

STRONGWELL®

Supplied by **Pipex px**
Producing excellence

SAF RAIL™ INDUSTRIAL HANDRAIL

INDUSTRIAL FIBERGLASS HANDRAIL SYSTEMS



SAFRAIL™ Industrial Fiberglass Handrail Systems



SAFRAIL™ system in a chemical plant.



Internal connections make circular handrail systems such as these possible around tanks.



SAFRAIL™ ladder and cage systems, also available from Strongwell, are an ideal accompaniment to Strongwell's handrail systems when additional access is needed.



SAFRAIL™ and DURAGRID® pultruded grating were fabricated to make access platforms over waste water recycling tanks. The previous steel structure corroded, and was unsafe.

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

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.
- **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.

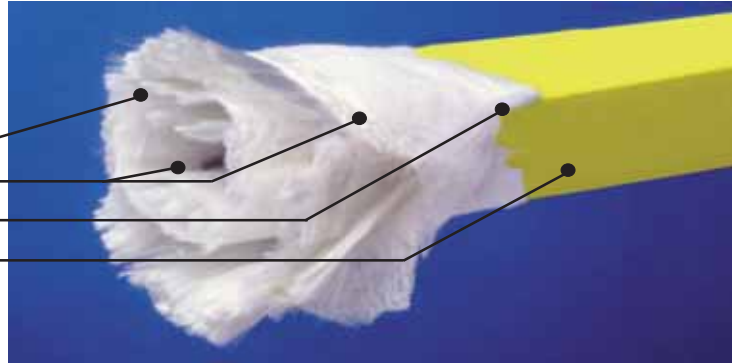
The OSHA loading requirement for both guardrail and handrail is a 200 pound (890 N) concentrated load at any point or direction on the top rail. Other building codes may require different loading conditions.

Materials of Construction

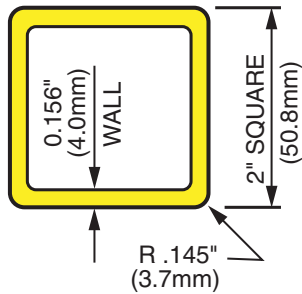
SAFRAIL™ is an engineered composite consisting of:

- 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.

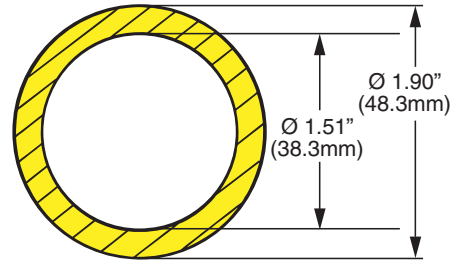


Square Post or Rail Section Properties



$A = 1.151 \text{ in.}^2$ (742.5mm²)
 $S = 0.657 \text{ in.}^3$ (1.077 x 10⁴ mm³)
 $I = 0.657 \text{ in.}^4$ (2.735 x 10⁵ mm⁴)
 $E = 3.7 \times 10^6 \text{ psi}$ (2.55 x 10¹⁰ N/m²)
 $WT = 0.95 \text{ lbs./lin.ft.}$ (431 Grams)
 where E = Flexural modulus full section

