DESIGN VALUES ARE PRESENTED IN THIS DOCUMENT IN BOTH METRIC AND U.S. CUSTOMARY UNITS AND WERE DEVELOPED INDEPENDENTLY WITHIN EACH SYSTEM. THE RELATIONSHIP BETWEEN THE METRIC AND U.S. CUSTOMARY VALUES IS NEITHER AN EXACT (SOFT) CONVERSION NOR A COMPLETELY RATIONALIZED (HARD) CONVERSION. THE METRIC VALUES ARE THOSE THAT WOULD HAVE BEEN USED HAD THIS DOCUMENT BEEN PRESENTED EXCLUSIVELY IN METRIC UNITS; THE U.S. CUSTOMARY VALUES ARE THOSE THAT WOULD HAVE BEEN USED IF THIS DOCUMENT HAD BEEN PRESENTED EXCLUSIVELY IN U.S. CUSTOMARY UNITS. THEREFORE, THE USER IS ADVISED TO WORK COMPLETELY IN ONE SYSTEM AND NOT ATTEMPT TO CONVERT DIRECTLY BETWEEN THE TWO.
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**DELAWARE DEPARTMENT OF TRANSPORTATION**

**GARDAIR APPLICATIONS**

**STANDARD NO.** B-1 02060  **SHT.** 1  **OF** 6  **APPROVED**

---

**NOTE #1:**

1. The distance from the edge of the travel lane or shoulder to the face of guardrail should be maximized. This area shall be graded 10:1 or flatter.

2. Place guardrail reflector every fifth post.

---

**FLARE RATES**

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<tr>
<td>60 MPH (96 km/h)</td>
<td>6d</td>
</tr>
<tr>
<td>55 MPH (89 km/h)</td>
<td>6d</td>
</tr>
<tr>
<td>50 MPH (80 km/h)</td>
<td>6d</td>
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<tr>
<td>45 MPH (72 km/h)</td>
<td>6d</td>
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<tr>
<td>40 MPH (64 km/h)</td>
<td>5d</td>
</tr>
<tr>
<td>30 MPH (48 km/h)</td>
<td>4d</td>
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**DESIGN SPEED**

- 70 MPH (112 km/h)
- 60 MPH (96 km/h)
- 55 MPH (89 km/h)
- 50 MPH (80 km/h)
- 45 MPH (72 km/h)
- 40 MPH (64 km/h)
- 30 MPH (48 km/h)

---

**GUARDRAIL FLARE RATES**

- EDGE OF TRAVEL LANE
- EDGE OF SHOULDER

---

**GUARDRAIL TREATMENT**

**TYPE 1 GUARDRAIL**

- TYPICAL GUARDRAIL TREATMENT
- WHEN THE REQUIRED 4' (1200) CLEARANCE TO OBSTRUCTION IS AVAILABLE

**TYPE 2 GUARDRAIL**

- TYPICAL GUARDRAIL TREATMENT
- WHEN 2' (600) TO 4' (1200) OF CLEARANCE TO OBSTRUCTION IS AVAILABLE

---

**TYPICAL GUARDRAIL PLACEMENT**

**PROPERTY OF THE STATE OF DELAWARE**

---

**DATE:** 01/01/05

---

**DESIGN ENGINEER**

---

**SCALE:** 1/16" = 1'-0" (N.T.S.)

---

**CHIEF ENGINEER**
OVERLAP W-BEAMS IN DIRECTION OF TRAVEL.

NOTE: OVERLAP W-BEAMS IN DIRECTION OF TRAVEL.
1. Flare the end treatment at 25°/beginning 50°/05 m from the end of the impact head, unless the construction plans or specifications specify a smaller flare.
2. This detail was solely created to show the grading required for this type of attenuator.
3. The guardrail end treatment attenuator shall be installed as per the manufacturer’s and the Department of Transportation’s specifications.
4. If curb is present, depress the curb to a maximum height of 2"/50 within the limits of the end treatment and throughout the length of the taper grading.

