

SECTION 13

SAFRAIL™ FIBERGLASS HANDRAIL AND LADDER SYSTEMS



Look for this blue line in the left margin of the Design Manual documents. This line shows you where the latest update has been made.

SAFRAIL™ FIBERGLASS SQUARE HANDRAIL AND LADDER SYSTEMS

INTRODUCTION TO SAFRAIL™ 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
- 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

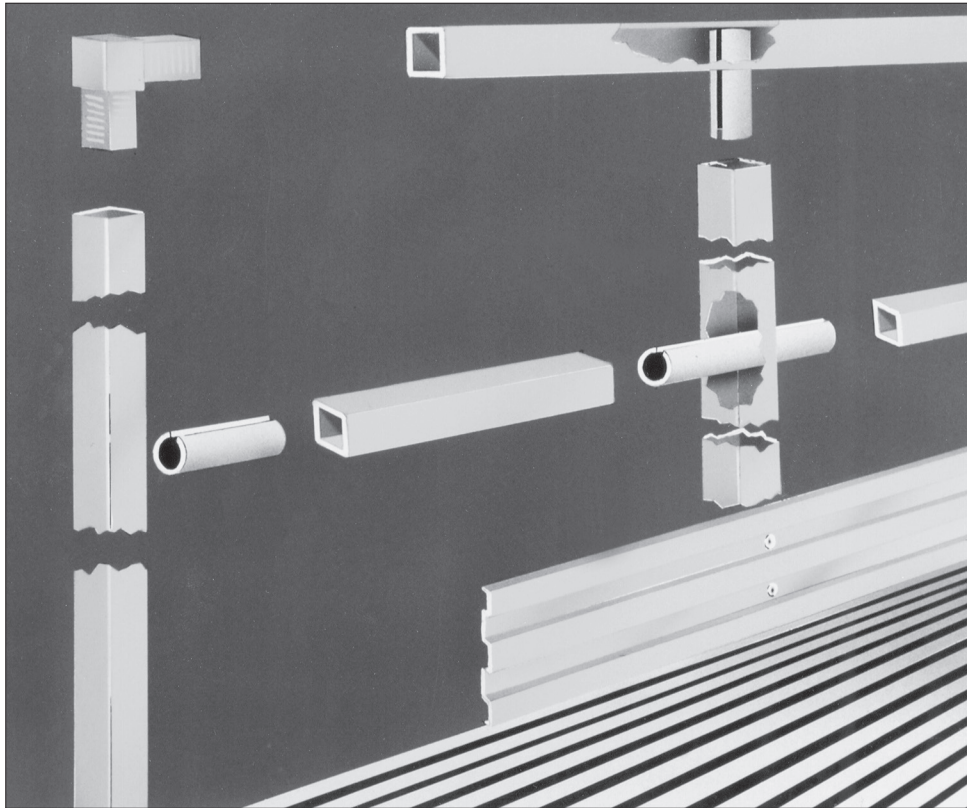
SAFRAIL™ industrial systems can be used in guardrail applications where railing is needed to protect the open side of an elevated walkway. **SAFRAIL™** systems meet OSHA requirements for a height of 42" (1067mm) from the top of walkway to the top of the guardrail.

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.

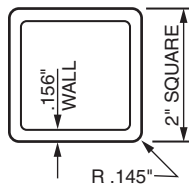
Custom Handrail Systems

SAFRAIL™ is designed to fit a wide variety of applications and because it is a standard system, to be cost effective. However, custom handrail systems are available from Strongwell to suit special needs. Contact Strongwell for special requirements.

BASIC SAFRAIL™ SQUARE HANDRAIL COMPONENTS



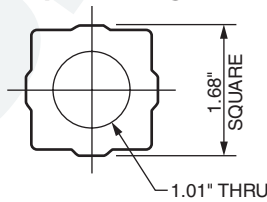
Post or Rail Section Properties



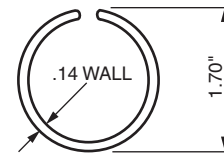
- A = 1.151 in²
- S = .657 in³
- I = .657 in⁴
- *E = 3.7 x 10⁶ psi
- WT = .95 lbs./lin. ft.

