ENGINEERING REPORT
PREPARED FOR

Barrette Outdoor Living

BOL ALUMINUM RAILING SYSTEM-LOAD ANALYSIS
IBC 2018 AND IRC 2018

2/26/2021

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BOL Aluminum Railing System Load Analysis

Scope

The Barrette Outdoor Living Aluminum Railing System is a powder-coated aluminum railing system. Because of Aluminum construction, it is considered to be a traditional building product. According to the 2018 International Building Code, this type of product need only be proven to comply with regulations by way of written calculations. The following document will describe the system performance requirements outlined in the IBC and IRC and show the appropriate calculations needed for compliance. This analysis is also valid for the 2009, 2012 & 2015 IBC/ IRC. The Barrette Aluminum Railing system will be evaluated at 69'', 93'', and 96" lengths.

Sections

I. Key Terms and Definitions
II. Geometric Properties
III. Structural Post Load Requirements
IV. Top Rail Load Requirements
V. Infill
VI. Fastener Considerations
VII. Conclusion

I. Key Terms and Definitions

Elastic Section Modulus (S): A geometric property for a given cross-section used in the design of beams or flexural members. The elastic section modulus is defined as S = I / y, where I is the second moment of area and y is the distance from the neutral axis to any given fiber.

Modulus of Elasticity (E): The elastic modulus of an object is defined as the slope of its stress–strain curve in the elastic deformation region.

Yield Strength (σ): The stress at which a predetermined amount of permanent deformation occurs.

Second Moment of Inertia (I): A property of a cross-section that can be used to predict the resistance of a beam to bending and deflection around an axis that lies in the cross-sectional plane.

Factor of Safety (FOS): Term describing the structural capacity of a system beyond the expected loads or actual loads.

II. Geometric Properties

The aluminum rail and post extrusions in the Avalon Railing system are created from aluminum alloy Al-6005-T5. The square baluster is created from Al-6063-T5 and the twisted baluster is created from Al-6063-T6.
The following calculations will be based on the material properties listed below. The specific numbers used in this analysis have been taken from a reputable material properties website (www.matweb.com).[1]

Al-6005-T5: $\sigma_{yr} = 34{,}800\,psi$

Al-6063-T5: $\sigma_{yr} = 21{,}000\,psi$

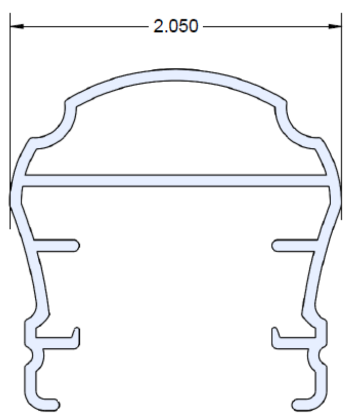
Al-6063-T6: $\sigma_{yr} = 31{,}000\ psi$

$\Omega_b = 1.67$ (AISC F1)

Due to the complex shape of the support extrusion used in the top rail of the Barrette Aluminum Railing system, the mass properties command in SolidWorks was used to calculate the geometric properties for each profile.

1. Top Rails

a. Cambridge Top Rail:



Section properties of the selected face of EPN 0565

Area = 0.617 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.126
Z = 69.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

[1] Date from Material Property Sheet (Appendix)

Lxx = 0.218	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.330	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.548

Polar moment of inertia of the area, at the centroid = 0.548 inches ^ 4

Angle between principal axes and part axes = 0.000 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.218
Iy = 0.330

Moments of inertia of the area, at the output coordinate system: (inches ^ 4)

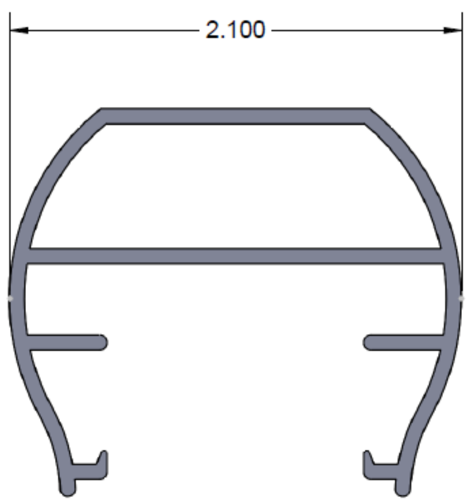
LXX = 2940.038	LXY = 0.000	LXZ = -0.000
LYX = 0.000	LYY = 2940.141	LYZ = 5.374
LZX = -0.000	LZY = 5.374	LZZ = 0.558

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_a = \frac{I_{ya}}{c_a} \qquad S_a = \frac{.330in^4}{1.025in} = .3219in^3$$

b. Winchester Top Rail:



Section properties of the selected face of EPN 0566

Area = 0.565 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.141
Z = 69.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.150	Lxy = 0.000	Lxz = 0.000

Lyx = 0.000	Lyy = 0.311	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.461

Polar moment of inertia of the area, at the centroid = 0.461 inches ^ 4

Angle between principal axes and part axes = 0.000 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.150
Iy = 0.311

Moments of inertia of the area, at the output coordinate system: (inches ^ 4)

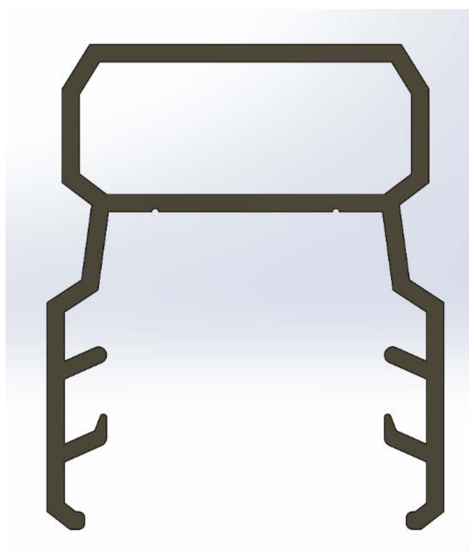
LXX = 2690.239	LXY = 0.000	LXZ = 0.000
LYX = 0.000	LYY = 2690.389	LYZ = 5.491
LZX = 0.000	LZY = 5.491	LZZ = 0.472

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_b = \frac{I_{yb}}{c_b} \qquad S_b = \frac{0.311 in^4}{1.05 in} = 0.2962 in^3$$

c. Avalon Tristan Top Rail:



Section properties of the selected face of EPN 0507

Area = 0.5806 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.0000
Y = -0.1586
Z = 70.2500

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.2284	Lxy = 0.0000	Lxz = 0.0000
Lyx = 0.0000	Lyy = 0.2412	Lyz = 0.0000
Lzx = 0.0000	Lzy = 0.0000	Lzz = 0.4696

Polar moment of inertia of the area, at the centroid = 0.4696 inches ^ 4

Angle between principal axes and part axes = -0.0000 degrees

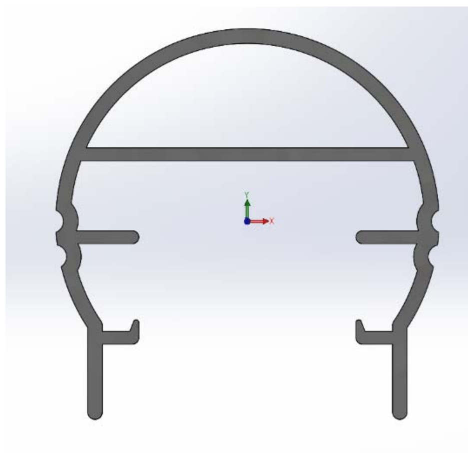
Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.2284
Iy = 0.2412

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_c = \frac{I_{yc}}{C_c} \qquad S_c = \frac{0.2412\ in^4}{0.85in} = 0.2838in^3$$

d. Avalon Lanval Top Rail:



Section properties of the selected face of EPN 0518

Area = 0.644 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.140
Z = 71.500

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.214	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.356	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.570

Polar moment of inertia of the area, at the centroid = 0.570 inches ^ 4

Angle between principal axes and part axes = -0.000 degrees

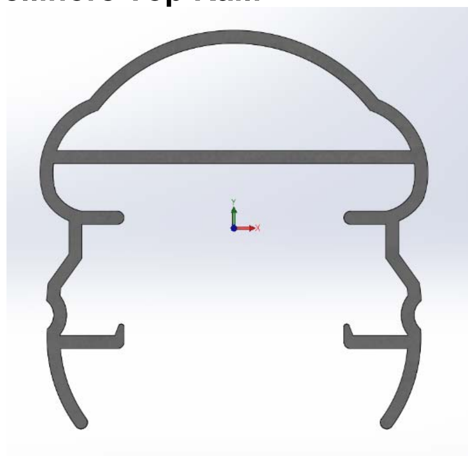
Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.214
Iy = 0.356

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_d = \frac{I_{yd}}{C_d} \; S_d = \frac{0.356\ in^4}{1.048in} = 0.3397in^3$$

e. Avalon Pellinore Top Rail:



Section properties of the selected face of EPN 0519

Area = 0.623 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.139
Z = 71.500

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.213	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.358	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.571

Polar moment of inertia of the area, at the centroid = 0.571 inches ^ 4

Angle between principal axes and part axes = -0.000 degrees

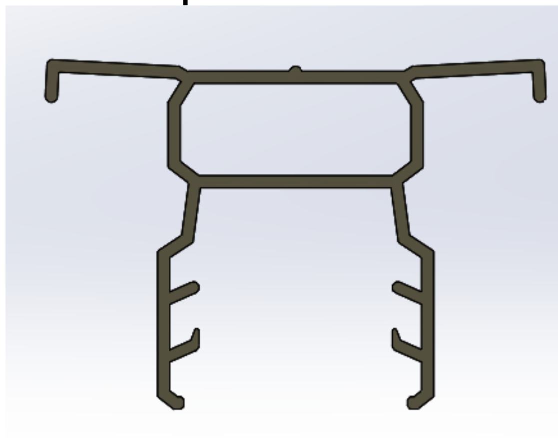
Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.213
Iy = 0.358

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_e = \frac{I_{ye}}{C_e} \qquad S_e = \frac{0.358\ in^4}{1.05 in} = 0.3410 in^3$$

f. Avalon Oberon Top Rail:



Section properties of the selected face of EPN 0519

Area = 0.737 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.026
Z = 71.500

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.322	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.465	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.787

Polar moment of inertia of the area, at the centroid = 0.571 inches ^ 4

Angle between principal axes and part axes = -0.000 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.322
Iy = 0.465

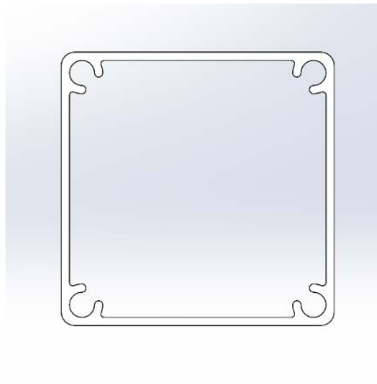
Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_f = \frac{I_{yf}}{C_f} \qquad S_f = \frac{0.465\ in^4}{1.5415 in} = 0.3016 in^3$$

b. Structural Posts

1. Residential Post



Section properties of the selected face of EPN 0504

Area = 0.83 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.00
Y = 0.00
Z = 39.00

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.82	Lxy = 0.00	Lxz = 0.00
Lyx = 0.00	Lyy = 0.82	Lyz = 0.00
Lzx = 0.00	Lzy = 0.00	Lzz = 1.63

Polar moment of inertia of the area, at the centroid = 1.63 inches ^ 4

Angle between principal axes and part axes = -0.00 degrees

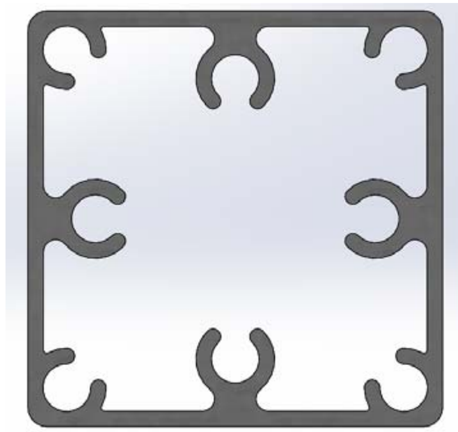
Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.82
Iy = 0.82

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_p = \frac{I_{yp}}{c_p} \qquad S_{p1} = \frac{0.82in^4}{1.25in} = 0.656in^3$$

2. Over The Top Post



Section properties of the selected face of EPN 0541

Area = 0.972 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.000
Z = 12.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.502	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.502	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 1.003

Polar moment of inertia of the area, at the centroid = 0.017 inches ^ 4

Angle between principal axes and part axes = -0.000 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.502
Iy = 0.502

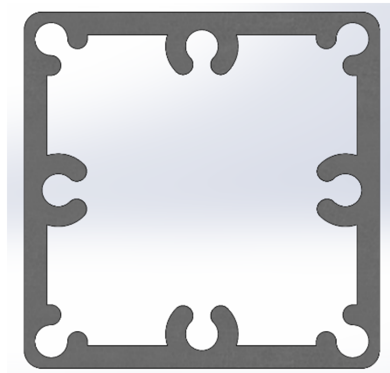
Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_P = \frac{I_P}{C_P}$$

$$S_P = \frac{.502in^4}{1.00in} = .502in^3$$

3. Commercial Post



Area = 1.782 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.000
Z = 60.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 1.468	Lxy = -0.000	Lxz = 0.000
Lyx = -0.000	Lyy = 1.468	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 2.937

Polar moment of inertia of the area, at the centroid = 2.937 inches ^ 4

Angle between principal axes and part axes = 79.210 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 1.468
Iy = 1.468

Moments of inertia of the area, at the output coordinate system: (inches ^ 4)

LXX = 6417.478	LXY = 0.000	LXZ = -0.000
LYX = 0.000	LYY = 6417.478	LYZ = -0.000
LZX = -0.000	LZY = -0.000	LZZ = 2.937

Section Modulus:

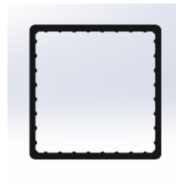
From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_p = \frac{I_{yp}}{c_p}$$

$$S_{p2} = \frac{1.468in^4}{1.25in} = 1.1744in^3$$

c. Infill (Balusters)

1. Square Baluster



Section properties of the selected face of EPN 0506

Area = 0.103 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.000
Z = 33.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.009	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.009	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.017

Polar moment of inertia of the area, at the centroid = 0.017 inches ^ 4

Angle between principal axes and part axes = -0.000 degrees

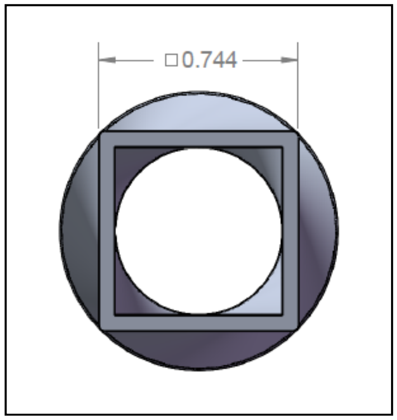
Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.009
Iy = 0.009

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_b = \frac{I_{yb}}{cb} \qquad S_b = \frac{0.009in^4}{0.372in} = 0.024in^3$$

2. Twisted Baluster



Section properties of the selected face of EPN 0563

Area = 0.161 inches^2

Centroid relative to output coordinate system origin: (inches)
X = 0.000
Y = 0.000
Z = 33.000

Moments of inertia of the area, at the centroid: (inches ^ 4)

Lxx = 0.013	Lxy = 0.000	Lxz = 0.000
Lyx = 0.000	Lyy = 0.013	Lyz = 0.000
Lzx = 0.000	Lzy = 0.000	Lzz = 0.025

Polar moment of inertia of the area, at the centroid = 0.025 inches ^ 4

Angle between principal axes and part axes = 0.000 degrees

Principal moments of inertia of the area, at the centroid: (inches ^ 4)
Ix = 0.013
Iy = 0.013

Moments of inertia of the area, at the output coordinate system: (inches ^ 4)

LXX = 175.686	LXY = 0.000	LXZ = 0.000
LYX = 0.000	LYY = 175.686	LYZ = 0.000
LZX = 0.000	LZY = 0.000	LZZ = 0.025

Section Modulus:

From the calculated Second Moment of Inertia from SolidWorks, the section modulus of the aluminum support extrusions can be found.

$$S_b = \frac{I_{yb}}{cb} \qquad S_b = \frac{0.013in^4}{0.372in} = 0.0349in^3$$

III. Structural Post Load Analysis

Load Distribution

Before analysis can be completed on the structural posts of a metal railing system, it must be determined if a Load Proportion Factor can be applied. In certain circumstances, a post is allowed a percent reduction in total load resistance requirements, assuming that adjacent posts and rails will take a percentage of any applied load. This reduction is called the Load Proportion Factor (Pf). The percentage is determined by the ratio of the stiffness of the rail (Kr) relative to the stiffness of the post (Kp). Calculation of the Stiffness Ratio (Rr) and the corresponding Load Proportion Factor can be seen below.

Stiffness Ratio:

$$R_r = \frac{K_r}{K_p}$$

The stiffness of the rail can be determined using the modulus of elasticity (E) of Aluminum, the second moment of inertia (I*) and the span length (L) of the rail:

$$K_r = \frac{E_r \cdot I_r}{L_r} \qquad E_r = 10e6\,psi$$

69'' Cambridge Rail Section

$$K_a = \frac{10e6\,psi \cdot 0.330in^4}{69in} = 47{,}826.08in$$

93'' Cambridge Rail Section

$$K_b = \frac{10e6\,psi \cdot 0.330in^4}{93in} = 35{,}483.87in$$

69'' Winchester Rail Section

$$K_c = \frac{10e6\,psi \cdot 0.311in^4}{69in} = 45{,}072.46in$$

93'' Winchester Rail Section

$$K_d = \frac{10e6\,psi \cdot 0.311in^4}{93in} = 33{,}440.86in$$

6' Avalon Tristan Rail Section

$$K_e = \frac{10e6\,psi \cdot .2412in^4}{72in} = 33{,}500.00in$$

8' Avalon Tristan Rail Section

$$K_f = \frac{10e6\,psi \cdot .2412in^4}{96in} = 25{,}125.00in$$

6' Avalon Lanval Rail Section

$$K_g = \frac{10e6\, psi \cdot .356in^4}{72in} = 49{,}444.44in$$

8' Avalon Lanval Rail Section

$$K_h = \frac{10e6\, psi \cdot .356in^4}{96in} = 37{,}083.33in$$

6' Avalon Pellinore Rail Section

$$K_i = \frac{10e6\, psi \cdot .358in^4}{72in} = 49{,}722.22in$$

8' Avalon Pellinore Rail Section

$$K_j = \frac{10e6\, psi \cdot .358in^4}{96in} = 37{,}291.67in$$

6' Avalon Oberon Rail Section

$$K_k = \frac{10e6\, psi \cdot .465in^4}{72in} = 64{,}583.33in$$

8' Avalon Oberon Rail Section

$$K_l = \frac{10e6\, psi \cdot .465in^4}{96in} = 48{,}437.5in$$

Stiffness of Post:

The stiffness of the post can be determined the same way using the height of the post instead of the length of the section and the Modulus of Elasticity. When performing these calculations, the height (h) of the post represents the tallest mounted height of the railing. See "Calculation of Post Section Modulus" for calculation of Post second moment of Inertia.

$$K_p = \frac{E_p \cdot I_p}{h_p} \qquad E_p = 10e6\, psi \qquad K_p = \frac{10e6\, psi \cdot 1.58in^4}{42in} = 376{,}190.48in$$

93'' Cambridge Rail Section Worst Case

$$\therefore R_a = \frac{K_b}{K_p} = \frac{35{,}483.87in}{376{,}190.48in} = .094$$

93'' Winchester Rail Section Worst Case

$$\therefore R_b = \frac{K_d}{K_p} = \frac{33{,}440.86in}{376{,}190.48in} = .088$$

6' Avalon Rail Section Worst Case

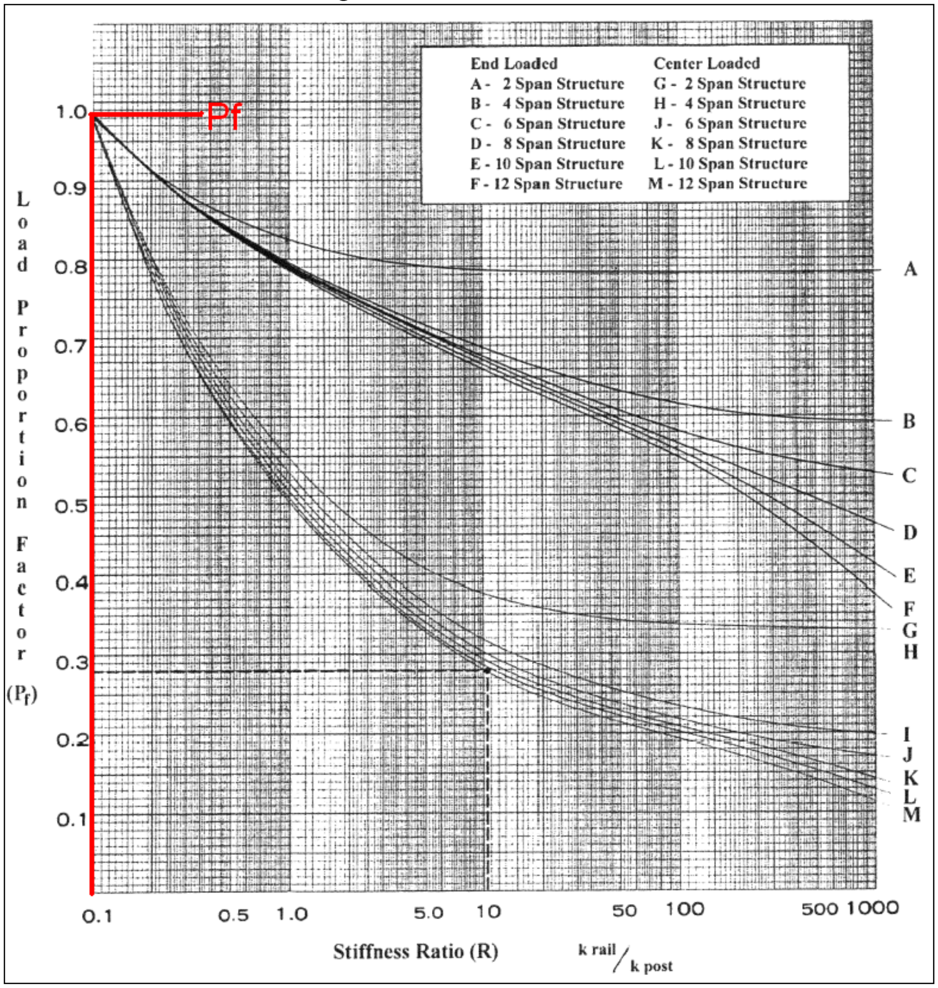
$$\therefore R_C = \frac{K_c}{K_p} = \frac{33{,}500in}{376{,}190.48in} = 0.089$$

8' Avalon Rail Section Worst Case

$$\therefore R_d = \frac{K_d}{K_p} = \frac{25{,}125in}{376{,}190.48in} = 0.067$$

Using the Chart below, the Load Proportion Factor (Pf) can be found.

Railing Load Distribution Data



The structural post analysis can now be completed without the application of a Load Proportion Factor to show the worst case scenario.

According to metal railing requirements, the bending moment (BM) on a post is defined as the horizontal load multiplied by the height of the load. This value can not be greater than the resisting moment (RM), which is defined as the allowable design stress multiplied by the section modulus.

Equations for post analysis:

$$BendingMoment : BM = P \cdot h$$
$$ResistingMoment : RM = \sigma_y \cdot S$$
$$\therefore BM \leq RM$$

Using the section modulus of the post in the Barrette Aluminum Railing system, it can be shown that the post more than exceeds the requirements of the governing equations.

Determination of appropriate Bending Moment:[2]

The analysis will be calculated considering the two possible scenarios, 36" and 42" heights.

$$\sigma_{yp} = 34{,}800\,psi$$

$$\Omega_b = 1.67 \text{ (AISC F1)}$$

According to the 2015 IBC, a guard rail of this type must undergo a 200 lb point load (P) at any point on the top rail and a 50lb/ft distributed load along the top rail. Under a 50lb/ft load, a 96'' rail section is exposed to 400lbs of force. In terms of the post of such a rail system, each supporting post on a section would take half of this applied load, or 200lb. With consecutive sections, any one post could be exposed to the loading of two sections. In this scenario, as much as a 400lb applied load could be experienced. This case shall be examined as it represents the largest possible bending moment.

For residential 36" applications, only the point load is required. Posts are sold in lengths of 39", so worst case scenario is calculated according to a point load at the very top of the post. Over the top posts are sold in 33" lengths so the finished rail height (36") is used to calculate the bending moment. For commercial 42" applications, uniform loading is the worst case scenario and occurs at the finished rail height of 42".

Residential 39" Post:

$$BendingMoment(BM) = P \cdot h_p = 200lb \cdot 39in = 7{,}800.00inlb$$

$$Resisting\ Moment\ (RM) = \sigma_{yp} \cdot S_{p1} = (34{,}800psi \cdot 0.656in^3) = 22{,}829\ inlb$$

$$\therefore RM > BM$$

Resulting Factor of Safety:

$$FOS = \frac{RM}{\text{BM}} = \frac{22{,}828inlb}{7{,}800inlb} = 2.93 > 1.67\ \textbf{DESIGN OK}$$

[2] Railing Dynamics Inc. recommends the use of thru bolts as a means of fastening to mounting surfaces. Because of the varying degrees of material strength regarding decking structure material, the attachment method is not considered in this analysis.

Over the Top 33” Post (OTT):

The over the top system is offered in both residential and commercial applications. Residential applications have a maximum span of 6 ft while commercial spans are limited to 5 ft.

Residential:

$$Bending\ Moment(BM) = P \cdot h_p = 200lb \cdot 36in = 7{,}200\ inlb$$

$$Resisting\ Moment\ (RM) = \sigma_{yp} \cdot S_{p1} = (34{,}800psi \cdot 0.502in^3) = 17{,}469.6\ inlb$$

$$\therefore RM > BM$$

Resulting Factor of Safety:

$$FOS = \frac{RM}{\mathrm{BM}} = \frac{17{,}469.6inlb}{7{,}200inlb} = 2.43 > 1.67\ \textbf{DESIGN OK}$$

Commercial OTT:

$$P = w \cdot l = 50lbft \cdot 5ft = 250\ lb$$

$$Bending\ Moment(BM) = P \cdot h_p = 250\ lb \cdot 36in = 9{,}000\ inlb$$

$$Resisting\ Moment\ (RM) = \sigma_{yp} \cdot S_{p1} = (34{,}800psi \cdot 0.502in^3) = 17{,}469.6\ inlb$$

$$\therefore RM > BM$$

Resulting Factor of Safety:

$$FOS = \frac{RM}{\mathrm{BM}} = \frac{17{,}469.6inlb}{9{,}000inlb} = 1.94 > 1.67\ \textbf{DESIGN OK}$$

Commercial 45” Post:

$$BendingMoment(BM) = P \cdot h_p = 400lb \cdot 42in = 16{,}800.00inlb$$

$$Resisting\ Moment\ (RM) = \sigma_{yp} \cdot S_{p1} = (34{,}800psi \cdot 1.174in^3) = 40{,}855.2\ inlb$$

$$\therefore RM > BM$$

Resulting Factor of Safety:

$$FOS = \frac{RM}{\mathrm{BM}} = \frac{40{,}855.2inlb}{16{,}800inlb} = 2.43 > 1.67\ \textbf{DESIGN OK}$$

With the above calculations, it is proven that the resisting moment in the post is larger than the bending moment caused by the load, showing that the posts in the Barrette Aluminum Railing system exceed design requirements.

Maximum Post Spacing:

According to the 2015 IBC, a metal railing system must be able to withstand a 50lb/ft uniform load (w) at the highest point on the rail in any direction. With this value and the geometric properties of the aluminum posts, the maximum post spacing can be calculated.

$$L_r = \frac{\sigma_{yp} \cdot S_p}{\Omega_b (w/12) \cdot h_p} \qquad L_r = \frac{34{,}800\,psi \cdot 1.1744 in^3}{1.67 \cdot (50/12) \cdot 42 in} = 139.84 in$$

The maximum span in a Barrette Aluminum Railing System is 93”. With this calculation, it is clear that the post more than exceeds the railing span requirements.

