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ALUMINCO S.A.
TEST REPORT

SCOPE OF WORK
STRUCTURAL PEFORMANCE TESTING ON THE *SYNTHESES TYPE B1*, ALUMINUM AND GLASS GUARDRAIL SYSTEM

REPORT NUMBER
I3376.01-119-19 R0

TEST DATE(S)
05/15/18 - 05/16/18

ISSUE DATE
06/26/18

RECORD RETENTION END DATE
05/16/22

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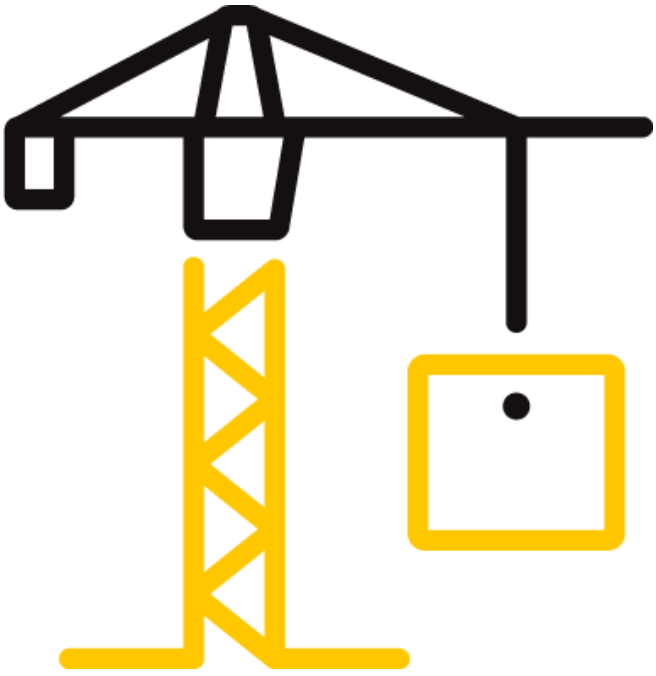

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TEST REPORT FOR ALUMINCO S.A.
Report No.: I3376.01-119-19 R0
Date: 06/26/18

REPORT ISSUED TO
ALUMINCO S.A. ENGINEERING DIVISION
Inofita
Viotia, 32011
Greece

SECTION 1
SCOPE

Intertek Building & Construction (B&C) was contracted by Aluminco S.A., Greece to perform structural performance testing in accordance with the 2018 IBC on their 46 in wide (nominal) by 47 in high (nominal) *Synthesis Type B1* aluminum and glass guardrail system. All tests performed were to evaluate structural performance of the guardrail assembly to carry and transfer imposed loads to the supporting structure. The test specimens evaluated included the infill, rails, rail brackets, and support posts. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at Intertek B&C's test facility in York, Pennsylvania. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

SECTION 2
SUMMARY OF TEST RESULTS

The specimen met the 2018 IBC design load performance requirements.

For INTERTEK B&C:

COMPLETED BY:	Emily C. Riley	**REVIEWED BY:**	V. Thomas Mickley, Jr., P.E.
TITLE:	Project Manager	**TITLE:**	Senior Staff Engineer
SIGNATURE:	Digitally Signed by: Emily C. Riley	**SIGNATURE:**	Digitally Signed by: Virgal Thomas Mickley, Jr.
DATE:	06/26/18	**DATE:**	06/26/18

ECR/vtm:aaa

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SECTION 3
TEST METHOD(S)

The specimen was evaluated in accordance with the following:

2018, *International Building Code®*, International Code Council

2018, *International Residential Code®*, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2018.

Limitations
All tests performed were to evaluate structural performance of the guardrail assembly to carry and transfer imposed loads to the supporting structure. The specimen was evaluated in accordance with the 2018 IBC performance requirements. The test specimens evaluated included the rails and their connection to the support posts, the glass panels and the support posts. Anchorage of the support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

SECTION 4
MATERIAL SOURCE/INSTALLATION

Test samples were provided by the client. Representative samples of the test specimen(s) will be retained by Intertek B&C for a minimum of four years from the test completion date.

