RailEX® ROUND

WHITE PAPER

Fibreglass Reinforced Plastic (FRP/GRP) Handrail / Guardrail Technical Selection & Overview

TREADWELL™

COMPLETE "Fit & Forget" SOLUTIONS

treadwellgroup.global

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Testing & Engineering

Treadwell would like to reaffirm that the RailEX® ROUND FRP Handrail system has been tested to AS 1657 – 2013 and found to be fully compliant by ALS Industrial Pty Ltd of 450 Dynon Road, West Melbourne Victoria 3003, Australia. This organisation, which is a part of the ALS Laboratory Group, is a NATA accredited testing laboratory and has the necessary approval to test items to AS 1657, holding an Accreditation No: 218 and is registered Site No: 14308. The contact through whom the bulk of Treadwell's discussions have been conducted over the years is Mr Chris Vines.

As a requirement of AS1657-2013 the Treadwell handrail system offers compliance to section 8.2 of the code and this is a mandatory requirement that the product is independently tested and found to comply with the rigor of AS1657-2013. It is advisable that companies such as yourselves ensure that all system certificates relating to handrails are supplied prior to any material arriving at site.

The test report, or product evaluation report, from the NATA accredited testing laboratory, confirming that the product complies with AS 1657 – 2013 has been included within this document – refer **ATTACHMENTS A & B.**

Stanchions or posts are significant in their role to stop deflection of the walkway handrail.

Stanchion / Post Spacing

All handrail/guardrail systems in Australia are required to be able to withstand the forces outlined within the applicable standard for walkway design, construction and installation – AS1657 – 2013, Appendix B (Testing of Guard Railing Comprising Rails and Posts).

Stanchions or posts are significant in their role to stop deflection of the walk way hand rail. With this in mind, it is relatively simplistic to comprehend that the closer stanchions are, the more force a handrail/guardrail will be able to withstand before it fails and gives way. However, for economic reasons, it is not viable to have excessive quantities of stanchions.

To this end, Treadwell has undertaken extensive testing to arrive at a conclusive maximum stanchion spacing and it can be affirmed that no 'guardrail span' between stanchions must exceed a 1,500mm (centres) maximum spacing – this must be respected and applied to all RailEX® installations regardless of whether they are all new or retrofitting to old or existing structures. To illustrate this, a comprehensive drawing has been developed and included within this document – refer **ATTACHMENT C**

Connections to Existing Steel

Treadwell has developed a number of brackets to compliment the RailEX® ROUND FRP Handrail system and these have been specifically developed to retrofit to existing structural steel on industrial sites and adapt to typical monowills style stanchion mounting holes (2 of 16mm diameter holes spaced at 102mm centres) – we do not believe that this will be a requirement on your current project (Wheatstone LNG).

These mounting brackets have been developed to comply with standards and Treadwell has undertaken in-house testing and conforms to AS 1657 – 2013.

Detailed drawings of how these brackets and the recommended connections are made to existing structural steel have been included within this document – refer **ATTCHMENT D**.

Since most industrial retro-fit applications are undertaken in scenarios where the existing structure comprises of mild steel, recommended insulation measures are also clearly displayed in the example drawings developed.

Based on Australian Standards 1657 (2018), handrails must be visually contrasting to its surroundings.

Fastener, Driver Type (RXH-SFK06)

RailEX® fastener driver being a security screw and the drive, therefore being unusual or unique, this fastener has been designed for safety reasons (i.e. to ensure as reasonably as practicably possible that the product is and remains tamperproof following installation completion).

Treadwell has made every effort to ensure that this component is not an inconvenience, and has made both hand operated drivers and attachment drivers for use in power drills/electric drivers available.

Regardless, we are definitely able to supply these fasteners with a more common drive type, i.e. 'Philips' or 'Socket' drive. This would be a special order and there would be a substantial minimum order quantity (i.e. 10,000 pieces).

Chemical Resistance

All RailEX® FRP handrail product components are typically produced from Treadwell's V-Series® resin system. Treadwell has published data available to all clients related to the chemical resistance of the resin systems available and this is published in the RailEX® Product Guide from pages 23 to 27.

To assist with locating this data, we have also included the chemical resistance guide within this document – refer **ATTACHMENT E.**

Maintenance Inspection Regime

Treadwell advise that a maintenance and inspection program for the product is set up, it is Treadwell's assumption that to ensure compliance with Department of Mines and Petroleum, the majority of mine sites and mineral processing operations or mining related organisations nationally would have a system of incident reporting in place as standard practice (i.e. when something such as a handrail is deemed damaged or unsafe) and we have also assumed this to be the case within your operations.

To coincide with this, Treadwell has developed the provided specifically developed Maintenance Regime Inspection Documentation which includes a Recommended Care Guide document and an Inspection Checklist – both of these are intended to be a guide only and they have been provided as a suggestion for your maintenance / engineering team to adopt and develop further based around site peculiarities and the experience of the various personnel employed to operate the site – refer to **ATTACHMENT F and G.**

Repair Strategies

Whilst Fibreglass Reinforced Plastic (FRP) products are remediable, and the Treadwell Fibreglass Fabrication & Repair Manual specifically deals with the many and varied types of damage to FRP products and their respective accepted repair procedures, it is Treadwell's recommendation that repairs to damaged FRP handrail are not attempted, especially when the simplicity afforded by the system when installing replacement parts with RailEX® ROUND components are considered.

In almost all instances, if a component part is damaged i.e. cracked through or fractured (large forces are required to break RailEX® handrail), it can be simply unbolted using the correct tools. With similar handrail systems constructed from metals, site works, hot works permits, blasting and coating are typically required, resulting in time consuming and expensive repair requirements

Fire Ratings & Approval

Treadwell has completed extensive testing on our range of FRP resin system according to a number of standards and the material is accredited to comply with ASTM-E84 and also test method AS/ISO 9239.1 2003 Reaction To Fire Tests For Floorings Part 1 Determination of Burning Behaviour Using a Radiant Heat Source. As required by specification C1.10 of the Building Code of Australia. Please also review the below link for a physical burn test carried out by Treadwell - https://www.linkedin.com/feed/update/urn:li:activity:6174365379578585088

References

Treadwell has provided a current listing of satisfied users of the RailEX® ROUND system in Australia previously, with contact details so that testimonials can be obtained. This document has been included within this document – refer **ATTACHMENT H**. Furthermore, the RailEX® ROUND FRP Handrail Assembly Guide has also been included within this document – refer **ATTACHMENT I**. This document should be referred to by all installers.

ATTACHMENT - A

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

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450 Dynon Rd
West Melbourne VIC 3003
T +61 3 8398 5900
F +61 3 9687 6990
ABN: 21 006 353 046

PRODUCT GAP ANALYSIS REPORT

Subject	GUARDRAILS AS PER AS 1657-2013 V'S AS 1657 -2018
Prepared For:	TREADWELL GROUP P/L
Address:	PO BOX 550 MARLESTON DC SA 5033
Attention:	ALEX WANG
PO Number:	TBC
Identification:	FIBERGLASS GUARD RAILS
Report Number:	063398-2
Test Personnel:	Chris Vines
Date:	15 August 2018

1. INTRODUCTION

It was requested that a comparison between the testing undertaken in March 2016 (ALS reports 030017/1 and /2) under AS 1657 "Fixed Platforms, Walkways, Stairways and Ladders Design, Construction and Installation" – 2013 and the new version of AS 1657 – 2018 be undertaken.

2. LOAD TESTING

The relevant testing sections of the code (appendix B, sections 4.6, 5.5, 6.1.1 and 6.1.2) were compared between the year versions with no apparent changes in the testing requirements between the two versions. There are some minor changes in the text relating to the need for compliance of toe-boards but nothing that impacts the testing requirements. There is also a minor change in the reporting requirements in the way the appendix clauses need to be referenced in the report however this also would not impact in any on the testing performed.

It is our conclusion that the testing performed under the previous version of AS 1657 - 2013 is still valid under AS 1657 – 2018 provided that no design/material changes have been made to the product tested originally.

Prepared by:

Chris Vines
Senior Metallurgical Engineer
Victoria, Australia

All work is subject to our standard terms and conditions, available on our website;
http://www.alsglobal.com/~/media/Files/Divisions/Industrial/Asset%20Care/Asset%20Care%20Resources/Terms%20and%20Conditions/ALS-Terms-and-Conditions-Industrial-Australia.pdf
NOTE: Where applicable, the items examined herein may be disposed of after a period of 3 months from the date of reporting, unless written notification of disposal requirements is received.