*E = Flexural modulus full strength

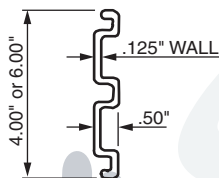
Square Plug



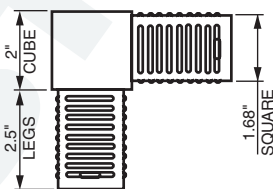
Split Tube Connector



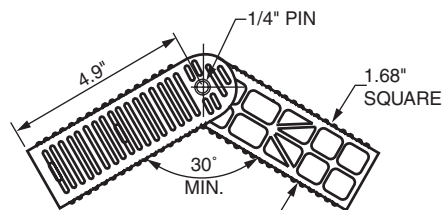
Kickplate



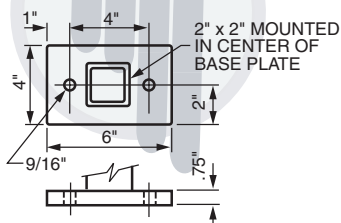
90° Corner



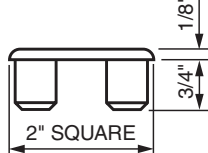
Adjustable Corner Assembly



Post Base



End Cap



Supplementary Components:

- Nylon Rivets
- 1/8" x 1-1/2" Tension Plus
- Two Part Epoxy Kits
- Mounting Bolts
- Kickplate Splice and Corner Connectors

SAFRAIL™ SQUARE HANDRAIL FABRICATION AND INSTALLATION

FABRICATION

The fiberglass handrail system can be fabricated into finished sections by fabricating and joining together the pultruded square tube using molded and pultruded components epoxy bonded and connected as shown in the fabrication details. Where required by OSHA, fiberglass kickplate shall be attached to the handrail posts with nylon rivets. Handrail sections shall be fabricated to the size shown on the approved fabrication drawings and shall be piece marked with a waterproof tag.

INSTALLATION AND MOUNTING

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

Post locations must be no greater than 18", nor less than 9" from horizontal or vertical change in handrail direction. Posts are centered 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. Contact approved fabricator for detailed information on these connection types.

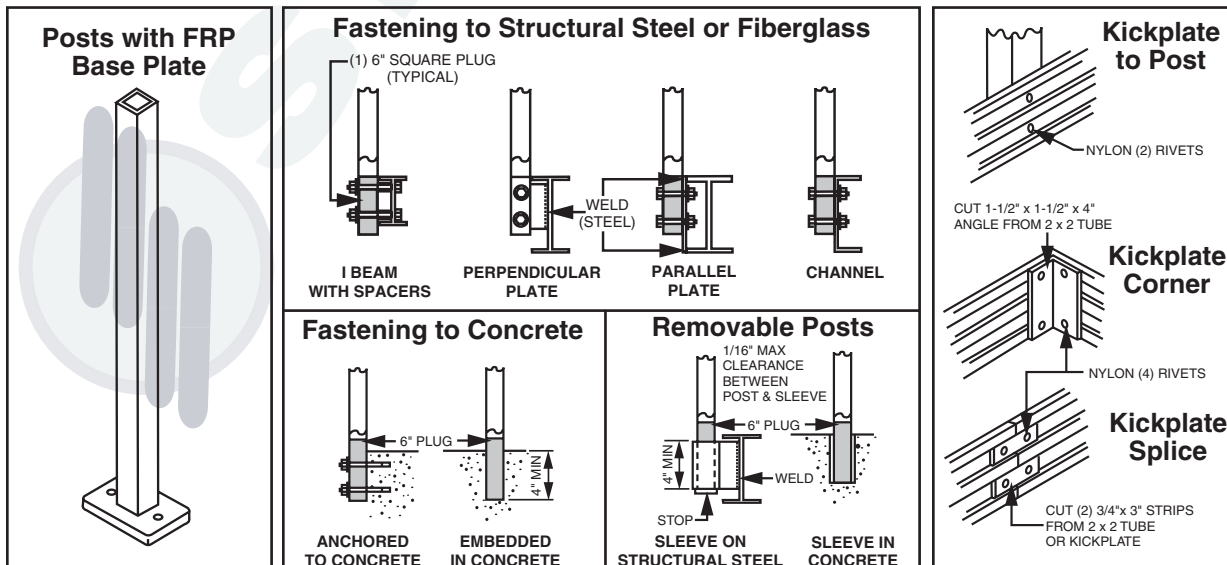
The fabricated handrail systems are supplied complete with fittings by Strongwell. The components used to join fabricated sections together may be shaped loose, to be epoxied and tension pinned together in the field by the contractor, per Strongwell's recommendations.

