SAFRAIL™ INDUSTRIAL HANDRAIL

INDUSTRIAL FIBERGLASS HANDRAIL SYSTEMS
SAFRAIL™ Industrial Fiberglass Handrail Systems

SAFRAIL™ industrial fiberglass handrails are commercial railing systems for stair rails, platform/walkway handrails and guardrails. SAFRAIL™ systems are fabricated from pultruded fiberglass components produced by Strongwell and molded thermoplastic 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.

SAFRAIL™ fiberglass handrail systems are:

- Corrosion resistant
- Easy to field fabricate
- Structurally strong
- Low in thermal conductivity
- Impact resistant
- Low electrical conductivity
- Lightweight

SAFRAIL™ systems are the result of more than 40 years of experience in the manufacture, design and fabrication of fiberglass handrail systems. The systems offer the following advantages:

- **Ease of Assembly** — SAFRAIL™ systems are produced in lightweight standard sections that include both post and rail. Systems can be prefabricated in large sections and shipped to the site or they can also be fabricated and installed on site with simple carpenter tools.

- **Internal Connection System** — All connections fit flush, resulting in a pleasing, streamlined appearance. The internal connections allow the construction of continuous handrail systems around circular tanks without special fittings.

- **Safety Features** — SAFRAIL™ systems come in a “safety yellow color”, feature low electrical conductivity for worker safety 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.

- **Low Maintenance** — Corrosion resistant fiberglass with molded-in color will outlast aluminum or steel systems with virtually no maintenance.

  Strongwell recommends an optional polyurethane coating to ensure prolonged years of color stability in UV intensive environments.

- **Cost Effective** — Fiberglass components and easy-to-assemble design provide savings on labor and maintenance, resulting in long-term savings and elimination of the cost and inconvenience of “downtime for repairs” in plant operations.

**Guardrail**

SAFRAIL™ industrial systems can be used in guardrail applications where railing is needed to protect the open side of an elevated walkway. SAFRAIL™ systems meet OSHA 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.

The OSHA loading requirement for both guardrail and handrail is a 200 pound (890 N) concentrated load at any point or direction on the top rail. Other building codes may require different loading conditions.
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

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

Square Post or Rail Section Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test Method</th>
<th>Square Rail Values</th>
<th>Round Rail Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Stress</td>
<td>ASTM D638</td>
<td>30,000 psi (207N/mm²)</td>
<td>30,000 psi (207N/mm²)</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>ASTM D638</td>
<td>2.5x10⁶ psi (17.2x10³ N/mm²)</td>
<td>2.5x10⁶ psi (17.2x10³ N/mm²)</td>
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<tr>
<td>Compressive Stress</td>
<td>ASTM D695</td>
<td>30,000 psi (207N/mm²)</td>
<td>30,000 psi (207N/mm²)</td>
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<tr>
<td>Compressive Modulus</td>
<td>ASTM D695</td>
<td>2.5x10⁶ psi (17.2x10³ N/mm²)</td>
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</tr>
<tr>
<td>Flexural Stress</td>
<td>ASTM D790</td>
<td>30,000 psi (207N/mm²)</td>
<td>30,000 psi (207N/mm²)</td>
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<tr>
<td>Flexural Modulus</td>
<td>ASTM D790</td>
<td>1.6x10⁶ psi (11.0x10³ N/mm²)</td>
<td>1.6x10⁶ psi (11.0x10³ N/mm²)</td>
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<tr>
<td>Shear Stress</td>
<td>ASTM D2344</td>
<td>4,500 psi (31N/mm²)</td>
<td>4,500 psi (31N/mm²)</td>
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<tr>
<td>Density</td>
<td>ASTM D792</td>
<td>0.060-0.070 lbs/in³ (1.72-1.94x10⁻³ g/mm³)</td>
<td>0.060-0.070 lbs/in³ (1.72-1.94x10⁻³ g/mm³)</td>
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<tr>
<td>24 Hr. Water Absorption</td>
<td>ASTM D570</td>
<td>0.6% max</td>
<td>0.6% max</td>
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<tr>
<td>Coef. Thermal Expansion</td>
<td>ASTM D696</td>
<td>4.4x10⁻⁶ in/in/°F (min.) (14.5x10⁻⁶ mm/mm/°C)</td>
<td>4.4x10⁻⁶ in/in/°F (min.) (14.5x10⁻⁶ mm/mm/°C)</td>
</tr>
<tr>
<td>Flexural Stress</td>
<td>Full Section</td>
<td>36,000 psi (typical) (248N/mm²)</td>
<td>60,000 psi (typical) (414N/mm²)</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>Full Section</td>
<td>3.7x10⁶ psi (typical) (25.5x10³ N/mm²)</td>
<td>4.5x10⁶ psi (typical) (31.0x10³ N/mm²)</td>
</tr>
</tbody>
</table>