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

Horizontal point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	46mm
Deflection after load removed:	10mm
Test date:	25/02/2016
Result:	Sample complies with AS 1657

Vertical point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	4.2mm
Deflection after load removed:	0.1mm
Test date:	25/02/2016
Result:	Sample complies with AS 1657

Vertical point load test on mid rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	4.6mm
Deflection after load removed:	0.3mm
Test date:	29/02/2016
Result:	Sample complies with AS 1657

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Chris Vines
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Victoria, AUSTRALIA

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AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

Horizontal UDL test on top rail	Top rail section
Guardrail span:	3000mm
Preload	10.7 kg per load point (5 points in total) 17.8kg/m
Test load	21.4 kg per load point (5 points in total) 35.7kg/m
Test hold time:	2 minutes
Deflection under load:	29mm (mid rail)
Deflection after load removed:	5mm (mid rail)
Test date:	29/02/2016
Result:	Sample complies with AS 1657

2.2 ULTIMATE LOADING

Horizontal point load test on post	End post
Preload	30.1 kg
Test load	122.4 kg
Test hold time:	2 minutes
Deflection under load:	68mm
Deflection after load removed:	2mm
Test date:	09/03/2016
Result:	Sample complies with AS 1657

Horizontal UDL test on top rail	Top rail section
Guardrail span:	3000mm
Preload	21.4 kg per load point (5 points in total) 35.7kg/m
Test load	42.9 kg per load point (5 points in total) 71.4kg/m
Test hold time:	2 minutes
Deflection under load:	69mm (mid rail)
Deflection after load removed:	5mm (mid rail)
Test date:	29/02/2016
Result:	Sample complies with AS 1657

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

ALS

Horizontal point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	122.4 kg
Test hold time:	2 minutes
Deflection under load:	98mm
Deflection after load removed:	1mm
Test date:	01/03/2016
Result:	Sample complies with AS 1657

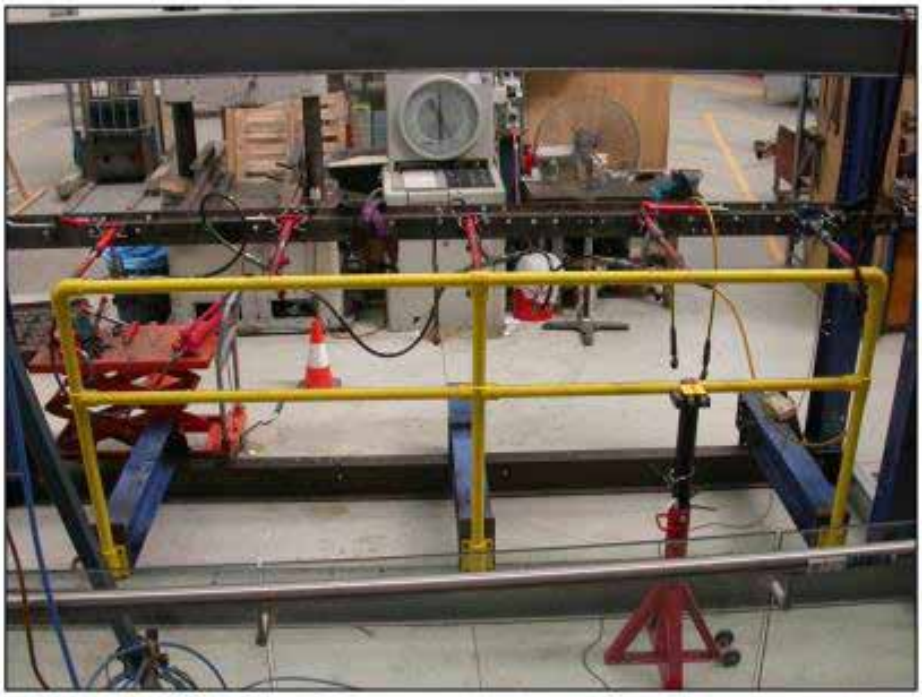

Figure: 1

Subject: F-RXH-R (1m high x 3m long) under the horizontal uniform distributed load)5 loading points on a linked hydraulic system (load cell is on extreme right hand unit).

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AS 1657 – 2013 Compliance Test Report / Product Evaluation Report

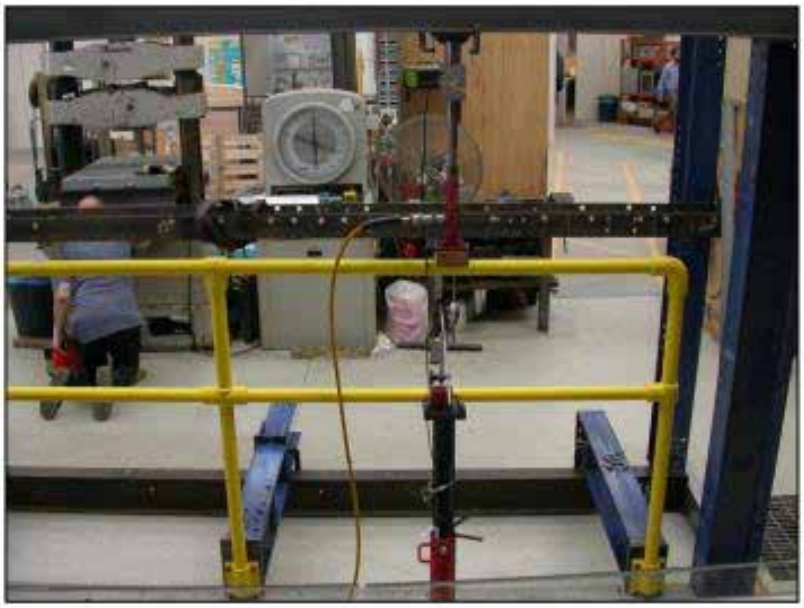

Figure: 2
Subject: Top rail point load vertical test with load cell at top hydraulics.

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Accreditation No: 218 Site No.: 14308
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ATTACHMENT - B

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report (Testing Of Guard Railing Comprising Rails and Posts).

AS 1657 – 2013 Compliance Test Report / Product Evaluation Report (Testing Of Guard Railing Comprising Rails and Posts)

17 March 2016

PRODUCT EVALUATION REPORT

Client:	TREADWELL GROUP
Address:	58 DEEDS RD, NORTH PLYMPTON, SA
Subject:	LOAD TESTING OF FIBERGLASS HANDRAIL SYSTEMS F-RXH-R WITH FLAT MOUNTED FOOTINGS
Client Reference:	MR MATTHEW SUTHERLAND
Client's Order No:	TBC
Correlation/Report No.:	030017/2

1.0 INTRODUCTION.

It was requested that a series of load tests be performed on a fiberglass handrail in accordance with AS 1657 "Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation" - 2013.

2.0 LOAD TESTING

The samples was installed in its standard configuration and the various loads as required by AS 1657 section 6 and appendix B were applied with the following results obtained;

2.1 DEFELCTION LOADING

Test Unit	F-RXH-R (1m high x 3m long)
Footing	F-RXH-R-NMB (flat mount)
Horizontal point load test on post	End post
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	87mm
Deflection after load removed:	3mm
Test date:	01/03/2016
Result:	Sample complies with AS 1657

ALS

Horizontal point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	61mm
Deflection after load removed:	2mm
Test date:	02/03/2016
Result:	Sample complies with AS 1657

Vertical point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	4.1mm
Deflection after load removed:	0.1mm
Test date:	2/03/2016
Result:	Sample complies with AS 1657

Vertical point load test on mid rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	61.2 kg
Test hold time:	2 minutes
Deflection under load:	4.0mm
Deflection after load removed:	0mm
Test date:	2/03/2016
Result:	Sample complies with AS 1657

Horizontal UDL test on top rail	Top rail section
Guardrail span:	3000mm
Preload	10.7 kg per load point (5 points in total) 17.8kg/m
Test load	21.4 kg per load point (5 points in total) 35.7kg/m
Test hold time:	2 minutes
Deflection under load:	45mm (mid rail)
Deflection after load removed:	8mm (mid rail)
Test date:	08/03/2016
Result:	Sample complies with AS 1657

Horizontal point load test on toeboard	mid toeboard section
Guardrail span:	1500mm
Test load	10 kg
Test hold time:	2 minutes
Deflection under load:	23mm
Deflection after load removed:	0mm
Test date:	08/03/2016
Result:	Sample complies with AS 1657

2.2 ULTIMATE LOADING

Horizontal point load test on post	End post
Preload	30.1 kg
Test load	122.4 kg
Test hold time:	2 minutes
Deflection under load:	125mm
Deflection after load removed:	10mm
Test date:	08/03/2016
Result:	Sample complies with AS 1657

ALS

Horizontal UDL test on top rail	Top rail section
Guardrail span:	3000mm
Preload	21.4 kg per load point (5 points in total) 35.7kg/m
Test load	42.9 kg per load point (5 points in total) 71.4kg/m
Test hold time:	2 minutes
Deflection under load:	98mm (mid rail)
Deflection after load removed:	0mm (mid rail)
Test date:	08/03/2016
Result:	Sample complies with AS 1657

Horizontal point load test on top rail	mid rail section
Guardrail span:	1500mm
Preload	30.1 kg
Test load	122.4 kg
Test hold time:	2 minutes
Deflection under load:	100mm
Deflection after load removed:	0mm
Test date:	08/03/2016
Result:	Sample complies with AS 1657

Figure: 1
Subject: F-RXH-R (1m high x 3m long) under the horizontal rail point load.