Round Post or Rail Section Properties

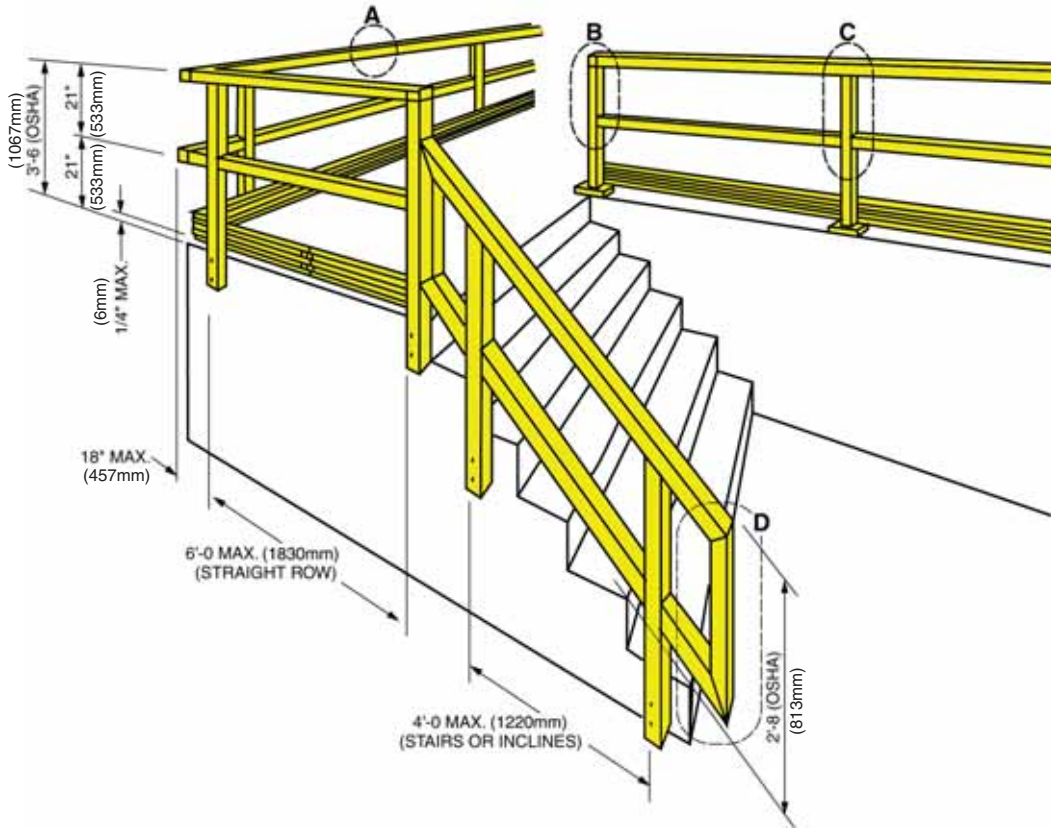


$A = 1.05 \text{ in.}^2$ (677.4mm²)
 $S = 0.405 \text{ in.}^3$ (6.637 x 10³ mm³)
 $I = 0.385 \text{ in.}^4$ (1.602 x 10⁵ mm⁴)
 $E = 4.5 \times 10^6 \text{ psi}$ (3.10 x 10¹⁰ N/m²)
 $WT = 0.86 \text{ lbs./lin. ft.}$ (380 grams)
 where E = Flexural modulus full section

Minimum Mechanical Properties for Pultruded Rail and Post

Properties	Test Method	Square Rail Values	Round Rail Values
Tensile Stress	ASTM D638	30,000 psi (207N/mm ²)	30,000 psi (207N/mm ²)
Tensile Modulus	ASTM D638	2.5x10 ⁶ psi (17.2x10 ³ N/mm ²)	2.5x10 ⁶ psi (17.2x10 ³ N/mm ²)
Compressive Stress	ASTM D695	30,000 psi (207N/mm ²)	30,000 psi (207N/mm ²)
Compressive Modulus	ASTM D695	2.5x10 ⁶ psi (17.2x10 ³ N/mm ²)	2.5x10 ⁶ psi (17.2x10 ³ N/mm ²)
Flexural Stress	ASTM D790	30,000 psi (207N/mm ²)	30,000 psi (207 N/mm ²)
Flexural Modulus	ASTM D790	1.6x10 ⁶ psi (11.0x10 ³ N/mm ²)	1.6x10 ⁶ psi (11.0x10 ³ N/mm ²)
Shear Stress	ASTM D2344	4,500 psi (31N/mm ²)	4,500 psi (31N/mm ²)
Density	ASTM D792	0.060-0.070 lbs/in ³ (1.72-1.94x10 ⁻³ g/mm ³)	0.060-0.070 lbs/in ³ (1.72-1.94x10 ⁻³ g/mm ³)
24 Hr. Water Absorption	ASTM D570	0.6% max	0.6% max
Coef. Thermal Expansion	ASTM D696	4.4x10 ⁻⁶ in/in/°F (min.) (14.5x10 ⁻⁶ mm/mm/C ^o)	4.4x10 ⁻⁶ in/in/°F (min.) (14.5x10 ⁻⁶ mm/mm/C ^o)
Flexural Stress	Full Section	36,000 psi (typical) (248N/mm ²)	60,000 psi (typical) (414N/mm ²)
Flexural Modulus	Full Section	3.7x10 ⁶ psi (typical) (25.5x10 ³ x10 ³ N/mm ²)	4.5x10 ⁶ psi (typical) (31.0x10 ³ N/mm ²)

Typical Square Handrail Construction

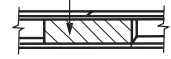


Connection Details

All components secured with epoxy.

