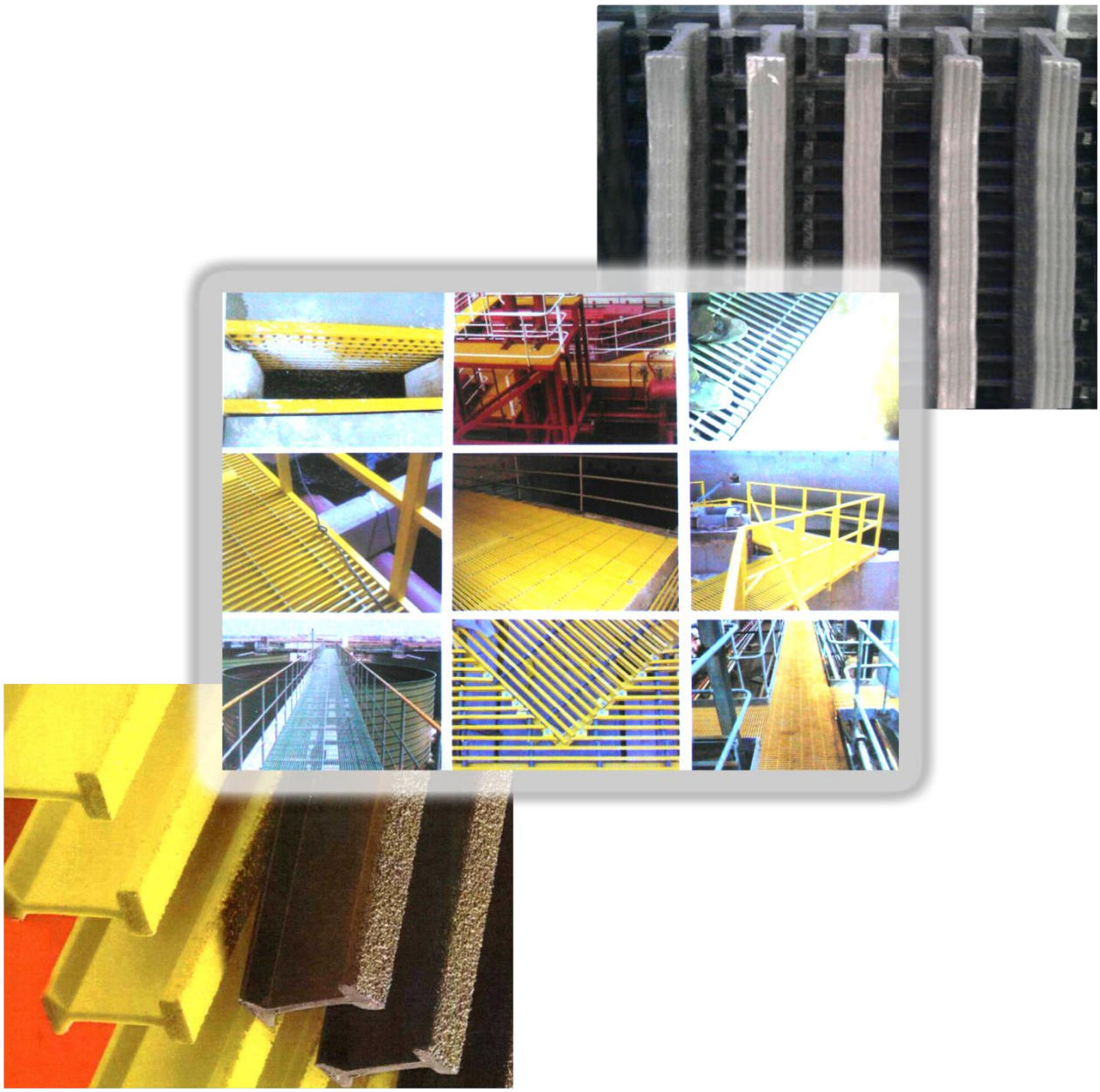
گـــروه فـــن آوری هـــای نـــویـــن

ارائه خدمات و تکنولوژیهای نوین صنعت ساختمان

MTgroup
CONSTRUCTIONS & DEVELOPMENT

# SPECIFICATIONS OF

# PULTRUDED GRATINGS



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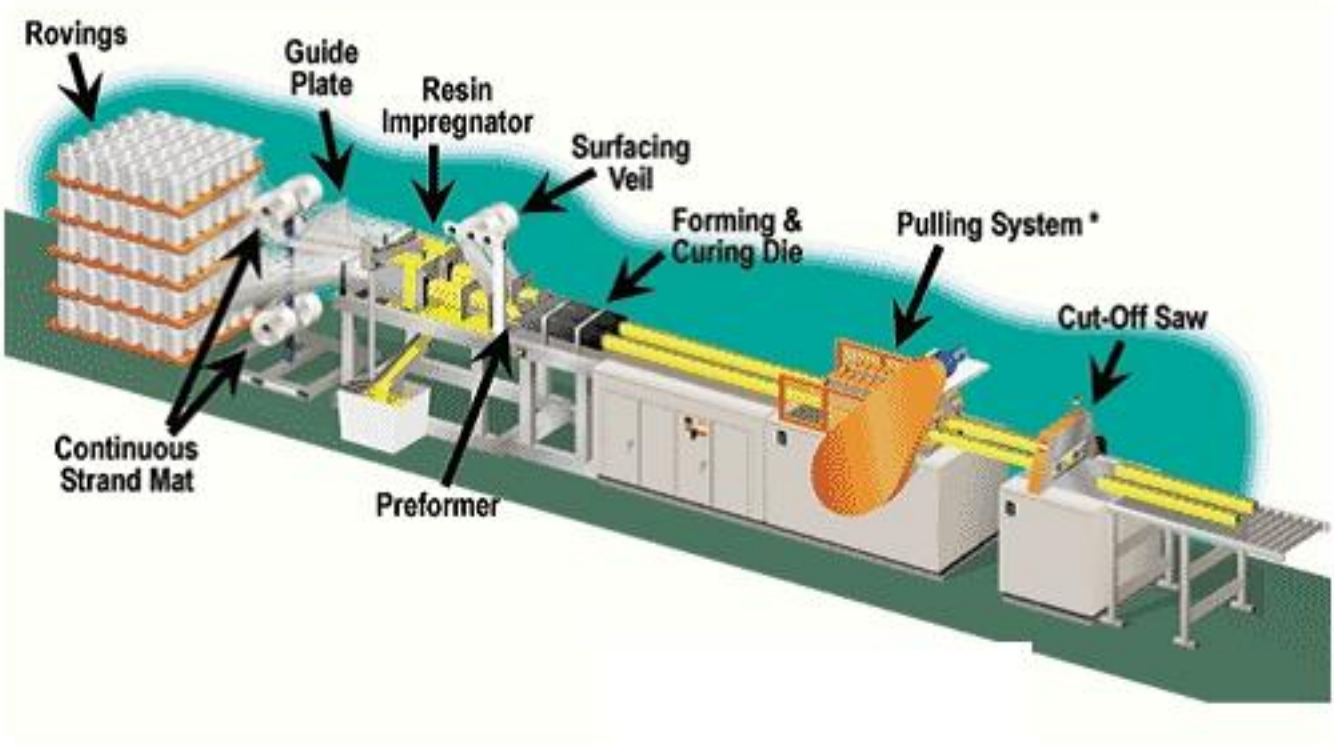
## *THE PULTRUSION PROCESS*

Pultrusion is a manufacturing process for producing continuous lengths of reinforced polymer structural shapes with constant cross-sections. Raw materials are a liquid resin mixture (containing resin, fillers and specialized additives) and flexible textile reinforcing fibers. The process involves pulling these raw materials (rather than pushing, as is the case in extrusion) through a heated steel forming die using a continuous pulling device. The reinforcement materials are in continuous forms such as rolls of mat and doffs of roving. As the reinforcements are saturated with the resin mixture ("wet-out") in the resin bath and pulled through the die, the gelatin or hardening, of the resin is initiated by the heat from the die and a rigid, cured profile is formed that corresponds to the shape of the die. While pultrusion machine design varies with part geometry, the basic pultrusion process concept is described in the following schematic.



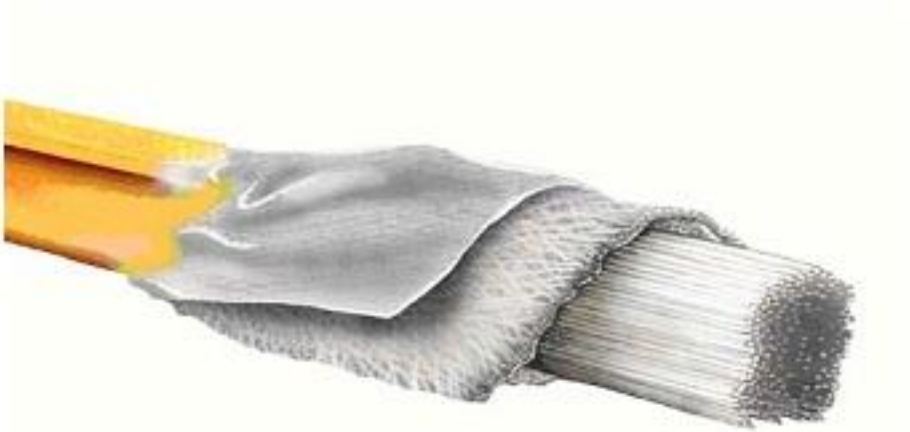

The creels position the reinforcements for subsequent feeding into the guides. The reinforcement must be located properly within the composite and this is the function of the reinforcement guides.

The resin bath saturates (wets out) the reinforcement with a solution containing the resin, fillers, pigment, and catalyst plus any other additives required. The interior of the resin bath is carefully designed to optimize the wet-out of the reinforcement.

On exiting the resin bath, the composite is in a flat sheet form. The performer is an array of tooling which squeezes away excess resin as the product is moving forward and gently shapes the materials prior to entering the forming and curing die. In the forming and curing die, the thermosetting reaction is heat activated (energy is primarily supplied electrically) and the composite is cured (hardened). On exiting the die, it is necessary to cool the hot part before it is gripped by the pull blocks (made of durable urethane foam) to prevent cracking and/or deformation by the pull blocks. Strong well uses two distinct pulling systems, one that is a caterpillar counter-rotating type and the other a hand-over-hand reciprocating type to pull the cured profile to the saw for cutting to length.

## *Pultruded Grating*

The pultruded grating product is a mostly mechanized process. Reinforcement of different shapes such as: strand, mat and veil are pulled through a liquid resin bath and a heated die where the bar is shaped and the resin is cured.



These pultruded bars can be cut into requested lengths. The bars are then drilled on the sides to accept the crossbars. The drilled bars are spaced. The final step is to seal the entire crossbars and holes with corrosion resistant epoxy resin.