FABRICATION METHODS

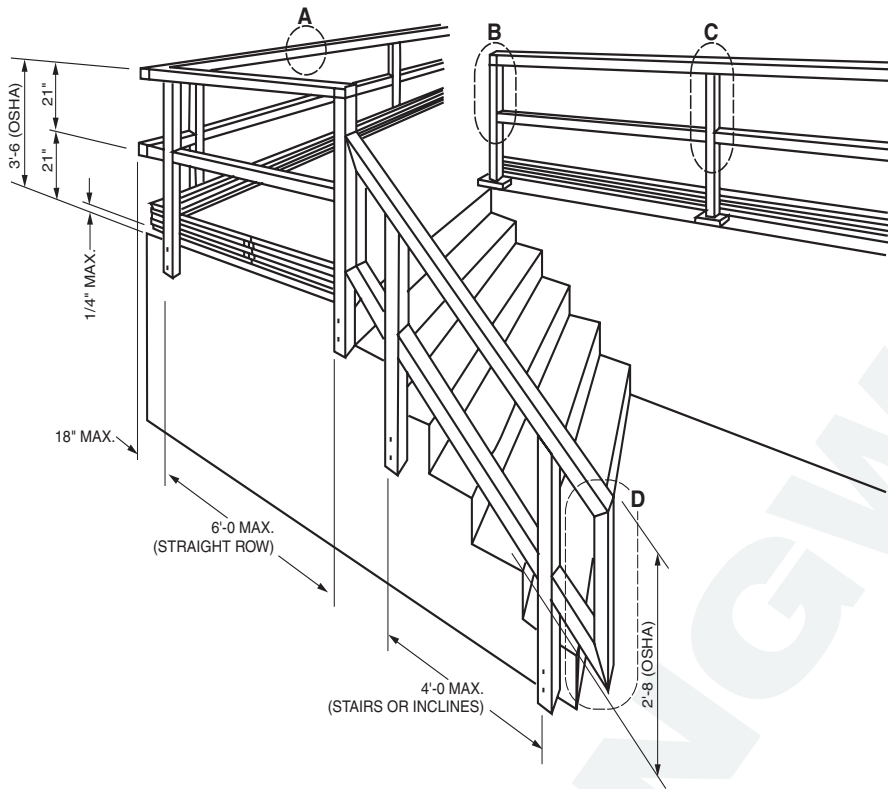
Cut components to length and miter where necessary. Locate and drill holes for split tube connector with a 1.68" diameter core drill. Apply recommended epoxy adhesive (available from Strongwell – Chatfield Division) to connectors and inside tube. Press sections together and wipe off excess adhesive. 1/8" tension pin is recommended at connections for field fabrication.

Joints must be immobilized until cured. The recommended temperature for epoxy cure is 60° F or above. Failure to use these installation and fabrication methods, including recommended epoxy adhesive and 1.68" diameter core drill, may cause failure.

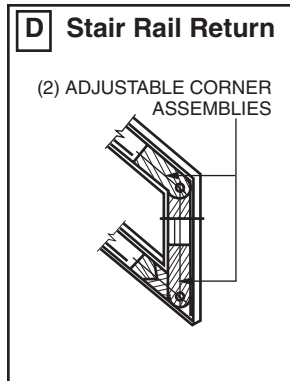
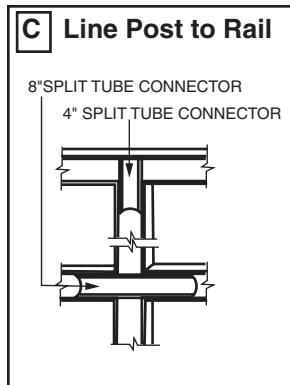
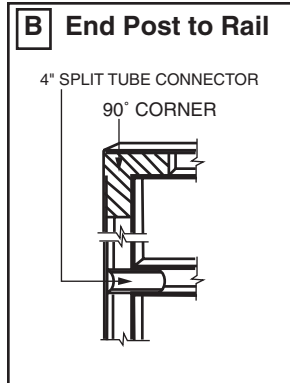
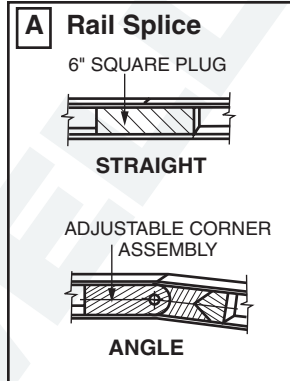
SUGGESTED POST AND KICK PLATE INSTALLATION