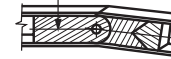
A Rail Splice

6" (152mm) SQUARE PLUG



STRAIGHT

ADJUSTABLE CORNER ASSEMBLY

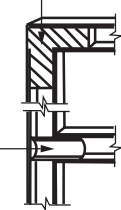


ANGLE

B End Post to Rail

4" (102mm) SPLIT TUBE CONNECTOR

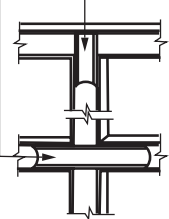
90° CORNER



C Line Post to Rail

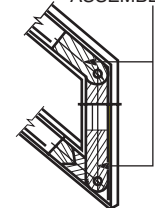
8" (203mm) SPLIT TUBE CONNECTOR

4" (102mm) SPLIT TUBE CONNECTOR

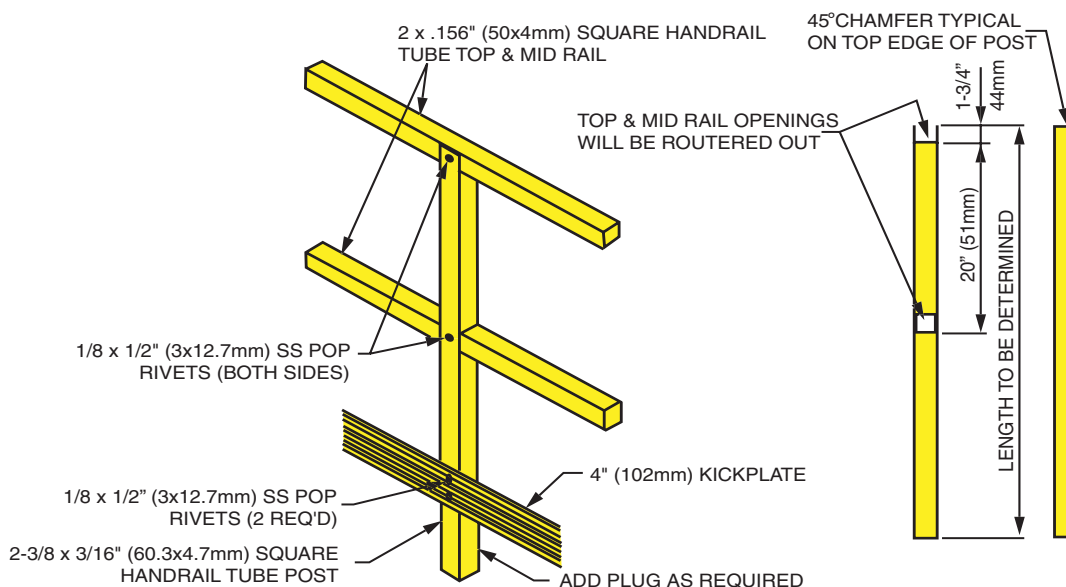


D Stair Rail Return

(2) ADJUSTABLE CORNER ASSEMBLIES



Alternative Post Design



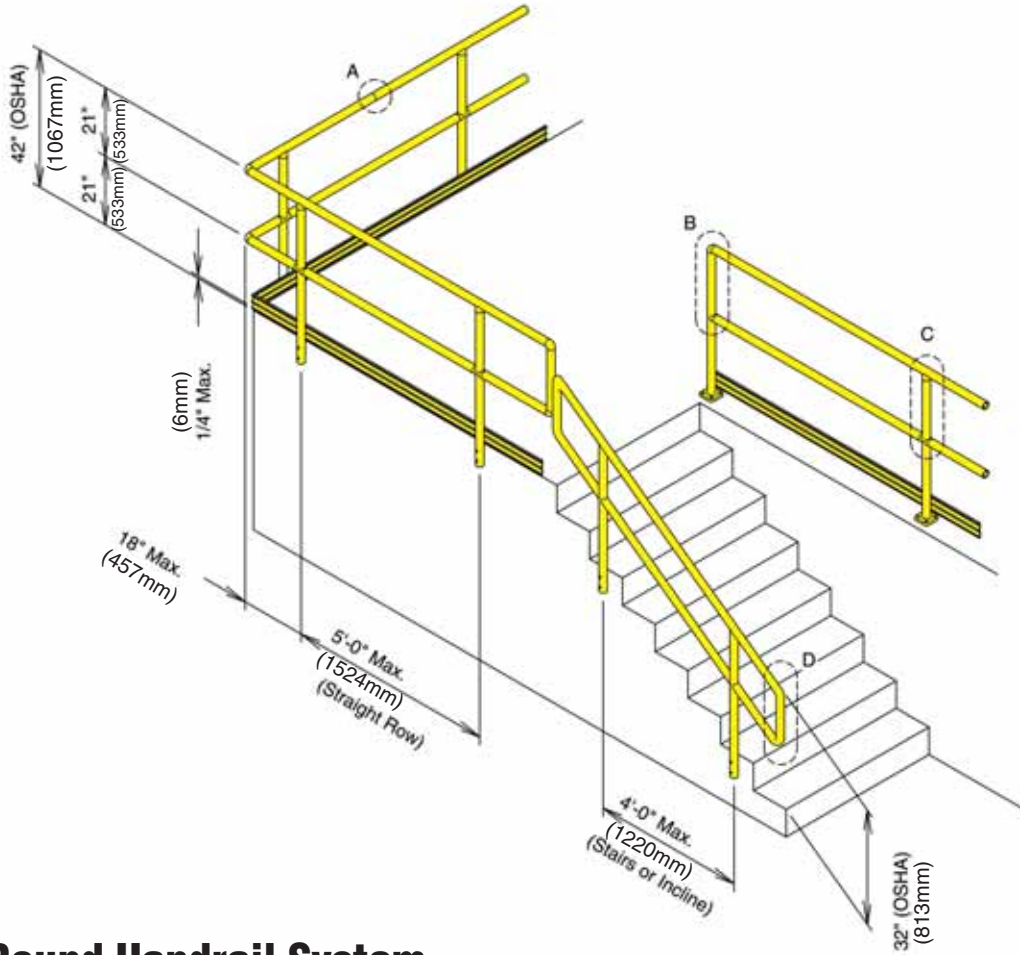
Suggested Square Post and Kick Plate Installation

<p>Posts with FRP Base Plate</p>	<p>Fastening to Structural Steel or Fiberglass</p> <p>(1) 6" (152mm) SQUARE PLUG (TYPICAL)</p> <p>I BEAM WITH SPACERS PERPENDICULAR PLATE PARALLEL PLATE CHANNEL</p> <p>WELD (STEEL)</p>			<p>Kickplate to Post</p> <p>1/8" x 1/2" (3x12.7mm) SS POP RIVETS</p> <p>CUT 1-1/2" x 1-1/2" x 4" (38x38x102mm) ANGLE FROM 2 x 2 TUBE</p> <p>Kickplate Corner</p> <p>1/8" x 1/2" (3x12.7mm) SS POP RIVETS</p> <p>Kickplate Splice</p> <p>CUT (2) 3/4" x 3" (20x76mm) STRIPS FROM 2 x 2 TUBE OR KICKPLATE</p>
