



Melbourne's Iconic Southbank Footbridge

StructuralCompTM
FIBRE REINFORCED PLASTIC COMPOSITE

SISCo-FCTM fibre
reinforced
plastic
composites
BRIDGES | BOARDWALKS | VIEWING PLATFORMS

StructuralComp SISCo-Deck FRP Decking Technical Data Documentation

V3.2

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PATENTS / PATENTS PENDING

Parts of the SISCo-FC™ System are protected by either patents, or patents pending. Individual components are protected by either patents, or patents pending. Fixing methodology is protected by patents, or patents pending.

special structural applications where more stiffness is required, graphite roving can be used. Conversely, polyester roving may be used in applications where more flex is needed in SISCo-Deck.

Continuous Strand Mat is the remainder of glass reinforcement used in the pultrusion process. Typically, it is 30%-50% of the total glass content. Unlike hand-laid-up or press-moulded processes that use short chopped fibres, the pultrusion process must have a multidirectional mat that has good pull strength to facilitate getting it to the die after it has been wet-out with resin. This continuous strand mat is designed specifically for the pultrusion process and offers good wet-out characteristics, conformability to the shape of SISCo-Deck, and good physical properties including the required pull strength. Generally, fiberglass continuous strand mat is used to obtain the desired transverse properties of the product. Whereas the roving ties the composite together in the longitudinal direction, the mat is responsible for tying the composite together in all directions, but mainly in the transverse direction. Although continuous

strand mat is suitable for most applications, a variety of products such as woven roving, stitched roving, and woven fabrics can be used in custom applications to increase the desired transverse properties of SISCo-Deck.

Surface Veils are used to enhance the surface of SISCo-Deck. Most widely used today are synthetic veils. The veil is added to the outside of the profile just prior to entrance of the die. As a result, the finished profile has a resin-rich surface that aids in resistance to ultraviolet (UV) degradation and makes the profile more hand-friendly. Since the veil brings more resin to the surface and the resin is the ingredient that gives the corrosion resistance, adding the veil therefor increases the corrosion resistance of GripDeck.

Anti-Slip Surface of SISCo-Deck is made up of 6 components including resin, accelerant, curing agent, UV absorbent, colour epoxy and sand. The way this is mixed and applied is a process which SIS guards closely as this can determine the overall quality of the SISCo-Deck's surface and its longevity and therefore separates SIS from its competition.





SIS has manufacturing facilities in Australia, North America and the PR China with offices or distribution facilities in Adelaide, Melbourne, Sydney, Brisbane, Shanghai, Shenzhen, Hong Kong and Los Angeles. SISCo-Deck can be manufactured in any one of our plants to the highest standards.

Products designed, manufactured and supplied by SIS embody state of the art technology and are engineered by our teams to deliver enhanced performance and sustainably effective operation for customers worldwide. All our products are manufactured to the highest industry standards, following strict quality assurance guidelines. With many employees dedicated to production, quality product and technical expertise is ensured at all times. Excellent long term relationships with our key suppliers of raw materials and components provide confidence in material quality as well as sustainable and efficient manufacturing and supply chain processes.

The close relationship with our research and development division ensures that SIS manufacturing teams can react quickly and professionally to customer needs. SIS has built a reputation based on excellent customer service, high quality manufacturing and on providing

the right solution in sustainable product design and manufacturing. Continuous improvement of equipment design, materials and manufacturing technology ensures SIS maintains its capability of offering clients the latest and most commercially viable sustainable products available. SIS also works with clients to develop specific solutions to meet their unique needs through the application of research and development efforts in a partnering relationship.

We manufacture and supply products from materials that include:

- Recycled Plastic
- Recycled Plastic Panel
- Fibreglass Reinforced Plastic
- Recycled Wood Plastic Composite
- Recycled Rubber
- Aluminium / Recycled Plastic Composite

With our global network of offices and manufacturing facilities, along with projects in Africa, the Middle East, Asia, Australia and the Pacific Rim, SIS can be trusted to provide easy, efficient and seamless supply to almost all places on earth.

You may choose SIS for just material manufacture and supply, or installation as well. Either way, you can be guaranteed of superior customer service and on-site support throughout any project. Our structures team were responsible for the design and construction of the first wholly composite boardwalk and wholly composite bridge installed in Australia and can construct pedestrian structures from ground up or can complete a simple retrofit to an existing sub-structure.



Our installation team is well established, reputable and award-winning and have acquired significant experience undertaking a wide range of design and construction projects including those in rural and remote locations. We provide a professional, quality service in commercial construction with all works completed with integrity and professionalism. Having consistently demonstrated a strong work ethic, quality and commitment to all works we undertake, SIS is trusted on a National level to carry out an ever growing variety of works requiring innovation and a sustainable outlook. We understand the importance of meeting milestones and completion dates, and strive to achieve all agreed requirements. We are committed to building relationships with our clients, which has ensured our growth and an award-winning reputation as a quality civil installation company.

Our experience and broad skill-set give us the expertise required to complete challenges such as restricted time-frames and remote locations. We have extensive experience in:

- Construction Only
- Fixed Lump Sum Contracts
- Construction Management
- Project Management
- Design and Construction Contracts

Recommended Fabrication Methods, Tools, Equipment & Handling:

SISCo-Deck can be cut, drilled, routed, punched & ground but requires special attention to certain areas as it is very different to timber, aluminium or steel. Simple rules to follow include but are not limited to;

1. Always follow common safety practices. Eye protection is a must.
2. FRP is dusty during fabrication. Wear a dust mask or a respirator and a long-sleeve shirt or coat.
3. FRP is extremely abrasive. Tools will wear rapidly, and frequent tool sharpening is common.
4. Diamond-coated router bits and saw blades are best for this application.
5. Always use appropriate machine speeds for each operation. The greater the thickness, the slower the cutting or drilling speed.
6. Avoid excessive pressure when sawing, drilling and routing etc. Using too much force can rapidly dull the tool.
7. Machines should be cleaned frequently. Dust and glass particles will build and become abrasive.

Installation Methodology:

SISCo-Deck has been designed to allow installation to occur quickly, efficiently and cost effectively. The simple yet effective design allows boards to be opened up on structures with little or no camber

for water egress, or closed together if there is appropriate camber for water to leave the deck surface. This design allows for fixings to be placed and then covered as the next board is inserted in to position therefor given a completely concealed fixing system.