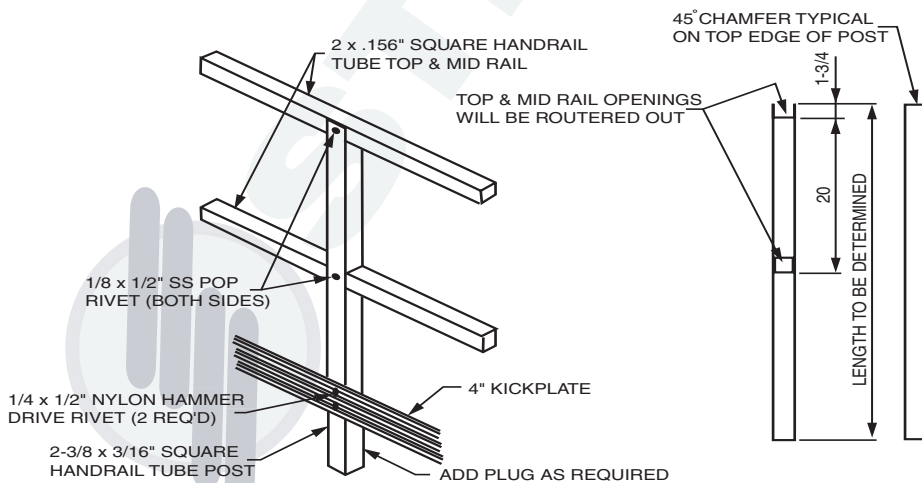
TYPICAL SAFRAIL™ SQUARE HANDRAIL CONSTRUCTION



Connection Details
All components secured with epoxy.



Alternative Post Design



SAFRAIL™ SQUARE HANDRAIL MECHANICAL PROPERTIES

**MINIMUM MECHANICAL PROPERTIES FOR
PULTRUDED SQUARE RAILS AND POSTS**

<i>Properties</i>	<i>Test Method</i>	<i>Values</i>
Tensile Stress	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2.5 x 10 ⁶ psi
Compressive Stress	ASTM D695	30,000 psi
Compressive Modulus	ASTM D695	2.5 x 10 ⁶ psi
Flexural Stress	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1.6 x 10 ⁶ psi
Shear Stress	ASTM D2344	4500 psi
Density	ASTM D792	.060-.070 lbs./in ³
24 Hr. Water Absorption	ASTM D570	0.6% max
Coef. Thermal Expansion	ASTM D696	4.4 x 10 ⁻⁶ in/in/°F (min.)
Flexural Stress	Full Section	36,000 psi (typical)
Flexural Modulus	Full Section	3.7 x 10 ⁶ psi (typical)



SAFRAIL™ ROUND HANDRAIL SYSTEM

INTRODUCTION

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.

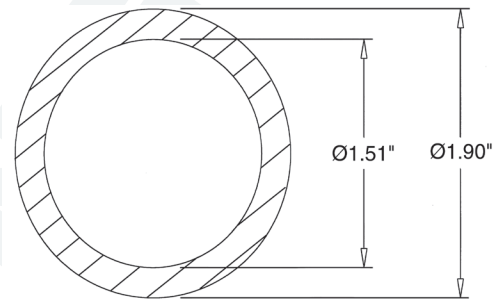
The handrail system meets OSHA strength requirements with a 2:1 factor of safety with a 5-foot maximum post spacing. The handrail system can be made to comply with ADA standards upon request.

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.