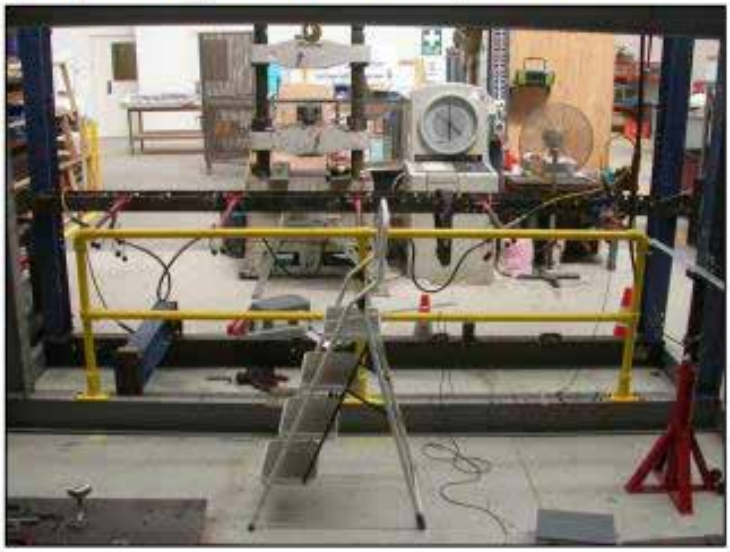
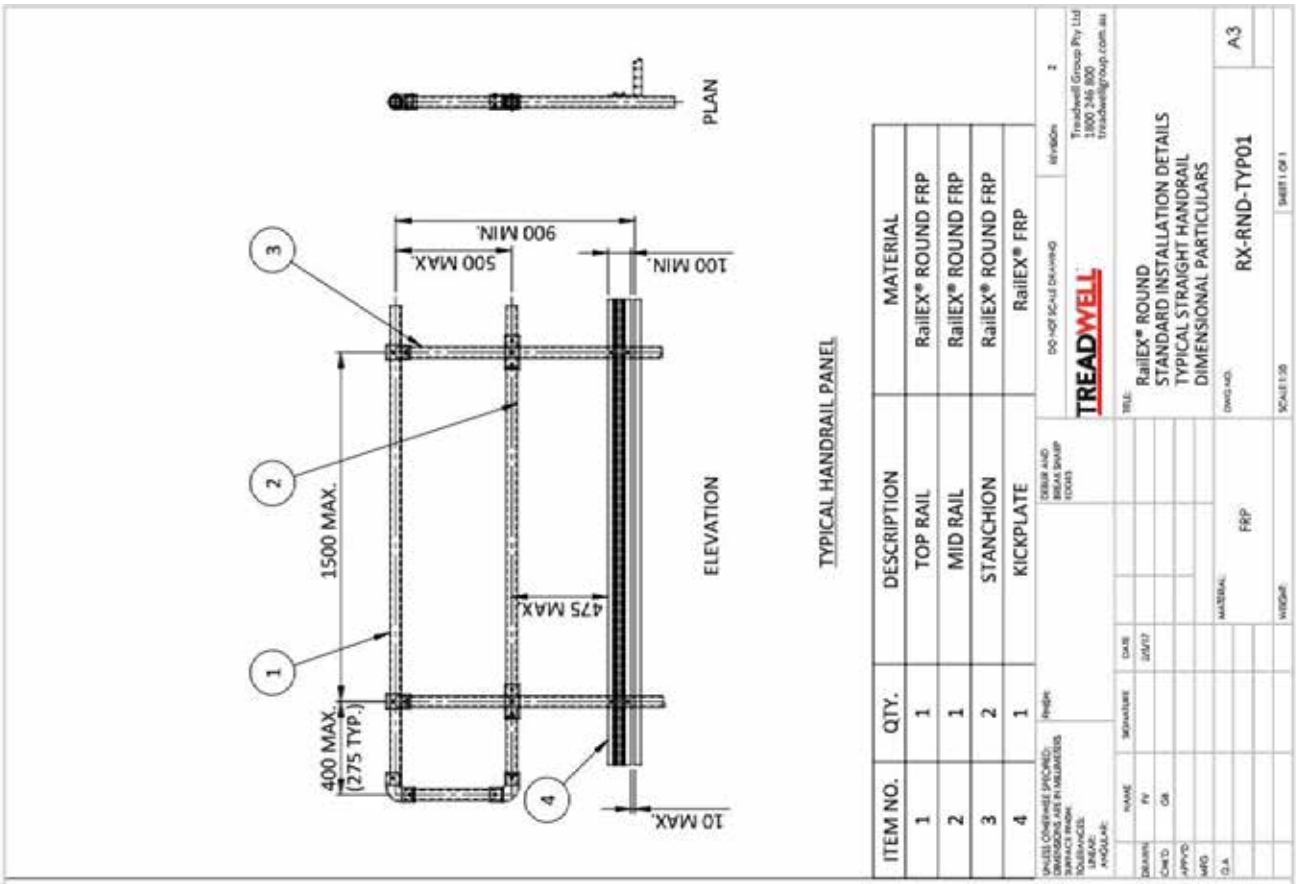


Figure: 2
Subject: Top rail uniform distributed load test.