	<p>Fastening to Concrete</p> <p>(152mm) 6" PLUG</p> <p>ANCHORED TO CONCRETE EMBEDDED IN CONCRETE</p> <p>4" MIN (102mm)</p>	<p>Removable Posts</p> <p>1/16" (1.6mm) MAX CLEARANCE BETWEEN POST & SLEEVE</p> <p>6" PLUG (152mm)</p> <p>STOP SLEEVE ON STRUCTURAL STEEL SLEEVE IN CONCRETE</p> <p>WELD</p> <p>4" MIN (102mm)</p>		

Square Handrail Components

<p>Post or Rail</p> <p>0.156" (4.0mm) WALL</p> <p>2" SQUARE (50.8mm)</p> <p>R .145" (3.7mm)</p>	<p>Square Plug</p> <p>1.68" (43mm) SQUARE</p> <p>1.01" (25.7mm) THRU</p>	<p>Split Tube Connector</p> <p>.14" WALL (3.6mm)</p> <p>1.70" (43mm)</p>	<p>Kickplate</p> <p>.125" WALL (3.18mm)</p> <p>.50" (12.7mm)</p> <p>4.00" or 6.00" (102mm or 152mm)</p> <p>6" also available.</p>
<p>90° Corner</p> <p>2" CUBE (50mm)</p> <p>2.5" LEGS (63.5mm)</p> <p>2" SQUARE (50.8mm)</p> <p>1.68" (43mm)</p>	<p>Adjustable Corner Assembly</p> <p>4.9" (124mm)</p> <p>1/4" (6mm) PIN</p> <p>30° MIN.</p> <p>1.68" (43mm) SQUARE</p>	<p>Post Base (Mounted To Post)</p> <p>(25mm) (102mm)</p> <p>1" (25mm)</p> <p>4"</p> <p>2" x 2" (50x50mm) MOUNTED IN CENTER OF BASE PLATE</p> <p>6" (152mm)</p> <p>2" (50mm)</p> <p>7/8" (20mm)</p> <p>9/16" (14mm)</p>	<p>End Cap</p> <p>Note: For Capping Tubes (Special Construction)</p> <p>1/8" (19mm)</p> <p>3/4" (19mm)</p> <p>2" SQUARE (50mm)</p>

Typical Round Handrail 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 (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.

