### 3D VIEW OF RAILING WITH TYPE 1 - PICKET INFILL PANEL

**42" Height shown, 48" Height Similar**

#### TABLE 1 - RAILING MEMBERS

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>ALLOY(1)</th>
<th>DESIGNATION</th>
<th>OUTSIDE DIMENSION</th>
<th>WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posts (Type &quot;C&quot;)</td>
<td>6061-T6</td>
<td>Extrusion</td>
<td>1.50 x 0.250</td>
<td>0.250</td>
</tr>
<tr>
<td>Top Rail (Type &quot;C&quot;)</td>
<td>6061-T6</td>
<td>Extrusion</td>
<td>2.50 x 0.750</td>
<td>1.000</td>
</tr>
<tr>
<td>Top Rail</td>
<td>6061-T6</td>
<td>1&quot; NPS (Sch. 40)</td>
<td>2.875</td>
<td>0.125</td>
</tr>
<tr>
<td>End Hoops</td>
<td>6063-T5</td>
<td>2.00 OD x 0.125 Wall</td>
<td>2.875</td>
<td>0.125</td>
</tr>
<tr>
<td>Handrail Joint/Splice Sleeves</td>
<td>6063-T5</td>
<td>2.00 OD x 0.125 Wall</td>
<td>2.500</td>
<td>0.125</td>
</tr>
<tr>
<td>Handrail Support Bar</td>
<td>6061-T6</td>
<td>6&quot; Round Bar</td>
<td>0.750</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### DESIGN LOADS, GEOMETRY AND APPLICABILITY:

See the Instructions for Design Standards for the design loads, geometry and applicability requirements.

**GENERAL:**

Adequate foundation support shall be provided for anchorage and stability against overturning (See Sheet 8). See Section No. 1861 for special requirements and modifications for use on bridges. The railing shown on these drawings requires a handrail for ramps steeper than a 5% grade to conform with the requirements of the Americans with Disabilities Act (ADA).

**HARDS, PANELS AND POSTS:**

Structural Extrusions, Tube, Pipe and Bar shall be in accordance with Table 1 and ASTM B221 or ASTM B429. Top, bottom and intermediate rail corner bends with maximum 4°-0'0" post spacing, may be Alloy 6063-T6. Perforated panels (Type S) shall be Alloy 6063-H14. Posts shall be fabricated and installed plumb, ± 1" tolerance when measured at 3'-6" above the foundation. Pickets and vertical panel elements shall be fabricated parallel to the posts, except that Type 2, 3 & 5 panel infills may be fabricated parallel to the longitudinal grade. Corners and changes in tangential longitudinal alignment shall be made continuous with a 9" bend radius or terminate at adjoining sections with mitered end sections when handrails are not required. For changes in tangential longitudinal alignment greater than 45°, posts shall be positioned at a maximum distance of 2'0" each side of the corner and shall not be located at the corner apex. For curved longitudinal alignments the top and bottom rails and handrails shall be shop bent to match the alignment radius.

**BASE PLATES AND RAIL CARTS:**

Base Plates and Post Cap plates shall be in accordance with ASTM B209, Alloy 6061-T6.

**SHIM PLATES:**

Shim Plates shall be in aluminum in accordance with ASTM B629, Alloy 6061 or 6063. Shim plates shall be used for foundation height adjustments greater than 8" between 3 posts and localized irregularities greater than 8" beneath base plates. Field trimmed shim plates may be used in lieu of trimmed flat shim plates shown. Stacked shim plates must be bonded together with adhesive bonding material and limited to a maximum total thickness of 8", unless longer anchor bolts are provided for the exposed thread length.