The pultruded grating provides increased load capacity with moderate levels of corrosion resistance. The components (bearing bars and cross bars) are pulled by machine to have a higher reinforcement content. Its superior load capacity is a result of the higher reinforcement to resin ratio. The pultrusion process is automated and produces a consistent, high quality finished product. Assembled from bars,

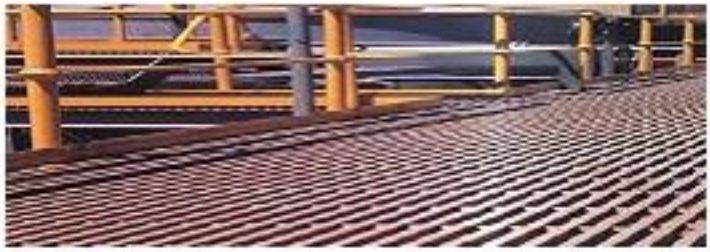
## *APPLICATIONS OF PULTRUDED GRATING*

### Applications

- *Flooring*
- *Platform*
- *Walkways*
- *Assembly Lines*
- *Trench Covers*
- *Stairs*
- *Catwalks*
- *Ramps*
- *Greenhouse Shelving*
- *Pool Drainage*
- *Portable Building Floors*

### Markets

- *Chemical*
- *Electronics*
- *Marine (including military vessels)*
- *Oil & Gas*
- *Petroleum Processing*
- *Plating*
- *Pulp and Paper*
- *Water/Wastewater*
- *Zoos/Aquariums*
- *Recreational Facilities*
- *Manufacturing*



## *Benefits and Characteristics of FRP Pultruded Grating*

- Non-Slip
- Corrosion Resistance
- Fire Resistance
- Non-Magnetic
- Impact Resistance
- Non-sparking
- Maintenance Free
- Light Weight
- Raised Floors
- Standard Bearing Surfaces
- Design
- Cost Savings
- Non-conductive
- Low Installation Costs
- Superior Strength
- Mechanical Strength
- Conductive Grating
- High Performance

## *DESCRIPTION*

### *NON-SLIP*

Composite Grating's integral grit top surface provides outstanding anti-slip protection for personnel in wet and oily environments. The grit is embedded in the top surface of each panel prior to curing. This combination of integral construction, plus depth of the embedded grit, creates a long-lasting maximum anti-slip top surface.

### *CORROSION RESISTANCE*

The ability of Composite grating is to guard against deterioration from industrial chemicals and environmental factors makes it a logical and cost-effective alternative to carbon steel, aluminium, wood or other conventional materials. Whether the grating is exposed to continuous submersion, splash, spills, fumes or gases, you can be assured that Composite grating will outperform other mediums.

### *FIRE RESISTANCE*

Composite Grating is available in various resin systems, two of which meet the Class 1 flame spread rating of 25 or less, in accordance with ASTM E-84 Tunnel Test Method. If a flame spread of 10 or less is required, it will be available in request.

### *NON-MAGNETIC*

The non-magnetic properties allow the Composite grating to be used in sensitive installations where the inherent magnetic properties of metallic grating would prove unsuitable.

### *IMPACT RESISTANCE*

The impact resistance of Composite Grating allows repeated deflection without permanent deformation. A certain amount of deflection can occur with loading. However, once the load is removed, the grating will return to its original shape, unlike metallic grating, which will remain deformed and require costly repairs or replacement.

## *NON-SPARKING*

The non sparking qualities of Composite Grating systems are ideally suited for those installations where hydrogen or other combustible gases may be found and which may explode or cause a fire from sparks produced from accidental dropping of tools onto the grating.

## *MAINTENANCE FREE*

The use of Composite Grating virtually eliminates maintenance costs since painting is not required, and UV inhibitors protect against degradation from the sun.

## *LIGHTWEIGHT*

Composite Grating weighs about one-quarter as much as steel grating. Two men can easily handle full panels, without the need for hoists, pulleys or dollies. If the Composite Grating needs to be moved for cleaning, maintenance or utility access, there is less chance of back injuries. The lightweight design of the grating reduces installation and fabrication costs, weighing only 12 kilos per sq mtr for 25mm and 18 kilos per sq mtr for 38mm.

## *RAISED FLOORS*

Many plant operations have a need for slightly elevated Floor Grating. Fixed or adjustable pedestals can be used for applications up to a height of 600mm. Plastic insert mouldings, which raise the Composite Grating panels 7mm off the floor, are ideal for allowing liquid drainage below the Grating.

## *STANDARD BEARING SURFACES*

On most installations, a minimum of 38mm bearing support should be provided under the edges of Composite Grating panels.

## *DESIGN*

The design procedures associated with Composite Grating are entirely different from those associated with other materials. The prime consideration in designing with this reinforcement is allowable 'deflection' as opposed to ultimate 'loading' used with steel and aluminium. The reason for this is the inherent elasticity of reinforced plastic, permitting far greater deflection than steel, without the danger of structural failure. Load and deflection tables are available on request.

## *COST SAVINGS*

In a review of costs, Composite grating showed significant savings over the use of stainless steel grating, and when consideration is given to 'life cycle costs', combining anti-slip benefits, the saving over the use of metal grating alternatives is quite considerable.

## *NON-CONDUCTIVE*

The non-conductive properties make Composite Grating ideally suited for work platforms and flooring situated in electrically hazardous locations.

## *LOW INSTALLATION COSTS*

Composite Grating weights considerably less than conventional metal gratings, and is easier and less expensive to transport, install and remove. Only simple hand tools are required for installation and removal, eliminating the need for costly equipment and labour costs associated with heavy lifting, cutting and welding.

## *SUPERIOR STRENGTH*

The high glass-to-resin ratio of Composite grating provides superior strength and load-bearing characteristics. With structural integrity protected by its unique corrosion resistance capabilities, Composite grating lasts longer than traditional materials.

## *MECHANICAL STRENGTH*

Breaking strength under a lateral force is exceptional. The uni-directional continuous Composite reinforcement offers numerous advantages, including rigidity, shock-resistance and no permanent deformation after overloading. These factors provide excellent mechanical strength and a generous factor of safety. Composite Grating is designed for maximum safety in intensive industrial use.

