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PATRIOT DECKING
ENGINEERING ANALYSIS

SCOPE OF WORK
LIVE LOAD ANALYSIS OF ALUMINUM DECK BOARD

REPORT NUMBER
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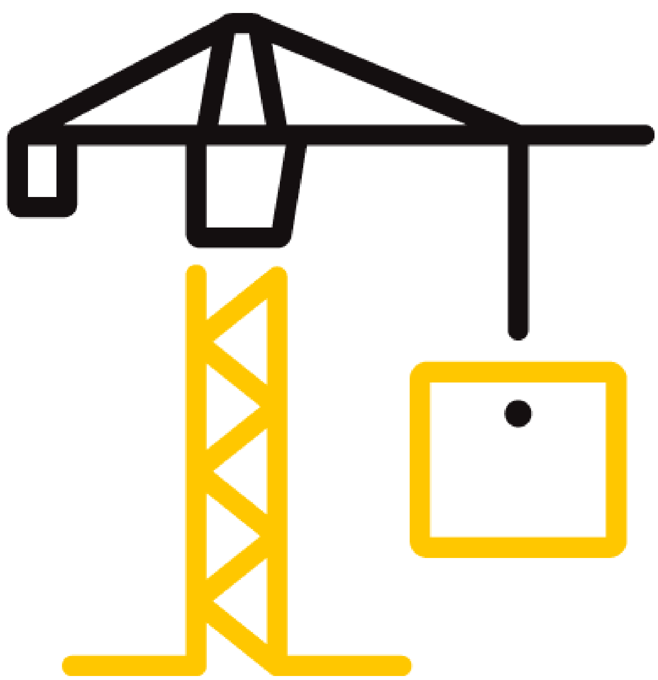

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Facsimile: 717-764-4129
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ENGINEERING ANALYSIS FOR PATRIOT DECKING

Report No.: N8658.01-119-34
Date: 06/29/22

REPORT ISSUED TO

PATRIOT DECKING
6141 Stark Road
Harris, MN 55032

SECTION 1

SCOPE

Architectural Testing, Inc. (an Intertek company) dba Intertek Building & Construction (B&C) was contracted by Patriot Decking, Harris, MN to determine the allowable design live load for their aluminum deck board spanning a maximum of 24 in over wood joists. Results obtained are calculated values and were secured by using the designated standards. The analysis was conducted at the Intertek B&C test facility in York, Pennsylvania.

Intertek B&C in York, Pennsylvania has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc. (IAS).

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Unless differently required, Intertek reports apply the "Simple Acceptance" rule, also called "Shared Risk approach," of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity. Intertek will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
VIRGAL THOMAS MICKLEY, JR.
ENGINEER
PE-078184

2022.06.29 13:28:57 -04'00'

For INTERTEK B&C:

COMPLETED BY:	Virgal T. Mickley, Jr., P.E.	**REVIEWED BY:**	Travis A. Hoover
TITLE:	Senior Staff Engineer	**TITLE:**	Program Manager
SIGNATURE:	Digitally Signed by: Virgal Thomas Mickley, Jr.	**SIGNATURE:**	Digitally Signed by: Travis Hoover
DATE:	06/29/22	**DATE:**	06/29/22

VTM:tah/aas

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SECTION 2
DESIGN STANDARDS

The specimens were evaluated in accordance with the following:

Aluminum Design Manual 2020, The Aluminum Association, Inc., 2020

2021 *International Building Code®*, International Code Council

2021 *International Residential Code®*, International Code Council

AISC Manual of Steel Construction, 9^{th} Edition

SECTION 3
GENERAL DESCRIPTION

The aluminum deck boards are composed of 6061-T6 extruded aluminum material. The product is comprised of one profile measuring 5-1/2 in wide by 15/16 in high by 0.065 in wall.

The manufactured products are intended for use as an exterior walking deck board. Drawings are included in Section 7 to verify the overall dimensions and other pertinent information of the tested product, its components, and any constructed assemblies.

