

LASTING SOLUTIONS  
for CHALLENGING  
CONDITIONS

composites  
**enduro**

# Tuff Span™ FRP Building Products

ROOFING & SIDING

INSULATED  
COMPOSITE PANELS

ROOF DECK

FORM DECK

PURLINS & GIRTS

STRUCTURAL  
SHAPES

LOUVERS

RIDGE VENTS

GUTTER

BUILDINGS





# Welcome to Enduro Composites

Tuff Span™ building products from Enduro provide a **total, corrosion-resistant, structural solution** including FRP building panels, beams, ventilation, and gutter systems. With its history of outstanding performance in the most challenging structural and environmental conditions, Tuff Span is the global leader for glass fiber reinforced plastic (FRP) building materials.

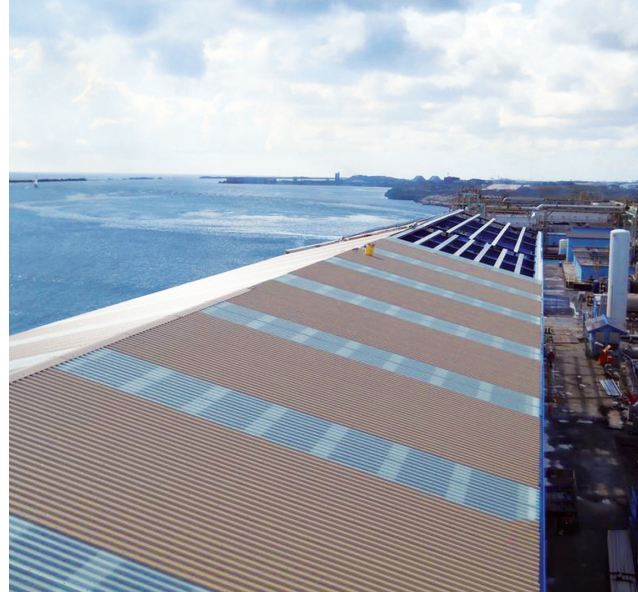
Within this guide, you will find information covering application, technical data, and uses for the FRP building products offered by Enduro.

To reach our product specialists for assistance, please call 800-231-7271, email us at [BPsales@EnduroComposites.com](mailto:BPsales@EnduroComposites.com), or visit our website: [EnduroComposites.com](http://EnduroComposites.com).

We, at Enduro, appreciate your interest in Tuff Span FRP building systems and look forward to serving you.

*Tuff Span opaque and translucent cladding, beams, louvers, and gutter at Desalination plant*

*Catalog Cover Photo: Tuff Span panels at cement plant designed by Industrial Architectural Alliance.*

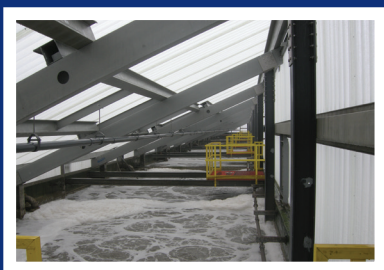


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*Tuff Span panels & beams at wastewater treatment plant*



*Tuff Span panels & beams at pulp and paper mill*



*Tuff Span panels at aluminum smelter*

# Reinforced Plastic Materials (FRP)

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## Corrosion Resistance

For superior protection in chemical, wet, or coastal environments, FRP material must include a premium resin system, either isophthalic polyester or vinyl ester. With good weathering properties, iso-polyester is recommended for most exterior applications and provides outstanding protection against caustics, acids, and continuous wet conditions. For higher temperature exposures, vinyl ester offers enhanced strength retention.

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## Structural Properties

With FRP materials, strength and stiffness is determined by the alignment and amount of its glass fiber reinforcements. FRP building panels with higher glass content in straight, bidirectional alignment, such as Tuff Span™, exhibit less panel deflection and provide better weather-tightness than alternative FRP materials.

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## UV Protection

For high-quality, long-term performance, FRP cladding panels must be properly protected against UV rays. It is recommended that users and specifiers require a UV stabilized resin system plus an exterior protective coating for FRP cladding.

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## Fire Retardance

Fire retardant, FRP materials have self-extinguishing, low flame spread properties. It is recommended (at minimum) that users require materials with Class I flame spread rating of 25 or less per ASTM E84. To comply with FM Global guidelines, materials having passed FM Corner Fire Test per Standard 4880 must be specified.

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## Non-conductivity RF Transparent

FRP materials provide an appealing, safe option for utilities and other high voltage conditions and are ideal to enclose radar, microwave, and communications equipment to reduce radio frequency interference.

## FACILITIES WITH TUFF SPAN FRP

ALUMINUM  
BATTERY RECYCLING  
CHEMICAL  
CEMENT  
COOLING TOWERS  
CORN PROCESSING  
DESALINATION

ELECTRONICS  
FERTILIZER  
FOOD & BEVERAGE  
GALVANIZING/  
PLATING  
LITHIUM  
PROCESSING  
METAL PROCESSING

MARINE/PORT  
FACILITIES  
MINING  
MILITARY  
NATATORIUMS  
PULP & PAPER  
POWER

RADIO FREQUENCY  
TRANSPARENT  
RENDERING  
SALT  
SOLVENT  
EXTRACTION/  
ELECTROWINNING  
WASTE TREATMENT

# Tuff Span FRP Roofing & Siding Panels

## Outstanding Corrosion Resistance, Strength & UV Protection

For demanding structural and environmental applications, Tuff Span™ FRP building panels from Enduro deliver unsurpassed performance as industrial roofing and siding. With its unique combination of corrosion resistance, high strength, and UV protection, Tuff Span is the optimum building panel worldwide for challenging, tough conditions.

### STRUCTURAL PERFORMANCE

Tuff Span has the highest strength and stiffness of any profiled FRP building panel and history of standing up to hurricane winds where aged metal, cementitious, and other materials have failed. The Tuff Span material includes higher content (up to 50% of its weight) of reinforcing fibers that are strategically placed in straight and continuous, bidirectional alignment to optimize load transfer and reaction. Designers can use the same structural criteria for Tuff Span as they would specify for high-strength steel.

### ROOFING PANELS SAFE FOR FOOT TRAFFIC

As the industry standard for walkable, fiberglass panels, Tuff Span Series 450 provides the strongest support for foot traffic of any fiberglass building panel designed for profiled roofing. The material's strength and stiffness offers installers and maintenance workers greater confidence and safer support when compared to other fiberglass roofing. This benefit is available for higher strength Tuff Span panels in specific profiles and Series classifications per Enduro's guidelines. Please see the Load/Span Tables in this guide and contact Enduro for assistance.

### LONG SERVICE LIFE

Huge life-cycle cost savings and long-term aesthetics are provided by a combination of outstanding corrosion resistance, high strength, and a 4-Level UV Protection System, which includes an exterior acrylic coating, UV stabilized resin, embossed resin-rich surface, and interior mat or veil.

### OPAQUE & TRANSLUCENT COLOR OPTIONS

Tuff Span panels are available in a number of standard opaque colors. Tuff Span panel color is integral throughout the material and will not rust, flake off, or peel. For slightly added cost and minimum quantity requirements, custom colors are easily developed to match existing materials or color schemes.

Tuff Span panels are also available in translucent colors. These materials provide natural and soft, diffused lighting that dramatically enhances workplace environments while reducing utility bills.



Tuff Span Roofing, Siding, and Purlins at metal treatment plant

## USES

ROOFING & SIDING PANELS

WALL & CEILING LINER

INSULATED PANEL ASSEMBLY

COOLING TOWER CASING

TANK COVERS & JACKETING

## FEATURES

CORROSION RESISTANCE

STRONGEST FRP BUILDING PANEL

4-LEVEL UV PROTECTION

FIRE RETARDANT

OPAQUE OR TRANSLUCENT COLORS

## BENEFITS

LIFE-CYCLE COST SAVINGS

MAINTENANCE-FREE LIFE

LIGHT TRANSMISSION OPTION

WALKABLE ROOF OPTION

IMPROVED FACILITY APPEARANCE



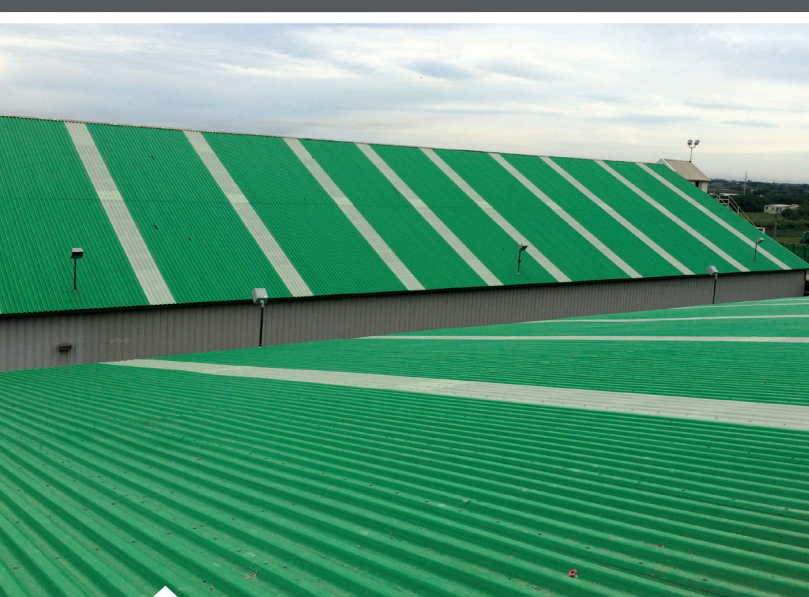


Tuff Span translucent roofing & siding at phosphate storage facility.



Roofing & Siding

At Waste to Energy facility, Tuff Span roofing and siding (on end wall) were undamaged by Hurricane Charlie's 145 mph winds. Corroded metal panels (on side wall) were damaged or blew off.



Tuff Span opaque & translucent cladding at fertilizer blending facility.



Tuff Span FM siding on 130 foot tall recovery boiler at coastal location



Tuff Span roof deck installation at chemical plant



Tuff Span louvers, translucent roofing & siding at USA military base.



# Tuff Span FRP Roofing & Siding Panels

## Properties & Certifications

The information on this page is a partial list of product descriptions and certifications. For more information and certifications, please contact Enduro. Enduro is ISO 9001:2015 Certified.



ISO 9001:2015  
CERTIFIED



Materials	PFR / VFR						FM		
	150	200	250	300	400	450	10	13	16
Nominal Weight, Oz/SF	8	9.5	10.5	12	14	16	10.5	13.5	16.5
Nominal Weight, Grams/M2	2440	2900	3200	3660	4270	4880	3200	4120	5035
Nominal Glass Content	48% by wt.						33% by wt.		
R-Value	0.07 based on generic thermoset resins								

Standard Colors	Light Transmission	Notes
Gray, White, Beige, Shale, Stone White-R	Opaque	
Translucent Clear	Up to 80%	CC1 - FR materials Light transmission varies with thickness, color, and profile.
Translucent White	Up to 45%	
Translucent Gray, Beige, Shale, Stone White-R	Contact Enduro	
Translucent Pearl (Off White)	Up to 27%	FM Approved

Contact us for additional opaque and translucent colors.

Fire and Smoke	FM	PFR / VFR	
	10, 13, 16	Series 150, 200, 250, 300	400, 450
Smoke Development, ASTM E-84	< 300	< 450	> 450 (all VFR)
Flame Spread Rating, ASTM E-84	Class 1: 15 or less	UL Class 1: 25 or less	
Fire Test for Roof Coverings, ASTM E-108	Class A: 3/12 max slope	Class C: 3/12 max slope	
Rate and Extent of Burning, ASTM D-635	N/A	CC1: ATB<5, AFB 10 mm	
FM Approvals Standard 4880, Corner Fire Test	FM approval without sprinkler requirements or height limits		
Fire Test of Exterior Wall Assemblies, ULC-S134	FM 10/13 wall assembly meets Section 3.1.5.5 of NBC 2010		

PFR = Iso-Polyester Fire Retardant; VFR = Vinyl Ester Fire Retardant; FM = FM Approved Iso-Polyester

Wind Uplift	Series	Class	Span	Notes
4.2 x 1.06	FM 13, 16	FM I-60	5'6"	0.729" washer
7.2 x 1.5, 7.0 x 1.5, 7.2D x 1.75	FM 10, 13, 16	FM I-90	5'6"	1.125" washer
7.2 x 1.5, 7.0 x 1.5, 7.2D x 1.75	FM 13, 16	FM I-90	6'8"	1.125" washer
6.5 x 2 Roof Deck	VFR 500	UL Class 90	6'3"	UL Construction No. NM523
8.0 x 3.5 Roof Deck	VFR 700	UL Class 90	8'0"	UL Construction No. NM524
12 x 1.25R	LC2-150	UL Class 90	5'0"	UL Construction No. 580

Other Certifications	Material	Notes
FM Standard 4881 - Exterior Wall Systems	FM 10, 13, 16	Approvals for 19 profiles
Roof Diaphragm Loading, ASTM C455	PFR 300, 250	Contact Enduro for diaphragm values
Coefficient of Thermal Expansion, ASTM D-696	Tuff Span Panels	Coefficient = $8 \times 10^{-6}$ in/in°F
Florida Building Code	LC2-150	FL25568, FL25569
Florida Building Code	PFR-250	FL32006, FL32007
Texas (TDI) Windstorm	LC2-150	Translucent Wall & Roof Assembly
Solar Reflectance, ASTM C 1549	FM Opaque White	Average Reflectance = .750, SRI = .923
Thermal Emittance, ASTM C 1371	FM Opaque White	Average Emittance = .890
Solar Reflectance, ASTM C 1549	PFR 300, Translucent White	Average Reflectance = .449
Thermal Emittance, ASTM C 1371	PFR 300, Translucent White	Average Emittance = .905

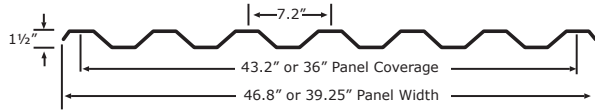




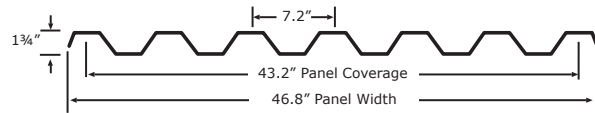
# Tuff Span FRP Roofing & Siding Panels

## STANDARD PROFILES

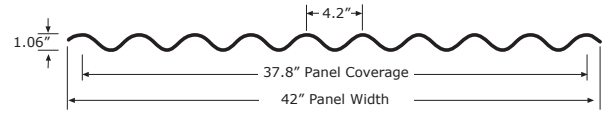
**7.2 x 1.5** page 8



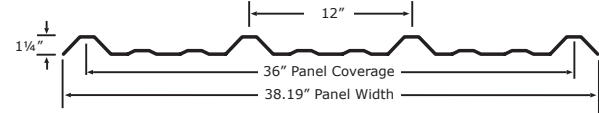
**7.2D x 1.75** page 10



**4.2 x 1.06** page 9

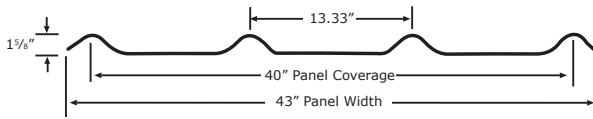


**12 x 1.25R** page 11

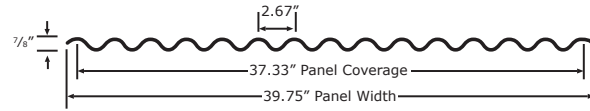


## ADDITIONAL PROFILES

**Trafford Tile** page 12

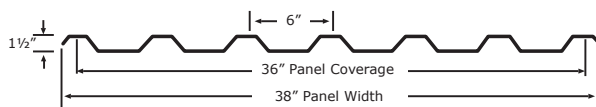


**2.67 x 7/8** page 14

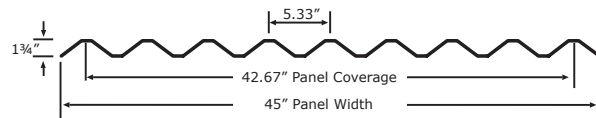


Additional widths are available.

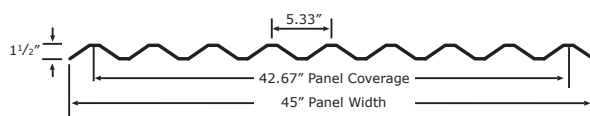
**6.0 x 1.5** page 16



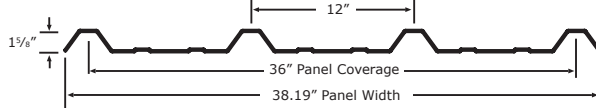
**5.33 x 1.75V** see note



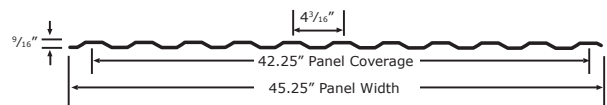
**5.33 x 1.5V** see note



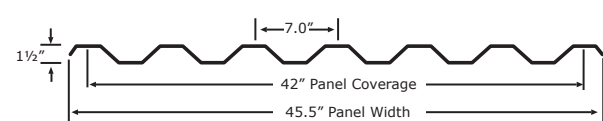
**12 x 1.62R** see note



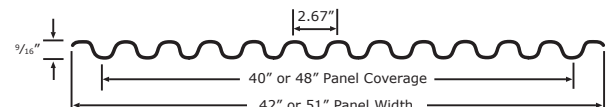
**4.1 x 9/16** page 13



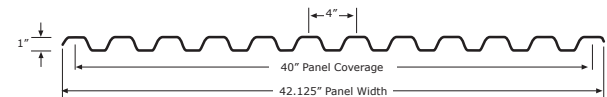
**7.0 x 1.5** page 15



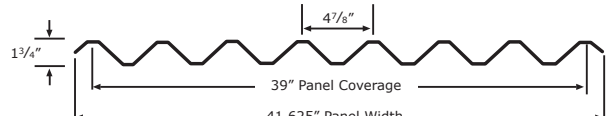
**2 1/2 x 1 1/2** page 17



**4.0 x 1** see note



**4.875 x 1.75V** see note



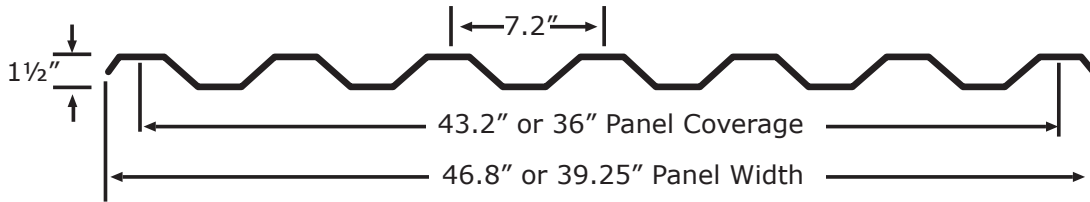
**Flat Sheet** see note



**NOTE** Please contact us for additional profiles and load/span data for 5.33 x 1.5V, 5.33 x 1.75V, 12 x 1.62R, 4.0 x 1, 4.875 x 1.75V, and Flat Sheet panels.

# Tuff Span FRP Roofing & Siding Panels

## 7.2 x 1.5



Personnel Load	Span	Defl @ 300 Lb. Load over 2.5 Ft. <sup>2</sup> Area
Tuff Span Series 450	7'6"	L/180 not to exceed 0.5"
Tuff Span Series 400	6'0"	

With its high strength and stiffness, Tuff Span can provide safe support for normal installation and worker foot traffic with observance of standard, OSHA safety measures. The user is responsible for worker safety including requirements for harnesses, tie-off lines, and safety shoes in addition to suitability of aged materials, slippery or sloped roofs. Single span conditions are not recommended for foot traffic.