Cutting:

When performing any cutting operation, use light, evenly applied pressure. Excessive pressure tends to clog blades with dust particles and this will shorten the life of the blade. Cutting speed is very important - cutting too fast will fray the edge

of the material and may cause it to turn black. Installers need to provide adequate support to keep the material from shifting as cuts are made. If the material is not supported properly, chipping will occur. A common masonry blade will work for small jobs. For small-volume work, a hand-held circular saw is good for on-site fabrication. A table saw is recommended for volume ripping and will provide a more accurate cut when equipped with the proper blade. A diamond-coated blade will produce the best results and helps ensure longer blade life.

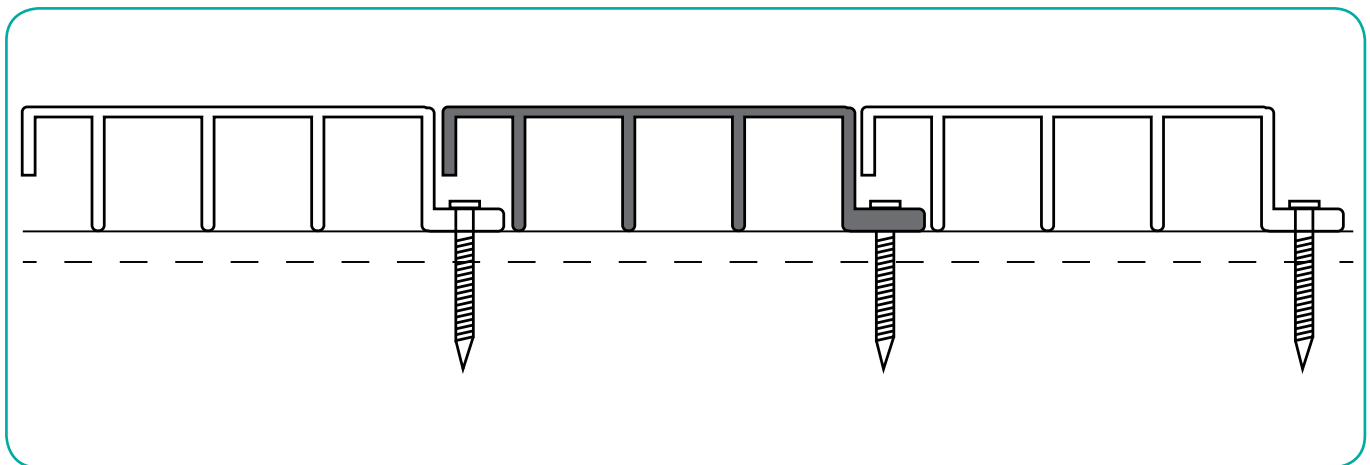


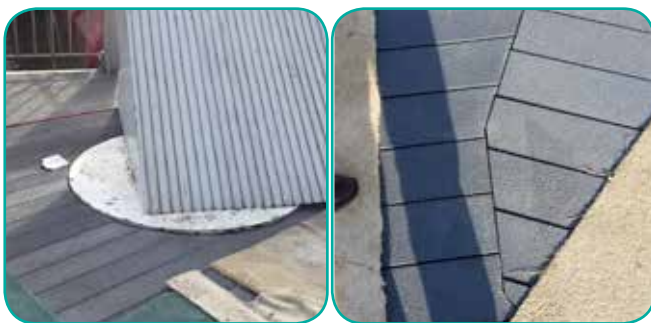
Fig. 2





Circular or Curved Cuts:

For circular or curved cuts, great results can be obtained using a saber saw or a band saw for small-volume cutting. Diamond-coated blades will increase production and lengthen the life of the blade. A hand router can also be used to cut curves and circles. When properly done, this method can produce excellent results but it will remove considerably more stock. Carbide grit saw blades are recommended for jig saws or reciprocating saws.



Drilling:

Drilling SISCO-Deck profiles is an easy, routine operation. Any standard high-speed steel drill bit can be used but it will require frequent sharpening. Properly sharpened brad-point bits provide excellent results. When drilling FRP, keep these tips in mind:

- The drill speed should be equivalent to those used for drilling hardwood.
- Carbide-tipped drills are recommended when

drilling large quantities.

- For large holes, a wood backup plate will reduce breakout on the back side of the hole.

SIS recommends using the QuikDrive auto-feed collated screw system for deck to joist screw fixing to FRP, steel, aluminium or timber (both hard & soft) sub-structures. Also, it is recommended to use spacer bars / kits to ensure an even gap between boards.



Routing:

For routing SISCO-Deck a CNC router is typically used in the fabrication shop to quickly perform highly repetitive standard routing operations. A typical CNC unit can be programmed electronically to produce exact repetitive routing operations. Most routing is done with diamond-coated bits. Routers can be used to make straight cuts and angle cuts, as well as radius cuts. Both hand-held and table routers deliver excellent results, as router cuts tend to be smooth and even. Rotary file bits (either tungsten-carbide or diamond-coated) perform best when routing large quantities. Wood bits can be used, but they will require frequent sharpening and will wear out quickly. Light pressure should be used when making a cut. Forcing the bit causes the FRP to heat and soften, damaging the material. Forcing the cut can also damage the bit.

Punching:

StructuralComp FRP is an easy material to punch, depending on the thickness of the material. It will punch better than metal because it will spring back, whereas metal will bend. The tonnage required for punching StructuralComp FRP will vary depending

on the material thickness, the size of the hole being punched, and the number of holes being punched at one time.

Grinding:

Although not generally recommended, grinding is necessary for some operations, such as notching and touching up edges. During grinding operations, the dust tends to load the stone and stop the grinding process. Grinding may be used on any thickness of material, but a medium or coarse carbide grinding wheel will yield the best results. Keep in mind that the grinding wheel will need to be cleaned regularly. Any standard grinder may be used, although air-powered equipment is preferred. Use light pressure when grinding to prevent burning the part.

When completing any of the operations above, it is important safety and environmental requirement to have a vacuum in operation close to where any fines and or dust might be released.



Handling:

Handling SISCo-Deck from when it is delivered to site in packs or crates should be done in a way which firstly prevents injury and secondly prevents damage to the material. For ultimate comfort, always wear gloves when handling StructuralComp FRP. When moving decking around work sites and structures, it is recommended to use a sturdy trolley, preferably with a brake. When placing

packs of deck on top of newly laid deck, ensure that a layer of protection is used between the pack and the newly laid deck. A sheet of plastic or old carpet is perfect for this application. For road transport, given SISCo-Deck is so light weight, in 95% of cases single axel trucks can be used for transport. Smaller crane attachments with correct slinging methods can also be used.



