirements. The handrail system sustained a falling weighted bag impact force of 216.5 ft-lb (293.6 N-m).

### Refer to OSHA 1910.25, Table D-2 for stairway handrail requirements.
RECOMMENDED CHANNEL TOP POST AND KICK PLATE INSTALLATION

Handrail Post, Top Rail & Mid Rail

2.50" x 2.38" (63.50mm x 60.45mm) Channel

2" (50.8mm)
Square Tube

Ø 1" (25.4mm)
Tube

3/16" x 3/4" (4.76mm x 19.05mm) Rivets (2 places)

4" (101.6mm)
Kickplate Riveted to Post

2" (50.8mm)
Square Tube

1-1/2" x 1-1/2" x 0.156" (38mm x 38mm x 3.96mm)
Angle Riveted in Place

KICKPLATE CORNER SPlice

4" (101.6mm)
Kickplate

3/16" x 3/4" (4.76mm x 19.05mm)
SS Pop Rivets (4 places)

KICKPLATE CORNER AT POST

4" (101.6mm)
Kickplate

3/16" x 3/4" (4.76mm x 19.05mm)
SS Pop Rivets (6 places)

KICKPLATE STRAIGHT SPlice

4" (101.6mm)
Kickplate

3/16" x 3/4" (4.76mm x 19.05mm)
SS Pop Rivets (4 places)

CHANEL TOP HANDRAIL COMPONENTS

TOP RAIL

5/8" (16.0mm)
WALL

3/16" (4.8mm)
WALL

Ø 1" (25.4mm)

0.11" (2.79mm)

1.68" (42.7mm)
SQUARE

KICKPLATE

4" or 6" (101.6mm or 152.4mm)

5/8" (16.0mm)
WALL

3/4" (19.1mm)

1" (25.4mm)

5/8" (15.9mm)

90° CORNER

ADJUSTABLE CORNER ASSEMBLY

POST BASE
(Mounted To Post)

END CAP

4" (101.6mm)

1/8" (3.2mm)

3/4" (19.1mm)

1" (25.4mm)

2" SQUARE
(50.8mm)

Note: For Capping Tubes (Special Construction)
In 1994, an industrial equipment supplier teamed with a coal company’s engineering group to address corrosion problems at the Galatia, Illinois coal preparation plant. The coal preparation environment results in significant deterioration of carbon steel within two years and stainless steel in less than six. The coal company’s goal was to use non-metallic structural products in the design of a new section of the plant.

Strongwell’s SAFRAIL™ FRP square tube industrial handrail combined with DURAGRID® I-6000 FRP grating and stair treads were specified in all areas of the new section.

After sixteen years of service, Strongwell revisited the plant in 2012. The results were a testament to the superior performance of the pultruded FRP solution. There had not been a single corrosion related problem, while the metal structures and components around the fiberglass railing and platforms were failing.

(Also featured on Cover) A chemical processing plant in Charleston, West Virginia was outfitted with square SAFRAIL™ FRP handrail along with DURAGRID® I-6000 FRP grating, EXTREN® FRP channels and angles and COMPOSOLITE® fiberglass building panels by a Strongwell fabricator. The fabricator designed, built, and installed the two new process vessels to replace old deteriorating wooden tanks, and provided new access walkways, railings, and covers for the two existing vessels.
**FABRICATION METHODS**

1. Cut components to length and miter where necessary.

2. Locate and drill holes for split tube connector. Must use 1.68” dia. core drill (available from Strongwell).

3. Apply recommended epoxy adhesive to connectors and inside tube (available from Strongwell).

4. Press together. Wipe off excess adhesive. 1/8” tension pins may be used at connections for field fabrication.

**List of Components & Accessory Items**

- 2” x 2” x .156” (51 x 51 x 4mm) Square Tube, Yellow, Polyester Fire Retardant, UV Inhibited @ 240° (6100mm)
- 2-3/8” x 2-3/8” x 3/16” (60 x 60 x 5mm) Square Tube, Yellow, Polyester Fire Retardant, UV Inhibited @ 240° (6100mm)
- 4” Kickplate, Yellow, Polyester Fire Retardant, UV Inhibited @ 240° (6100mm)
- 6” Kickplate, Yellow, Polyester Fire Retardant, UV Inhibited @ 240° (6100mm)
- FRP Base Plate with Post — Total Height 40” (1016mm) (Polyester)
- 2-3/8” x 2-3/8” x 3/16” (60 x 60 x 5mm) Alternate Handrail Post, Routed Out, No Bottom Plugs
- Black End Caps
- Adjustable Corner Assembly (Total Assembly)
- 90° Corner Plug
- Kickplate Splice
- Kickplate 90° Splice
- Split Round Tube 8” (200mm) Length
- Split Round Tube 4” (100mm) Length
- Split Round Tube 144” (3660mm) Length
- 6” (150mm) Square Plug
- 144” (3660mm) Square Plug
- 1/8” x 1-1/2” Tension Pins
- Epoxy Kits — 1 Pint Yellow
- Core Drill (1.68” Dia.)
- 1/8” x 1/2” SS Pop Rivets
- 90° Corner Sample
- Tee Sample
- Mounting Bolts

**Tools**

- Electric Drill
- Circular Saw
- Hammer
- Sandpaper
- Core Drill
- 1/8” Drill Bits
- Circular Saw Blades

**NOTE:** Tungsten carbide-tipped core drill bit and 7” grit-edged tungsten carbide circular saw blades are recommended (available from Strongwell).

**NOTE:** Joints must be immobilized until cured. The recommended temperature for epoxy cure is 60°F (15°C) or above. Failure to use these installation and fabrication methods, including recommended epoxy adhesive and 1.68” dia. core drill, may cause failure.
SAFRAIL™ LADDER AND CAGE SYSTEMS

SAFRAIL™ fiberglass ladders and ladder cages mounted on the sides of tanks and buildings are a common application in a wide range of industries. Fiberglass ladder and ladder cage systems have been in use since the 1950’s in chemical plants and other corrosive environments. Even in complete immersion applications, fiberglass has outlasted and outperformed aluminum and steel and required little or no maintenance.

Sizes & Availability
SAFRAIL™ ladders are fabricated in a standard 18” (457mm) rung width configuration with 12” (305mm) rung spacings. Various ladder lengths can be produced as practical. Standard SAFRAIL™ ladder and ladder cage systems are designed and fabricated to meet the requirements of OSHA 1910.23 and 1926.1053. Custom colors and custom designed ladders and access cages can be fabricated upon request. Ladders can be shipped pre-assembled for installation in the field.

Materials of Construction
SAFRAIL™ ladders and ladder cage systems are produced using a premium grade polyester resin system with flame retardant and ultraviolet (UV) inhibitor additives. A vinyl ester resin system is available upon request for additional corrosion resistance. Standard side rails and cages are pigmented OSHA safety yellow. The rungs are a pultruded fiberglass polyester tube with a fluted, non-skid surface.

See the SAFRAIL™ Ladder and Cage Systems brochure for more information.