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF	Span	20			30			40			50			60		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 11"	10' 7"	9' 9"	6' 11"	9' 3"	8' 6"	6' 3"	8' 5"	7' 9"	5' 10"	7' 9"	7' 2"	5' 6"	7' 1"	6' 9"
	FR 400	7' 7"	10' 2"	9' 4"	6' 7"	8' 11"	8' 2"	6' 0"	8' 0"	7' 5"	5' 7"	7' 2"	6' 11"	5' 3"	6' 6"	6' 6"
	FR 300	7' 0"	9' 4"	8' 8"	6' 1"	7' 7"	7' 7"	5' 7"	6' 7"	6' 10"	5' 2"	5' 10"	6' 5"	4' 10"	5' 4"	6' 0"
	FR 250	6' 5"	7' 10"	7' 11"	5' 7"	6' 5"	6' 11"	5' 1"	5' 6"	6' 2"	4' 8"	4' 11"	5' 6"	4' 5"	4' 6"	5' 1"
	FR 200	5' 10"	7' 3"	7' 3"	5' 1"	5' 11"	6' 4"	4' 8"	5' 1"	5' 8"	4' 4"	4' 7"	5' 1"	4' 1"	4' 2"	4' 8"
	FR 150	5' 5"	5' 11"	6' 7"	4' 8"	4' 10"	5' 5"	4' 2"	4' 2"	4' 8"	3' 9"	3' 9"	4' 2"	3' 5"	3' 5"	3' 10"
	FM 16	7' 2"	9' 8"	8' 11"	6' 3"	8' 5"	7' 9"	5' 8"	7' 8"	7' 0"	5' 3"	7' 1"	6' 6"	5' 0"	6' 6"	6' 2"
	FM 13	6' 8"	8' 6"	8' 3"	5' 10"	6' 11"	7' 2"	5' 3"	6' 0"	6' 6"	4' 11"	5' 4"	6' 0"	4' 7"	4' 11"	5' 6"
	FM 10	6' 1"	7' 3"	7' 6"	5' 4"	5' 11"	6' 7"	4' 10"	5' 1"	5' 8"	4' 6"	4' 7"	5' 1"	4' 2"	4' 2"	4' 8"

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF	Span	20			30			40			50			60		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 11"	10' 7"	9' 9"	6' 11"	9' 3"	8' 6"	6' 3"	8' 5"	7' 9"	5' 10"	7' 10"	7' 2"	5' 6"	7' 4"	6' 9"
	FR 400	7' 7"	10' 2"	9' 4"	6' 7"	8' 10"	8' 2"	6' 0"	8' 1"	7' 5"	5' 7"	7' 6"	6' 11"	5' 3"	6' 7"	6' 6"
	FR 300	7' 0"	9' 5"	8' 8"	6' 1"	8' 3"	7' 7"	5' 7"	7' 5"	6' 10"	5' 2"	6' 8"	6' 5"	4' 10"	5' 7"	6' 0"
	FR 250	6' 5"	8' 7"	7' 11"	5' 7"	7' 4"	6' 11"	5' 1"	6' 5"	6' 3"	4' 8"	5' 8"	5' 10"	4' 5"	4' 8"	5' 4"
	FR 200	5' 10"	7' 10"	7' 3"	5' 1"	6' 9"	6' 4"	4' 8"	5' 10"	5' 9"	4' 4"	4' 8"	5' 3"	4' 1"	3' 10"	4' 5"
	FR 150	5' 5"	6' 10"	6' 8"	4' 8"	5' 7"	5' 10"	4' 3"	4' 10"	5' 3"	3' 11"	4' 1"	4' 8"	3' 9"	3' 5"	3' 10"
	FM 16	7' 2"	9' 8"	8' 11"	6' 3"	8' 5"	7' 9"	5' 8"	7' 8"	7' 0"	5' 3"	7' 1"	6' 6"	5' 0"	5' 10"	6' 2"
	FM 13	6' 8"	8' 11"	8' 3"	5' 10"	7' 9"	7' 2"	5' 3"	6' 11"	6' 6"	4' 11"	5' 11"	6' 1"	4' 7"	4' 11"	5' 7"
	FM 10	6' 1"	8' 2"	7' 6"	5' 4"	6' 9"	6' 7"	4' 10"	5' 11"	6' 0"	4' 6"	5' 1"	5' 6"	4' 2"	4' 3"	4' 10"

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF	Span	20			30			40			50			60		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	10' 0"	13' 4"	12' 4"	8' 8"	11' 6"	10' 9"	7' 11"	10' 0"	9' 9"	7' 4"	8' 11"	9' 1"	6' 11"	7' 9"	8' 6"
	FR 400	9' 7"	12' 10"	11' 10"	8' 4"	10' 8"	10' 4"	7' 7"	9' 3"	9' 4"	7' 0"	7' 11"	8' 8"	6' 7"	6' 7"	7' 6"
	FR 300	8' 10"	10' 9"	10' 11"	7' 9"	8' 9"	9' 7"	7' 0"	7' 7"	8' 6"	6' 6"	6' 8"	7' 7"	6' 1"	5' 7"	6' 4"
	FR 250	8' 1"	9' 0"	10' 0"	7' 1"	7' 4"	8' 3"	6' 5"	6' 5"	7' 2"	5' 8"	5' 8"	6' 5"	5' 2"	4' 8"	5' 4"
	FR 200	7' 5"	8' 4"	9' 2"	6' 5"	6' 9"	7' 7"	5' 10"	5' 10"	6' 7"	5' 3"	4' 8"	5' 3"	4' 9"	3' 10"	4' 5"
	FR 150	6' 9"	6' 10"	7' 8"	5' 7"	5' 7"	6' 3"	4' 10"	4' 10"	5' 5"	4' 4"	4' 1"	4' 8"	3' 11"	3' 5"	3' 10"
	FM 16	9' 1"	12' 2"	11' 2"	7' 11"	10' 7"	9' 9"	7' 2"	8' 10"	8' 11"	6' 8"	7' 1"	8' 0"	6' 3"	5' 10"	6' 8"
	FM 13	8' 5"	9' 9"	10' 4"	7' 4"	8' 0"	8' 11"	6' 8"	6' 11"	7' 9"	6' 2"	5' 11"	6' 9"	5' 8"	4' 11"	5' 7"
	FM 10	7' 8"	8' 4"	9' 4"	6' 8"	6' 9"	7' 7"	5' 11"	5' 11"	6' 7"	5' 3"	5' 1"	5' 9"	4' 9"	4' 3"	4' 10"

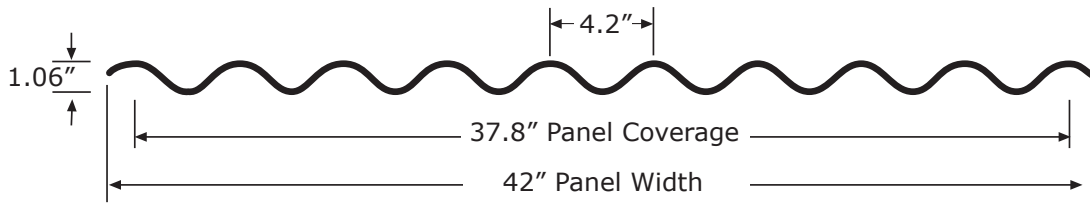
Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 7.2" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.





# Tuff Span FRP Roofing & Siding Panels

## 4.2 x 1.06



Personnel Load	Span	Defl @ 300 Lb. Load over 2.5 Ft. <sup>2</sup> Area
Tuff Span Series 450	6'0"	L/150 not to exceed 0.5"
Tuff Span Series 400	5'6"	

With its high strength and stiffness, Tuff Span can provide safe support for normal installation and worker foot traffic with observance of standard, OSHA safety measures. The user is responsible for worker safety including requirements for harnesses, tie-off lines, and safety shoes in addition to suitability of aged materials, slippery or sloped roofs. Single span conditions are not recommended for foot traffic.

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 3"	8' 5"	7' 9"	5' 6"	7' 4"	6' 9"	5' 0"	6' 8"	6' 2"	4' 7"	6' 2"	5' 9"	4' 4"	5' 10"	5' 5"
	FR 400	6' 1"	8' 2"	7' 7"	5' 4"	7' 2"	6' 7"	4' 10"	6' 6"	6' 0"	4' 6"	6' 0"	5' 7"	4' 3"	5' 8"	5' 3"
	FR 300	5' 5"	7' 3"	6' 8"	4' 8"	6' 4"	5' 10"	4' 3"	5' 9"	5' 3"	3' 11"	5' 4"	4' 11"	3' 9"	5' 0"	4' 7"
	FR 250	5' 2"	7' 0"	6' 5"	4' 6"	6' 1"	5' 7"	4' 1"	5' 6"	5' 1"	3' 10"	5' 1"	4' 9"	3' 7"	4' 8"	4' 5"
	FR 200	4' 8"	6' 4"	5' 10"	4' 1"	5' 6"	5' 1"	3' 9"	5' 0"	4' 7"	3' 5"	4' 8"	4' 3"	3' 3"	4' 4"	4' 0"
	FR 150	4' 5"	5' 11"	5' 5"	3' 10"	5' 2"	4' 9"	3' 6"	4' 8"	4' 4"	3' 3"	4' 3"	4' 0"	3' 1"	3' 11"	3' 9"
	FM 16	5' 6"	7' 4"	6' 9"	4' 9"	6' 5"	5' 11"	4' 4"	5' 10"	5' 4"	4' 0"	5' 5"	5' 0"	3' 9"	5' 1"	4' 8"
	FM 13	5' 0"	6' 9"	6' 2"	4' 4"	5' 10"	5' 5"	3' 11"	5' 4"	4' 11"	3' 8"	4' 11"	4' 7"	3' 5"	4' 8"	4' 3"
	FM 10	4' 6"	6' 1"	5' 7"	3' 11"	5' 4"	4' 11"	3' 7"	4' 10"	4' 5"	3' 4"	4' 5"	4' 1"	3' 1"	4' 2"	3' 10"

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 3"	8' 5"	7' 9"	5' 6"	7' 4"	6' 9"	5' 0"	6' 8"	6' 2"	4' 7"	6' 2"	5' 9"	4' 4"	5' 10"	5' 5"
	FR 400	6' 1"	8' 2"	7' 7"	5' 4"	7' 2"	6' 7"	4' 10"	6' 6"	6' 0"	4' 6"	6' 0"	5' 7"	4' 3"	5' 8"	5' 3"
	FR 300	5' 5"	7' 3"	6' 8"	4' 8"	6' 4"	5' 10"	4' 3"	5' 9"	5' 3"	3' 11"	5' 4"	4' 11"	3' 9"	5' 0"	4' 7"
	FR 250	5' 2"	6' 11"	6' 5"	4' 6"	6' 1"	5' 7"	4' 1"	5' 6"	5' 1"	3' 10"	5' 1"	4' 9"	3' 7"	4' 6"	4' 5"
	FR 200	4' 8"	6' 4"	5' 10"	4' 1"	5' 6"	5' 1"	3' 9"	5' 0"	4' 7"	3' 5"	4' 8"	4' 3"	3' 3"	4' 4"	4' 0"
	FR 150	4' 5"	5' 11"	5' 5"	3' 10"	5' 2"	4' 9"	3' 6"	4' 8"	4' 4"	3' 3"	4' 4"	4' 0"	3' 1"	4' 0"	3' 9"
	FM 16	5' 5"	7' 4"	6' 9"	4' 9"	6' 5"	5' 11"	4' 4"	5' 10"	5' 4"	4' 0"	5' 5"	5' 0"	3' 9"	5' 1"	4' 8"
	FM 13	5' 0"	6' 9"	6' 2"	4' 4"	5' 10"	5' 5"	3' 11"	5' 4"	4' 11"	3' 8"	4' 11"	4' 7"	3' 5"	4' 6"	4' 3"
	FM 10	4' 6"	6' 1"	5' 7"	3' 11"	5' 3"	4' 11"	3' 7"	4' 10"	4' 5"	3' 4"	4' 3"	4' 1"	3' 1"	3' 6"	3' 10"

### Siding: Wind Load

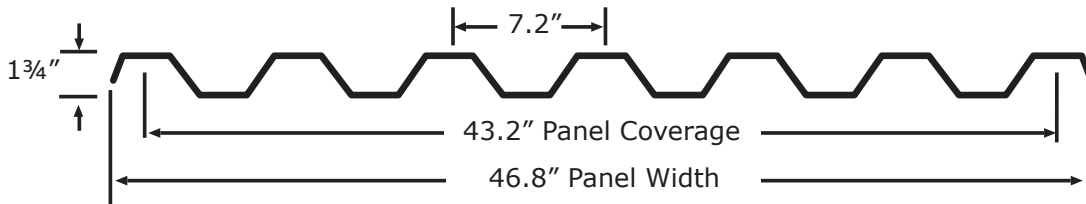
Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 11"	10' 8"	9' 10"	6' 11"	9' 3"	8' 7"	6' 3"	8' 5"	7' 9"	5' 10"	7' 10"	7' 3"	5' 6"	6' 7"	6' 9"
	FR 400	7' 8"	10' 4"	9' 6"	6' 9"	9' 0"	8' 4"	6' 1"	8' 2"	7' 7"	5' 8"	7' 7"	6' 12"	5' 4"	6' 5"	6' 7"
	FR 300	6' 9"	9' 1"	8' 5"	5' 11"	7' 11"	7' 4"	5' 5"	7' 2"	6' 8"	5' 0"	6' 5"	6' 2"	4' 8"	5' 10"	5' 10"
	FR 250	6' 6"	8' 9"	8' 1"	5' 8"	7' 7"	7' 1"	5' 2"	6' 7"	6' 5"	4' 10"	5' 5"	5' 11"	4' 6"	4' 6"	5' 2"
	FR 200	5' 11"	8' 0"	7' 4"	5' 2"	6' 11"	6' 5"	4' 8"	6' 2"	5' 10"	4' 4"	5' 2"	5' 5"	4' 1"	4' 4"	4' 11"
	FR 150	5' 7"	7' 6"	6' 11"	4' 10"	6' 4"	6' 0"	4' 5"	5' 6"	5' 5"	4' 1"	4' 10"	5' 1"	3' 10"	4' 0"	4' 7"
	FM 16	6' 11"	9' 3"	8' 6"	6' 0"	8' 1"	7' 5"	5' 5"	7' 4"	6' 9"	5' 1"	6' 8"	6' 3"	4' 9"	5' 6"	5' 11"
	FM 13	6' 4"	8' 6"	7' 10"	5' 6"	7' 5"	6' 10"	5' 0"	6' 9"	6' 2"	4' 8"	5' 5"	5' 9"	4' 4"	4' 6"	5' 2"
	FM 10	5' 8"	7' 8"	7' 1"	5' 0"	6' 8"	6' 2"	4' 6"	5' 3"	5' 7"	4' 2"	4' 3"	4' 10"	3' 11"	3' 6"	4' 0"

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer at every other corrugation over supports. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.

# Tuff Span FRP Roofing & Siding Panels

## 7.2D x 1.75



7.2D x 1.75

Personnel Load	Span	Defl @ 300 Lb. Load over 2.5 Ft. <sup>2</sup> Area
Tuff Span Series 450	7'6"	L/180 not to exceed 0.5"
Tuff Span Series 400	6'0"	

With its high strength and stiffness, Tuff Span can provide safe support for normal installation and worker foot traffic with observance of standard, OSHA safety measures. The user is responsible for worker safety including requirements for harnesses, tie-off lines, and safety shoes in addition to suitability of aged materials, slippery or sloped roofs. Single span conditions are not recommended for foot traffic.

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	8'6"	11'4"	10'6"	7'5"	9'11"	9'2"	6'9"	9'0"	8'4"	6'3"	8'4"	7'8"	5'10"	7'8"	7'3"
	FR 400	8'4"	11'2"	10'3"	7'3"	9'9"	9'0"	6'7"	8'8"	8'2"	6'1"	7'9"	7'7"	5'9"	7'1"	7'1"
	FR 300	7'9"	10'0"	9'7"	6'9"	8'2"	8'4"	6'2"	7'1"	7'7"	5'8"	6'4"	7'1"	5'4"	5'9"	6'6"
	FR 250	7'2"	9'0"	8'10"	6'3"	7'4"	7'9"	5'8"	6'4"	7'0"	5'3"	5'8"	6'4"	4'11"	5'2"	5'9"
	FR 200	6'7"	7'10"	8'2"	5'9"	6'4"	7'1"	5'2"	5'6"	6'2"	4'10"	4'11"	5'6"	4'6"	4'6"	5'0"
	FR 150	6'0"	6'4"	7'1"	5'2"	5'2"	5'9"	4'6"	4'6"	5'0"	4'0"	4'0"	4'6"	3'8"	3'8"	4'1"
	FM 16	8'2"	11'0"	10'1"	7'2"	9'7"	8'10"	6'6"	8'7"	8'0"	6'0"	7'8"	7'5"	5'8"	7'0"	7'0"
	FM 13	7'3"	9'2"	9'0"	6'4"	7'6"	7'10"	5'9"	6'6"	7'1"	5'4"	5'9"	6'6"	5'0"	5'3"	5'11"
	FM 10	6'8"	7'10"	8'3"	5'10"	6'4"	7'1"	5'3"	5'6"	6'2"	4'11"	4'11"	5'6"	4'6"	4'6"	5'0"

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	8'6"	11'4"	10'6"	7'5"	9'11"	9'2"	6'9"	9'0"	8'4"	6'3"	8'4"	7'8"	5'10"	7'10"	7'3"
	FR 400	8'4"	11'2"	10'3"	7'3"	9'9"	9'0"	6'7"	8'10"	8'2"	6'1"	8'3"	7'7"	5'9"	7'2"	7'1"
	FR 300	7'9"	10'5"	9'7"	6'9"	9'1"	8'4"	6'2"	8'2"	7'7"	5'8"	7'2"	7'1"	5'4"	6'0"	6'8"
	FR 250	7'2"	9'7"	8'10"	6'3"	8'5"	7'9"	5'8"	7'4"	7'0"	5'3"	6'6"	6'6"	4'11"	5'8"	6'2"
	FR 200	6'7"	8'10"	8'2"	5'9"	7'4"	7'1"	5'2"	6'4"	6'5"	4'10"	5'3"	6'0"	4'7"	4'5"	5'0"
	FR 150	6'0"	7'4"	7'5"	5'3"	6'0"	6'6"	4'9"	5'2"	5'9"	4'5"	4'7"	5'2"	4'2"	3'10"	4'4"
	FM 16	8'2"	11'0"	10'1"	7'2"	9'7"	8'10"	6'6"	8'8"	8'0"	6'0"	7'7"	7'5"	5'8"	6'4"	7'0"
	FM 13	7'3"	9'9"	9'0"	6'4"	8'6"	7'10"	5'9"	7'6"	7'1"	5'4"	6'4"	6'7"	5'0"	5'3"	6'0"
	FM 10	6'8"	8'11"	8'3"	5'10"	7'4"	7'2"	5'3"	6'4"	6'6"	4'11"	5'6"	6'1"	4'7"	4'7"	5'2"

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	10'8"	14'4"	13'3"	9'4"	12'6"	11'6"	8'6"	10'10"	10'6"	7'10"	9'8"	9'9"	7'5"	8'6"	9'2"
	FR 400	10'6"	14'1"	13'0"	9'2"	11'6"	11'4"	8'4"	10'0"	10'3"	7'9"	8'7"	9'7"	7'3"	7'2"	8'2"
	FR 300	9'9"	11'7"	12'1"	8'6"	9'5"	10'7"	7'9"	8'2"	9'2"	7'2"	7'2"	8'2"	6'8"	6'0"	6'10"
	FR 250	9'0"	10'4"	11'2"	7'11"	8'5"	9'5"	7'2"	7'4"	8'2"	6'6"	6'6"	7'4"	6'0"	5'8"	6'5"
	FR 200	8'3"	9'0"	10'1"	7'3"	7'4"	8'2"	6'4"	6'4"	7'1"	5'8"	5'3"	6'0"	5'2"	4'5"	5'0"
	FR 150	7'4"	7'4"	8'2"	6'0"	6'0"	6'8"	5'2"	5'2"	5'9"	4'7"	4'7"	5'2"	4'2"	3'10"	4'4"
	FM 16	10'4"	13'10"	12'9"	9'0"	11'6"	11'2"	8'2"	9'6"	10'1"	7'7"	7'7"	8'8"	7'2"	6'4"	7'3"
	FM 13	9'2"	10'7"	11'4"	8'0"	8'7"	9'8"	7'3"	7'6"	8'4"	6'8"	6'4"	7'3"	6'1"	5'3"	6'0"
	FM 10	8'4"	9'0"	10'1"	7'4"	7'4"	8'2"	6'4"	6'4"	7'1"	5'8"	5'6"	6'3"	5'2"	4'7"	5'2"

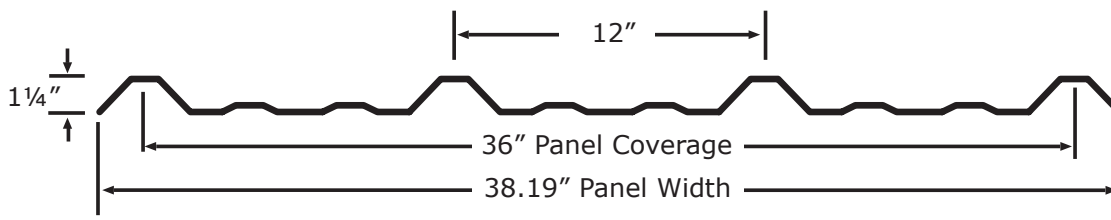
Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 7.2" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.