IV. Guard Rails

Maximum Concentrated Load:

For railing systems required to experience a concentrated load, the maximum moment and thus determining point, occurs at midspan. This moment is determined by the load and the span length and is resisted by the allowable stress multiplied by the section modulus.

For simply supported rail with the point load:

$$Bending\ Moment (BM) = \frac{P \cdot L}{4}$$

$$Resisting\ Moment\ (RM) = \sigma_{yr} \cdot S_r$$

$\sigma_{yr} = 34{,}800\,psi$

Ω_b = 1.67 (AISC F1)

In order to calculate allowable point force, bending moment and resisting moment needs to be compared:

$$\frac{P \cdot L}{4} = \sigma_{yr} \cdot S_r$$

Rearranging the above equation, allowable load “P” can be calculated

$$P = \frac{\sigma_{yr} \cdot S_r \cdot 4}{L}$$

Resulting Factor of Safety:

$$if\ FOS = \frac{P}{200\text{lbs}} > 1.67\ then\ \boldsymbol{DESIGN\ OK}$$

200lbs load is required by ASTM. To meet or exceed 1.67 ratio (FOS) P has to meet or exceed 334lbs.

a. 93’’ Cambridge Railing:

$$P_a = \frac{34{,}800psi \cdot 0.3219in^3 \cdot 4}{93in} = 481.8lbs$$

$$FOS(P_a) = \frac{481.8lbs}{200\text{lbs}} = 2.41 > 1.67\ \boldsymbol{DESIGN\ OK}$$

b. 93’’ Winchester Railing:

$$P_b = \frac{34{,}800psi \cdot 0.2962in^3 \cdot 4}{93in} = 443..3lbs$$

$$FOS(P_b) = \frac{443.3lbs}{200\text{lbs}} = 2.21 > 1.67\ \boldsymbol{DESIGN\ OK}$$

c. 8’ Avalon Rail - Tristan:

$$P_c = \frac{34{,}800psi \cdot 0.2838in^3 \cdot 4}{96in} = 411.5lbs$$

$$FOS(P_c) = \frac{411.5lbs}{200\text{lbs}} = 2.06 > 1.67\ \boldsymbol{DESIGN\ OK}$$

d. 8’ Avalon Rail - Lanval:

$$P_d = \frac{34{,}800psi \cdot 0.3397in^3 \cdot 4}{96in} = 492.6lbs$$

$$FOS(P_d) = \frac{492.6lbs}{200\text{lbs}} = 2.46 > 1.67 \textbf{\textit{ DESIGN OK}}$$

e. 8’ Avalon Rail - Pellinore:

$$P_e = \frac{34{,}800psi \cdot 0.3410in^3 \cdot 4}{96in} = 494.5lbs$$

$$FOS(P_e) = \frac{494.5lbs}{200\text{lbs}} = 2.47 > 1.67 \textbf{\textit{ DESIGN OK}}$$

f. 8’ Avalon Rail – Oberon

$$P_f = \frac{34{,}800psi \cdot 0.3016in^3 \cdot 4}{96in} = 437.3.5lbs$$

$$FOS(P_f) = \frac{437.3lbs}{200\text{lbs}} = 2.19 > 1.67 \textbf{\textit{ DESIGN OK}}$$

According to the ASTM standard E 985, “Standard Specification for Permanent Metal Railing Systems and Rails for Buildings”, the maximum required concentrated load the Barrette Aluminum Railing System is 200lb. With this calculation, it is clear that the rail more than exceeds this railing load requirement.

Maximum Uniform Load:
For simply supported rail with uniform distributed load:

$$Bending\ Moment(BM) = \frac{w \cdot L^2}{8}$$

$$Resisting\ Moment\ (RM) = \sigma_{yr} \cdot S_r$$

$\sigma_{yr} = 34{,}800\, psi$
$\Omega_b = 1.67$ (AISC F1)

In order to calculate allowable point force, bending moment and resisting moment needs to be compared:

$$\frac{w \cdot L^2}{8} = \sigma_{yr} \cdot S_r$$

Rearranging the above equation, allowable load "w" can be calculated

$$w = \frac{\sigma_{yr} \cdot S_r \cdot 8}{L^2} \cdot 12 \frac{in}{ft}$$

Resulting Factor of Safety:

$$if\ FOS(w) = \frac{w}{50\text{lbs}} > 1.67\ then\ \boldsymbol{DESIGN\ OK}$$

50lbs load is required by ASTM. To meet or exceed 1.67 ratio (FOS) "w" has to meet or exceed 83.5lbs.

a. 93'' Cambridge Railing:

$$w_a = \frac{34800psi \cdot 0.3219in^3 \cdot 8}{(93in)^2} \cdot 12 \frac{in}{ft} = 124.34lb/ft$$

$$FOS(w_a) = \frac{124.34lbs}{50\text{lbs}} = 2.49 > 1.67\ \boldsymbol{DESIGN\ OK}$$

b. 93'' Winchester Railing:

$$w_b = \frac{34800psi \cdot 0.2962in^3 \cdot 8}{(93in)^2} \cdot 12\frac{in}{ft} = 114.41lb/ft$$

$$FOS(w_b) = \frac{114.41lbs}{50\text{lbs}} = 2.29 > 1.67 \textbf{ DESIGN OK}$$

c. 8' Avalon Rail - Tristan:

$$w_c = \frac{34800psi \cdot 0.2838in^3 \cdot 8}{(96in)^2} \cdot 12\frac{in}{ft} = 102.88lb/ft$$

$$FOS(w_c) = \frac{102.88lbs}{50\text{lbs}} = 2.06 > 1.67 \textbf{ DESIGN OK}$$

d. 8' Avalon Rail - Lanval:

$$w_d = \frac{34800psi \cdot 0.3397in^3 \cdot 8}{(96in)^2} \cdot 12\frac{in}{ft} = 123.14lb/ft$$

$$FOS(w_d) = \frac{123.14lbs}{50\text{lbs}} = 2.46 > 1.67 \textbf{ DESIGN OK}$$

e. 8' Avalon Rail - Pellinore:

$$w_e = \frac{34800psi \cdot 0.3410in^3 \cdot 8}{(96in)^2} \cdot 12\frac{in}{ft} = 123.61lb/ft$$

$$FOS(w_e) = \frac{123.61lbs}{50\text{lbs}} = 2.47 > 1.67 \textbf{ DESIGN OK}$$

f. 8' Avalon Rail - Oberon:

$$w_f = \frac{34800psi \cdot 0.3016in^3 \cdot 8}{(96in)^2} \cdot 12\frac{in}{ft} = 109.33lb/ft$$

$$FOS(w_f) = \frac{109.33lbs}{50\text{lbs}} = 2.19 > 1.67 \textbf{ DESIGN OK}$$

According to the ASTM standard E 985, "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings", the maximum required uniform load is 50lb/ft. With this calculation, it is clear that the rail more than exceeds this railing load requirement.

V. Infill

The infill is required to resist a 50lb. load applied over 12" x 12" square. This load will be spread over 2 balusters, exhibiting a force of 25 lbs. on each baluster.

For simply supported picket with the point load:

$$Bending\ Moment(BM) = \frac{P \cdot L}{4}$$

$$Resisting\ Moment\ (RM) = \sigma_{yr} \cdot S_r$$

Ω_b = 1.67 (AISC F1)

In order to calculate allowable point force, bending moment and resisting moment needs to be compared:

$$\frac{P \cdot L}{4} = \sigma_{yr} \cdot S_r$$

Rearranging the above equation, allowable load "P" can be calculated

$$P = \frac{\sigma_{yr} \cdot S_r \cdot 4}{L}$$

Resulting Factor of Safety:

$$if\ FOS = \frac{P}{25\text{lbs}} > 1.67\ then\ \textbf{DESIGN OK}$$

25lbs load (per picket) is required by ASTM. To meet or exceed 1.67 ratio (FOS) P has to meet or exceed 41.75lbs.

Square Baluster:

Material: Al-6063-T5,
$\sigma_{yr} = 21{,}000\,psi$

$$P_a = \frac{21{,}000psi \cdot 0.024in^3 \cdot 4}{39in} = 51.69lbs$$

$$FOS(P_a) = \frac{51.69lbs}{25\text{lbs}} = 2.07 > 1.67\ \textbf{DESIGN OK}$$

Square Baluster:

Material: Al-6063-T6,
$\sigma_{yr} = 21{,}000\,psi$

$$P_a = \frac{21{,}000psi \cdot 0.024in^3 \cdot 4}{39in} = 51.69lbs$$

$$FOS(P_a) = \frac{51.69lbs}{25\text{lbs}} = 2.07 > 1.67\ \boldsymbol{DESIGN\ OK}$$

Twisted Baluster:

Material: Al-6063-T6,
$\sigma_{yr} = 31{,}000\ psi$

$$P_a = \frac{31{,}000psi \cdot 0.0349in^3 \cdot 4}{33in} = 131{,}14lbs$$

$$FOS(P_a) = \frac{131.14lbs}{25\text{lbs}} = 5.25 > 1.67\ \boldsymbol{DESIGN\ OK}$$

Glass Infill:

Material: AFG Standard Float Glass

Glass infill is compliant per IBC Section 2407.1 at finished rail heights of 36” and 42” (See appendix for Barrette material spec).

VI. System Assembly Fastener Considerations

The posts of the Barrette Aluminum Railing System are attached to the base plate custom screws part 34109436 (See appendix for screw information). Four screws are used for residential applications and eight are used for commercial applications. The screws have a minimum minor diameter of 0.185in. The withdrawal of these screws have been tested and approved through third party testing. ATI test report "B8389.01-119-19" conducted on 10/31/12 shows a similar railing system being tested using the same posts and fasteners for this system. From this testing and data, it can be seen that the post and fastener assembly exceeded both code and design requirements.

In addition, the maximum shear load resistance the fasteners must exhibit occurs when a load is applied directly adjacent to the mounting plate. At this point, bending of the post is negligible and all force is being transmitted through the bracket fasteners in the form of shear force.

Residential Post Application:

Screw material: C1022

Safety factor for screw - 3

$\sigma_{TU} = 55{,}000\ psi$

$\sigma_S = 0.6 * \sigma_{TU} = 0.6 * 55{,}000\ psi = 33{,}060 psi$

$V = \tau A \qquad \tau = \frac{V}{A} \qquad A = \pi (r)^2 = \pi (\frac{D}{2})^2 \qquad V = \frac{F}{4}$ (4 fasteners)

$$A = \pi (\frac{0.185in}{2})^2 = 0.02688in^2$$

$$V = \frac{200lb}{4} = 50lb$$

$$\tau = \frac{50lb}{0.02688in^2} = 1{,}860.12\,psi$$

We determine the Factor of Safety using the yield stress for a C1022 steel proof load:

$$FOS(\tau) = \frac{\sigma_s}{\tau}$$

$\sigma_S = 33{,}060 psi$

$$FOS(t) = \frac{33{,}060 psi}{1{,}860.12\text{psi}} = 17.77 > 3 \textbf{ DESIGN OK}$$

Commercial Post Application:

$$V = \tau A \qquad \tau = \frac{V}{A} \qquad A = \pi (r)^2 = \pi (\frac{D}{2})^2 \qquad V = \frac{F}{8} \text{ (8 fasteners)}$$

$$A = \pi (\frac{0.185in}{2})^2 = 0.02688in^2$$

$$V = \frac{400lb}{8} = 50lb$$

$$\tau = \frac{50lb}{0.02688in^2} = 1{,}860.12\,psi$$

We determine the Factor of Safety using the yield stress for a 410 Stainless steel proof load:

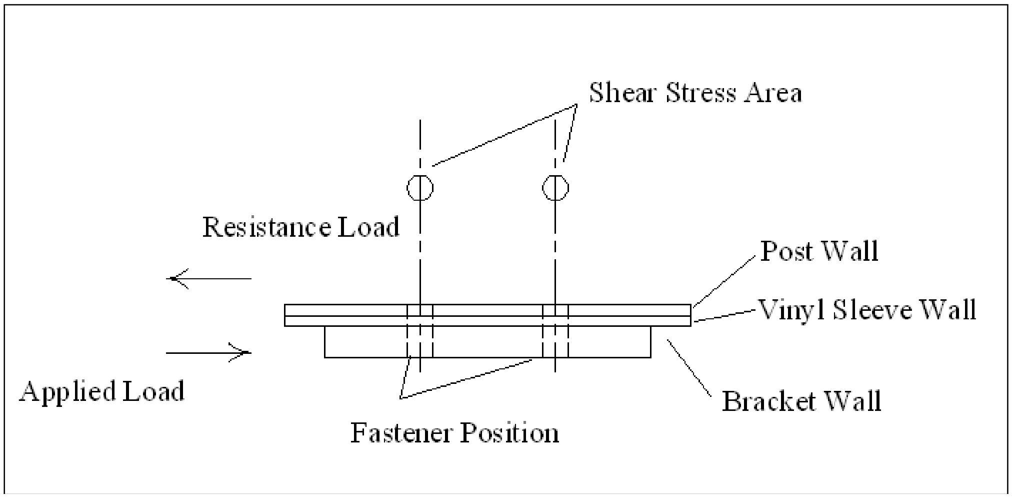
$$FOS(\tau) = \frac{\sigma_s}{\tau} \qquad \sigma_s = 42{,}100\,psi$$

$$FOS(\tau) = \frac{42{,}100\,psi}{1{,}860.12\,psi} = 22.63$$

Guardrail Application:

The guard rails of the Barrette Aluminum Railing System are attached to the posts with self-tapping 410 stainless steel screws with Aluminum ADC12 brackets. The screws have a minimum minor diameter of 0.1in.

The maximum load resistance the fasteners must exhibit occurs when a 200lb load is applied directly adjacent to the post. At this point, bending of the guard rail is negligible and all force is being transmitted through the bracket fasteners in the form of shear force. A shear force diagram and calculation can be seen below.



$V = \tau A$ $\qquad \tau = \dfrac{V}{A}$ $\qquad A = \pi (r)^2 = \pi (\dfrac{D}{2})^2$ $\qquad V = \dfrac{F}{4}$ (4 fasteners)

$$A = \pi (\frac{0.1in}{2})^2 = 0.00785in^2$$

$$V = \frac{200lb}{4} = 50lb$$

$$\tau = \frac{50lb}{0.00785in^2} = 6{,}369.4\,psi$$

We determine the Factor of Safety using the yield stress for a 410 Stainless steel proof load:

$$\sigma_s = 42{,}100\,psi$$

$$FOS_{(\tau)} = \frac{42{,}100\,psi}{6{,}369.4\,psi} = 6.6$$

Impact Consideration:

A general calculation can be done to show the ability of the fasteners to withstand an impact load, as if a person was to fall into the railing system.

Consider the weight of an average man being dropped onto a horizontally mounted railing system being modeled as a beam supported by stiff springs. The weight will be dropped from a height so as to represent a distance one would travel in a trip and fall type scenario. With this information, an impact factor can be calculated and applied to the stress experienced in normal static loading conditions.

Assumptions:

Falling distance: 36in
Average male weight: 190lbs
Impact occurs at mid span

Impact Factor Calculation:

$$I.F._{(r)} = 1 + \sqrt{1 + \frac{2h}{\delta_t}} \qquad \delta_t = \delta_b + \delta_s \qquad \delta_{br} = \frac{PL_r^{\,3}}{48EI_{yr}} \qquad \delta_{sr} = \frac{P}{2k}$$

h= height at which load is dropped, 36 in.
δ_b = beam deflection
δ_s = spring deflection ~ 0

a. 93'' Cambridge Railing:

$$\delta_{ba} = \frac{PL_a^{\,3}}{48EI_{ya}} = \frac{190lb \cdot (93in)^3}{48 \cdot 10e^6\,psi \cdot .330in^4} = .9648in$$

$$\delta_{sa} = \frac{P}{2k} = \frac{190}{2 \cdot \infty} = 0in$$

$$\delta_{ta} = \delta_{ba} = .9648in$$

$$I.F._{(a)} = 1 + \sqrt{1 + \frac{2 \cdot 36in}{.9648in}} = 9.69$$

This factor can now be applied to the loading scenario and compared to the maximum load resistance of the fastening screws.

Assumptions:

Because the force is being applied at the mid span of the beam, its value can be decreased by half to represent equal support on each end.

$$V_a = \frac{\frac{F}{2} \cdot I.F._{(a)}}{4} = \frac{\frac{190lb}{2} \cdot 9.69}{4} = 230.138lb$$ (adjust for 4 fasteners in each bracket)

$$\tau_a = \frac{V_a}{A} = \frac{230.138lb}{0.00785in^2} = 29{,}316.9\,psi$$

$\sigma_s = 42{,}100\,psi$ (410 stainless steel proof load)

$$FOS_{(\tau a)} = \frac{\sigma_p}{\tau_a} = \frac{42{,}100\,psi}{29{,}316.9} = 1.43$$

a. 93'' Winchester Railing:

$$\delta_{ba} = \frac{PL_b^3}{48EI_{yb}} = \frac{190lb \cdot (93in)^3}{48 \cdot 10e^6\,psi \cdot .311in^4} = 1.023in$$

$$\delta_{sa} = \frac{P}{2k} = \frac{190}{2 \cdot \infty} = 0in$$

$$\delta_{ta} = \delta_{ba} = 1.023in$$

$$I.F._{(a)} = 1 + \sqrt{1 + \frac{2 \cdot 36in}{1.023in}} = 9.448$$

This factor can now be applied to the loading scenario and compared to the maximum load resistance of the fastening screws.

Assumptions:

Because the force is being applied at the mid span of the beam, its value can be decreased by half to represent equal support on each end.

$$V_a = \frac{\frac{F}{2} \cdot I.F._{(a)}}{4} = \frac{\frac{190lb}{2} \cdot 9.448}{4} = 224.39lb$$ (adjust for 4 fasteners in each bracket)

$$\tau_a = \frac{V_a}{A} = \frac{224.39lb}{0.00785in^2} = 28{,}584.7\,psi$$

$\sigma_s = 42{,}100\,psi$ (410 stainless steel proof load)

$$FOS_{(\tau a)} = \frac{\sigma_p}{\tau_a} = \frac{42{,}100\,psi}{28{,}584.7} = 1.47$$

VII. Post Surface Connection Details:

The force at the bottom of the post/plate must be calculated and then compared to the resisting moment and shear exerted by the fasteners. The same calculation method will be used for the analysis for residential and commercial structural posts. The structure supporting the post and the connection from the post to the structure must be designed to resist the listed shear load(S) and the listed tension/compression load(F). The design of the supporting structure and the connection to the structure are the responsibility of others. Sample connection shown below for illustration purposes only.

From section III:

Residential 36" Post:

$$BendingMoment(BM) = P \cdot h_P = 200lb \cdot 39in = 7{,}800.00inlb = 650lb - ft$$

Commercial 42" Post:

$$BendingMoment(BM) = P \cdot h_P = 400lb \cdot 42in = 16{,}800.00inlb = 1{,}400lb - ft$$

This results in the force on the bottom of the baseplate as follows:

Residential – mounting baseplate 34115035 (See Appendix for details)

$$F = BM / d = 650lb / .3 = 2{,}167.00lb - ft = 2.2Kips$$

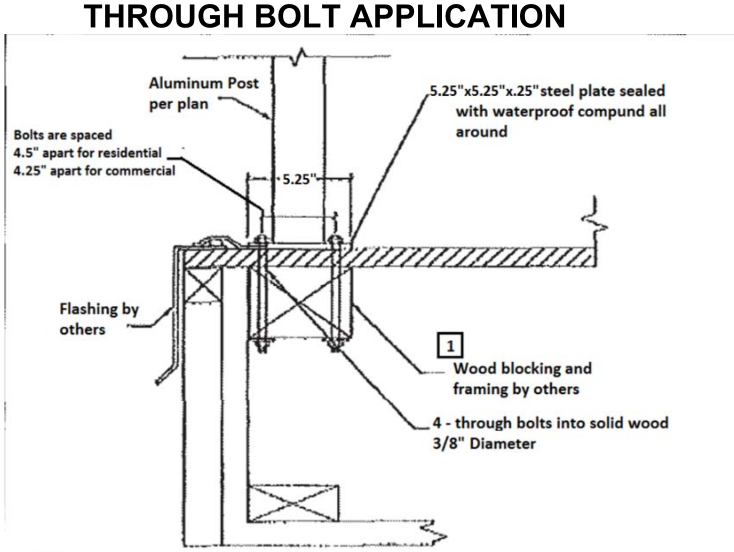
Shear (S) = P = 200lb

Commercial – mounting baseplate 34115034 (See Appendix for details)

$$F = BM / d = 1{,}500lb / .3 = 1{,}400.00lb - ft = 4{,}667lbs = 4.7Kips$$

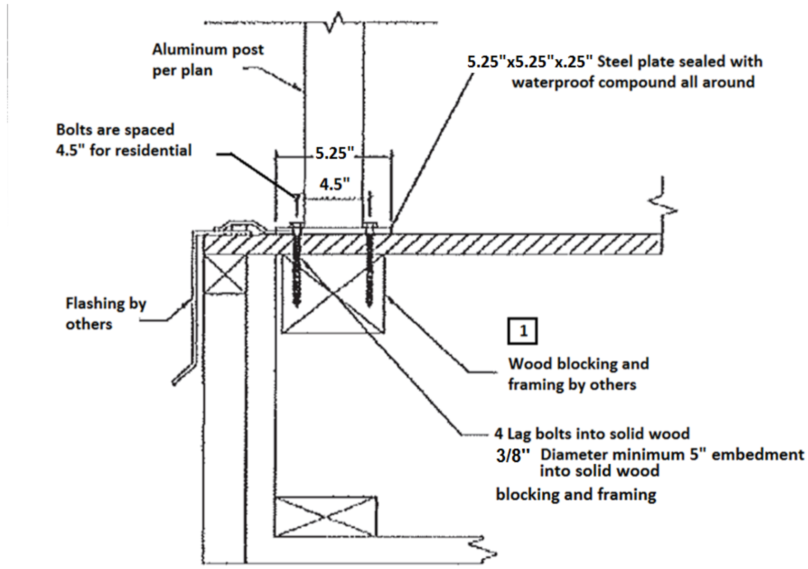
Shear (S) = P = 400lb

THROUGH BOLT APPLICATION



1 **POST BASE CONNECTION INTO WOOD WITH THROUGH BOLTS**

LAG SCREW APPLICATION



POST BASE CONNECTION INTO WOOD WITH LAG BOLTS

VIII. Conclusion

With the above analysis, it can be proven that the Barrette Aluminum Railing system, more than exceeds the design requirements set forth by the applicable sections of the 2018 IBC and 2018 IRC. This analysis is also valid for the 2009,2012 & 2015IBC/ IRC

The engineering department at Railing Dynamics, Inc. gives its full endorsement of the Barrette Aluminum Railing system as a qualified safety guardrail system

IX. Appendix

A. Material Properties
   a. Aluminum 6005-T5
   b. Aluminum 6063-T5
   c. Aluminum 6063-T6
   d. Tensile Strength of Bolts
   e. Withdrawal Design Values
B. ATI Test Report
C. Barrette Outdoor Living – Parts
   a. EPN-0504 – 2.5’’ Post
   b. EPN-0527 – 2.5’’ Heavy Duty Post
   c. 34115036 – Post Mount Plate (4 Holes)
   d. 34115035 – Post Mount Plate (8 Holes)
   e. 34115034 – Post Mount Plate (12 Holes)
   f. 34109436 – Custom Screw
   g. 34114816 – Bottom Bracket
   h. 34114819 – Bottom Bracket Cover
   i. EPN-0566 – Winchester Rail Channel
   j. EPN-0565 – Cambridge Rail Channel
   k. EPN-0513 – Avalon U-Channel
   l. 34114813 – Top Bracket
   m. EPN-0506 – Square Baluster
   n. EPN-0563 – Twisted Baluster
   o. 34114807 – Rail Support Foot
   p. 34114810 – Rail Support Foot Cover
   q. 34107308 – Glass Baluster 36” Rail
   r. EPN-0507 – Tristan Rail
   s. EPN-0518 – Lanval Rail
   t. EPN-0519 – Pellinore Rail
   u. EPN-0743 – Oberon Rail
   v. EPN-0541 – 2”x2” Post (Over the Top)
   w. 34110275 – Glass Baluster 42” Rail

With cooperation with:

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Appendix A

Aluminum 6005-T5

Categories: Metal; Nonferrous Metal; Aluminum Alloy; 6000 Series Aluminum Alloy

Material Notes: Data points with the AA note have been provided by the Aluminum Association, Inc. and are NOT FOR DESIGN.

Composition Notes:
Composition information provided by the Aluminum Association and is not for design.

Key Words: UNS A96005; ISO AlSiMg; Aluminium 6005-T5; AA6005-T5

Vendors: No vendors are listed for this material. Please click here if you are a supplier and would like information on how to add your listing to this material.

Physical Properties	Metric	English	Comments
Density	2.70 g/cc	0.0975 lb/in³	AA; Typical

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	95	95	500 kg load with 10 mm ball
Hardness, Knoop	120	120	Converted from Brinell Hardness Value
Hardness, Rockwell A	39.8	39.8	Converted from Brinell Hardness Value
Hardness, Rockwell B	60	60	Converted from Brinell Hardness Value
Hardness, Vickers	107	107	Converted from Brinell Hardness Value
Tensile Strength, Ultimate	260 MPa	37700 psi	
Tensile Strength, Yield	240 MPa	34800 psi	
Elongation at Break	8.0 % @Thickness 1.60 mm	8.0 % @Thickness 0.0630 in	In 5 cm
Modulus of Elasticity	69.0 GPa	10000 ksi	Average of Tension and Compression. In Aluminum alloys, the compressive modulus is typically 2% greater than the tensile modulus
Poissons Ratio	0.33	0.33	Estimated from trends in similar Al alloys.
Fatigue Strength	100 MPa @# of Cycles 5.00e+8	14500 psi @# of Cycles 5.00e+8	
Shear Modulus	26.0 GPa	3770 ksi	Estimated from similar Al alloys.
Shear Strength	205 MPa	29700 psi	

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.00000349 ohm-cm @Temperature 20.0 °C	0.00000349 ohm-cm @Temperature 68.0 °F	AA; Typical

Thermal Properties	Metric	English	Comments
CTE, linear	23.4 µm/m-°C @Temperature 20.0 - 100 °C	13.0 µin/in-°F @Temperature 68.0 - 212 °F	AA; Typical; average over range

	Metric	English	Comments
	25.0 µm/m-°C @Temperature 20.0 - 300 °C	13.9 µin/in-°F @Temperature 68.0 - 572 °F	
Specific Heat Capacity	0.890 J/g-°C	0.213 BTU/lb-°F	Estimated from trends in similar Al alloys.
Thermal Conductivity	189 W/m-K	1310 BTU-in/hr-ft²-°F	AA; Typical at 77°F
Melting Point	607.2 - 654 °C	1125 - 1210 °F	AA; Typical range based on typical composition for wrought products 1/4 inch thickness or greater; Eutectic melting can be completely eliminated by homogenization.
Solidus	607.2 °C	1125 °F	AA; Typical
Liquidus	654 °C	1210 °F	AA; Typical

Processing Properties	**Metric**	**English**	**Comments**
Annealing Temperature	414 °C	778 °F	hold at temperature for 2 to 3 hr
Solution Temperature	546.1 °C	1015 °F	
Aging Temperature	174 °C	346 °F	hold at temperature for 8 hr

Component Elements Properties	**Metric**	**English**	**Comments**
Aluminum, Al	97.5 - 99 %	97.5 - 99 %	As remainder
Chromium, Cr	<= 0.10 %	<= 0.10 %	
Copper, Cu	<= 0.10 %	<= 0.10 %	
Iron, Fe	<= 0.35 %	<= 0.35 %	
Magnesium, Mg	0.40 - 0.60 %	0.40 - 0.60 %	
Manganese, Mn	<= 0.10 %	<= 0.10 %	
Other, each	<= 0.05 %	<= 0.05 %	
Other, total	<= 0.15 %	<= 0.15 %	
Silicon, Si	0.60 - 0.90 %	0.60 - 0.90 %	
Titanium, Ti	<= 0.10 %	<= 0.10 %	
Zinc, Zn	<= 0.10 %	<= 0.10 %	

References for this datasheet.

Aluminum 6063-T5

Categories: Metal; Nonferrous Metal; Aluminum Alloy; 6000 Series Aluminum Alloy

Material Notes: Applications include pipe, railings, furniture, architectural extrusions, irrigation pipes, and transportation.