## *CONDUCTIVE GRATING*

Composite Conductive Grating provides a specially formulated carbon, black surface, which will eliminate hazardous static electricity when properly grounded. This anti-static property is most advantageous in high-tech electronic industries where sophisticated equipment may be damaged due to static electricity. It also provides a safe environment in combustible areas by not allowing static sparks. Conductive Grating can be used in Railway Fuel Stations, Circuit Board Manufacture, Oil Refineries, Underground Mining Operations, Ammunition Factories etc.

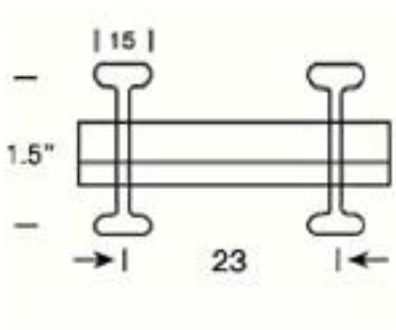
## *HIGH PERFORMANCE*

Composite structural Composite grating materials have demonstrated a proven ability to withstand the harsh side effects of corrosive conditions better than galvanized steel. For many years, composites have been reliably used in traditionally corrosive industries such as chemical processing, plating and marine construction. While the cost of material is an important criteria in the design of a project, it does not reflect the total cost of the project. Beyond material purchase price, the engineer also should consider the related costs of installation, maintenance over time and replacement of debilitated materials.

## *PULTRUDED GRATING SELECTION*

| Type | Thickness | Bar Width (mm) | Open Space (mm) | Open Area (%) | Appro. Wt. ($kg/m^2$) |
|---|---|---|---|---|---|
| G1.5 I-6000 | 1.5" | 15 | 23 | 60 | 18 |
| G1.5 I-5000 | 1.5" | 15 | 15 | 50 | 22 |
| G1.5 I-4000 | 1.5" | 15 | 10 | 40 | 26 |
| G1.0 I-6000 | 1.0" | 15 | 23 | 60 | 11.5 |
| G1.0 I-5000 | 1.0" | 15 | 15 | 50 | 14 |
| G1.0 I-4000 | 1.0" | 15 | 10 | 40 | 16.5 |
| G40I-5000 | 40 mm | 30 | 30 | 50 | 12 |
| G40I-5000 | 10 mm | 30 | 20 | 40 | 13.5 |
| G65I-5000 | 65 mm | 30 | 30 | 50 | 14 |
| G65I-4000 | 65 mm | 30 | 20 | 40 | 17 |

**G1 5 I-6000**




# *PULTRUDED GRATING CHEMICAL RESISTANCE GUIDE*

| CHEMICAL | VINYL ESTER RESIN | | ISOPHATHALIC POLYESTER | |
|---|---|---|---|---|
| ENVIRONMENT | % CONCENTRATION | MAX. OPEN. TEMP. F/C | % CONCENTRATION | MAX. OPEN. TEMP. F/C |
| Acetic Acid | 50 | 180/82 | 50 | 125/52 |
| Aluminum Hydroxide | 100 | 170/77 | 100 | 160/71 |
| Ammonium Chloride | ALL | 190/88 | ALL | 170/77 |
| Ammonium Hydroxide | 28 | 100/38 | 28 | N/R |
| Ammonium Bicarbonate | 50 | 150/65 | 15 | 125/52 |
| Ammonium Sulfate | ALL | 200/93 | ALL | 170/77 |
| Benzene | N/R | N/R | N/R | N/R |
| Benzoic Acid | SAT | 200/93 | SAT | 150/66 |
| Borax | SAT | 200/93 | SAT | 170/77 |
| Calcium Carbonate | ALL | 180/82 | SAT | 170/77 |
| Calcium Nitrate | ALL | 200/93 | ALL | 180/82 |
| Carbon Tetrachloride | 100 | 75/24 | N/R | N/R |
| Chlorine, Dry Gas | - - | 170/77 | - - | 140/60 |
| Chlorine Water | SAT | 180/82 | SAT | 80/27 |
| Chromic Acid | 10 | 120/49 | 5 | 70/21 |
| Citric Acid | ALL | 200/93 | ALL | 170/77 |
| Copper Chloride | ALL | 200/93 | ALL | 170/77 |
| Copper Cyanide | ALL | 200/93 | ALL | 170/77 |
| Copper Nitrate | ALL | 200/93 | ALL | 170/77 |
| Ethanol | 50 | 90/32 | 50 | 75/24 |
| Ethylene Glycol | 100 | 200/93 | 100 | 90/32 |
| Ferric Chloride | ALL | 200/93 | ALL | 170/77 |
| Ferrous Chloride | ALL | 200/93 | ALL | 170/77 |
| Formaldehyde | ALL | 100/38 | 50 | 75/24 |
| Gasoline | 100 | 150/65 | 100 | 80/27 |
| Glucose | 100 | 200/93 | 100 | 170/77 |
| Glycerin | 100 | 200/93 | 100 | 150/66 |
| Hydrobromic Acid | 50 | 120/49 | 50 | 120/49 |
| Hydrochloric Acid | 37 | 100/38 | 37 | 75/24 |
| Hydrogen Peroxide | 30 | 100/38 | 5 | 100/38 |
| Lactic Acid | ALL | 200/93 | ALL | 170/77 |
| Lithium Chloride | SAT | 200/93 | SAT | 150/66 |
| Magnesium Chloride | ALL | 200/93 | ALL | 170/77 |