Installation of Additional Fixtures & Fittings:



Fixing conduit to a web or installing low voltage lights through the deck is simple and easy to complete. SIS recommends only cool LED lights be used that emit only very low temperatures. When attaching ancillary items to the web of SISCo-Deck ensure that in any 1000mm length of decking a void ratio does not exceed 87%. It is also recommended to only attach items on one web at any one location. For these works it is best to pre-drill and rivet any bracket to the web. For any additional works relating to drilling any web or through hole, approval must be granted from a SIS engineer.

Max. Allowable Cantilever:

SIS engineers calculate deflection at approximately 5mm for 400mm cantilever at 1.8kN concentrated load at end. AASHTO specification for FRP Pedestrian Bridges advises to limit deflection to 1/500 of cantilever therefore allowable cantilever for SISCo-Deck should be determined on a case by case basis. Any cantilever will require approval from SIS engineers.

Sealing of any Holes or Cuts:

When SISCo-Deck boards are delivered to a client the entire board is sealed at point of production with resin. When a cut is made or a hole is drilled (larger than a screw fixing) in to any FRP it should be sealed to give the fibres maximum protection. SIS recommends using a 2 part process to maximise product life – a fiberglass resin mixed with a resin catalyst at 3ml catalyst to 100ml resin will ensure maximum product life. Contact SIS for full details and application methodology.

Screw Locations & Recommended Types:

SIS recommends using the QuikDrive auto-feed collated screw system for deck to joist screw fixing to FRP, steel, aluminium or timber (both hard & soft) sub-structures. (See additional drilling / fixing details on page 12). When installing SISCo-Deck to joists it is recommended to use 1 fixing per joist per deck board.

Replacing a Damaged Board:



It would be very rare for a SISCo-Deck board to need replacing. With a 2000kg point load failure point at 600mm centres it would be almost impossible to crack or split a board under pedestrian loads. However, if through miss use, vandalism or other factors a board needs replacing it will need to be cut out of the structure. Any new board that needs to replace it will require a top fix. Contact SIS for methodology.

Storage of Materials:

Although SISCo-Deck is designed to be the most robust decking material available today, for long term storage it is best to store it in a dry place, off the ground and out of direct sunlight. This will ensure that when the SISCo-Deck is installed it will look and perform at its best.

Finishing / Fascia Board / End Caps:

Finishing off the board ends is different on every project. When SIS design's a new structure it will be up to the client to determine whether the boards are to sit flush or proud of any other parts of the structure. When retrofitting it is harder to conceal the board ends and a secondary application may be required. This can be by way of end cap, right angle StructuralComp FRP capping or a kick rail / capping all in one.

Coverage:

Coverage is entirely dependent on the gap (if any) that is required between the deck boards. This can



be determined from an aesthetic or operational view point i.e. water egress / high heels etc. There is no requirement for the boards to have a gap between them when installed. On most projects a 3-4mm gap is specified between boards giving a coverage calculation of $1000\text{mm} / 154\text{mm} = 6.49$ boards required per m^2 .



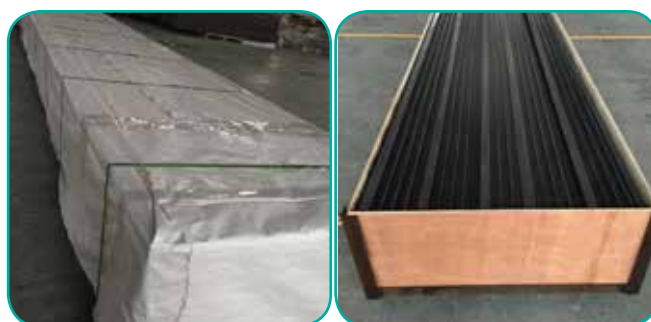
Thermal Movement:

The coefficient of linear expansion was tested under ASTM D-696 with a value result of $12 \times 10^{-6} \text{cm/cm } ^\circ\text{C}$. This means that 1 metre length of SISCO-Deck will expand approximately 1.2mm for each 10°C rise or fall of temperature. Thermal movement is only considered in design when butt joints are required. In most design / projects thermal movement has very little consideration given the width of most pedestrian structures.

Things not to do with SISCO-Deck FRP Decking

1. Don't use nail guns;
2. Don't install direct on to concrete;
3. Don't exceed specified design distributed or point loads;

4. Don't store in dark damp environments for extended periods;
5. Don't install without prior engineering approval



Freight & Packaging:

When SISCO-FC is delivered to a client, either to a facility or a work site, in most cases it is packaged in either steel or timber crates with protection boards at the base and all sides. When handling crates of SISCO-Deck with crane & slings or forklift, care is needed to ensure that the crate is not penetrated in any way in which boards can be damaged. With manufacturing facilities in Australia, North America and PR China, your pack of SISCO-Deck can sometimes travel vast distances without incident or damage and SIS takes extreme care to ensure that all boards are protected in the way transport crates are packed.

How to Specify:

To specify SISCO-Deck on your next project simply follow the coding below. The standard colour of SISCO-Deck is grey (RAL 7043) and coffee brown (RAL 8017).

How to Specify								
SIS-SISCO-DECK-3000-RAL7043 = 3000mm length of SISCO-Deck in Medium Grey								
SIS	-	SISCO	-	Deck	-	0000	-	RAL7043
Manufacturer	-	Material Code	-	Product Code	-	Length (mm)		Colour

Recommended Fixings

For Fixing to StructuralComp FRP



Hours of testing with fixings has allowed SISCo-Deck projects to be completed cost effectively and on time with quick and easy certification. SIS with Simpson Strong-Tie have developed a FRP to FRP fixing which can be installed using the super productive QuikDrive Auto-Feed system, or by more traditional methods if desired. Contact SIS for further details. Below is test results from the Screw Pull Out Test on the 316 SS fixing.