SECTION 4
ANALYSIS

Deck board strength and stiffness is calculated using allowable design stress methodology of the Aluminum Design Manual. The lower of these two values will be the maximum allowable live load for the deck board.

Deck board strength is based on the lowest limit states of compression and tension to find a maximum F_b. The maximum bending stress is then used to solve for a maximum Live Load based on the physical properties of the deck board and a maximum span length of 24 in.

Deck board is limited to a maximum deflection of L/360 per the IBC codes. The maximum deflection is then used to solve for a maximum Live Load based on the physical properties of the deck board and a maximum span length of 24 in.

Determination of the allowable live load is presented on page 5 to page 8.

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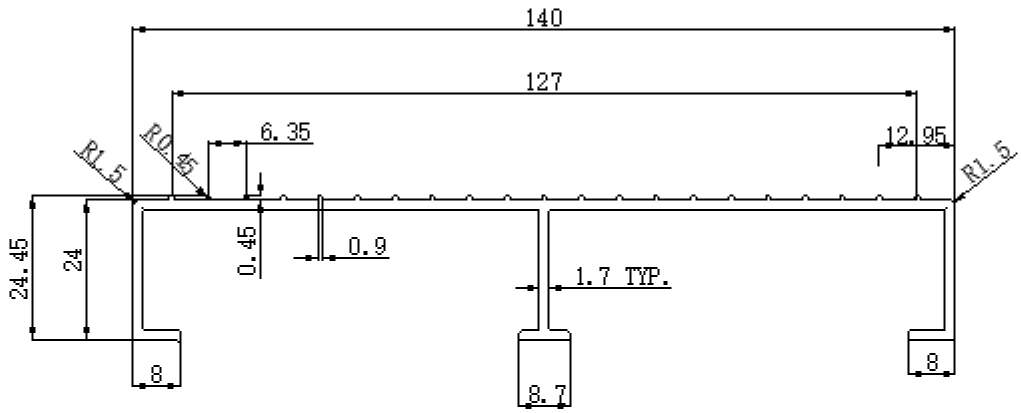
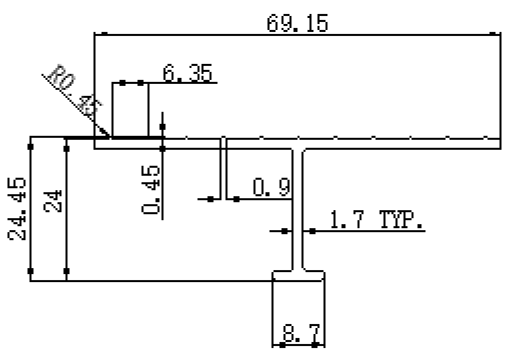
SECTION 5
CALCULATIONS

Decking Profile



Area:	0.6055 in^2
Bounding Box:	X: -2.7559 in -- 2.7559 in
	Y: -0.7004 in -- 0.2622 in
Moments of Inertia:	X: 0.0633 in^4
	Y: 2.0355 in^4
Radii of Gyration:	X: 0.3232 in
	Y: 1.8334 in

Intermediate Stiffener



Area:	0.2648 in^2
Bounding Box:	X: -1.3612 in -- 1.3612 in
	Y: -0.7468 in -- 0.2158 in
Moments of Inertia:	X: 0.0239 in
	Y: 0.1162 in
Radii of Gyration:	X: 0.3003 in
	Y: 0.6623 in

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Deck Board Uniform Live Load Rating

Material: 6061-T6 Aluminum

F_{tu} = 38 ksi	*(Aluminum Design Manual Table A.4.3)*
F_{ty} = 35 ksi	*(Aluminum Design Manual Table A.4.3)*
F_{cy} = 0.9 x F_{ty} = 31.5 ksi	*(Aluminum Design Manual Table A.4.1)*
F_{su} = 0.6 x F_{tu} = 22.8 ksi	*(Aluminum Design Manual Table A.4.1)*
E = 10,100 ksi	*(Aluminum Design Manual Table A.4.1)*
K_t = 1.0	*(Aluminum Design Manual Table A.4.3)*
$\Omega_{tensile\ rupture}$ = 1.95	*(Aluminum Design Manual Section F.1)*
$\Omega_{all\ else}$ = 1.65	*(Aluminum Design Manual Section F.1)*
K = 1.0	*(Aluminum Design Manual Table B.4.2)*
K_1 = 0.35	(Aluminum Design Manual Table B.4.3)
K_2 = 2.27	*(Aluminum Design Manual Table B.4.3)*