The 46 in wide (nominal) by 47 in high (nominal) guardrail assembly was installed and tested as a single railing section by directly securing the posts onto the surface of rigid steel channels (to simulated anchorage into concrete), which allowed the posts to rotate under load. Transducers mounted to an independent reference frame were located to record movement of reference points on the guardrail system components (ends and mid-point) to determine net component deflections. See photographs in Section 11 for individual test setups.

SECTION 5
EQUIPMENT

The guardrail was tested in a self-contained structural frame designed to accommodate anchorage of the guardrail assembly and application of the required test loads. The specimens were loaded using an electric winch mounted to a rigid steel test frame. High strength steel cables, nylon straps, and load distribution beams were used to impose test loads on the specimens. Applied load was measured using an electronic load cell located in-line with the loading system. Electronic linear motion transducers were used to measure deflections.

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SECTION 6
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Alva R. Baker	Intertek B&C
Emily C. Riley	Intertek B&C

SECTION 7
TEST PROCEDURE

The test specimen was inspected prior to testing to verify size and general condition of the materials, assembly, and installation. No potentially compromising defects were observed prior to testing.

An initial load, not exceeding 50% of design load, was applied and transducers were zeroed. Load was then applied at a steady uniform rate until reaching 2.0 times design load in no less than 10 seconds. After reaching 2.0 times design load, the load was released. After allowing a minimum period of one minute for stabilization, load was reapplied to the initial load level used at the start of the loading procedure, and deflections were recorded and used to analyze recovery. Load was then increased at a steady uniform rate until reaching 2.5 times design load (loads on aluminium components) / 4.0 times design load (loads on glass components) or until failure occurred. The testing time was continually recorded from the application of initial test load until the ultimate test load was reached.

Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

Key to Test Results Tables:

Load Level: Target test load

Test Load: Actual applied load at the designated load level (target).

Elapsed Time (E.T.): The amount of time into the test with zero established at the beginning of the loading procedure.

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SECTION 8
TEST SPECIMEN DESCRIPTION

Aluminco S.A. provided the fully-assembled test specimens with the following details:

PRODUCT	*Synthesis Type B1*
TYPE	Aluminum and glass guardrail system
MATERIAL	Unspecified aluminum alloy
OVERALL DIMENSIONS	45-7/16 in wide (inside of post to inside of post) 47 in (center of post to center of post) 47-1/4 in high (bottom of base plate to top of top rail)
TOP RAIL	11/16 in high by 2-15/16 in wide contoured aluminum extrusion with 0.09 in wall and a 1-1/8 in high by 3-1/8 in wide by 0.060 in thick snap-fit extruded aluminum cover
GLASS RAILS (BOTTOM AND INTERMEDIATE)	1-1/8 in high by 2-5/16 in wide aluminum extrusion with 0.09 in wall
GLASS PANEL (IN-FILL)	7/16 in thick laminated glass constructed with two sheets of 3/16 in thick clear tempered glass and a 0.060 in interlayer
SUPPORT POST	Two 2-1/2 in deep x 1/2 in wide aluminum extrusions with 9/16 in gap between
BASE PLATE	3-15/16 in deep by 4-3/8 in wide by 9/16 in / 7/16 in thick extruded aluminum base plate with two 1/2 in diameter countersunk holes for attachment to substructure and four 1/4 in diameter countersunk holes for attachment of support post to base plate

Fastening Schedule

CONNECTION	FASTENER
GLASS PANEL INFILL TO GLASS RAILS	The glass panels were channel glazed in the glass rails against a 0.187 in backed co-extruded weatherstripping and kerf mounted rubber fin
TOP RAIL TO POST ATTACHMENT	Four 1/4 in x 2 in long Phillips flat head stainless steel screws through top rail into post screw chases (two per section)
GLASS RAIL TO POST ATTACHMENT	Two #8 x 1-1/2 in long Phillips flat head stainless steel screws at each end of rail
BASE PLATE TO POST	Four 1/4 in x 2 in long Phillips flat head stainless steel screws through base plate into post screw chases (two per section)
POST MOUNT TO SUBSTRUCTURE	Two M10 x 50 mm long allen drive flat head socket cap bolts and nylon lock nuts

