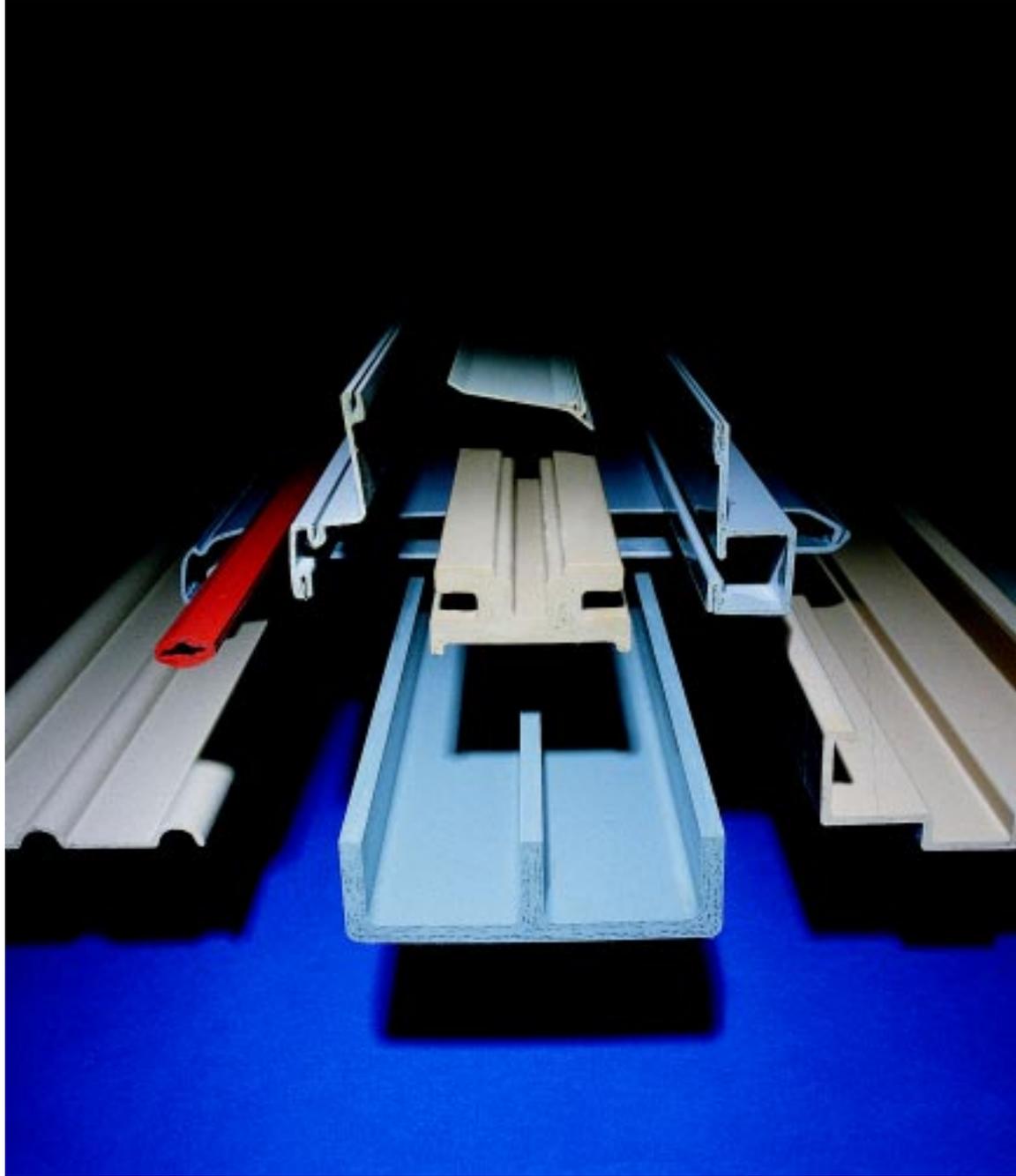


STRONGWELL

CUSTOM PULTRUSIONS

TECHNOLOGY • SOLUTIONS • CAPABILITIES



Technology

With over 50 pultrusion machines running from 1 to 40 lines per machine, Strongwell has unmatched production capability to manufacture custom pultruded parts. With the broadest range of pultrusion design and engineering expertise, Strongwell can offer more custom capabilities than anyone in the industry.