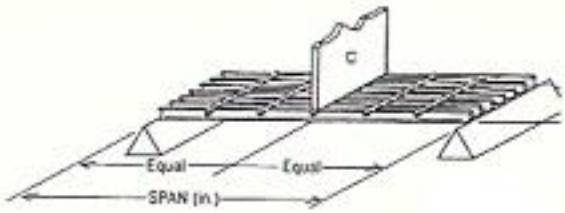
| CHEMICAL | VINYL ESTER RESIN | | ISOPHATHALIC POLYESTER | |
|---|---|---|---|---|
| ENVIRONMENT | % CONCENTRATION | MAX. OPEN. TEMP. F/C | % CONCENTRATION | MAX. OPEN. TEMP. F/C |
| Magnesium Nitrate | ALL | 180/82 | ALL | 140/66 |
| Magnesium Sulfate | ALL | 190/88 | ALL | 170/77 |
| Mercuric Chloride | 100 | 190/88 | 100 | 150/66 |
| Mercurous Chloride | ALL | 180/82 | ALL | 140/60 |
| Nickel Chloride | ALL | 200/93 | ALL | 170/77 |
| Nickel Sulfate | ALL | 200/93 | ALL | 170/77 |
| Nitric Acid | 20 | 100/38 | 20 | 70/21 |
| Oxalic Acid | ALL | 120/96 | ALL | 75/24 |
| Perchloric Acid | 30 | 80/27 | N/R | N/R |
| Phosphoric Acid | 100 | 200/93 | 100 | 120/49 |
| Potassium Chloride | ALL | 200/93 | ALL | 170/77 |
| Potassium Dichromate | ALL | 200/93 | ALL | 170/77 |
| Potassium Nitrate | ALL | 200/93 | ALL | 170/77 |
| Potassium Sulfate | ALL | 200/93 | ALL | 170/77 |
| Propylene Glycol | ALL | 200/93 | ALL | 170/77 |
| Sodium Acetate | ALL | 200/93 | ALL | 160/71 |
| Sodium Bisulfate | ALL | 200/93 | ALL | 170/77 |
| Sodium Bromide | ALL | 200/93 | ALL | 170/77 |
| Sodium Cyanide | ALL | 200/93 | ALL | 170/77 |
| Sodium Hydroxide | 25 | 150/66 | N/R | N/R |
| Sodium Nitrate | ALL | 200/93 | ALL | 170/77 |
| Sodium Sulfate | ALL | 200/93 | ALL | 170/77 |
| Stannic Chloride | ALL | 190/88 | ALL | 160/71 |
| Sulfuric Acid | 75 | 100/38 | 25 | 75/24 |
| Tartaric Acid | ALL | 200/93 | ALL | 170/77 |
| Vinegar | 100 | 200/93 | 100 | 170/77 |
| Water, Distilled | 100 | 180/82 | 100 | 170/77 |
| Zinc Nitrate | ALL | 200/93 | ALL | 170/77 |
| Zinc Sulfate | ALL | 200/93 | ALL | 170/77 |

ALL…Concentrations; SAT…Saturated Solution; N/R…Not Recommended; -…No Information Available.

## *Physical Properties of Pultruded Grating*

| Property | Test Method | Units | I-Bar 70-75 % Glass | I-Bar 65-70 % Glass |
|---|---|---|---|---|
| Tensile Strength | ASTM D-638 | PSI | 125,000 | 100,000 |
| Tensile Modulus | ASTM D-638 | PSI | $6.0 \times 10^6$ | $5.6 \times 10^6$ |
| Flexural Strength | ASTM D-790 | PSI | 125,000 | 100,000 |
| Flexural Modulus | ASTM D-790 | PSI | $6.0 \times 10^6$ | $5.6 \times 10^6$ |
| Compressive Strength | ASTM D-695 | PSI | 65,000 | 60,000 |
| Izod Impact Notch | ASTM D-256 | Ft.-Lbs./In. | 40 | 40 |
| Barcol Hardness | | | 50 (Min.) | 50 (Min.) |
| Specific Gravity | ASTM D-792 | | 2 | 2 |
| Water Absorption | ASTM D-570 | Max. % | .03 | .03 |
| Flame Retardant | ASTM E-84 | | Less than 25 | Less than 25 |
| Flame Retardant | ASTM D-635 | | Self-Extinguishing | Self-Extinguishing |