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SECTION 9
TEST RESULTS

Test No. 1 - 05/15/18
DESIGN LOAD: 200 lb Concentrated Load at End of Top Rail (Bracket/Post)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL END/POST DISPLACEMENT (in)
Initial Load	38	00:00	0.00
2.0x Design Load	399	00:29	4.60
Initial Load	40	02:21	1.39
70% Recovery from 2.0 x Design Load			
2.5x Design Load	501	03:10	Achieved Load without Failure

Test No. 2 - 05/15/18
DESIGN LOAD: 200 lb Horizontal Concentrated Load at Midspan of Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)			
			END	MID	END	NET [1]
Initial Load	39	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	400	00:21	3.19	3.66	3.91	0.11
Initial Load	40	02:39	1.37	1.29	1.26	<0.00
>100% Recovery from 2.0 x Design Load						
2.5x Design Load	502	03:07	Achieved Load without Failure			

[1] *Net displacement was mid-rail displacement relative to the rail at the support posts.*

TEST NO. 3 - 05/15/18
DESIGN LOAD: 50 lb / 1 square ft at Center of In-fill

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)			
			END	MID	END	NET [1]
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	102	00:13	0.14	0.12	0.02	0.04
Initial Load	10	02:16	0.00	0.00	0.00	0.00
100% Recovery from 2.0 x Design Load						
4.0x Design Load	203	02:29	Achieved Load without Failure			

[1] *Net displacement was the infill displacement relative to its top and bottom.*

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TEST NO. 4 - 05/15/18
DESIGN LOAD: 50 lb / 1 square ft at Bottom of In-fill

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)			
			END	MID	END	NET [1]
Initial Load	10	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	121	02:11	0.00	0.04	0.00	0.04
Initial Load	10	04:19	0.00	0.01	0.00	0.01
75% Recovery from 2.0 x Design Load						
4.0x Design Load	202	04:30	Achieved Load without Failure			

[1] *Net displacement was the bottom rail displacement relative to its ends.*

Test No. 5 - 05/15/18
DESIGN LOAD: 200 lb Vertical Concentrated Load at Midspan of Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)
Initial Load	44	00:00	0.00
2.0x Design Load	410	00:13	0.46
Initial Load	40	01:52	0.02
96% Recovery from 2.0 x Design Load			
2.5x Design Load	505	02:12	Achieved Load without Failure

Test No. 6 - 05/15/18
DESIGN LOAD: 50 plf x (47 in ÷ 12in/ft) = 196 lb Vertical Uniform Load Top Rail [1]

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)
Initial Load	40	00:00	0.00
2.0x Design Load	394	00:18	0.34
Initial Load	41	02:24	0.00
100% Recovery from 2.0 x Design Load			
2.5x Design Load	527	02:38	Achieved Load without Failure

[1] *Uniform load was simulated with quarter point loading.*

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Test No. 7 - 05/15/18
DESIGN LOAD: **50 plf x (47 in ÷ 12in/ft) = 196 lb Horizontal Uniform Load Top Rail** [1]

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RAIL DISPLACEMENT (in)			
			END	MID	END	NET [1]
Initial Load	42	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	392	00:16	2.23	2.28	2.20	0.07
Initial Load	42	02:27	0.51	0.53	0.53	0.01
86% Recovery from 2.0 x Design Load						
2.5x Design Load	493	02:50	Achieved Load without Failure			

[1] *Uniform load was simulated with quarter point loading.*

TEST NO. 8 - 05/16/18
DESIGN LOAD: 50 lb / 1 square ft at Edge of In-fill

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	DISPLACEMENT (in)			
			END	MID	END	NET [1]
Initial Load	11	00:00	0.00	0.00	0.00	0.00
2.0x Design Load	109	00:09	0.61	0.33	0.06	<0.00
Initial Load	11	02:13	0.01	0.00	0.00	<0.00
100% Recovery from 2.0 x Design Load						
4.0x Design Load	200	02:41	Achieved Load without Failure			

[1] *Net displacement was the infill displacement relative to its top and bottom.*