Test Reference No. SSBFHSD2SA-14112014

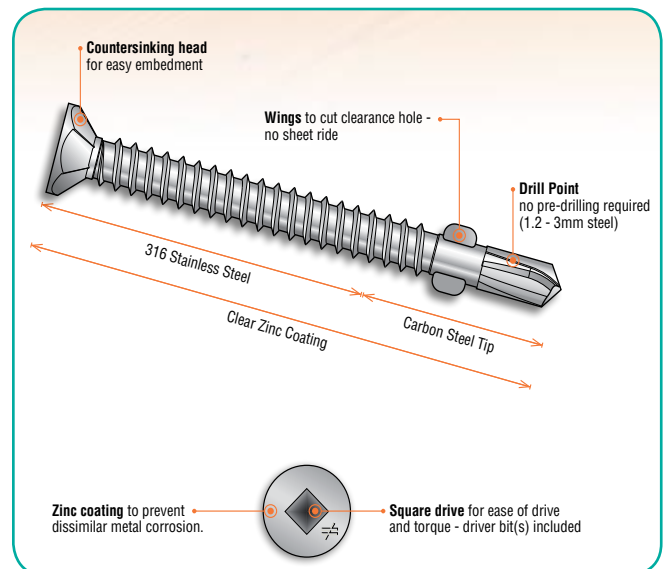
Date(s): 14/11/2014

Test Description: Srew Pull Out

Project Name / Address: Simpson Strong-Tie
Mt. Waverley office

Base Material

Member Description: 12mm StructuralComp FRP



Product Information

Product Model No.: SSBFHSD2SA B. Metal Winged Screw

Test No.	Product Tested	Embedment Depth (mm.)	Maximum Test No. Tension Load (KN.)	Failure Mode / Comments
1	SSBFHSD2SA B. Metal Winged Screw	12 mm	5.00	Screw pull-out of base material
2	SSBFHSD2SA B. Metal Winged Screw	12 mm	6.50	Screw pull-out of base material
3	SSBFHSD2SA B. Metal Winged Screw	12 mm	6.00	Screw pull-out of base material
4	SSBFHSD2SA B. Metal Winged Screw	12 mm	4.50	Screw pull-out of base material
5	SSBFHSD2SA B. Metal Winged Screw	12 mm	7.00	Screw pull-out of base material
		Characterisitic	5.19	
		Average	5.80	
		Std. Deviation	0.18	

Quik Drive® Collated

Model No.	Size	Diametre (mm)	Length (mm)	Thread	Point	Finish	Ctn Qty	PRO 250
SSBFHSD2SA	#10	4.9	50	16 TPI	#Drill Point	Clear Zinc	1000	√

#2 square drive (replacement driver bit - BIT2S)

Accelerated Wear Test

Registered Testing Authority - CSIRO

TEST REPORT No. 7224aw



Date	17 November 2014
Requested by	Sustainable Infrastructure Systems (AUST) Pty Ltd Unit 6 / 7-9 Streiff Road, Wingfield SA 5013
Test Performed by	Khanh Ho
Product Description	SISCO-FC™ FRP GripDeck 150mm x 45mm
Preparation	Deionised Water
Abrasive Pad Used	Scotch Brite (SB) No. 96
Test equipment	GARDCO Washability and Wear Tester (Linear) Model no. D12V Friction Boat 1000gms & 1000mm²

Comment:

The potential wear factor of a tile in situ can be assessed by the CSIRO Accelerated Wear Test (CAWT). The test involves a number of revolutions of a wetted 3M Scotch Brite No.96 pad over the tile surface. The tile is initially tested to AS4856 Appendix A: Wet Pendulum test. One tile is then subjected to 500 revolutions of CAWT and then retested to Appendix A: Wet Pendulum test. Depending on the tile surface the wet pendulum classification may drop to a lower level. This is due to the scrubbing of the tile surface either removing the fine pinnacles on the tile structure or scrubbing the surface smooth. The CAWT is relevant for tiles that may have a high pedestrian traffic flow or vehicular traffic flow.

AS 4586:2013	Mean BPN	Class	Date Tested
Appendix A Wet Pendulum	68	P5	17/11/2014

CAWT TABLE

Revolutions	Pendulum Swings					Mean BPN (final 3 swings)	Pendulum Class
	1	2	3	4	5		
0	70	69	69	69	69	69	P5
100	63	63	63	63	63	63	P5
300	61	60	59	58	58	58	P5
500	56	56	55	55	54	55	P5

The results of the test relate only to the samples tested and any information provided by the client or approved third party. CSIRO does not accept responsibility for deviations in the manufactured quality and performance of the product. The testing method is used to measure the change in slip resistance within a controlled environment, and cannot be used to definitively predict the long term slip resistance / sustainability of the product. Other factors such as installation, maintenance, surface treatment, specific wear

and contamination need to be considered when assessing changes in slip resistance. CSIRO will not be responsible for the results of any actions taken by the client or any other person on the basis of the information contained in the report or any opinions expressed within it. The reproduction of this test report is authorised only in the form of a complete photographic facsimile. Our written approval is necessary for any partial reproduction.

Requested by	Sustainable Infrastructure Systems (AUST) Pty Ltd - Unit 6 / 7-9 Streiff Road - Wingfield - SA 5013
On (date)	14 November 2014
Manufacturer	Sustainable Infrastructure Systems (AUST) Pty Ltd
Product Description	SISCO-FCTm FRP GripDeck 150mm x 45mm
Sampling details	
Where	Delivered
Date	14 November 2014
By whom	Courier
How (methods)	N/A

SUMMARY OF SLIP RESISTANCE TESTS PERFORMED: (*) = AS 4568:2004 classification

	1	Result	Class
AS 4586:2013	Slip resistance classification of new pedestrian surface materials. Appendix A: WET Pendulum (Slider 96):	Mean SRV: 68	P5 (V*)
(*) = AS 4568:2004 classification			

In order to interpret the classifications, please refer to Standards Australia Handbook 198, An Introductory Guide to the Slip Resistance of Pedestrian Surface Materials, which recommends minimum classifications for a wide variety of locations. It is important to realise that test results obtained on unused factory-fresh samples may not be directly applicable in service, where proprietary surface coatings, contamination, wear and subsequent cleaning all influence the behaviour of the pedestrian surface.

**SLIP RESISTANCE CLASSIFICATION OF NEW PEDESTRIAN SURFACE MATERIALS
WET PENDULUM TEST METHOD**

TEST CARRIED OUT IN ACCORDANCE WITH AS 4586:2013 (Appendix A)

Test Date: 17 November 2014

RESULTS:

Location: Slip Resistance Laboratory

Slider used: 96 Conditioned with grade P400 paper, dry

Sample: Unfixed

Cleaning: Deionized water

Temperature: 23.5°C

Pendulum Friction Tester: Stanley (S/N: 0312, calibrated 03/06/2014)

Test conducted by: Khanh Ho

Specimen	1	2	3	4	5
Last 3 swings (BPN)	73	65	71	64	69
	72	64	71	64	69
	71	64	70	64	69
Averages	72	64	71	64	69
Mean SRV : 68					
CLASS : P5 (V*)					

Where products are to be used in wet barefoot areas, it is more appropriate to test to Appendix C of AS 4586 (which is technically equivalent to DIN 51097).

