FIBERGLASS HANDRAIL & LADDER SYSTEMS
Fiberglass Handrail Systems

SAFRAIL™ fiberglass handrails are industrial/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
- High impact resistant
- Low electrical conductivity
- Lightweight

SAFRAIL™ systems are the result of more than 20 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 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.

- **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™ systems can be used in guardrail applications where railing is needed to protect the open side of an elevated walkway. SAFRAIL™ systems meet OSHA requirements for a height of 42” from the top of walkway to the top of the guardrail.

The OSHA loading requirement for both guardrail and handrail is a 200 pound 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

A = 1.151 in.$^2$
S = .657 in.$^3$
I = .657 in.$^4$
E = $3.7 \times 10^6$ psi
WT = .95 lbs./lin.ft.
where $E$ = Flexural modulus full strength

Minimum Mechanical Properties for Pultruded Parts

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test Method</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Stress</td>
<td>ASTM D638</td>
<td>30,000 psi</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>ASTM D638</td>
<td>$2.5 \times 10^6$ psi</td>
</tr>
<tr>
<td>Compressive Stress</td>
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</tr>
<tr>
<td>Flexural Stress</td>
<td>ASTM D790</td>
<td>30,000 psi</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>ASTM D790</td>
<td>$1.6 \times 10^6$ psi</td>
</tr>
<tr>
<td>Shear Stress</td>
<td>ASTM D2344</td>
<td>4,500 psi</td>
</tr>
<tr>
<td>Density</td>
<td>ASTM D792</td>
<td>.060-.070 lbs./in$^3$</td>
</tr>
<tr>
<td>24 Hr. Water Absorption</td>
<td>ASTM D570</td>
<td>0.6% max</td>
</tr>
<tr>
<td>Coef. Thermal Expansion</td>
<td>ASTM D696</td>
<td>$4.4 \times 10^6$ in/in/$^\circ$F (min.)</td>
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<tr>
<td>Flexural Stress</td>
<td>Full Section</td>
<td>36,000 psi (typical)</td>
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<tr>
<td>Flexural Modulus</td>
<td>Full Section</td>
<td>$3.7 \times 10^6$ psi (typical)</td>
</tr>
</tbody>
</table>
Typical Square Handrail Construction

Connection Details
All components secured with epoxy.

Alternative Post Design

A Rail Splice
6" SQUARE PLUG
STRAIGHT
ADJUSTABLE CORNER ASSEMBLY
ANGLE

B End Post to Rail
4" SPLIT TUBE CONNECTOR
90° CORNER

C Line Post to Rail
6" SPLIT TUBE CONNECTOR
4" SPLIT TUBE CONNECTOR

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

<table>
<thead>
<tr>
<th>Posts with FRP Base Plate</th>
<th>Fastening to Structural Steel or Fiberglass</th>
<th>Fastening to Concrete</th>
<th>Removable Posts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) 6&quot; SQUARE PLUG (TYPICAL)</td>
<td>6&quot; PLUG</td>
<td>1/16&quot; MAX CLEARANCE BETWEEN POST &amp; SLEEVE</td>
</tr>
<tr>
<td></td>
<td>I BEAM WITH SPACERS</td>
<td>ANCHORED TO CONCRETE</td>
<td>STOP SLEEVE ON STRUCTURAL STEEL</td>
</tr>
<tr>
<td></td>
<td>PERPENDICULAR PLATE</td>
<td>EMBEDDED IN CONCRETE</td>
<td>SLEEVE IN CONCRETE</td>
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<tr>
<td></td>
<td>PARALLEL PLATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHANNEL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Square Handrail Components

- **Post or Rail**
- **Square Plug**
- **Split Tube Connector**
- **Kickplate**
- **90° Corner**
- **Adjustable Corner Assembly**
- **Post Base**
- **End Cap**

**Note:** For Capping Tubes (Special Construction)
Round Handrail System

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 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” O.D. x 1.51” 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

Post or Rail Section Properties

\[
\begin{align*}
A &= 1.05 \text{ in.}^2 \\
S &= .405 \text{ in.}^3 \\
I &= .385 \text{ in.}^4 \\
E &= 4.5 \times 10^8 \text{ psi} \\
WT &= .86 \text{ lbs./lin. ft.}
\end{align*}
\]

where \( E = \text{Flexural modulus full section} \)

Minimum Mechanical Properties for Pultruded Rail and Post:

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<td>ASTM D696</td>
<td>4.4 x 10⁻⁶ in./in./°F (min.)</td>
</tr>
<tr>
<td>Flexural Stress</td>
<td>Full Section</td>
<td>60,000 psi (typical)</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>Full Section</td>
<td>4.5 x 10⁸ psi (typical)</td>
</tr>
</tbody>
</table>
Typical Round Handrail Construction

Connection Details
All components secured with epoxy.