## *LOAD DESCRIPTION*




**PULTRUDED GRATING (Metric units)**
CONCENTRATED LOAD TABLES - DEFLECTION IN mm

| SPAN IN mm | STYLE | LOAD IN KN/m OF WIDTH (CONCENTRATED) 3 | 5 | 8 | 10 | 13 | 15 | 20 | 25 | 39 | 50 | 100 | 150 | 200 | 250 | MAXIMUM RECOMMENDED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 400 | 1" I-60 | 0.4 | 0.6 | 1.0 | 1.3 | 1.7 | 1.9 | 2.6 | 3.2 | 5.0 | 6.4 | 12.8 | | | | 56 |
| | 1" I-40 | 0.3 | 0.4 | 0.7 | 0.9 | 1.1 | 1.3 | 1.7 | 2.1 | 3.3 | 4.3 | 8.5 | 12.8 | | | 83 |
| | 1 1/2" I-60 | 0.2 | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 1.1 | 1.4 | 2.2 | 2.8 | 5.6 | 8.4 | 11.3 | 14.1 | 76 |
| | 1 1/2" I-40 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 | 1.5 | 1.9 | 3.8 | 5.6 | 7.5 | 9.4 | 114 |
| | 2" T-50 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 1.0 | 1.6 | 2.1 | 4.1 | 6.2 | 8.3 | 10.3 | 79 |
| | 2" T-33 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 1.2 | 1.6 | 3.1 | 4.7 | 6.2 | 7.8 | 138 |
| 600 | 1" I-60 | 1.0 | 1.7 | 2.8 | 3.5 | 4.5 | 5.2 | 7.0 | 8.7 | 13.6 | | | | | | 41 |
| | 1" I-40 | 0.7 | 1.2 | 1.9 | 2.3 | 3.0 | 3.5 | 4.7 | 5.8 | 9.1 | 11.7 | | | | | 62 |
| | 1 1/2" I-60 | 0.4 | 0.7 | 1.1 | 1.4 | 1.8 | 2.1 | 2.8 | 3.5 | 5.4 | 7.0 | 13.9 | | | | 51 |
| | 1 1/2" I-40 | 0.3 | 0.5 | 0.7 | 0.9 | 1.2 | 1.4 | 1.9 | 2.3 | 3.6 | 4.6 | 9.3 | 13.9 | | | 78 |
| | 2" T-50 | 0.3 | 0.5 | 0.7 | 0.9 | 1.2 | 1.4 | 1.8 | 2.3 | 3.6 | 4.6 | 9.2 | 13.8 | | | 79 |
| | 2" T-33 | 0.2 | 0.3 | 0.6 | 0.7 | 0.9 | 1.0 | 1.4 | 1.7 | 2.7 | 3.4 | 6.9 | 10.3 | 13.8 | | 105 |
| 800 | 1" I-60 | 2.3 | 3.5 | 6.2 | 7.7 | 10.0 | 11.6 | 15.4 | | | | | | | | 33 |
| | 1" I-40 | 1.5 | 2.6 | 4.1 | 5.2 | 6.7 | 7.7 | 10.3 | 12.9 | | | | | | | 50 |
| | 1 1/2" I-60 | 0.8 | 1.5 | 2.4 | 2.9 | 3.8 | 4.4 | 5.9 | 7.4 | 11.5 | 14.7 | | | | | 41 |
| | 1 1/2" I-40 | 0.6 | 1.0 | 1.6 | 2.0 | 2.6 | 2.9 | 3.9 | 4.9 | 7.7 | 9.8 | | | | | 61 |
| | 2" T-50 | 0.5 | 0.9 | 1.4 | 1.8 | 2.4 | 2.7 | 3.6 | 4.5 | 7.1 | 9.0 | | | | | 63 |
| | 2" T-33 | 0.4 | 0.7 | 1.1 | 1.4 | 1.8 | 2.0 | 2.7 | 3.4 | 5.3 | 6.8 | 13.6 | | | | 85 |
| 1000 | 1" I-60 | 4.4 | 7.3 | 11.7 | 14.7 | | | | | | | | | | | 25 |
| | 1" I-40 | 2.9 | 4.9 | 7.8 | 9.8 | 12.7 | 14.7 | | | | | | | | | 38 |
| | 1 1/2" I-60 | 1.6 | 2.7 | 4.4 | 5.5 | 7.1 | 8.2 | 10.9 | 13.7 | | | | | | | 33 |
| | 1 1/2" I-40 | 1.1 | 1.8 | 2.9 | 3.7 | 4.7 | 5.5 | 7.3 | 9.1 | 14.2 | | | | | | 50 |
| | 2" T-50 | 1.0 | 1.7 | 2.7 | 3.3 | 4.3 | 5.0 | 6.6 | 8.3 | 13.0 | | | | | | 50 |
| | 2" T-33 | 0.7 | 1.2 | 2.0 | 2.5 | 3.2 | 3.7 | 5.0 | 6.2 | 9.7 | 12.5 | | | | | 67 |
| 1200 | 1" I-60 | 7.5 | 12.4 | | | | | | | | | | | | | 21 |
| | 1" I-40 | 5.0 | 8.3 | 13.3 | | | | | | | | | | | | 31 |
| | 1 1/2" I-60 | 2.8 | 4.7 | 7.5 | 9.3 | 12.1 | 14.0 | | | | | | | | | 26 |
| | 1 1/2" I-40 | 1.9 | 3.1 | 5.0 | 6.2 | 8.1 | 9.3 | 12.5 | 15.6 | | | | | | | 39 |
| | 2" T-50 | 1.7 | 2.8 | 4.4 | 5.5 | 7.2 | 8.3 | 11.0 | 13.8 | | | | | | | 33 |
| | 2" T-33 | 1.2 | 2.1 | 3.3 | 4.1 | 5.4 | 6.2 | 8.3 | 10.4 | | | | | | | 44 |
| 1400 | 1 1/2" I-60 | 4.4 | 7.4 | 11.8 | 14.8 | | | | | | | | | | | 19 |
| | 1 1/2" I-40 | 3.0 | 4.9 | 7.9 | 9.9 | 12.8 | 14.8 | | | | | | | | | 29 |
| | 2" T-50 | 2.6 | 4.3 | 6.8 | 8.5 | 11.1 | 12.8 | | | | | | | | | 31 |
| | 2" T-33 | 1.9 | 3.2 | 5.1 | 6.4 | 8.3 | 9.6 | 12.8 | 16.0 | | | | | | | 42 |
| 1600 | 1 1/2" I-60 | 6.6 | 11.0 | | | | | | | | | | | | | 15 |
| | 1 1/2" I-40 | 4.4 | 7.3 | 11.7 | 14.7 | | | | | | | | | | | 24 |
| | 2" T-50 | 3.8 | 6.3 | 10.1 | 12.6 | | | | | | | | | | | 26 |
| | 2" T-33 | 2.8 | 4.7 | 7.6 | 9.5 | 12.3 | 14.2 | | | | | | | | | 35 |

### *NOTES:*

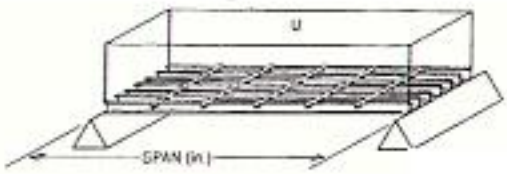
1- The designer should not exceed MAXIMUM RECOMMENDED load at any time. MAXIMUM LOAD represents a 2:1 factor of safety on ULTIMATE CAPACITY.