Round Post or Rail Section Properties

<table>
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<tr>
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<th>Test Method</th>
<th>Square Rail Values</th>
<th>Round Rail Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 1.05 in.² (677.4mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S = 0.405 in.³ (6.637 x 10³ mm³)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l = 0.385 in.⁴ (1.602 x 10⁵ mm⁴)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E = 4.5 x 10⁶ psi (3.10 x 10¹⁰ N/m²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WT = 0.86 lbs./lin. ft. (380 grams)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Round Rail Values

Ø 1.51” (38.3mm)

Minimum Mechanical Properties for Pultruded Rail and Post

Where E = Flexural modulus full section
Typical Square Handrail Construction

Connection Details
All components secured with epoxy.

Alternative Post Design

<table>
<thead>
<tr>
<th>2 x .156&quot; (50x4mm) SQUARE HANDRAIL TUBE TOP &amp; MID RAIL</th>
<th>45°CHAMFER TYPICAL ON TOP EDGE OF POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 x 1/2&quot; (3x12.7mm) SS POP RIVETS (BOTH SIDES)</td>
<td>1-3/4&quot; (44mm)</td>
</tr>
<tr>
<td>1/8 x 1/2&quot; (3x12.7mm) SS POP RIVETS (2 REQ'D)</td>
<td>20&quot; (51mm)</td>
</tr>
<tr>
<td>2-3/8 x 3/16&quot; (60.3x4.7mm) SQUARE HANDRAIL TUBE POST</td>
<td>LENGTH TO BE DETERMINED</td>
</tr>
<tr>
<td>4&quot; (102mm) KICKPLATE</td>
<td></td>
</tr>
<tr>
<td>ADD PLUG AS REQUIRED</td>
<td></td>
</tr>
</tbody>
</table>

A Rail Splice
6" (152mm) SQUARE PLUG
STRAIGHT
ADJUSTABLE CORNER ASSEMBLY
ANGLE

B End Post to Rail
4" (102mm) SPLIT TUBE CONNECTOR
90° CORNER

C Line Post to Rail
8" (203mm) SPLIT TUBE CONNECTOR
4" (102mm) SPLIT TUBE CONNECTOR

D Stair Rail Return
(2) ADJUSTABLE CORNER ASSEMBLIES
Suggested Square Post and Kick Plate Installation

**Posts with FRP Base Plate**

**Fastening to Structural Steel or Fiberglass**

1. **6" (152mm) SQUARE PLUG** (TYPICAL)
   - 1 BEAM WITH SPACERS
   - PERPENDICULAR PLATE
   - PARALLEL PLATE
   - CHANNEL
   - WELD (STEEL)

2. **6" PLUG**
   - 4" MIN
   - (152mm)
   - (102mm)

3. **STOP**
   - 1/16" (1.6mm) MAX CLEARANCE BETWEEN POST & SLEEVE
   - (152mm)
   - (102mm)

4. **CUT 1-1/2" x 1-1/2" x 4" (38x38x102mm) ANGLE FROM 2 x 2 TUBE**

**Fastening to Concrete**

- **ANCHORED TO CONCRETE**
- **EMBEDDED IN CONCRETE**

**Removable Posts**

- **1/16" (1.6mm) MAX CLEARANCE BETWEEN POST & SLEEVE**
- **6" PLUG**
  - (152mm)
  - (102mm)
- **WELD**

**Kickplate to Post**

- 1/8" x 1/2" (3x12.7mm)
  - SS POP RIVETS

**Kickplate Corner**

- 1/8" x 1/2" (3x12.7mm)
  - SS POP RIVETS

**Kickplate Splice**

- CUT (2) 3/4" x 3" (20x76mm) STRIPS FROM 2 x 2 TUBE OR KICKPLATE

**Square Handrail Components**

- **Post or Rail**
  - 2" SQUARE (50.8mm)
  - 1.68" (43mm)
- **Square Plug**
  - 2" SQUARE (50.8mm)
  - 1.68" (43mm)
- **Split Tube Connector**
  - 1/4" (6mm) WALL
  - 1.01" (25.7mm) THRU
  - 2" SQUARE (50.8mm)
- **Kickplate**
  - 1/4" WALL (3.5mm)
  - 1.70" (43mm)
  - 50" (127mm)
  - 6" also available.