Flexural Load Testing

Registered Testing Authority - Bureau Veritas

Test Report No. 15-2768048 Rev A

Test Date: 12th February 2015



SAMPLE DESCRIPTION: Supplied fibre reinforced decking samples, 1 - 5

TEST SPECIFICATION: ASTM D790 (modified)

TEST TYPE: 3 Point Bend Test

TEST DETAILS: 15mm support radius x 15mm loading radius x 600mm support span Load was applied in the middle of the support span (300mm from each support)

SAMPLE DESCRIPTION: Tension testing on supplied steel hook samples – 8mm dia & 6mm dia

Sample ID	Initial Failure Load/ Yield (Newtons)	Ultimate Failure Load (Newtons)	Ultimate Failure Load (Kg force)
Sample 1	19 605	22 157	2259
Sample 2	19 490	22 816	2326
Sample 3	18 469	23 617	2408
Sample 4	15 857	23 013	2347
Sample 5	15 750	23 001	2345
Average	17 834	22 920	2337

Remarks:

Samples failed and cracked through the middle of the span. All samples exhibited same failure mode
See page 2 of 2 for test set up and failure photographs.

Structural Engineering Analysis

Analysis conducted by GHD Engineers

Project Reference No. 33/01072/04



Background

Sustainable Infrastructure Systems (SIS) has developed a new Fibre Reinforced Plastic (FRP) decking board to be used for pedestrian footbridge applications. Five decking board samples have been subjected to flexural load testing certified by Bureau Veritas on 12 February 2015. GHD has been engaged to review the test data, comment on the suitability of the new decking profile for use in pedestrian footbridge applications, and prepare span tables for a variety of load cases.

Design Load Cases

Design loads and load factors have been adopted in accordance with AS5100.2 (Bridge Design – Part 2: Design Loads), and AS1170.1 (Structural Design Actions – Part 1: Permanent, imposed and other actions) as follows:

Design Loads

- | | |
|--|--------------------------------|
| • Self-Weight (Dead Load) | 0.031 kN/m; |
| • Uniform Distributed Load (Live Load) | 3 kPa, 4 kPa, 5 kPa; |
| • Point Load (Live Load) | 1.8 kN, 2.7 kN, 3.5 kN, 4.5kN. |

Load Factors

- | | |
|-----------------------------------|------|
| • Ultimate Dead Load Factor | 1.2; |
| • Ultimate Live Load Factor | 1.8; |
| • Serviceability Dead Load Factor | 1.0; |
| • Serviceability Live Load Factor | 1.0. |

Analysis

Two key assessments are required when designing structural members: ultimate strength capacity and serviceability requirements. Assessing ultimate strength is undertaken to confirm the member has sufficient capacity to resist failure under maximum loading conditions. Assessing serviceability is undertaken to confirm the deflection or deformation of the member under regular loading is limited to an acceptable level.

Ultimate Strength

A statistical analysis of the flexural test data has been completed in order to establish a basis for the ultimate strength capacity. Five decking board samples were tested from a statistically large population, and exhibit the following properties:

- Mean 17834 N;
- Standard Deviation 1906 N.

It is not possible to confirm the data distribution type due to the small number of samples tested, however it is expected that the data would follow a normal distribution. Assuming this is the case, a 95% confidence interval for the population mean (μ) has been calculated as follows:

$$16163 < \mu < 19505$$

Assuming the standard deviation of the sample data is similar to that of the population, and given 95% of data falls within ± 2 standard deviations from the mean; it is considered appropriate to

adopt the lower confidence interval bound and further reduce its value by 2 standard deviations to capture the lowest likely event. Therefore, following this philosophy, the value adopted to represent the ultimate strength capacity is 12351 N.

Based on the above value and span geometry of the flexural load testing, the allowable bending moment and shear forces have been determined as follows:

- Allowable Shear Force 6.18 kN;
- Allowable Bending Moment 1.85 kNm.

Serviceability

Deformation data from the flexural load testing has not been made available, and therefore no conclusions can be made from the test data regarding serviceability performance. In order to assess the serviceability performance of the GripDeck, theoretical analysis has been undertaken. Based on the cross section geometry and published material properties (Bedford Reinforced Plastics Inc. Design Guide), the flexural rigidity (EI) has been calculated as follows:

- Modulus of Elasticity, E (published) 19.3 GPa;
- Moment of Inertia, I (calculated) 323,983 mm⁴.

In order to provide practical guidance for the future use of the GripDeck decking boards, the following span table has been developed covering both ultimate strength and serviceability requirements. For a given design load and service deflection limit, the maximum allowable span can be determined.

Table 1 GripDeck Allowable Span Table

Design Loads		Serviceability Limits		
UDL (kPa)	Point Load (kN)	L/300	L/240	L/150
		Maximum Allowable Span		
		mm	mm	mm
3 - 5	1.8	740	820	1040
3 - 5	2.4	600	670	850
3 - 5	3.5	530	590	750
3 - 5	4.5	470	520	660

As expected, point loads were the governing design load for all load cases. Also, in all cases, the maximum allowable span was limited by serviceability requirements rather than ultimate strength requirements.

A range of deflection limits are included in Table 1, however, it should be noted that the serviceability limit requirement to Australian Standards (AS1170.0) for a typical footbridge application is L/300.