2- ULTIMATE CAPACITY represents a complete and total failure of the grating.

3- Walking loads, typically 2.4 KN/M$^2$ is recommended for pedestrian traffic. Deflections for worker comfort are typically limited to 9mm or SPAN divided by 120 under full live load.
For a firmer feel under full live load or a 3.6 KN/M load, limit deflection to 6mm or SPAN divided by 200.

4- The allowable loads are for STATIC LOAD CONDITIONS at ambient temperatures. Allowable loads for impact or dynamic loads should be a maximum of ONE-HALF the value shown.
Long term loads will result in added deflection due to creep in the material and will also require higher safety factors to ensure acceptable performance.

5- For applications at elevated temperatures, consult your manufacture.




**PULTRUDED GRATING (Metric units)**
**UNIFORM LOAD TABLES - DEFLECTION IN mm**

| SPAN IN mm | STYLE | LOAD IS KN/SQm (UNIFORM) 3 | 5 | 8 | 10 | 13 | 15 | 20 | 25 | 39 | 50 | 100 | 150 | 200 | 250 | MAXIMUM RECOMMENDED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 400 | 1" I-60 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 1.2 | 1.6 | 3.2 | 4.8 | 6.4 | 8.0 | 279 |
| | 1" I-40 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.8 | 1.1 | 2.1 | 3.2 | 4.3 | 5.3 | 419 |
| | 1 1/2" I-60 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.7 | 1.4 | 2.1 | 2.8 | 3.5 | 383 |
| | 1 1/2" I-40 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.4 | 0.5 | 0.9 | 1.4 | 1.9 | 2.3 | 574 |
| | 2" T-50 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 1.0 | 1.6 | 2.1 | 2.6 | 520 |
| | 2" T-33 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.8 | 1.2 | 1.6 | 1.9 | 694 |
| 600 | 1" I-60 | 0.4 | 0.7 | 1.0 | 1.3 | 1.7 | 2.0 | 2.6 | 3.3 | 5.1 | 6.6 | 13.1 | | | | 138 |
| | 1" I-40 | 0.3 | 0.4 | 0.7 | 0.9 | 1.1 | 1.3 | 1.8 | 2.2 | 3.4 | 4.4 | 8.8 | 13.1 | | | 207 |
| | 1 1/2" I-60 | 0.2 | 0.3 | 0.4 | 0.5 | 0.7 | 0.8 | 1.0 | 1.3 | 2.0 | 2.6 | 5.2 | 7.8 | 10.4 | 13.0 | 173 |
| | 1 1/2" I-40 | 0.1 | 0.2 | 0.3 | 0.3 | 0.5 | 0.5 | 0.7 | 0.9 | 1.4 | 1.7 | 3.5 | 5.2 | 7.0 | 8.7 | 259 |
| | 2" T-50 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.7 | 0.9 | 1.3 | 1.7 | 3.4 | 5.2 | 6.9 | 8.6 | 264 |
| | 2" T-33 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 1.0 | 1.3 | 2.6 | 3.9 | 5.2 | 6.4 | 353 |
| 800 | 1" I-60 | 1.2 | 1.9 | 3.1 | 3.9 | 5.0 | 5.8 | 7.7 | 9.6 | 15.1 | | | | | | 86 |
| | 1" I-40 | 0.8 | 1.3 | 2.1 | 2.6 | 3.4 | 3.9 | 5.2 | 6.4 | 10.1 | 12.9 | | | | | 126 |
| | 1 1/2" I-60 | 0.4 | 0.7 | 1.2 | 1.5 | 1.9 | 2.2 | 2.9 | 3.7 | 5.7 | 7.4 | 14.7 | | | | 103 |
| | 1 1/2" I-40 | 0.3 | 0.5 | 0.8 | 1.0 | 1.3 | 1.5 | 2.0 | 2.5 | 3.8 | 4.9 | 9.8 | 14.7 | | | 155 |
| | 2" T-50 | 0.3 | 0.5 | 0.7 | 0.9 | 1.2 | 1.4 | 1.8 | 2.3 | 3.5 | 4.5 | 9.0 | 13.6 | | | 160 |
| | 2" T-33 | 0.0 | 0.3 | 0.5 | 0.7 | 0.9 | 1.0 | 1.4 | 1.7 | 2.7 | 3.4 | 6.8 | 10.2 | 13.6 | | 214 |
| 1000 | 1" I-60 | 2.8 | 4.6 | 7.3 | 9.2 | 11.9 | 13.8 | | | | | | | | | 51 |
| | 1" I-40 | 1.8 | 3.1 | 4.9 | 6.1 | 8.0 | 9.2 | 12.3 | 15.3 | | | | | | | 77 |
| | 1 1/2" I-60 | 1.0 | 1.7 | 2.7 | 3.4 | 4.4 | 5.1 | 6.8 | 8.6 | 13.3 | | | | | | 67 |
| | 1 1/2" I-40 | 0.7 | 1.1 | 1.8 | 2.3 | 3.0 | 3.4 | 4.6 | 5.7 | 8.9 | 11.4 | | | | | 100 |
| | 2" T-50 | 0.6 | 1.0 | 1.7 | 2.1 | 2.7 | 3.1 | 4.2 | 5.2 | 8.1 | 10.4 | | | | | 101 |
| | 2" T-33 | 0.5 | 0.8 | 1.2 | 1.5 | 2.0 | 2.3 | 3.1 | 3.9 | 6.1 | 7.8 | 15.6 | | | | 135 |
| 1200 | 1" I-60 | 5.6 | 9.3 | 14.9 | | | | | | | | | | | | 35 |
| | 1" I-40 | 3.7 | 6.2 | 9.9 | 12.4 | | | | | | | | | | | 52 |
| | 1 1/2" I-60 | 2.1 | 3.5 | 5.6 | 7.0 | 9.1 | 10.5 | 14.0 | | | | | | | | 43 |
| | 1 1/2" I-40 | 1.4 | 2.3 | 3.7 | 4.7 | 6.1 | 7.0 | 9.3 | 11.7 | | | | | | | 66 |
| | 2" T-50 | 1.2 | 2.1 | 3.3 | 4.1 | 5.4 | 6.2 | 8.3 | 10.3 | | | | | | | 55 |
| | 2" T-33 | 0.9 | 1.6 | 2.5 | 3.1 | 4.0 | 4.7 | 6.2 | 7.8 | 12.1 | 15.5 | | | | | 75 |
| 1400 | 1 1/2" I-60 | 3.9 | 6.5 | 10.4 | 12.9 | | | | | | | | | | | 28 |
| | 1 1/2" I-40 | 2.6 | 4.3 | 6.9 | 8.6 | 11.2 | 13.0 | | | | | | | | | 42 |
| | 2" T-50 | 2.2 | 3.7 | 6.0 | 7.4 | 9.7 | 11.2 | 14.9 | | | | | | | | 45 |
| | 2" T-33 | 1.7 | 2.8 | 4.5 | 5.6 | 7.3 | 8.4 | 11.2 | 14.0 | | | | | | | 60 |
| 1600 | 1 1/2" I-60 | 5.5 | 11.0 | | | | | | | | | | | | | 19 |
| | 1 1/2" I-40 | 4.4 | 7.3 | 11.7 | 14.7 | | | | | | | | | | | 29 |
| | 2" T-50 | 3.8 | 6.3 | 10.1 | 12.6 | | | | | | | | | | | 33 |
| | 2" T-33 | 2.8 | 4.7 | 7.6 | 9.5 | 12.3 | 14.2 | | | | | | | | | 45 |