Find F_b for lowest of limit states:

Tension

Uniform Tension: $\Omega F_t = F_{ty}/\Omega$ = 35 ksi/1.65 = **21.21 ksi**

Tensile Rupture: $\Omega F_t = (F_{tu} / K_t) / \Omega$ = (38 ksi/1.0)/1.95 = **19.49 ksi**

Compression

Flat Elements Supported on Both Edges (Aluminum Design Manual Section B.5.4.2)

b/t = 40.25

where: b = 2.656 in - 2(0.020 in) = 2.616

t = 0.065 in

$$B_p = F_{cy}\left[1+\left(\frac{F_{cy}}{1500K}\right)^{1/3}\right] = 40.191 \qquad (Aluminum\ Design\ Manual\ Table\ B.4.2)$$

$$D_p = \frac{B_p}{10}\left(\frac{B_p}{E}\right)^{\frac{1}{2}} = 0.254 \qquad (Aluminum\ Design\ Manual\ Table\ B.4.2)$$

$$\lambda_1 = \frac{B_p - F_{cy}}{1.6 \times D_p} = 21.39 \qquad (Aluminum\ Design\ Manual\ Table\ B.5.4.2)$$

$$\lambda_2 = \frac{K_1 \times B_p}{1.6 \times D_p} = 34.61 \qquad (Aluminum\ Design\ Manual\ Table\ B.5.4.2)$$

Since b/t > λ_2 $F_c = \frac{k_2\sqrt{B_p E}}{1.6\frac{b}{t}}$ = **22.46 ksi**

Flat Elements Supported on Both Edges with Intermediate Stiffener

(Aluminum Design Manual B.5.4.4)

$$\lambda_s = 4.62\left(\frac{b}{t}\right)\sqrt{\frac{1+\frac{A_s}{bt}}{1+\sqrt{1+\frac{10.67\times I_o}{bt^3}}}} = 48.14$$

(Aluminum Design Manual Equation B.5-10)

where: A_s = 0.858 in x 0.065 in = 0.056 in^2
I_o = 0.0239 in^4 (Intermediate Stiffener)
b = 2.618 in
t = 0.065 in

$$B_c = F_{cy}\left(1+\left(\frac{F_{cy}}{2250\times K}\right)^{\frac{1}{2}}\right) = 35.227 \qquad (Aluminum\ Design\ Manual\ Table\ B.4.2)$$

$$D_c = \frac{B_c}{10}\left(\frac{B_c}{E}\right)^{\frac{1}{2}} = 0.208 \qquad (Aluminum\ Design\ Manual\ Table\ B.4.2)$$

$$C_c = \lambda_2 = 0.41\frac{B_c}{D_c} = 69.438 \qquad (Aluminum\ Design\ Manual\ Table\ B.4.2)$$

$$\lambda_1 = \frac{B_c - F_{cy}}{D_c} = 17.92$$

Since $\lambda_1 < \lambda_s < \lambda_2$ $F_c = B_c - D_c \times \lambda_s$ = **25.21 ksi**

F_b = 19.49 ksi (Tensile Rupture Controls)

Solve for Live Load (Bending Strength)

F_b = 19.49 ksi

F_b = Mc/I → M = F_bI/c

= (19,490 psi)(0.0633 in^4)/0.7004 in

= 1,761.45 lb-in

M = $wl^2/8$ → w = $8M/l^2$

= 8(1,761.45 lb-in)/$(24\ in)^2$ = 24.5 pli

= 24.5 pli x 12 in/ft = 294 plf

294 plf/0.459 ft = 641 psf

Maximum Live Load based on F_b is 641 psf

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Solve for Live Load (Stiffness)