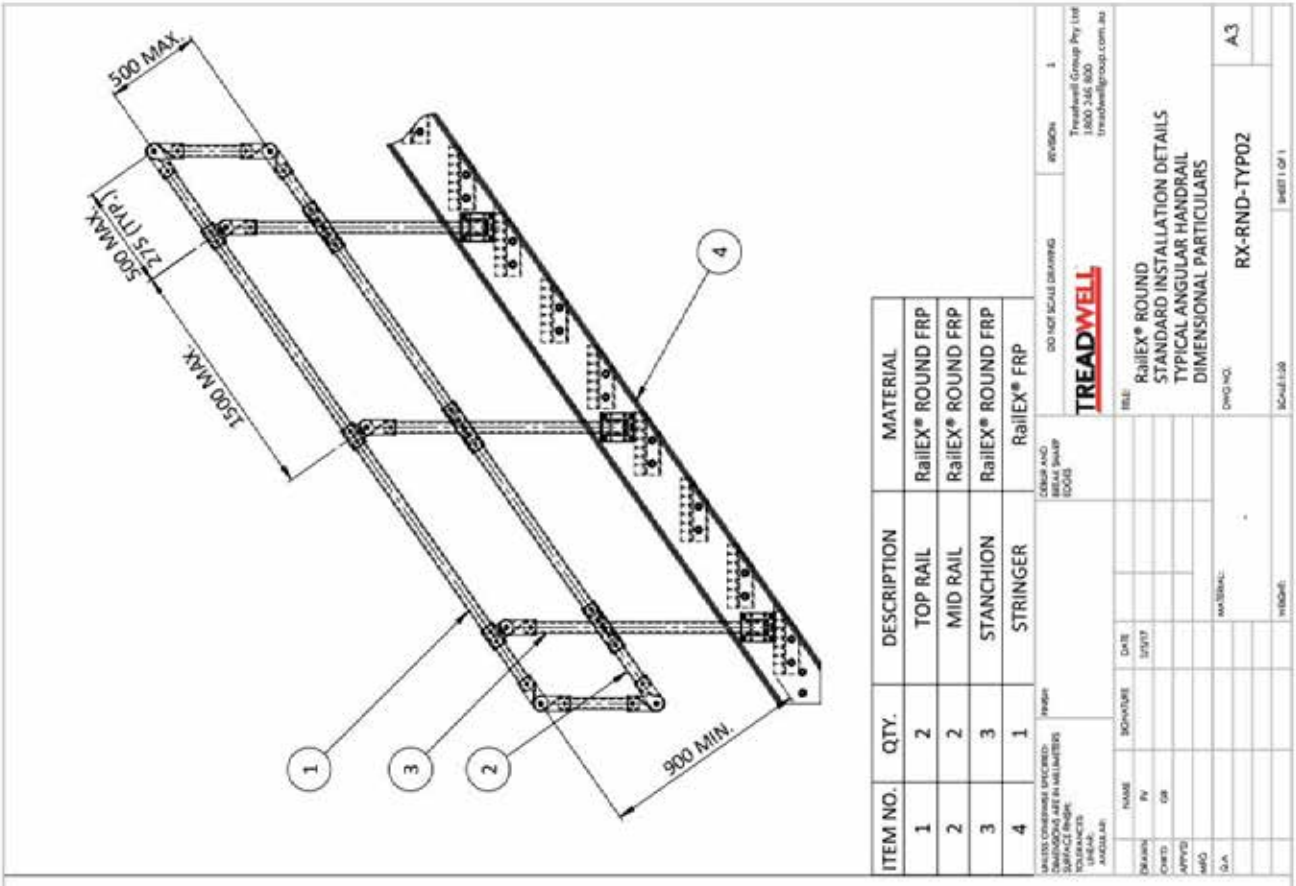
ATTACHMENT - C

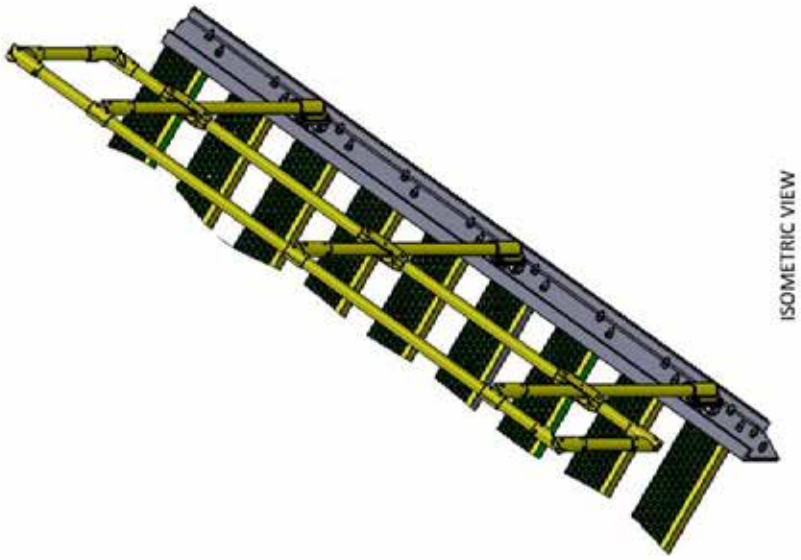
Typical Stanchion / Post Spacing Drawing

Typical Stanchion / Post Spacing Drawing



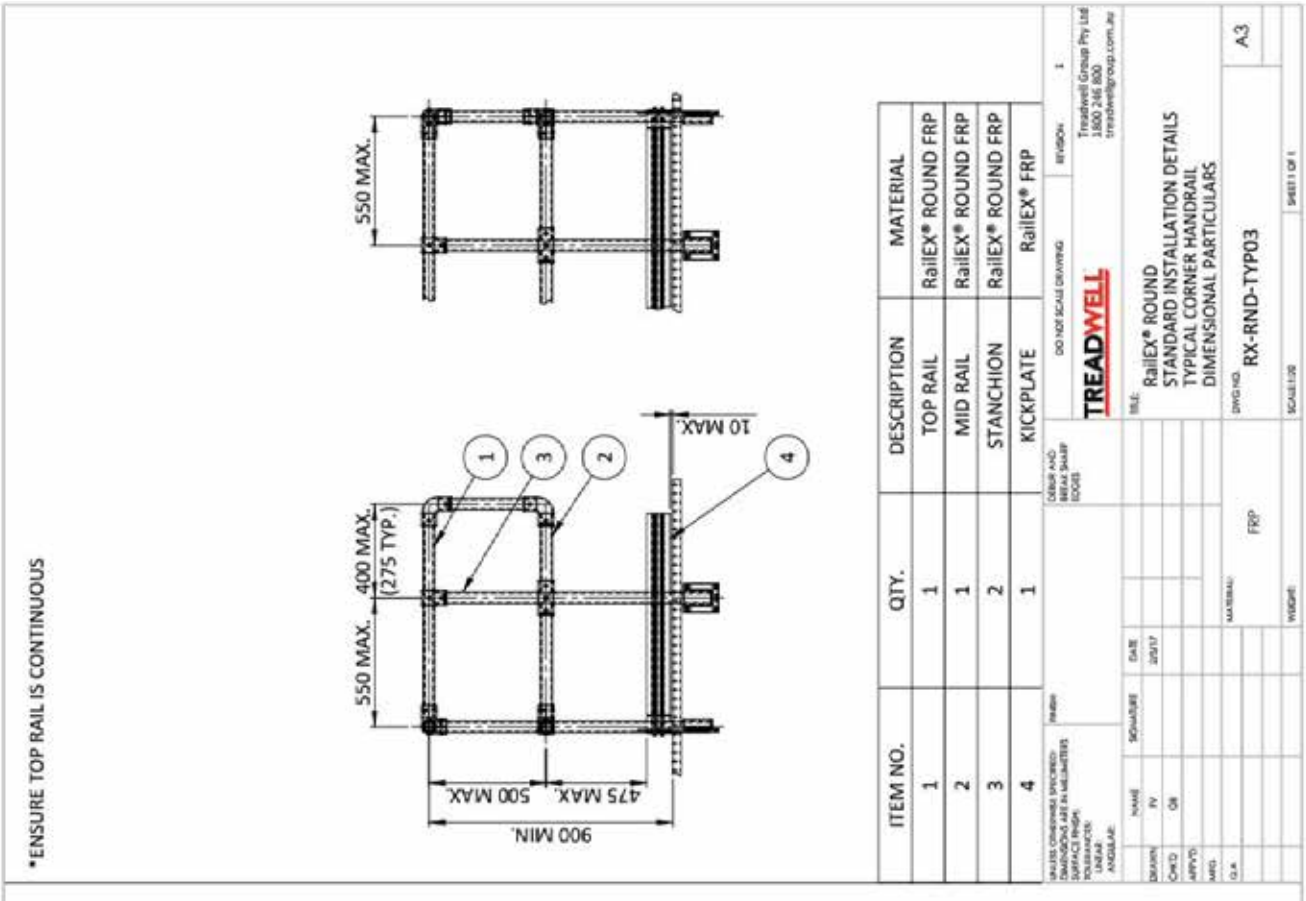
Typical Stanchion / Post Spacing Drawing