***NOTES:***

1- The designer should not exceed MAXIMUM RECOMMENDED load at any time. MAXIMUM LOAD represents a 2:1 factor of safety on ULTIMATE CAPACITY.

2- ULTIMATE CAPACITY represents a complete and total failure of the grating.

3- Walking loads, typically 2.4 KN/M$^2$ is recommended for pedestrian traffic. Deflections for worker comfort are typically limited to 9mm or SPAN divided by 120 under full live load.
For a firmer feel under full live load or a 3.6 KN/M load, limit deflection to 6mm or SPAN divided by 200.

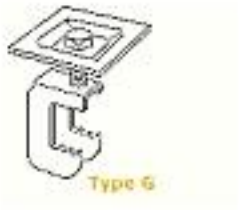
4- The allowable loads are for STATIC LOAD CONDITIONS at ambient temperatures. Allowable loads for impact or dynamic loads should be a maximum of ONE-HALF the value shown.
Long term loads will result in added deflection due to creep in the material and will also require higher safety factors to ensure acceptable performance.

5- For applications at elevated temperatures, consult your manufacture.

## *PULTRUDED GRATING FASTENERS*

Type ***"M"*** stainless steel hold down clips used to secure panels to a support using two adjacent grating bars for a secure fit.


Type ***"G"*** stainless steel hold clips designed to attach grating to any structural member flange, 3/4" or smaller in thickness, with no drilling required.




Type ***"FB"*** stainless steel flange blocks fit inside close mesh products allowing for installation of cap screws from the top surface of the grating.


Type ***"RK"*** stainless steel fasteners offer effective and more secure means for installing pultruded grating.

## *STANDARDS OF FRP COMPOSITES*

**Dielectric**

The Following Standards are used in composite productions:

| | |
|---|---|
| ASTM C-177-85 | **Heat Flux** |
| ASTM D-149-87 | **Dielectric Strength** |
| ASTM D-229-86 | **Testing Rigid Sheet for Electrical Insulation (Ladder)** |
| ASTM D-256-87 | **Impact Resistance** |
| ASTM D-495-84 | **Electrical Resistance** |
| ASTM D-570-81 | **Water Absorption** |
| ASTM D-635-81 | **Flammability** |
| ASTM D-638-87b | **Tensile Strength** |
| ASTM D-695-85 | **Compressive Strength** |
| ASTM D-696-79 | **Thermal Expansion** |
| ASTM D-709-87 | **Specifications for Laminated Thermosetting Materials** |
| ASTM D-732-85 | **Shear Strength by Punch** |
| ASTM D-790-86 | **Flexural Strength** |
| ASTM D-792-86 | **Specific Gravity** |
| ASTM D-953-87 | **Bearing Strength** |
| ASTM D-1499-84 | **Weathering** |
| ASTM D-1505-85 | **Density** |
| ASTM D-2344-89 | **Interlaminar Short Beam Shear Strength** |
| ASTM D-2583-87 | **Hardness** |
| ASTM D-2584-85 | **Ignition Loss** |
| ASTM D-3647-84 | **Classifying Pultruded Shapes** |
| ASTM D-3846-85 | **In – plane Shear Strength** |
| ASTM D-3914-84 | **In plane Shear** |
| ASTM D-3916-84 | **Tensile** |
| ASTM D-3917-88 | **Dimensional Tolerances** |
| ASTM D-3918-80 | **Pultrusion Terms** |
| ASTM D-4385-88 | **Visual Defects** |
| ASTM D-4475-85 | **Short Beam Shear Strength** |
| ASTM D-4476-90 | **Flexural Properties** |
| ASTM E-84-87 | **Tunnel Beam Test** |
| ASTM E-662-83 | **Smoke Chamber** |
| ASTM E-831-86 | **Linear Thermal Expansion (CTE)** |
| ASTM F-1092-94 | **Handrails** |
| ASTM G-23-81 | **Weathering** |
| ASTM G-53-84 | **Weathering** |