ROUND POST OR RAIL SECTION PROPERTIES

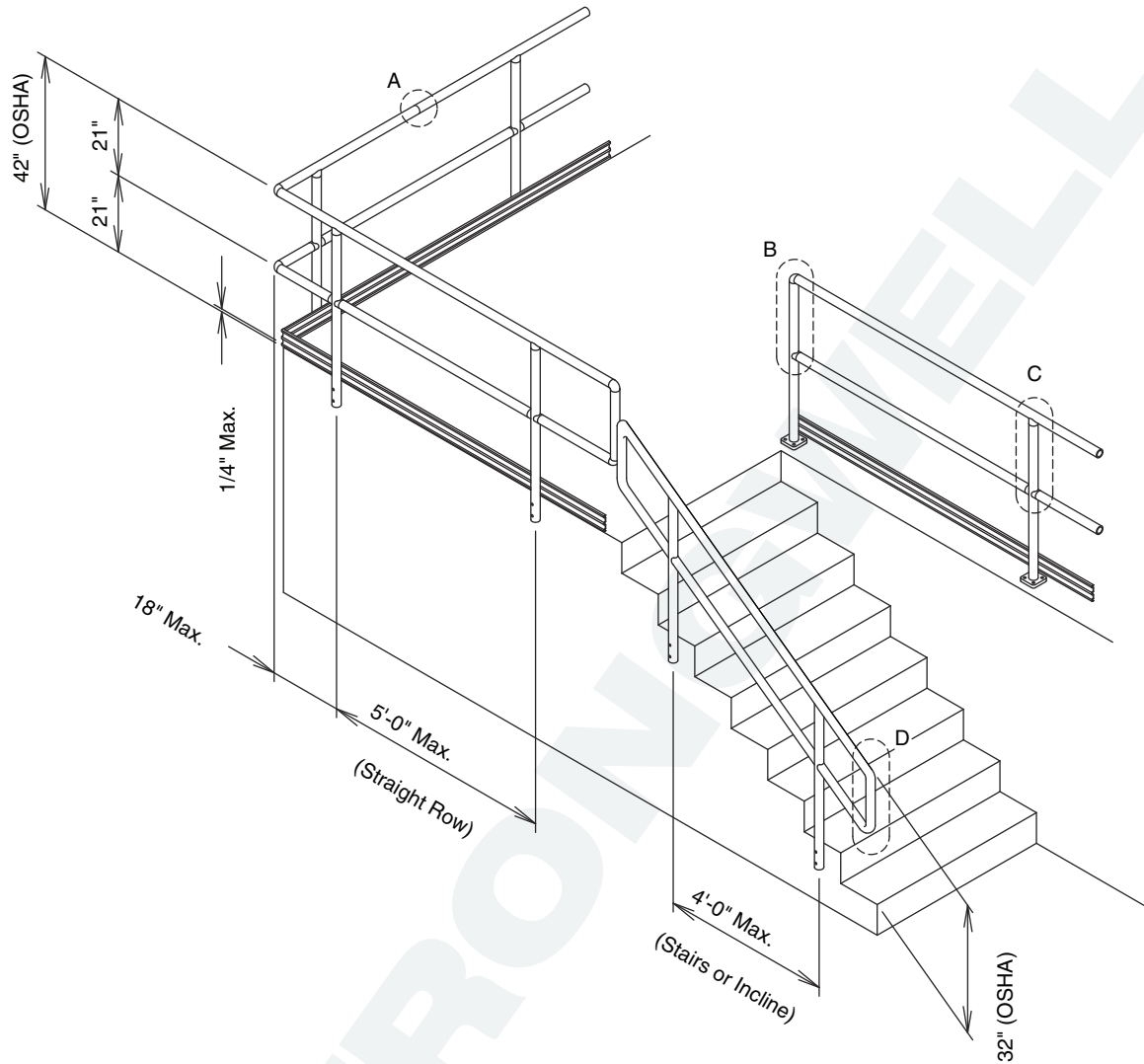
- A = 1.05 in.²
- S = .405 in.³
- I = .385 in.⁴
- E = 4.5 x 10⁶ psi
- WT = .86 lbs./lin. ft.
- where E = Flexural modulus full section