**NOTES:**

**SECTION A-A**

**GRADING FOR GUARDRAIL END TREATMENT ATTENUATOR, TYPE 1**
1. Flare shall be 4' (1200) unless the construction plans or specifications specify a smaller flare, flare may be parabolic or straight based on manufacturer's specifications.

2. This detail was solely created to show the grading required for this type of attenuator. The guardrail end treatment attenuator shall be installed as per the manufacturer's and the department of transportation's specifications.

3. If curb is present, depress the curb to a maximum height of 2" (50) within the limits of the end treatment and throughout the length of the taper grading.

**NOTES:**

**SECTION A-A**

**GRADING FOR GUARDRAIL END TREATMENT ATTENUATOR, TYPE 2**

**DELTA**

**DEPARTMENT OF TRANSPORTATION**

**GUARDRAIL APPLICATIONS**

**STANDARD NO.** B-1 (2007)

**SHT.** 5 OF 6

**APPROVED**

**RECOMMENDED**

**SCALE 1/8 INCH = 50 FEET**
1. This detail was solely created to show the grading required for this type of attenuator.
2. 6:1 or flatter grading is allowable when the barrier is located 12' (3650 mm) or more from the outside edge of the shoulder.
3. This end treatment can also be used in ramp gores or other areas where 2 rails of W-beam come together and terminate with one end treatment.
4. When opposing roadways have equal elevations the traffic barrier system should be placed on the opposite side of the ditch line from approaching traffic.
5. The guardrail end treatment attenuator shall be installed as per the manufacturer’s and the Department of Transportation’s specifications.
6. If curb is present, depress the curb to a maximum height of 2'/500 (750 mm) within the limits of the end treatment and throughout the length of the taper grading.

**NOTES:**
- Normal double face W-beam barrier or transition to concrete barrier
- 50' HS: Limit of payment
- Direction of traffic
- Shoulder
- Median ditch
- Transition grading shown on plans (if required)
- Median grading
- Shoulder
- 10' (3000) min
- Variance 1' (300 mm) offset from flow line
- Post

**SECTION A-A**

**GRADING FOR END TREATMENT ATTENUATOR, TYPE 3**

**PLAN VIEW**

**NORMAL DOUBLE FACE W-BEAM BARRIER OR TRANSITION TO CONCRETE BARRIER**

**NOTE:**
- 10:1 or flatter slope
- Beginning of transition
- Post
- Shoulder

**SCALE:** 1/100

**DATE:** 10/23/07

**APPROVED:**

**DEPARTMENT OF TRANSPORTATION**

**GUARDRAIL APPLICATIONS**

**STANDARD NO.** B-1 (2007)  **SHT.** 6  **OF** 6

**RECOMMENDED**

**NOTE:**
- 6:1 or flatter grading is allowable when the barrier is located 12' (3650 mm) or more from the outside edge of the shoulder.
- This end treatment can also be used in ramp gores or other areas where 2 rails of W-beam come together and terminate with one end treatment.
- When opposing roadways have equal elevations the traffic barrier system should be placed on the opposite side of the ditch line from approaching traffic.
- The guardrail end treatment attenuator shall be installed as per the manufacturer’s and the Department of Transportation’s specifications.
- If curb is present, depress the curb to a maximum height of 2'/500 (750 mm) within the limits of the end treatment and throughout the length of the taper grading.
**NOTES:**
1. ALL W-BEAMS ARE 13'-4"/16'0" IN LENGTH.
2. PLACE GUARDRAIL REFLECTOR EVERY FIFTH POST.
NOTES:
1. ALL #BEAMS ARE 12'-6"/14'-0") IN LENGTH.
2. PLACE GUARDRAIL REFLECTOR EVERY FIFTH POST.
DELAWARE
DEPARTMENT OF TRANSPORTATION