Data points with the AA note have been provided by the Aluminum Association, Inc. and are NOT FOR DESIGN.

Composition Notes:
Composition information provided by the Aluminum Association and is not for design.

Key Words: UNS A96063; ISO AlMg0.5Si; Aluminium 6063-T5; AA6063-T5

Vendors: No vendors are listed for this material. Please click here if you are a supplier and would like information on how to add your listing to this material.

Physical Properties	Metric	English	Comments
Density	2.70 g/cc	0.0975 lb/in³	AA; Typical

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	60	60	AA; Typical; 500 g load; 10 mm ball
Hardness, Knoop	83	83	Converted from Brinell Hardness Value
Hardness, Vickers	70	70	Converted from Brinell Hardness Value
Tensile Strength, Ultimate	186 MPa	27000 psi	AA; Typical
	16.0 MPa @Temperature 371 °C	2320 psi @Temperature 700 °F	
	23.0 MPa @Temperature 316 °C	3340 psi @Temperature 601 °F	
	31.0 MPa @Temperature 260 °C	4500 psi @Temperature 500 °F	
	62.0 MPa @Temperature 204 °C	8990 psi @Temperature 399 °F	
	138 MPa @Temperature 149 °C	20000 psi @Temperature 300 °F	
	165 MPa @Temperature 100 °C	23900 psi @Temperature 212 °F	
	186 MPa @Temperature 24.0 °C	27000 psi @Temperature 75.2 °F	
	193 MPa @Temperature -28.0 °C	28000 psi @Temperature -18.4 °F	
	200 MPa @Temperature -80.0 °C	29000 psi @Temperature -112 °F	
	255 MPa @Temperature -196 °C	37000 psi @Temperature -321 °F	
Tensile Strength, Yield	145 MPa	21000 psi	AA; Typical

	14.0 MPa @Strain 0.200 %, Temperature 371 °C	2030 psi @Strain 0.200 %, Temperature 700 °F	
	17.0 MPa @Strain 0.200 %, Temperature 316 °C	2470 psi @Strain 0.200 %, Temperature 601 °F	
	24.0 MPa @Strain 0.200 %, Temperature 260 °C	3480 psi @Strain 0.200 %, Temperature 500 °F	
	45.0 MPa @Strain 0.200 %, Temperature 204 °C	6530 psi @Strain 0.200 %, Temperature 399 °F	
	124 MPa @Strain 0.200 %, Temperature 149 °C	18000 psi @Strain 0.200 %, Temperature 300 °F	
	138 MPa @Strain 0.200 %, Temperature 100 °C	20000 psi @Strain 0.200 %, Temperature 212 °F	
	145 MPa @Strain 0.200 %, Temperature 24.0 °C	21000 psi @Strain 0.200 %, Temperature 75.2 °F	
	152 MPa @Strain 0.200 %, Temperature -80.0 °C	22000 psi @Strain 0.200 %, Temperature -112 °F	
	152 MPa @Strain 0.200 %, Temperature -28.0 °C	22000 psi @Strain 0.200 %, Temperature -18.4 °F	
	165 MPa @Strain 0.200 %, Temperature -196 °C	23900 psi @Strain 0.200 %, Temperature -321 °F	
Elongation at Break	18 % @Temperature 100 °C	18 % @Temperature 212 °F	
	20 % @Temperature 149 °C	20 % @Temperature 300 °F	
	22 % @Temperature 24.0 °C	22 % @Temperature 75.2 °F	
	23 % @Temperature -28.0 °C	23 % @Temperature -18.4 °F	
	24 % @Temperature -80.0 °C	24 % @Temperature -112 °F	
	28 % @Temperature -196 °C	28 % @Temperature -321 °F	
	40 % @Temperature 204 °C	40 % @Temperature 399 °F	
	75 % @Temperature 260 °C	75 % @Temperature 500 °F	
	80 % @Temperature 316 °C	80 % @Temperature 601 °F	
	105 % @Temperature 371 °C	105 % @Temperature 700 °F	
	12 % @Thickness 1.59 mm	12 % @Thickness 0.0625 in	AA; Typical
Modulus of Elasticity	68.9 GPa	10000 ksi	AA; Typical; Average of tension and compression. Compression modulus is about 2% greater than tensile modulus.
Poissons Ratio	0.33	0.33	
Fatigue Strength	68.9 MPa @# of Cycles 5.00e+8	10000 psi @# of Cycles 5.00e+8	completely reversed stress; RR Moore machine/specimen
Shear Modulus	25.8 GPa	3740 ksi	
Shear Strength	117 MPa	17000 psi	AA; Typical

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.00000316 ohm-cm @Temperature 20.0 °C	0.00000316 ohm-cm @Temperature 68.0 °F	AA; Typical

Thermal Properties	Metric	English	Comments
CTE, linear	21.8 µm/m-°C @Temperature -50.0 - 20.0 °C	12.1 µin/in-°F @Temperature -58.0 - 68.0 °F	
	23.4 µm/m-°C @Temperature 20.0 - 100 °C	13.0 µin/in-°F @Temperature 68.0 - 212 °F	AA; Typical; average over range
	24.5 µm/m-°C @Temperature 20.0 - 200 °C	13.6 µin/in-°F @Temperature 68.0 - 392 °F	
	25.6 µm/m-°C @Temperature 20.0 - 300 °C	14.2 µin/in-°F @Temperature 68.0 - 572 °F	
Specific Heat Capacity	0.900 J/g-°C	0.215 BTU/lb-°F	
Thermal Conductivity	209 W/m-K	1450 BTU-in/hr-ft²-°F	AA; Typical at 77°F
Melting Point	616 - 654 °C	1140 - 1210 °F	AA; Typical range based on typical composition for wrought products 1/4 inch thickness or greater
Solidus	616 °C	1140 °F	AA; Typical
Liquidus	654 °C	1210 °F	AA; Typical

Processing Properties	Metric	English	Comments
Annealing Temperature	413 °C	775 °F	hold at temperature for 2 to 3 hr; cool at 50° F per hour from 775 to 500°F
Solution Temperature	521 °C	970 °F	
Aging Temperature	182 °C	360 °F	hold at temperature for 1 hr
	204 °C	400 °F	hold at temperature for 1 hr

Component Elements Properties	Metric	English	Comments
Aluminum, Al	<= 97.5 %	<= 97.5 %	As remainder
Chromium, Cr	<= 0.10 %	<= 0.10 %	
Copper, Cu	<= 0.10 %	<= 0.10 %	
Iron, Fe	<= 0.35 %	<= 0.35 %	
Magnesium, Mg	0.45 - 0.90 %	0.45 - 0.90 %	
Manganese, Mn	<= 0.10 %	<= 0.10 %	
Other, each	<= 0.05 %	<= 0.05 %	
Other, total	<= 0.15 %	<= 0.15 %	
Silicon, Si	0.20 - 0.60 %	0.20 - 0.60 %	
Titanium, Ti	<= 0.10 %	<= 0.10 %	
Zinc, Zn	<= 0.10 %	<= 0.10 %	

References for this datasheet.

Aluminum 6063-T6

Categories: Metal; Nonferrous Metal; Aluminum Alloy; 6000 Series Aluminum Alloy

Material Notes: Applications include pipe, railings, furniture, architectural extrusions, irrigation pipes, and transportation.

Data points with the AA note have been provided by the Aluminum Association, Inc. and are NOT FOR DESIGN.

Composition Notes:
Composition information provided by the Aluminum Association and is not for design.

Key Words: UNS A96063; ISO AlMg0.5Si; Aluminium 6063-T6; AA6063-T6

Vendors: **Click here to view all available suppliers for this material.**

Please click here if you are a supplier and would like information on how to add your listing to this material.

Physical Properties	Metric	English	Comments
Density	2.70 g/cc	0.0975 lb/in³	AA; Typical

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	73	73	AA; Typical; 500 g load; 10 mm ball
Hardness, Knoop	96	96	Converted from Brinell Hardness Value
Hardness, Vickers	83	83	Converted from Brinell Hardness Value
Tensile Strength, Ultimate	241 MPa	35000 psi	AA; Typical
	16.0 MPa @Temperature 371 °C	2320 psi @Temperature 700 °F	
	23.0 MPa @Temperature 316 °C	3340 psi @Temperature 601 °F	
	31.0 MPa @Temperature 260 °C	4500 psi @Temperature 500 °F	
	62.0 MPa @Temperature 204 °C	8990 psi @Temperature 399 °F	
	145 MPa @Temperature 149 °C	21000 psi @Temperature 300 °F	
	214 MPa @Temperature 100 °C	31000 psi @Temperature 212 °F	
	241 MPa @Temperature 24.0 °C	35000 psi @Temperature 75.2 °F	
	248 MPa @Temperature -28.0 °C	36000 psi @Temperature -18.4 °F	
	262 MPa @Temperature -80.0 °C	38000 psi @Temperature -112 °F	
	324 MPa @Temperature -196 °C	47000 psi @Temperature -321 °F	
	214 MPa	31000 psi	AA; Typical

Tensile Strength, Yield			
	14.0 MPa @Strain 0.200 %, Temperature 371 °C	2030 psi @Strain 0.200 %, Temperature 700 °F	
	17.0 MPa @Strain 0.200 %, Temperature 316 °C	2470 psi @Strain 0.200 %, Temperature 601 °F	
	24.0 MPa @Strain 0.200 %, Temperature 260 °C	3480 psi @Strain 0.200 %, Temperature 500 °F	
	45.0 MPa @Strain 0.200 %, Temperature 204 °C	6530 psi @Strain 0.200 %, Temperature 399 °F	
	133 MPa @Strain 0.200 %, Temperature 149 °C	19300 psi @Strain 0.200 %, Temperature 300 °F	
	193 MPa @Strain 0.200 %, Temperature 100 °C	28000 psi @Strain 0.200 %, Temperature 212 °F	
	214 MPa @Strain 0.200 %, Temperature 24.0 °C	31000 psi @Strain 0.200 %, Temperature 75.2 °F	
	221 MPa @Strain 0.200 %, Temperature -28.0 °C	32100 psi @Strain 0.200 %, Temperature -18.4 °F	
	228 MPa @Strain 0.200 %, Temperature -80.0 °C	33100 psi @Strain 0.200 %, Temperature -112 °F	
	248 MPa @Strain 0.200 %, Temperature -196 °C	36000 psi @Strain 0.200 %, Temperature -321 °F	
Elongation at Break	15 % @Temperature 100 °C	15 % @Temperature 212 °F	
	18 % @Temperature 24.0 °C	18 % @Temperature 75.2 °F	
	19 % @Temperature -28.0 °C	19 % @Temperature -18.4 °F	
	20 % @Temperature -80.0 °C	20 % @Temperature -112 °F	
	20 % @Temperature 149 °C	20 % @Temperature 300 °F	
	24 % @Temperature -196 °C	24 % @Temperature -321 °F	
	40 % @Temperature 204 °C	40 % @Temperature 399 °F	
	75 % @Temperature 260 °C	75 % @Temperature 500 °F	
	80 % @Temperature 316 °C	80 % @Temperature 601 °F	
	105 % @Temperature 371 °C	105 % @Temperature 700 °F	
	12 % @Thickness 1.59 mm	12 % @Thickness 0.0625 in	AA; Typical
Modulus of Elasticity	68.9 GPa	10000 ksi	AA; Typical; Average of tension and compression. Compression modulus is about 2% greater than tensile modulus.
Ultimate Bearing Strength	434 MPa	62900 psi	Edge distance/pin diameter = 2.0

Bearing Yield Strength	276 MPa	40000 psi	Edge distance/pin diameter = 2.0
Poissons Ratio	0.33	0.33	
Fatigue Strength	68.9 MPa @# of Cycles 5.00e+8	10000 psi @# of Cycles 5.00e+8	completely reversed stress; RR Moore machine/specimen
Machinability	50 %	50 %	0-100 Scale of Aluminum Alloys
Shear Modulus	25.8 GPa	3740 ksi	
Shear Strength	152 MPa	22000 psi	AA; Typical

Electrical Properties	**Metric**	**English**	**Comments**
Electrical Resistivity	0.00000332 ohm-cm @Temperature 20.0 °C	0.00000332 ohm-cm @Temperature 68.0 °F	AA; Typical

Thermal Properties	**Metric**	**English**	**Comments**
CTE, linear	21.8 µm/m-°C @Temperature -50.0 - 20.0 °C	12.1 µin/in-°F @Temperature -58.0 - 68.0 °F	
	23.4 µm/m-°C @Temperature 20.0 - 100 °C	13.0 µin/in-°F @Temperature 68.0 - 212 °F	AA; Typical; average over range
	24.5 µm/m-°C @Temperature 20.0 - 200 °C	13.6 µin/in-°F @Temperature 68.0 - 392 °F	
	25.6 µm/m-°C @Temperature 20.0 - 300 °C	14.2 µin/in-°F @Temperature 68.0 - 572 °F	
Specific Heat Capacity	0.900 J/g-°C	0.215 BTU/lb-°F	
Thermal Conductivity	200 W/m-K	1390 BTU-in/hr-ft²-°F	AA; Typical at 77°F
Melting Point	616 - 654 °C	1140 - 1210 °F	AA; Typical range based on typical composition for wrought products 1/4 inch thickness or greater
Solidus	616 °C	1140 °F	AA; Typical
Liquidus	654 °C	1210 °F	AA; Typical

Processing Properties	**Metric**	**English**	**Comments**
Annealing Temperature	413 °C	775 °F	hold at temperature for 2 to 3 hr; cool at 50° F per hour from 775 to 500°F
Solution Temperature	521 °C	970 °F	
Aging Temperature	177 °C	350 °F	hold at temperature for 8 hr

Component Elements Properties	**Metric**	**English**	**Comments**
Aluminum, Al	<= 97.5 %	<= 97.5 %	As remainder
Chromium, Cr	<= 0.10 %	<= 0.10 %	
Copper, Cu	<= 0.10 %	<= 0.10 %	
Iron, Fe	<= 0.35 %	<= 0.35 %	
Magnesium, Mg	0.45 - 0.90 %	0.45 - 0.90 %	
Manganese, Mn	<= 0.10 %	<= 0.10 %	

Other, each	<= 0.05 %	<= 0.05 %
Other, total	<= 0.15 %	<= 0.15 %
Silicon, Si	0.20 - 0.60 %	0.20 - 0.60 %
Titanium, Ti	<= 0.10 %	<= 0.10 %
Zinc, Zn	<= 0.10 %	<= 0.10 %

References for this datasheet.

Table 7–2
Available Tensile Strength of Bolts, kips

Nominal Bolt Diameter d_b, in.			5/8		3/4		7/8		1	
Nominal Bolt Area, in.²			0.307		0.442		0.601		0.785	
ASTM Desig.	F_{nt}/Ω (ksi)	ϕF_{nt} (ksi)	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n
	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD
A325 & F1852	45.0	67.5	13.8	20.7	19.9	29.8	27.1	40.6	35.3	53.0
A490	56.5	84.8	17.3	26.0	25.0	37.4	34.0	51.0	44.4	66.6
A307	22.5	33.8	6.90	10.4	9.94	14.9	13.5	20.3	17.7	26.5

Nominal Bolt Diameter d_b, in.			1 1/8		1 1/4		1 3/8		1 1/2	
Nominal Bolt Area, in.²			0.994		1.23		1.48		1.77	
ASTM Desig.	F_{nt}/Ω (ksi)	ϕF_{nt} (ksi)	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n	r_n/Ω	ϕr_n
	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD
A325 & F1852	45.0	67.5	44.7	67.1	55.2	82.8	66.8	100	79.5	119
A490	56.5	84.8	56.2	84.2	69.3	104	83.9	126	99.8	150
A307	22.5	33.8	22.4	33.5	27.6	41.4	33.4	50.1	39.8	59.6

ASD	LRFD
$\Omega_v = 2.00$	$\phi_v = 0.75$

11.2 Reference Withdrawal Design Values

1605

11.2.1 Lag Screws

11.2.1.1 The reference withdrawal design values, in lb/in. of penetration, for a single lag screw inserted in side grain, with the lag screw axis perpendicular to the wood fibers, shall be determined from Table 11.2A or Equation 11.2-1, within the range of specific gravities and screw diameters given in Table 11.2A. Reference withdrawal design values, W, shall be multiplied by all applicable adjustment factors (see Table 10.3.1) to obtain adjusted withdrawal design values, W'.

$$W = 1800\,G^{3/2}D^{3/4} \qquad (11.2\text{-}1)$$

11.2.1.2 When lag screws are loaded in withdrawal from end grain, reference withdrawal design values, W, shall be multiplied by the end grain factor, $C_{eg} = 0.75$.

11.2.1.3 When lag screws are loaded in withdrawal, the tensile strength of the lag screw at the net (root) section shall not be exceeded (see 10.2.3).

Table 11.2A Lag Screw Reference Withdrawal Design Values (W)[1]

Tabulated withdrawal design values (W) are in pounds per inch of thread penetration into side grain of main member. Length of thread penetration in main member shall not include the length of the tapered tip (see Appendix L).

Specific Gravity, G	Lag Screw Unthreaded Shank Diameter, D										
	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"
0.73	397	469	538	604	668	789	905	1016	1123	1226	1327
0.71	381	450	516	579	640	757	868	974	1077	1176	1273
0.68	357	422	484	543	600	709	813	913	1009	1103	1193
0.67	349	413	473	531	587	694	796	893	987	1078	1167
0.58	281	332	381	428	473	559	641	719	795	869	940
0.55	260	307	352	395	437	516	592	664	734	802	868
0.51	232	274	314	353	390	461	528	593	656	716	775
0.50	225	266	305	342	378	447	513	576	636	695	752
0.49	218	258	296	332	367	434	498	559	617	674	730
0.47	205	242	278	312	345	408	467	525	580	634	686
0.46	199	235	269	302	334	395	453	508	562	613	664
0.44	186	220	252	283	312	369	423	475	525	574	621
0.43	179	212	243	273	302	357	409	459	508	554	600
0.42	173	205	235	264	291	344	395	443	490	535	579
0.41	167	198	226	254	281	332	381	428	473	516	559
0.40	161	190	218	245	271	320	367	412	455	497	538
0.39	155	183	210	236	261	308	353	397	438	479	518
0.38	149	176	202	227	251	296	340	381	422	461	498
0.37	143	169	194	218	241	285	326	367	405	443	479
0.36	137	163	186	209	231	273	313	352	389	425	460
0.35	132	156	179	200	222	262	300	337	373	407	441
0.31	110	130	149	167	185	218	250	281	311	339	367

1. Tabulated withdrawal design values (W) for lag screw connections shall be multiplied by all applicable adjustment factors (see Table 10.3.1).

Appendix B

Architectural Testing

TEST REPORT

Rendered to:

BARRETTE OUTDOOR LIVING, INC.

For:

***VersaRail* Aluminum Guardrail Assembly**

Report No: B8389.01-119-19
Report Date: 10/31/12

130 Derry Court
York, PA 17406-8405
phone: 717-764-7700
fax: 717-764-4129
www.archtest.com

Architectural Testing

TEST REPORT

B8389.01-119-19
October 31, 2012

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Architectural Testing

TEST REPORT

Rendered to:

BARRETTE OUTDOOR LIVING, INC.
740 North Main Street
Bulls Gap, Tennessee 37711

Report No.:	B8389.01-119-19
Test Started:	04/20/12
Test Completed:	04/20/12
Report Date:	10/31/12

1.0 General Information

1.1 Product

VersaRail Aluminum Guardrail Assembly

1.2 Project Description

Architectural Testing was contracted by Barrette Outdoor Living Inc. to conduct structural performance tests on their *VersaRail* aluminum guardrail assembly in a level application. The assembly was evaluated for the design load requirements of the following building codes:

2012 *International Residential Code*®, International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2012.

1.3 Limitations

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.

1.4 Qualifications

Architectural Testing has demonstrated compliance with ANS/ISO/IEC Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc.

1.5 Product Description

Barrette Outdoor Living provided the partially-assembled test specimens with details as listed below. All extruded parts were 6005-T5, 6063-T5 or 6063-T6 alloy aluminum, and all cast parts were AA380.0-F aluminum. See drawings in Appendix A and photographs in Appendix B for additional details.

Top Rail Cap: 2-1/8 in high by 1-3/4 in wide contoured aluminum extrusion with 0.07 in wall

Top Sub-rail and Bottom Rail: 1-3/16 in wide by 1 in deep **U**-shaped aluminum extrusion with 0.07 in wall

Pickets: 3/4 in square, hollow aluminum extrusion with 0.04 in wall

Picket Locking Strip: 3/4 in wide by 0.07 in thick polypropylene extrusion located in bottom and top sub-rail

Rail Brackets: Cast aluminum socket brackets contoured to shape of rails

Fasteners: #8 x 1-1/4 in (18-TPI, 0.162 in major dia., 0.120 in minor dia.) hex head, self-starting, sheet metal screw (four in top bracket / post and two in bottom bracket / post); #8 x 2 in (18-TPI, 0.165 in major dia., 0.113 in minor dia.) pan head, square drive, self-starting, carbon steel screw (two in top bracket / rail)

Posts: 2-1/2 in square by 0.07 in thick extruded aluminum attached to a 5-1/4 in square by 0.25 in thick AISI 1010 steel base plate with four 1/4 in by 2-1/2 in (20-TPI, 0.245 in major dia., 0.185 in minor dia., type F point) trim head, phillips drive, stainless steel screws.

2.0 Structural Performance Testing of Assembled Railing Systems

2.1 Test 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 displacement transducers were used to measure deflections.

2.2 Test Setup

The 8 ft by 36 in *VersaRail* aluminum guardrail assembly was installed and tested as a single railing section by directly securing the posts into a simulated mock wood deck with four 5/16 in Gr. 5 bolts with washers and nuts. Additional wood blocking was added to the simulated wood deck per the manufacturer's instructions. See blocking instructions in Appendix C for additional information. 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 Appendix B for individual test setups.

2.3 Test Procedure

Each 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 or until failure occurred. The testing time was continually recorded from the application of initial test load until the ultimate test load was reached.

2.4 Test Results

The following tests were performed on the guardrail assemblies for the design load requirements of the referenced codes. 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.

2.4 Test Results (Continued)

Test Series No. 1
93-1/2 in by 36 in *VersaRail* Aluminum Level Guardrail System
Limited to IRC – One- and Two-Family Dwellings

Specimen No. 1 of 1

Test No. 1 – 04/20/12 Design Load: 50 lb / 1 Square Ft at Center of In-Fill (Two Pickets)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Picket Displacement (in)**			
			End	**Mid**	**End**	**Net** [1]
Initial Load	26	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	101	00:16	0.42	0.97	1.14	0.19
Initial Load	26	01:52	0.00	0.00	0.04	0.00
100% Recovery from 2.0 x Design Load						
2.5 x Design Load	125	02:12	Achieved Load without Failure			

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

Test No. 2 – 04/20/12 Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (Two Pickets)						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Bottom Rail Displacement (in)**			
			End	**Mid**	**End**	**Net** [1]
Initial Load	25	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	101	00:25	0.11	1.72	0.13	1.60
Initial Load	25	02:08	0.00	0.01	0.01	0.01
99% Recovery from 2.0 x Design Load						
2.5 x Design Load	126	02:49	Achieved Load without Failure			

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

Test No. 3 – 04/20/12 Design Load: 200 lb Concentrated Load at Mid-Span of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Rail Displacement (in)**			
			End	**Mid**	**End**	**Net** [1]
Initial Load	80	00:00	0.00	0.00	0.00	0.00
2.0 x Design Load	401	00:56	1.10	2.89	0.77	1.96
Initial Load	80	02:47	0.15	0.20	0.09	0.08
96% Recovery from 2.0 x Design Load						
2.5 x Design Load	500	03:51	Achieved Load without Failure			

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

2.4 Test Results (Continued)

Test Series No. 1 (Continued)

Test No. 4 - 04/20/12 Design Load: 200 lb Concentrated Load at End of Top Rail (Bracket) and Post Tests [1]				
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**	
			Post #1	**Post #2**
Initial Load	101	00:00	0.00	0.00
2.0 x Design Load	802	01:04	2.60	2.02
Initial Load	101	02:45	0.57	0.38
78% Post #1 Recovery from 2.0 x Design Load 81% Post #2 Recovery from 2.0 x Design Load				
2.5 x Design Load	1002	04:07	Achieved Load without Failure	

[1] *Transducers were mounted to the posts.*

2.5 Summary and Conclusions

Using performance criteria of withstanding an ultimate load of 2.5 times design load, the test results met the test load requirements (design load plus factor of safety of two and one-half) of the referenced building codes for the nominal 8 ft wide by 36 in high *VersaRail* aluminum guardrail assembly and its support posts 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.

3.0 Closing Statement

Detailed drawings, data sheets, representative samples of test specimens, a copy of this test report, and all other supporting evidence will be retained by Architectural Testing for a period of four years from the original test date. At the end of this retention period, said materials shall be discarded without notice, and the service life of this report by Architectural Testing shall expire. Results obtained are tested values and were secured using the designated test methods. This report neither constitutes certification of this product nor expresses an opinion or endorsement by this laboratory; it is the exclusive property of the client so named herein and relates only to the tested specimens. This report may not be reproduced, except in full, without the written approval of Architectural Testing.

For ARCHITECTURAL TESTING:

Digitally Signed by: Kyle Evans

Kyle J. Evans
Technician II
Structural Systems Testing

Digitally Signed by: Virgal Thomas Mickley, Jr.

Virgal T. Mickley, Jr., P.E.
Senior Project Engineer
Structural Systems Testing

KJE:vtm/drm

Attachments (pages): This report is complete only when all attachments listed are included.

- Appendix A - Drawings (14)
- Appendix B - Photographs (4)
- Appendix C - Blocking Instructions (1)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	10/31/12	N/A	Original report issue

APPENDIX A

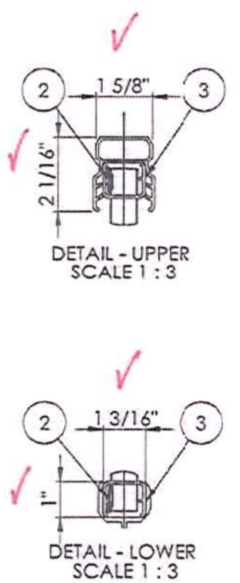
Drawings

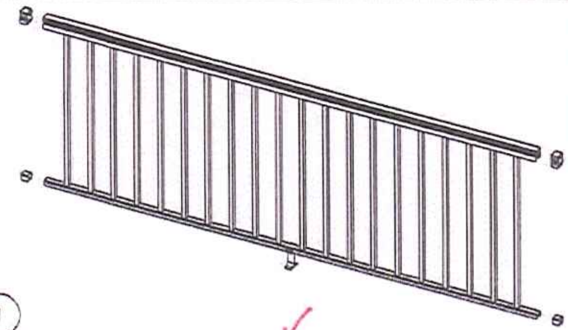
POWDER COAT OPTIONS

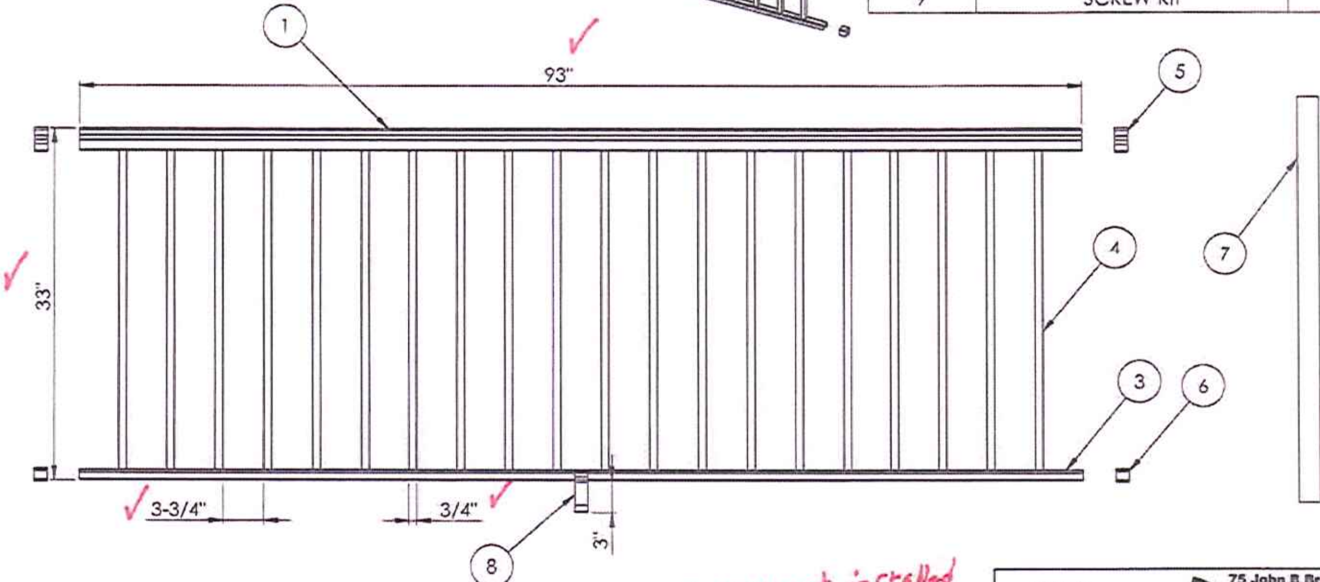
BLACK FINISH
8' X 36" VERSARAIL SQ BAL W/ BRKTS 73013139

WHITE FINISH
8' X 36" VERSARAIL SQ BAL W/ BRKTS 73013140

THESE ARE UNASSEMBLED KITS







ITEM	DESCRIPTION	QTY.
1	HAND RAIL	1
2	CORIGIN STRIP	8
3	INFILL CHANNEL	2
4	BALUSTER	20
5	UPPER LINE BRACKET	2
6	LOWER LINE BRACKET	2
7	SCREW LOCATION TEMPLATE	1
8	CRUSH BLOCK	1
9	SCREW KIT	1

Note: Foot block was not installed on test specimen.