# Tuff Span FRP Roofing & Siding Panels

## 12.0 x 1.25R



12.0 x 1.25R

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 1"	8' 2"	7' 6"	5' 3"	7' 1"	6' 6"	4' 10"	6' 5"	5' 11"	4' 5"	5' 10"	5' 6"	4' 2"	5' 4"	5' 2"
	FR 400	5' 10"	7' 10"	7' 2"	5' 1"	6' 10"	6' 3"	4' 7"	6' 1"	5' 8"	4' 3"	5' 5"	5' 3"	4' 0"	4' 11"	5' 0"
	FR 300	5' 4"	7' 0"	6' 8"	4' 8"	5' 9"	5' 10"	4' 3"	5' 0"	5' 3"	3' 11"	4' 5"	4' 11"	3' 9"	4' 1"	4' 6"
	FR 250	4' 11"	5' 11"	6' 1"	4' 3"	4' 10"	5' 4"	3' 11"	4' 2"	4' 8"	3' 7"	3' 9"	4' 2"	3' 5"	3' 5"	3' 10"
	FR 200	4' 6"	5' 5"	5' 7"	3' 11"	4' 5"	4' 10"	3' 7"	3' 10"	4' 3"	3' 3"	3' 5"	3' 10"	3' 1"	3' 1"	3' 6"
	FR 150	4' 1"	4' 5"	5' 0"	3' 7"	3' 7"	4' 1"	3' 1"	3' 1"	3' 6"	2' 9"	2' 9"	3' 1"	2' 6"	2' 6"	2' 10"
	FM 16	5' 6"	7' 5"	6' 10"	4' 10"	6' 5"	5' 11"	4' 4"	5' 10"	5' 5"	4' 0"	5' 5"	5' 0"	3' 10"	4' 11"	4' 8"
	FM 13	5' 1"	6' 5"	6' 4"	4' 5"	5' 3"	5' 6"	4' 0"	4' 7"	5' 0"	3' 9"	4' 1"	4' 7"	3' 6"	3' 8"	4' 2"
FM 10	4' 8"	5' 5"	5' 9"	4' 1"	4' 5"	5' 0"	3' 8"	3' 10"	4' 3"	3' 5"	3' 5"	3' 10"	3' 1"	3' 1"	3' 6"	

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 1"	8' 2"	7' 6"	5' 3"	7' 1"	6' 6"	4' 10"	6' 5"	5' 11"	4' 5"	6' 0"	5' 6"	4' 2"	5' 7"	5' 2"
	FR 400	5' 10"	7' 10"	7' 2"	5' 1"	6' 10"	6' 3"	4' 7"	6' 2"	5' 8"	4' 3"	5' 9"	5' 3"	4' 0"	5' 5"	5' 0"
	FR 300	5' 4"	7' 3"	6' 8"	4' 8"	6' 4"	5' 10"	4' 3"	5' 9"	5' 3"	3' 11"	5' 1"	4' 11"	3' 9"	4' 8"	4' 7"
	FR 250	4' 11"	6' 7"	6' 1"	4' 3"	5' 7"	5' 4"	3' 11"	4' 10"	4' 10"	3' 7"	4' 4"	4' 5"	3' 5"	3' 11"	4' 2"
	FR 200	4' 6"	6' 0"	5' 7"	3' 11"	5' 1"	4' 10"	3' 7"	4' 5"	4' 5"	3' 3"	3' 11"	4' 1"	3' 1"	3' 7"	3' 10"
	FR 150	4' 1"	5' 1"	5' 1"	3' 7"	4' 2"	4' 5"	3' 3"	3' 7"	4' 0"	3' 0"	3' 3"	3' 7"	2' 10"	2' 11"	3' 3"
	FM 16	5' 6"	7' 5"	6' 10"	4' 10"	6' 5"	5' 11"	4' 4"	5' 10"	5' 5"	4' 0"	5' 5"	5' 0"	3' 10"	5' 1"	4' 8"
	FM 13	5' 1"	6' 10"	6' 4"	4' 5"	6' 0"	5' 6"	4' 0"	5' 3"	5' 0"	3' 9"	4' 8"	4' 8"	3' 6"	4' 3"	4' 4"
FM 10	4' 8"	6' 3"	5' 9"	4' 1"	5' 1"	5' 0"	3' 8"	4' 5"	4' 7"	3' 5"	3' 11"	4' 3"	3' 3"	3' 7"	4' 0"	

### Siding: Wind Load

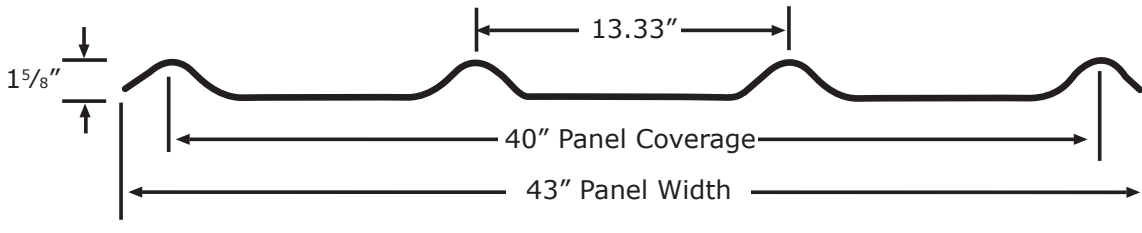
Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 8"	10' 3"	9' 5"	6' 8"	8' 9"	8' 3"	6' 1"	7' 7"	7' 6"	5' 7"	6' 9"	6' 11"	5' 3"	6' 2"	6' 6"
	FR 400	7' 4"	9' 10"	9' 1"	6' 5"	8' 1"	7' 11"	5' 10"	7' 0"	7' 2"	5' 5"	6' 3"	6' 8"	5' 1"	5' 9"	6' 3"
	FR 300	6' 9"	8' 1"	8' 5"	5' 11"	6' 7"	7' 4"	5' 4"	5' 9"	6' 5"	5' 0"	5' 1"	5' 9"	4' 8"	4' 8"	5' 3"
	FR 250	6' 2"	6' 10"	7' 8"	5' 5"	5' 7"	6' 3"	4' 10"	4' 10"	5' 5"	4' 4"	4' 4"	4' 10"	3' 11"	3' 11"	4' 5"
	FR 200	5' 8"	6' 3"	7' 0"	4' 11"	5' 1"	5' 9"	4' 5"	4' 5"	4' 11"	3' 11"	3' 11"	4' 5"	3' 7"	3' 7"	4' 0"
	FR 150	5' 1"	5' 1"	5' 9"	4' 2"	4' 2"	4' 8"	3' 7"	3' 7"	4' 0"	3' 3"	3' 3"	3' 7"	2' 11"	2' 11"	3' 3"
	FM 16	6' 11"	9' 4"	8' 7"	6' 1"	8' 1"	7' 6"	5' 6"	7' 0"	6' 10"	5' 1"	6' 3"	6' 4"	4' 10"	5' 8"	5' 11"
	FM 13	6' 5"	7' 5"	7' 11"	5' 7"	6' 1"	6' 9"	5' 1"	5' 3"	5' 10"	4' 8"	4' 8"	5' 3"	4' 3"	4' 3"	4' 9"
FM 10	5' 11"	6' 3"	7' 0"	5' 1"	5' 1"	5' 9"	4' 5"	4' 5"	4' 11"	3' 11"	3' 11"	4' 5"	3' 7"	3' 7"	4' 0"	

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer on each side of every high rib over supports. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.

# Tuff Span FRP Roofing & Siding Panels

## Trafford Tile



### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 8"	9' 0"	8' 3"	5' 10"	7' 8"	7' 3"	5' 3"	6' 8"	6' 7"	4' 11"	5' 11"	6' 1"	4' 7"	5' 5"	5' 9"
	FR 400	6' 7"	8' 4"	8' 2"	5' 9"	6' 10"	7' 1"	5' 2"	5' 11"	6' 5"	4' 10"	5' 3"	5' 11"	4' 7"	4' 9"	5' 4"
	FR 300	6' 3"	7' 3"	7' 9"	5' 6"	5' 11"	6' 8"	5' 0"	5' 1"	5' 9"	4' 7"	4' 7"	5' 1"	4' 2"	4' 2"	4' 8"
	FR 250	5' 11"	6' 5"	7' 2"	5' 2"	5' 3"	5' 11"	4' 7"	4' 7"	5' 1"	4' 1"	4' 1"	4' 7"	3' 8"	3' 8"	4' 2"
	FR 200	5' 6"	5' 6"	6' 2"	4' 6"	4' 6"	5' 0"	3' 11"	3' 11"	4' 4"	3' 6"	3' 6"	3' 11"	3' 2"	3' 2"	3' 6"
	FR 150	4' 7"	4' 7"	5' 1"	3' 9"	3' 9"	4' 2"	3' 3"	3' 3"	3' 7"	2' 11"	2' 11"	3' 3"	2' 8"	2' 8"	2' 11"
	FM 16	6' 5"	8' 8"	8' 0"	5' 8"	7' 5"	7' 0"	5' 1"	6' 5"	6' 4"	4' 9"	5' 9"	5' 11"	4' 6"	5' 3"	5' 6"
	FM 13	6' 0"	6' 11"	7' 5"	5' 3"	5' 8"	6' 4"	4' 9"	4' 11"	5' 6"	4' 4"	4' 4"	4' 11"	4' 0"	4' 0"	4' 6"
	FM 10	5' 5"	6' 5"	6' 9"	4' 9"	5' 3"	5' 10"	4' 4"	4' 6"	5' 1"	4' 0"	4' 0"	4' 6"	3' 8"	3' 8"	4' 1"

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	6' 8"	9' 0"	8' 3"	5' 10"	7' 10"	7' 3"	5' 3"	7' 1"	6' 7"	4' 11"	6' 1"	6' 1"	4' 7"	5' 1"	5' 9"
	FR 400	6' 7"	8' 10"	8' 2"	5' 9"	7' 8"	7' 1"	5' 2"	6' 9"	6' 5"	4' 10"	6' 1"	6' 0"	4' 7"	5' 1"	5' 8"
	FR 300	6' 3"	8' 5"	7' 9"	5' 6"	6' 10"	6' 9"	5' 0"	5' 11"	6' 2"	4' 7"	5' 3"	5' 8"	4' 4"	4' 5"	5' 0"
	FR 250	5' 11"	7' 5"	7' 3"	5' 2"	6' 1"	6' 4"	4' 8"	5' 3"	5' 9"	4' 4"	4' 5"	5' 0"	4' 1"	3' 8"	4' 2"
	FR 200	5' 8"	6' 4"	7' 0"	4' 11"	5' 2"	5' 9"	4' 6"	4' 6"	5' 0"	4' 0"	3' 9"	4' 4"	3' 8"	3' 2"	3' 7"
	FR 150	5' 3"	5' 3"	5' 11"	4' 4"	4' 4"	4' 10"	3' 9"	3' 9"	4' 2"	3' 4"	3' 2"	3' 7"	3' 0"	2' 8"	3' 0"
	FM 16	6' 5"	8' 8"	8' 0"	5' 8"	7' 7"	7' 0"	5' 1"	6' 10"	6' 4"	4' 9"	5' 11"	5' 11"	4' 6"	4' 11"	5' 6"
	FM 13	6' 0"	8' 0"	7' 5"	5' 3"	6' 6"	6' 6"	4' 9"	5' 8"	5' 10"	4' 5"	5' 0"	5' 5"	4' 2"	4' 2"	4' 9"
	FM 10	5' 5"	7' 4"	6' 9"	4' 9"	6' 0"	5' 11"	4' 4"	4' 11"	5' 4"	4' 0"	3' 11"	4' 6"	3' 9"	3' 3"	3' 9"

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	8' 5"	10' 10"	10' 5"	7' 4"	8' 10"	9' 1"	6' 8"	7' 8"	8' 3"	6' 2"	6' 1"	6' 11"	5' 10"	5' 1"	5' 9"
	FR 400	8' 3"	9' 7"	10' 3"	7' 3"	7' 10"	8' 9"	6' 7"	6' 9"	7' 7"	6' 1"	6' 1"	6' 9"	5' 6"	5' 1"	5' 9"
	FR 300	7' 11"	8' 5"	9' 5"	6' 10"	6' 10"	7' 8"	5' 11"	5' 11"	6' 7"	5' 3"	5' 3"	5' 11"	4' 10"	4' 5"	5' 1"
	FR 250	7' 5"	7' 5"	8' 4"	6' 1"	6' 1"	6' 9"	5' 3"	5' 3"	5' 10"	4' 8"	4' 5"	5' 0"	4' 3"	3' 8"	4' 2"
	FR 200	6' 4"	6' 4"	7' 1"	5' 2"	5' 2"	5' 9"	4' 6"	4' 6"	5' 0"	4' 0"	3' 10"	4' 4"	3' 8"	3' 2"	3' 7"
	FR 150	5' 3"	5' 3"	5' 11"	4' 4"	4' 4"	4' 10"	3' 9"	3' 9"	4' 2"	3' 4"	3' 2"	3' 7"	3' 0"	2' 8"	3' 0"
	FM 16	8' 2"	10' 5"	10' 1"	7' 1"	8' 6"	8' 10"	6' 5"	7' 4"	8' 0"	6' 0"	5' 11"	6' 9"	5' 8"	4' 11"	5' 8"
	FM 13	7' 7"	8' 0"	8' 11"	6' 6"	6' 6"	7' 4"	5' 8"	5' 8"	6' 4"	5' 1"	5' 0"	5' 8"	4' 7"	4' 2"	4' 9"
	FM 10	6' 10"	7' 4"	8' 3"	6' 0"	6' 0"	6' 9"	5' 2"	4' 11"	5' 8"	4' 8"	3' 11"	4' 6"	4' 3"	3' 3"	3' 9"

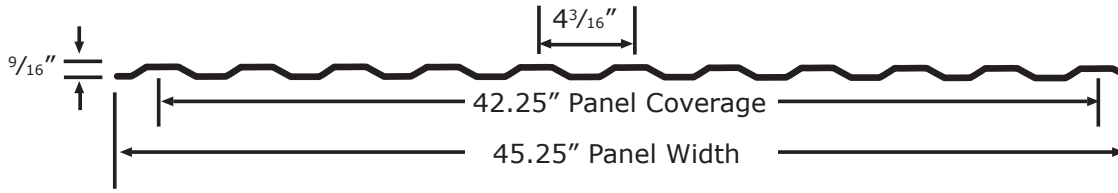
Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer on each side of every high rib over supports. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.





# Tuff Span FRP Roofing & Siding Panels

## 4.1 x 9/16



4.1 X 9/16

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 5"	5' 11"	5' 5"	3' 10"	5' 2"	4' 9"	3' 6"	4' 8"	4' 4"	3' 3"	4' 4"	4' 0"	3' 0"	4' 1"	3' 9"
	FR 400	4' 3"	5' 8"	5' 3"	3' 8"	5' 0"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 300	4' 0"	5' 5"	5' 0"	3' 6"	4' 9"	4' 4"	3' 2"	4' 3"	3' 11"	2' 11"	4' 0"	3' 8"	2' 9"	3' 9"	3' 5"
	FR 250	3' 9"	5' 1"	4' 8"	3' 4"	4' 5"	4' 1"	3' 0"	4' 0"	3' 8"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 3"
	FR 200	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 8"	3' 7"	3' 4"	2' 6"	3' 5"	3' 1"
	FR 150	3' 4"	4' 6"	4' 2"	2' 11"	3' 11"	3' 7"	2' 8"	3' 7"	3' 3"	2' 5"	3' 4"	3' 1"	2' 4"	3' 1"	2' 10"
	FM 16	4' 0"	5' 4"	4' 11"	3' 6"	4' 8"	4' 4"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 9"	3' 8"	3' 5"
	FM 13	3' 8"	4' 11"	4' 7"	3' 3"	4' 4"	4' 0"	2' 11"	3' 11"	3' 7"	2' 8"	3' 8"	3' 4"	2' 6"	3' 5"	3' 2"
FM 10	3' 4"	4' 6"	4' 2"	2' 11"	3' 11"	3' 8"	2' 8"	3' 7"	3' 4"	2' 6"	3' 4"	3' 1"	2' 4"	3' 2"	2' 11"	

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 5"	5' 11"	5' 5"	3' 10"	5' 2"	4' 9"	3' 6"	4' 8"	4' 4"	3' 3"	4' 4"	4' 0"	3' 0"	4' 1"	3' 9"
	FR 400	4' 3"	5' 8"	5' 3"	3' 8"	4' 11"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 300	4' 0"	5' 5"	5' 0"	3' 6"	4' 8"	4' 4"	3' 2"	4' 3"	3' 11"	2' 11"	4' 0"	3' 8"	2' 9"	3' 9"	3' 5"
	FR 250	3' 9"	5' 1"	4' 8"	3' 4"	4' 5"	4' 1"	3' 0"	4' 0"	3' 8"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 3"
	FR 200	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 8"	3' 7"	3' 4"	2' 6"	3' 5"	3' 1"
	FR 150	3' 4"	4' 6"	4' 2"	2' 11"	3' 11"	3' 7"	2' 8"	3' 7"	3' 3"	2' 5"	3' 4"	3' 1"	2' 4"	3' 0"	2' 10"
	FM 16	4' 0"	5' 4"	4' 11"	3' 6"	4' 8"	4' 4"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 9"	3' 8"	3' 5"
	FM 13	3' 8"	4' 11"	4' 7"	3' 3"	4' 4"	4' 0"	2' 11"	3' 11"	3' 7"	2' 8"	3' 8"	3' 4"	2' 6"	3' 5"	3' 2"
FM 10	3' 4"	4' 6"	4' 2"	2' 11"	3' 11"	3' 8"	2' 8"	3' 7"	3' 4"	2' 6"	3' 4"	3' 1"	2' 4"	3' 2"	2' 11"	

### Siding: Wind Load

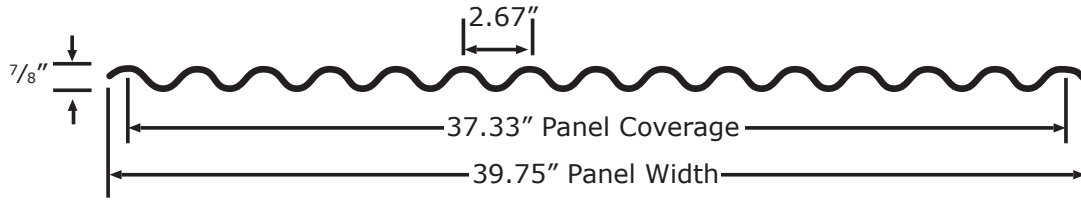
Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	5' 6"	7' 5"	6' 10"	4' 10"	6' 6"	6' 0"	4' 5"	5' 11"	5' 5"	4' 1"	5' 6"	5' 0"	3' 10"	5' 2"	4' 9"
	FR 400	5' 4"	7' 2"	6' 7"	4' 8"	6' 3"	5' 9"	4' 3"	5' 8"	5' 3"	3' 11"	5' 3"	4' 10"	3' 8"	4' 11"	4' 7"
	FR 300	5' 1"	6' 10"	6' 3"	4' 5"	5' 11"	5' 6"	4' 0"	5' 5"	5' 0"	3' 9"	5' 0"	4' 7"	3' 6"	4' 8"	4' 4"
	FR 250	4' 9"	6' 5"	5' 11"	4' 2"	5' 7"	5' 2"	3' 9"	5' 1"	4' 8"	3' 6"	4' 8"	4' 4"	3' 4"	4' 3"	4' 1"
	FR 200	4' 7"	6' 2"	5' 8"	4' 0"	5' 5"	5' 0"	3' 8"	4' 11"	4' 6"	3' 5"	4' 3"	4' 2"	3' 2"	3' 6"	3' 11"
	FR 150	4' 3"	5' 8"	5' 3"	3' 8"	4' 11"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	3' 7"	3' 10"	2' 11"	3' 0"	3' 5"
	FM 16	5' 0"	6' 9"	6' 3"	4' 5"	5' 11"	5' 5"	4' 0"	5' 4"	4' 11"	3' 8"	5' 0"	4' 7"	3' 6"	4' 8"	4' 4"
	FM 13	4' 8"	6' 3"	5' 9"	4' 1"	5' 5"	5' 0"	3' 8"	4' 11"	4' 7"	3' 5"	4' 7"	4' 3"	3' 3"	4' 4"	4' 0"
FM 10	4' 3"	5' 9"	5' 3"	3' 9"	5' 0"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 10"	3' 8"	

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 8.375" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.

# Tuff Span FRP Roofing & Siding Panels

## 2.67 x 7/8



Additional widths are available.