GUARDRAIL OVER CULVERT, TYPE 3

STANDARD NO. B-2 (2009)  SHT. 3 OF 3

APPROVED

SIGNATURE ON FILE  01/10/2010

RECOMMENDED

SIGNATURE ON FILE  01/14/2010

NOTES:
1. PLACE GUARDRAIL REFLECTOR EVERY FIFTH POST.
2. POSTS 1-4 AND 9-14 ARE TO BE 6X6X3000 (OBS-TDSI) STEEL POSTS. POSTS 5-8 ARE TO BE 6X6X1500 (OBS-1500) BREAKAWAY WOOD POSTS WITH 2 WOOD BLOCKS AT EACH OF THESE 6 POSTS.
3. THE SPIKES AT POSTS 5, 8, & 10 ARE TO USE ¾”-16 GUARDRAIL BOLT L-22” (660I).
1. No washers are used on the rail side of the long wood breakaway posts.
2. The curved guardrail section shall be shop bent.
3. Place guardrail reflector every fifth post.
4. If curb is used in conjunction with curved guardrail section, the curb cannot be higher than 2" (50).
5. On the 8'6" (2600) radius system only, the rail is not to be bolted to the center post.
END SECTION PLAN

END SECTION ELEVATION

NOTES:
1. ADDITIONAL HOLES FOR ANCHOR PLATE SHALL BE DRILLED PRIOR TO GALVANIZING. SEE STANDARD HARDWARE SHEET FOR HOLE SPACING INFORMATION.
2. CONTRACTOR HAS THE OPTION OF USING A 6' (060) STEEL TUBE WITHOUT A SOIL PLATE OR A 5' (050) STEEL TUBE WITH A SOIL PLATE.
Flare Rates

<table>
<thead>
<tr>
<th>Design Speed</th>
<th>Flare Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>To MPH 40 km/h</td>
<td>15d</td>
</tr>
<tr>
<td>50 MPH 80 km/h</td>
<td>40d</td>
</tr>
<tr>
<td>55 MPH 90 km/h</td>
<td>30d</td>
</tr>
<tr>
<td>45 MPH 70 km/h</td>
<td>10c</td>
</tr>
<tr>
<td>40 MPH 60 km/h</td>
<td>9c</td>
</tr>
<tr>
<td>30 MPH 50 km/h</td>
<td>7c</td>
</tr>
</tbody>
</table>

Section A-A

Section B-B (with Rubrail)

Section C-C (with Rubrail)

Section D-D

Flanged Back Slope

Flanged Back Slope

NOTE: 1) BURIED END SECTION PAYMENT INCLUDES THE CONCRETE OR POST ANCHORAGE, EXCAVATION, BACKFILL, AND ALL APPLICABLE ITEMS, INCLUDING LABOR NECESSARY TO COMPLETE END ANCHORAGE.

2) THE CONTRACTOR HAS THE OPTION OF USING EITHER A CONCRETE BLOCK ANCHOR OR A POST ANCHOR TO TERMINATE THE BURIED END SECTION.


4) WHEN USING A SECOND RAIL, 8' (2400MM) LONG POSTS ARE REQUIRED BEHIND THE DITCHLINE. POSTS MUST PROVIDE 4" (100MM) MINIMUM EMERGENCE (20" (508MM) WHEN ROCK IS ENCOUNTERED). POSTS FOR THE POST ANCHOR SHALL BE 4' (1200MM) LONG.

5) WHEN USING THE BURIED END SECTION, THE DESIGN MUST PROVIDE A MINIMUM OF 75" (1230MM) FROM WHERE THE GUARDRAIL CROSSES THE DITCH LINE TO THE BEGINNING OF THE HAZARD.

6) MAINTAIN THE FLARE OF THE GUARDRAIL UNTIL THE 12' (3600MM) COVER HAS BEEN ATTAINED. IF THE 12' (3600MM) COVER CANNOT BE ATTAINED BEFORE THE RAIL IS 7' (2100MM) BEHIND THE BOTTOM OF THE DITCH, THEN SLOPE THE GUARDRAIL FROM THE POINT WHERE IT CROSSES THE DITCH TO WHERE IT IS 7' (2100MM) BEHIND THE DITCH, SO THAT IT HAS 2' (600MM) OF COVER.
STEEL PLATE - 1/4" (3) THICK
GALVANIZED
NOTE: ALL HOLES TO BE DRILLED PRIOR TO GALVANIZING.