Other key capabilities include:

- Strong process engineering
- In-house structural design engineering
- CAD mechanical and structural detailing
- Equipment and machine shop for design and build of advanced pultrusion machinery, tooling and dies
- Laboratory for ASTM structural and electrical testing and active R&D programs
- Complete fabrication facilities to machine parts for custom applications

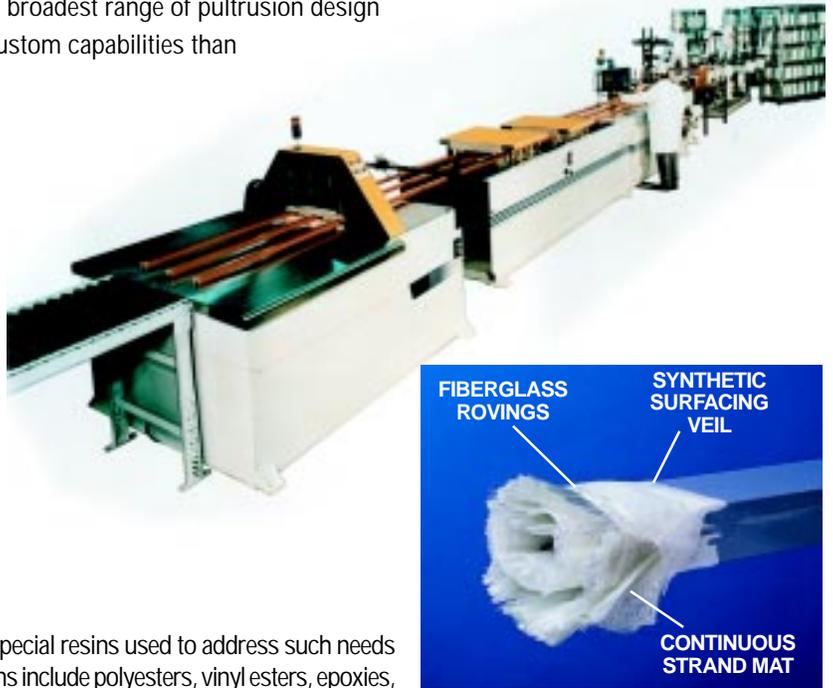
A pultruded product can be customized in one or more of the following ways to meet specific requirements:

Shape: Virtually any constant cross-section part can be pultruded.

Resin Matrix: Standard resin systems can be modified or special resins used to address such needs as elevated temperature or special environments. Typical resins include polyesters, vinyl esters, epoxies, phenolics and blends.

Reinforcements: The type, form, placement and quantity of reinforcements can be customized to maximize economy, develop oriented-strength, and create or enhance other physical characteristics. Typical reinforcements are glass or carbon fibers in multi-filament strands, mat (long fibers held together or Kevlar with a resinous binder), or stitched fabrics.

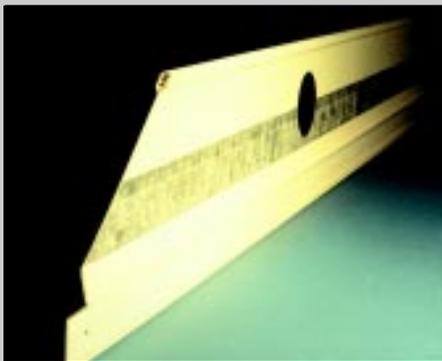
Composite Design: A standard shape could be made into a custom pultrusion by customizing the resin or reinforcement to achieve a particular customer need.



Typical fiberglass laminate

Market Snapshots

The applications shown across the bottom of these pages depict a few of the many custom pultrusion possibilities for a variety of markets.