SECTION 10
CONCLUSION

Using performance criteria of withstanding an ultimate load of 2.5 (4.0 for glass infill) times design load, the test results substantiate compliance with the design load requirements of the referenced building codes for the 46 in wide (nominal) by 47 in high (nominal) railing assembly (*Synthesis Type B1*) reported herein. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

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SECTION 11
PHOTOGRAPHS

Photo No. 1
Concentrated Load Test at End of Top Rail (Bracket/Post)

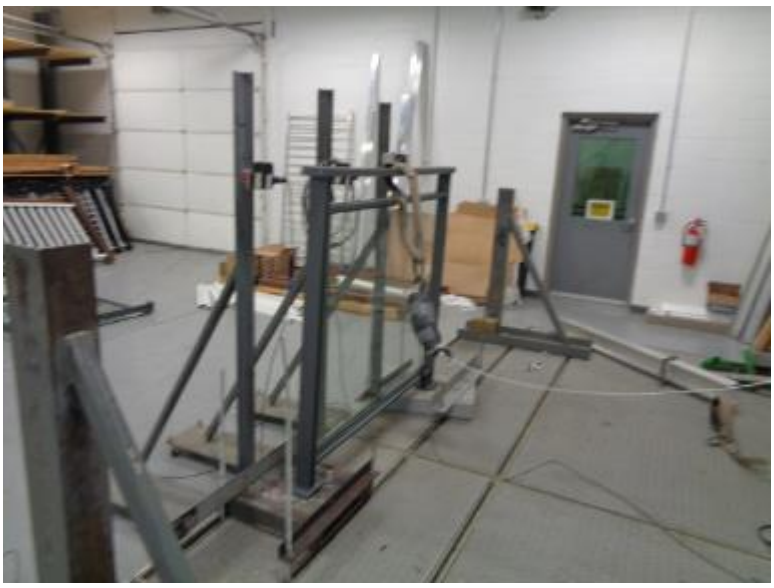

Photo No. 2
Horizontal Concentrated Load at Midspan of Top Rail

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Photo No. 3
Infill Test at Bottom

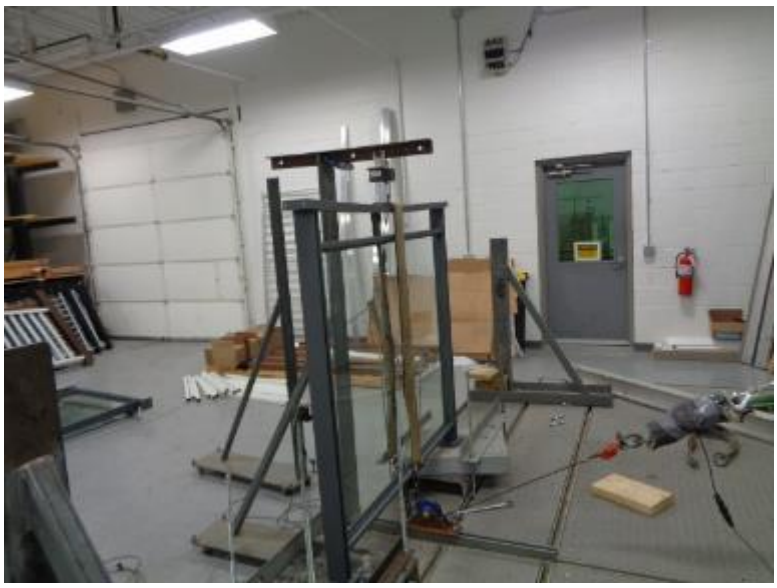

Photo No. 4
Vertical Concentrated Load Test at Midspan of Top Rail

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Photo No. 5
Horizontal Uniform Load Test on Top Rail

Photo No. 6
Infill Load Test at Edge

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SECTION 12
DRAWINGS

The "As-Built" drawings for the *Synthesis Type B1* guardrail system which follow have been reviewed by Intertek B&C and are representative of the project reported herein. Project construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.