**ANCHOR BOLTS:**

Anchor bolts shall be in accordance with ASTM F1554 (Grade 36 for 1" Ø and Grade 55 for 1½" Ø Bolt Anchorage). Headless anchor bolts for Adhesive Anchors shall be threaded full length. Cutting of reinforcing steel is permitted for drilled hole installation. Expansion Anchors are not permitted. All anchor bolts shall have single self-locking hex nuts. Tack welding of the nut to the anchor bolt may be used in lieu of self-locking nuts. All nuts shall be in accordance with ASTM A563 or ASTM A194. Flat Washers shall be in accordance with ASTM F436 and Plate Washers (for long slotted holes only), shall be in accordance with ASTM A36 or ASTM A516 Grade 36. After the nuts have been snug tightened, distort the anchor bolt threads to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with the Specifications.

**RESILIENT AND NEOPRENE PADS:**

Resilient and Neoprene pads shall be in accordance with Specification Section 932 except that testing of the finished pads shall not be required. Neoprene pads shall be dometop hardness 60 to 80.

**JOINTS:**

Grind welded joints as necessary to remove laps and weld splatter, additionally remove any sharp edges on rails to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with the Specifications. The expansion joint detail may be approved by the Engineer to facilitate handling, but top rail must be continuous across the joint to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with the Specifications.

**WELDING:**

All welding shall be in accordance with the American Welding Society Structural Welding Code (Aluminum) AWS D1.1/D1.1M-13 (current edition). Filler metal shall be either ER5183, ER5356 or ER5556. Nondestructive testing of welds is not required. Filler metal for plug welds and bend splices may be ER6043.

**COATINGS:**

The aluminum railing shall be mill finish unless otherwise noted in the Contract Documents. All nuts, bolts and washers shall be galvanized in accordance with Specification Section 902.

**SHOP DRAWINGS:**

Details addressing project specific geometry (line & grade) showing post and expansion joint locations, post and panel type, anchor bolt installation (Case or length, must be submitted by the Contractor for the Engineer's approval prior to fabrication of the railing. Shop drawings shall be in accordance with the Specifications.

**PAYMENT:**

Payment includes rails, posts, pickets, panels, rail splice assembly, base plates, anchor bolts, nuts, washers, resilient or neoprene pads and all incidental materials and labor required to complete installation of the railing.

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**NOTES:**

(1) Alloy 6061-T6 or 6063-T5 & T6 may be substituted for Alloy 6063-T5.

(2) 1½" wall thickness permitted for rails with post spacings less than 5'-9".

(3) 1½" NPS (Sch. 40) non-slit rail sleeves may be substituted when welded connection Detail "K" is utilized.
RAILINGS ON GRADES STEEPER THAN 5%
(Type 1 - Picket Railing Shown, Other Types Similar)

RAMP REQUIREMENTS
For slopes greater than 5%:
- Max. ramp slope = 8.33%
- Max. ramp cross-slope = 2.0%

LANDING REQUIREMENTS
Max. landing slope = 2%
Max. landing cross slope = 3%

ELEVATION (Showing Inside Face of Railing with Type "A" Posts)

TYPICAL RAILING DETAILS & RAILINGS ON GRADES 0% TO 5%
(Type 1 - Picket Railing Shown, Other Types Similar)

EXPANDED ELEVATION AT CORNERS

DETAIL FOR NON-CONTINUOUS RAILING AT CORNERS

NOTES:
* Keyed construction joints in Index No. 6011 Gravity Wall are not considered to be expansion joints.
** Contraction joints (Tooled or Saw Cut) in sidewalks do not require a 6" minimum offset.

ALUMINUM PEDESTRIAN/BICYCLE RAILING

2016 DESIGN STANDARDS

INDEX NO.
862

SHEET NO.
2 of 9
**railings on steps & stairs**

**rail termination details**

**detail "l" - plan view handrail termination**

- Handrail termination (Typ.) See detail "l".
- Rail termination (end cap) equal to one tread length.

**detail "j" - elevation view top rail termination**

- Top rail cap (Typ.) See detail "j".
- Round over corner's 3⁄8" (Typ.).

**detail "k" - elevation view bottom rail connection (intermediate rail similar)**

- Post.
- Handrail continuous at landing.
- Leveling channel (Typ.) See detail, Sheet 4.

**elevation**

- (At-grade steps shown, elevated stairs similar).