**90° Corner**

- **Adjustable Corner Assembly**
  - 1/4" (6mm) PIN
  - 2" x 2" (50x50mm) MOUNTED IN CENTER OF BASE PLATE
  - 1/16" (1.6mm) SQUARE
  - 9/16" (14mm)
  - 25° (63.5mm)
  - 6" (152mm)

**Post Base**

- (Mounted To Post)
  - 4.9" (124mm)
  - 1.68" (43mm)
  - 30° MIN.

**End Cap**

- Note: For Capping Tubes (Special Construction)
The SAFRAIL™ round handrail system is a round fiberglass system that is ideal for any high traffic area where handrail is needed. The round rails are easy to grip and 90° molded corners eliminate sharp edges.

The handrail system meets OSHA strength requirements with a 2:1 factor of safety with a 5-foot (1524mm) maximum post spacing. The handrail system can be made to comply with ADA standards upon request.

Internally bonded fiberglass connectors result in no visible rivets or metal parts. Rail and posts are 1.90" (48.3mm) O.D. x 1.51" (38.3mm) I.D. This is the same outside dimension as typical metal rails for ease of adapting to common metal brackets. Kickplates are available upon request.

The SAFRAIL™ round handrail system is pultruded using either a vinyl ester or a polyester resin system. The handrail system includes a UV inhibitor for additional resistance to ultraviolet degradation and corrosion.

Typical applications include:
- Food Processing Facilities
- Platforms & Walkways
- Heavy Industrial Plants
Suggested Round Post and Kick Plate Installation

**Round Handrail Components**

**Intermediate Connector**

**Round Plug**

**Split Tube Connector**

**Kickplate**

- **Kickplate to Post**
  - 1/8" x 1/2" (3.2 x 12.7mm) SS Pop Rivets
  - Cut 1-1/2" x 1-1/2" x 4" (38 x 38 x 102mm) Angle From 2 x 2 (50 x 50mm) Tube

- **Kickplate Corner**
  - 1/8" x 1/2" (3.2 x 12.7mm) SS Pop Rivets
  - Cut 3/4" x 3" (20 x 76mm) Strips From 2 x 2 (50 x 50mm) Tube

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

**Posts with FRP Base Plate**

- S.S. Kickplate Bracket

- 1/4" (6mm) Bolts

**Fastening to Structural Steel or Fiberglass**

- Ø 1.5 (38mm) Tube
  - Typical

- I BEAM WITH SPACERS
- PERPENDICULAR PLATE
- PARALLEL PLATE
- CHANNEL

**Fastening to Concrete**

- ANCHORED TO CONCRETE
- EMBEDDED IN CONCRETE

**Removable Posts**

- SLEEVE ON STRUCTURAL STEEL
- SLEEVE IN CONCRETE

**125° WALL**

- 4 1/4" or 6 1/4" (107mm or 159mm)
- 3" (76mm) also available.

**90° Corner**

**Adjustable Corner Assembly**

**Post Base**

- (Mounted To Post)

- 4" (102mm)
- 30° Min.

- 1.5" (38mm)

**End Cap**

- Note: For Capping Tubes (Special Construction)

- 3/4" (20mm)
- 2.5" (64mm)
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™ as needed.

SAFRAIL™ channel top systems are fabricated as handrails and guardrails using pultruded fiberglass components produced by Strongwell and molded thermoplastic connectors.

SAFRAIL™ channel top system consists of a 2.50” x 2.38” (63.50mm x 60.45mm) channel top rail, 2” x 2” x .156” (50.80mm x 50.80mm x 3.96mm) square tube posts and a 1” inch diameter round tube mid rail.

Advantages
The benefits to designing a SAFRAIL™ channel top fiberglass handrail system are:

- Easy installation and field fabrication
- Economical installation of long straight runs
- Fewer components, reducing freight cost
- No epoxy required
- All riveted connections

In addition, SAFRAIL™ channel top shares same benefits and advantages of the original SAFRAIL™ such as:

- Corrosion resistance
- Strength
- Impact resistance
- Light weight
- Low thermal conductivity
- Low electrical conductivity

Standard SAFRAIL™ channel top handrail systems are pultruded using a polyester, fire-retardant resin system. The handrail system includes a UV inhibitor for additional resistance to ultraviolet degradation and corrosion. Standard color is yellow, however, other colors are available upon request.