GLASS + intermediate rail

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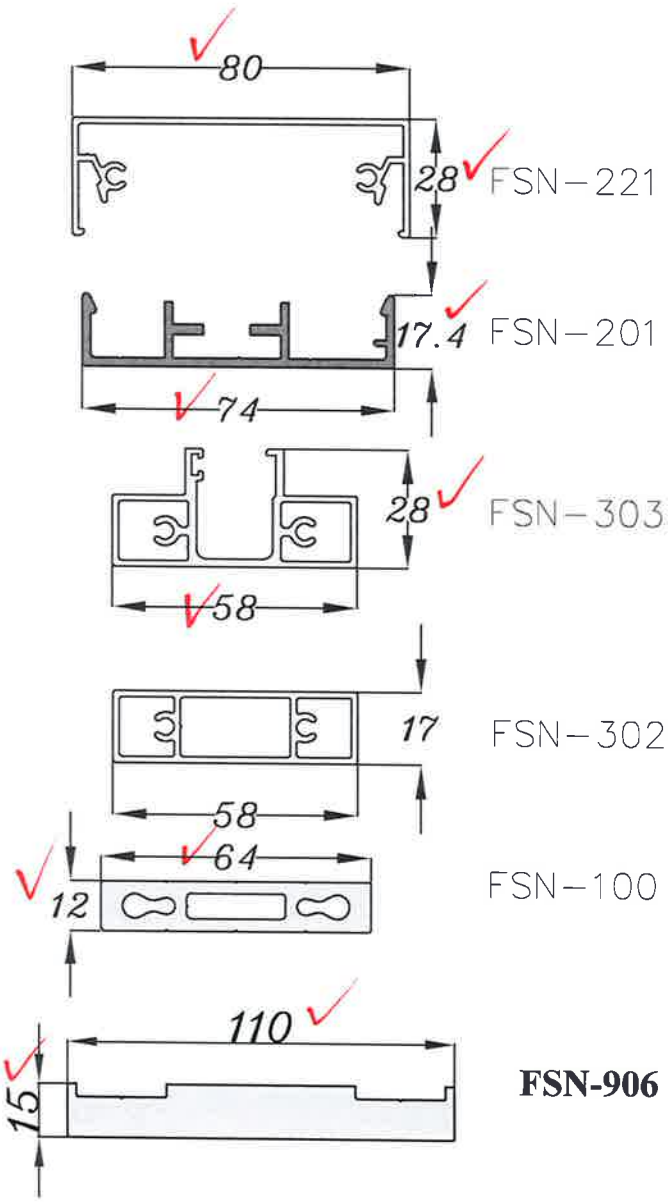
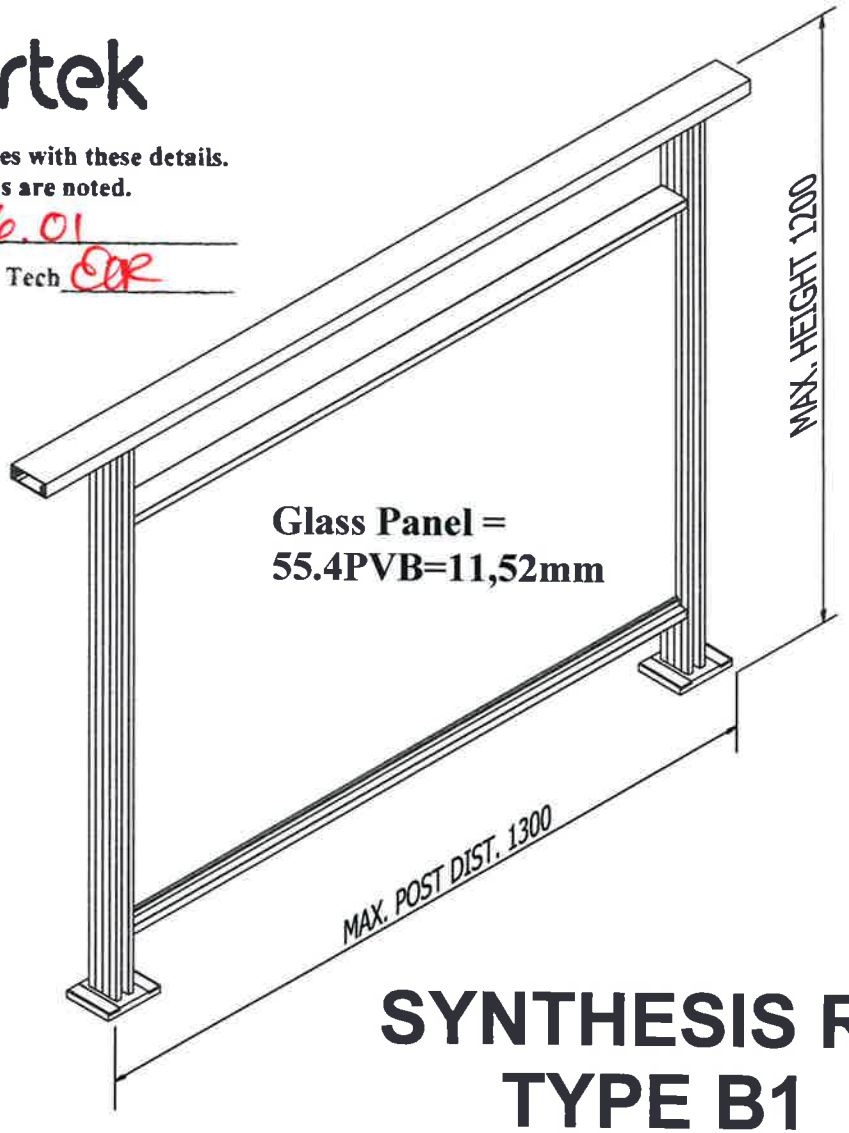
Test sample complies with these details.
Deviations are noted.