The data in this corrosion guide is based on field service performance, laboratory testing and extrapolated values from our resin manufacturers' recommendations. Data shown is intended as a guide only. It is recommended that for a specific application, testing be done in the actual chemical environment. The following conditions will effect the suitability of a specific resin laminate:

Periodic changes in temperature
Changes in chemical concentrations
Exposure to vapor only
Exposure to intermittent splashes and spills
Load bearing or non-load bearing requirements

Temperature spikes
Combinations of chemicals
Exposure to frequent splashes and spills
Frequency of maintenance wash down

Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Acetic Acid, to 10%	76	26
Acetic Acid to 50%	81	NR
Acetic Acid, Glacial	NR	NR
Acetone	NR	NR
Aluminum Chloride	76	49
Aluminum Hydroxide	60	49
Aluminum Nitrate	60	49
Aluminum Sulfate	76	49
Aluminum Chloride	76	49
Ammonium Hydroxide, 5%	60	NR
Ammonium Nitrate, to 50%	76	49
Ammonium Nitrate, Saturated	76	NR
Ammonium Persulfate, to 25%	69	32
Ammonium Phosphate	76	49
Ammonium Sulfate	76	49
Amyl Alcohol	26	NR
Barium Carbonate	76	49
Barium Chloride	76	49
Barium Sulfate	76	49
Benzene	NR	NR
Benzene Sulfonic Acid 50%	43	NR
Benzoic Acid	76	49
Benzyl Alcohol	NR	NR
Borax	76	49
Brinc (Sodium Chloride Sol.)	76	49
Bromine, Liquid or Vapor	NR	NR
Ethyl Alcohol	NR	NR
Ethylene Glycol	76	49

Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Butyl Acetate	NR	NR
Butyl Alcohol	26	NR
Calcium Carbonate	76	49
Calcium Hydroxide	60	49
Calcium Hypochlorite	49	NR
Calcium Nitrate	76	49
Calcium Sulfate	76	49
Carbon Disulfide	NR	NR
Carbon Monoxide Gas	76	60
Carbon Dioxide Gas	76	60
Carbon Tetrachloride	20	NR
Liquid or Vapor	43	NR
Chlorine, Dry Gas	76	NR
Chlorine, Wet Gas	76	NR
Chlorine Water	60	NR
Chloroform	60	NR
Chromic Acid, to 5%	43	NR
Chromous Sulfate	60	49
Citric Acid	76	49
Copper Chloride	76	76
Copper Cyanide	76	76
Copper Nitrate	76	76
Crude Oil, Sour	76	76
Cyclohexane, Liquid and Vapor	76	NR
Diesel Fuel	60	32
Ethyl Acetate	NR	NR
Phosphoric Acid, Vapor	76	49
Potassium Aluminum Sulfate	76	49

Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Fatty Acids	76	26
Ferric Chloride	76	43
Ferric Sulfate	76	43
Formaldehyde	43	NR
Fuel Oil	60	26
Gasoline, Aviation and Ethyl	60	26
Glucose	76	37
Glycerine	76	37
Hexane	49	32
Hydraulic Fluid (Glycol Based)	60	NR
Hydraulic Fluid Skydraul	60	NR
Hydrobromic Acid	43	NR
Hydrochloric Acid, up to 15%	60	26
Hydrochloric Acid, Concentrated	43	NR
Hydrogen Bromide, Dry Gas	60	26
Hydrogen Bromine, Wet Gas	60	NR
Hydrogen Chloride, Dry Gas	76	26
Hydrogen Chloride, Wet Gas	76	26
Hydrogen Fluoride, Sol or Vapor	NR	NR
Hydrogen Peroxide, to 10%	43	NR
Hydrogen Sulfide, Dry Gas	60	26
Hydrogen Sulfide, Wet Gas	60	26
Isopropyl Alcohol	26	NR
JP-4	60	26
Kerosene	60	43

Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Lactic Acid	76	49
Lead Acetate	76	49
Linseed Oil	76	37
Lithium Chloride	76	49
Magnesium Carbonate	76	49
Magnesium Chloride	76	49
Magnesium Hydroxide	76	37
Magnesium Nitrate	76	49
Magnesium Sulfate	76	49
Mercuric Chloride	76	49
Mercuric Metal	76	49
Methyl Ethyl Ketone	NR	NR
Mineral Oil	76	49
Monochlorobenzene	NR	NR
Naphtha	60	49
Nickel Chloride	76	49
Nitric Acid, to 5%	43	37
Nitric Acid, Concentrated	NR	NR
Nitric Acid, Vapor	60	37
Oleic Acid	76	49
Oxalic Acid	76	49
Paper Mill Liquor	37	37
Phenol Solution or Vapor	NR	NR
Phosphoric Acid	76	37
Phosphoric Acid, Salts thereof	76	49



Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Potassium Bicarbonate	43	37
Potassium Carbonate, to 10%	110	NR
Potassium Chloride	76	49
Potassium Hydroxide	60	NR
Potassium Nitrate	76	49
Potassium Sulfate	76	49
Propylene Glycol	76	49
Sodium Acetate	76	49
Sodium Benzoate	60	49
Sodium Bicarbonate	60	49
Sodium Bisulfate	76	49
Sodium Bisulfite	76	49
Sodium Borate	76	49
Sodium Bromide	76	49
Sodium Carbonate, to 10%	60	20
Sodium Chloride	76	49
Sodium Cyanide	76	49
Sodium Dichromate	76	49
Sodium Di-Phosphate	76	49
Sodium Hydroxide, 10%	60	NR
Sodium Hypochlorite, to 5 ¼%	43	20
Sodium Monophosphate	76	49
Sodium Nitrate	76	49
Sodium Nitrite	76	49
Sodium Sulfate	76	49

Chemical Environment	Maximum Recommended Service Temperatures °C	
	Vinylester	Polyester
Sodium Tetraborate	60	49
Sodium Thiosulfate	60	49
Soy Oil	76	37
Stearic Acid	76	49
Styrene	NR	NR
Sulfamic Acid	76	49
Sulfated Detergents	NR	49
Sulfite Liquor	71	37
Sulfur Dioxide, gas-dry	76	49
Sulfur Dioxide, gas-wet	76	20
Sulfur Trioxide, gas-wet or dry	76	NR
Sulfuric Acid, to 25%	76	26
Tartaric Acid	76	49
Tetrachloroethylene	NR	NR
Toluene	NR	NR
Trichloroethylene vapor	NR	NR
Trisodium Phosphate	76	NR
Urea, 35%	43	NR
Vinegar	76	65
Water, Distilled	81	65
Water, Tap	81	65
Zinc Chloride	76	49
Zinc Nitrate	76	49
Zinc Sulfate	76	49



Typical Coupon Properties



Below are test results for typical properties of SIS structural fiberglass profiles (Standard, Fire Retardant, & Vinylester shapes). Properties are derived per the ASTM test method shown. Synthetic surfacing veil and ultraviolet inhibitors are standard.