THREADED INSERT FOR 1/4" (220) HIGH STRENGTH HEX BOLT (32,500 LB; 30,700 KG) ULTIMATE ADHESIVE BOND STRENGTH 90' (2550) MINIMUM ENGAGEMENT

CONCRETE BLOCK ANCHOR
BOLT PLATE TO POST WITH 3 - 1/4" (6) DIAL HEX BOLTS 2" (50) LONG WITH HEX NUTS.

ELEVATION

POST ANCHOR DETAIL

DELTA DEPARTMENT OF TRANSPORTATION

STANDARD NO. B-6 (2002)
SHT. 3 OF 3

RECOMMENDED
NOTES:
0. CURB SHALL NOT BE USED AT THE FACE OF RAIL WITHIN THE LIMITS OF THIS INSTALLATION.
2. POSTS 1, 2, 3, 4, AND 6 REQUIRE AN ADDITIONAL HOLE TO ATTACH WOOD BLOCKS AND/OR BENT RAIL.
3L. DO NOT ATTACH RAILS TO POSTS 1, 2, 3, 5, OR 7.
4L. POSTS 1 AND 2 ARE W6x3 (W200x63). ALL OTHER POSTS IN TRANSITION ARE W6x9 (W50x135).
5L. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.
6L. BENT RAIL MAY BE SHAPED BENT TO FACILITATE INSTALLATION OR MAY BE FIELD BENT USING HEAT.
7L. APPROVED CONCRETE INSERTS MAY BE USED IN NEW CONSTRUCTION TO ATTACH TERMINAL CONNECTORS TO PARAPET.
8L. PLACE GUARDRAIL REFLECTOR EVERY FIFTH POST.
9L. FOR INSTALLATIONS WHERE CURB EXISTS, IF THE EXISTING CURB IS 8" (200) OR HIGHER AND CANNOT BE REMOVED, THE BOTTOM RAIL CAN BE ELIMINATED.

DELAWARE
DEPARTMENT OF TRANSPORTATION

GUARDRAIL TO BARRIER CONNECTION, APPROACH TYPE 2

STANDARD NO. B-8 (2005)  SHT. 1 OF 2

APPROVED

Cordell Wich 12/5/05

RECOMMENDED

John来历 11/6/05

10/17/2005
BEND RAIL

BENT RAIL WOOD BLOCKS
1'-2" (360) x 4½" (115)

<table>
<thead>
<tr>
<th>BLOCK</th>
<th>WIDTH</th>
<th>BOLT LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5&quot; (125)</td>
<td>8&quot; (200)</td>
</tr>
<tr>
<td>2</td>
<td>4&quot; (100)</td>
<td>6½&quot; (165)</td>
</tr>
<tr>
<td>3</td>
<td>3½&quot; (95)</td>
<td>6½&quot; (165)</td>
</tr>
<tr>
<td>4</td>
<td>2½&quot; (65)</td>
<td>4&quot; (100)</td>
</tr>
</tbody>
</table>

NOTE: BOTTOM WOOD BLOCKS LOCATED ON POSTS 1-4 ARE OFFSET DRILLED TO SIT SQUARELY ON THE POST FLANGE AND SECURED WITH 5/16" CARRIAGE BOLTS.

04/05/2001
**NOTES:**

1. **This Installation Shall be Used When the Existing Sidewalk is 6'0" (1800) or Less.**

2. Use a Thrie Beam Expansion Section at Bridge Expansion Joints.

3. Place Guardrail Reflector in the Upper Valley of the Thrie Beam Every Fifth Post.

4. Thrie Beam Block Thickness shall be Adjusted to Allow Face of the Thrie Beam to Be Flush with Bottom of Curb. Minimum Thickness shall be 4" (100).

5. The Exit End Application Shall be Used Only on Divided Highways. For All Other Situations, the Entrance End Application shall be Used on Both Ends of the Bridge Parapet.

6. Spacing of Wood Posts May Need to Be Reduced to Accommodate Lining Up Posts at the End of the Parapet.
NOTE: 1. THIS INSTALLATION SHALL BE USED WHEN THE EXISTING SIDEWALK IS 18" (450) OR WIDER, AND DEAD LOAD CONSIDERATIONS ARE A CONCERN WHEN USING BRIDGE RAIL RETROFIT, TYPE 2.