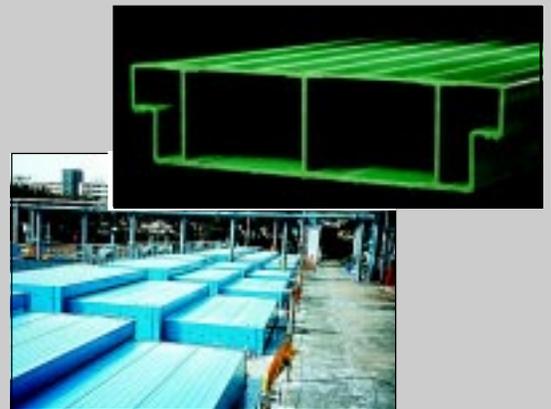
Petrochemical

A fiberglass coalescent grid, with a 5" wide graphite strip running the full length of the part is used to carry electric current in an electrostatic dehydrator operation at an oil refinery.



Architecture

Fiberglass spires and towers atop high rise buildings are transparent to electromagnetic waves and integrate housing for antennae with overall building design.



Wastewater

Designed to interlock by alternating top and bottom, these large pultruded profiles (20" wide x 5" high) nest together to form structural covers for wastewater treatment cells.

Solutions

Every day Strongwell is working to provide solutions to tough engineering and design challenges like the examples shown here. The unique properties possible with pultruded composite materials offer cost effective solutions. As engineers become aware of the features and benefits of pultrusion, the range of applications for composite materials continues to grow.



Fiberglass tool handles are long lasting, strong, corrosion resistant alternatives to wood or metal handles. These fiberglass handles will not absorb water and are twice as strong as government requirements. Fiberglass tool handles are now the preferred choice for many consumers.



A lightweight one-piece driveshaft of fiberglass/graphite pultruded over an aluminum tube, replaces conventional two-piece steel driveshafts on GM and Chrysler pick-up trucks and vans for fuel economy and better mileage. The composite of fiberglass, graphite and a special resin, reinforces the aluminum tube eliminating the need for center bearings. The one-piece driveshaft reduces assembly time, inventory costs, powertrain noise and vibration, and maintenance.

Electrically non-conductive fiberglass ladder rails provide long lasting, strong alternatives to wood, metal, or aluminum ladders.



Pulp and Paper

Fiberglass profiles topped with ceramic plates replaced polyethylene or stainless steel for felt blades or foils in paper manufacturing. The fiberglass/ceramic foil holds dimensional stability and is resistant to corrosion from the chemicals used for manufacturing and cleanup.



Automotive

Two fiberglass/vinyl ester beams support the fuel tank on Dodge Caravan and Plymouth Voyager Minivans to reduce weight and vibration.



Hotel/Motel

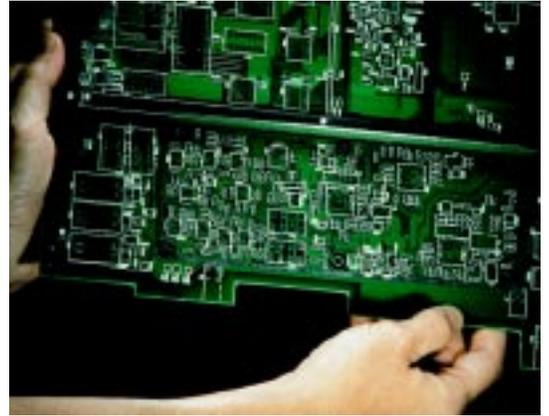
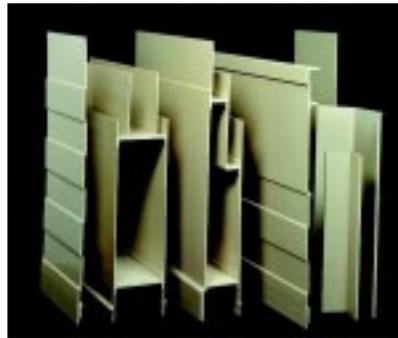
A fiberglass E-channel reduces maintenance for Red Roof Inns by encasing the exposed edge of concrete walkways on the second floor balconies. Corrosion resistant fiberglass handrail systems attach to the channel replacing badly corroded steel structures.