Architectural Testing

Test sample complies with these details. Deviations are noted.

Report # B8389.01-119-19

Date 10/26/12 Tech KJE

BUILT BY Barrette Outdoor Living

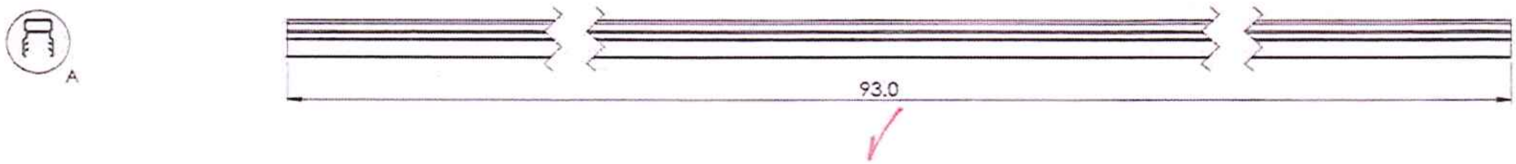
75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

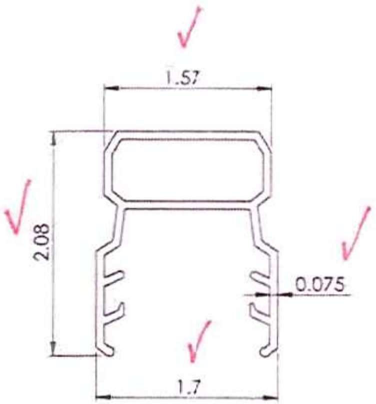
DRAWN BY	DATE	SCALE
Ray Clark	10/18/2012	1:10

TITLE: VERSARAIL 36" H X 8 FT w/BALUSTERS

EQUIPMENT No.	SECTION	REVISION	DRAWING No.
REFERENCE No.	2 of 6	0	36 X 8'

ITEM NO.	DESCRIPTION	LENGTH	QTY.
1	8 FT VERSARAIL HANDRAIL	93"	1





DETAIL A
SCALE 1 : 1

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE

Weight = 5.27 lbs
Material = 6063-T5 Aluminum

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No	NAME	DATE	DESCRIPTION
			REVISION

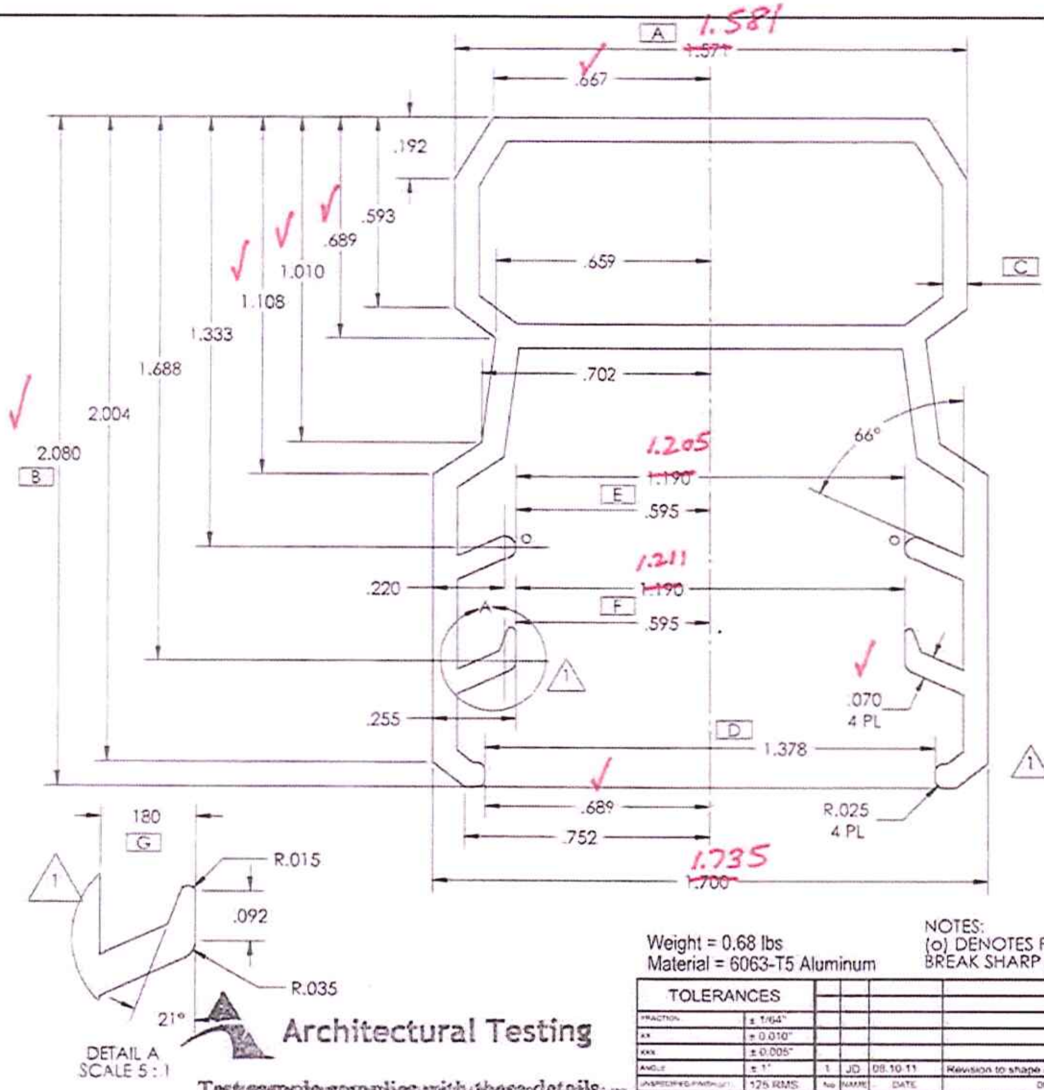
BUILT BY
Barrette Outdoor Living

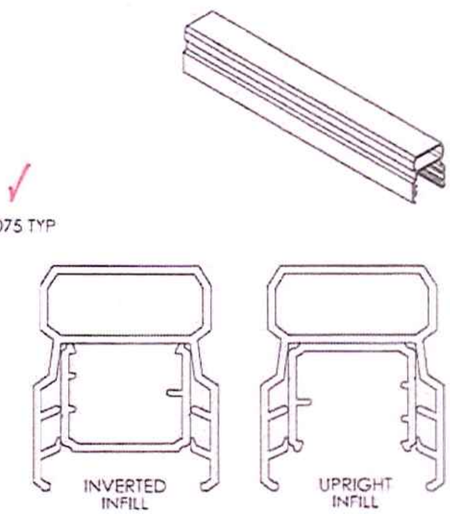
75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY: Roy Clark | DATE: 10/18/2012 | SCALE: 1:6

8 FT VERSARAIL HANDRAIL

SECTION: 2 of 3 | REVISION: 0





Dm	Print	Min.	Max	Actual
A	1.571			
B	2.080			
C	0.075			
D	1.378			
E	0.595			
F	0.595			
G	0.180			

Weight = 0.68 lbs
Material = 6063-T5 Aluminum

NOTES:
(o) DENOTES FULL R 2 PL
BREAK SHARP CORNERS .015 R

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No	NAME	DATE	DESCRIPTION
1	JD	08.10.11	Revision to shape of feature in Detail "A"

REVISION

BUILT BY Barrette Outdoor Living

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY: Ray Clark | DATE: 10/25/2012 | SCALE: 3:1

TITLE: VERSARAIL HANDRAIL

1 of 1 | REVISION: 1 | Sheet1

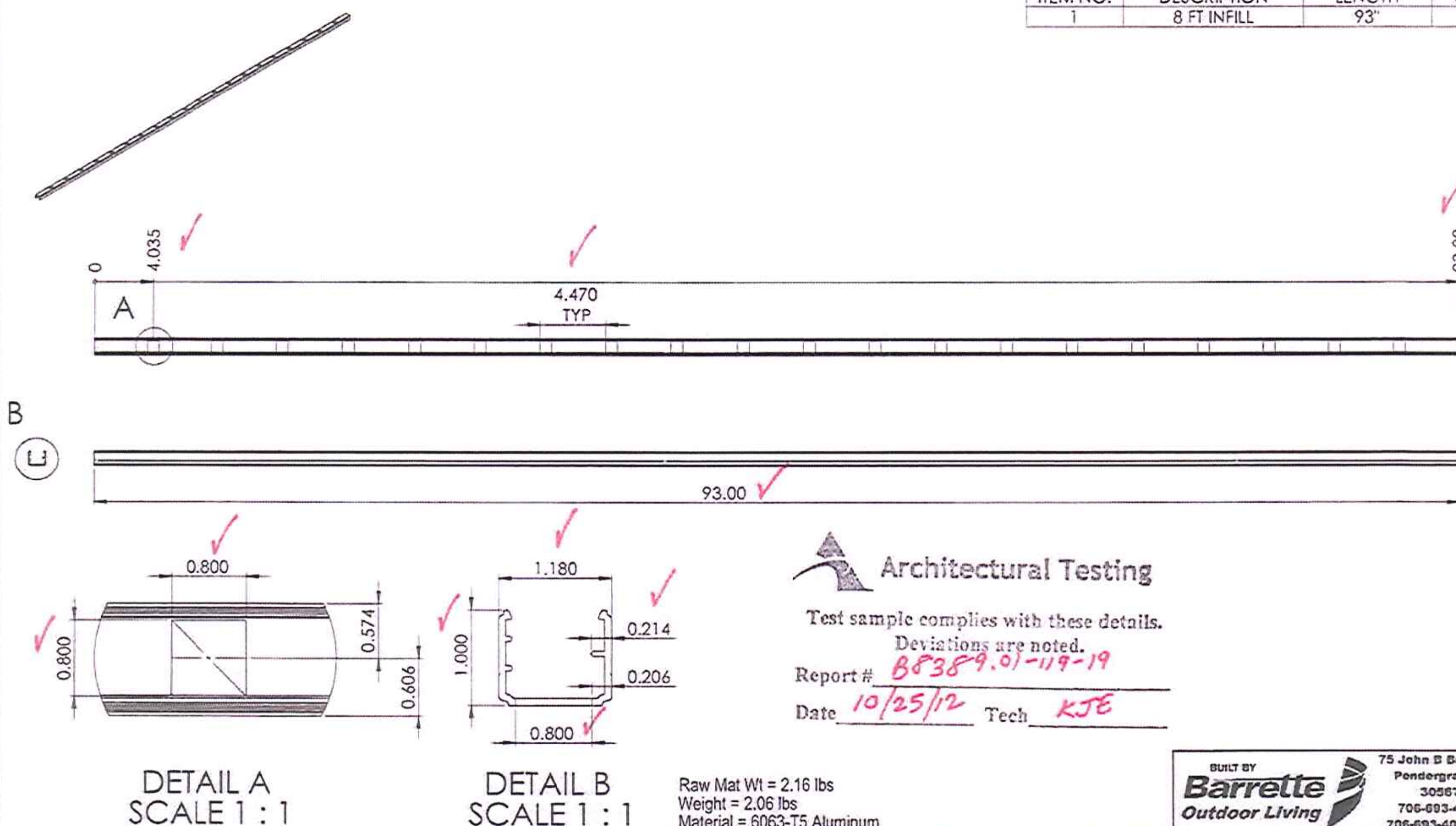
Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # 88389.01-119-19

Date 10/25/12 Tech KJE

ITEM NO.	DESCRIPTION	LENGTH	QTY.
1	8 FT INFILL	93"	1



Architectural Testing

Test sample complies with these details. Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE

Raw Mat Wt = 2.16 lbs
Weight = 2.06 lbs
Material = 6063-T5 Aluminum

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH (µ")	125 RMS
UNLESS OTHERWISE SPECIFIED	

NO	NAME	DATE	DESCRIPTION
REVISION			

BUILT BY Barrette Outdoor Living

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

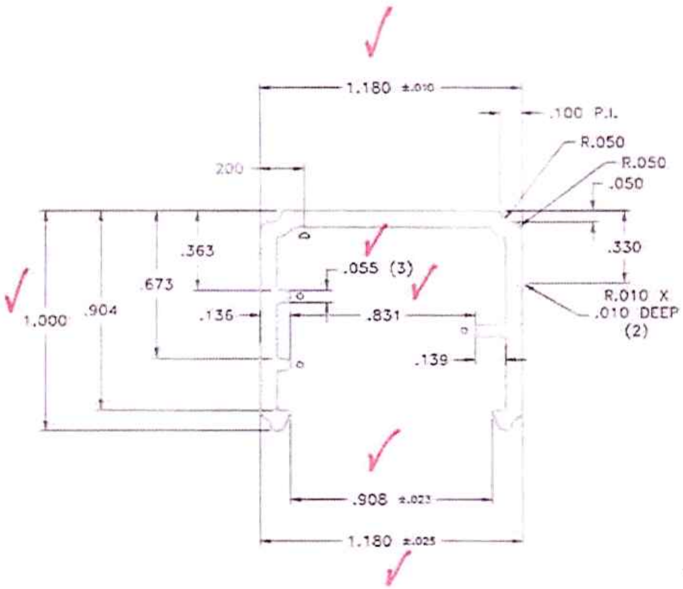
DRAWN BY Ray Clark | DATE 10/18/2012 | SCALE 1:6.5

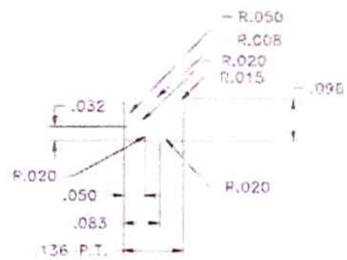
TITLE P:\Engineering 2011\Research and Development\ANDIS\...\Drawings for Testing ...

8 FT INFILL

EQUIPMENT No. | SECTION | REVISION 0 | DRAWING No.

REFERENCE No. | 2 of 3





PRINT APPROVAL

PLEASE INDICATE EXPOSED SURFACES

PLEASE INDICATE WHERE INTEX I.D. GOES

COMPANY __________

SIGNATURE __________

DATE __________

YOUR SIGNATURE INDICATES NO CHANGES TO DIMENSIONS OR TOLERANCES AS SHOWN ON THIS DRAWING. THIS IS NOT AN INTERNATIONAL EXTRUSIONS DESIGN. IT IS AN INTERPRETATION OF THE CUSTOMER'S DRAWING. NO WARRANTY OF FITNESS OR APPLICATION OF USE IS IMPLIED. ALL DIMENSIONAL CHECKS WILL BE DONE USING THIS PRINT ONLY.

KE-10509

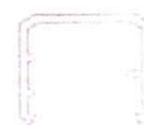
Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE

VERSION TWO DRAWING



Material = 6063-T5

(⌂) R.01 X .01 DEEP I.D. MARK

(⊘) DENOTES FULL R.

TYPICAL UNMARKED WALL .075

BREAK SHARP CORNERS .015 R

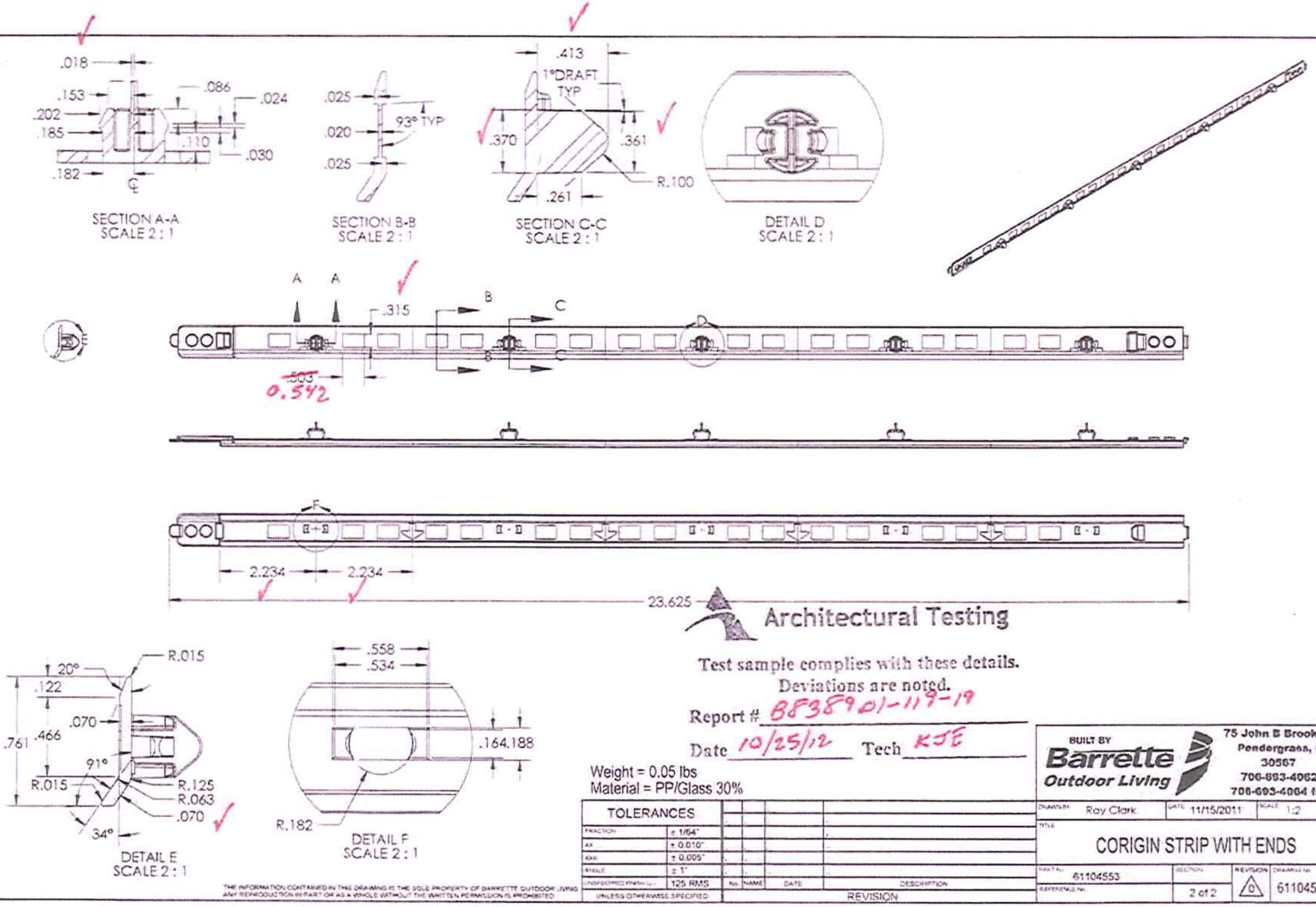
ALUMINUM ASSOCIATION STANDARD EXTRUSION TOLERANCES WILL APPLY UNLESS OTHERWISE NOTED ON PRINT

DIMENSIONS CHKD BY	
EST. AREA	.237
EST. WT. FT.	.285
EST. PER.	6.562
FIN. PER.	
CLASS	SOLID
CIRCLE SIZE	1.500
CUS. REV.	NONE

DESCRIPTION: INFILL PROFILE

CUSTOMER: BARRETTE OUTDOOR PRODUCTS

DR. BY	LGP	DATE	6-22-2011
SLS	97	SCALE	2X
FILE	PLUTO	DIE NO	
DWG#	11B17382		
		PART NO	NONE



Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B838901-119-19

Date 10/25/12 Tech KJE

Weight = 0.05 lbs
Material = PP/Glass 30%

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No.	NAME	DATE	DESCRIPTION

REVISION

BUILT BY Barrette Outdoor Living

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY	DATE	SCALE
Ray Clark	11/15/2011	1:2

TITLE: CORIGIN STRIP WITH ENDS

PART No.	SECTION	REVISION	DRAWING No.
61104553	2 of 2	0	61104553

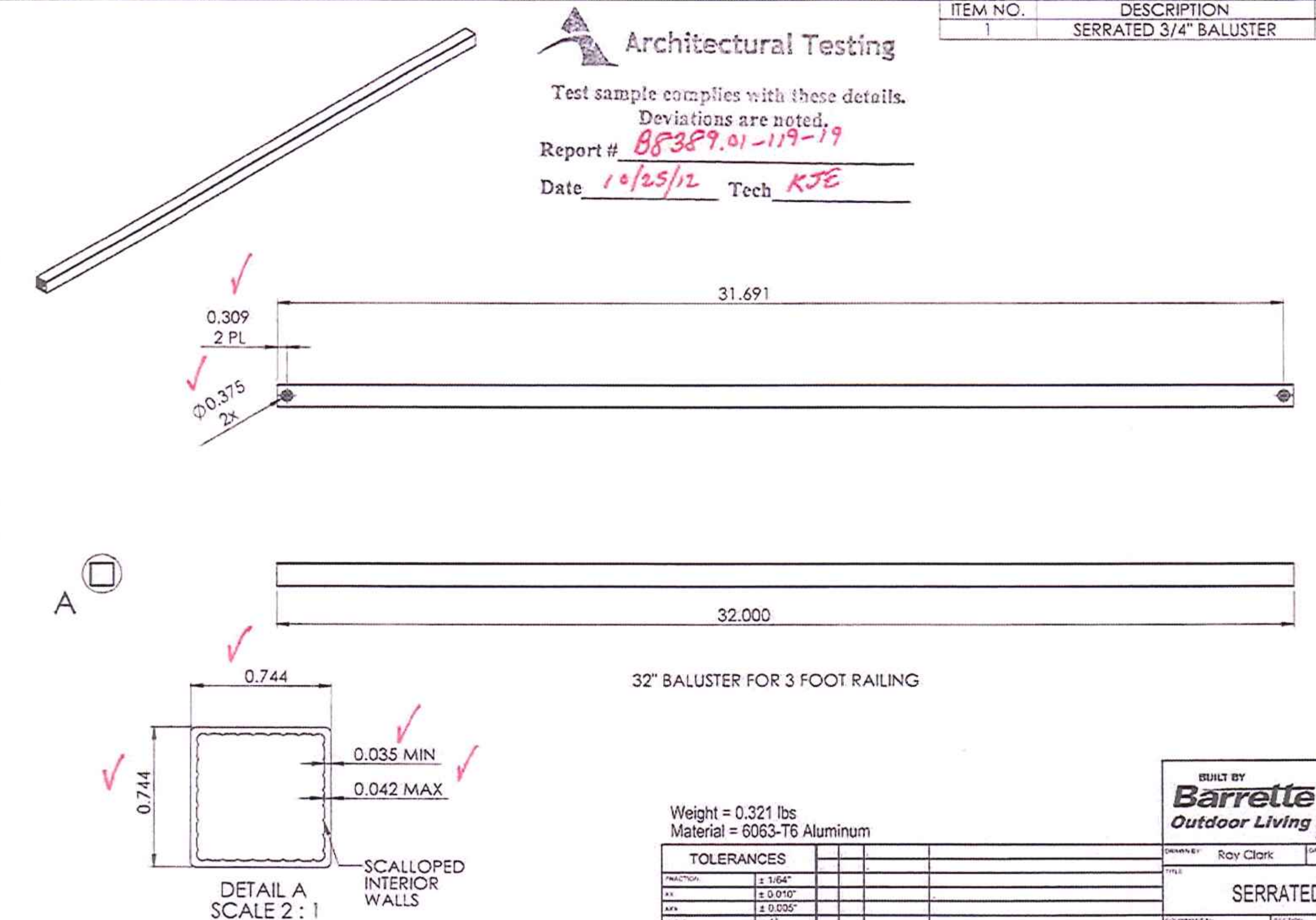
ITEM NO.	DESCRIPTION	LENGTH	QTY.
1	SERRATED 3/4" BALUSTER	32"	1

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE



32" BALUSTER FOR 3 FOOT RAILING

Weight = 0.321 lbs
Material = 6063-T6 Aluminum

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No.	NAME	DATE	DESCRIPTION
REVISION			

BUILT BY Barrette Outdoor Living

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY	DATE	SCALE
Ray Clark	10/18/2012	1:3

TITLE: SERRATED 3/4" BALUSTER

EQUIPMENT No.	SECTION	REVISION	DRAWING No.
REFERENCE No.	1 of 2	0	32"

PRINT APPROVAL

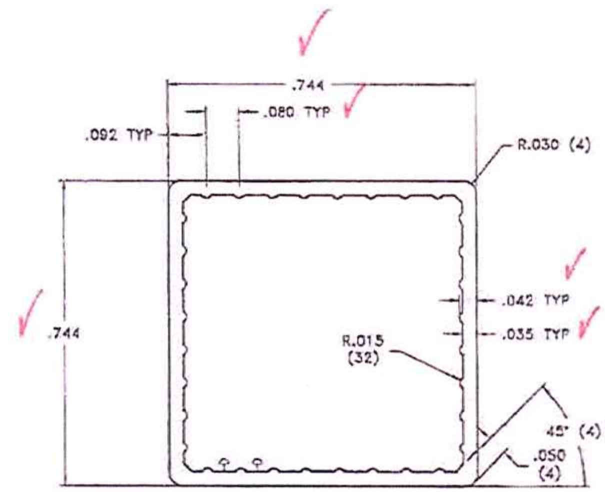
PLEASE INDICATE EXPOSED SURFACES

COMPANY Satellite Mfg. Inc.

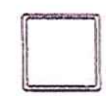
SIGNATURE [signature]

DATE 4/20/11

YOUR SIGNATURE INDICATES NO CHANGES TO DIMENSIONS OR TOLERANCES AS SHOWN ON THIS DRAWING. THIS IS NOT AN INTERNATIONAL EXTRUSIONS DESIGN, IT IS AN INTERPRETATION OF THE CUSTOMER'S DRAWING. NO WARRANTY OF FITNESS OR APPLICATION OF USE IS IMPLIED. ALL DIMENSIONAL CHECKS WILL BE DONE USING THIS PRINT ONLY.