A Rail Splice
1.5” x 8”
Straight
Adjustable Corner Assembly

B End Post to Rail
1.5” x 4” Split Tube
90° Corner
Intermediate Connector

C Line Post to Rail
1.5” x 8” Split Tube
1.5” x 4” Split Tube
Intermediate Connector

D Stair Rail Return
(2) Adj. Corner Assemblies
Round Handrail Components

**Posts with FRP Base Plate**

- **S.S. Kickplate Bracket**
- **1/4" BOLTS**

**Fastening to Structural Steel or Fiberglass**

- **1.5 Tube**
  - Typical
  - 2’ Min.
- **Weld (Stl.)**
- **2’ Min.**

**Fastening to Concrete**

- **1.5 Tube**
  - Typical
  - 2’ Min.
- **Weld (Stl.)**
- **2’ Min.**

**Removable Posts**

- **2’ Min.**

**Kickplate to Post**

- **Nylon (2) Rivets**
- **Cut 1-1/2" x 1-1/2" x 4" Angle From 2 x 2 Tube**

**Kickplate Corner**

- **Nylon (4) Rivets**

**Kickplate Splice**

- **Cut 3/4" x 3" Strips From 2 x 2 Tube**

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**Round or Rail**

- **1.90" OD.**
- **1.51" ID.**

**Round Plug**

- **1.50" OD.**
- **1.00" ID.**

**Split Tube Connector**

- **1.50" OD.**
- **1.25" ID.**

**Kickplate**

- **4.00” or 6.00”**
- **50”**
- **6" also available.**

**90° Corner**

- **2.5”**
- **1.5”**

**Adjustable Corner Assembly**

- **5.7”**
- **1.5”**
- **30° Min.**

**Post Base**

- **(Mounted To Post)**
  - **.75”**
  - **4”**

**End Cap**

- **Note: For Capping Tubes (Special)**
  - **1.9”**
  - **3/4”**
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, heavy duty handrail and phenolic 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 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.
SAFRAIL™ fiberglass ladders and ladder cages mounted on the sides of tanks are a common sight in a wide range of industries. Fiberglass ladder and ladder cage systems have been in continuous use for more than 20 years in chemical plants and other corrosive environments. Even in complete immersion applications, fiberglass has outlasted aluminum and steel and required little or no maintenance.

**Sizes & Availability**
SAFRAIL™ ladders are fabricated in a standard 18” rung width configuration with 12” 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 1910.27. 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 in a premium grade polyester resin system with flame retardant and ultraviolet (UV) inhibitor additives. Standard side rails and cages are pigmented safety yellow. The rungs are a pultruded fiberglass polyester tube with a fluted non-skid surface.
Ladder Systems

Part Identification

<table>
<thead>
<tr>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Side Rail</td>
<td>2” x .156” sq. tube</td>
</tr>
<tr>
<td>2 Rung</td>
<td>1.25” dia. fluted tube</td>
</tr>
<tr>
<td>3 Top or Bottom Hoop</td>
<td>3” x 1/4” strip</td>
</tr>
<tr>
<td>4 Intermediate Hoop</td>
<td>2” x 1/4” strip</td>
</tr>
<tr>
<td>5 Cage Straps</td>
<td>2” x 3/16” strip</td>
</tr>
<tr>
<td>6 Standoff Bracket</td>
<td>5” bracket plate</td>
</tr>
<tr>
<td>7 Standoff Bracket</td>
<td>10-1/2” bracket plate</td>
</tr>
<tr>
<td>8 Base Angle</td>
<td>3” angle</td>
</tr>
<tr>
<td>9 End Plug</td>
<td>Molded end cap</td>
</tr>
</tbody>
</table>

Rung Detail

End View of Rung

Ladder Options

Walk-Through Cage w/Return
Side Mount Cage
Walk-Through w/Return
Floor Mount
Wall Mount
Specifications

SAFRAIL™ fiberglass handrail and ladder systems shall be fabricated from pultruded fiberglass components as produced by Strongwell. Cage hoops shall be produced by the open molded hand lay-up method.