From Large to Small

Strongwell has the capability of producing custom pultrusions in a wide range of sizes from the very large cooling tower components shown here, to the small 1/4" square bars used for circuit board stiffeners.



Seven interlocking components form the structure of an all fiberglass cooling tower. A custom pultrusion machine (one of the largest in the world) was specially designed to pultrude the two largest components, hollow profiles nearly 4' wide and up to 10" deep.

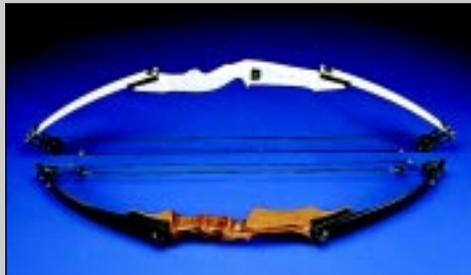


FRP circuit board stiffeners of 1/4" bars cut to length and custom machined have a proven track record in the satellite, computer and communications markets. Used to strengthen the board and lighten the load, fiberglass is non-conductive, corrosion resistant and dependable.



Transportation

Fiberglass railroad gate arms are pultruded in two sections and are fully telescopic. Light weight enough for one man installation, the gate arms are strong, weather resistant, and non-conductive to prevent short circuiting of overhead wires.



Sport/Recreation

Solid 1.83" wide x .62" thick x 18-1/2" long fiberglass bow limbs endure the high stresses of a pulley system. The pultruded blank is machined into the shape shown here.



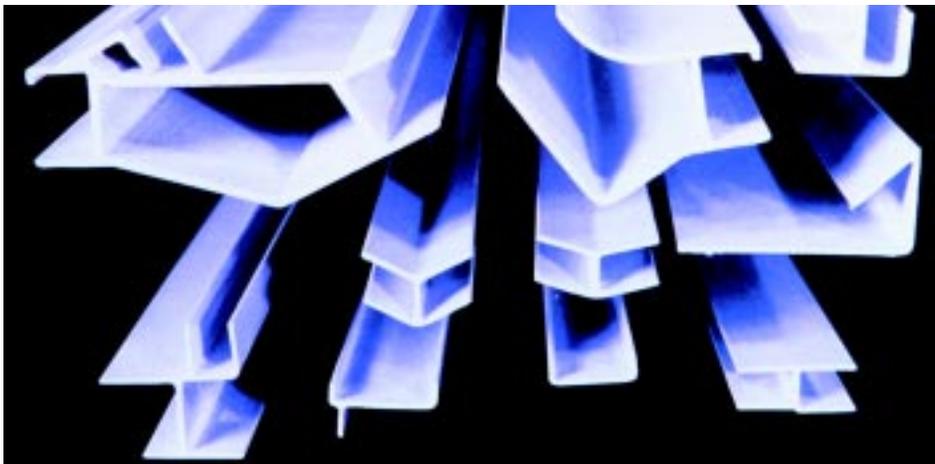
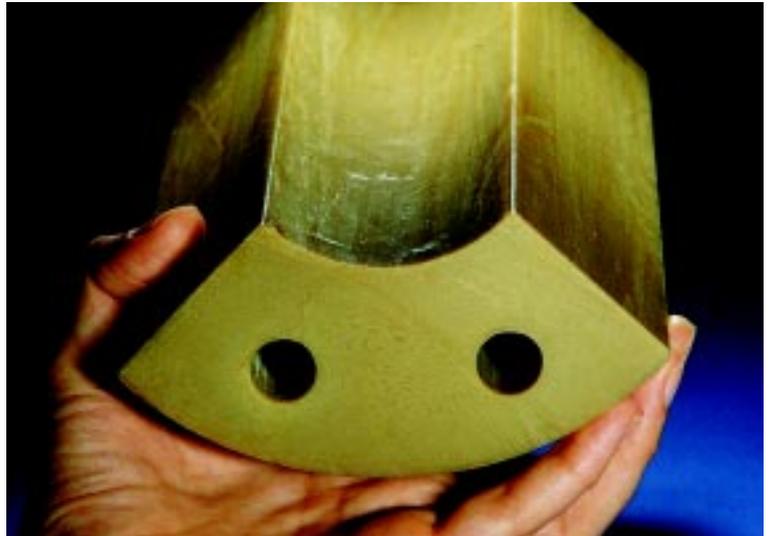
Manufacturing