EXTERIOR PERIMETER EXPOSED



ACTUAL SIZE

PRELIMINARY DRAWING

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # 88389.01-119-19

Date 10/25/12 Tech KJE

Material = 6063-T5

(a) R.01 X .01 HI I.D. MARK

BREAK SHARP CORNERS .010 R

International Extrusions

5800 Venoy Rd. – Garden City MI 48135

ALUMINUM ASSOCIATES STANDARD EXTRUSION TOLERANCES WILL APPLY UNLESS OTHERWISE NOTED ON PRINT

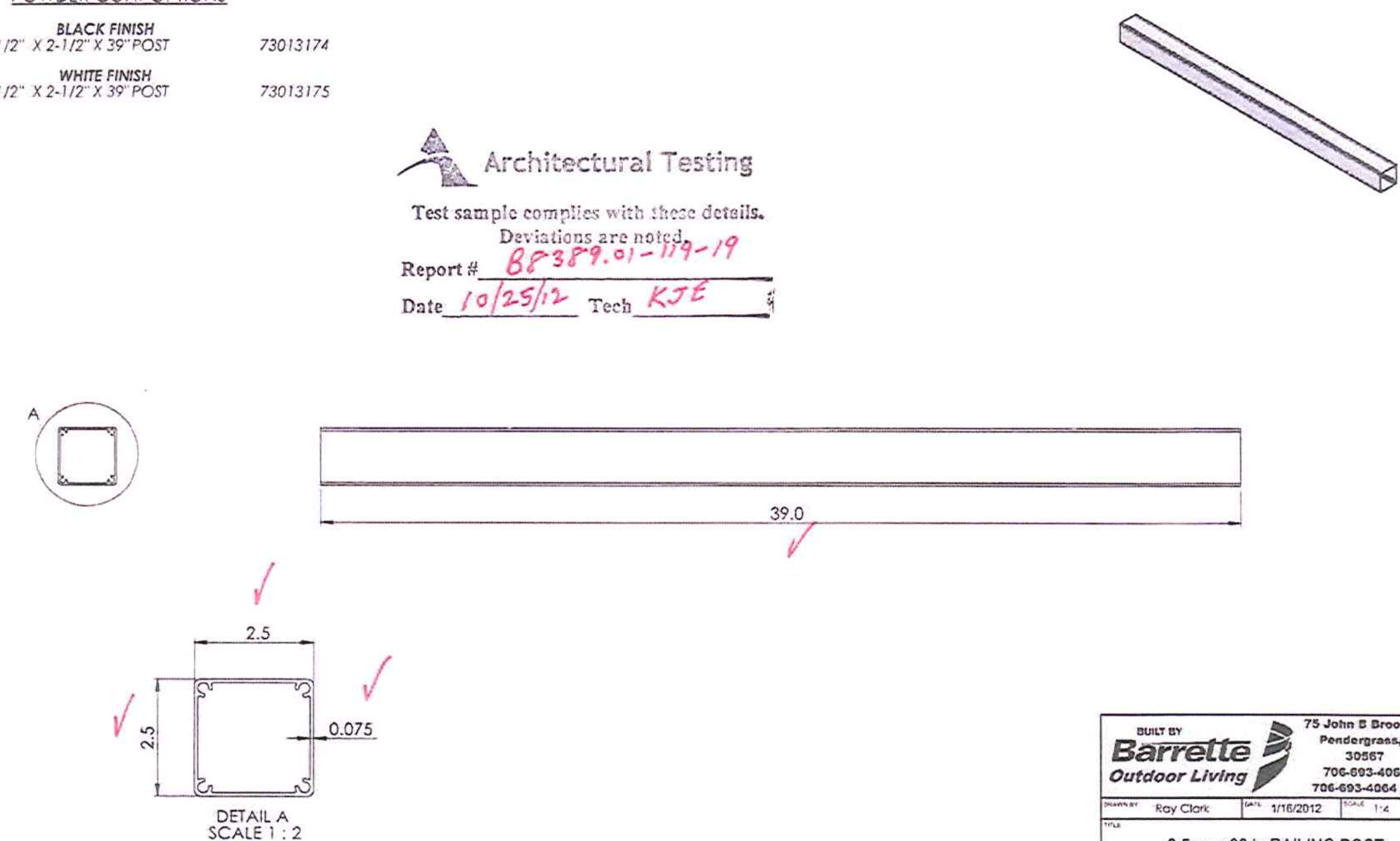
DIMENSIONS CHKD BY					
EST. AREA	.103	DESCRIPTION	DR. BY	ECP	DATE 4-20-2011
EST. WT. FT.	.124	NEW 3/4" SQUARE COMMERTIAL PICKET	SLS	97	SCALE 4X
EST. PER.	2.924		FILE	PLUTO	DIE NO.
FIN. PER.	2.924		DWG#	11S11082	
CLASS	HOLLOW				
CIRCLE SIZE	1.250	CUSTOMER BARRETTE OUTDOOR PRODUCTS			PART NO. RND75040
CUST REV LEV	NONE				

POWDER COAT OPTIONS

BLACK FINISH 2-1/2" X 2-1/2" X 39" POST	73013174
WHITE FINISH 2-1/2" X 2-1/2" X 39" POST	73013175

Architectural Testing

Test sample complies with these details.
Deviations are noted.
Report # 88389.01-119-19
Date 10/25/12 Tech KJE



BUILT BY Barrette Outdoor Living

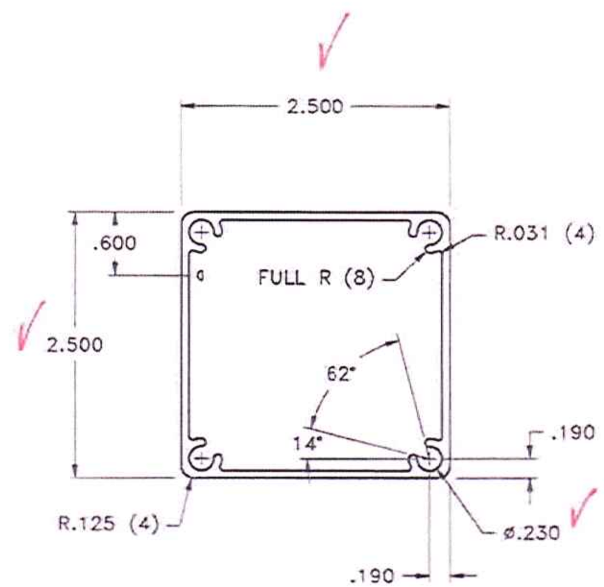
75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY Ray Clark | DATE 1/16/2012 | SCALE 1:4

TITLE 2.5 sq x 39 in RAILING POST

SECTION 1 of 3 | REVISION 0 | DRAWING NO. 39 in

KE9582



Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE

Material = 6005-T5

EXTERIOR PERIMETER EXPOSED

(a) R.01 X .01 HI I.D. MARK
TYPICAL UNMARKED WALL .075
BREAK SHARP CORNERS .015 R

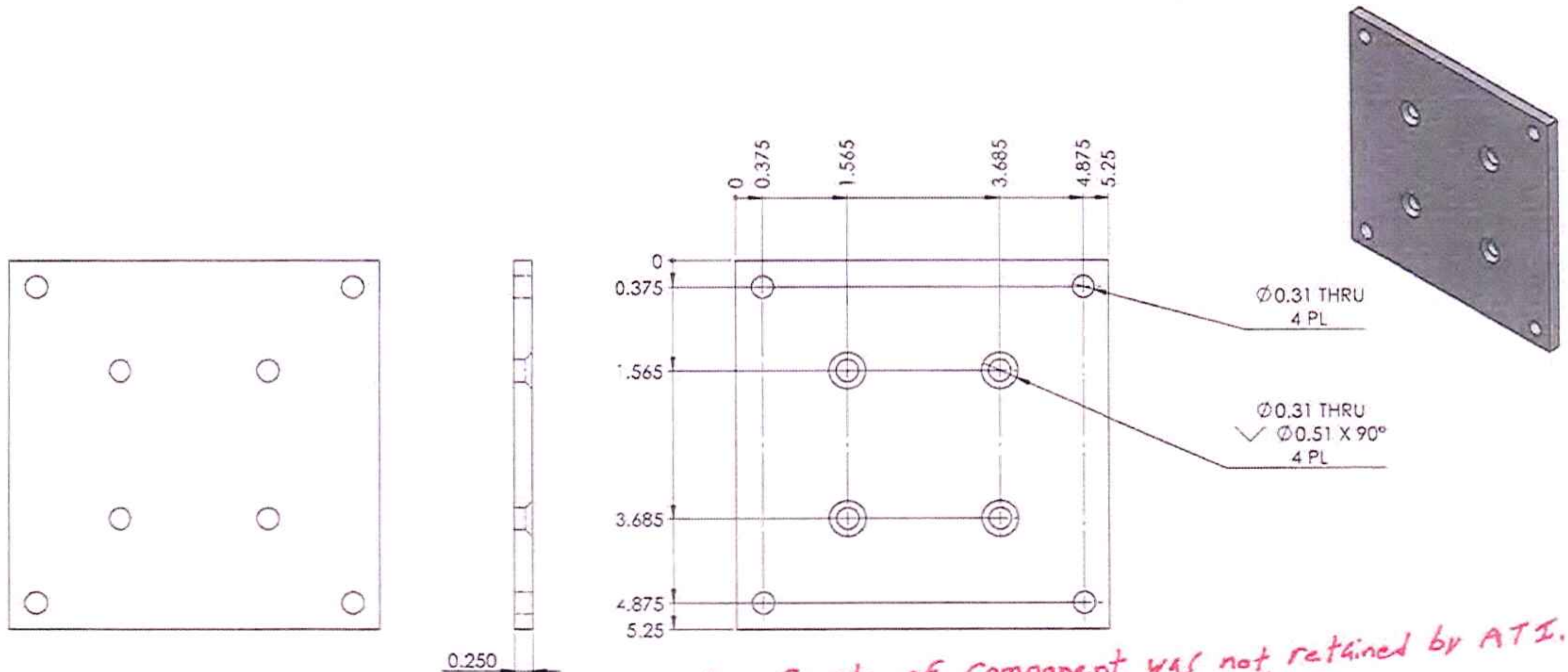
International Extrusions
5800 Venoy Rd. – Garden City MI 48135

ALUMINUM ASSOCIATES STANDARD EXTRUSION TOLERANCES WILL APPLY UNLESS OTHERWISE NOTED ON PRINT

DIMENSIONS CHKD BY

EST. AREA	.828	DESCRIPTION: 2-1/2" POST	DR. BY ECP	DATE 7-16-2008
EST. WT. FT.	.994		SLS 97	SCALE FULL
EST. PER.	9.785		FILE PLUTO	DIE NO KE9582
FIN. PER.	9.785		DWG# 08S198B1	
CLASS	HOLLOW	CUSTOMER: BARRETTE OUTDOOR PRODUCTS		PART NO. NONE
CIRCLE SIZE	3.500			
CUST REV LEV	NONE			

ITEM NO.	DESCRIPTION	LENGTH	QTY.
1	5.25" Base for 2.5" Hand Rail Post	5.25"	1



Note: Sample of component was not retained by ATI. Dimensions could not be verified.

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/26/12 Tech KJE

Weight = 1.91 lbs
Material = AISI 1010 Steel, hot rolled bar

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

REVISION

REV	NAME	DATE	DESCRIPTION

BUILT BY Barrette Outdoor Living
75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY: Ray Clark | DATE: 10/18/2012 | SCALE: 1:1.5

TITLE: 5.25" Base for 2.5" Hand Rail Post

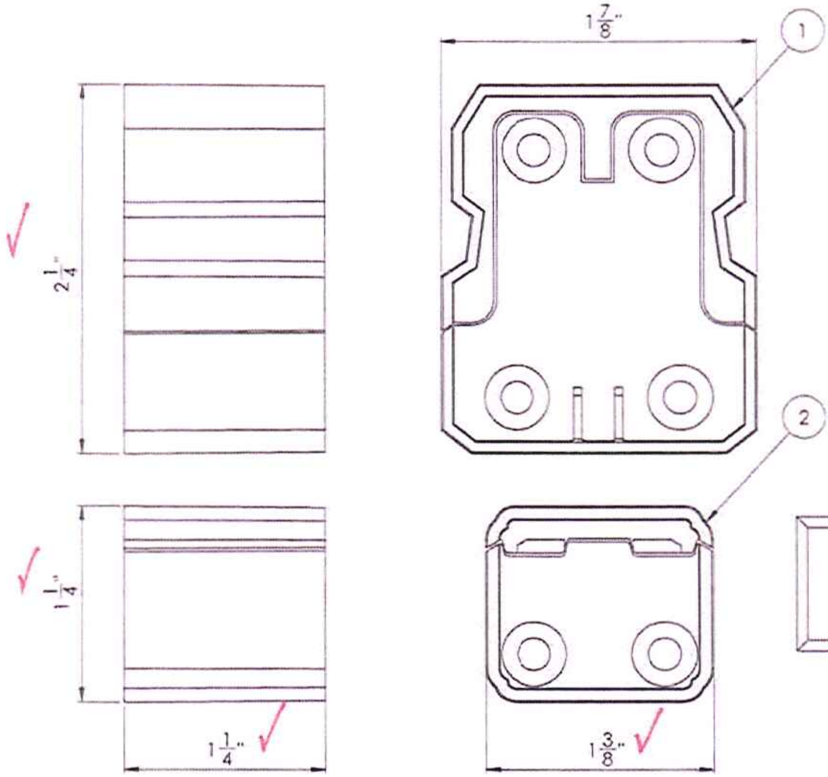
SECTION: 1 of 1 | REVISION: 0

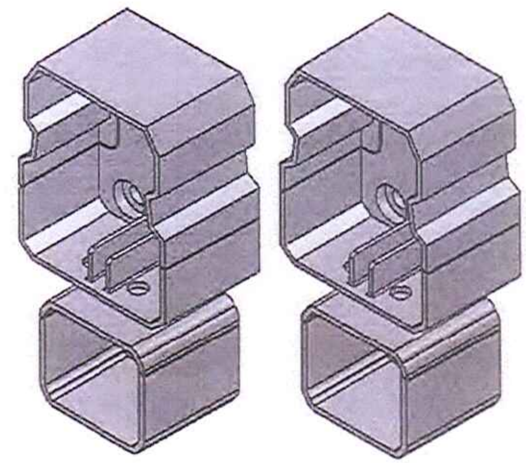
POWDER COAT OPTIONS

BLACK FINISH
VERSARAIL LINE BRACKET KIT 73017727

WHITE FINISH
VERSARAIL LINE BRACKET KIT 73017729

ITEM	DESCRIPTION	QTY.
1	UPPER LINE BRACKET W/ COVERS	2
2	LOWER LINE BRACKET W/COVERS	2
3	LINE BRACKET SCREW KIT	1





LINE BRACKET SCREW KIT

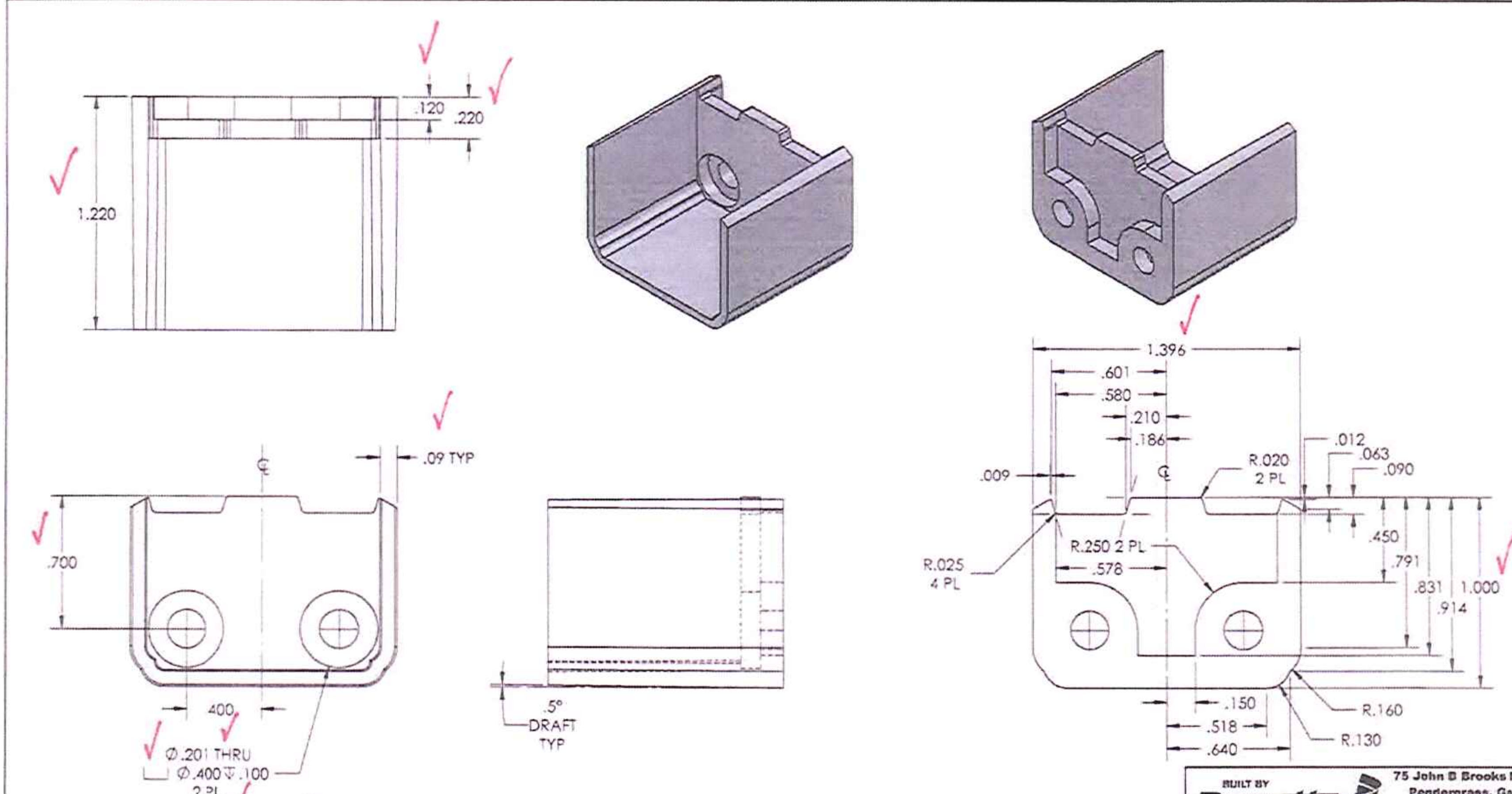
DESCRIPTION	QTY
8 x 3/4" Pan head square drive type "A" 18-8 stainless, black powder coat head	12
8 x 2" Pan head square drive, self drilling screw, carbon steel, 1000 hr coating	4

BUILT BY Barrette Outdoor Living
75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY: Ray Clark	DATE: 10/18/2012	SCALE: 1.5:1
TITLE: LINE BRACKET KIT		
EQUIPMENT No. / REFERENCE No.	SECTION: 1 of 1	REVISION: 0 / DRAWING No.: Sheet1

Architectural Testing

Test sample complies with these details.
~~Deviations are noted.~~
Report # B5389.01-119-19
Date 10/25/12 Tech KJE



Weight = 0.0413 lbs
Material = AA380.0-F die Aluminum

TOLERANCES	
FRACTION	± 1/64"
XX	± 0.010"
XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No.	NAME	DATE	DESCRIPTION

REVISION

BUILT BY **Barrette Outdoor Living**

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

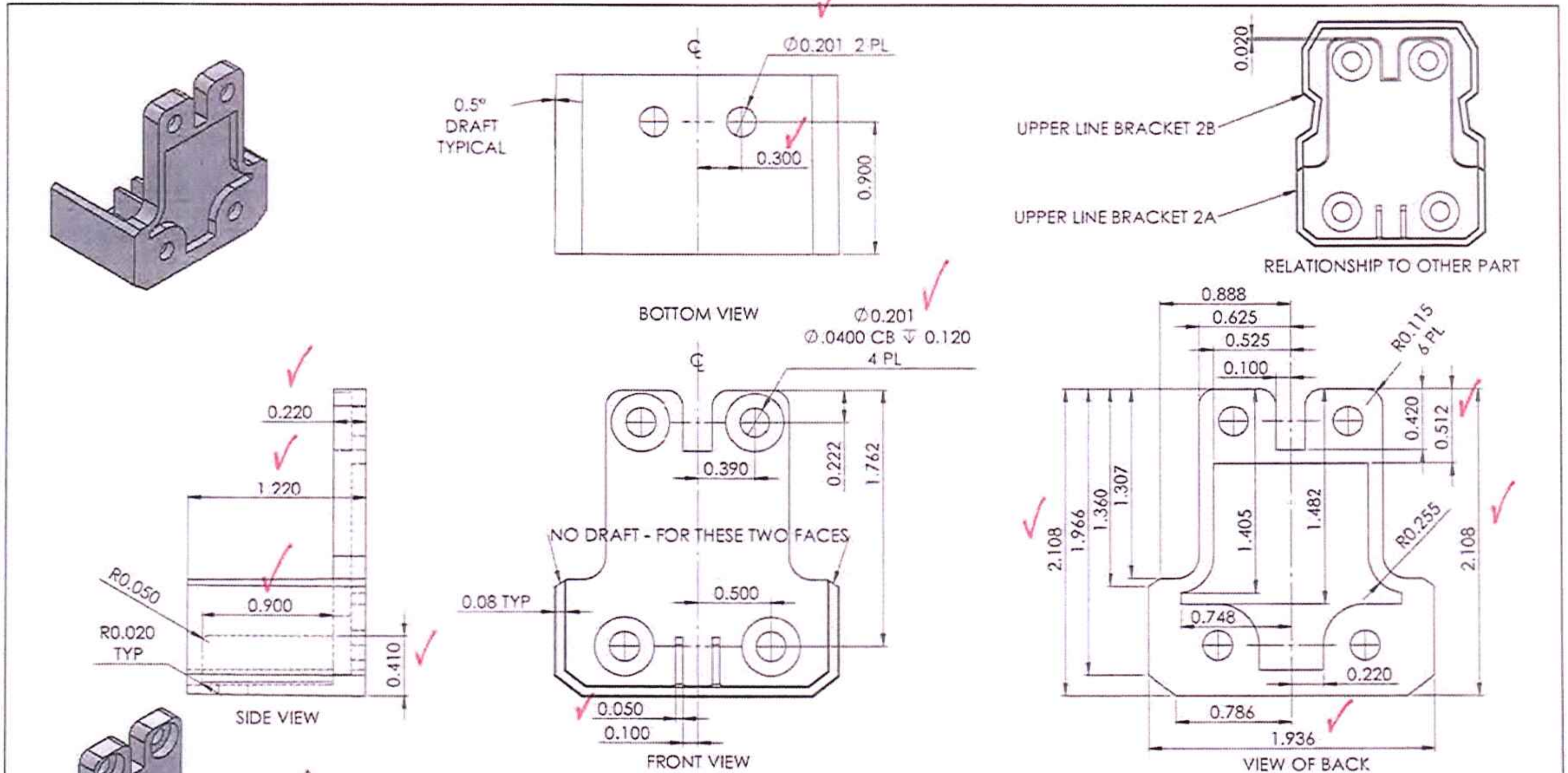
DRAWN BY: Ray Clark	DATE: 1/17/2012	SCALE: 2:1	
TITLE: LOWER LINE BRACKET - BOTTOM			
EQUIPMENT No.	SECTION	REVISION	DRAWING No.
REFERENCE No.	1 of 2	0	PART A

Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # B8389.01-119-19

Date 10/25/12 Tech KJE



Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report # BP389.01-119-19

Date 10/25/12 Tech KJE

Weight = 0.0709 lbs
Material = AA380.0-F die Aluminum

TOLERANCES	
FRACTION	± 1/64"
.XX	± 0.010"
.XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

No	NAME	DATE	DESCRIPTION
REVISION			

BUILT BY Barrette Outdoor Living

75 John B Brooks Rd
Pendergrass, Ga
30567
706-693-4062
706-693-4064 fax

DRAWN BY Roy Clark	DATE 1/17/2012	SCALE 1.5:1	
TITLE UPPER LINE BRACKET 2A			
EQUIPMENT No	SECTION 1 of 1	REVISION 0	DRAWING No Sheet1
REFERENCE No			

APPENDIX B

Photographs

Photo No. 1
In-Fill Load Test at Center of Two Pickets

Photo No. 2
In-Fill Load Test at Bottom of Two Pickets

Photo No. 3
Concentrated Load Test at Mid-Span of Top Rail

Photo No. 4
Concentrated Load Test at End of Top Rail (Bracket) and Post Tests

Photo No. 5
Post Mount Attached to Mock Wood Deck

Photo No. 6
Top Rail Bracket-to-Rail Connection

Photo No. 7
Bottom Rail Bracket-to-Rail Connection

APPENDIX C

Blocking Instructions

NEW CASTLE / SOMERSET / ELITE ALUMINUM RAIL POST INSTALLATION INSTRUCTIONS

*2 person installation recommended

It is the responsibility of the installer to meet and/or exceed all code and safety requirements, and to obtain all required building permits. The deck and railing installer should determine and implement appropriate installation techniques for each installation. Barrette Outdoor Living and its distributors shall not be held liable for improper or unsafe installations.

What is Included:

- Post
- Mounting Plate
- Installation Plate
- Base Trim
- ¼" x 2½" Phillips Head Screws

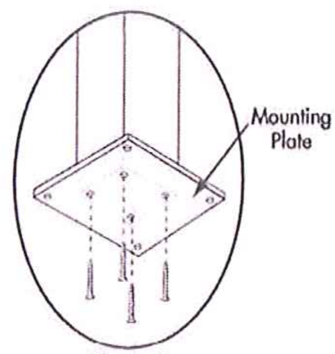


Figure 1

Deck/Wood Surface

1.) Attach mounting plate to posts with ¼" x 2½" phillips head screws *Figure 1*.

2.) Cut a 2x8 wood spacer block (not included) *Figure 2* and attach underneath the deck surface to substructure joists directly under the post location with 3" deck screws (not included). Length of the spacer block should be the distance between the existing deck joists.

3.) Cut one 2x8 joist (same length as spacer block cut in Step 3) (not included) *Figure 3*. Box in the spacer block with this newly cut joist with 3" deck screws (not included).

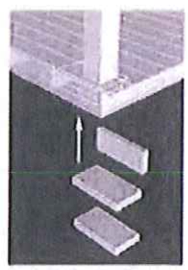


Figure 2

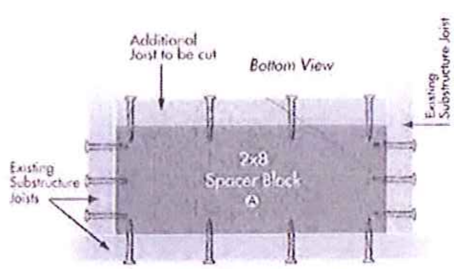


Figure 3

Install Posts to Deck

4.) Mark holes with a pencil through bottom of installation plate *Figure 4* onto deck surface. Drill ⅜" holes in all four locations.

5.) Push 5/16" bolts (not included) through installation plate and attach separate bottom plate *Figure 5 (C)* from underneath deck surface (posts can be leveled as needed by using steel washers as shims).

- Purchase 5/16" bolts with nuts approximately 1" longer than the distance between plates (minimum 3⅞" long).

6.) Install base trim *Figure 5 (D)* around deck post at deck surface before installing rail.

Figure 4

Concrete Surface

1.) Purchase four 5/16" masonry anchors according to local building codes.

2.) Mark holes through mounting plate onto concrete surface and follow anchor installation instructions.

3.) Install base trim *Figure 5* (D) around deck post at deck surface before installing rail.

Installing Remainder of Deck Posts

1.) Measure the length of your rail section and add ¾" to measurement for brackets and expansion clearance. This is the distance between posts.

2.) Follow installation instructions from above.