MINIMUM MECHANICAL PROPERTIES FOR PULTRUDED ROUND RAILS AND POSTS

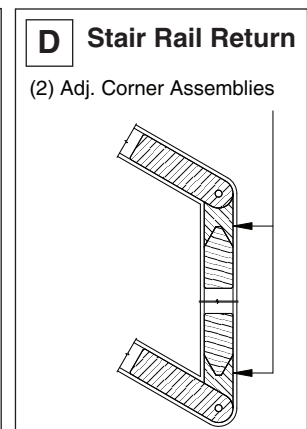
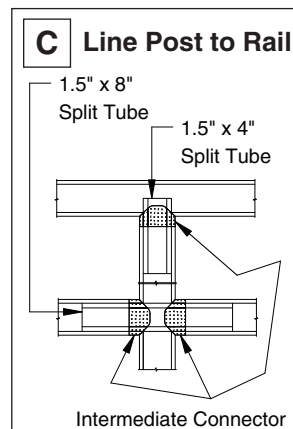
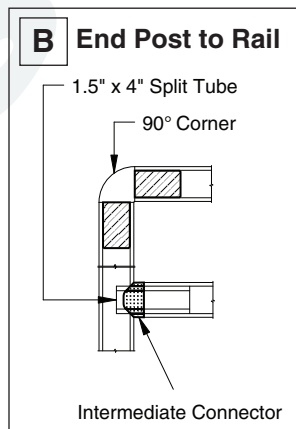
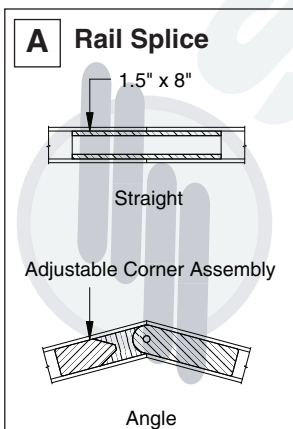
<i>Properties</i>	<i>Test Method</i>	<i>Values</i>
Tensile Stress	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2.5 x 10 ⁶ psi
Compressive Stress	ASTM D695	30,000 psi
Compressive Modulus	ASTM D695	2.5 x 10 ⁶ psi
Flexural Stress	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1.6 x 10 ⁶ psi
Shear Stress	ASTM D2344	4500 psi
Density	ASTM D792	.060-.070 lbs./in. ³
24 Hour Water Absorption	ASTM D570	0.6% max
Coefficient of Thermal Expansion	ASTM D696	4.4 x 10 ⁻⁶ in./in./°F (min.)
Flexural Stress	Full Section	60,000 psi (typical)
Flexural Modulus	Full Section	4.5 x 10 ⁶ psi (typical)