The pultruded parts shall be made with a fire retardant polyester resin which meets the ASTM E-84 test for flame spread of 25 or less and contains a UV inhibitor. The color shall be OSHA safety yellow.

SAFRAIL™ Square Handrail

The handrail system shall be designed to meet the configuration and loading requirements of OSHA 1910.23, with a minimum factor of safety on loading of 2.0.

Materials

The rails and posts shall be 2" x 2" x .156" square tube manufactured by the pultrusion process. The kickplate shall be 4" x 1/2" (corrugated) x .125" thick pultruded fiberglass shape.

Installation and Mounting

Post shall be constructed with a square pultruded bottom plug. Length shall be sufficient to extend a minimum of 1" beyond the uppermost bolt hole to prevent crushing of post tubing. Bolt holes shall provide clearance of 1/16" for 1/2" diameter bolts/studs. Holes shall be on longitudinal center line of post, 1" from bottom of post (minimum) and not less than 3" apart on center. Posts shall be fastened with stainless steel anchor bolts or studs, 1/2" diameter, extending no less than 2-1/4" into the concrete, or into a minimum thickness of 1/4" structural steel or pultruded fiberglass.

Post locations shall be no greater than 18", nor less than 9" from horizontal or vertical change in handrail direction. Post centers shall be no greater than 72" apart on any straight run of rail, or 48" apart on any inclined rail section.

Base mount, embedded and removable are also types of mounting procedures for handrail.

The fabricated handrail systems shall be supplied complete with fittings by the FRP manufacturer. The components used to join fabricated sections together shall be shipped loose, to be epoxied and riveted together in the field by the contractor, per the manufacturer’s recommendations.

SAFRAIL™ Round Handrail

The handrail shall be designed to meet the configuration and loading requirement of OSHA 1910.23 with a minimum factor of safety loading of 2.0.

Materials

The rails and posts shall be 1.90" OD x 1.51" ID round tube manufactured by the pultrusion process. The kickplate shall be 4" x 1/2" (corrugated) x .125" thick pultruded fiberglass shape.

Installation and Mounting

The post shall be constructed with a round pultruded bottom plug. Length shall be sufficient to extend a minimum of 2" beyond the uppermost support structure. Bolt holes shall provide clearance of 1/16" for 1/2" diameter bolts/studs. Holes shall be on longitudinal center line of post, 1" from bottom of post (minimum) and not less than 3" apart on center. The post shall be fastened with stainless steel anchor bolts or studs, 1/2" diameter, extending no less than 2-1/2" into the concrete, or into a minimum thickness of 1/4" structural steel or pultruded fiberglass.

Post locations shall be no greater than 18", nor less than 9" from horizontal or vertical change in handrail direction. Post centers shall be no greater than 60" apart on any straight run of rail, or 48" apart on any inclined rail section.

Base mount, embedded and removable are also types of mounting procedures for handrail.

The fabricated handrail systems shall be supplied complete with fittings by the FRP manufacturer. The components used to join fabricated sections together shall be shipped loose, to be epoxied and riveted together in the field by the contractor, per the manufacturer’s recommendations.

SAFRAIL™ Ladders and Ladder Cages

SAFRAIL™ fiberglass reinforced plastic (FRP) ladder and cage systems shall meet the requirements set forth in OSHA 1910.27.

Ladders shall be shop assembled and may be pre-drilled and prepared for field attachments of standoff clips.

Materials

The side rails, rungs and cage straps shall be pultruded fiberglass reinforced components. The side rails shall be 2" square tube with a wall thickness of .156" or greater. The rungs shall be pultruded 1.25" diameter FRP fluted tube.

Cage hoops shall be manufactured by the open mold hand lay-up process with a width of 3" and thickness of 1/4" minimum at the top and bottom and 2" x 1/4" at the intermediate hoops. The cage shall be interconnected with 2" x 3/16" pultruded straps spaced 9" on center around the hoop.