2. ADHESIVE ANCHORS SHALL BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS AND SHALL BE GALVANIZED.

3. USE A THRIE BEAM EXPANSION SECTION AT BRIDGE EXPANSION JOINTS.

4. PLACE GUARDRAIL REFLECTOR IN THE UPPER VALLEY OF THE THRIE BEAM EVERY FIFTH POST.

5. THE EXIT END APPLICATION SHALL BE USED ONLY ON DIVIDED HIGHWAYS. FOR ALL OTHER SITUATIONS, THE ENTRANCE END APPLICATION SHALL BE USED ON BOTH ENDS OF THE BRIDGE PARAPET.

6. SPACING OF STEEL POSTS MAY NEED TO BE REDUCED TO ACCOMMODATE LINING UP POSTS AT THE END OF THE PARAPET.
W6 x 15 (W150 x 22) STEEL GUARDRAIL POST

BASE PLATE DETAIL

POST 10''

3/4" (19) DIA.

3/4" (19) DIA.

1/2" (13) DIA.

W6 x 15 (W150 x 22)

TRAFFIC FACE

WELD ALL AROUND INCLUDING EXTERIOR FLANGE SURFACE

DELAWARE
DEPARTMENT OF TRANSPORTATION

BRIDGE RAIL RETROFIT, TYPE 2

STANDARD NO. B-11 (2001) SHT. 2 OF 2

APPROVED 01/09/01

RECOMMENDED 01/09/01

04/05/2001
Type I Guardrail Placement or Appropriate End Treatment
Guardrail to Barrier Connection
Limit of Payment

End of Sidewalk
Taper End of Wall to Top of
Guardrail at a slope of 4:1 or flatter
Existing Bridge Rail
Contraction Joints
Bridge Barrier
Direction of Travel

Plan

Existing Rail - Do Not Disturb

2" (50mm) Cover
Typ.

Notes:
Standard Guardrail to Barrier Connections shall be connected to the ends of the new
Bridge Barrier and Transitioned to the existing
Guardrail.

Section A-A

Drill 2-1/8" dia. hole, fill with high
strength, non-sagging grout

#6 (4) @ 18" (457mm) Longitudinally,
Front and back rows shall be staggered

Approved

Delaware Department of Transportation
Bridge Rail Retrofit, Type 3
Standard No. B-12 (2001)
Sheet 1 of 1
Recommended
**NOTES:**

B. Two additional $\frac{1}{4}' (20) x 2$" (50) Post Bolt Slots shall be provided at 6'-3" (1905) spacing for beam length of 26'-1$\frac{1}{8}$" (7940).

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**DELTAW ARE DEPARTMENT OF TRANSPORTATION**

**HARDWARE**

STANDARD NO. B-13 (2004) SHT. 1 OF 15

**APPROVED**

[Signature]

[Date] 1/3/05
NOTE: WHERE CONDITIONS REQUIRE, ALTERNATE LENGTHS IN INCREMENTS OF 6" (150) MAY BE USED.

NOTE: ALL HOLES SHALL BE 3/8" (9.53) BOLT
HOLE PATTERN IS SYMMETRICAL WITH RESPECT TO THE VERTICAL AXIS OF THE POST.

W-BEAM STEEL POST AND WOOD OFFSET BLOCK

DELAWARE
DEPARTMENT OF TRANSPORTATION

HARDWARE

STANDARD NO. B-13 (2000) SHT. 2 OF 13

APPROVED

DELTA STEEL
M-POST

OFFSET BLOCK

NOTE: \[ 6' (1830) \text{ MIN.} \]
\[ +1" (25) \]
\[ 2" (50) \]
\[ 5" (125) \]
\[ +4" (100) \]
\[ +12" (300) \]
\[ 6" (150) \]
\[ +1" (25) \]
\[ 5" (125) \]
\[ 6" (150) \]
\[ +12" (300) \]

FOR GUARDRAIL TO BARRIER CONNECTIONS - TYPE 1

FOR GUARDRAIL TO BARRIER CONNECTIONS - TYPE 2

WHERE RUB RAIL IS USED.