Report # I3376.01

Date 6/26/18 Tech EOR





SYNTHESIS RAIL - TYPE B1

ALUMINCO®

ALUMINIUM BUILDING SYSTEMS

intertek

Test sample complies with these details.
Deviations are noted.

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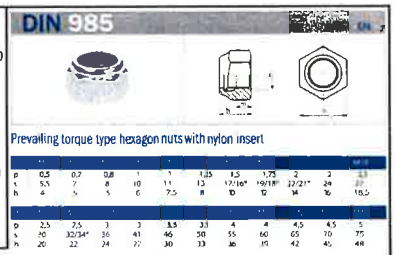
SYNTHESIS RAIL - TYPE B1

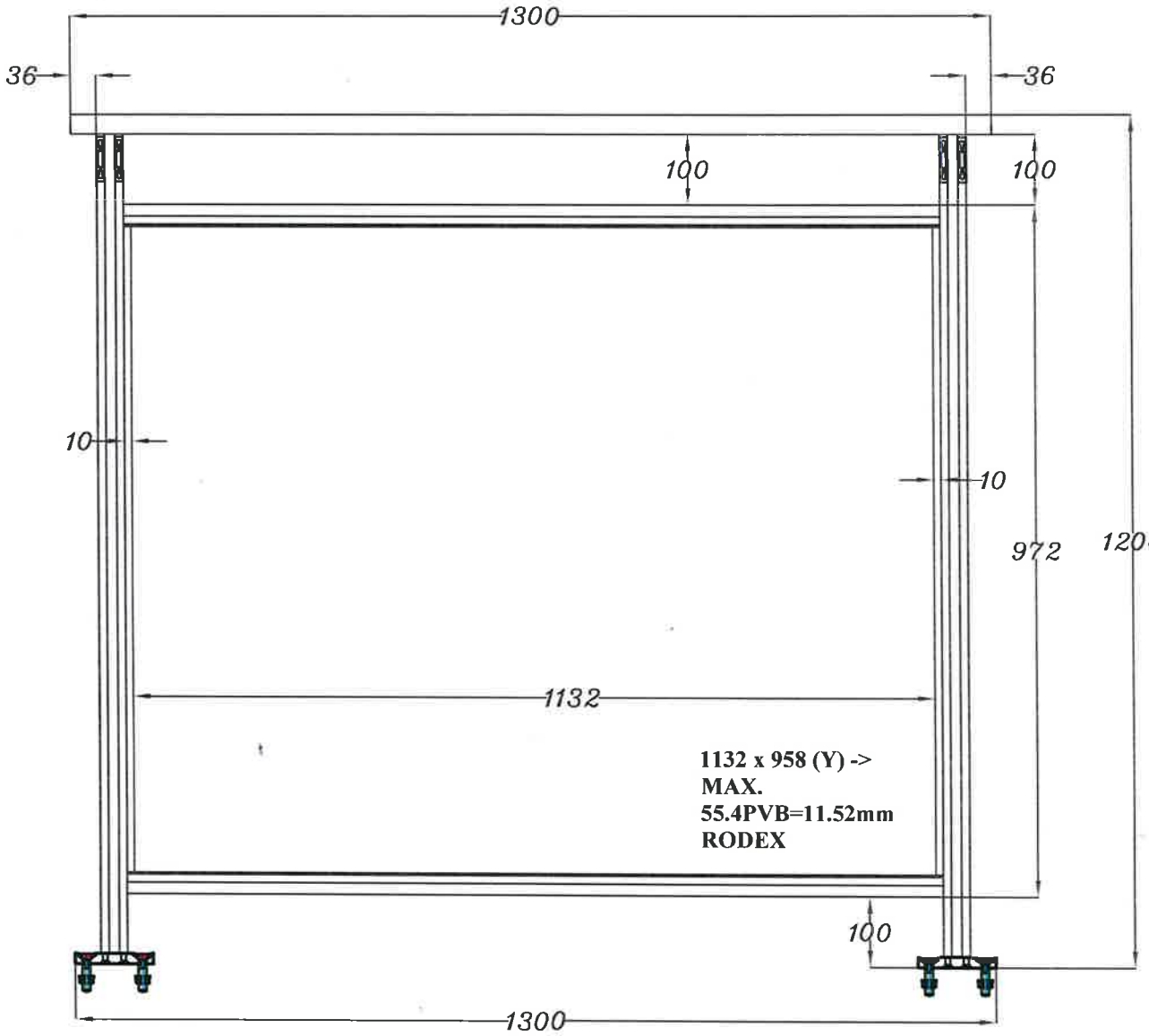