**alternate handrail end treatment or mounting location for sloped walls**

- Not considered an expansion joint for railing fabrication (Typ.).
BASE PLATE DETAILS FOR TYPE "C" POST

(Screws Not Shown For Clarity)

BASE PLATE DETAILS FOR TYPE "C" POST

(TOP PLATE DETAILS FOR TYPE "C" POST
(Screws Not Shown For Clarity)

† See Sheet 4 for Notes.
†† See Sheet 4 for Notes.
††† Length varies for beveled posts on grades. Holes must be drilled plumb to align with screw slot.
**PICKET NOTES:**

* Picket Spacing of 6½" centers is based on a ⅛" Ø Bar for standard applications. When shown in the Contract Plans a 4½" picket spacing may be required. If an alternate design is used, maintain a maximum clear opening of 5½" for standard installations and 3½" for special conditions.

**NOTES:**

1. See Plans for Infill Panel option required.
TYPE 3 - SUNSHINE INFILL PANEL

* Arc, Rays and Sun Segment may be formed in a single panel from 1/2" plate (ASTM B209 Alloy 6061-T6 or T651) pattern cut with laser or plasma CNC, welded to a 1x1x1/2 Angle Border or the 3x3x1/2 Channel Border shown.

NOTES:
1. See Plans for Infill Panel Option required.
SECTION A-A

TYPE A - PERFORATED INFILL PANEL

SECTION C-C

DETAIL "SA"
PANEL/RAIL CONNECTION
(Top Shown, Bottom Similar)

SECTION A-A

DETAIL "SB"
PANEL END CONNECTION
(Expansion Joint Shown, Sides Similar)

DETAIL REPEATING PATTERN DETAIL FOR PERFORATED PANEL

ALUMINUM PEDESTRIAN/BICYCLE RAILING
TYPICAL SECTION ON CONCRETE SIDEWALK (Case I)

1 - 1/2" C-I-P Hex Head Anchor Bolts, or 1 - 7/8" Headless Anchor Bolts set with an Adhesive Bonding Material System in accordance with Specification Sections 416 and 937. Self-Locking Hex Nut & Washer. Place Anchor Bolts perpendicular to Base ℅ for Grades ≤ 8.33% (Ramps) with flat washer. Place anchor bolts plumb for grades > 8.33° (Stairs) with flat washer & beveled washer, or leveling channel.

DETAIL "D" (OPTIONAL SHIMMING DETAIL FOR CROSS SLOPE CORRECTION) (Used in lieu of Beveled Shim Plates)

TYPICAL SECTION ON RETAINING WALL (Case II)

TYPICAL SECTION ON STEPS & STAIRS (Case III)

TYPICAL SECTION FOR 4-BOLT ANCHORAGE (Case IV)

ANCHOR BOLT TABLE

<table>
<thead>
<tr>
<th>CASE TYPE</th>
<th>STRUCTURE</th>
<th>DIMENSIONS</th>
<th>ANCHOR LENGTH</th>
<th>ANCHOR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unreinforced Concrete</td>
<td>6&quot;</td>
<td>1&quot;-2&quot;</td>
<td>9&quot;</td>
<td>10 1/2&quot;</td>
</tr>
<tr>
<td>Reinforced Concrete</td>
<td>4&quot;</td>
<td>4&quot;</td>
<td>9&quot;</td>
<td>10 1/2&quot;</td>
</tr>
<tr>
<td>Gravity Wall</td>
<td>6½&quot;</td>
<td>2½&quot;</td>
<td>9&quot;</td>
<td>10 1/2&quot;</td>
</tr>
<tr>
<td>Step Cheekwall</td>
<td>4½&quot;</td>
<td>4½&quot;</td>
<td>9&quot;</td>
<td>10 1/2&quot;</td>
</tr>
</tbody>
</table>

* Embedment length "C" may be reduced to 9" for the 42" height railings for Case IIb, when the post spacing does not exceed 5'-0".

** When required; measured from top of sidewalk (Typ.)