Mechanical Properties	ASTM	Units	Value
Tensile Stress, LW	D-638	MPa	206.9
Tensile Stress, CW	D-638	MPa	48.2
Tensile Modulus, LW	D-638	GPa	17.2
Tensile Modulus, CW	D-638	GPa	5.5
Compressive Stress, LW	D-695	MPa	206.8
Compressive Stress, CW	D-695	MPa	103.4
Compressive Modulus, LW	D-695	GPa	17.2
Compressive Modulus, CW	D-695	GPa	6.9
Flexural Stress, LW	D-790	MPa	206.8
Flexural Stress, CW	D-790	MPa	68.9
Flexural Modulus, LW	D-790	GPa	12.4
Flexural Modulus, CW	D-790	GPa	5.5
Modulus of Elasticity, E	Full Section	GPa	19.3
Shear Modulus	--	GPa	3.1
Short Beam Shear	D-2344	MPa	31.0
Punch Shear	D-732	MPa	68.9
Notched Izod Impact, LW	D-256	J/mm	1.33
Notched Izod Impact, CW	D-256	J/mm	.21
Physical Properties	ASTM	Units	Value
Barcol Hardness	D-2583	--	45
24 Hour Water Absorbtion	D-570	% max	0.45
Density	D-792	g/cc	1.72-1.94
Coefficient of Thermal Expansion, LW	D-696	10 ⁶ cm./cm.°C	12
Electrical Properties	ASTM	Units	Value
Arc Resistance, LW	D-495	seconds	120
Dielectric Strength, LW	D-149	kv./mm	1.37
Dielectric Strength, PF	D-149	volts/mil	200
Dielectric Constant, PV	D-150	@60hs	5
Fire Retardant Polyester and Fire Retardant Vinylester Structural Profiles:			
Flammability Properties	ASTM	Value	
Tunnel Test	E-84	25 max.	
Flammability	D-635	Nonburning	
LW: Lengthwise CW: Crosswise PF: Perpendicular to Laminate Face			

Weathering

Property loss is experienced in Fire Retardant (FR), Polyester, and Vinylester Fiberglass pultrusion when exposed to continuous high temperatures. The loss of properties is considered during the designing stages. The following table shows the percentage of property retention at certain continuous temperatures.

	Temperature	FR/Polyester	Vinylester
Ultimate Stress	37°C	85%	90%
	51°C	70%	80%
	65°C	50%	80%
	79°C	Not Recommended	75%
	93°C	Not Recommended	50%
	Temperature	FR/Polyester	Vinylester
Modulus of Elasticity	37°C	100%	100%
	51°C	90%	95%
	65°C	85%	90%
	79°C	Not Recommended	88%
	93°C	Not Recommended	85%

After exposure to outdoor weathering, almost all plastics undergo some degradation in surface appearance.

The surface of pultrusions typically have good water and ambient temperature resistance, but are attacked by ultraviolet light.

Ultraviolet light is the light spectrum 290 to 400 nanometers. The light has higher energy and can significantly degrade polymers by breaking chemical bonds or starting chemical reactions that lead to polymer degradation. Fire retardant polyester formulations, which contain a halogen, are typically more susceptible to ultraviolet light degradation, due to the halogen additive.

Ultraviolet light will cause the surface of the pultrusion to fade (yellow) and lose gloss. Over a longer period of time, fiberglass closest to the surface will be exposed. This condition is known as fiberbloom. Physical Properties are not affected by this surface degradation.

SIS adds a UV stabilizer to our resin mix formulation. This slows the effects of UV degradation. We also incorporate a layer of polyester veil directly to the surface of the pultrusion during processing. This veil gives a resin rich surface and acts as a barrier between the surface and the top layer of fiberglass reinforcement. Pigments used in our resin formulations also slow the effects of weathering.

MATERIAL SAFETY DATA SHEET - Date of Issue 14th July 2013

NOT CLASSIFIED AS HAZOUREDUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA

IDENTIFICATION	
Product Name:	FIBREGLASS REINFORCED PLASTIC
Other Names:	F.R.P – PULTRUDED PROFILE; F.R.P.
Manufacturers Product Code:	NOT APPLICABLE
UN Number:	NOT APPLICABLE
Dangerous Goods Class and Subsidiary Risk:	NOT APPLICABLE
Hazchem Code:	NOT APPLICABLE
Poisons Schedule Number:	NOT APPLICABLE
Use:	
<ul style="list-style-type: none"> • Manufacture of fibre optic cables, cable ladders, ladders, Gratings, rods, various profile shapes to be used in structural Applications ie. Bridges, boardwalks, cross arms: • General use replacing steel, aluminium, wood etc. 	

Physical Description / Properties	
Appearance:	SOLID MATERIAL WITH VERY LOW ODOUR. COLOURS VARY.
Boiling Point/Melting Point:	NOT APPLICABLE
Vapour Pressure:	NOT APPLICABLE
Specific Gravity:	1.7 to 2.1
Flashpoint:	NOT APPLICABLE
Flammability Limits:	NOT APPLICABLE
Solubility in water:	NOT APPLICABLE

Other Properties	
Chemical Name	340° to 370°C
Odour Threshold:	VERY LOW
Physical State (20°C)	SOLID
Fire Point:	500°C

Ingredients		
Autoignition Temperature:	CAS Number	Proportion
Cured Thermoset Resin	NOT APPLICABLE	15-60%
Glass Filament/mat	6599-17-3	40-85%

MATERIAL SAFETY DATA SHEET - Date of Issue 14th July 2013

NOT CLASSIFIED AS HAZOUREDIOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA

HEALTH HAZARD INFORMATION

Health Effects

- Information on health effects are for substances which may result from operations generating nuisance dust;
- Based on available animal experiments and epidemiology as per NOHSC:1001(1989).

Chronic

- Animal experiments and evidence from human studies have caused the International Agency for Research and Cancer to conclude that reinforcing glass filament cannot be classified as to its carcinogenity to humans due to inadequate or insufficient information (group 3/IARCA).
- No risk of lung cancer has been demonstrated in the reinforcing glass filament sector.
- No evidence of lung fibrosis has been shown in the reinforcing glass filament sector.
- No risk of mesothelioma has been demonstrated in the reinforcing glass filament sector.

Acute	
Swallowed:	Non-irritant. No adverse effects expected.
Eye:	May cause mild eye irritation from operations generating a nuisance dust. Use of safety glasses with side shields or a vented safety goggle recommended for dusty environments.
Skin:	May cause mild skin irritation from operations generating a nuisance dust. Use of long sleeve shirts and leather gloves may reduce skin exposure. Good ventilation system suggested.
Inhaled:	May produce low respiratory irritation and coughing from operations generating a nuisance dust. Use of dust masks and a good ventilation system may reduce the exposure.