ALUMINCO
ALUMINIUM BUILDING SYSTEMS

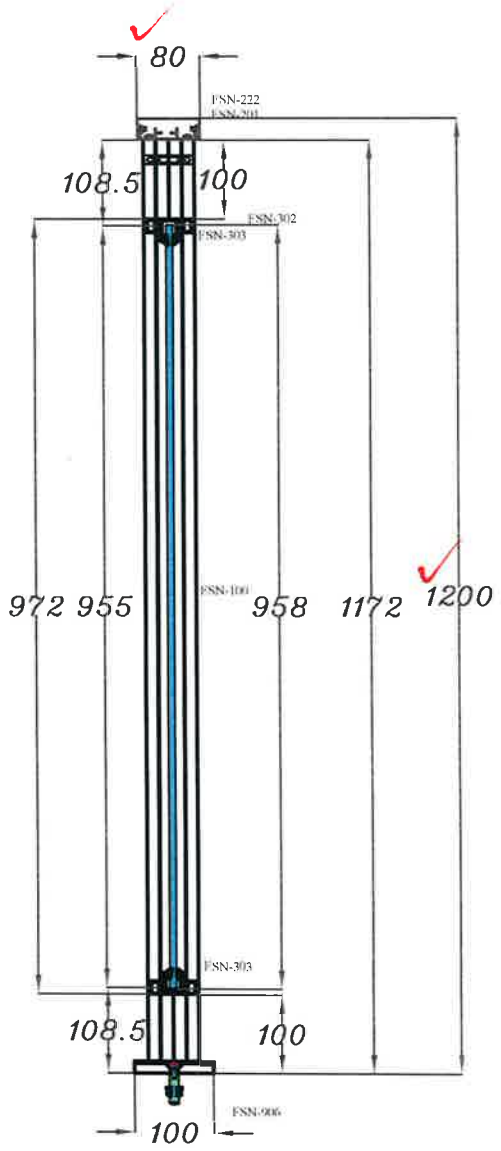
DIN7991 - M10 x 50 Full Thread

DIN125-1-A - M10

DIN985-HEX LOCKNUT- M10







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SECTION 13
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	06/26/18	N/A	Original Report Issue