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 5"	5' 11"	5' 6"	3' 10"	5' 2"	4' 9"	3' 6"	4' 9"	4' 4"	3' 3"	4' 4"	4' "	3' 1"	4' 1"	3' 9"
	FR 400	4' 4"	5' 9"	5' 4"	3' 9"	5' 1"	4' 8"	3' 5"	4' 7"	4' 3"	3' 2"	4' 3"	3' 11"	3' 0"	4' 0"	3' 8"
	FR 300	4' 3"	5' 8"	5' 3"	3' 8"	5' 0"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 250	4' 1"	5' 6"	5' 1"	3' 7"	4' 9"	4' 5"	3' 3"	4' 4"	4' 0"	3' 0"	4' 0"	3' 9"	2' 10"	3' 9"	3' 6"
	FR 200	3' 11"	5' 3"	4' 10"	3' 5"	4' 7"	4' 3"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"	2' 9"	3' 8"	3' 4"
	FR 150	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 8"	3' 7"	3' 4"	2' 6"	3' 5"	3' 1"
	FM 16	3' 10"	5' 2"	4' 9"	3' 4"	4' 6"	4' 2"	3' 1"	4' 1"	3' 9"	2' 10"	3' 10"	3' 6"	2' 8"	3' 7"	3' 3"
	FM 13	3' 6"	4' 9"	4' 4"	3' 1"	4' 1"	3' 10"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 2"	2' 5"	3' 3"	3' 0"
FM 10	3' 2"	4' 3"	3' 11"	2' 9"	3' 9"	3' 5"	2' 6"	3' 5"	3' 1"	2' 4"	3' 2"	2' 11"	2' 2"	2' 11"	2' 9"	

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 5"	5' 11"	5' 6"	3' 10"	5' 2"	4' 9"	3' 6"	4' 8"	4' 4"	3' 3"	4' 4"	4' 0"	3' 1"	4' 1"	3' 9"
	FR 400	4' 4"	5' 9"	5' 4"	3' 9"	5' 0"	4' 8"	3' 5"	4' 7"	4' 3"	3' 2"	4' 3"	3' 11"	3' 0"	4' 0"	3' 8"
	FR 300	4' 3"	5' 8"	5' 3"	3' 8"	4' 11"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 250	4' 1"	5' 6"	5' 1"	3' 7"	4' 9"	4' 5"	3' 3"	4' 4"	4' 0"	3' 0"	4' 0"	3' 9"	2' 10"	3' 9"	3' 6"
	FR 200	3' 11"	5' 3"	4' 10"	3' 5"	4' 7"	4' 3"	3' 1"	4' 2"	3' 10"	2' 11"	3' 6"	3' 7"	2' 9"	2' 11"	3' 4"
	FR 150	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 11"	3' 7"	2' 8"	3' 2"	3' 4"	2' 6"	2' 7"	3' 0"
	FM 16	3' 10"	5' 2"	4' 9"	3' 4"	4' 6"	4' 2"	3' 1"	4' 1"	3' 9"	2' 10"	3' 10"	3' 6"	2' 8"	3' 7"	3' 3"
	FM 13	3' 6"	4' 9"	4' 4"	3' 1"	4' 1"	3' 10"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 2"	2' 5"	3' 3"	3' 0"
FM 10	3' 2"	4' 3"	3' 11"	2' 9"	3' 9"	3' 5"	2' 6"	3' 5"	3' 1"	2' 4"	3' 2"	2' 11"	2' 2"	2' 11"	2' 9"	

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	5' 7"	7' 6"	6' 11"	4' 10"	6' 7"	6' 0"	4' 5"	5' 11"	5' 6"	4' 1"	5' 6"	5' 1"	3' 10"	5' 2"	4' 9"
	FR 400	5' 5"	7' 3"	6' 9"	4' 9"	6' 4"	5' 10"	4' 4"	5' 9"	5' 4"	4' 0"	5' 4"	4' 11"	3' 9"	5' 0"	4' 8"
	FR 300	5' 4"	7' 2"	6' 7"	4' 8"	6' 3"	5' 9"	4' 3"	5' 8"	5' 3"	3' 11"	5' 2"	4' 10"	3' 8"	4' 4"	4' 7"
	FR 250	5' 2"	6' 11"	6' 4"	4' 6"	6' 0"	5' 7"	4' 1"	5' 6"	5' 1"	3' 9"	4' 8"	4' 8"	3' 7"	3' 11"	4' 5"
	FR 200	5' 0"	6' 8"	6' 2"	4' 4"	5' 10"	5' 4"	3' 11"	4' 5"	4' 10"	3' 8"	3' 6"	4' 0"	3' 5"	2' 11"	3' 4"
	FR 150	4' 7"	6' 2"	5' 8"	4' 0"	5' 3"	5' 0"	3' 8"	3' 11"	4' 6"	3' 5"	3' 2"	3' 7"	3' 2"	2' 7"	3' 0"
	FM 16	4' 10"	6' 6"	6' 0"	4' 3"	5' 8"	5' 3"	3' 10"	5' 2"	4' 9"	3' 7"	4' 10"	4' 5"	3' 4"	4' 6"	4' 2"
	FM 13	4' 5"	6' 0"	5' 6"	3' 10"	5' 2"	4' 10"	3' 6"	4' 9"	4' 4"	3' 3"	4' 5"	4' 0"	3' 1"	3' 9"	3' 10"
FM 10	4' 0"	5' 5"	5' 0"	3' 6"	4' 8"	4' 4"	3' 2"	4' 3"	3' 11"	2' 11"	3' 6"	3' 8"	2' 9"	2' 11"	3' 4"	

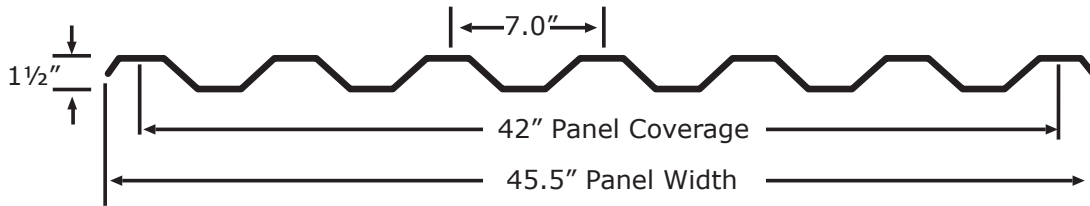
Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 8" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.

2.67 x 7/8



# Tuff Span FRP Roofing & Siding Panels

## 7.0 x 1.5



7.0 x 1.5

Personnel Load	Span	Defl @ 300 Lb. Load over 2.5 Ft. <sup>2</sup> Area
Tuff Span Series 450	7'6"	L/180 not to exceed 0.5"
Tuff Span Series 400	6'0"	

With its high strength and stiffness, Tuff Span can provide safe support for normal installation and worker foot traffic with observance of standard, OSHA safety measures. The user is responsible for worker safety including requirements for harnesses, tie-off lines, and safety shoes in addition to suitability of aged materials, slippery or sloped roofs. Single span conditions are not recommended for foot traffic.

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 11"	10' 7"	9' 9"	6' 11"	9' 3"	8' 6"	6' 3"	8' 5"	7' 9"	5' 10"	7' 9"	7' 2"	5' 6"	7' 1"	6' 9"
	FR 400	7' 7"	10' 3"	9' 5"	6' 8"	8' 11"	8' 3"	6' 1"	8' 0"	7' 6"	5' 7"	7' 2"	6' 11"	5' 3"	6' 6"	6' 6"
	FR 300	7' 0"	9' 4"	8' 8"	6' 1"	7' 7"	7' 7"	5' 7"	6' 7"	6' 10"	5' 2"	5' 10"	6' 5"	4' 10"	5' 4"	6' 0"
	FR 250	6' 5"	7' 10"	7' 11"	5' 7"	6' 5"	6' 11"	5' 1"	5' 6"	6' 2"	4' 8"	4' 11"	5' 6"	4' 5"	4' 6"	5' 1"
	FR 200	5' 10"	7' 3"	7' 3"	5' 1"	5' 11"	6' 4"	4' 8"	5' 1"	5' 8"	4' 4"	4' 7"	5' 1"	4' 1"	4' 2"	4' 8"
	FR 150	5' 5"	5' 11"	6' 7"	4' 8"	4' 10"	5' 5"	4' 2"	4' 2"	4' 8"	3' 9"	3' 9"	4' 2"	3' 5"	3' 5"	3' 10"
	FM 16	7' 5"	9' 11"	9' 2"	6' 5"	8' 8"	8' 0"	5' 10"	7' 10"	7' 3"	5' 5"	7' 2"	6' 9"	5' 1"	6' 6"	6' 4"
	FM 13	6' 8"	8' 6"	8' 3"	5' 10"	6' 11"	7' 2"	5' 3"	6' 0"	6' 6"	4' 11"	5' 4"	6' 0"	4' 7"	4' 11"	5' 6"
	FM 10	6' 1"	7' 3"	7' 6"	5' 4"	5' 11"	6' 7"	4' 10"	5' 1"	5' 8"	4' 6"	4' 7"	5' 1"	4' 2"	4' 2"	4' 8"

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 11"	10' 7"	9' 9"	6' 11"	9' 3"	8' 6"	6' 3"	8' 5"	7' 9"	5' 10"	7' 10"	7' 2"	5' 6"	7' 4"	6' 9"
	FR 400	7' 7"	10' 3"	9' 5"	6' 8"	8' 11"	8' 3"	6' 0"	8' 1"	7' 6"	5' 7"	7' 6"	6' 11"	5' 3"	6' 9"	6' 6"
	FR 300	7' 0"	9' 5"	8' 8"	6' 1"	8' 3"	7' 7"	5' 7"	7' 5"	6' 10"	5' 2"	6' 9"	6' 5"	4' 10"	5' 9"	6' 0"
	FR 250	6' 5"	8' 7"	7' 11"	5' 7"	7' 4"	6' 11"	5' 1"	6' 5"	6' 3"	4' 8"	5' 8"	5' 10"	4' 5"	4' 10"	5' 6"
	FR 200	5' 10"	7' 10"	7' 3"	5' 1"	6' 9"	6' 4"	4' 8"	5' 11"	5' 9"	4' 4"	5' 1"	5' 4"	4' 1"	4' 3"	4' 10"
	FR 150	5' 5"	6' 10"	6' 8"	4' 8"	5' 7"	5' 10"	4' 3"	4' 10"	5' 3"	3' 11"	4' 4"	4' 10"	3' 9"	3' 7"	4' 1"
	FM 16	7' 5"	9' 11"	9' 2"	6' 5"	8' 8"	8' 0"	5' 10"	7' 10"	7' 3"	5' 5"	7' 3"	6' 9"	5' 1"	6' 0"	6' 4"
	FM 13	6' 8"	8' 11"	8' 3"	5' 10"	7' 9"	7' 2"	5' 3"	6' 11"	6' 6"	4' 11"	6' 1"	6' 1"	4' 7"	5' 1"	5' 8"
	FM 10	6' 1"	8' 2"	7' 6"	5' 4"	6' 9"	6' 7"	4' 10"	5' 11"	6' 0"	4' 6"	5' 3"	5' 6"	4' 2"	4' 4"	4' 11"

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

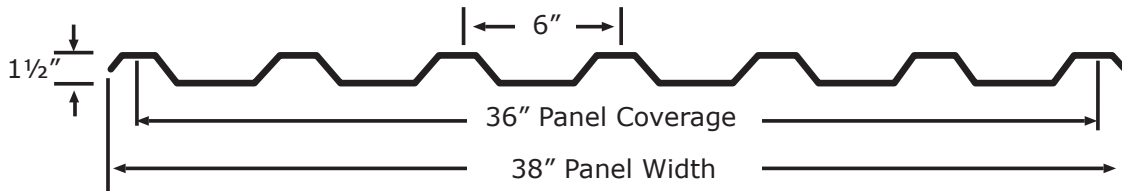
Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	10' 0"	13' 4"	12' 4"	8' 8"	11' 6"	10' 9"	7' 11"	10' 0"	9' 9"	7' 4"	8' 11"	9' 1"	6' 11"	8' 0"	8' 6"
	FR 400	9' 7"	12' 11"	11' 11"	8' 5"	10' 8"	10' 5"	7' 7"	9' 3"	9' 5"	7' 1"	8' 2"	8' 9"	6' 8"	6' 9"	7' 8"
	FR 300	8' 10"	10' 9"	10' 11"	7' 9"	8' 9"	9' 7"	7' 0"	7' 7"	8' 6"	6' 6"	6' 9"	7' 7"	6' 1"	5' 9"	6' 6"
	FR 250	8' 1"	9' 0"	10' 0"	7' 1"	7' 4"	8' 3"	6' 5"	6' 5"	7' 2"	5' 8"	5' 8"	6' 5"	5' 2"	4' 10"	5' 6"
	FR 200	7' 5"	8' 4"	9' 2"	6' 5"	6' 9"	7' 7"	5' 10"	5' 11"	6' 7"	5' 3"	5' 1"	5' 9"	4' 9"	4' 3"	4' 10"
	FR 150	6' 9"	6' 10"	7' 8"	5' 7"	5' 7"	6' 3"	4' 10"	4' 10"	5' 5"	4' 4"	4' 4"	4' 10"	3' 11"	3' 7"	4' 1"
	FM 16	9' 4"	12' 6"	11' 7"	8' 2"	10' 8"	10' 1"	7' 5"	9' 1"	9' 2"	6' 10"	7' 3"	8' 3"	6' 5"	6' 0"	6' 10"
	FM 13	8' 5"	9' 9"	10' 4"	7' 4"	8' 0"	8' 11"	6' 8"	6' 11"	7' 9"	6' 2"	6' 1"	6' 11"	5' 8"	5' 1"	5' 9"
	FM 10	7' 8"	8' 4"	9' 4"	6' 8"	6' 9"	7' 7"	5' 11"	5' 11"	6' 7"	5' 3"	5' 3"	5' 11"	4' 9"	4' 4"	4' 11"

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 7" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.



# Tuff Span FRP Roofing & Siding Panels

## 6.0 x 1.5



6.0 x 1.5

### Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 7"	10' 2"	9' 5"	6' 7"	8' 11"	8' 2"	6' 0"	8' 1"	7' 5"	5' 7"	7' 4"	6' 11"	5' 3"	6' 9"	6' 6"
	FR 400	7' 3"	9' 9"	9' 0"	6' 4"	8' 6"	7' 10"	5' 9"	7' 7"	7' 2"	5' 4"	6' 10"	6' 7"	5' 0"	6' 3"	6' 3"
	FR 300	6' 9"	8' 10"	8' 4"	5' 10"	7' 3"	7' 3"	5' 4"	6' 3"	6' 7"	4' 11"	5' 7"	6' 1"	4' 8"	5' 1"	5' 9"
	FR 250	6' 2"	7' 5"	7' 7"	5' 4"	6' 1"	6' 8"	4' 10"	5' 3"	5' 11"	4' 6"	4' 8"	5' 3"	4' 3"	4' 3"	4' 9"
	FR 200	5' 7"	6' 10"	6' 11"	4' 11"	5' 7"	6' 1"	4' 5"	4' 10"	5' 5"	4' 1"	4' 4"	4' 10"	3' 11"	3' 11"	4' 5"
	FR 150	5' 4"	6' 3"	6' 7"	4' 8"	5' 1"	5' 9"	4' 2"	4' 5"	5' 0"	3' 11"	4' 0"	4' 5"	3' 7"	3' 7"	4' 1"
	FM 16	6' 11"	9' 3"	8' 6"	6' 0"	8' 1"	7' 5"	5' 5"	7' 4"	6' 9"	5' 1"	6' 10"	6' 3"	4' 9"	6' 2"	5' 11"
	FM 13	6' 5"	8' 1"	7' 11"	5' 7"	6' 7"	6' 11"	5' 1"	5' 8"	6' 3"	4' 8"	5' 1"	5' 8"	4' 5"	4' 8"	5' 2"
FM 10	5' 10"	6' 10"	7' 3"	5' 1"	5' 7"	6' 3"	4' 7"	4' 10"	5' 5"	4' 3"	4' 4"	4' 10"	3' 11"	3' 11"	4' 5"	

### Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	7' 7"	10' 2"	9' 5"	6' 7"	8' 11"	8' 2"	6' 0"	8' 1"	7' 5"	5' 7"	7' 6"	6' 11"	5' 3"	7' 1"	6' 6"
	FR 400	7' 3"	9' 9"	9' 0"	6' 4"	8' 6"	7' 10"	5' 9"	7' 9"	7' 2"	5' 4"	7' 2"	6' 7"	5' 0"	6' 9"	6' 3"
	FR 300	6' 9"	9' 0"	8' 4"	5' 10"	7' 11"	7' 3"	5' 4"	7' 2"	6' 7"	4' 11"	6' 5"	6' 1"	4' 8"	5' 11"	5' 9"
	FR 250	6' 2"	8' 3"	7' 7"	5' 4"	7' 0"	6' 8"	4' 10"	6' 1"	6' 0"	4' 6"	5' 5"	5' 7"	4' 3"	4' 11"	5' 3"
	FR 200	5' 7"	7' 6"	6' 11"	4' 11"	6' 5"	6' 1"	4' 5"	5' 7"	5' 6"	4' 1"	5' 0"	5' 1"	3' 11"	4' 6"	4' 10"
	FR 150	5' 4"	7' 2"	6' 7"	4' 8"	5' 11"	5' 9"	4' 2"	5' 1"	5' 2"	3' 11"	4' 7"	4' 10"	3' 8"	4' 1"	4' 7"
	FM 16	6' 11"	9' 3"	8' 6"	6' 0"	8' 1"	7' 5"	5' 5"	7' 4"	6' 9"	5' 1"	6' 10"	6' 3"	4' 9"	6' 5"	5' 11"
	FM 13	6' 4"	8' 7"	7' 11"	5' 7"	7' 6"	6' 11"	5' 1"	6' 7"	6' 3"	4' 8"	5' 11"	5' 10"	4' 5"	5' 4"	5' 5"
FM 10	5' 10"	7' 10"	7' 3"	5' 1"	6' 5"	6' 4"	4' 7"	5' 7"	5' 9"	4' 3"	5' 0"	5' 4"	4' 0"	4' 6"	5' 0"	

### Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

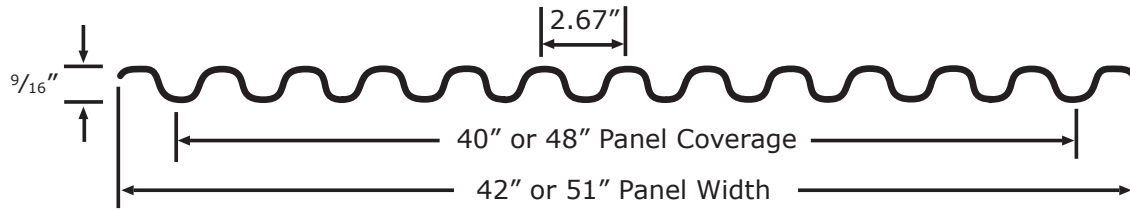
Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	9' 7"	12' 10"	11' 10"	8' 4"	11' 0"	10' 4"	7' 7"	9' 6"	9' 5"	7' 0"	8' 6"	8' 8"	6' 7"	7' 9"	8' 2"
	FR 400	9' 2"	12' 4"	11' 4"	8' 0"	10' 2"	9' 11"	7' 3"	8' 9"	9' 0"	6' 9"	7' 10"	8' 4"	6' 4"	7' 2"	7' 10"
	FR 300	8' 6"	10' 3"	10' 6"	7' 5"	8' 4"	9' 2"	6' 9"	7' 3"	8' 1"	6' 3"	6' 5"	7' 3"	5' 10"	5' 11"	6' 7"
	FR 250	7' 9"	8' 7"	9' 7"	6' 9"	7' 0"	7' 10"	6' 1"	6' 1"	6' 9"	5' 5"	5' 5"	6' 1"	4' 11"	4' 11"	5' 6"
	FR 200	7' 1"	7' 11"	8' 9"	6' 2"	6' 5"	7' 2"	5' 7"	5' 7"	6' 3"	5' 0"	5' 0"	5' 7"	4' 6"	4' 6"	5' 1"
	FR 150	6' 8"	7' 3"	8' 1"	5' 10"	5' 11"	6' 7"	5' 1"	5' 1"	5' 9"	4' 7"	4' 7"	5' 1"	4' 2"	4' 1"	4' 8"
	FM 16	8' 8"	11' 8"	10' 9"	7' 7"	10' 2"	9' 5"	6' 11"	8' 9"	8' 6"	6' 5"	7' 10"	7' 11"	6' 0"	6' 9"	7' 5"
	FM 13	8' 0"	9' 4"	9' 11"	7' 0"	7' 7"	8' 6"	6' 4"	6' 7"	7' 4"	5' 11"	5' 11"	6' 7"	5' 4"	5' 4"	6' 0"
FM 10	7' 4"	7' 11"	8' 10"	6' 5"	6' 5"	7' 2"	5' 7"	5' 7"	6' 3"	5' 0"	5' 0"	5' 7"	4' 6"	4' 6"	5' 1"	

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 6" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.