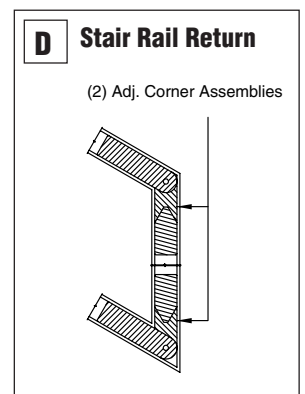
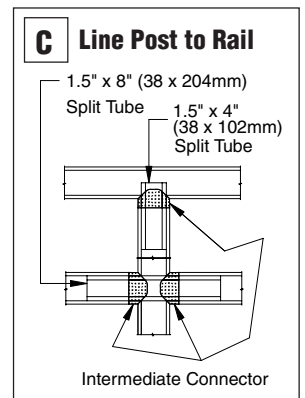
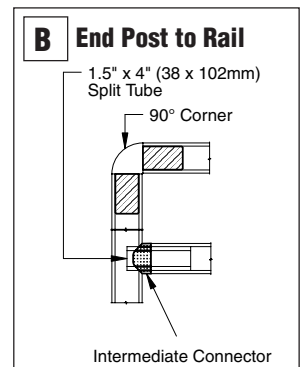
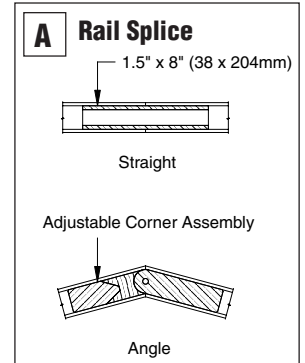
Typical applications include:

- Food Processing Facilities
- Platforms & Walkways
- Heavy Industrial Plants



Connection Details

All components secured with epoxy.



Suggested Round Post and Kick Plate Installation

Posts with FRP Base Plate

Fastening to Structural Steel or Fiberglass

Ø 1.5 (38mm) Tube Typical

I BEAM WITH SPACERS PERPENDICULAR PLATE PARALLEL PLATE CHANNEL

Kickplate to Post

1/8" x 1/2" (3.2 x 12.7mm) SS Pop Rivets

Fastening to Concrete

ANCHORED TO CONCRETE EMBEDDED IN CONCRETE SLEEVE IN CONCRETE

Removable Posts

SLEEVE ON STRUCTURAL STEEL SLEEVE IN CONCRETE

Kickplate Corner

1/8" x 1/2" (3.2 x 12.7mm) SS Pop Rivets

Kickplate Splice

Cut 3/4" x 3" (20 x 76mm) Strips From 2 x 2 (50 x 50mm) Tube

Round Handrail Components

Intermediate Connector

Round Plug

Split Tube Connector

Kickplate

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

1.5" (38mm) OD.
1" (25mm) ID.

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

4.00" or 6.00"
.125" WALL (3.18mm)
.50" (12.7mm)
ø" also available.

90° Corner

Adjustable Corner Assembly

Post Base

End Cap

2.5" (64mm)
1.5" (38mm)

5.7" (145mm)
30° Min.

.75" (20mm)
4" (102mm)

(Mounted To Post)

1.9" (48.3mm)
3/4" (20mm)

Note: For Capping Tubes (Special Construction)