Architectural Testing
Test sample complies with these details.
Deviations are noted.
Report # B8389.01-119-19
Date 10/25/12 Tech KJE

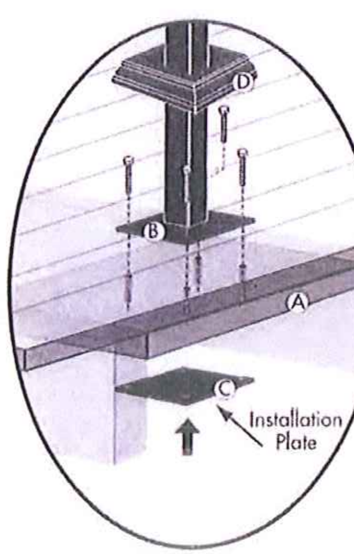
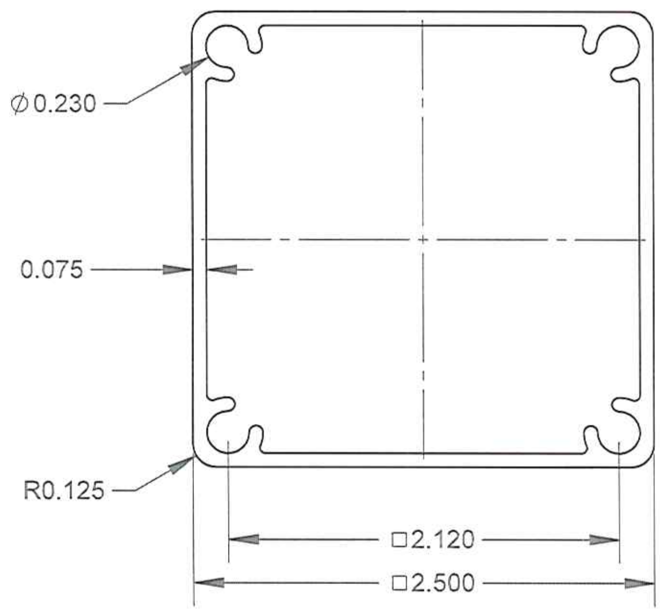


Figure 5

Appendix C

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
4. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34109097	2.5" POST W/SCREWBOSS 39" KE9582	39"
34109238	2.5" SQUARE TUBE W/SCREWBOSS 45" KE9582	45"
34109513	2.5" SQUARE TUBE W/SCREWBOSS 60" KE9582	60"

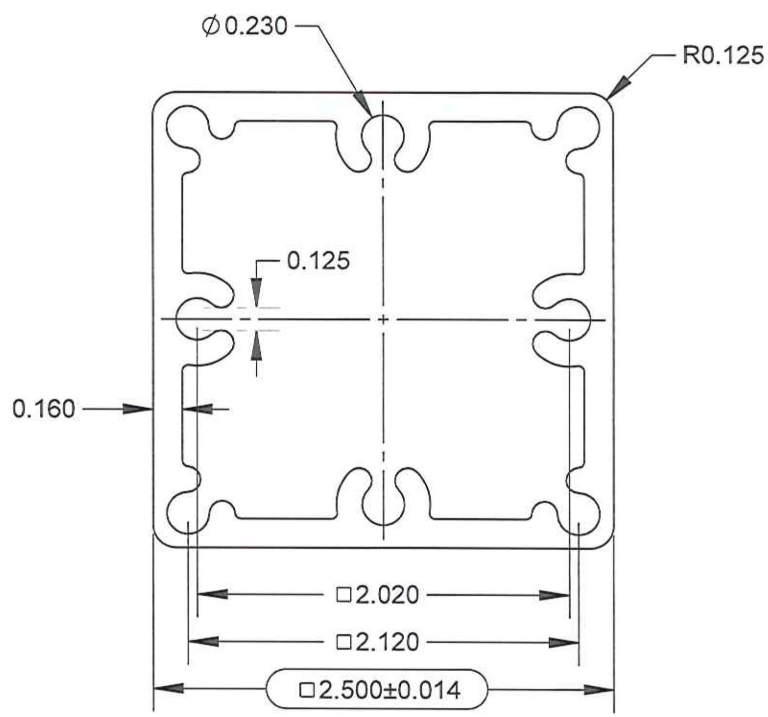


BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 3/10/2014	APPROVED:
DESCRIPTION: KE9582 - 2.5" ANCHORABLE POST		
SHEET 1 OF 1 / SCALE 1:1 / WEIGHT: 0.97	REVISION: 0	PART NUMBER: EPN-0504

NOTES:
1. MATERIAL 6005-T5
2. LENGTH TOLERANCE +/-1/16"

PART NO.	DESCRIPTION	LENGTH
34109930	2.5" HD POST W/SCREWBOSS 45" EPN-0527	45"
34109931	2.5" HD POST W/SCREWBOSS 60" EPN-0527	60"

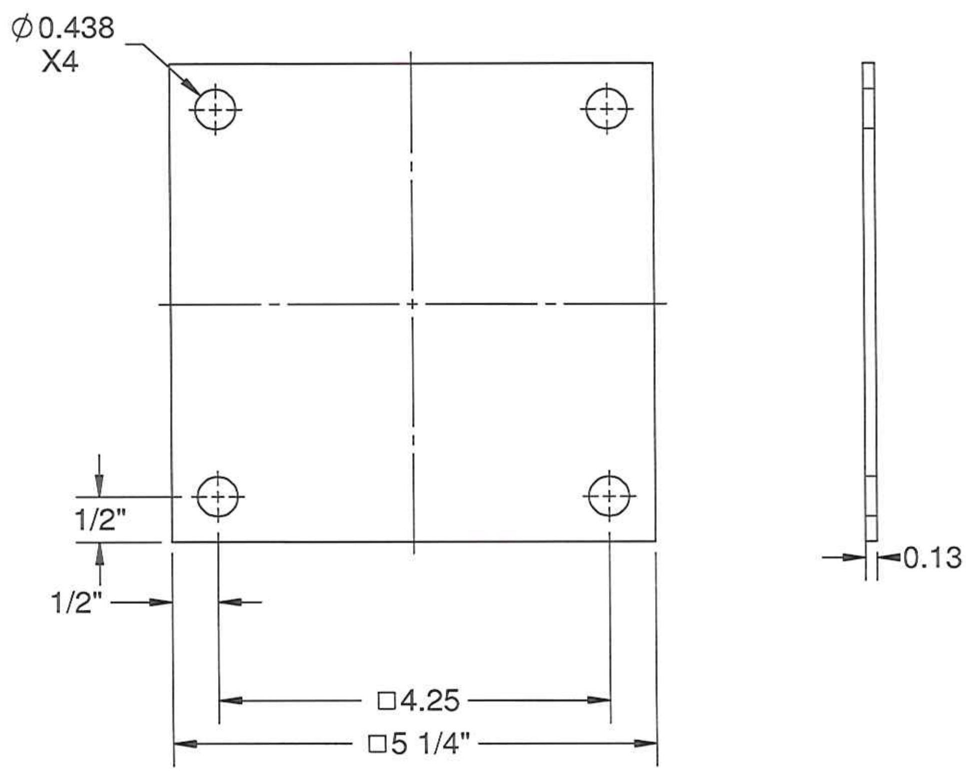


REV	BY	DATE	PCR	DESCRIPTION

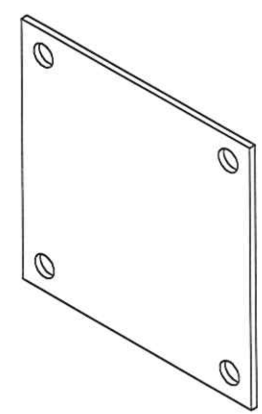
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 3/12/2014	APPROVED:
DESCRIPTION: 2.5" HD POST W/SCREWBOSS EPN-0527		
SHEET 1 OF 1 SCALE 1:1 WEIGHT: 2.091	REVISION: 0	PART NUMBER: EPN 0527

NOTES:
1. AISI 1010 STEEL, HOT ROLLED BAR
2. BREAK EDGES
3. POWDER COAT BLACK
4. CORNER HOLES MATCH EPN 34115034 & 34115035
5. DACROMAT 3X BEFORE POWDER COAT



1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0



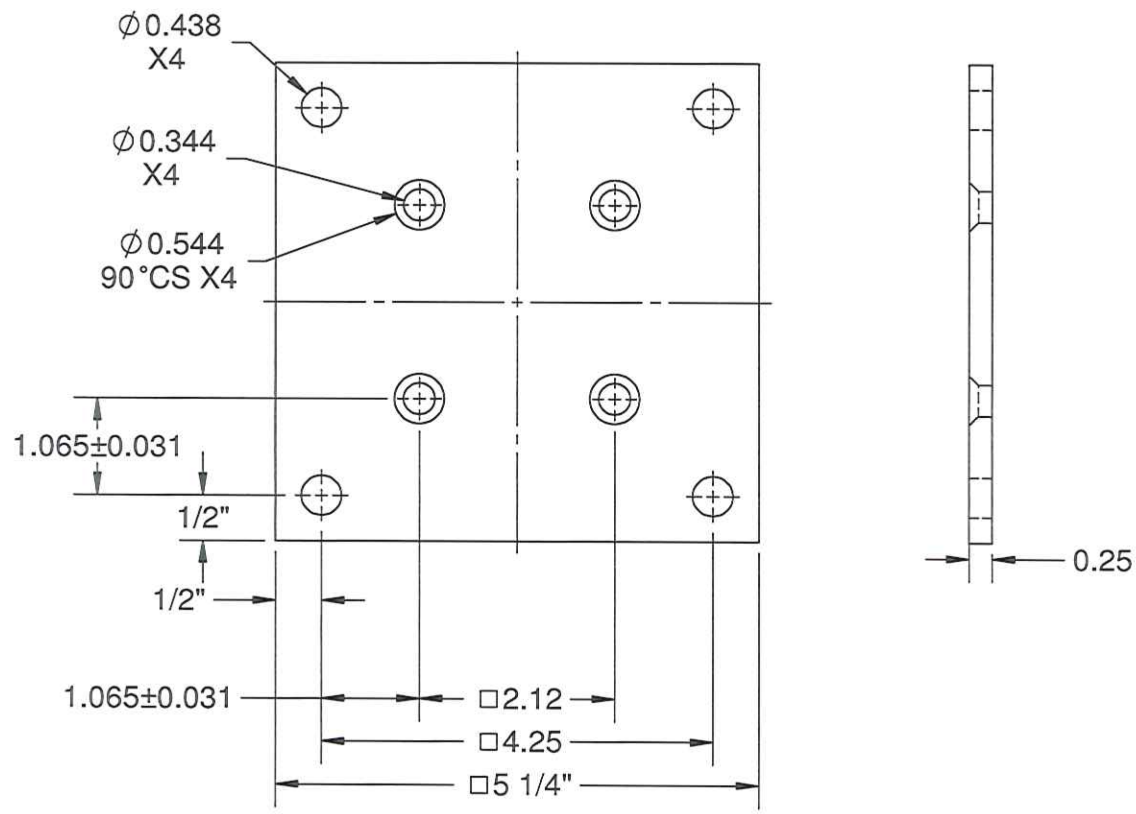
REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

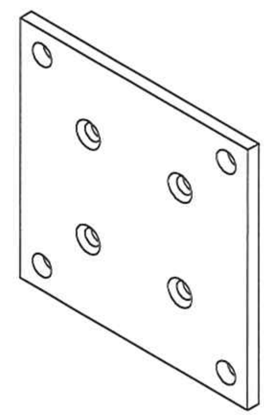
Barrette
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: M DESALLE	DATE: 4/24/2015	APPROVED:
DESCRIPTION: 2.5 POST SANDWICH PLATE 4 HOLES		
SHEET 1 OF 1 / SCALE 1:2 / WEIGHT: 0.96	REVISION: 0	PART NUMBER: 34115036

NOTES:
1. AISI 1010 STEEL, HOT ROLLED BAR
2. BREAK EDGES
3. POWDER COAT BLACK
4. CENTER HOLES MATCH EPN 0527 & EPN 0504
5. DACROMAT COATING 3X BEFORE POWDER COAT



1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0



REV	BY	DATE	PCR	DESCRIPTION

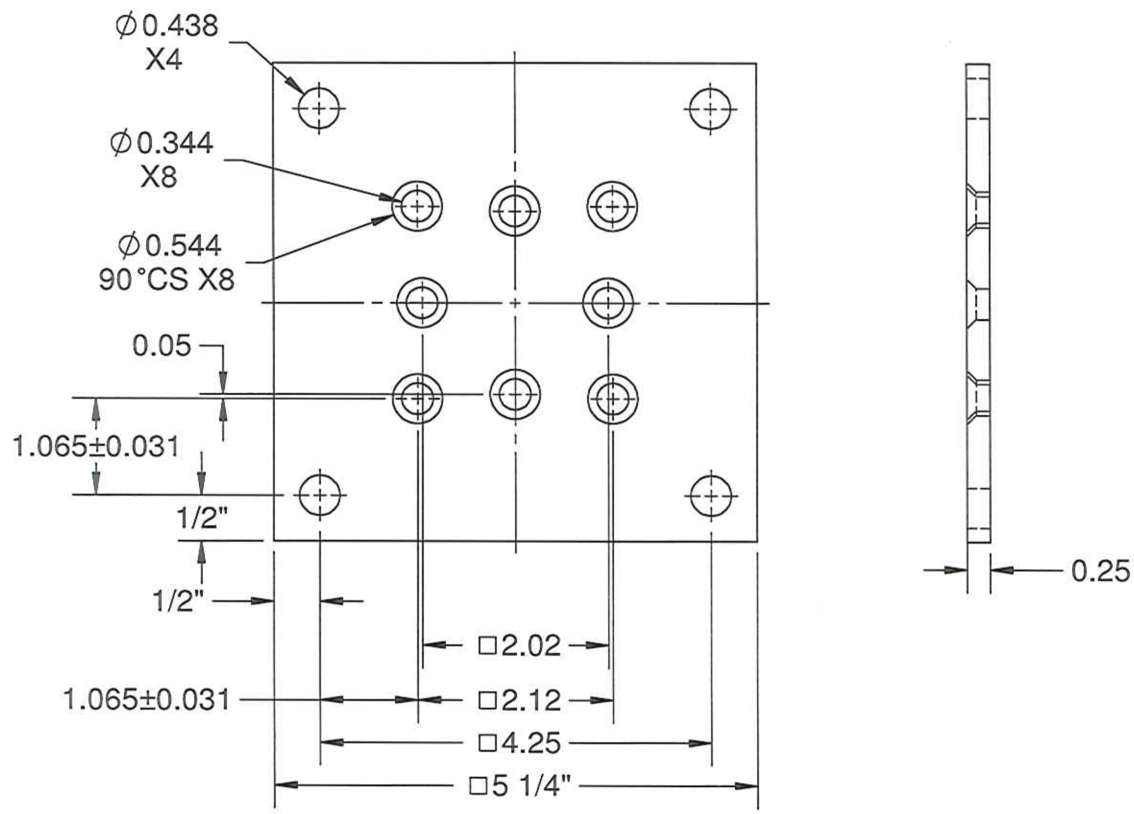
TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

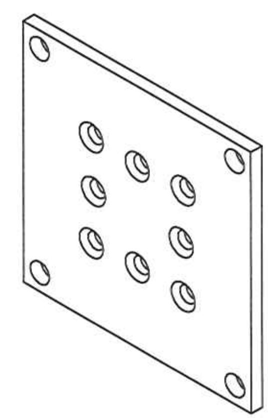
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: M DESALLE	DATE: 4/24/2015	APPROVED:
DESCRIPTION: 2.5 POST MOUNT PLATE 8 HOLES		
SHEET 1 OF 1 / SCALE 1:2 / WEIGHT: 1.88	REVISION: 0	PART NUMBER: 34115035

NOTES:
1. AISI 1010 STEEL, HOT ROLLED BAR
2. BREAK EDGES
3. POWDER COAT BLACK
4. CENTER HOLES MATCH EPN 0527
5. DACROMAT COATING 3X BEFORE POWDER COAT

1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0





TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: M DESALLE DATE: 4/24/2015 APPROVED:

DESCRIPTION: 2.5 HD POST MOUNT PLATE 12 HOLES

SHEET 1 OF 1
SCALE 1:2
WEIGHT: 1.85
REVISION: 0
PART NUMBER: 34115034

REV	BY	DATE	PCR	DESCRIPTION

GENERAL SPECIFICATIONS

PACK OF 4 (FOUR) IN BAG
THIS IS A "CUSTOM" SCREW
MATERIAL C1022 W/ STANDARD COMMERCIAL
ELECTROPLATED ZINC - BAKE FOR 4 HOURS AT 400°F
1/4-20 X 2-1/2" FLAT HEAD, FULL THREAD,
TYPE "F", PHILLIPS HEAD #3

CUSTOM

CORE HARDNESS:	RC30-38
HEAD PROTRUSION:	0.04-0.07"
RECESS PENETRATION:	0.134-0.140

MUST BE MADE AT HEAD WITH ADDITION OF FULL RADIUS (R.200") AT HEAD TO SHANK AS SHOWN.
- REQUIRED FOR ADDITIONAL STRENGTH -

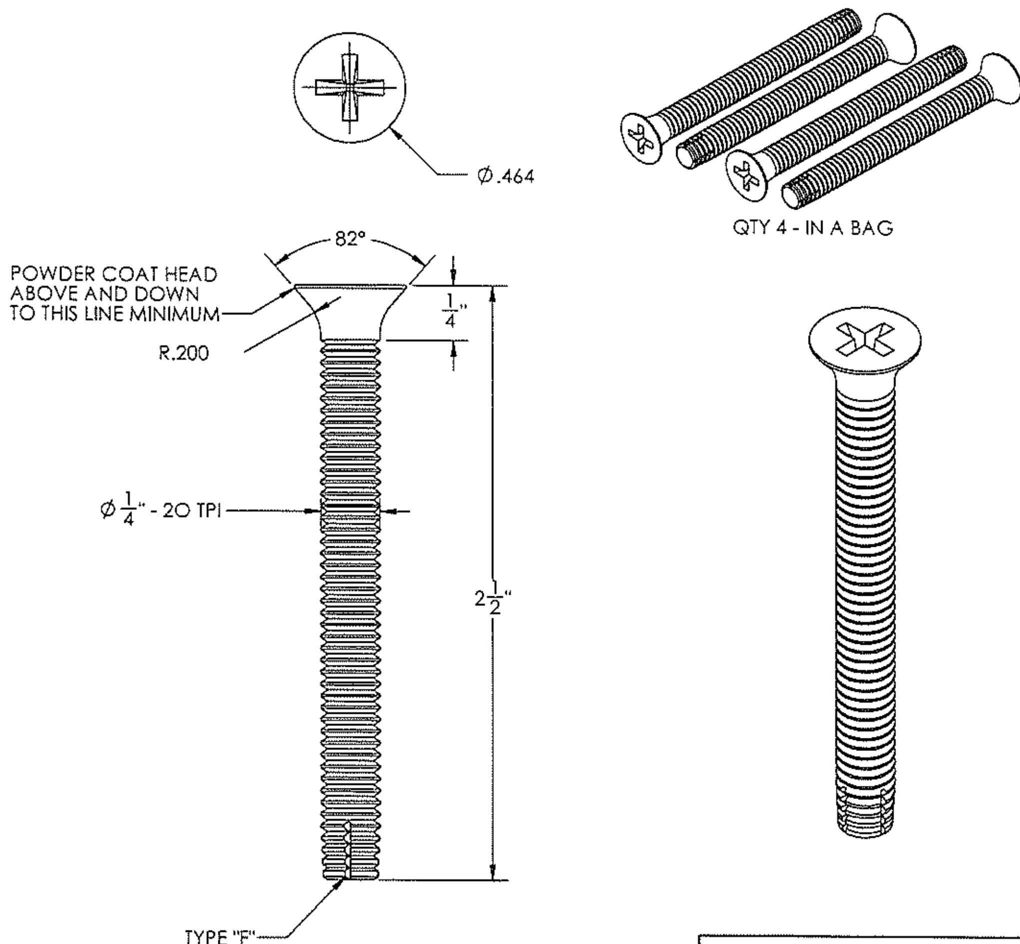
OPTION #1 - POWDER COAT

1. POWDER COAT FINISH TO AAMA 2604-02 STANDARD,
   - COLOR - BLACK OR WHITE - NO COLOR MEASUREMENTS REQUIRED
   - COATING MUST BE LEAD FREE
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)

OPTION #2 - PLATING

- DACROMET 320 WITH LTX TOP COAT
- COATING MUST BE LEAD FREE
- CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT

PART WILL BE EXPOSED TO:
- OUTSIDE WEATHERING
- PRESSURE TREATED WOOD



TOLERANCES	
FRACTION	± 1/64"
XX	± 0.010"
XXX	± 0.005"
ANGLE	± 1°
UNSPECIFIED FINISH (µ")	125 RMS
UNLESS OTHERWISE SPECIFIED	

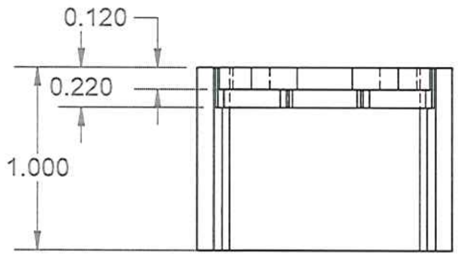
No	NAME	DATE	DESCRIPTION
REVISION			

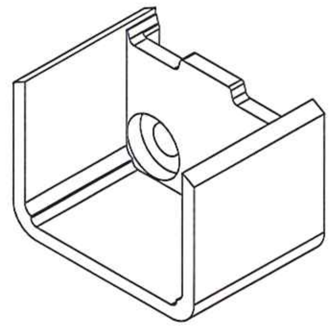
BUILT BY Barrette Outdoor Living
75 John B. Brooks Rd
Pendergrass, GA
30567
706-693-4082
706-693-4064 fax

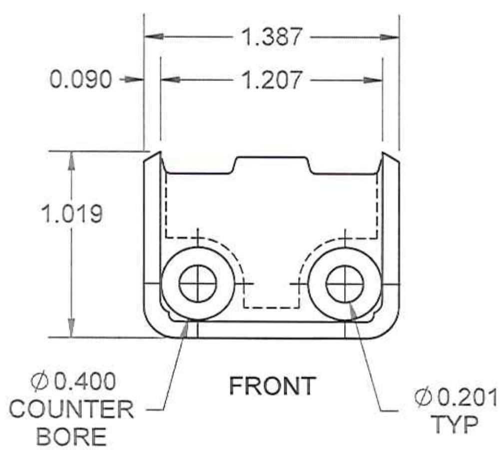
DRAWN BY: Ray Clark	DATE: 2/15/2013	SCALE: 2:1	
TITLE: 34109436			
EQUIPMENT No:	SECTION	REVISION	DRAWING No:
REFERENCE No:	1 of 1	0	Sheet1

NOTES:
1. MATERIAL:ADC12
2. FINISH POWDER COAT

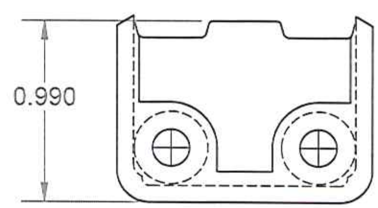
COLOR	PART NO.	DESCRIPTION
BLACK	34114816	BRKT LEVEL BTMM AL 1X1.4X0.38 BLACK
SATIN BLK	34114818	BRKT LEVEL BTMM AL 1X1.4X0.38 SATIN BLACK
WHITE	34114817	BRKT LEVEL BTMM AL 1X1.4X0.38 WHITE







FRONT



BACK

1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0

REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

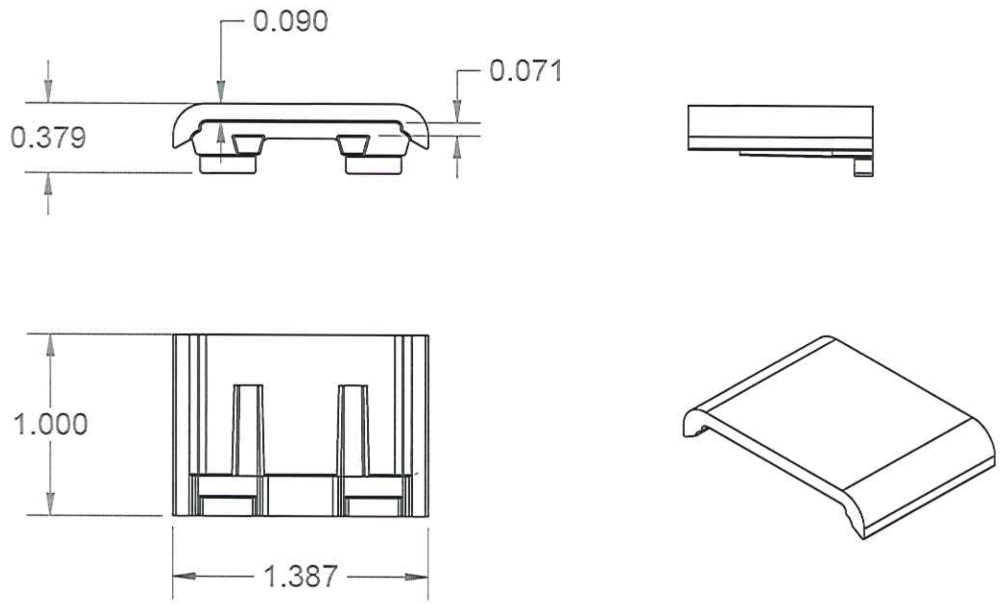
Barrette

BARRETTE
Outdoor Living

DRAWN: C.CLARK	DATE: 06/17/2017	APPROVED:
DESCRIPTION: BRKT LEVEL BTMM AL 1X1.4X0.38 BLACK		
SHEET 1 OF 1 SCALE 1:1 WEIGHT: 0.0400	REVISION: 0	PART NUMBER: 34114816

NOTES:
1. MATERIAL:ADC12
2. FINISH POWDER COAT
3. EPN-2122

COLOR	PART NO.	DESCRIPTION
BLACK	34114819	BRKT CVR LEVEL BTTM AL 1X1.4X1.3 BLACK
SATIN BLK	34114821	BRKT CVR LEVEL BTTM AL 1X1.4X1.3 SATIN
WHITE	34114820	BRKT CVR LEVEL BTTM AL 1X1.4X1.3 WHITE



1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0

REV	BY	DATE	PCR	DESCRIPTION

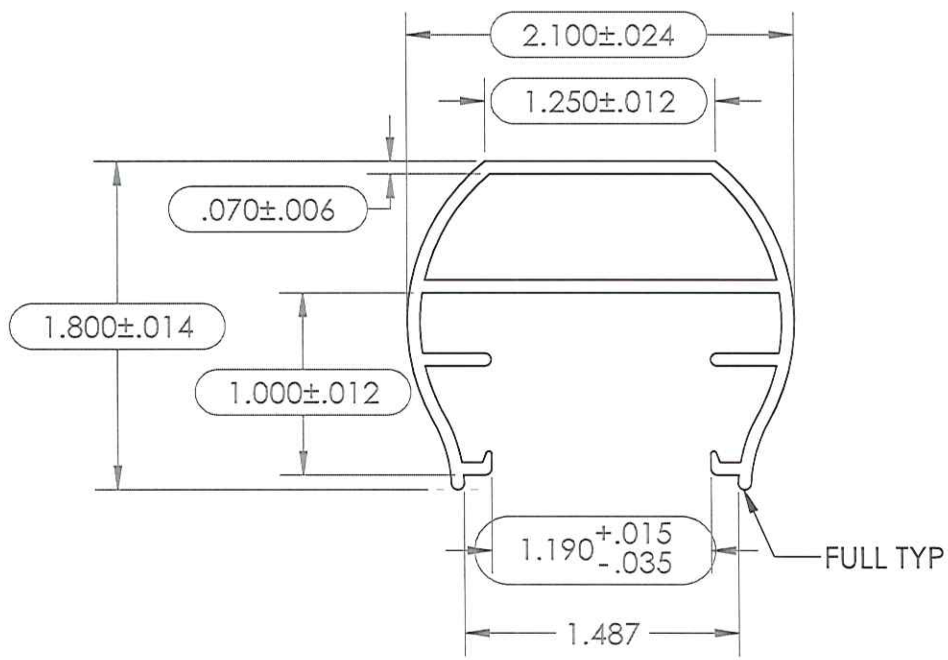
TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE Outdoor Living

DRAWN: W DIXON	DATE: 8/15/2014	APPROVED:
DESCRIPTION: BRKT CVR LEVEL BTTM AL 1X1.4X1.3 BLACK		
SHEET 1 OF 1 / SCALE 1:1 / WEIGHT: 0.0203	REVISION: 0	PART NUMBER: CHART DRAWING

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS OVER EPN 0513
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34107268	TOP RAIL 2.1X1.8X 69 (EPN 0566 AG)	69"