# Tuff Span FRP Roofing & Siding Panels

2 1/2 x 1/2



## Roofing: Positive Load

Deflection Limit = L/60; Moment Factor of Safety = 2.5

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 3"	5' 8"	5' 3"	3' 8"	5' 0"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 400	4' 1"	5' 6"	5' 1"	3' 7"	4' 9"	4' 5"	3' 3"	4' 4"	4' 0"	3' 0"	4' 0"	3' 9"	2' 10"	3' 9"	3' 6"
	FR 300	3' 10"	5' 3"	4' 10"	3' 5"	4' 7"	4' 2"	3' 1"	4' 2"	3' 10"	2' 10"	3' 10"	3' 6"	2' 8"	3' 7"	3' 4"
	FR 250	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 10"	3' 7"	2' 8"	3' 7"	3' 4"	2' 6"	3' 5"	3' 1"
	FR 200	3' 6"	4' 9"	4' 4"	3' 1"	4' 1"	3' 10"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 2"	2' 5"	3' 3"	3' 0"
	FR 150	3' 3"	4' 4"	4' 0"	2' 10"	3' 9"	3' 6"	2' 7"	3' 5"	3' 2"	2' 4"	3' 2"	2' 11"	2' 3"	3' 0"	2' 9"
	FM 16	3' 10"	5' 2"	4' 9"	3' 4"	4' 6"	4' 2"	3' 0"	4' 1"	3' 9"	2' 10"	3' 9"	3' 6"	2' 8"	3' 7"	3' 3"
	FM 13	3' 7"	4' 9"	4' 5"	3' 1"	4' 2"	3' 10"	2' 10"	3' 9"	3' 6"	2' 7"	3' 6"	3' 3"	2' 5"	3' 4"	3' 0"
FM 10	3' 3"	4' 4"	4' 0"	2' 10"	3' 10"	3' 6"	2' 7"	3' 6"	3' 2"	2' 5"	3' 2"	2' 11"	2' 3"	3' 0"	2' 9"	

## Roofing: Negative Load

Deflection Limit = L/60; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	4' 3"	5' 8"	5' 3"	3' 8"	4' 11"	4' 7"	3' 4"	4' 6"	4' 2"	3' 1"	4' 2"	3' 10"	2' 11"	3' 11"	3' 7"
	FR 400	4' 1"	5' 6"	5' 1"	3' 7"	4' 9"	4' 5"	3' 3"	4' 4"	4' 0"	3' 0"	4' 0"	3' 9"	2' 10"	3' 9"	3' 6"
	FR 300	3' 10"	5' 2"	4' 10"	3' 5"	4' 7"	4' 2"	3' 1"	4' 1"	3' 10"	2' 10"	3' 10"	3' 6"	2' 8"	3' 7"	3' 4"
	FR 250	3' 8"	4' 11"	4' 6"	3' 2"	4' 3"	3' 11"	2' 11"	3' 10"	3' 7"	2' 8"	3' 7"	3' 4"	2' 6"	3' 5"	3' 1"
	FR 200	3' 6"	4' 9"	4' 4"	3' 1"	4' 1"	3' 10"	2' 9"	3' 9"	3' 5"	2' 7"	3' 6"	3' 2"	2' 5"	3' 3"	3' 0"
	FR 150	3' 3"	4' 4"	4' 0"	2' 10"	3' 9"	3' 6"	2' 7"	3' 5"	3' 2"	2' 4"	3' 2"	2' 11"	2' 3"	2' 10"	2' 9"
	FM 16	3' 10"	5' 2"	4' 9"	3' 4"	4' 6"	4' 2"	3' 0"	4' 1"	3' 9"	2' 10"	3' 9"	3' 6"	2' 8"	3' 7"	3' 3"
	FM 13	3' 7"	4' 9"	4' 5"	3' 1"	4' 2"	3' 10"	2' 10"	3' 9"	3' 6"	2' 7"	3' 6"	3' 3"	2' 5"	3' 4"	3' 0"
FM 10	3' 3"	4' 4"	4' 0"	2' 10"	3' 10"	3' 6"	2' 7"	3' 5"	3' 2"	2' 5"	3' 2"	2' 11"	2' 3"	3' 0"	2' 9"	

## Siding: Wind Load

Deflection Limit = L/30; Moment Factor of Safety = 1.88; Pullover Factor of Safety = 1.88

Load, PSF		20			30			40			50			60		
Span		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
S E R I E S	FR 450	5' 4"	7' 2"	6' 7"	4' 8"	6' 3"	5' 9"	4' 3"	5' 8"	5' 3"	3' 11"	5' 3"	4' 10"	3' 8"	4' 11"	4' 7"
	FR 400	5' 2"	6' 11"	6' 4"	4' 6"	6' 0"	5' 7"	4' 1"	5' 6"	5' 1"	3' 9"	5' 1"	4' 8"	3' 7"	4' 9"	4' 5"
	FR 300	4' 11"	6' 7"	6' 1"	4' 3"	5' 9"	5' 3"	3' 10"	5' 2"	4' 10"	3' 7"	4' 10"	4' 5"	3' 5"	4' 7"	4' 2"
	FR 250	4' 7"	6' 2"	5' 8"	4' 0"	5' 5"	5' 0"	3' 8"	4' 11"	4' 6"	3' 4"	4' 6"	4' 2"	3' 2"	4' 0"	3' 11"
	FR 200	4' 5"	6' 0"	5' 6"	3' 10"	5' 2"	4' 10"	3' 6"	4' 9"	4' 4"	3' 3"	3' 11"	4' 0"	3' 1"	3' 3"	3' 8"
	FR 150	4' 1"	5' 6"	5' 0"	3' 7"	4' 9"	4' 5"	3' 3"	4' 3"	4' 0"	3' 0"	3' 5"	3' 8"	2' 10"	2' 10"	3' 3"
	FM 16	4' 10"	6' 6"	6' 0"	4' 3"	5' 8"	5' 3"	3' 10"	5' 2"	4' 9"	3' 7"	4' 9"	4' 5"	3' 4"	4' 6"	4' 2"
	FM 13	4' 6"	6' 0"	5' 7"	3' 11"	5' 3"	4' 10"	3' 7"	4' 9"	4' 5"	3' 3"	4' 5"	4' 1"	3' 1"	4' 1"	3' 10"
FM 10	4' 1"	5' 6"	5' 1"	3' 7"	4' 10"	4' 5"	3' 3"	4' 4"	4' 0"	3' 0"	3' 11"	3' 9"	2' 10"	3' 7"	3' 6"	

Maximum span for uniform load, PSF, is shown in lineal feet and based on panel fasteners with .729" diameter washer located 8" on center. Structural properties and maximum spans are based on large-scale tests that consider: bending moment at failure, flexural stiffness and pullover force per fastener.

# Tuff Span FRP Roofing & Siding Panels

## Specification

### Part 1 - General

#### 1.01 Description of Work

The scope shall include roofing and/or siding panels and required accessories as shown on the drawings.

- A. FRP roofing and siding panels
- B. FRP trim and flashing
- C. Fasteners for panels and flashing
- D. Closures and sealants

#### 1.02 Quality Assurance

A. Materials shall comply with federal and local laws, applicable codes, and standards including:

- 1. ASTM E72: Strength of Panels for Building Construction
- 2. ASTM E84: Surface Burning Characteristics of Building Materials
- 3. ASTM D696: Coefficient of Linear Thermal Expansion of Plastics
- 4. ASTM D2583: Indentation Hardness of Plastics
- 5. ASTM D1494: Diffused Light Transmission

B. Roofing and siding panels shall meet the design criteria listed herein for the spans shown on the drawings.

#### 1.03 Design Criteria

A. Design Loads

Roofing: Positive \_\_\_\_\_psf Negative Wind \_\_\_\_\_psf  
Siding: Positive \_\_\_\_\_psf Negative Wind \_\_\_\_\_psf  
*Positive load should be the higher of live or snow load or a minimum load of 20 psf.*

B. Deflection Limit

Roofing: L/D = \_\_\_\_\_ Siding: L/D = \_\_\_\_\_  
*IBC specifies L/60 as a minimum limit for deflection.*

C. Factor of Safety (FOS)

Roofing: Positive = 2.5 Negative Wind = 1.88  
Siding: FOS = 1.88

#### 1.04 Submittals

Submittals shall include, but not be limited to:

- A. Complete list and description of materials to be furnished
- B. Product literature
- C. Technical data demonstrating compliance with design criteria
- D. Layout drawings (if required)

### Part 2 - Products

#### 2.01 Manufacturers

The standard for design, characteristics, and performance shall be Tuff Span roofing and siding as manufactured by Enduro Composites, Houston, Texas, [www.endurocomposites.com](http://www.endurocomposites.com).

#### 2.02 Materials

A. Roof and siding panels shall conform to the following:

- 1. Profile/Series shall be \_\_\_\_\_.
- 2. Resin type shall be Isophthalic Polyester.
- 3. Glass fiber reinforcements shall be continuous, straight and bi-directional along the length and width. Glass content shall be 48% by weight.

*For FM approved materials revise to: Glass content shall be minimum of 33% by weight*

4. Materials shall be fire retardant with UL Class 1 Flame Spread Rating of 25 or less per ASTM E-84 test.

*For FM materials add: Materials shall have FM approval per Standard 4880 (Corner Fire Test).*

5. Materials shall be protected from UV rays by all of the following:

- a. UV stabilized resin with neopentyl glycol and acrylic monomer
- b. UV acrylic polymer exterior coating, factory-applied with minimum .4 mil dry film thickness
- c. Surfacing mat or veil
- d. Embossed resin-rich surface

6. Finish shall be embossed top, smooth bottom.

7. Color shall be Enduro standard or as selected by owner.

8. Diffused light transmission (if applicable) shall be \_\_\_\_\_% per ASTM D 1494.

B. FRP Flashing and trim shall be thickness, dimensions, and profile required for a complete installation per drawings.

C. Fasteners

1. Structural fasteners shall be (304/316) stainless steel with seal washers installed per manufacturer's guidelines.

2. Panel side lap and flashing fasteners shall be (316) stainless steel SB2 grommets and installed per manufacturer's guidelines.

D. Closures and Sealants

1. EPDM closures shall match unit profile.

2. Sealant tape for roofing side and end laps shall be 3/32 x 1/2 in. thick non-shrink/non-hardening butyl tape.

3. Sealant for translucent panels shall be Boss 380 Silicon or Silglaze II SCS 2800 caulk.

### Part 3 - Execution

#### 3.01 Handling and Storage

A. When handling materials, spreader bars shall be used when lifting FRP panels and surfaces protected from cuts, gouges, abrasions, and impacts. Wire slings shall not be used unless panel is protected.

B. During storage, bundled panels shall be protected against standing water on top of and between sheets. Bundled panels shall be kept under cover (but ventilated) and dry. Materials shall be stored off the ground for air circulation and with one end elevated to permit water drainage.

#### 3.02 Installation

Installer shall follow Manufacturer's Installation Instructions and Layout Drawings.

A. For 304SS or 316SS Type A or B, self tapping screws, pilot holes must be drilled through the panel and support. Pilot holes are not required for stainless steel self-drilling screws, which have a carbon steel point.

B. For SB2 Grommets used for side lap and flashing attachment, pilot holes must be drilled through flashing and panels.

C. End laps shall be 6 inches minimum for roofing panels, and 4 inches minimum for siding panels.



# Tuff Span FRP Roofing & Siding Panels

## Handling & Storage

When lifting FRP materials, spreader bars should be used. Wire slings should be avoided unless materials are protected. Material surfaces should be protected from cuts, impact, and abrasions. FRP cannot be reshaped by external force such as hammering or extreme bending.

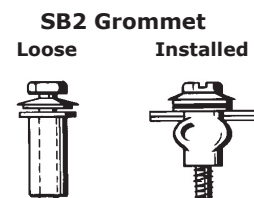
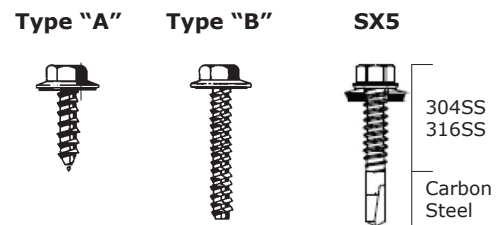
Bundled panels should be stored off the ground high enough to allow for air circulation under the bundle and to be above standing water. One end should be elevated for water drainage and moisture prevented between bundled panels.

## Fastener & Sealant Guide

Profile	Structural Fasteners	Side Lap Fasteners / End & Side Laps
2.67 x 7/8, 2.5 x 1/2	Every 3rd high rib	For roofing or siding, allow 1 full rib (min.) for side laps. Roofing w/slope 3/12 or greater: Fasten side laps 18" o.c. Roofing w/slope less than 3/12: Fasten side laps 12" o.c. Siding: Fasten side laps 18" o.c. For roofing, end laps should be 6" minimum. For siding, end laps should be 4" minimum. For ridge, gable, transition, and corner flashing overlap ends 4". For other flashings, butt ends unless noted otherwise. For fastening flashing to panels: Fasten to 7.2, 7.0, or 7.2D every other rib; 4.2 x 1.06, every 3rd rib; or 12" on center. Side lap Fastening: 6.5x2_18" o.c.; 8.0x3.5_24" o.c. Diaphragm Applications: 12" o.c. Butt or lap ends 3"
4.2 x 1.06 Roofing	Every other high rib	
4.2 x 1.06 Siding	Every other low rib	
4.1 x 9/16, 4.0 x 1, 4.875 x 1.75V	Every other low rib	
7.2 x 1.5, 7.2D x 1.75, 7.0 x 1.5, 5.3 x 1.75V	Every low rib	
12 x 1.25R, 12 x 1.62R, Trafford Tile	One on each side of every high rib	
6.5 x 2 Roof Deck, 8.0 x 3.5 Roof Deck	Every low rib	

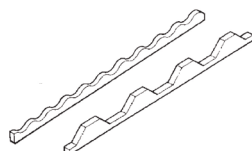
1. Sealant: Butyl tape sealant is required for roofing side and end laps. For translucent roofing, clear caulk may be used. Sealant is not required for siding or roof deck unless noted otherwise.
2. Fasteners: 304SS and 316SS Type A or B self-tapping screws require pilot holes before installation. SX5/SX14/12XS self-drilling fasteners are bi-metal screws with 304SS or 316SS head and clamping thread section. The drill point and lead thread are carbon steel. In some conditions, the carbon steel point, which is necessary for self-drilling installation, will exhibit rust or corrosion.
3. Washers, 0.729" diameter are typically required. Exceptions are 8.0 x 3.5 roof deck and FM ratings for 7.2" rib panels that require 1.125" diameter washers.

Structural Fastener	Beam Thickness	Drill Bit Size	Side Lap Fastener	Drill Bit Size
#14 Type B	.065-.085"	#8 (.199")	SB2 Grommet	3/8"
	.085-.115"	#7 (.201") or 13/64		
	.115-.375"	#1 (.228") or 7/32		
	.375-.500"	#1 (.228") or 7/32		
#14 Type A	.021-.026"	1/8 (.125")	SB2 Grommet	3/8"
	.027-.050"	3/16 (.187")		
	.051-.075"	#8 (.199") or 13/64		
	Wood	5/32"		
FRP	#22 (.157") or 11/64			
SX5 Self Driller	.075-.157"	Not required		
SX14 Self Driller	.158-.550"	Not required		
12XS Self Driller	FRP	Not required		



### Closure Strips

Closure strips made from synthetic rubber (EDPM) are available for use with specific panel profiles.



### Butyl Tape

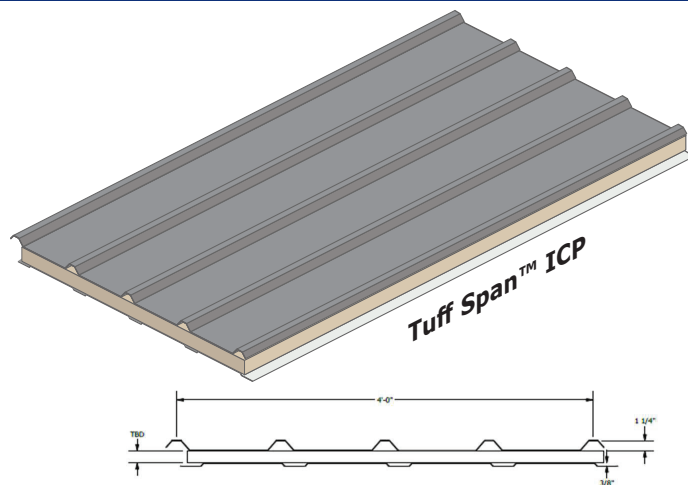
Tape is 3/32" thick x 1/2" wide non-shrinking, non-hardening, used for sealing side and end laps.





## Shop-assembled Insulated Composite Panel

With a proven history of outstanding product performance, Tuff Span™ FRP roofing and siding is the market leader providing safe, weathertight, long-term building solutions in the most chemically aggressive and harsh environments. The Tuff Span technology utilizes premium raw materials and constructability designed to achieve the highest performance.



### NEW Shop Fabricated Insulated Panel!

Introducing Enduro's next generation non-metallic insulated panel system, Tuff Span ICP (insulated composite panel) utilizes insulation board sandwiched between premium Tuff Span fiberglass exterior and interior panels. Now shop fabricated, the ICP panels significantly reduce total installed time and cost while providing excellent corrosion resistance and superior UV protection, extending a building's service life in the most chemically aggressive and harsh environments.

#### Reduced Installed Cost

**SHOP FABRICATED • MODULAR DESIGN • LIGHTWEIGHT**

The shop fabricated Tuff Span ICP panel's enhanced modular design provides a more efficient installation method, greatly reducing installation time and costs. In addition to the installation cost savings from reduced man-hours, reducing the construction time onsite positions the facility to begin operations sooner. Utilizing fiberglass panels for both exterior and interior panels provides a lightweight insulated panel with better maneuverability and ease of installation.

#### Excellent Corrosion Resistance

**LONG SERVICE LIFE • MAINTENANCE FREE**

Enduro's ICP panels utilize Tuff Span for the exterior and interior panels, which do not corrode in facilities with continuous wet or tough chemical exposure. Its premium, isophthalic polyester, aliphatic, or vinyl ester resin system ensures long, maintenance free service life and dramatically improves work conditions.

#### Superior UV Protection

**EXTENDED COLOR RETENTION • GREATER AESTHETICS**

Tuff Span panels utilize an acrylic polymer coating and UV stabilized resin system resulting in extended UV protection and retention of its aesthetic properties. The halogen-free, aliphatic resin offers the best weathering and color retention properties for structural, corrosion resistant cladding panels.



**Roofing Positive Load**

L/D = 60

Moment FOS = 2.5

Uniform Load, PSF	20			30			40			50			60		
	Span	1	2	3	1	2	3	1	2	3	1	2	3	1	2
ICP 450	6.08	8.16	7.50	5.25	7.08	6.50	4.83	6.41	5.91	4.41	5.83	5.50	4.16	5.33	5.16

**Roofing Negative Load**

L/D = 60

Moment FOS = 1.88

Pullover FOS = 1.88

Uniform Load, PSF	20			30			40			50			60		
	Span	1	2	3	1	2	3	1	2	3	1	2	3	1	2
ICP 450	6.08	8.16	7.50	5.25	7.08	6.50	4.83	6.41	5.83	4.41	6.00	5.50	4.16	5.58	5.16

**Siding Wind & Liner Load**

L/D = 30

Moment FOS = 1.88

Pullover FOS = 1.88

Uniform Load, PSF	20			30			40			50			60		
	Span	1	2	3	1	2	3	1	2	3	1	2	3	1	2
ICP 450	7.66	10.25	9.41	6.66	8.75	8.25	6.08	7.58	7.50	5.58	6.75	6.33	5.25	6.17	5.25

Maximum spans are shown in lineal feet and based on panel fasteners, w/.729" diameter washers, located 6" on center. Span limits and structural properties are determined from large-scale tests that consider bending moment at failure, flexural stiffness, and pullover force per fastener. Span conditions shown apply to all insulation thicknesses.

MATERIAL CHARACTERISTICS & TEST CERTIFICATIONS:	
Exterior and Interior Panels	Tuff Span™ fiberglass
Panel Resin	AHR (Aliphatic Hybrid), PFR (Iso-polyester), VFR (Vinyl Ester)
Insulation	Polyisocyanurate Rigid Board (3" = R-value of 20; 2" R-value of 13)*
	Mineral Wool Board (4" = R-value of 17; 3" R-value of 13)
Panel Lengths	12, 14, or 16 ft
Standard Colors	Gray, White, Beige, Stone-white-R (Contact Enduro for others )
Flame Spread Rating, ASTM E84	Class 1, 25 or less
Smoke Development, ASTM E84	< 450

\* Polyisocyanurate board insulation in 3" and 2" thicknesses are standard insulation type and thicknesses for Tuff Span™ ICP. For other type and thickness not referenced, please contact Enduro.



## Specification

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- Insulated Composite Wall Panels with glass fiber reinforced plastic (FRP/GRP) face sheets and foam insulating core.
- Insulated Composite Roof Panels with glass fiber reinforced plastic (FRP/GRP) face sheets and foam insulating core.
- FRP/GRP trim and flashing for Insulated Composite Panels.
- Fasteners for panels and flashing.
- Closures and sealants.

#### 1.2 DESIGN REQUIREMENTS

- The insulated composite panels with glass fiber reinforced plastic (FRP) face sheets and foam insulating core shall be factory laminated or foamed-in-place under a certified ISO 9001 Quality Control program.
- Design Requirements for Insulated Wall and Roof Panels:
  - Thermal Properties: The panel shall provide a nominal R-value of \_\_\_ per inch (minimum) of core insulation thickness. Reference Section 2.5 for R-value by insulation type.
  - Flame Spread: Rating of 25 or less, when tested in accordance with ASTM E84.
  - Smoke Development: Rating of 450 or less, when tested in accordance with ASTM E84.
- Design Requirements for Insulated Wall Panels:
  - The wall panels shall be designed and furnished by the manufacturer as a complete system.
  - Design loads shall be in accordance with local building code.
  - Wind loads shall be based on criteria in accordance with local building code or not less than 20 lbs. psf (.957 kPa).
  - Deflection requirements shall be in accordance with the applicable building code and deflection limit of L/30.
  - Factor of safety of 1.88 shall apply for wind loads.
  - Accessories and fasteners shall be capable of resisting specified wind loads.

**CONTINUED**

## Specification *CONTINUED*

- D. Design Requirements for Insulated Roof Panels:
  - I. The roof panels shall be designed and furnished by the manufacturer as a complete system.
  - II. Design loads shall be in accordance with local building code.
  - III. Dead load shall be the weight of the roof panels.
  - IV. Live load shall be a minimum of 20 lbs. PSF (.957 kPa).
  - V. Snow load shall be defined in accordance with local building code.
  - VI. Design positive load shall be the higher of the live+dead or snow+dead load or as defined by the local building code.
  - VII. Wind loads shall be based on wind criteria in accordance with local building code.
  - VIII. Collateral loads shall not be applied to the roof panels.
  - IX. Deflection requirements shall be in accordance with the applicable building code and deflection limit of L/60.
  - X. Factor of safety of 2.5 shall apply for positive loads. Factor of safety of 1.88 shall apply for wind loads.
  - XI. Accessories and fasteners shall be capable of resisting specified wind uplift loads.