SAFRAIL™ Channel Top Handrail System



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

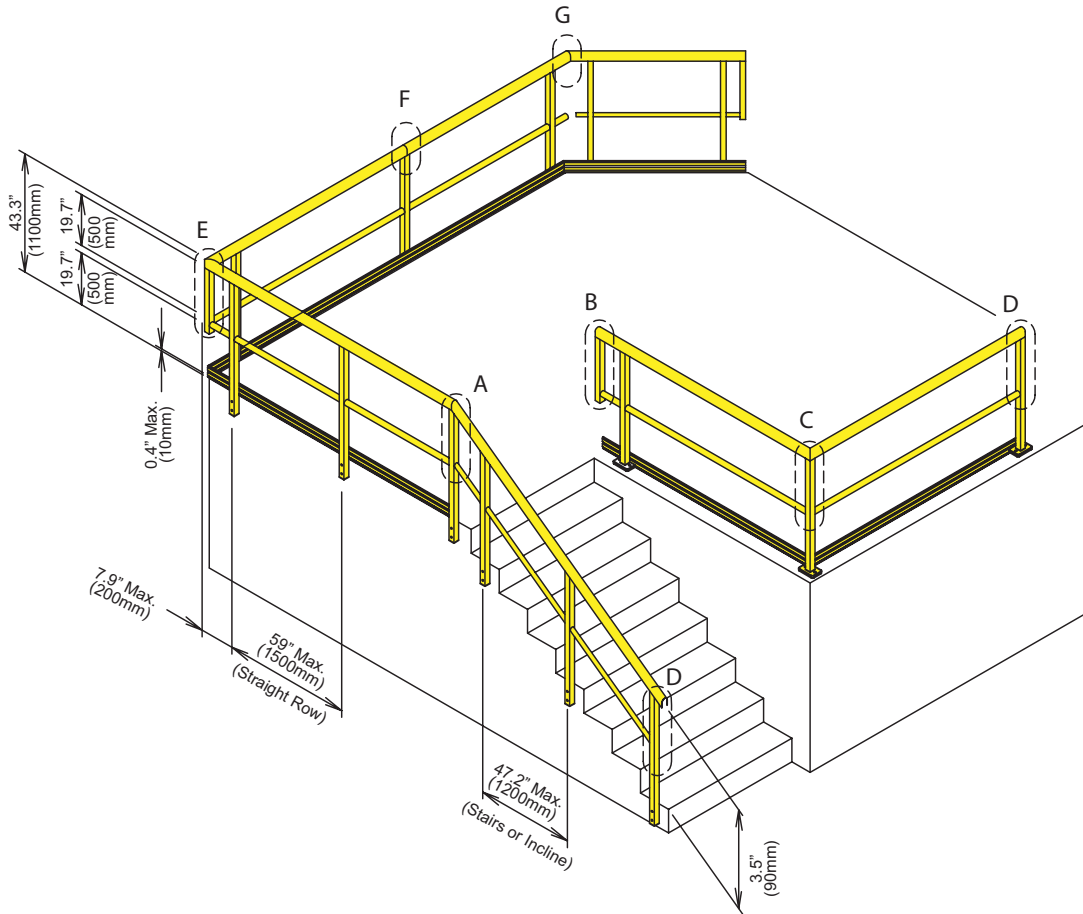
Standard SAFRAIL™ channel top handrail systems are pultruded using a polyester, fire-retardant resin system. The handrail system includes a UV inhibitor for additional resistance to ultraviolet degradation and corrosion. Standard color is yellow, however, other colors are available upon request.