TYPICAL SAFRAIL™ ROUND HANDRAIL CONSTRUCTION



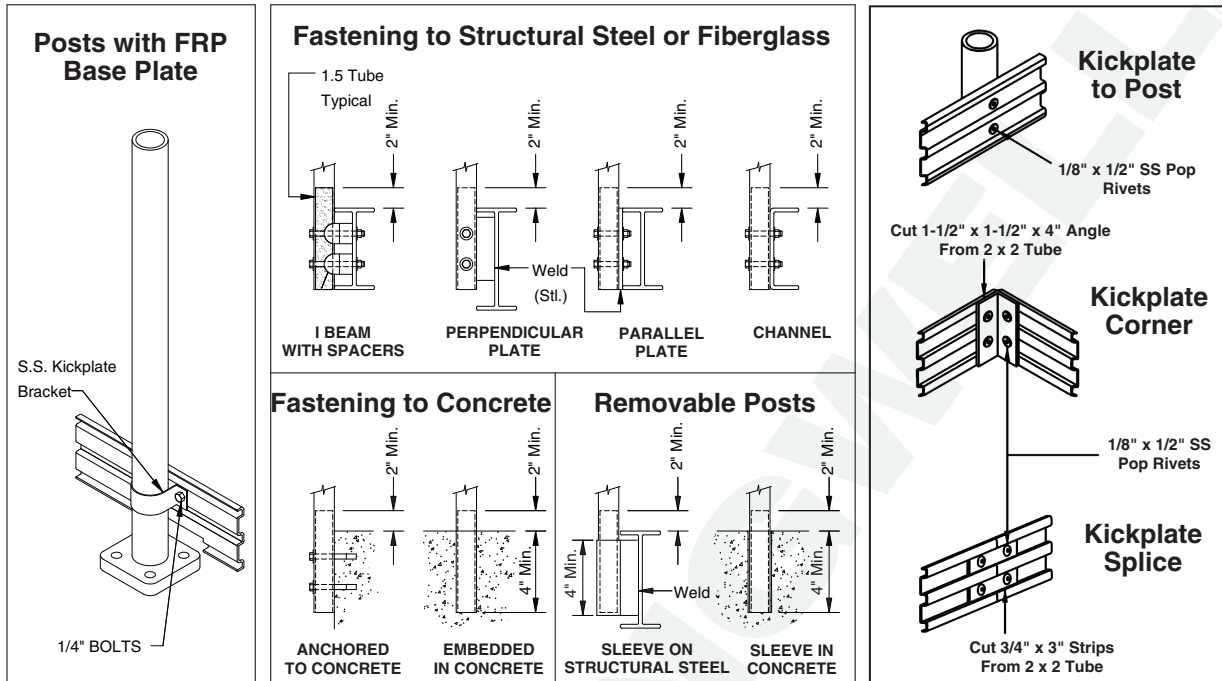
Connection Details

All components secured with epoxy.

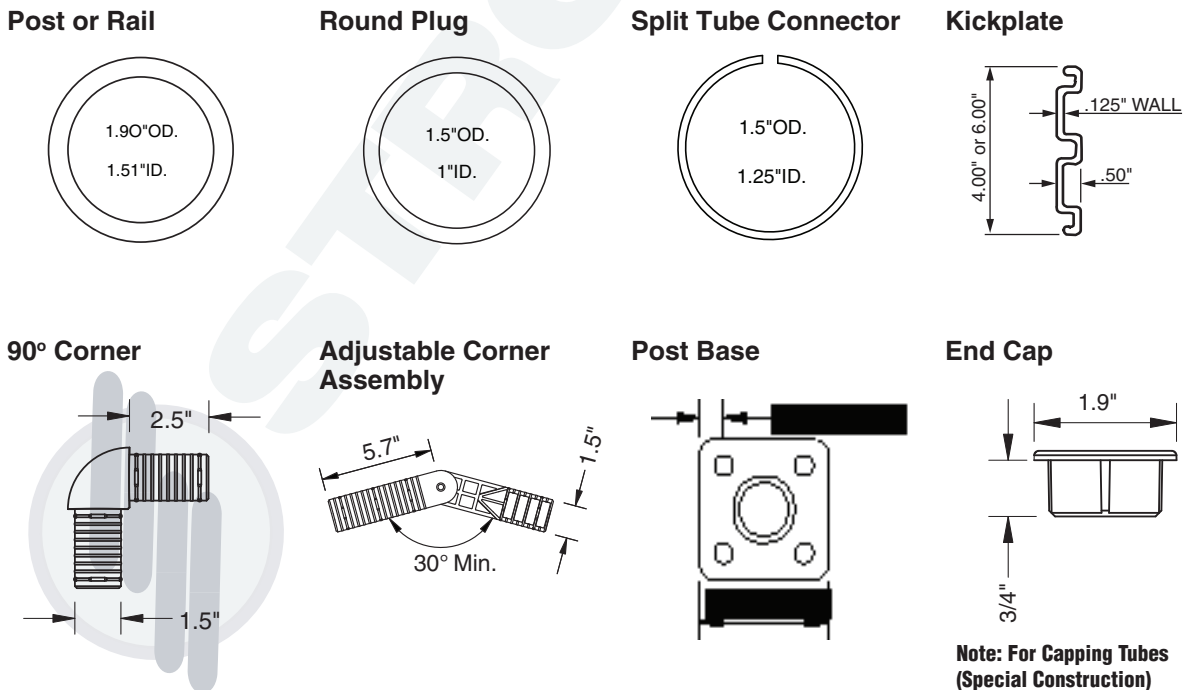


SAFRAIL™ ROUND HANDRAIL SYSTEM

SUGGESTED ROUND POST AND KICKPLATE INSTALLATION



ROUND HANDRAIL COMPONENTS



FIBERGLASS LADDERS & LADDER CAGES

INTRODUCTION TO SAFRAIL™ LADDERS AND LADDER CAGE SYSTEMS

SAFRAIL™ fiberglass ladders and ladder cages are fabricated from pultruded fiberglass components and produced by Strongwell. **SAFRAIL™** fiberglass ladders are constructed of side rails, rungs and cage straps produced by the pultrusion process and cage hoops produced by the open molded hand lay-up method.

SAFRAIL™ ladder and cage systems meet the requirements set forth in OSHA 1910.27.