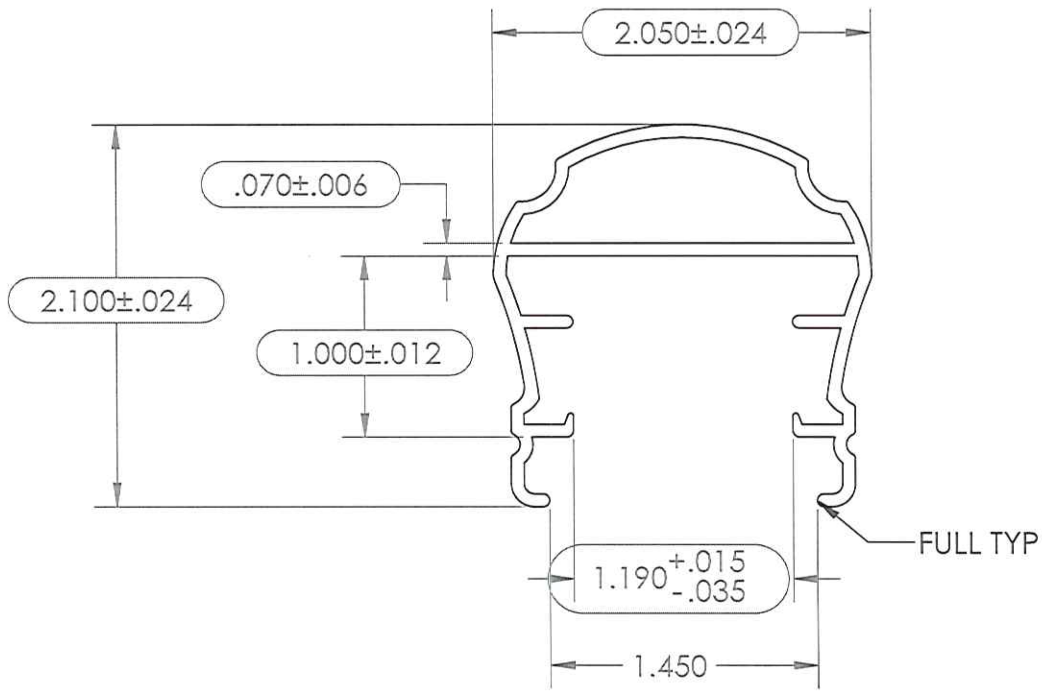
REV	BY	DATE	PCR	DESCRIPTION
3	WED	3/18/2015	N/A	ADD TOLERANCES
2	WED	2/27/2015	N/A	CHG LENGTH 70.25 TO 69 34107268
1	WED	12/22/2014	N/A	CHG TOL 1.190 DIM

Barrette
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 11/26/2014	APPROVED:	
DESCRIPTION: WINCHESTER RAIL CHANNEL			
SHEET 1 OF 1	REVISION	PART NUMBER	
SCALE 1:1	3	EPN 0566	
WEIGHT: 0.661			

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS OVER EPN 0513
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34107269	TOP RAIL 2.05X2.1X 69 (EPN 0565 AG)	69"



REV	BY	DATE	PCR	DESCRIPTION
3	WED	3/18/2015	N/A	ADD TOLERANCES
2	WED	2/27/2015	N/A	CHG LENGTH 70.25 TO 69 34107269
1	WED	12/22/2014	N/A	CHG TOL 1.190 DIM

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

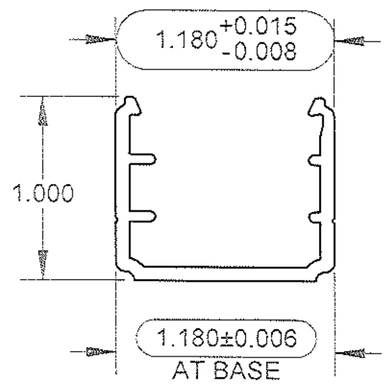
DRAWN:	DATE:	APPROVED:
W DIXON	11/26/2014	

DESCRIPTION: CAMBRIDGE RAIL CHANNEL

SHEET 1 OF 1
SCALE 1:1
WEIGHT: 0.722
REVISION: 3
PART NUMBER: EPN 0565

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS INTO EXTRUSIONS EPN 0507, 0518, 0519
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34109920	VERSA RAIL CHANNEL 93" EPN-0513	93"
34109921	VERSA RAIL CHANNEL 70.25" EPN-0513	70.25"
34109922	AVALON CHANNEL 71.5" EPN-0513	71.5"
34109923	AVALON CHANNEL 95.5" EPN-0513	95.5"
34107334	CHANNEL 280" EPN 0513	280"



REV	BY	DATE	PCR	DESCRIPTION
1	WD	3/5/2015	N/A	ADD 280" LENGTH 34107334

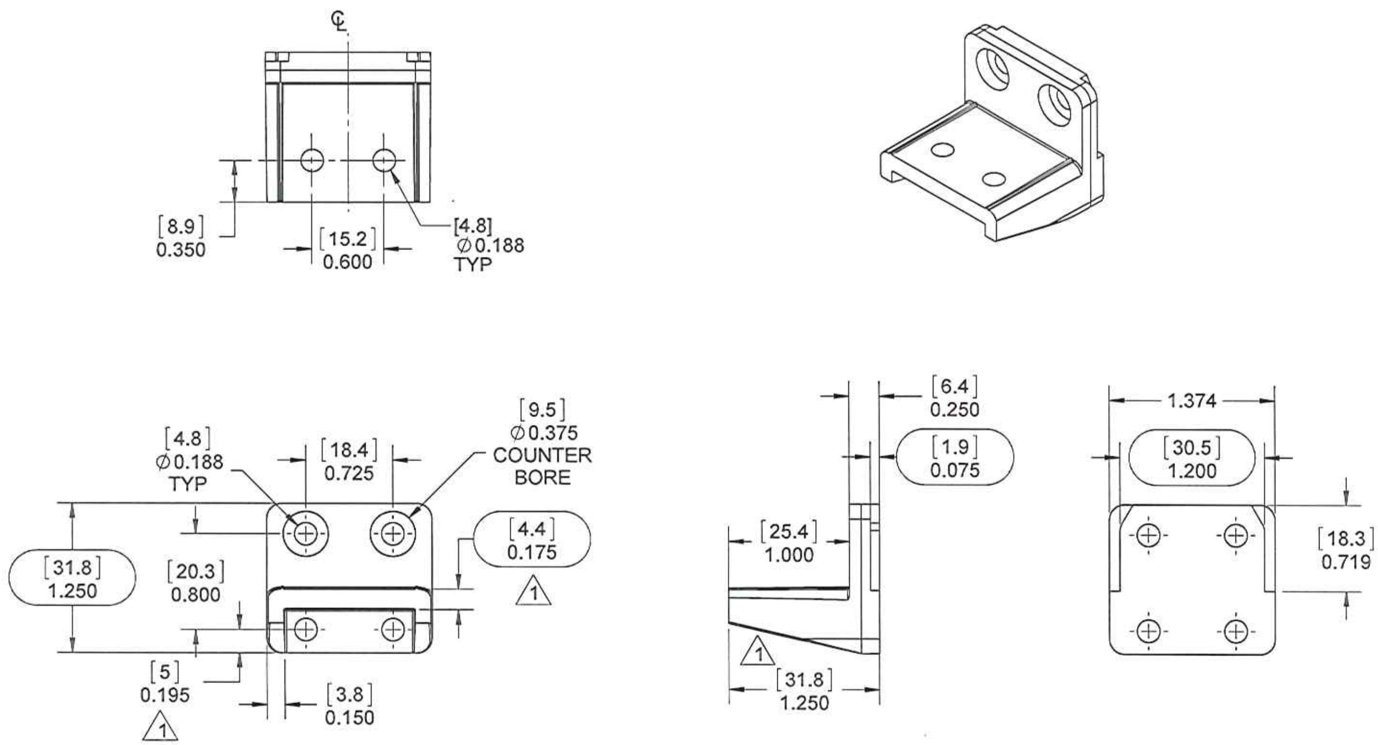
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 2/28/2014	APPROVED:	
DESCRIPTION: AVALON CHANNEL			
SHEET 1 OF 1	REVISION 1	PART NUMBER **EPN 0513**	
SCALE 1:1			
WEIGHT: 0.285			

NOTES:
1. MATERIAL: ADC12
2. FINISH POWDER COAT
3. TOOLING TO BE PRODUCED FROM 3D CAD MODEL

COLOR	PART NO.	DESCRIPTION
BLACK	34114813	BRKT LEVEL TOP AL 1.3X1.4X1.3 BLACK
SATIN BLACK	34114815	BRKT LEVEL TOP AL 1.3X1.4X1.3 SATIN BLK
WHITE	34114814	BRKT LEVEL TOP AL 1.3X1.4X1.3 WHITE

POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
COATING MUST BE LEAD FREE
CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
PART WILL BE EXPOSED TO:
OUTSIDE WEATHERING
PRESSURE TREATED WOOD
2. MUST PASS ASTM TESTING TO (MIN):
GLOSS D-523(40-50%)
FILM THICKNESS D-7091 (2.5±0.5 MILS)
HARDNESS D3363 (2H-9H)
IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
ADHESION/CROSS HATCH D-3359 (PASS)
FLEXIBILITY D22 (PASS)
3. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
1) ΔL = ±1.0
2) Δa = ±0.5
3) Δb = ±1.0



REV	BY	DATE	PCR	DESCRIPTION
2	CC	4/14/2014	N/A	
1	WD	8/19/2013	N/A	ADD WALL THICKNESS/MODIFIED SHAPE OF "U" SHAPED PROJECTION ADDED ADDITIONAL DIMS

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

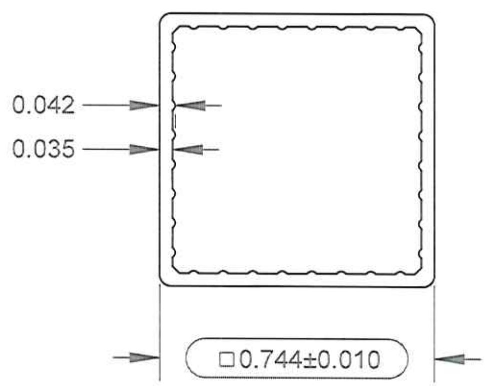
Barrette

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON DATE: 8/19/2013 APPROVED:
DESCRIPTION: BRKT LEVEL TOP AL 1.3X1.4X1.3 BLACK
SHEET 1 OF 1
SCALE 1:1
WEIGHT: 0.061
REVISION: 2
PART NUMBER: CHART DRAWING

NOTES:
1. MATERIAL 6063-T5
2. OUTSIDE SURFACES EXPOSED
3. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
4. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34109170	3/4" PICKET SCALLOPED 32" KE10529	32"
34109498	3/4" PICKET SCALLOPED 38" KE10529	38"
34109924	3/4" PICKET SCALLOPED 33" EPN-0506	33"
34109925	3/4" PICKET SCALLOPED 39" EPN-0506	39"



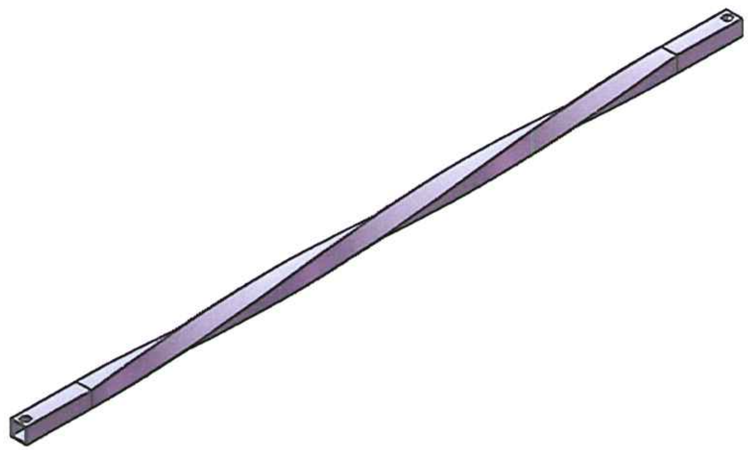
REV	BY	DATE	PCR	DESCRIPTION

BARRETTE Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 3/5/2014	APPROVED:
DESCRIPTION: 3/4" PICKET SCALLOPED EPN 0506		
SHEET 1 OF 1 SCALE 2:1 WEIGHT: 0.121	REVISION: 0	PART NUMBER: EPN 0506

NOTES:
1. MATERIAL: ALUMINUM 5050
2. POWER COAT PER SPEC.
3. ROTATION 270 DEGREES

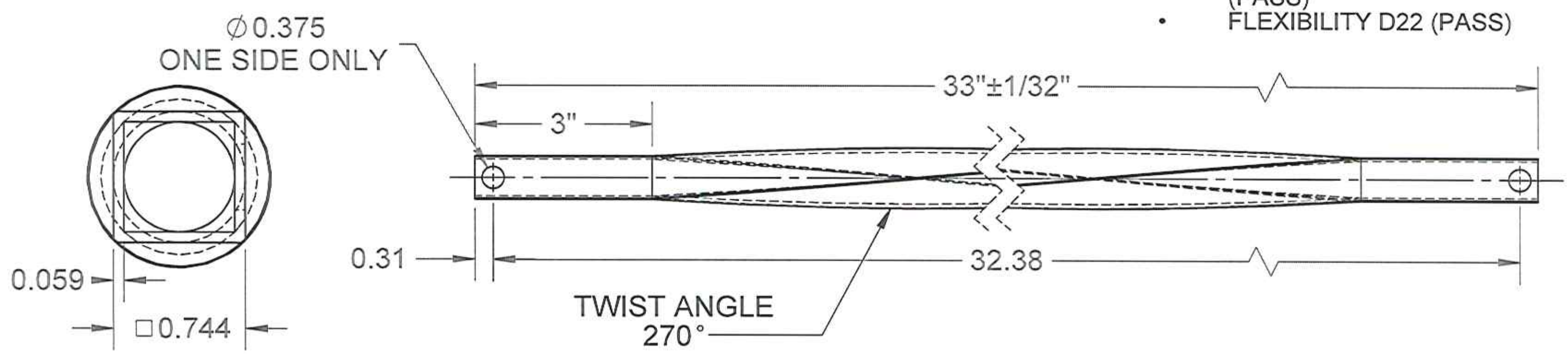
COLORS
SATIN BLACK
WHITE



POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 1 YEAR WARRANTY.

- COATING MUST BE LEAD FREE
- CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT

1. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
2. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)



REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

Barrette

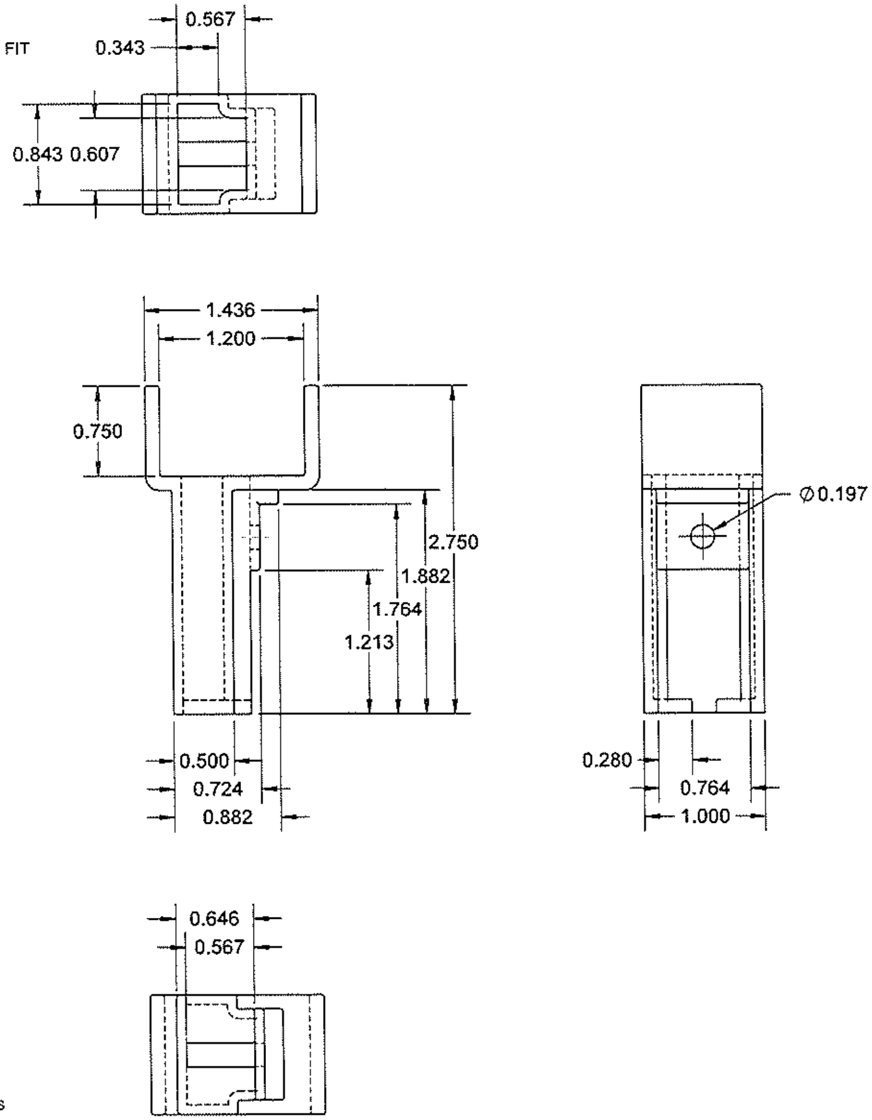
BARRETTE
Outdoor Living

DRAWN: W DIXON	DATE: 11/14/2014	APPROVED:

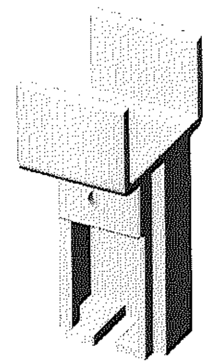
DESCRIPTION: TWISTED 3/4" BALUSTER

SHEET 1 OF 1 SCALE 1:4 WEIGHT: 0.514	REVISION: A	PART NUMBER: EPN-0563

NOTES:
1. MATERIAL: ADC12
2. FINISH: POWDER COAT
3. COVER 34114810 MUST FIT



COLOR	PART NO.	DESCRIPTION
BLACK	34114807	RAIL SUPPORT AL 1.44X1X2.75 BLACK
SATIN BLK	34114809	RAIL SUPPORT AL 1.44X1X2.75 SATIN BLK
WHITE	34114808	RAIL SUPPORT AL 1.44X1X2.75 WHITE



1. POWDER COAT FINISH, COLOR (WHITE/BLACK), TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0

REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE
Outdoor Living
740 N. Main St., Suite Gap, TN 37711

DRAWN: C.CLARK DATE: 04/15/2014 APPROVED:

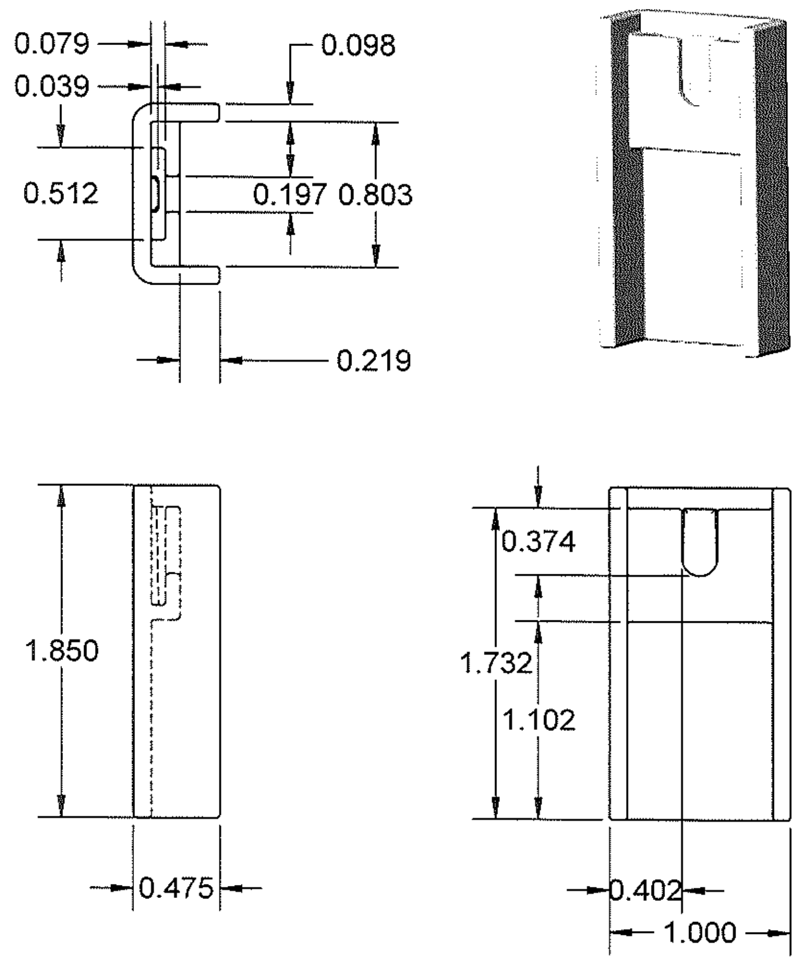
DESCRIPTION: RAIL SUPPORT AL 1.44X1X2.75 BLACK

SHEET 1 OF 1
SCALE 1:1
WEIGHT: 32.58

REVISION: 0 PART NUMBER: CHART DRAWING

NOTES:
1. MATERIAL: ADC12
2. FINISH: POWDER COAT

COLOR	PART NO.	DESCRIPTION
BLACK	34114810	RAIL SUPPORT CVR AL 0.5X1X1.85 BLACK
SATIN BLK	34114812	RAIL SUPPORT CVR AL 0.5X1X1.85 SATIN BLK
WHITE	34114811	RAIL SUPPORT CVR AL 0.5X1X1.85 WHITE



1. POWDER COAT FINISH, COLOR (WHITE/BLACK). TO AAMA 2603-98 STANDARD, WITH ADDITIONAL REQUIREMENTS OF 2.5±0.5 MIL THICKNESS AND MINIMUM OF 15 YEAR WARRANTY.
   - COATING MUST BE LEAD FREE
   - CERTIFICATE OF CONFORMITY MUST BE INCLUDED WITH EACH SHIPMENT
2. PART WILL BE EXPOSED TO:
   - OUTSIDE WEATHERING
   - PRESSURE TREATED WOOD
3. MUST PASS ASTM TESTING TO (MIN):
   - GLOSS D-523(40-50%)
   - FILM THICKNESS D-7091 (2.5±0.5 MILS)
   - HARDNESS D3363 (2H-9H)
   - IMPACT DIRECT/INDIRECT D-2794 (1.5 MILS)
   - ADHESION/CROSS HATCH D-3359 (PASS)
   - FLEXIBILITY D22 (PASS)
4. COLOR, PER BARRETTE SUPPLIED COLOR STANDARD SAMPLE LISTED IN THE CHART WITH THE FOLLOWING TOLERANCES:
   1. D L = ±1.0
   2. D a = ±0.5
   3. D b = ±1.0

REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

Barrette

BARRETTE
Outdoor Living

DRAWN: C.CLARK | DATE: 04/15/2014 | APPROVED:

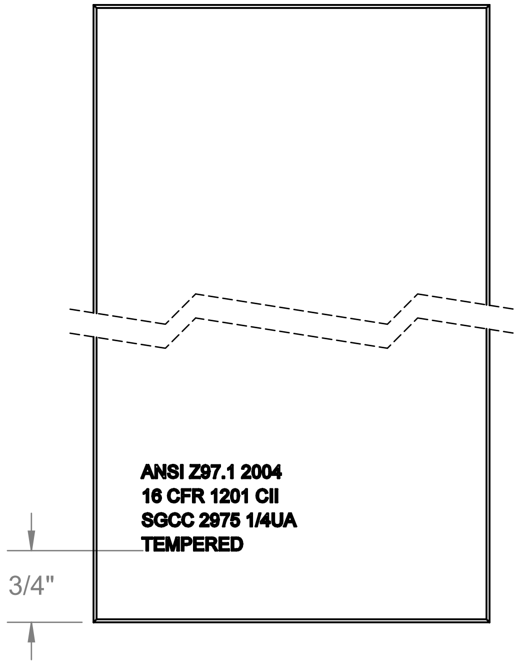
DESCRIPTION: RAIL SUPPORT CVR AL 0.5X1X1.85 BLACK

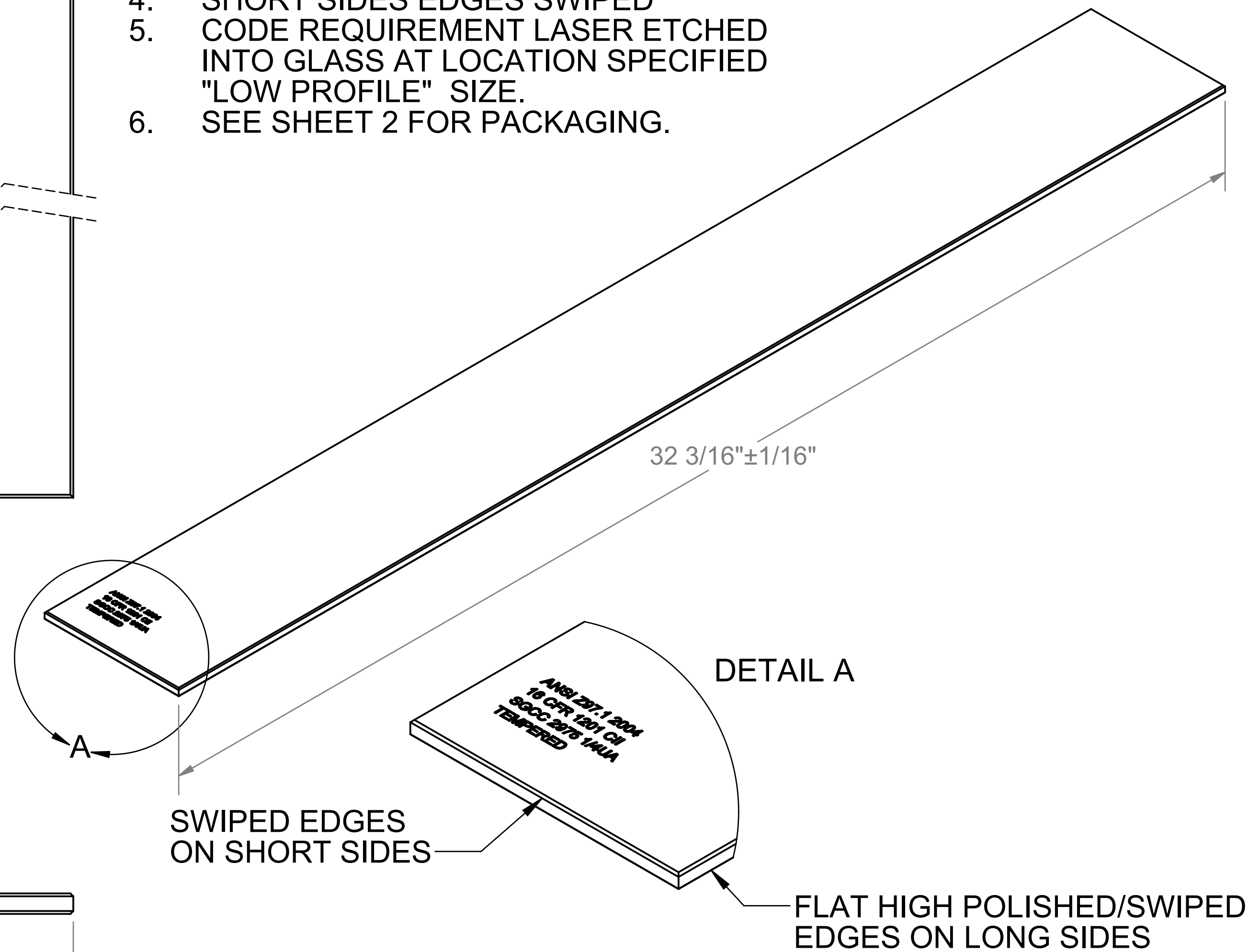
SHEET 1 OF 1
SCALE 1:1
WEIGHT: 16.42

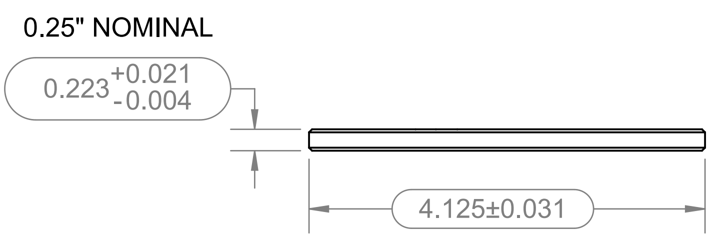
REVISION: 0

PART NUMBER: **CHART DRAWING**

NOTES:
1. MATERIAL, AFG STANDARD FLOAT GLASS
2. 1/4" SPECIFICATION, TEMPERED
3. LONG SIDES HIGH POLISHED
4. SHORT SIDES EDGES SWIPED
5. CODE REQUIREMENT LASER ETCHED INTO GLASS AT LOCATION SPECIFIED "LOW PROFILE" SIZE.
6. SEE SHEET 2 FOR PACKAGING.