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



Typical Details

A Rail Splice

B End Return

C Corner Post

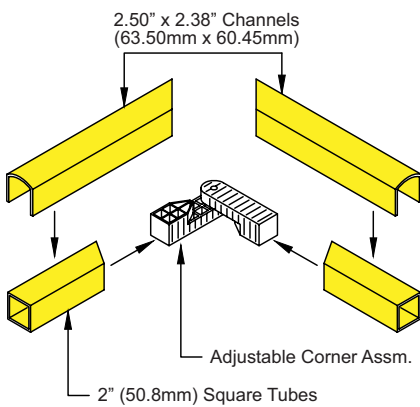
D End Post to Rail

E Corner End Return

F Top & Mid Rail Splice

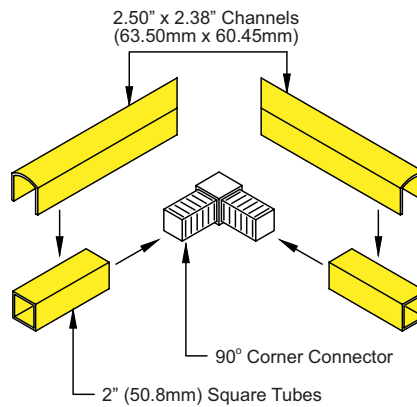
Alternative Post Design

G Adjustable Top Rail Splice



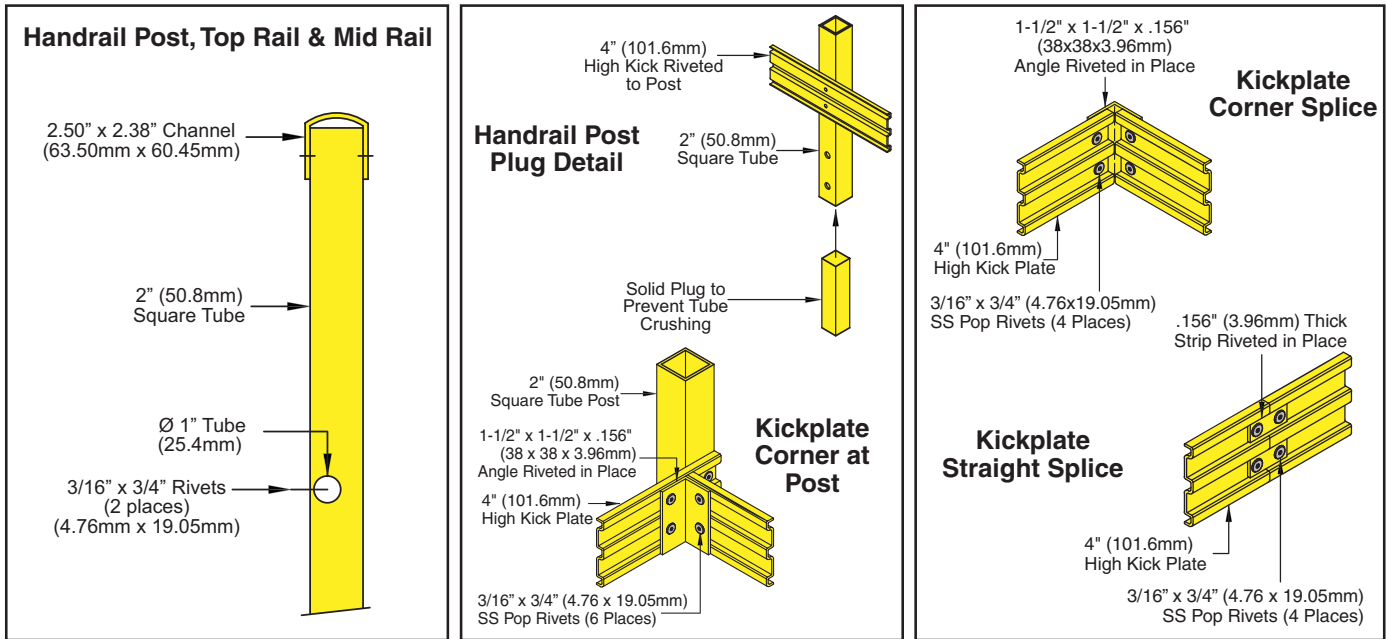
Note: Field epoxy adjustable corner inside 2" (50.8mm) tubes at angled intersections. Slip inside 2.50" (63.50mm) channels.