### **PART 2 PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURER**

- A. Enduro Composites, Inc., located at 16602 Central Green Blvd., Houston, TX 77032; Tel: 800-231-7271, 713-358-4000; Email: BPsales@endurocomposites.com; Web: EnduroComposites.com.

#### **2.2 INSULATED COMPOSITE PANELS (ICP)**

- A. Exterior face panel shall be Tuff Span™ glass fiber reinforced plastic (FRP) as manufactured by Enduro Composites, Inc. with ribs 12 in. (304.8 mm) on center with 1.25 in. (31.75 mm) depth and coverage of 48 inches (1219.2 mm).
- B. Exterior face panel shall be Series 450 and meet all specified Design Requirements.
- C. Surface of face panel exposed to outside environment shall have an embossed finish.
- D. Exterior face sheet shall have acrylic polymer exterior UV coating protection, factory-applied with minimum .4 mil dry film thickness.
- F. Color of exterior panel shall be Enduro standard Gray or as selected by owner.
- G. Interior liner panel shall be Tuff Span glass fiber reinforced plastic FRP Siding Panel as manufactured by Enduro Composites, Inc. with ribs 12 in. (304.8 mm) on center with maximum .375 in. (9.5 mm) depth and coverage of 48 in. (1219.2 mm).
- H. Interior liner panel shall be Series 300 at minimum and meet all specified Design Requirements.
- I. Color of interior panel shall be Enduro standard White or as selected by owner.
- J. Lengths of panels shall be +/- 1/4" with maximum length of 16'0".

#### **2.4 GLASS FIBER REINFORCED PLASTIC PANEL MATERIAL**

- A. Material resin shall be premium grade, Isophthalic Polyester, UV stabilized with neopentyl glycol and acrylic monomer.
- B. Glass fiber reinforcements shall be continuous, straight and bi-directional along the length and width.
- C. Material shall be fire retardant with UL Class 1 Flame Spread Rating of 25 or less per ASTM E-84 test.
- D. Material shall have smoke development of 450 or less per ASTM E-84 test.

#### **2.5 FOAM INSULATING CORE**

- A. Foam insulating core shall be 2"/3" (select one) thick, polyisocyanurate foam insulation with minimum R-value of 6 per inch or 3"/4" (select one) thick, mineral wool board insulation with minimum R-value of 4 per inch. The foam insulating core shall be factory laminated or foamed-in-place to face sheet and liner to develop finished insulated composite panel unit.
- B. Foam insulating core shall be tested to ASTM E84 and shall have these characteristics.
  - a. Flame spread index: 25 or less.
  - b. Smoke developed index: 450 or less.

#### **2.6 ACCESSORIES**

- A. Accessories shall include flashing, trim, closures, sealant, fasteners, and other items as required for a complete installation.
- B. FRP/GRP flashing and trim shall be in thickness, dimensions, and profile as required.
- C. Fasteners
  - a. Structural fasteners shall be 304/316 (select one) stainless steel with seal washers and installed per manufacturer's instructions.
  - b. Side lap and flashing fasteners shall be 316 stainless steel SB2 grommets and installed per manufacturer's instructions.
- D. Closures and Sealant
  - a. Closures shall be EPDM material and match panel profile.
  - b. Sealant shall be 3/32 x 1/2 inch, non-shrink/non-hardening butyl tape.

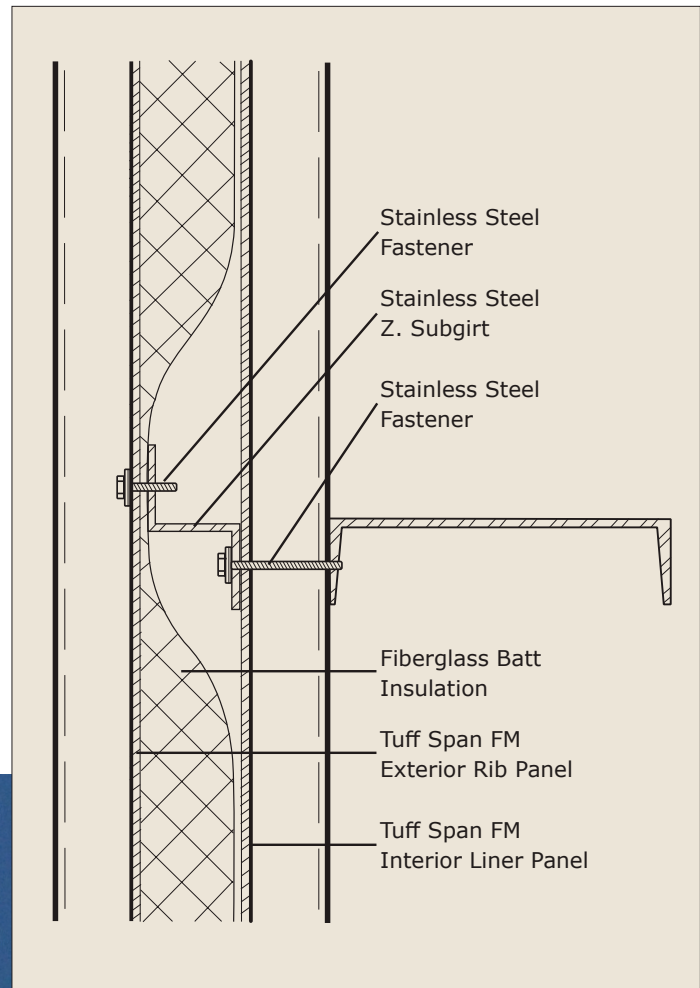


# Field-assembled Insulated Panel System

In addition to the shop assembled ICP, Tuff Span™ panels are offered as a field-assembled insulated panel system. This assembly is approved by Factory Mutual for use as a wall and roof/ceiling with no height limitations or sprinklers.

A Tuff Span insulated panel assembly has passed ULC-S134, fire test for exterior cladding. Please contact us for additional information.

*Tuff Span insulated panel system at potash operation. Assembly includes liner, stainless steel sub-girt, mineral wool insulation, and exterior sheet.*

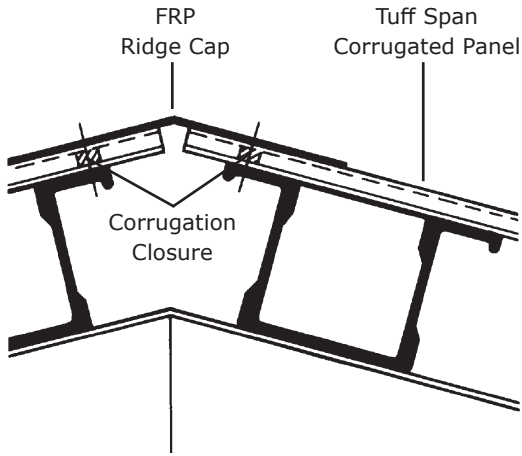


Insulated Panels

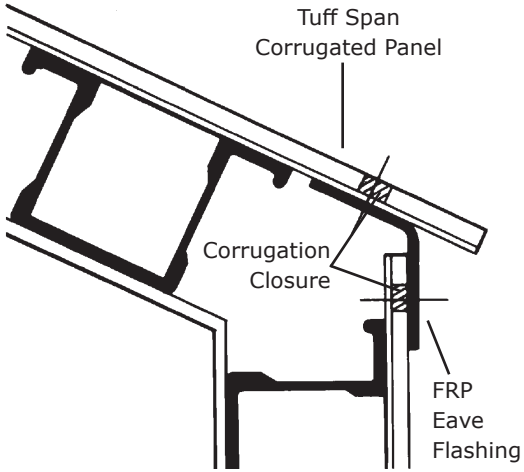
# Tuff Span FRP Roofing & Siding Panels

## Typical Details

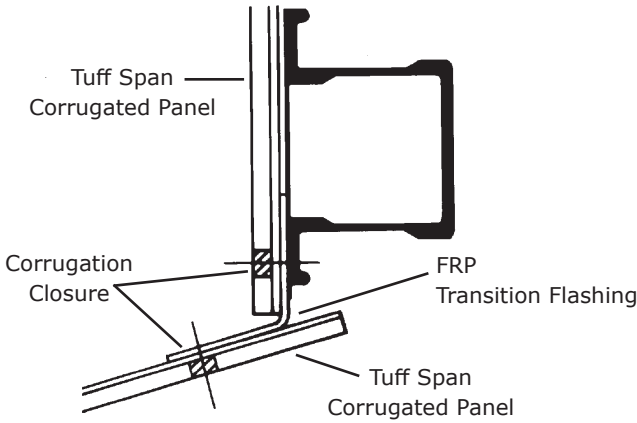
### Ridge Detail



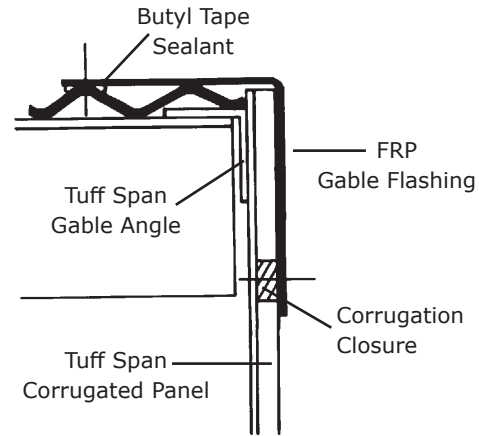
### Eave Detail



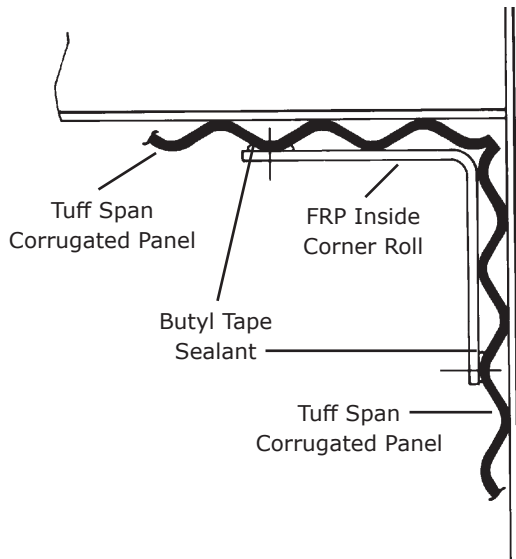
### Transition Flashing



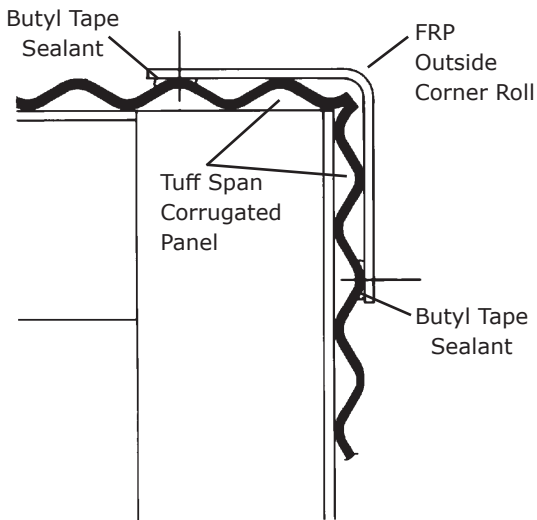
### Gable Trim



### Inside Corner Roll



### Outside Corner Roll



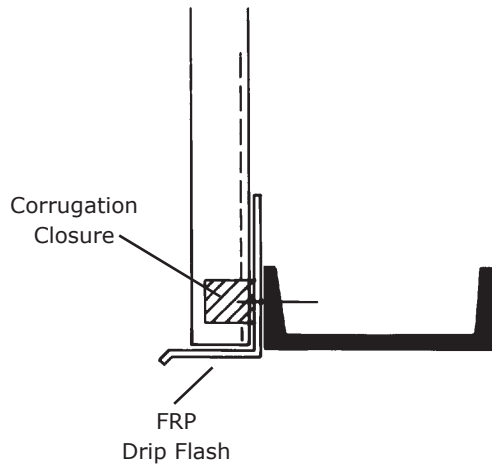
Typical Details



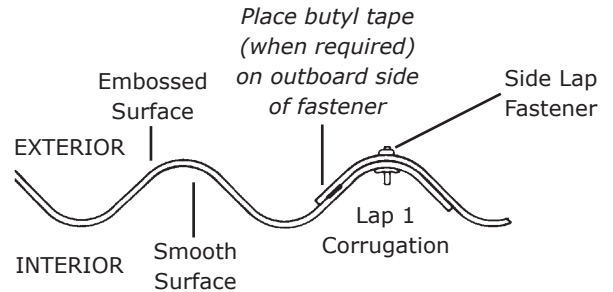
# Tuff Span FRP Roofing & Siding Panels

## Typical Details

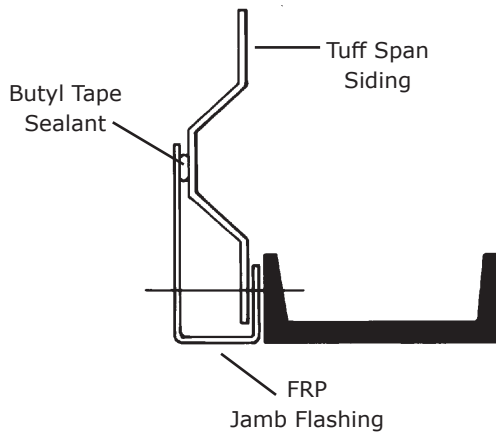
### Drip Flash Detail



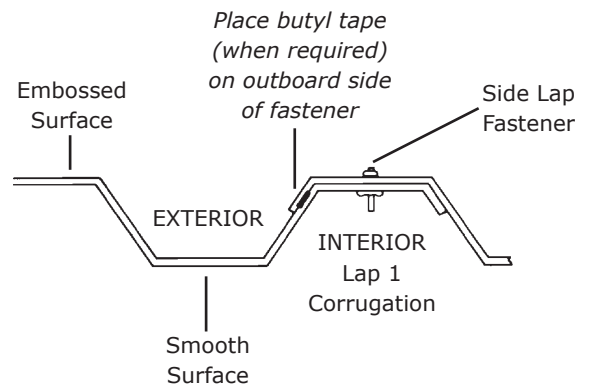
### Corrugated Panel Side Lap Detail



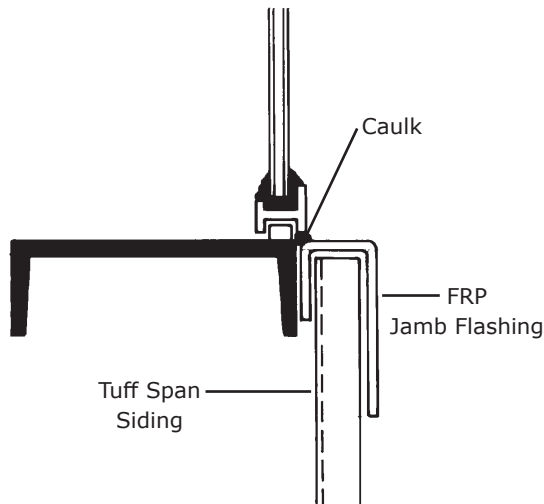
### Jamb Detail



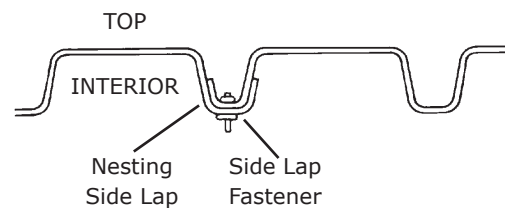
### Rib Panel Side Lap Detail



### Sill Detail



### Roof Deck Side Lap Detail





# Tuff Span FRP Roof Deck

## Unsurpassed Strength & Corrosion Resistance

With outstanding corrosion resistance, Tuff Span™ fiberglass reinforced plastic Roof Deck provides long-term structural support for both built-up and single ply roofing materials.

As an alternative to metal or wood, Tuff Span Roof Deck does not rust, rot, peel, or flake, thus eliminating the threat of falling deck particles that could damage equipment or contaminate product. As an alternative to concrete, Tuff Span offers an 11 lb. psf reduction in dead load on the building structure and huge installation cost and time savings. In addition, its bright white color can dramatically improve work conditions.

### STRUCTURAL PERFORMANCE

To optimize structural properties, Tuff Span material includes high (50% by weight) content of glass fiber reinforcements in bidirectional alignment. This provides the strength and stiffness necessary to withstand high wind uplift and support dead load of roofing materials. Available in two profiles, Tuff Span roof decks are



Corrosion resistant Tuff Span Roof Deck is a suitable substrate for either single-ply or built-up roofing

designed to handle typical load and span conditions found in conventional building construction.

The fiberglass reinforced plastic (FRP) decking delivers significant benefits for natatoriums, paper mills, food processing plants, industrial facilities with chemical exposures and other challenging conditions.

### USES

ROOF DECK FOR  
MEMBRANE  
ROOFING

ROOF DECK FOR  
BUILT UP ROOFING

### FEATURES

CORROSION RESISTANCE

STRONGEST FRP  
BUILDING PANEL

FIRE RETARDANT

UL LISTED

LOW THERMAL EXPANSION

WHITE OR GRAY COLOR OPTIONS

### BENEFITS

LIFE-CYCLE COST SAVINGS

MAINTENANCE-FREE LIFE

NO RUST, ROT,  
PEEL, OR FLAKE

EQUIPMENT &  
PRODUCT SAFETY

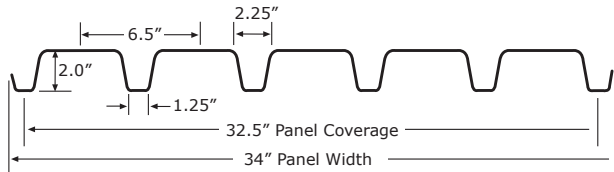
IMPROVED WORK  
CONDITIONS

Properties	6.5 x 2 Series 500	8.0 x 3.5 Series 700
Nominal Weight /SF	1.05 lb.	1.375 lb.
Nominal Glass Content, %	50	50
Resin System	Fire-Retardant Vinyl Ester	Fire-Retardant Vinyl Ester
Flame Spread Rating (ASTM E-84)	25 or less (Class 1)	25 or less (Class 1)
Moment Capacity/ft.	11,850 lbs. in.	12,400 lb. in.
Stiffness EI/ft.	2.32 x 10 <sup>6</sup> lb. in.	5.85 x 10 <sup>6</sup> lbs. in. <sup>2</sup>
Fastener Pullover, per fastener	630 lb. (.729" diam. washer)	850 lb. (1.125" diam. washer)
Flextural Strength / ASTM D-790	55,000 psi	55,000 psi
Flexural Modulus / ASTM D-790	2.4 x 10 <sup>6</sup> psi	2.4 x 10 <sup>6</sup> psi
Tensile Strength / ASTM D-790	42,000 psi	42,000 psi
Coefficient of Thermal Expansion / ASTM D-696	8 x 10 <sup>-6</sup> in/in°F	8 x 10 <sup>-6</sup> in/in°F

# Tuff Span FRP Roof Deck

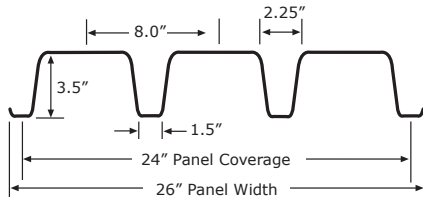
## Load/Span Tables: Dead + Live / Uplift Loading

### 6.5 x 2 VFR 500



Uniform Loads, PSF	20	30	40	50	60	70	80
Single Span	7'0"	6'1"	5'6"	5'1"	4'10"	4'7"	4'4"
Two Span	9'4"	8'2"	7'5"	6'11"	6'6"	6'2"	5'10"
Three or More Spans	8'7"	7'6"	6'10"	6'4"	6'0"	5'8"	5'5"

### 8.0 x 3.5 VFR 700



Uniform Loads, PSF	20	30	40	50	60	70	80
Single Span	9'6"	8'3"	7'6"	7'0"	6'7"	6'3"	6'0"
Two Span	12'9"	10'6"/11'1"	9'1"/10'1"	8'1"/9'4"	7'5"/8'6"	6'10"/7'9"	6'5"/6'9"
Three Spans	11'9"	10'3"	9'4"	8'8"	8'2"	7'8"	7'2"/7'5"

#### Roof Deck Design Parameters:

Span limits shown are based on roof deck being attached to each support at each low rib.

Deflection Limit = L/180

Live Load - Factor of Safety = 2.5 (1st span listed).

Uplift Load - Factor of Safety = 1.88.

## Wind Uplift

Tuff Span Roof Deck	6.5 x 2 Series 500	8.0 x 3.5 Series 700
Maximum Span	6'3"	8'0"
Fastener - Washer Diam. (1)	1-60: .729"; 1-90: 1.125"	1.125"
Fastener Spacing at Side Laps	18" o.c.	24" o.c.
Insulation Fasteners (2)	18 fasteners	18 fasteners
Poly-Iso Insulation Board	1.3" thick min.	1.3" thick min.
Wind Uplift Rating	1-90	1-90
Deflection Limit (3)	L/240	L/240

#### Notes:

- 1) Structural fasteners are required at each low rib of the deck unit.
- 2) Quantity is for each 4' x 8' insulation board panel.
- 3) With 300 lb. concentrated load.
- 4) Automatic sprinklers are required for Class 2 deck systems.