Graphite conveyor bars used in printed circuit production systems endure temperatures up to 140°F and are resistant to corrosion from etching, developing and cleaning chemicals.

From Thick to Thin

A wide range of wall thicknesses in custom composites is made possible by Strongwell's pultrusion design and engineering expertise.

A 2" thick x 5" wide fiberglass/epoxy composite was required for the 33' long insulators used in an electromagnetic gun prototype.



Thin walled panel joiners and door framing for modular lavatories on commercial aircraft were .060" - .090" thick.



Electrical

Non-conductive fiberglass buss bar covers provide safety for electrically operated monorails in theme parks.



Appliances

Specially designed fiberglass door jamb houses anti-condensate heater circuits to insulate and save energy for commercial walk-in cooler/freezers.



Billboards

Fiberglass outdoor panel trim replaces metal and wood to eliminate weathering and maintenance problems. Attractive, durable and lightweight for easier installation, fiberglass trim can be produced in custom colors.

From Complex to Simple



Three highly complex pultruded profiles were developed for a communications shelter on the US Army's High Mobility Multi-purpose Wheeled Vehicle (HMMWV). Designed with special reinforcements and close dimensional tolerances, the custom profiles exhibited numerous production challenges.

Round tubes pultruded in a wide range of sizes and colors, demonstrate that simple shapes can be customized for a variety of markets. From large thin-walled tubes (11.2" diameter x .075" thick) to small .265" diameter tubes, a simple round shape can be modified by special resins, reinforcement materials, and pigments.



Custom Fabrication

Pultruded parts can be machined in a number of ways (routing, drilling, grinding, punching, etc.) for specialized parts and custom applications.



The pultruded tubes shown here are cut and ground to fit into an antenna monopole section as an electrical insulation splice.

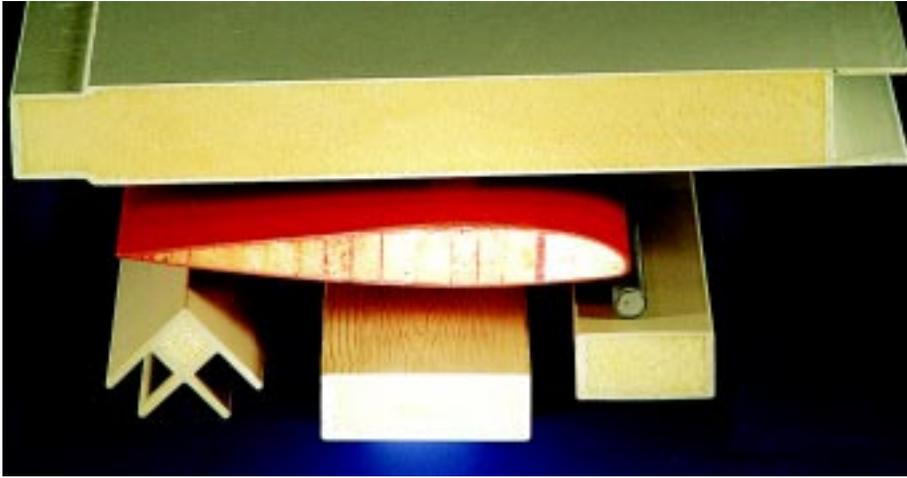


Custom electrical crossbars are pultruded with a high temperature epoxy resin, post cured, and cut to length. A multiple spindle drill maintains the tight hole tolerances required.



Specially designed plugging machines were developed by Strongwell to reinforce stress points for shovels and other tool handles.