G 90° Corner Top Rail Splice

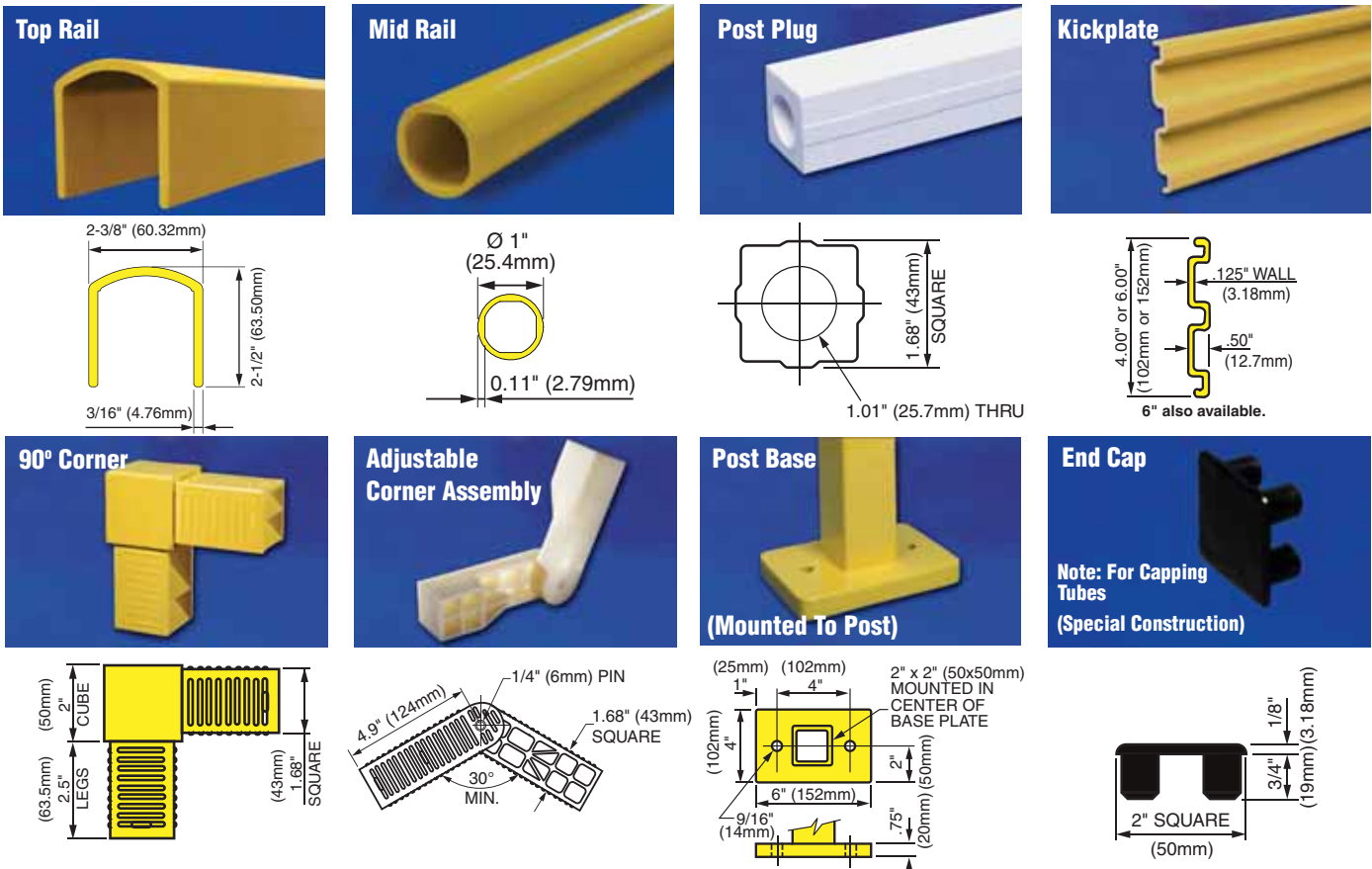


Note: Field epoxy adjustable corner inside 2" (50.8mm) tubes at angled intersections. Slip inside 2.50" (63.50mm) channels.

Suggested Channel Top Post and Kick Plate Installation



Channel Top Handrail Components



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 SAFRIL™ handrail systems are unpainted; the polyurethane UV coating must be requested when ordered.

Resin Systems

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

Colors

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



Strongwell designed this vertical rail system to use less material and, in turn, be more cost effective than conventional horizontal aluminum or fiberglass handrail systems.



Fiberglass platforms at the Road Division of Franklin County, Ohio use SAFRIL™ square handrail around tanks that contain de-icing fluids which are extremely corrosive to metal.



SAFRIL™ handrail is used on walkways and platforms for safe, maintenance-free worker access.



In 2002, Fort Lauderdale, FL received the very first installation of Strongwell's round SAFRIL™ on the 17th Street Bridge's fenders. Inspection in 2010 (shown here) revealed that 8 years of exposure to the Florida sun and the Atlantic Ocean have resulted in no corrosion related issues.

More than 70,000 lineal feet of SAFRIL™ handrail lines the walkways and emergency escape routes of the Chicago Transit Authority's rail lines. The handrail, along with the DURADEK® grating also supplied by Strongwell, represents one of the largest fiberglass installations in America.

More Applications



BEFORE



AFTER

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.

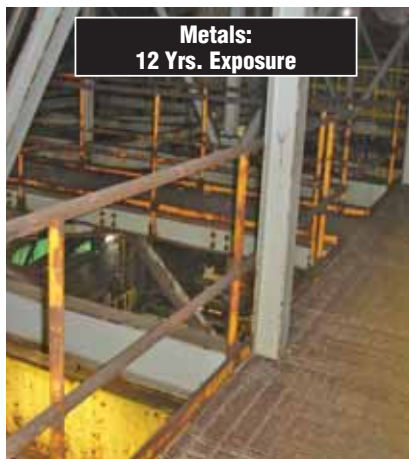


With over ten years of exposure over a salt water aquarium, a fiberglass platform continues to thwart corrosion damage at a popular zoo.

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.



**Fiberglass:
12 Years Exposure**



**Metals:
12 Yrs. Exposure**

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.

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