ISOMETRIC VIEW

Typical Stanchion / Post Spacing Drawing

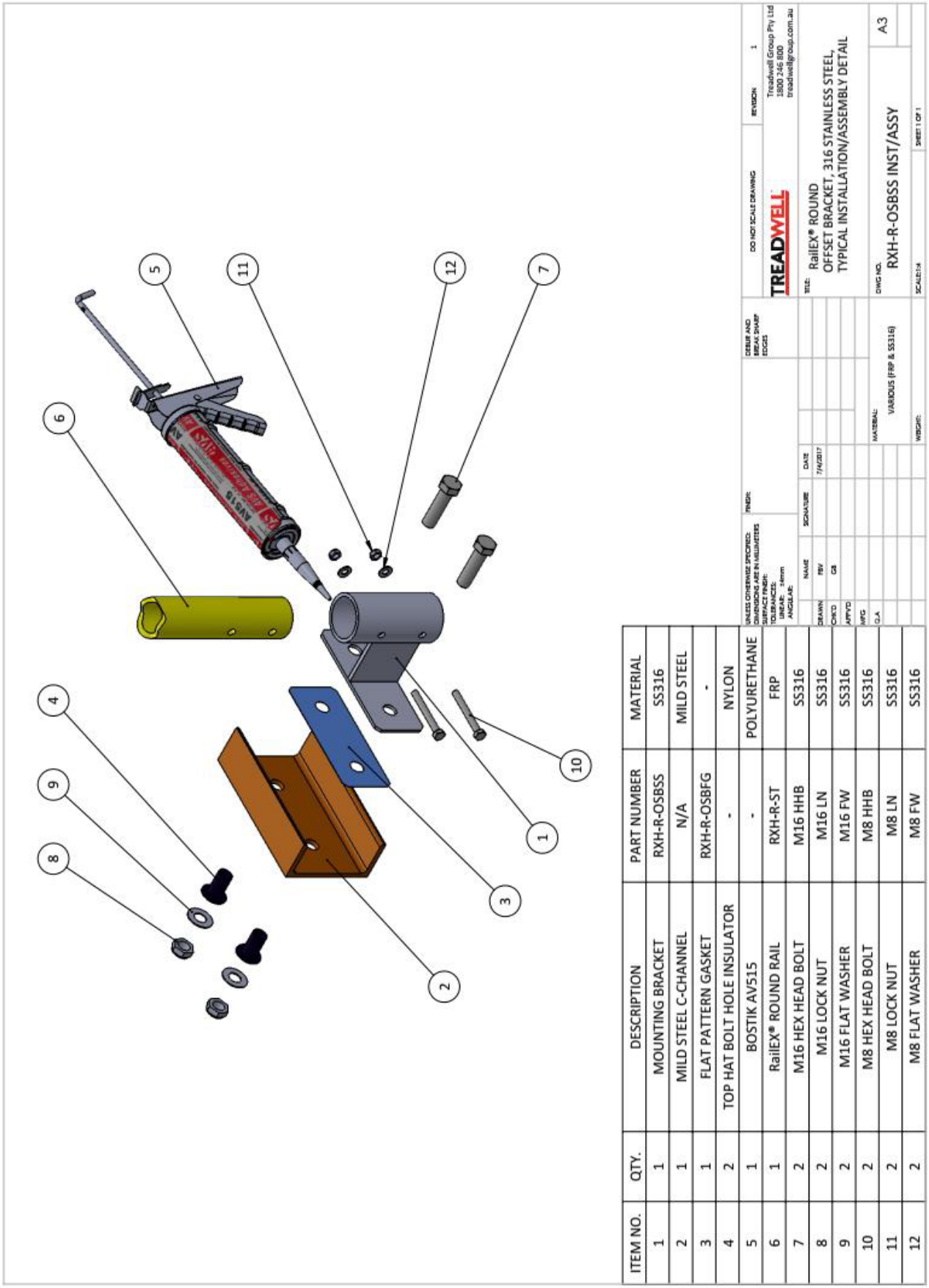


ISOMETRIC VIEW

ATTACHMENT - D

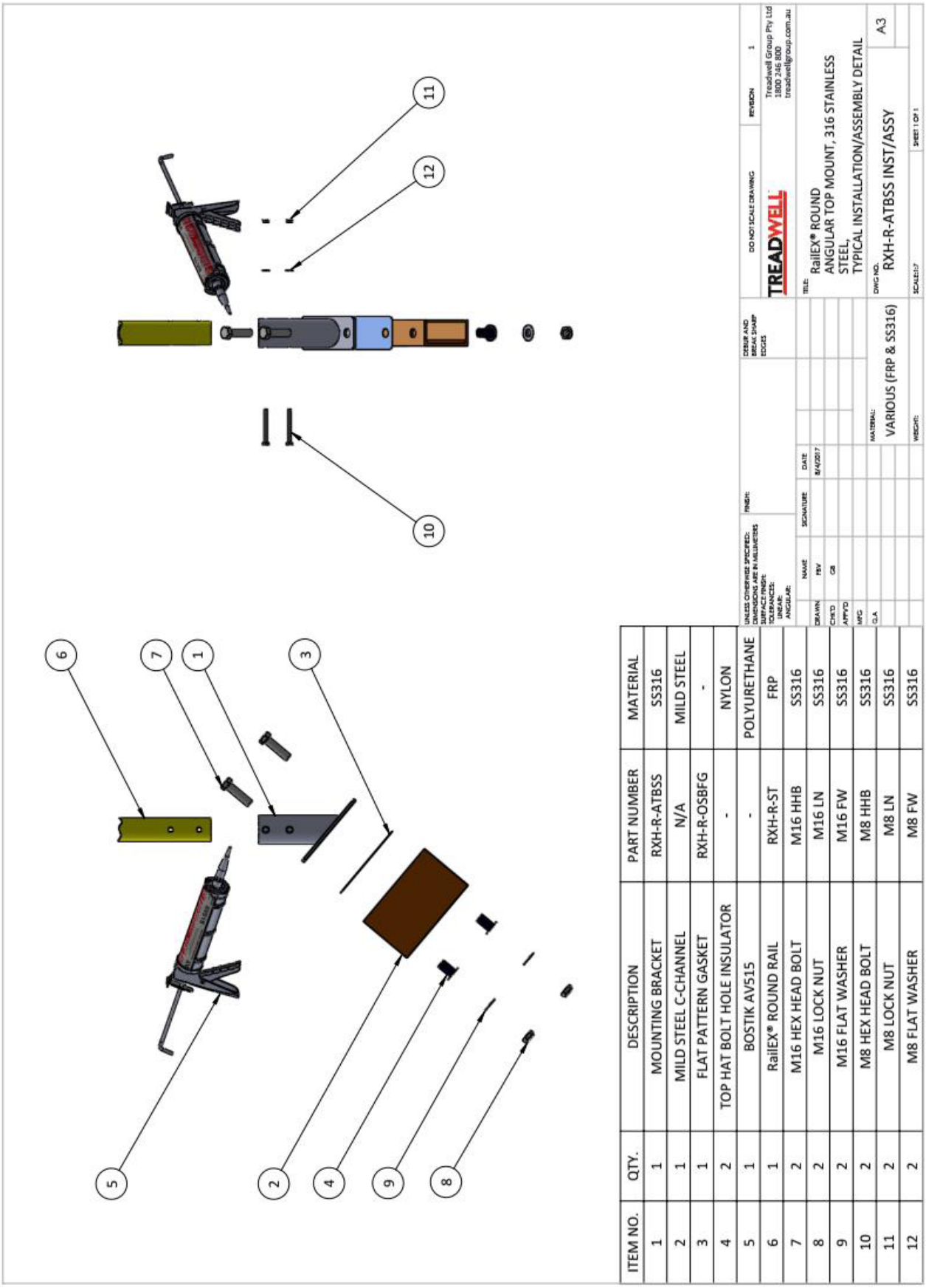
Typical Connections to Existing Steel

Typical Connections to Existing Steel



ITEM NO.	QTY.	DESCRIPTION	PART NUMBER	MATERIAL
1	1	MOUNTING BRACKET	RXH-R-OSBSS	SS316
2	1	MILD STEEL C-CHANNEL	N/A	MILD STEEL
3	1	FLAT PATTERN GASKET	RXH-R-OSBFG	-
4	2	TOP HAT BOLT HOLE INSULATOR	-	NYLON
5	1	BOSTIK AV515	-	POLYURETHANE
6	1	RailEX® ROUND RAIL	RXH-R-ST	FRP
7	2	M16 HEX HEAD BOLT	M16 HHB	SS316
8	2	M16 LOCK NUT	M16 LN	SS316
9	2	M16 FLAT WASHER	M16 FW	SS316
10	2	M8 HEX HEAD BOLT	M8 HHB	SS316
11	2	M8 LOCK NUT	M8 LN	SS316
12	2	M8 FLAT WASHER	M8 FW	SS316

Typical Connections to Existing Steel



ITEM NO.	QTY.	DESCRIPTION	PART NUMBER	MATERIAL
1	1	MOUNTING BRACKET	RXH-R-ATBSS	SS316
2	1	MILD STEEL C-CHANNEL	N/A	MILD STEEL
3	1	FLAT PATTERN GASKET	RXH-R-OSBFG	-
4	2	TOP HAT BOLT HOLE INSULATOR	-	NYLON
5	1	BOSTIK AV515	-	POLYURETHANE
6	1	RailEX® ROUND RAIL	RXH-R-ST	FRP
7	2	M16 HEX HEAD BOLT	M16 HHB	SS316
8	2	M16 LOCK NUT	M16 LN	SS316
9	2	M16 FLAT WASHER	M16 FW	SS316
10	2	M8 HEX HEAD BOLT	M8 HHB	SS316
11	2	M8 LOCK NUT	M8 LN	SS316
12	2	M8 FLAT WASHER	M8 FW	SS316

ATTACHMENT - E

RailEX®
Chemical Resistance

TREADWELL™

RailEX® Resin Systems

Options Overview

O-Series® is an architectural grade Polyester Resin System with a moderate chemical resistance. O-Series® is a good choice for commercial or light industrial applications, especially in areas where moisture is prevalent. O-Series® is often utilized for public infrastructure applications were it has been proven to outperform tradition timber decking products.

I-Series® is a premium Isopthalic Resin System. This system provides an intermediate level of chemical resistance and is the correct choice for areas subjected to splash and spill contact with harsh chemicals. This system is an excellent general-purpose resin and is a more favourably priced alternative to the vinyl ester system. This system has a flame spread of 25 or less.

V-Series® Vinylester Resin System is a high quality and is the most chemical resistant system offered in the industry and has been developed for use in environments where fibreglass/FRP products are subject to frequent and direct contact with the harshest of chemicals: including a broad range of acids and caustics. This system has a flame spread of 25 or less.

P-Series® Phenolic Resin System is a system designed specifically for use where fire resistance, low smoke and low toxic fumes are critical. P-Series® is typically used in offshore applications and confines spaces where such criteria are an absolute necessity. This system is tested in accordance with ASTM E-84. Various products also conforming to US Coast Guard Approvals, Level 2 and 3, are also offered by Treadwell. This particular Resin System has a flame spread rating of 5 and a smoke density rating of 5.

Chemical Resistance Guide

Information contained in this guide is based on data collected from several years of actual industrial applications. Recommendations are based on conservative evaluations of the changes which occur in certain properties of replicate laminates after exposures of one year or longer, both in the laboratory and the field.

Temperatures are neither the minimum nor the maximum but represent standard test conditions (Room Temperature & 70˚C). The products may be suitable at higher temperatures but individual test data should be required to establish such suitability. Contact Treadwell for any special applications that you may have.

The recommendations (• : resistant: – :not resistant) contained in this specification sheet are made without guarantee or representation as to results. We suggest that you evaluate these recommendations and suggestions in your own laboratory oractual field trial prior to use. Our responsibility for claims arising from breach of warranty, negligence, or otherwise is limited to the purchase price of the material.