REV	BY	DATE	PCR	DESCRIPTION

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE
Outdoor Living

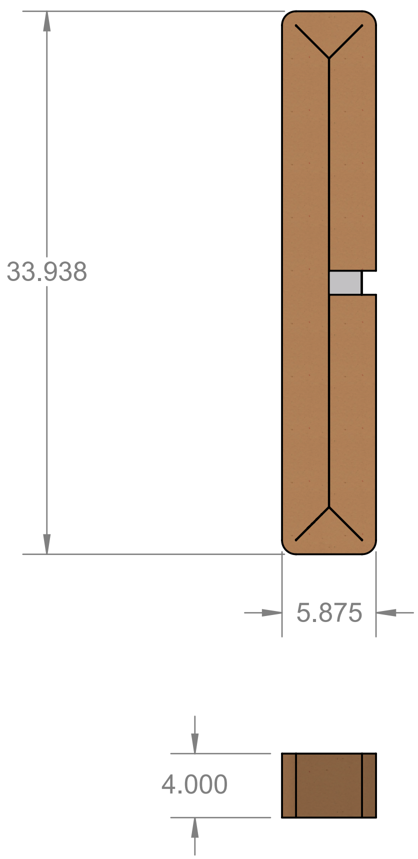
DRAWN:	DATE:	APPROVED:
W DIXON	2/9/2015	

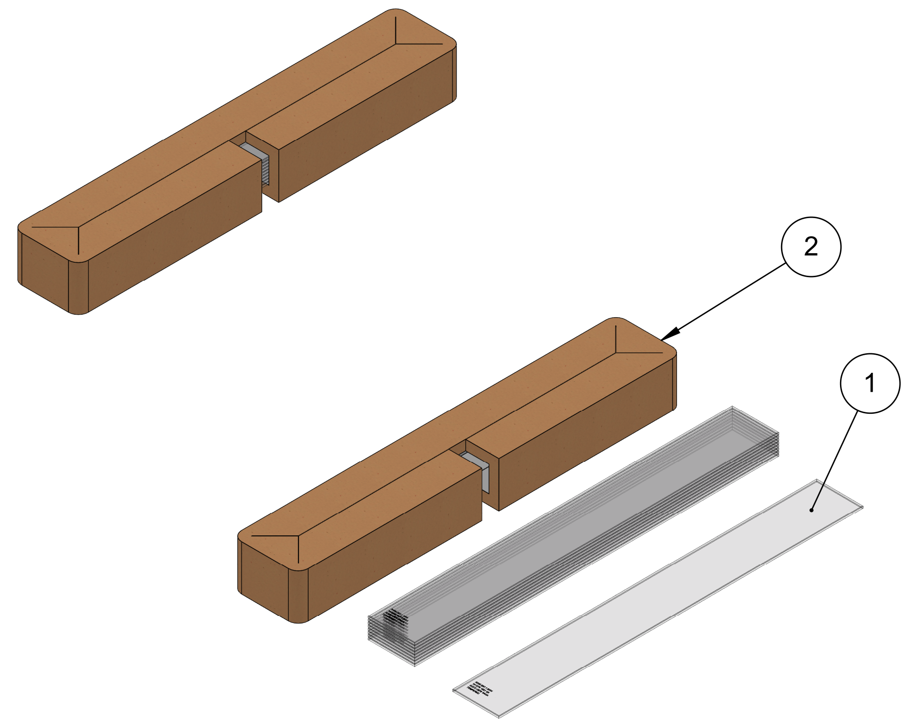
DESCRIPTION: 1/4X4-1/8X32-3/16 TEMPERED GLASS - 9-PK

SHEET 1 OF 2	REVISION	PART NUMBER
SCALE 1:2	1	34107308
WEIGHT: 2.62		

NOTES:
1. NINE PIECES OF GLASS PACKAGED AS SHOWN BY SUPPLIER.
2. TAPE CORREGATED SECURELY.

ITEM NO.	PART NO.	DESCRIPTION	QTY
1	34107308	1/4X4-1/8X32-3/16 TEMPERED GLASS - 9-PK	9
2	34107318	GLASS PROTECTION PACKAGE for 9 PCS ON 36" RAIL	1





BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

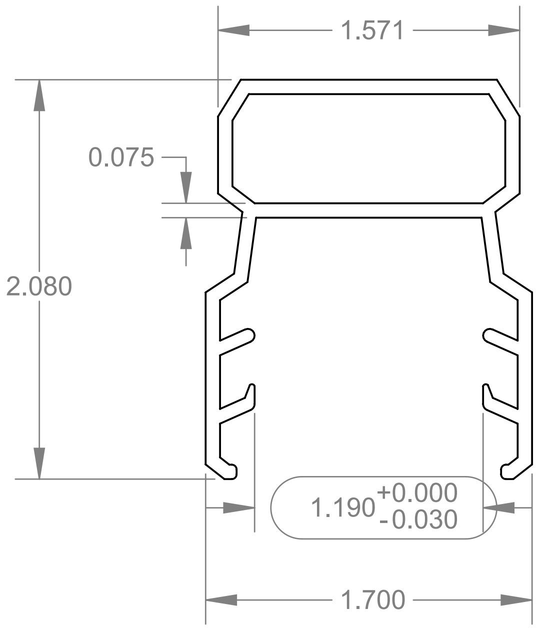
DRAWN: W DIXON	DATE: 2/9/2015	APPROVED:

DESCRIPTION: 1/4X4-1/8X32-3/16 TEMPERED GLASS - 9-PK

SHEET 2 OF 2	REVISION	PART NUMBER
SCALE 1:2	1	**34107308**
WEIGHT: 26.85		

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS OVER EPN 0513
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH
34109496	VERSA RAIL TOP RAIL 70.25" EPN-0507	70.25"
34109194	VERSA RAIL TOP RAIL 93" EPN-0507	93"
34109918	TRISTAN TOP RAIL 71.5" EPN-0507	71.5"
34109919	TRISTAN TOP RAIL 95.5" EPN-0507	95.5"



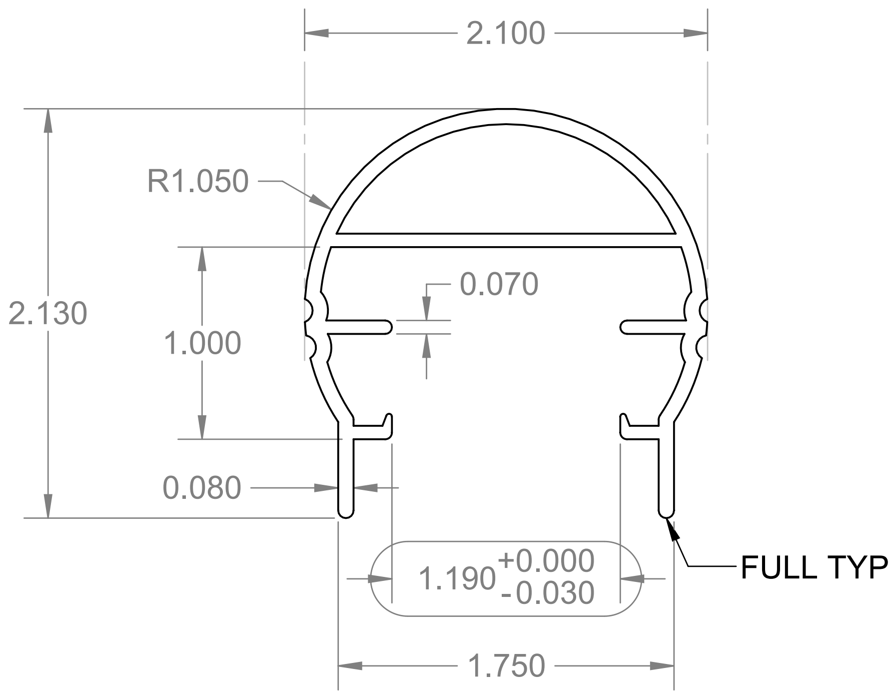
REV	BY	DATE	PCR	DESCRIPTION

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 2/28/2014	APPROVED:
DESCRIPTION: VERSARAIL PROFILE		
SHEET 1 OF 1	REVISION 1	PART NUMBER EPN 0507
SCALE 1:1		
WEIGHT: 0.68		

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS OVER EPN 0513
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH	MATERIAL	HEAT TREAT	WEBSTER RANGE
34109926	LANVAL TOP RAIL CHANNEL 71.5" EPN-0518	71.5"	6005	T5	14.0 TO 18.0
34109927	LANVAL TOP RAIL CHANNEL 95.5" EPN-0518	95.5"	6005	T5	14.0 TO 18.0



REV	BY	DATE	PCR	DESCRIPTION
1	PBS	8/16/2017	N/A	ADDED WEBSTER RANGE TO TABLE

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

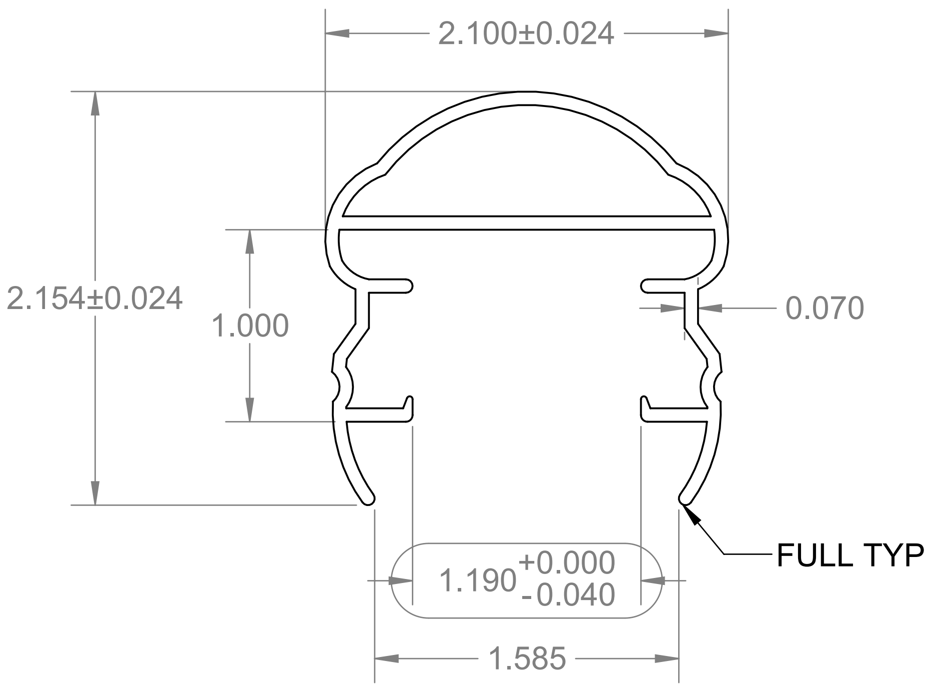
DRAWN: W DIXON | DATE: 2/28/2014 | APPROVED:

DESCRIPTION: LANVAL RAIL CHANNEL

SHEET 1 OF 1
SCALE 1:1
WEIGHT: 0.754
REVISION: 1
PART NUMBER: **EPN 0518**

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED
3. SNAPS OVER EPN 0513
4. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
5. LENGTH TOLERANCE +/- 1/16"

PART NO.	DESCRIPTION	LENGTH	MATERIAL	HEAT TREAT	WEBSTER RANGE
34109928	PELLINORE TOP RAIL CHANNEL 71.5" EPN-0519	71.5"	6005	T5	14.0 TO 18.0
34109929	PELLINORE TOP RAIL CHANNEL 95.5" EPN-0519	95.5"	6005	T5	14.0 TO 18.0
34115500	PELLINORE TOP RAIL CHANNEL 144.25" EPN-0519	144.25"	6005	T5	14.0 TO 18.0
34115501	PELLINORE TOP RAIL CHANNEL 192.375" EPN-0519	192.375"	6005	T5	14.0 TO 18.0



REV	BY	DATE	PCR	DESCRIPTION
5	PBS	8/16/2017	N/A	ADDED WEBSTER RANGE TO TABLE
4	PBS	4/20/2016	N/A	ADDED NEW LENGTHS, 34115500 AND 34115501.
3	PBS	2/18/2016	N/A	UPDATED TOLERANCES
2	WD	2/5/2016	N/A	CHG INSP DIM FOR HEIGHT
1	WD	8/20/2013	N/A	REMOVED BUMP FROM BOTTOM LEG

TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

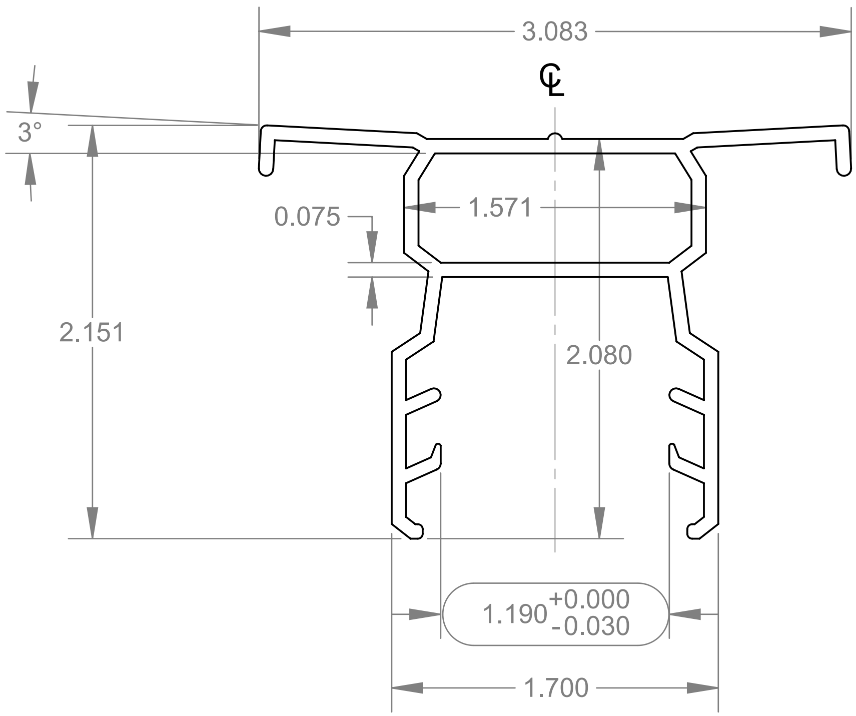
BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

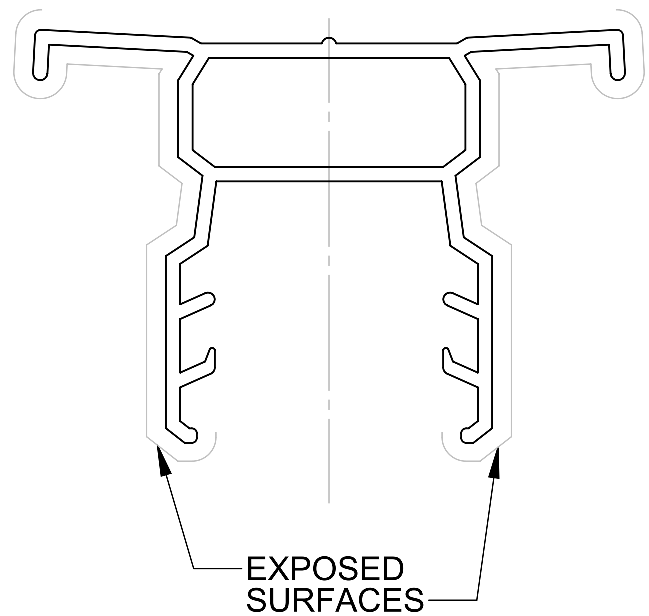
DRAWN: W DIXON	DATE: 2/28/2014	APPROVED:
DESCRIPTION: PELLINORE RAIL CHANNEL		
SHEET 1 OF 1 / SCALE 1:1 / WEIGHT: 0.729	REVISION 5	PART NUMBER EPN 0519

NOTES:
1. MATERIAL 6005-T5
2. OUTSIDE SURFACES EXPOSED AS INDICATED
3. STANDARD ALUM EXTR TOLERANCES APPLY UNLESS NOTED.
4. LENGTH TOLERANCE +/- 1/16"

DESCRIPTION	LENGTH
OBERON TOP RAIL EPN-0743 71.5	71.5"
OBERON TOP RAIL EPN-0743 95.5	95.5"

Area = 0.737 inches^2





REV	BY	DATE	PCR	DESCRIPTION

BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

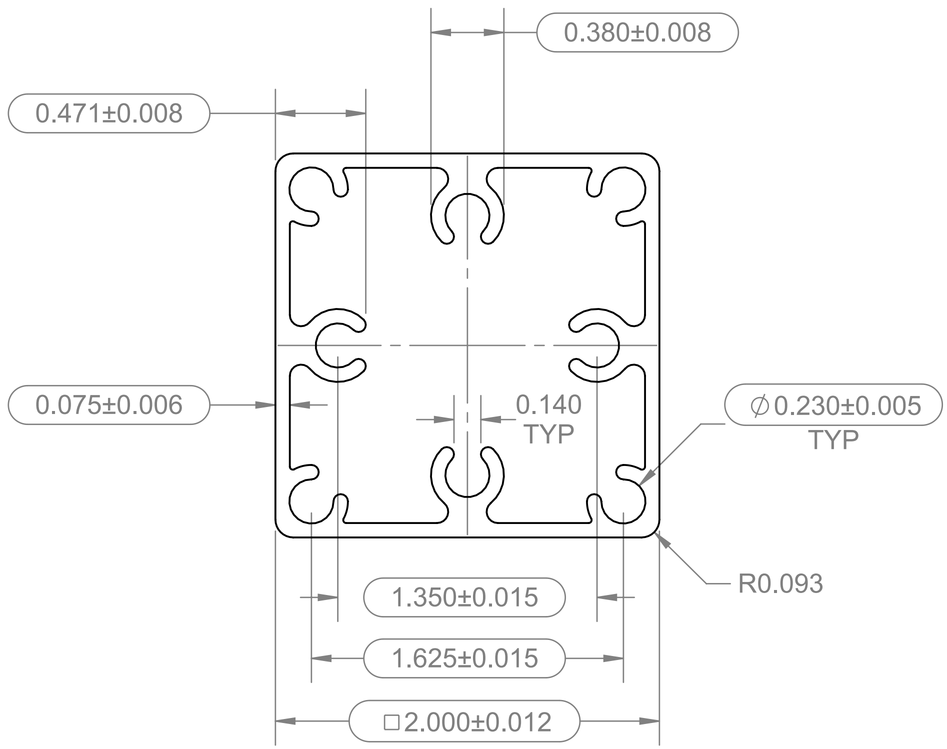
DRAWN: W DIXON | DATE: 8/17/2017 | APPROVED:

DESCRIPTION: OBERON TOP RAIL

SHEET 1 OF 1
SCALE 1:1
WEIGHT: 0.863
REVISION 0
PART NUMBER EPN-0743

PART NO.	DESCRIPTION	LENGTH
34107348	EPN 0541 2X2 POST 33"	33"
34107349	EPN 0541 2X2 POST 39"	39"
34107350	EPN 0541 2X2 POST 45"	45"
34107351	EPN 0541 2X2 POST 51"	51"

NOTES:
1. MATERIAL: 6005-T5 / 6005A-T61
2. ALUMINUM ASSOCIATION STANDARD TOLERANCES APPLY.
3. LENGTH TOLERANCE +/- 1/16"
4. OUTSIDE SURFACES EXPOSED



TOLERANCES	
FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE Outdoor Living

DRAWN: W DIXON | DATE: 1/9/2015 | APPROVED:

DESCRIPTION: 2X2 POST

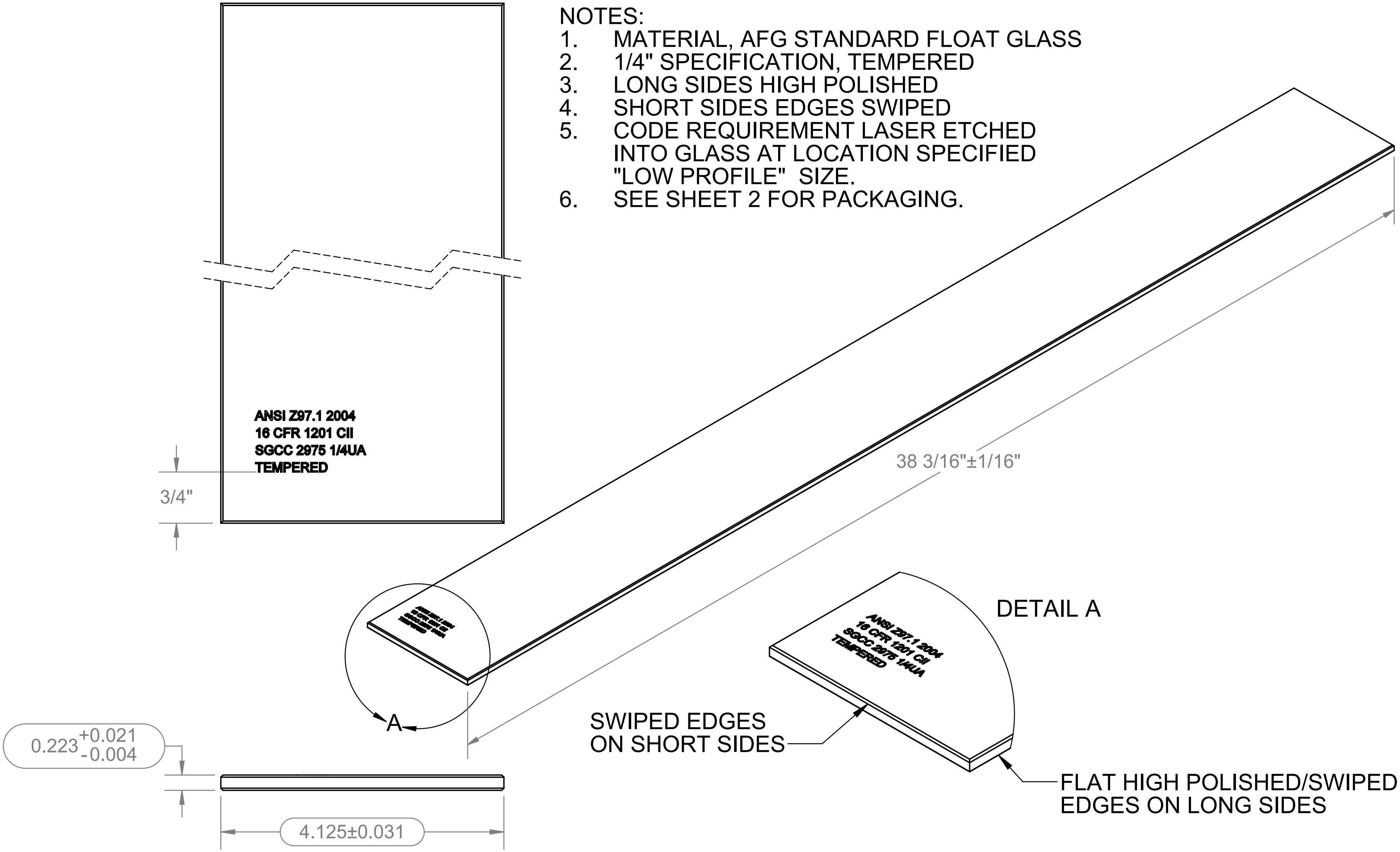
SHEET 1 OF 1
SCALE 1:1
WEIGHT: 1.137

REVISION: 2

PART NUMBER: **EPN-0541**

REV	BY	DATE	PCR	DESCRIPTION
2	PBS	9/22/2015	N/A	UPDATED LENGTH DIMENSIONS
1	WED	2/9/2015	N/A	ADD TOLEANCES AND 6005A-T61 ALLOY OPTION

NOTES:
1. MATERIAL, AFG STANDARD FLOAT GLASS
2. 1/4" SPECIFICATION, TEMPERED
3. LONG SIDES HIGH POLISHED
4. SHORT SIDES EDGES SWIPED
5. CODE REQUIREMENT LASER ETCHED INTO GLASS AT LOCATION SPECIFIED "LOW PROFILE" SIZE.
6. SEE SHEET 2 FOR PACKAGING.



TOLERANCES

FRACTION	±1/16
XX	±0.01
XXX	±0.005
ANGLE	±1.0°
FINISH	125 RMS
UNLESS OTHERWISE SPECIFIED	

BARRETTE
Outdoor Living

DRAWN:	DATE:	APPROVED:
W DIXON	6/29/2015	

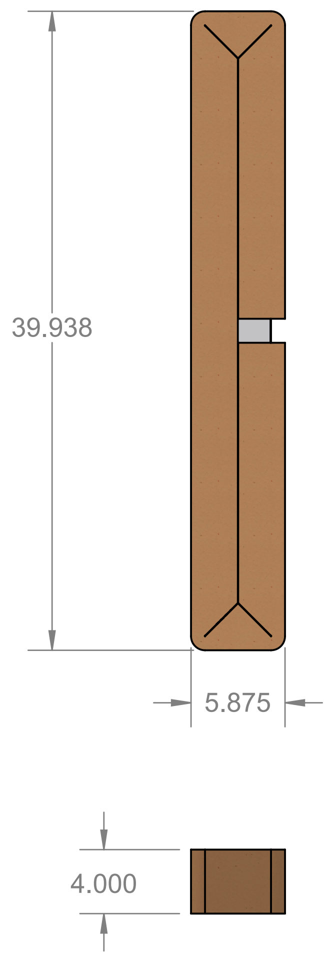
DESCRIPTION: 1/4X4-1/8X38-3/16 TEMPERED GLASS - 9-PK

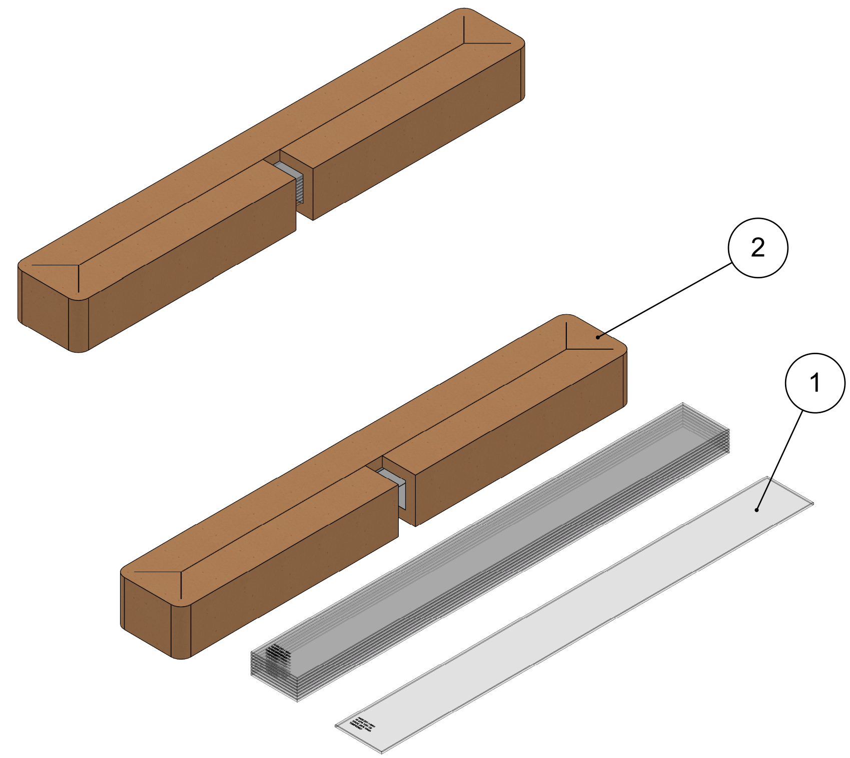
	REVISION	PART NUMBER
SHEET 1 OF 2	1	34110275
SCALE 1:2		
WEIGHT: 3.11		

REV	BY	DATE	PCR	DESCRIPTION
1	WED	8/10/2015	N/A	CHG LENGTH FOR GLASS DIMENSION 40-1/4" TO 38-3/16" ON PACKAGING SHEET GLASS LENGTH DID NOT CHANGE

NOTES:
1. NINE PIECES OF GLASS PACKAGED AS SHOWN BY SUPPLIER.
2. TAPE CORREGATED SECURELY.

ITEM NO.	PART NO.	DESCRIPTION	QTY
1	34110275	1/4X4-1/8X38-3/16 TEMPERED GLASS - 9-PK	9
2	EPN-5420	GLASS PROTECTION PACKAGE FOR 9 PCS ON 42" RAIL	1





BARRETTE
Outdoor Living
740 N. Main St., Bulls Gap, TN 37711

DRAWN: W DIXON	DATE: 6/29/2015	APPROVED:

DESCRIPTION: 1/4X4-1/8X38-3/16 TEMPERED GLASS - 9-PK

SHEET 2 OF 2	REVISION	PART NUMBER
SCALE 1:2	1	34110275
WEIGHT: 31.82		