Tuff Span roof decks are UL Listed for Class 90 Uplift: Construction #NM523 for 6.5; #NM524 for 8.0.

## Specification

### Part 1 - General

Tuff Span products establish the minimum quality standard.

### Part 2 - Products

FRP roof deck shall be Tuff Span as manufactured by Enduro Composites, Houston, Texas or approved equal.

2.01 Profile/Series shall be:

\_\_\_\_\_ 6.5, Series 500 \_\_\_\_\_ 8.0, Series 700

2.02 Glass fiber reinforcements shall be continuous, straight, and bi-directional (along the length and width of the unit).

Glass content shall be a minimum of 50% by weight.

2.03 Resin type shall be premium grade vinyl ester.

2.04 Material shall have Class I Flame Spread of 25 or less per ASTM E 84

2.05 Color shall be: \_\_\_\_\_ White \_\_\_\_\_ Gray.

2.06 Design Criteria

A. Dead + Live Load: L/D = 180, FOS = 2.5

B. Wind Uplift Load: L/D = 180, FOS = 1.88

C. Compliance with design criteria shall be established by large scale, vacuum box testing for live and uplift loads.

### Part 3 - Execution

3.01 FRP roof deck units shall be installed in accordance with Manufacturer's Installation Guide.

3.02 Roofing insulation / membrane shall be attached by:

\_\_\_\_\_ Mechanical (positive lock) fasteners: Enduro N-C Plastic, TPR Peel Rivet, or Speed-Lock Toggle.

\_\_\_\_\_ Cold adhesive: Olybond 500, Duro-Grip, or equal.

\_\_\_\_\_ Hot bituminous adhesive: Maximum temperature per NRCA Handbook of Accepted Roofing Knowledge



# Tuff Span FRP Form Deck

## Permanent Form & Corrosion Protection for Concrete Slabs

**Extending concrete life and improving plant safety, Tuff Span™ Fiberglass Reinforced Plastic (FRP) Form Deck by Enduro delivers important value for industrial plants.**

In chemical exposure, corrosion can attack steel form deck, concrete slabs, and its reinforcing bars. For these tough conditions, Tuff Span FRP Form Deck can provide a permanent form and corrosion protection for the underside of slabs. In addition, the corrosion resistant form deck can protect personnel and equipment located below by eliminating the threat of falling particles that can occur with a deteriorated steel deck.

Reinforced with high-tensile strength glass fibers consisting of 48% of its weight, Tuff Span has the strength and stiffness needed for reliable support of heavy, wet concrete. Strategically placed in bidirectional alignment, the straight and continuous glass fiber reinforcements provide efficient load transfer within the section.

The reinforcements are embedded within a vinyl ester resin system that provides enhanced strength retention at high temperatures in addition to outstanding corrosion resistance. The fire retardant material has a Class I flame spread rating of 25 or less per ASTM E84 testing.

For worker safety and finished slab quality, deflection must be minimized during concrete pour and curing stage. For form deck applications, Enduro recommends selection of one of its higher strength, Tuff Span panel products and maximum allowable deflection of L/180.



Form Deck

### USES

**PERMANENT FORM FOR CONCRETE**  
**PROTECTION FOR UNDERSIDE OF SLAB**

### FEATURES

**CORROSION RESISTANCE**  
**STRONGEST FRP BUILDING PANEL**  
**FIRE RETARDANT**

### BENEFITS

**LONGER LIFE FOR CONCRETE SLAB**  
**IMPROVED PLANT SAFETY**

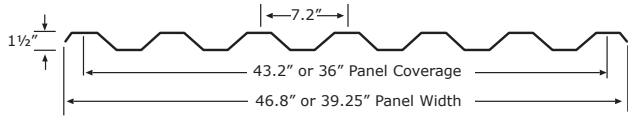
Properties	7.2 x 1.5 VFR 450	7.2D x 1.75 VFR 450	6.5 x 2 VFR 500	8.0 x 3.5 VFR 700
Nominal Weight / SF	1.0 lb.	1.0 lb.	1.06 lb.	1.375 lb.
Nominal Glass Content	48% by Wt.	48% by Wt.	50% by Wt.	50% by Wt.
Moment Capacity / ft.	11,350 lb. in.	13,250 lb. in.	11,850 lb. in.	12,400 lb. in.
Stiffness EI / ft.	1.126 x 10 <sup>6</sup> lb. in. <sup>2</sup>	1.385 x 10 <sup>6</sup> lb. in. <sup>2</sup>	2.32 x 10 <sup>6</sup> lb. in. <sup>2</sup>	5.85 x 10 <sup>6</sup> lb. in. <sup>2</sup>
Resin System	Fire-Retardant, Vinyl Ester (VFR)			
Flame Spread Rating (ASTM E-84)	25 or less (Class 1)			
Standard Colors	White or Gray			



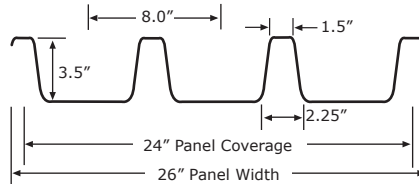
# Tuff Span FRP Form Deck

## Permanent Form & Corrosion Protection for Concrete Slabs

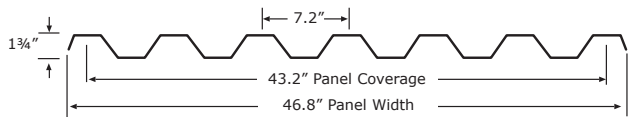
### 7.2 x 1.5 RIB



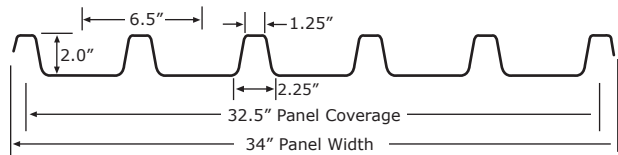
### 8.0 x 3.5



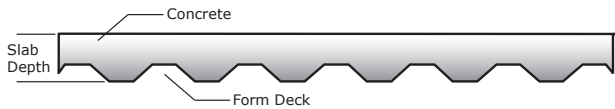
### 7.2D x 1.75 RIB



### 6.5 x 2.0



## Diagram



Total slab depth is considered from bottom of deck to top of slab.

## Maximum Unshored Spans: Normal Wt. Concrete, 145 PCF, Uniform Load

Slab Depth	Tuff Span Form		Load PSF	L/D = 180, FOS = 2.5			L/D = 240, FOS = 2.5		
	Profile	Series		1 Span	2 Span	3 Span	1 Span	2 Span	3 Span
4.0"	7.2D x 1.75	450	39	4'9"	6'5"	5'11"	4'4"	5'10"	5'4"
	7.2 x 1.5	450	41	4'3"	5'9"	5'3"	3'10"	5'2"	4'10"
4.5"	7.2D x 1.75	450	45	4'7"	6'1"	5'8"	4'2"	5'7"	5'1"
	7.2 x 1.5	450	47	4'1"	5'6"	5'1"	3'8"	5'0"	4'7"
5.0"	6.5 x 2.0	500	56	4'11"	6'7"	6'1"	4'6"	6'0"	5'6"
	7.2D x 1.75	450	51	4'4"	5'10"	5'5"	3'11"	5'4"	4'11"
5.5"	6.5 x 2.0	500	62	4'9"	6'5"	5'11"	4'3"	5'10"	5'4"
	7.2D x 1.75	450	57	4'2"	5'8"	5'2"	3'10"	5'1"	4'9"
6.0"	8.0 x 3.5	700	65	6'5"	7'1"	7'11"	5'10"	7'1"	7'2"
	6.5 x 2.0	500	68	4'7"	6'2"	5'9"	4'2"	5'8"	5'2"
6.5"	8.0 x 3.5	700	71	6'3"	6'9"	7'7"	5'8"	6'9"	7'0"
	6.5 x 2.0	500	74	4'6"	6'0"	5'7"	4'1"	5'6"	5'1"
7.0"	8.0 x 3.5	700	77	6'1"	6'6"	7'3"	5'6"	6'6"	6'10"
	6.5 x 2.0	500	80	4'4"	5'11"	5'5"	4'0"	5'4"	4'11"
7.5"	8.0 x 3.5	700	83	5'11"	6'3"	7'0"	5'4"	6'3"	6'7"
	6.5 x 2.0	500	86	4'3"	5'9"	5'3"	3'10"	5'2"	4'10"
8.0"	8.0 x 3.5	700	89	5'9"	6'1"	6'9"	5'3"	6'1"	6'6"
	6.5 x 2.0	500	92	4'2"	5'7"	5'2"	3'9"	5'1"	4'8"

### Notes:

- 1) Load, PSF = Uniform weight of concrete + Weight of form deck.
- 2) Maximum spans shown are based on:
  - Deflection not exceeding the more conservative value of L/180 or L/240 (as specified) or 1/2" under uniform concrete load.
  - Deflection, prior to concrete placement, not exceeding L/120 under 50 lbs/SF construction load.
  - Minimum factor of safety of 2.5 for Moment Capacity.
- 3) Form Deck panels must be fastened to structural supports in every low rib and to adjacent panels at side-laps, 18" on center.
- 4) The information in the tables is intended for use as a guideline only. Please contact us for assistance with material selection and information not covered such as maximum shored spans and other slab conditions.

# Tuff Span FRP Louvers

## Corrosion Resistant Ventilation Components

**Tuff Span™ fiberglass reinforced plastic louvers from Enduro provide effective air control and long service life for applications with demanding structural and environmental conditions. Servicing a range of needs, the louvers are available with either fixed or adjustable blades and openings.**

With durable FRP components, Tuff Span louvers have a long history of standing up to tough chemical exposures and high windstorms. Having a glass fiber reinforcing content of over 50% of its weight, the FRP frames and blades are extremely strong and stiff. Formulated with premium iso-polyester resin, the units are resistant to attack from aggressive chemicals.

The fire retardant FRP components have a Class I flame spread rating of 25 or less per ASTM E84. The units are available in opaque colors that match and blend with Tuff Span siding panels. In addition, as an option, the louver blades can be translucent to provide natural lighting for the facility.



*Tuff Span Louvers & Windwall Panels at offshore platform.*



*Tuff Span Louvers, Beams & Cladding at copper mine*

### USES

FRP-6 STATIONARY LOUVERS

FRP-6 ADJUSTABLE LOUVERS

### FEATURES

CORROSION RESISTANCE

STRONG & DURABLE

FIXED OR ADJUSTABLE BLADES

SIZE OPTIONS

FIRE RETARDANT

### BENEFITS

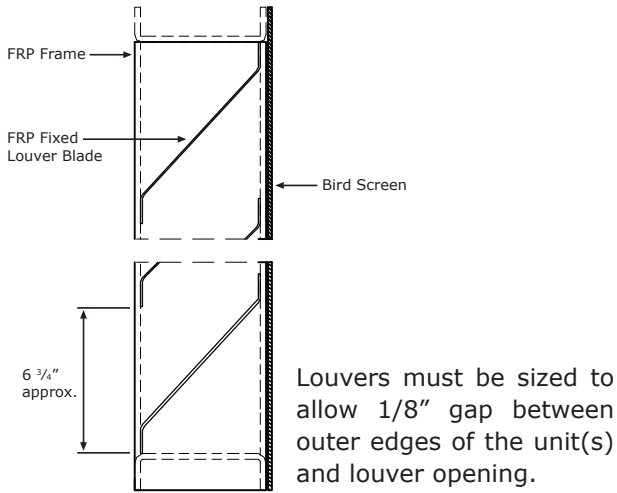
LIFE-CYCLE COST SAVINGS

LONG, MAINTENANCE-FREE LIFE

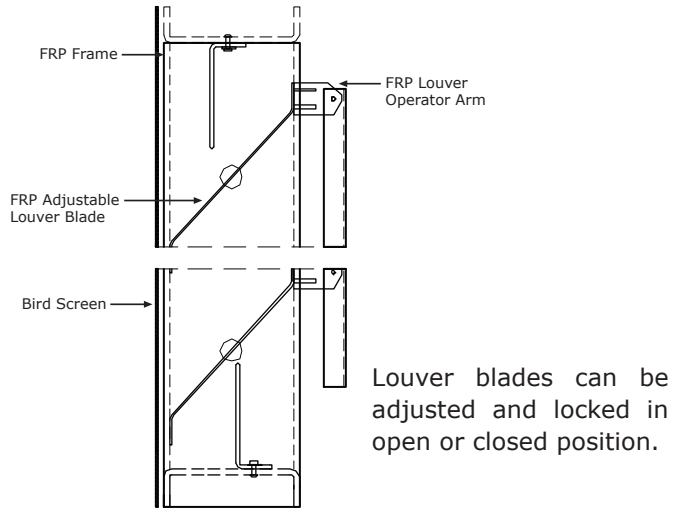
Product Description			
FRP-6 Stationery Louver - Size Range	Height: 24" - 120"	Width: 24" - 96"	Depth: 6"
FRP-6 Adjustable Louvers - Size Range	Height: 24" - 96"	Width: 24" - 48"	Depth: 6"
FRP Components	Frames: Pultruded Channel	Blades: Tuff Span Panel	
Resin Systems	Isophthalic Polyester		
Flame Spread Rating, ASTM E-84	Class 1, 25 or less		
Hardware: 304 Stainless Steel	Optional Adder: Hardware - 316 Stainless Steel		
Bird Screen: Black Plastic - 1/2" (12.7mm) Mesh	Optional Adder: Bird Screen - 304 or 316 SS - 1/2" mesh - 19ga Wire Optional Adder: Insect Screen - 304 or 316 SS - 18x18 Mesh - 33ga Wire Cloth		
Standard Colors	Blades: Gray, White, Beige, Translucent Clear		Frame: Gray
Custom colors are available for added cost & order minimums			

# Tuff Span FRP Louvers

## FRP-6 Stationary Louver



## FRP-6 Adjustable Louver

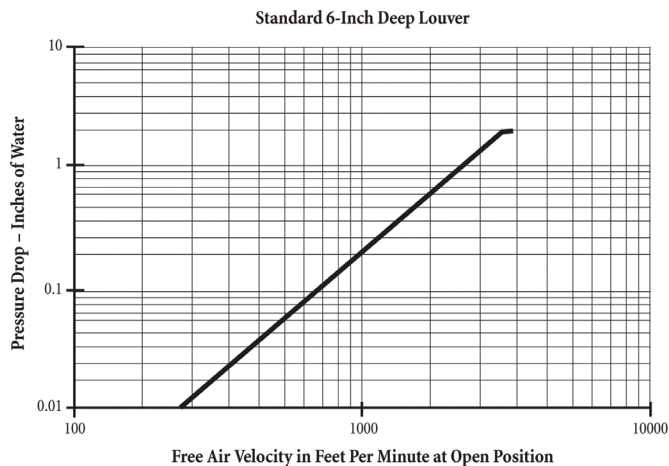


## Free Area Guide in SF:

	24	30	36	42	48	54	60	66	72	78	84	90	96
24	1.10	1.42	1.73	2.05	2.37	2.69	3.00	3.32	3.64	3.96	4.28	4.59	4.91
30	1.65	2.12	2.60	3.08	3.55	4.03	4.51	4.98	5.46	5.94	6.41	6.89	7.37
36	2.20	2.83	3.47	4.10	4.74	5.37	6.01	6.65	7.28	7.92	8.55	9.19	9.82
42	2.75	3.54	4.34	5.13	5.92	6.72	7.51	8.31	9.10	9.90	10.69	11.48	12.28
48	3.30	4.25	5.20	6.16	7.11	8.06	9.01	9.97	10.92	11.87	12.83	13.78	14.73
54	3.85	4.96	6.07	7.18	8.29	9.41	10.52	11.63	12.74	13.85	14.97	16.08	17.19
60	3.85	4.96	6.07	7.18	8.29	9.41	10.52	11.63	12.74	13.85	14.97	16.08	17.19
66	4.39	5.67	6.94	8.21	9.48	10.75	12.02	13.29	14.56	15.83	17.10	18.37	19.64
72	4.94	6.37	7.80	9.23	10.66	12.09	13.52	14.95	16.38	17.81	19.24	20.67	22.10
78	5.49	7.08	8.67	10.26	11.85	13.44	15.02						
84	6.04	7.79	9.54	11.29	13.03	14.78	16.53						
90	6.59	8.50	10.40	12.31	14.22	16.12	18.03						
96	7.14	9.21	11.27	13.34	15.40	17.47	19.53						
102	7.14	9.21	11.27	13.34	15.40	17.47	19.53						
108	7.69	9.92	12.14	14.36	16.59	18.81	21.03						
114	8.24	10.62	13.01	15.39	17.77	20.15	22.54						
120	8.79	11.33	13.87	16.41	18.96	21.50	24.04						

Notes: 1) Free area calculations do not consider obstructed area created by bird or insect screen. 2) Contact Enduro for open area of sizes not listed.

## Free Air Velocity Chart





# Tuff Span FRP Ridge Vents

## Corrosion Resistant Ventilation Components

**Tuff Span™ FRP Ridge Vents from Enduro provide effective air flow and long, service life for applications with demanding structural and environmental conditions. The fiberglass reinforced plastic ventilators are designed for optimum air flow and moisture drainage plus high wind conditions.**

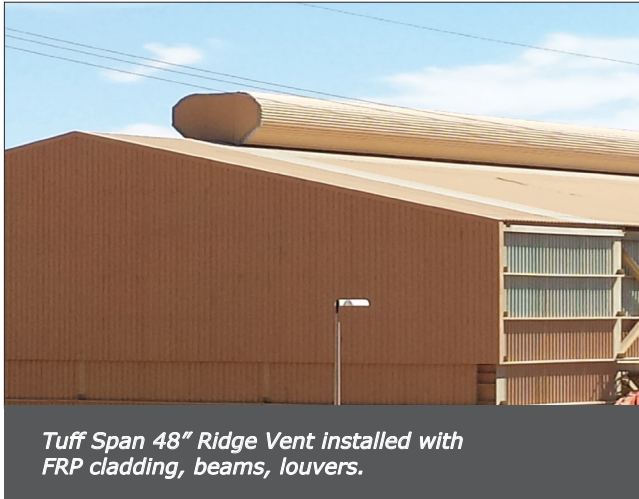
Ridge Vents with 12" and 18" throats are available with fixed or operable dampers for stationary or adjustable openings. These units are offered in factory-assembled, 10' sections for installation as individual units or in continuous, adjacent sections.

Large throat ventilators with 24" to 96" fixed openings include factory fabricated components, cut and pre-drilled, for easy field assembly and handling.

Tuff Span FRP Ridge Vents have a long, proven history of resistance to tough chemical exposures and structural conditions in addition to providing effective ventilation.