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Acetaldehyde	–	–	–	–
Acetic Acid 0-25%	•	•	•	•
Acetic Acid 25-50%	•	•	•	–
Acetic Anhydride	–	–	–	–
Acetone	–	–	–	–
Acrylonitrile	–	–	–	–
Alcohol, Butyl	•	–	–	–
Alcohol, Ethyl 10%	•	66	–	–
Alcohol, Ethyl 100%	•	–	–	–
Alcohol, Isopropyl 10%	•	66	–	–
Alcohol, Isopropyl 100%	•	–	–	–
Alcohol, Methyl 10%	•	66	–	–
Alcohol, Methyl 100%	–	–	–	–
Alcohol, Methyl Isobutyl	•	66	–	–
Alcohol, Secondary Butyl	•	66	–	–
Aluminium	•	•	•	•
Aluminium Chloride	•	•	•	•
Aluminium Hydroxide	•	49	•	–
Aluminium Nitrate	•	•	•	•

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Aluminium Potassium Sulfate	•	•	•	•
Ammonia, Aqueous 0-10%	•	38	–	–
Ammonia, Gas	•	38	–	–
Ammonium Bicarbonate	•	49	•	–
Ammonium Bisulfite	•	49	–	–
Ammonium Carbonate	•	49	–	–
Ammonium Citrate	•	49	•	–
Ammonium Fluoride	•	49	–	–
Ammonium Hydroxide 5%	•	49	•	–
Ammonium Hydroxide 10%	•	49	•	–
Ammonium Hydroxide 20%	•	49	–	–
Ammonium Nitrate	•	49	•	•
Ammonium Persulfate	•	49	–	–
Ammonium Phosphate	•	49	–	–
Ammonium Sulfate	•	•	•	•
Arsenious Sulfate	•	•	•	–
O-Benzoyl Benzoic Acid	•	•	–	–
Barium Carbonate	•	•	•	–
Barium Chloride	•	•	•	–

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RailEX® Chemical Resistance Guide

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Barium Hydroxide	•	49	–	–
Barium Sulfate	•	•	•	•
Barium Sulfide	•	•	–	–
Beer	•	49	•	–
Benzene	–	–	–	–
5% Benzene in Kerosene	•	•	•	–
Benzene Sulfonic Acid	•	•	•	•
Benzoic Acid	•	•	•	–
Benzyl Alcohol	•	–	–	–
Benzyl Chloride	–	–	–	–
Brass Plating Solution:				
– 3% Copper Cyanide	•	•	–	–
– 6% Sodium Cyanide	•	•	–	–
– 1% Zinc Cyanide	•	•	–	–
– 3% Sodium Carbonate	•	•	–	–
Butyl Acetate	–	–	–	–
Butyric Acid 0-50%	•	•	•	–
Butylene Glycol	•	•	•	•
Cadmium Chloride	•	•	•	–
Cadmium Cyanide Plating Soln:				
– 3% Cadmium Oxide	•	49	–	–
– 6% Sodium Cyanide	•	49	–	–
– 1% Caustic Soda	•	49	–	–
Calcium Bisulfate	•	•	•	•
Calcium Carbonate	•	•	•	–
Calcium Chlorate	•	•	•	•
Calcium Chloride	•	•	•	•
Calcium Hydroxide	•	49	•	–
Calcium Hypochlorite	•	49	•	–
Calcium Nitrate	•	•	•	•
Calcium Sulfate	•	•	•	•
Calcium Sulfite	•	•	•	•
Caprylic Acid	•	•	•	–
Carbon Dioxide	•	•	•	•
Carbon Disulfide	–	–	–	–
Carbon Monoxide	•	•	•	•
Carbon Tetrachloride	•	38	–	–
Carbon Acid	•	•	•	–
Castor Oil	•	•	•	•
Carbon Methyl Cellulose	•	49	–	–
Chlorinated Wax	•	•	–	–
Chlorine Doixide/Air	•	•	•	–
Chlorine Dioxide, Wet Gas	•	•	–	–
Chlorine, Dry Gas	•	•	–	–
Chlorine, Wet Gas	•	•	–	–
Chlorine, Liquid	–	–	–	–

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Chlorine, Water	•	•	–	–
Chloroacetic Acid 0-50%	•	38	–	–
Chlorobenzene	–	–	–	–
Chloroform	–	–	–	–
Chlorosulfonic Acid	–	–	–	–
Chromic Acid 20%	•	49	–	–
Chromic Acid 30%	–	–	–	–
Chromium Sulfate	•	•	•	•
Citric Acid	•	•	•	•
Coconut Oil	•	•	•	–
Copper Chloride	•	•	•	•
Copper Cyanide	•	•	–	–
Copper Fluoride	•	•	–	–
Copper Nitrate	•	•	•	•
Copper Plating Solution:				
– Copper Cyanide	•	•	–	–
– 10.5% Copper	•	•	–	–
– 4% Copper Cyanide	•	•	–	–
– 6% Rochelle Salts	•	•	–	–
Copper Brite Plating:				
– Caustic Cyanide	•	38	–	–
Copper Plating Solution:				
– 45% Copper Fluorobrate	•	•	–	–
– 19% Copper Sulfate	•	•	–	–
– 8% Sulfuric Acid	•	•	–	–
Copper Matte Dipping Bath:				
– 30% Ferric Chloride	•	•	–	–
– 19% Hydrochloric	•	•	–	–
Copper Pickling Bath:				
– 10% Ferric Sulfate	•	•	–	–
– 10% Sulfuric Acid	•	•	–	–
Copper Sulfate	•	•	•	•
Corn Oil	•	•	•	–
Corn Starch-Slurry	•	•	•	–
Corn Sugar	•	•	•	–
Cottonseed Oil	•	•	•	–
Crude Oil, Sour	•	•	•	–
Crude Oil, Sweet	•	•	•	–
Cyclohexane	•	49	•	–
Detergents, Sulfonated	•	•	•	–
Di-Ammonium Phosphate	•	•	•	–
Dibromophenol	–	–	–	–
Dibutyl Ether	•	49	–	–
Dichloro Benzene	–	–	–	–
Dichloroethylene	–	–	–	–
Diesel Fuel	•	•	•	–

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Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Diethylene Glycol	•	•	•	—
Dimenthyl Phthalate	•	•	—	—
Dioctyl Phthalate	•	•	—	—
Diprophylene Gylcol	•	•	•	—
Dodecyl Alcohol	•	•	—	—
Esters, Fatty Acids	•	•	•	•
Ethyl Acetate	—	—	—	—
Ethyl Benzene	—	—	—	—
Ethyl Ether	—	—	—	—
Ethylene Gylcol	•	•	•	•
Ethylene Dichloride	—	—	—	—
Fatty Acids	•	•	•	•
Ferric Chloride	•	•	•	•
Ferric Nitrate	•	•	•	•
Ferric Sulfate	•	•	•	•
Ferrous Chloride	•	•	•	•
Ferrous Nitrate	•	•	•	•
Ferrous Sulfate	•	•	•	•
8-8-8 Fertiliser	•	49	•	—
Fertiliser:				
– Urea Ammoium Nitrate	•	49	—	—
Fuel Gas	•	•	—	—
Fluoboric Acid	•	49	—	—
Fluosilicic Acid 0-20%	•	•	—	—
Formaldehyde	•	•	•	—
Formic Acid	•	•	•	—
Fuel Oil	•	•	•	—
Gas Natural	•	•	•	—
Gasoline, Auto	•	•	•	—
Gasoline, Aviation	•	•	•	—
Gasoline, Ethyl	•	•	•	—
Gluconic Acid	•	•	•	—
Gasoline, Sour	•	•	•	—
Glucose	•	•	•	•
Glycerine	•	•	•	•
Glycol, Ethylene	•	•	•	•
Glycol, Propylene	•	•	•	•
Glycolic Acid	•	•	•	—
Gold Plating Solution:				
– 63% Potassium Ferrocyanide	•	•	—	—
– 2% Potassium Gold Cyanide	•	•	—	—
– 8% Sodium Cyanide	•	•	—	—
Heptane	•	•	•	—
Hexane	•	•	•	—
Hexylene Glycol	•	•	•	•
Hydraulic Fluid	•	•	•	—