Δ_{max} = l/360 (IBC 2021, Table 1604.3)

Δ_{max} = 24 in/360 = 0.067 in

$\Delta_{max} = 5wl^4/384EI \rightarrow w = 384EI\Delta_{max}/5l^4$ (AISC 9th edition, Page 2-296)

$= (384)(10{,}100{,}000\ psi)(0.0633\ in^4)(0.067\ in)/5(24\ in)^4 = 9.9\ pli$

= 9.9 pli x 12 in/ft = 119 plf

119 plf/0.5 ft = 238 psf

Maximum Live Load based on Δ_{max} = l/360 is 238 psf

Deflection Controls: Maximum Live Load is 238 psf for 24 in Span

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SECTION 6
CONCLUSION

When installed over support framing members spaced at a maximum of 24 in on-center, the aluminum deck boards are capable of supporting a uniform design live load of 238 psf.

This analysis is solely based upon classic engineering mechanics.

SECTION 7
DRAWINGS

The "As-Built" drawings for the aluminum deck board 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.

Test sample complies with these details.
Deviations are noted.

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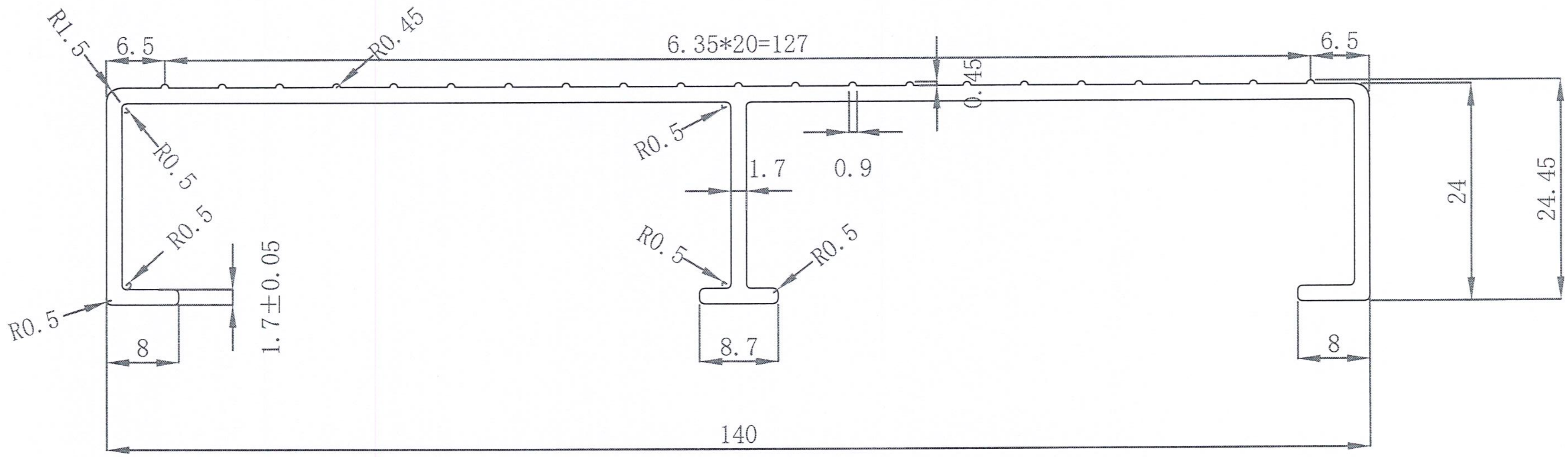
Date 6/28/22 Tech vtm



Specifications						Standard	GB5237.1-2008			Proportion 1: 1
Area	390.657 mm²	Unmarked thickness	1.7 mm						Date	2022.06.15
Weight	1.06 kg/m	Unmarked radius	0.5 mm							
Primeter	mm	Alloy	6061-T6							

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SECTION 8
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	06/29/22	N/A	Original Report Issue