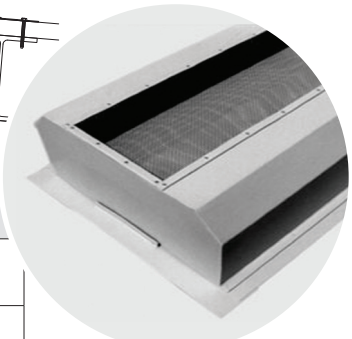
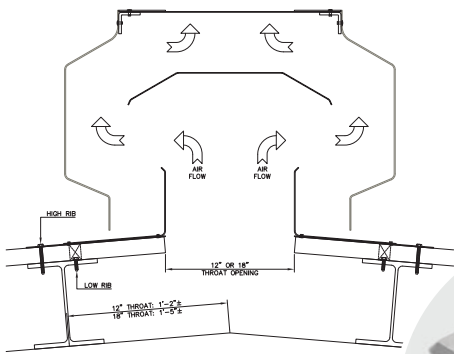
*Tuff Span 12" Ridge Vent installed with FRP cladding, louvers, gutter.*



*Tuff Span 48" Ridge Vent installed with FRP cladding, beams, louvers.*

### FEATURES & BENEFITS

- CORROSION RESISTANCE
- STRONG & DURABLE
- FIRE RETARDANT
- SIZE & COLOR OPTIONS
- FIXED & ADJUSTABLE THROAT
- LONG, MAINTENANCE-FREE LIFE



Product Description	
Size Options	12" to 18" Throat Opening, Fixed or Adjustable, Factory Assembled Units 24" to 96" Throat Opening, Fixed, Field Assembled Units
Colors	Gray, white, or beige exterior. Internal components are charcoal gray.
Bird Screen	Black Plastic-1/2" Mesh (12.7mm). Stainless steel screen is available for added cost.
Hardware	304 Stainless Steel. 316 stainless steel hardware is available for added cost.
Resin System	Isophthalic Polyester
Flame Spread Rating	Class 1, 25 or less per ASTM E-84

Ridge Vents



# Tuff Span FRP Gutter & Downspout

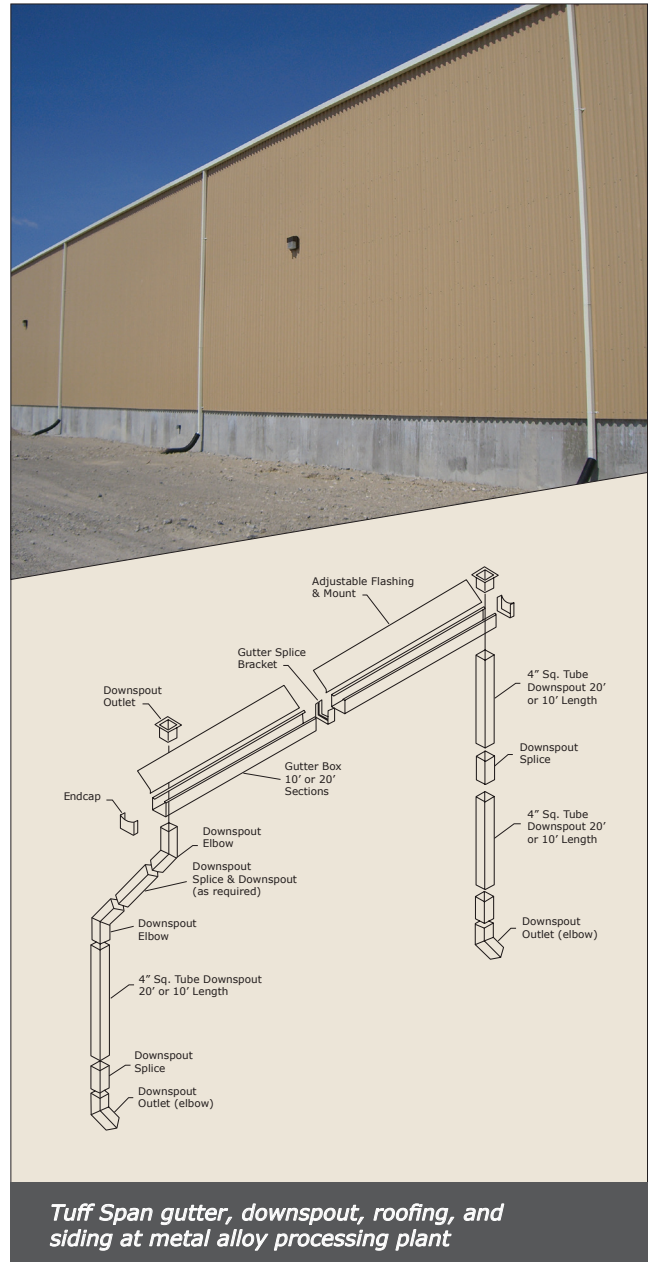
## Corrosion Resistant Drainage Components

Tuff Span™ fiberglass reinforced plastic gutter systems from Enduro provide effective moisture drainage and long, service life for applications with demanding structural and environmental conditions. With gutter, downspout, and accessories the system provides a complete corrosion resistant solution.

The gutter's continuously-hinged flange pivots to fit any roof pitch. This eliminates the need for individual hangers or brackets that may be required with other systems.

With high strength and outstanding corrosion resistance, the gutter system handles high loads and tough chemical exposures. Its pultruded FRP components are built with glass fiber reinforcements exceeding 50% of its weight that produce high structural properties. Formulated with premium iso-polyester resin, the units are resistant to attack from aggressive chemicals.

The fire retardant FRP components have a Class I flame spread rating of 25 or less per ASTM E84. The units are offered in colors and materials that blend with Tuff Span roofing and siding panels.



Tuff Span gutter, downspout, roofing, and siding at metal alloy processing plant

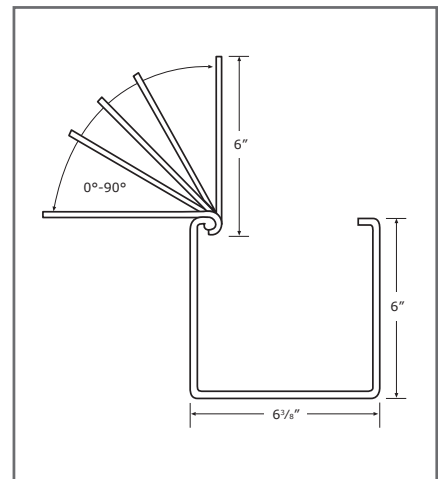
### PRODUCTS

- 6" X 6 3/8" FRP GUTTER
- ADJUSTABLE MOUNTING FLANGE
- 4" X 4" FRP DOWNSPOUT
- END CAPS, ELBOWS
- ACCESSORIES

### FEATURES & BENEFITS

- CORROSION RESISTANCE
- STRONG & DURABLE
- FIRE RETARDANT
- MAINTENANCE FREE
- LIFE-CYCLE COST SAVINGS

Hinged gutter flange pivots to match any roof slope.



Product Description	
Gutter & Downspout	High Strength, Pultruded FRP Components
Resin System	Isophthalic Polyester
Flame Spread Rating, ASTM E-84	Class 1, 25 or less
Standard Colors	Gray, White, Beige



### Designed for High Load & Long Span Capability

**Tuff Span™ Flanged Tube Beams** are developed specifically for applications that require high load and long span capability plus corrosion resistance. This includes building structures, baffle wall columns, and support of tank cover decking. These sections utilize a custom design that optimizes structural properties and cost through innovative use of shape, glass fiber reinforcing, and manufacturing process.

Tuff Span purlins & girts are designed for the harshest environments. Utilizing an iso-polyester or vinyl resin system provides outstanding corrosion protection and is fire retardant with a flame spread rating of 25 or less. The resulting combination of corrosion resistance, non-conductivity, and long span capability delivers significant end user benefits and life cost savings.

The flanged tube shape increases structural properties and contributes to easy installation.

#### STRUCTURAL PERFORMANCE

As a result of efficient design, 8F6 Flanged Tube Beams, at lesser weight and without bracing, carry more load than heavier FRP I-Beams and WF-Beams! 8F6 Flanged Tube, at 15% and 30% less weight, has greater load capacity than heavier FRP I-beams and WF Beams with bracing for single span conditions. For two span conditions, the 8F6 capacity is even greater.

#### EASIER INSTALLATION

The flanged tube shape provides lateral stability eliminating the need for lateral bracing, plates or angles on primary framing, or sag rods. FRP components are lighter in weight and far easier to drill and cut in the field than steel components while not requiring hot work permits. These features provide time and cost savings to facilities.



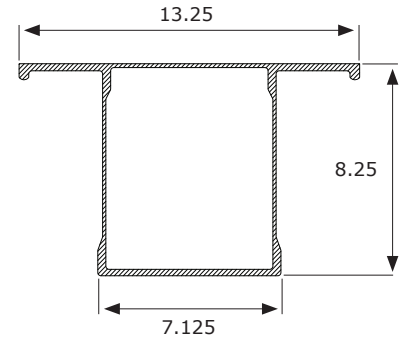
USES	FEATURES	BENEFITS
PURLINS	CORROSION RESISTANCE	LIFE-CYCLE COST SAVINGS
GIRTS	TUBULAR SHAPE	MAINTENANCE-FREE LIFE
PENETRATION & ACCESSORY FRAMING	FIRE RETARDANT	LONG SPAN CAPABILITY WITHOUT LATERAL BRACING
WALKWAY & PLATFORM FRAMING	LIGHTWEIGHT	REDUCED INSTALLATION TIME & COSTS





## 8F6 Purlin / Girt

Allowable Uniform Load - Unbraced												
Span (Ft.)	Purlin Positive Load, FOS = 2.5						Purlin/Girt Wind Load, FOS = 1.88					
	L/D = 120			L/D = 180			L/D = 120			L/D = 180		
	1	2	3	1	2	3	1	2	3	1	2	3
16	388	290	330	258	290	330	388	632	731	258	622	488
17	323	273	310	215	273	310	323	560	610	215	519	407
18	272	258	293	181	258	293	272	499	514	181	437	342
19	231	244	278	154	244	278	231	448	437	154	372	291
20	198	232	264	132	232	250	198	404	374	132	319	250
21	171	221	251	114	221	216	171	367	324	114	275	216
22	149	211	240	99	211	188	149	334	281	99	239	188
23	130	202	229	87	202	164	130	306	246	87	210	164
24	115	193	217	77	184	144	115	277	217	77	184	144
25	102	186	192	68	163	128	102	245	192	68	163	128
26	90	178	170	60	145	114	90	218	170	60	145	114
27	81	167	152	54	130	101	81	194	152	54	130	101
28	72	155	136	48	116	91	72	174	136	48	116	91
29	65	145	123	43	105	82	65	157	123	43	105	82
30	59	135	111	39	94	74	59	142	111	39	94	74



- W = 6.1 lb/ft
- A = 8 in<sup>2</sup>
- I<sub>xx</sub> = 93 in<sup>4</sup>
- I<sub>yy</sub> = 98 in<sup>4</sup>
- E = 3,841,000 psi
- G = 450,000 psi
- M = 456,000 lb-in

Shaded areas: 8F6 Beam has web stiffeners. Contact Enduro for purlin spans without stiffeners.

Covering a broad range of structural requirements, flanged tube sections are available in 8", 12" and 18" depths.



Tuff Span 8F6 girts on a chlor-alkali facility.



Tuff Span 8F6 purlins and girts on a fertilizer storage facility.



# Tuff Span FRP Structural Shapes

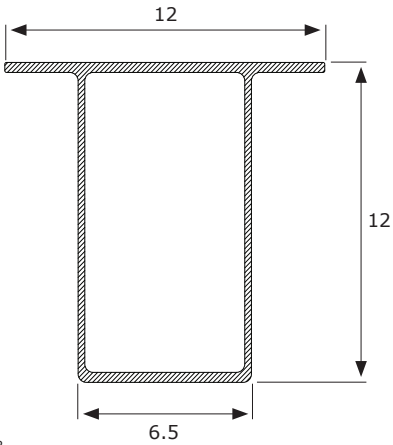
## 12F12 Flanged Tube

Span (Ft.)	Allowable Uniform Load - Unbraced					
	L/D = 120		L/D = 180		L/D = 240	
	1	2	1	2	1	2
21	570	741	380	741	285	687
22	496	675	331	675	248	597
23	434	618	289	618	217	523
24	382	567	255	567	191	460
25	338	523	225	523	169	407
26	300	483	200	483	150	362
27	268	448	179	431	134	323
28	241	417	160	386	120	290
29	217	388	144	348	108	261
30	196	363	130	314	98	236
31	177	340	118	285	89	214
32	161	319	107	259	81	194
33	147	300	98	236	73	177
34	134	283	90	216	67	162
35	123	267	82	198	62	148

Beam FOS = 2.5

Column Load	
Lth (Ft.)	Axial (Lbs.)
6	55349
7	50850
8	47249
9	44285
10	41792
11	39658
12	37804
13	36176
14	34731
15	33438
16	32272
17	31214
18	30248
19	29361
20	28545

Col. FOS = 3



- W = 12 lb/ft
- A = 12.64 in<sup>2</sup>
- I<sub>xx</sub> = 284.26 in<sup>4</sup>
- I<sub>yy</sub> = 118.31 in<sup>4</sup>
- E = 4,180,000 psi
- G = 425,000 psi
- M = 1,225,000 lb-in
- r = 3.0572 in
- B<sub>f</sub>/B<sub>t</sub> = 32
- K = 1

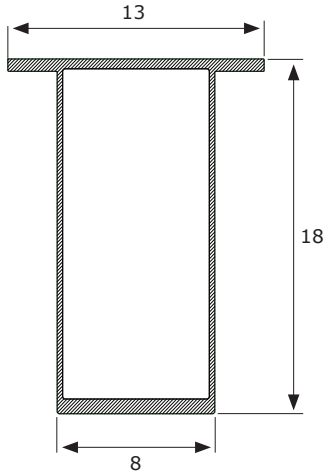
## 18F17 Flanged Tube

Span (Ft.)	Allowable Uniform Load - Unbraced					
	L/D = 120		L/D = 180		L/D = 240	
	1	2	1	2	1	2
31	555	555	472	555	354	555
32	521	521	429	521	322	521
33	490	490	392	490	294	490
34	461	461	358	461	269	461
35	435	435	328	435	246	435
36	412	412	302	412	226	412
37	390	390	278	390	208	390
38	369	369	256	369	192	369
39	351	351	237	351	178	351
40	330	333	220	333	165	333
41	306	317	204	317	153	317
42	285	302	190	302	142	302
43	266	288	177	288	133	288
44	248	275	165	275	124	275
45	232	263	154	263	116	263

Beam FOS = 2.5

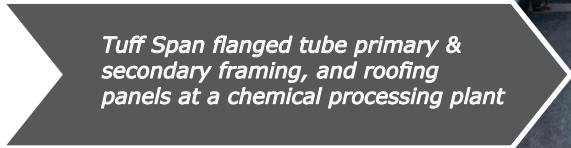
Column Load	
Lth (Ft.)	Axial (Lbs.)
11	72396
12	69013
13	66041
14	63403
15	61042
16	58914
17	56982
18	55218
19	53600
20	52109
21	50730
22	49448
23	48254
24	47137
25	46091

Col. FOS = 3



- W = 16.75 lb/ft
- A = 22.47 in<sup>2</sup>
- I<sub>xx</sub> = 1197.3 in<sup>4</sup>
- I<sub>yy</sub> = 279.7 in<sup>4</sup>
- E = 3,967,000 psi
- G = 425,000 psi
- M = 2,000,000 lb-in
- r = 3.53 in
- B<sub>f</sub>/B<sub>t</sub> = 20.8
- K = 1

Structural Shapes



*Tuff Span flanged tube primary & secondary framing, and roofing panels at a chemical processing plant*





# Tuff Span FRP Structural Shapes


## Tuff Span™ Standard Shapes


Tuff Span Standard Shapes include fiberglass reinforced plastic channel, angle, tube, wide flange, and flat plate sections. The sections are manufactured by pultrusion process that provides consistent properties, close tolerances, good surface finish, and optimum strength and stiffness with glass fiber reinforcements up to 60% of the material weight.


The material's iso-polyester or vinyl resin system provides outstanding corrosion protection and is fire retardant with a flame spread rating of 25 or less. The resulting combination of corrosion resistance, non-conductivity, and long span capability delivers significant end user benefits and life cost savings.


Channel 	
Size	Lbs/Ft
3" x 1" x 3/16"	0.68
4" x 1 1/8" x 1/4"	1.13
4 3/4" x 3 1/4" x 1/4"	2.06
6" x 1 5/8" x 1/4"	1.70
6" x 1 5/8" x 5/16"	2.10
6 7/8" x 5 3/8" x 1/4"	3.08
8" x 1 3/4" x 5/16"	2.50
10" x 2 3/4" x 3/8"	4.27

Angle 	
Size	Lbs/Ft
2" x 2" x 1/4"	0.69
3" x 3" x 3/8"	1.53
4" x 4" x 3/8"	2.09
6" x 6" x 3/8"	3.35

Flat Sheet 	
Size	Lbs/Ft
3' x 10' x 1/8" Thick	1.41
3' x 10' x 3/16" Thick	1.71
3' x 10' x 1/4" Thick	2.34
3' x 10' x 3/8" Thick	3.35
3' x 10' x 1/2" Thick	4.03

Square Tube 	
Size	Lbs/Ft
1 5/8" x 1 5/8" x 1/8"	0.56
2" x 2" x 1/4"	1.40
3" x 3" x 1/4"	2.20
4" x 4" x 1/4"	3.25

Wide Flange Beam 	
Size	Lbs/Ft
6" x 6" x 3/8"	5.30

Round Tube 	
Size	Lbs/Ft
2 3/8" x 1/4"	1.45

Please contact Enduro for additional information and our Structural Shapes Technical Data Guide.



Structural Shapes

# Chemical Resistance Guide

It is important to consider the effects of chemical exposure to materials in the design stage. Many factors should be evaluated, including chemical type, concentration, duration of exposure, and operating temperature. Enduro Composites should be contacted for material recommendations regarding specific applications and for information on chemical exposures not listed in this guide.

Enduro Composites offers panels in three standard resin systems, which provide outstanding corrosion protection for a broad range of applications. Premium grade isophthalic polyester and aliphatic hybrid are recommended for splash and spill chemical exposure and moderate operating temperatures. Having better strength retention at elevated temperatures, vinyl ester is recommended for certain higher temperatures and chemical exposures.

Chemical	Max. Cont. Temp. (°F)				Chemical	Max. Cont. Temp. (°F)			
	%	Iso Polyester	Aliphatic Hybrid	Vinyl Ester		%	Iso Polyester	Aliphatic Hybrid	Vinyl Ester
Acetic Acid	10	150	150	210	Kerosene/Fuel Oil	100	150	150	180
Acetic Acid	50	125	125	180	Magnesium Chloride	100	150	150	210
Acetone	All	NR	NR	180	Methyl Alcohol	100	90	90	120
Alum	Vapor	150	150	210	Mineral Oil	100	150	150	210
Aluminum Potassium Sulfate	All	150	150	210	Naptha	100	150	150	180
Aluminum Sulfate	All	150	150	210	Nitric Acid	5	150	150	160
Ammonia	-	-	-	100	Nitric Acid	20	-	-	120
Ammonium Hydroxide	10	90	90	160	Nitric Acid Vapor	20	150	150	180
Ammonium Nitrate	All	150	150	210	Phosphoric Acid	85	150	150	210
Benzene	All	90	90	NR	Potassium Aluminum Sulfate	Sat'd	150	150	210
Benzenesulfonic Acid	30	150	150	210	Sodium Bicarbonate	10	140	140	180
Bromine (Dry & Wet Gases)	100	90	90	100	Sodium Bisulfate	All	150	150	210
Calcium Chloride	All	150	150	210	Sodium Carbonate	All	90	90	160
Carbon Tetrachloride	Vapor	70	70	175	Sodium Chloride	Sat'd	150	150	210
Chloride Dioxide	Fumes	90	90	210	Sodium Hydroxide	5	150	150	180
Chlorine (Wet Gas)	All	90	90	210	Sodium Hydroxide	Vapor	150	150	180
Chlorine Cell Plant	10	-	-	150	Sodium Hypochlorite	5	125	125	180
Chromic Acid	10	-	-	150	Sodium Hypochlorite	Vapor	150	150	180
Cooling Tower Water	-	130	130	170	Sodium Nitrate	All	150	150	210
Copper Sulfate	All	150	150	210	Sodium Silicate	All	NR	NR	210
Diammonium Phosphate	Vapor	90	90	210	Sodium Sulfate	All	150	150	210
Dibutyl Phthalaic	100	90	90	150	Soya Oil	100	130	130	210
Ethylene Chlorohydrin	100	90	90	150	Sulfite Liquors	-	120	120	210
Ethylene Dichloride	All	NR	NR	100	Sulfur Dioxide	Dry/Wet	150	150	210
Ethylene Glycol	All	150	150	210	Sulfur Trioxide	100	90	90	210
Fatty Acids	100	150	150	210	Sulfuric Acid	50	150	150	210
Ferrous Sulfate	All	150	150	210	Sulfuric Acid	70	150	150	180
Floussilic Acid	10	100 (4)	100 (4)	180 (4)	Sulfuric Acid	Vapor	150	150	210
Fungicides, Organic	100	90	90	-	Tannic Acid	All	150	150	210
Hydrochloric Acid	15	150	150	210	Trisodium Phosphate	25	-	-	210
Hydrochloric Acid	32	100	100	180	Urea	Sat'd	90	90	180
Hydrochloric Acid	Vapor	150	150	210	Water Distilled	100	150	150	210
Hydrofluoric Acid	10	100 (4)	100 (4)	150 (4)	Water (city/sea)	100	150	150	210
Hydrogen Chloride (Gas)	100	120	120	210	Zinc Sulfate	All	150	150	210
Hydrogen Sulfide	All	150	150	210					

**Notes:**

1. Design engineers and plant personnel should use this guide to help with selecting the appropriate resin for their application. Since specific applications vary, this information should be used as a guide only and not considered as a guarantee of performance.  
 2. The information shown is for standard Tuff Span iso-polyester and vinyl ester materials having a Class I Flame Spread rating.

3. The resin system for Tuff Span FM approved panels is an iso-polyester with specific additives for enhanced fire retardance. The chemical resistance for Tuff Span FM Series panels is excellent but should not be considered the same as standard iso-polyester. Enduro Composites should be contacted for specific recommendations.  
 4. A surfacing veil is recommended for this exposure.





# Other Enduro Products

## CABLE MANAGEMENT PRODUCTS

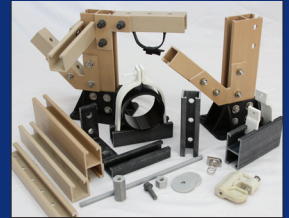
FRP CABLE TRAY (LADDER-TYPE)

FRP INSTRUMENTATION TRAY (CHANNEL-TYPE)

FRP INSTRUMENT STANDS

FRP STRUT SUPPORT SYSTEMS

LIGHT RAIL COVERBOARD



## WATER & WASTEWATER PRODUCTS

FRP BAFFLE & PARTITION WALLS

FLAT, FRP TANK COVERS

WALK-IN FRP TANK COVERS

SLUDGE DRYING BED ROOFS

FRP BUILDINGS



## CLARIFIER PRODUCTS

FRP WEIRS AND SCUM BAFFLES

FRP DENSITY CURRENT BAFFLES

FRP LAUNDER COVERS

FRP LAUNDER TROUGHS







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**BUILDING PRODUCTS**  
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