Advice to doctor – treat like general dust.

MATERIAL SAFETY DATA SHEET - Date of Issue 14th July 2013**NOT CLASSIFIED AS HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA
PRECAUTIONS FOR USE**

Exposure Standards - As per NOHSC:1003 (1995) – Exposure Standards for Atmospheric Contaminants in the Occupational Environment.

Respirable dust (SMF) TWA = 0.5 fibres/mL

Nonrespirable dust TWA = 2 mg/m³

Engineering Controls

- segregation of processes generating nuisance dust from other personnel;
- capture of dust at source and safe disposal with a local exhaust ventilation system.

Personal Protection	
Eye:	Safety glasses with side shields or a vented safety goggle recommended for dusty environments.
Skin:	Long sleeve shirts and leather gloves may reduce skin exposure.
Inhaled:	Dust masks may reduce the risk of inhaling and/or swallowing.

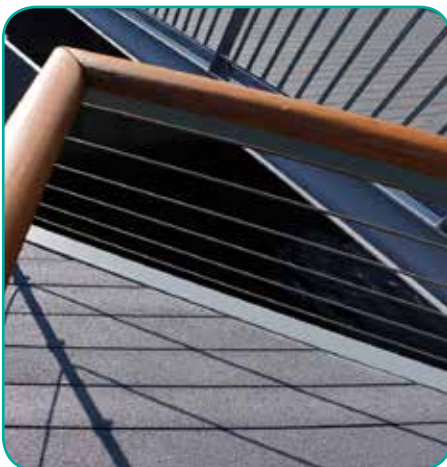
SAFE HANDLING INFORMATION	
Storage and Transport:	Not classified as dangerous goods according to Dangerous Goods (Storage and Handling) Regulations 1989.
Spills and Disposal:	NOT APPLICABLE
Fire/Explosion Hazard:	No fire or explosion hazards under any reasonably foreseeable conditions of use or storage. May produce toxic fumes of carbon monoxide if burning in confined space. Any type of extinguisher or fire-fighting agent is acceptable – water, foam, dry chemical. Self-contained breathing apparatus may be used in confined space.

OTHER INFORMATION	
Toxicity and Ecotoxicity:	NOT APPLICABLE
Biodegradability:	NOT APPLICABLE
Persistence in Soil/Water: :	NOT APPLICABLE

CONTACT POINT

For more information contact Sustainable Infrastructure Systems National Customer Service Centre on 1300 26 10 74 or service@sisau.com.au.

Project Photos



Southbank Pedestrian Bridge, Melbourne.
Client – City of Melbourne.
745 m2 SISCO-Deck / 1398 L/M StructuralComp FRP Joist

Effective 1st June 2013

Subject to the limitations set forth in this Warranty, Sustainable Infrastructure Systems (Aust) Pty Ltd ('Manufacturer') warrants that the StructuralComp structural shape ("product") will be free of manufacturing and design defects and meets the specifications (if any) provided by the Manufacturer to the first purchaser ("customer") at the time of purchase. This limited warranty applies only to the structural serviceability and does not apply to superficial blemishes, discoloration, and/or other defects that occur with aging and normal use. If, in response to a warranty claim, Manufacturer issues a refund for the purchase price of the product, the refund amount shall be determined by prorating the purchase price amount based upon length of use during a twenty-five (25) year product lifespan. Except where otherwise required by law, the warranty runs solely to the customer.

The customer is solely responsible for determining the effectiveness, suitability and safety of any particular use or application of the product. This warranty shall be invalid if a loss occurs from improper installation, normal wear and tear, misuse, intentional or unintentional abuse, settlement or shifting of the earth or any supporting structural components used in conjunction with the product, user negligence, modification of the product, accidents, improper maintenance, impact of foreign objects, or cyclones, floods, fire, or other acts of God. This warranty does not cover applications involving exposure of the product to chemicals or other pollutants.

THIS WARRANTY SET FORTH ABOVE IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR USE. IF THE PRODUCT DOES NOT CONFORM TO THE WARRANTY ABOVE, MANUFACTURER MAY, AT ITS OPTION, REPAIR OR REPLACE THE PRODUCT. MANUFACTURER WILL NOT BE LIABLE FOR, AND CUSTOMER IS SOLELY RESPONSIBLE FOR, LABOR, INSTALLATION, REINSTALLATION, FREIGHT, TAXES, OR ANY OTHER CHARGE RELATED TO THE FOREGOING.

The customer must give notice of any warranty claim within ten (10) days of discovery and include proof of purchase, photograph of defect, and written description of defect. Manufacturer reserves the right to investigate any claim hereunder. Upon verification of a claim, Manufacturer shall arrange for the delivery of replacement product or repair the defective product, within a reasonable time.

CUSTOMER'S REMEDY WITH RESPECT TO BREACH OF WARRANTY SHALL BE LIMITED AS SET FORTH ABOVE. IN ALL OTHER CASES, MANUFACTURER'S LIABILITY SHALL IN NO EVENT EXCEED THE PURCHASE PRICE OF THE PRODUCT. MANUFACTURER SHALL NOT BE SUBJECT TO AND DISCLAIMS: (1) ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR OF WARRANTY; (2) ANY OBLIGATIONS WHATSOEVER ARISING FROM TORT CLAIMS (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR ARISING UNDER OTHER THEORIES OF LAW WITH RESPECT TO PRODUCTS SOLD BY MANUFACTURER, OR ANY UNDERTAKINGS, ACTS, OR OMISSIONS RELATING THERETO; AND (3) ALL CONSEQUENTIAL, INCIDENTAL, EXEMPLARY, CONTINGENT, AND OTHER DAMAGES WHATSOEVER.

Without limiting the generality of the foregoing, Manufacturer specifically disclaims any liability for penalties (including administrative penalties), special or punitive damages, damages for lost profits or revenues, loss of use of products or any associated equipment, cost of capital, facilities, or services, downtime, shut-down or slow-down costs, spoilage of material, or for any other types of economic loss.

This Warranty may not be altered except in a written instrument signed by Manufacturer. No dealer or other person or entity is authorized by the Manufacturer to make statements or representations regarding the performance of the product except as contained in this Warranty, and the Manufacturer shall not be bound by any such statements.



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