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Hydrobromic Acid 0-25%	•	•	•	—
Hydrochloric Acid 0-37%	•	•	•	—
Hydrocyanic Acid	•	•	•	—
Hydrofluoric Acid 10%	•	—	—	—
Hydrofluosilicic Acid, 10%	•	•	—	—
Hydrogen Bromide, Wet Gas	•	•	—	—
Hydrogen Chloride, Dry Gas	•	•	—	—
Hydrogen Chloride, Wet Gas	•	•	—	—
Hydrogen Peroxide	•	49	—	—
Hydrogen Sulfide, Dry	•	•	•	—
Hydrogen Sulfide, Aqueous	—	•	•	—
Hydrogen Fluoride, Vapour	•	•	—	—
Hydrosulfite Bleach	•	49	—	—
Hydrochlorus Acid 0-10%	—	—	—	—
Iron Plating Solution:				
– 45% Fecl: 15% Cacl	•	•	—	—
– 20% Fecl: 11% (Nh4)2 So4	•	•	—	—
Iron And Steel Claeaning Bath:				
–9% Hydrochloric: 23% Sulfuric	•	•	—	—
Isopropyl Amine	•	38	—	—
Isopropyl Palmitate	•	•	•	•
Jet Fuel	•	•	•	—
Kerosene	•	•	•	—
Lactic Acid	•	•	•	—
Lauroyl Chloride	•	•	—	—
Lauric Acid	•	•	•	—
Lead Acetate	•	•	•	—
Lead Chloride	•	•	•	—
Lead Nitrate	•	•	•	—
Lead Plating Solution:				
–.8% Fluoboric, 0.4% Boric Acid	•	•	—	—
Levulinic Acid	•	•	•	—
Linseed Oil	•	•	•	•
Lithium Bromide	•	•	•	•
Lithium Sulfate	•	•	•	•
Magnesium Bisulfite	•	•	•	—
Magnesium Carbonate	•	•	•	—
Magnesium Chloride	•	•	•	•
Magnesium Hydroxide	•	60	—	—
Magnesium Nitrate	•	•	•	—
Magnesium Sulfate	•	•	•	•
Maleic Acid	•	•	•	•
Mercuric Chloride	•	•	•	—
Mercurous Chloride	•	•	•	—
Methylene Chloride	—	—	—	—
Methyl Ethyl Ketone	—	—	—	—

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RailEX® Chemical Resistance Guide

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Methyl Isobutyl Carbitol	—	—	—	—
Methanol (See Alcohol)	•	•	•	—
Methyl Isobutyl Ketone	—	—	—	—
Methyl Styrene	—	—	—	—
Mineral Oils	•	•	•	•
Molybdenum Disulfide	•	•	•	—
Monochloro Acetic Acid	—	—	—	—
Monoethyanolamine	—	—	—	—
Motor Oil	•	•	•	•
Myristic Acid	•	•	—	—
Naptha	•	•	•	•
Napthalene	•	•	•	—
Nickel Chloride	•	•	•	•
Nickel Nitrate	•	•	•	•
Nickel Plating:				
– 8% Lead, 0.8% Flouboric Acid	•	•	—	—
– 0.4% Boric Acid	•	•	—	—
Nickel Plating:				
– 11% Nickel Sulfate	•	•	•	—
– 2% Nickel Chloride	•	•	•	—
– 1% Boric Acid	•	•	•	—
Nickel Plating:				
– 44% Nickel Sulfate	•	•	•	—
– 4% Ammonium Chloride	•	•	•	—
– 4% Boric Acid	•	•	•	—
Nickel Sulfate	•	•	•	•
Nitric Acid 0-5%	•	•	•	•
Nitric Acid 20%	•	49	—	—
Nitric Acid Fumes	—	—	—	—
Nibrobenzene	—	—	—	—
Octanoci Acid	•	•	•	—
Oil, Sour Crude	•	•	•	•
Oil, Sweet Crude	•	•	•	•
Oleic Acid	•	•	•	•
Oleum (Fuming Sulfuric)	—	—	—	—
Olive Oil	•	•	•	•
Oxalic Acid	•	•	•	•
Peroxide Bleach:				
– 25% Peroxide 95%	•	•	•	•
– 0.025% Epsom Salts	•	•	•	•
– 5% Sodium Silicate 42.Be	•	•	•	•
– 1.4% Sulfuric Acid 66.Be	•	•	•	•
Phenol	—	—	—	—
Phenol Sulfonic Acid	—	—	—	—
Phosphoric Acid	•	•	•	•
Phosphoric Acid Fumes	•	•	•	•

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Phosphorous Pentoxide	•	•	•	•
Phosphorous Trichloride	—	—	—	—
Phthalic Acid	•	•	•	•
Pickling Acids (Sulfuric & Hydrochloric)	•	•	•	•
Picric Acid, Alcoholic	—	—	—	—
Polyvinyl Acetate Latex	•	•	•	—
Polyvinyl Alcohol	•	38	•	—
Polyvinyl Chloride Latex W/35 (Parts Dop)	•	49	—	—
Potassium Aluminium Sulfate	•	•	•	•
Potassium Bicarbonate	•	60	•	—
Potassium Bromide	•	38	•	—
Potassium Carbonate	•	60	•	—
Potassium Chloride	•	•	•	•
Potassium Dichromate	•	60	•	—
Potassium Ferricyanide	•	•	•	•
Potassium Ferrocyanide	•	•	•	•
Potassium Hydroxide	•	66	—	—
Potassium Nitrate	•	•	•	•
Potassium Permanganate	•	60	•	—
Potassium Persulfate	•	•	•	—
Potassium Sulfate	•	•	•	•
Propionic Acid 1-50%	•	49	—	—
Propionic Acid 50-100%	—	—	—	—
Propylene Glycol	•	•	•	•
Pulp Paper Mill Effluent	•	•	•	—
Pyridine	—	—	—	—
Salicylic Acid	•	60	—	—
Sebacic Acid	•	•	—	—
Selenious Acid	•	•	—	—
Silver Nitrate	•	•	•	•
Silver Plating Solution:				
– 44% Silver Cyanide	•	•	—	—
– 7% Potassium Cyanide	•	•	—	—
– 5% Sodium Cyanide	•	•	—	—
– 2% Potassium Carbonate	•	•	—	—
Soaps	•	•	•	—
Sodium Acetate	•	•	•	—
Sodium Benzoate	•	•	•	—
Sodium Bicarbonate	•	•	•	•
Sodium Bifluoride	•	49	•	—
Sodium Bisulfate	•	•	•	•
Sodium Bisulfite	•	•	•	•
Sodium Bromate	•	60	•	•
Sodium Bromide	•	•	•	•
Sodium Carbonate 0-25%	•	•	•	—

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RailEX® Chemical Resistance Guide

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Sodium Chlorate	•	•	•	–
Sodium Chloride	•	•	•	•
Sodium Chlorite	•	•	•	–
Sodium Chromite	•	•	•	•
Sodium Cyanide	•	•	•	–
Sodium Dichromate	•	•	•	•
Sodium Di-Phosphate	•	•	•	•
Sodium Ferricyanide	•	•	•	•
Sodium Fluoride	•	49	•	–
Sodium Fluoro Silicate	•	49	–	–
Sodium Hexametaphosphates	•	38	–	–
Sodium Hydroxide 0-5%	•	66	–	–
Sodium Hydroxide 5-25%	•	66	–	–
Sodium Hydroxide 50%	•	66	–	–
Sodium Hydrosulfide	•	•	•	–
Sodium Hypochlorite	•	66	•	–
Sodium Lauryl Sulfate	•	•	•	•
Sodium Mono-Phosphate	•	•	•	•
Sodium Nitrate	•	•	•	•
Sodium Silicate	•	•	•	–
Sodium Sulfate	•	•	•	•
Sodium Sulfide	•	•	•	–
Sodium Sulfite	•	•	•	–
Sodium Tetra Borate	•	•	•	•
Sodium Thiocyanate	•	•	–	–
Sodium Thiosulfate	•	•	•	–
Sodium Tripolyphosphate	•	•	•	–
Sodium Xylene Sulfonate	•	•	•	–
Sodium Solutions	•	•	•	–
Sodium Crude Oil	•	•	•	•
Soya Oil	•	•	•	•
Stannic Chloride	•	•	•	•
Stannous Chloride	•	•	•	•
Stearic Acid	•	•	•	•
Styrene	–	–	–	–
Sugar, Beet And Cane Liquor	•	•	•	–
Sugar, Sucrose	•	•	•	•
Sulfamic Acid	•	•	•	–
Sulfanilic Acid	•	•	•	–
Sulfated Detergents	•	•	•	–
Sulfur Dioxide, Dry Or Wet	•	•	–	–
Sulfur Trioxide/Air	•	•	–	–
Sulfuric Acid 0-30%	•	•	•	•
Sulfuric Acid 30-50%	•	•	–	–
Sulfuric Acid 50-70%	•	49	–	–
Sulfurous Acid	•	38	–	–