The side rails and cage straps are fiberglass reinforced pultruded polyester with OSHA safety yellow pigment. An optional industrial grade polyurethane coating may be applied to the finished ladder and cage for outdoor application.

The side rails are 2" square tube with a wall thickness of .156" or greater. The rungs are 1.25" pultruded fluted round tube for a non-skid surface.

Cage hoops are produced 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 is interconnected with 2" x 3/16" pultruded straps spaced 9" on center around the hoop.

All cut or machined edges, holes and abrasions shall be sealed with a resin compatible with the resin matrix used in the structural shape.

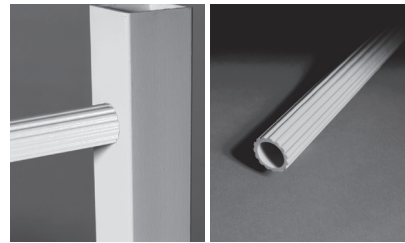
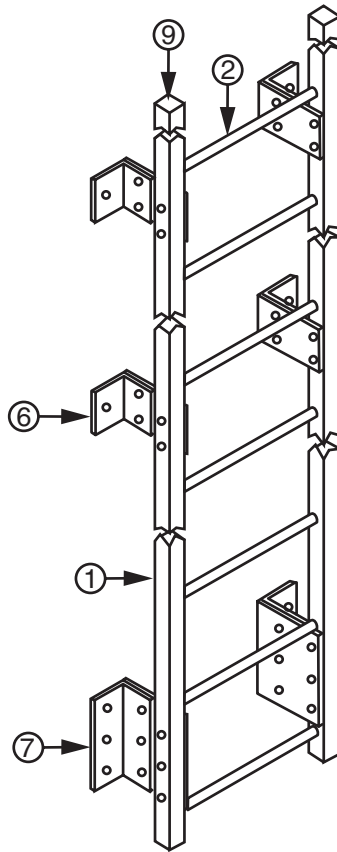
All joints and rungs are epoxied and riveted. The hoops are attached to the rails so that hand clearance is provided throughout the length of the ladder. The cages may be shipped as kits for field assembly.

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

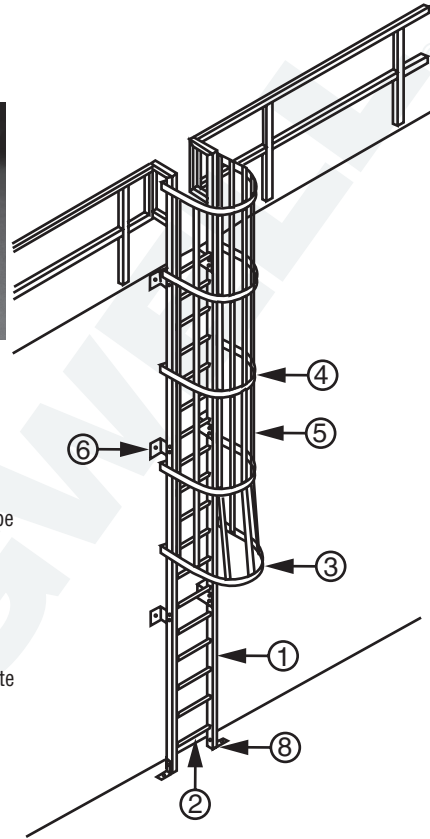


FIBERGLASS LADDERS & LADDER CAGES

Part Identification



Side Rail and Rung Detail



Name	Description
1 Side Rail	2" x .156" sq. tube
2 Rung	1.25" dia. fluted tube
3 Top or Bottom Hoop	3" x 1/4" strip
4 Intermediate Hoop	2" x 1/4" strip
5 Cage Straps	2" x 3/16" strip
6 Standoff Bracket	5" bracket plate
7 Standoff Bracket	10-1/2" bracket plate
8 Base Angle	3" angle
9 End Plug	Molded end cap

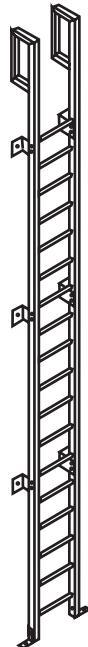
Ladder Options



Walk-Through Cage w/Return



Side Mount Cage



Walk-Through w/Return



Floor Mount



Wall Mount