More Custom Capabilities



Strongwell has extensive experience in pultruding over various core materials, including foam, balsa, polyethylene, and aluminum. In other applications, foam can be added after the part is pultruded.

Examples shown here include:

- *Tongue-and-groove building panels of fiberglass over polyurethane foam core*
- *Multi-cavity, foam filled fiberglass wind turbine blade*
- *Foam planks and corner posts of fiberglass reinforced polyester pultruded over foam core (one with special wood grain surface)*
- *Fiberglass stud with a vinyl ester core (special pultruded surface for threading provided)*

Carbon and graphite fibers offer higher modulus and higher strength than other reinforcing fibers. The advanced technology at Strongwell and experience in the technical difficulties of processing these materials, offers the customer unique advantages.

Precision arrows for target archers and bowhunters are .230" diameter carbon tubes pultruded with critical concentric tolerances.



Beams like these prototypes developed for government sponsored research and development programs, may be used in rebuilding the infrastructure.



By preprinting the surfacing veil, a pultruded part can be easily customized for market identification or specific product needs.



Strongwell is the leader in the research and development of pultruding with phenolic resins. A dramatic innovation for markets where fire safety is a major concern, DURAGRID® Phenolic Grating withstood temperatures over 1700° F for one hour during testing per USCG 46 CFR CH. 1.

Custom Pultrusion Checklist

In order to provide you with a quote for your particular inquiry, please copy the following form and fax or mail it to us. If you have questions about completing it, call us and we'll help.

Attention: <u>Strongwell Technical Sales Department</u>	Fax Number: <u>540-645-8132</u>
FROM	
Name: _____	Company: _____
Mailing Address: _____	
<p>1. Attach a sketch or drawing of part(s) cross-section. List length(s) required.</p> <p>2. Describe how the part is used:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>3. List the most critical features or properties required:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>4. Is the part new or currently manufactured in other material?</p> <p><input type="checkbox"/> New <input type="checkbox"/> Other Material</p> <p>If another material, why change?</p> <p>_____</p> <p>_____</p> <p>5. Part Requirements:</p> <p>Environment: <input type="checkbox"/> Indoors <input type="checkbox"/> Outdoors</p> <p>Chemical Exposure (list chemicals below):</p> <p>_____</p> <p>_____</p> <p>Chemical Concentration: _____</p> <p>_____</p>	<p>Exposure Level: <input type="checkbox"/> Spray <input type="checkbox"/> Splash <input type="checkbox"/> Fumes</p> <p>Temperature:</p> <p>Normal Operating Temperature: _____</p> <p>Temperature Range: _____</p> <p>Spikes/Excursion: _____</p> <p>Properties: <input type="checkbox"/> Fire Retardant <input type="checkbox"/> UV Inhibitor</p> <p>Resin: <input type="checkbox"/> Polyester <input type="checkbox"/> Vinyl Ester <input type="checkbox"/> Epoxy <input type="checkbox"/> Phenolic</p> <p>Color: <input type="checkbox"/> Ball Park <input type="checkbox"/> Color "Match" Required</p> <p>Tolerances: <input type="checkbox"/> Special <input type="checkbox"/> Standard</p> <p>Properties: <input type="checkbox"/> Standard <input type="checkbox"/> Compressive <input type="checkbox"/> Tensile</p> <p> <input type="checkbox"/> Flexural <input type="checkbox"/> Shear</p> <p>6. Secondary Work:</p> <p>Is any fabrication or assembly work required? If so, describe:</p> <p>_____</p> <p>_____</p> <p>Does part need to be painted? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Any special packaging? Explain below:</p> <p>_____</p> <p>_____</p> <p>7. Ordering Information:</p> <p>Anticipated initial order (in feet): _____</p> <p>Is this a one-time order? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If not a one-time order, what is annual volume? _____</p> <p>Please enter anticipated order or release quantity: _____</p> <p>Required initial delivery date: _____</p>



STRONGWELL

ISO-9001 Certified Manufacturing Plants

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