Safety
The channel top handrail system meets OSHA strength requirements. It has also been independently tested and meets the 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).
Typical Channel Top Handrail Construction

Alternative Post Design

**G Adjusted Top Rail Splice**

- 2.50" x 2.38" Channels (63.50mm x 60.45mm)
- 2" (50.8mm) Square Tubes
- Adjustable Corner Asm.

Note: Field epoxy adjustable corner inside 2" (50.8mm) tubes at angled intersections. Slip inside 2.50" (63.50mm) channels.

**G 90° Corner Top Rail Splice**

- 2.50" x 2.38" Channels (63.50mm x 60.45mm)
- 2" (50.8mm) Square Tubes
- 90° Corner Connector

Note: Field epoxy adjustable corner inside 2" (50.8mm) tubes at angled intersections. Slip inside 2.50" (63.50mm) channels.

Typical Details

- **A Rail Splice**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube

- **B End Return**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube

- **C Corner Post**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube

- **D End Post to Rail**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube

- **E Corner End Return**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube

- **F Top & Mid Rail Splice**
  - 2.50" x 2.38" Channel (63.50mm x 60.45mm)
  - Ø 1" Tube (25.4mm)
  - 2" (50.8mm) Square Tube
Suggested Channel Top Post and Kick Plate Installation

Handrail Post, Top Rail & Mid Rail

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

2” (50.8mm) Square Tube

Ø 1” Tube (25.4mm)

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

Handrail Post Plug Detail

2” (50.8mm) Square Tube

Solid Plug to Prevent Tube Crushing

Kickplate Corner at Post

3/16” x 3/4” (4.76 x 19.05mm) SS Pop Rivets (6 Places)

Kickplate Corner Splice

4” (101.6mm) High Kick Plate

3/16” x 3/4” (4.76 x 19.05mm) SS Pop Rivets (4 Places)

1-1/2” x 1-1/2” x .156” (38x38x3.96mm) Angle Riveted in Place

Kickplate Straight Splice

4” (101.6mm) High Kick Plate

3/16” x 3/4” (4.76 x 19.05mm) SS Pop Rivets (4 Places)

Channel Top Handrail Components

Top Rail

Mid Rail

Post Plug

Kickplate

90° Corner

Adjustable Corner Assembly

Post Base (Mounted To Post)

End Cap

Note: For Capping Tubes (Special Construction)
Handrail System Options

Custom Handrail Systems

SAFRAIL™ systems are designed to fit a wide variety of applications and, because they are standard systems, to be cost effective. However, custom handrail systems are available from Strongwell to suit special needs. Some examples of custom handrail from Strongwell include vertical pickets, two-color handrail, architectural handrail and heavy duty handrail systems.

UV Coating

Strongwell recommends that an industrial grade polyurethane coating be applied to the finished handrail and/or ladder and cage for additional protection against fading in outdoor applications. Standard SAFRAIL™ handrail systems are unpainted; the polyurethane UV coating must be requested when ordered.

Resin Systems

A polyester resin system is standard for SAFRAIL™ handrail systems but other resin systems are available upon request.

Colors

SAFRAIL™ handrail and ladder systems are produced in a standard safety yellow color. Other colors are available upon request.
More Applications

A chemical processing plant in Charleston, West Virginia was outfitted with square SAFRAIL™ along with DURADEK® I-6000 fiberglass grating, EXTREN® channels and angles and COMPOSOLITE™ panels courtesy of Strongwell fabricator, GEF Incorporated. GEF Incorporated 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.

In 1994, Westfall Company teamed with the engineering group of Kerr McGee Coal Company 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. Kerr McGee’s goal was to use as much non-metallic structural products as possible in the design of a new section of the plant. Strongwell’s SAFRAIL™ square tube industrial handrail combined with DURADEK® I-6000 grating and stair treads were specified in all areas of the new section.

After twelve years of service, Strongwell revisited the plant in 2008, which is now owned by American Coal. The results were a testament to the resilience of the pultruded solution. There had not been a single corrosion related problem, while the metal structures and components around the fiberglass railing and platforms were failing.

With over ten years of exposure over a salt water aquarium, a fiberglass platform continues to thwart corrosion damage at a popular zoo.

The Ohio-based zoo that operates the aquarium platform has had no maintenance or repair related problems since installation in 1999. The platform was built using Strongwell’s DURADEK® fiberglass grating, SAFRAIL™ fiberglass handrail system and EXTREN® structural shapes. The structure maintains its initial integrity even after more than a decade of use.

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Fiberglass: 12 Years Exposure

Metals: 12 Yrs. Exposure

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