Chemical	V-Series®		I-Series®	
	Room Temp	70°C	Room Temp	70°C
Superphosphoric Acid (76% P2 05)	•	•	•	–
Tall Oil	•	60	•	–
Tannic Acid	•	66	•	–
Tartaric Acid	•	•	•	•
Thionyl Chloride	–	–	–	–
Tin Plating:				
– 18% Stannous Fluorborate	•	•	–	–
– 7% Tin	•	•	–	–
– 9% Fluoroboric Acid	•	•	–	–
– 2% Boric Acid	•	•	–	–
Toluene	–	–	–	–
Toluene Sulfonic Acid	•	•	–	–
Transformer Oils:				
– Mineral Oil Types	•	•	•	•
– Chloro-Phenyl Types)	•	•	•	•
Trichlor Acetic Acid	•	•	•	–
Trichlorethylene	–	–	–	–
Trichloropenol	–	–	–	–
Tricresyl Phosphate	•	49	–	–
Tridecylbenzene Sulfonate	•	•	•	–
Trisodium Phosphate	•	•	•	–
Turpentine	•	38	–	–
Urea	•	38	–	–
Vegetable Oils	•	•	•	•
Vinegar	•	•	•	•
Vinyl Acetate	–	–	–	–
Water:				
– Deionised	–	–	–	–
– Demineralised	•	•	•	•
– Distilled	•	•	•	•
– Fresh	•	•	•	•
– Salt	•	•	•	•
– Sea	•	•	•	•
White Liquor (Pulp Mill)	•	•	•	–
Xylene	–	–	–	–
Zinc Chlorate	•	•	•	•
Zinc Nitrate	•	•	•	•
Zinc Plating Solution:				
– 9% Zinc Cyanide	•	49	–	–
– 4% Sodium Cyanide	•	49	–	–
–9% Sodium Hydroxide	•	49	–	–
Zinc Plating Solution:				
– (49% Zinc Fluoroborate	•	•	•	–
– 5% Ammonium Chloride	•	•	•	–
– 6% Ammonium Fluoroborate	•	•	•	–
Zinc Sulfate	•	•	•	•

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ATTACHMENT - F

Maintenance & Inspection Regime

TREADWELL™

RailEX® FRP Handrail - Recommended Housekeeping Maintenance Guide

Treadwell fully supports and recommends that users of the RailEX® ROUND FRP Handrail system to not only implement a disciplined housekeeping procedure involving frequent and regular cleaning of the product, but also carry out consistent inspections and pragmatic maintenance to maximise the serviceable life of the product.

Please Note: With any cleaning product used, test it on a small inconspicuous area rst and always follow the manufacturer's instructions. DO NOT use bleach, as it will lighten the product colour.

Frequency	Regular scheduled cleaning is recommended to avoid any build-up of dust, dirt or even chemical residue, i.e. fertiliser dust. This can be simply achieved, often times with just compressed air, but generally with a pressure washer.
Industrial Environments - General Dirt & Grime	Utilise warm soapy water or an alkaline detergent solution and scrub the surface carefully with a lightly bristled brush to clean dirt and grime from the surface and inside crevices or grooves between components. A pressure washer will assist in removing stubborn stains. Finalise cleaning the product by washing o the surface with fresh water.
Food Processing - Food and Drink	If a food product of any kind is spilled on the product, it should be cleaned from the surface as soon as possible to avoid the unwanted product remaining and drying on the surface, and potentially staining it. A pressure washer or hose and warm soapy water should remove most food products from the surface.
Cold Climates - Ice & Snow	To remove snow or ice from the handrail, careful use of a simple implement such as a broom or brush is recommended - if any frozen precipitation remains, i.e. ice, which will require melting, utilise rock salts or calcium chloride.
Rust (from foreign metallic items) & Dirt Stains	Cleaning products containing oxalic or phosphoric acid can be utilised to remove rust stains and stains from embedment in dirt if required. Apply oxalic acid neatly with a brush directly to the aected area. Leave for 10 to 15 minutes and then wash o with a pressure washer. **WARNING** - Bleach must not be used on the surface of the product as this will cause accelerated fading of the surface.
Mould & Mildew	Mould and mildew can grow on surface residue. To remove this, scrub the surface with a light bristle brush and wash with warm soapy water.

ATTACHMENT - G

RailEX®
ROUND FRP Handrail Maintenance Regime Checklist

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RailEX® ROUND FRP Handrail Maintenance Regime Checklist

Inspection Activity	Potential Damage / Defect	Date	Work Number	Site Plant Area

Daily Usage Awareness	DEFECTS	Action Required (If DEFECTS Noted)	Work Required	Notes
Physical Damage	YES | NO			
Broken Fittings	YES | NO			
Separations of components	YES | NO			
Loose Fittings	YES | NO			
Quarterly Inspection				
Physical Damage	YES | NO			
Loose Systems	YES | NO			
Broken or Degraded fittings and rails	YES | NO			
Broken Stanchions / Bases.	YES | NO			
Annual Inspection				
Physical Damage	YES | NO			
Loose Systems	YES | NO			
Broken or Degraded fittings and rails	YES | NO			
Broken Stanchions / Bases.	YES | NO			
Hand Rail Surface Degradation	YES | NO			
Check for exposed fibres	YES | NO			
Excessive weathering	YES | NO			
Damage				
Broken Fittings	YES | NO			
Separations of components	YES | NO			
Loose Fittings	YES | NO			
Brocken Stanchions	YES | NO			
Cracked/ Split/ Bent Stanchions & Rails	YES | NO			
Wear and Tear				
Bases Tight and Torqued up	YES | NO			
Fittings Tight	YES | NO			

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ATTACHMENT - H

RailEX®
ROUND FRP Handrail Assembly Guide

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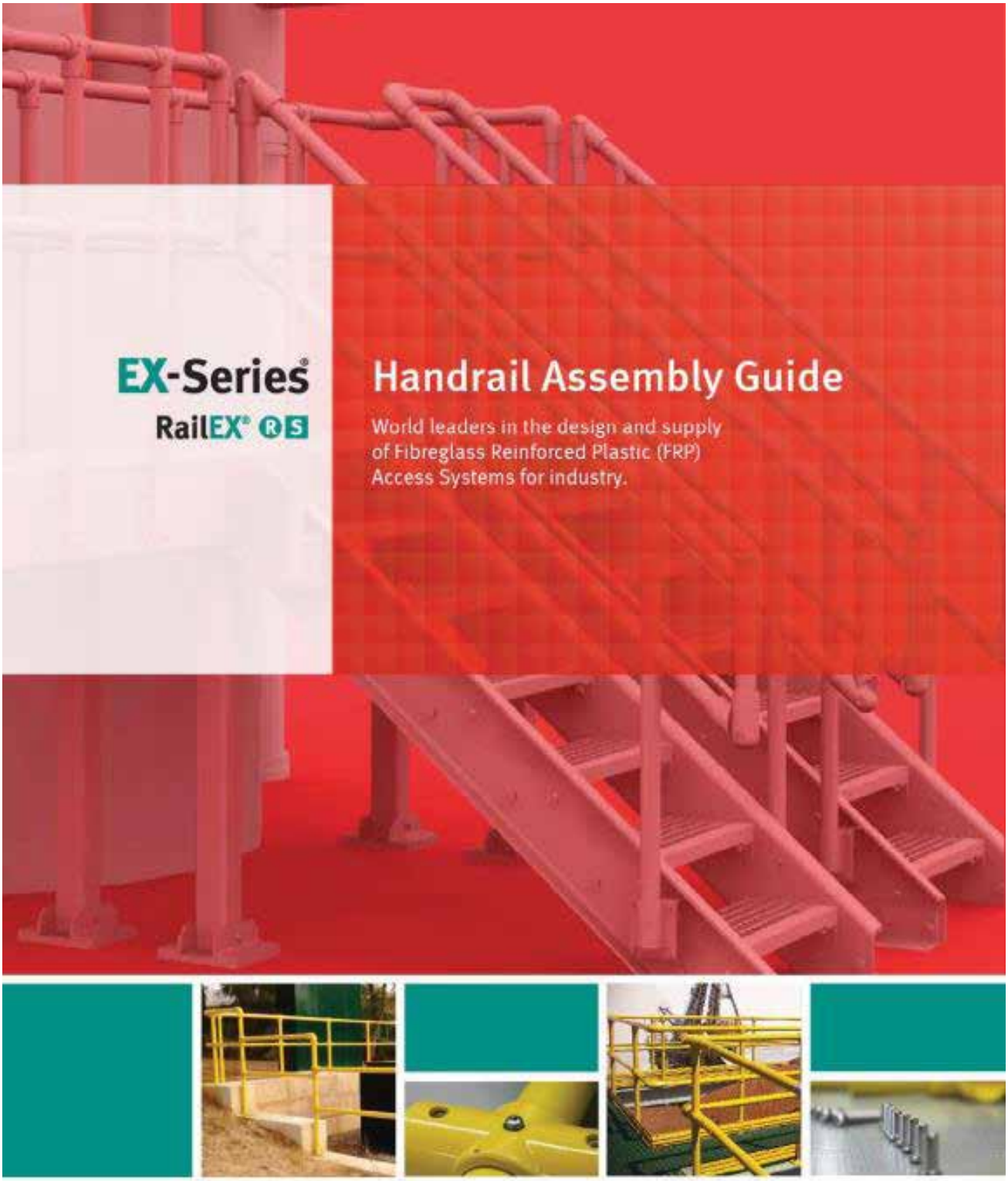

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