Appendix 1

Dimensions and Specifications of the RCAR Bumper Barrier System

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INDEX

1.0 INTRODUCTION

This document gives the specifications and dimensions for the bumper barrier and energy absorber test devices used as part of the assessment of damageability in low speed crashes.

2.0 STEEL BARRIER

2.1 Design and Dimensions

The bumper barrier (Figure 1) is a rigid construction made of steel with a radius of 3400 mm ± 25 mm across its full width. It is 1500 mm ± 25 mm wide with a flat, 100 mm ± 2 mm tall vertical face. The barrier is at least 230 mm deep at its center (without flanges) and should be constructed such that it can be mounted to an unyielding and immovable crash wall at various heights. (See section 4 for drawings)

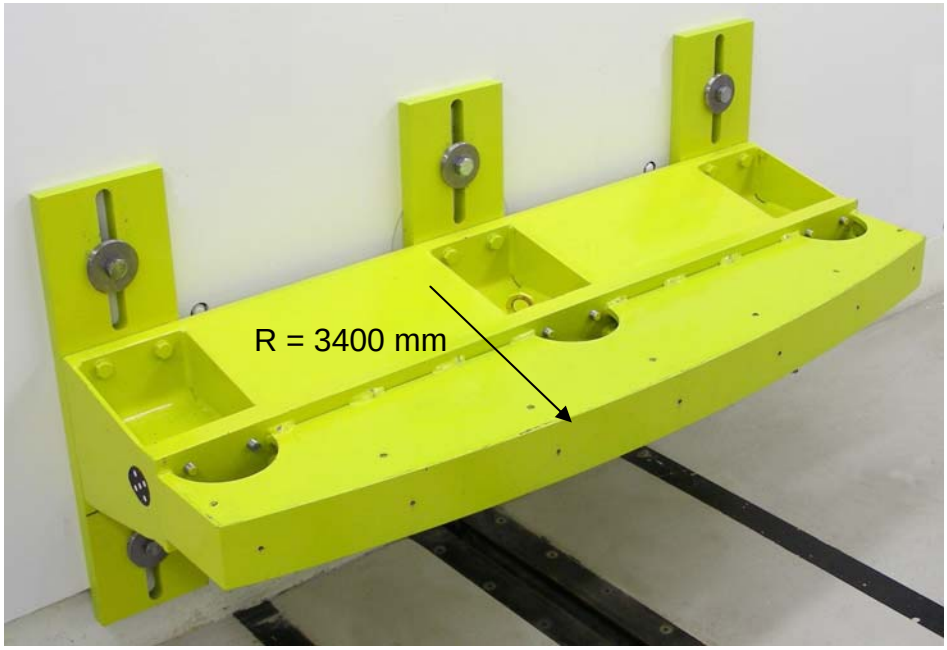

Fig. 1: Bumper barrier steel body (example AZT)

2.2 Backstop

A rigid backstop is fixed on top of the barrier. It is constructed from a steel plate, 200 mm ± 2 mm tall and at least 8 mm thick, with the same radius and width as the bumper barrier. The backstop is positioned 25 mm ±1 mm behind the flat vertical steel bumper barrier face, measured in the bumper barrier center line (fig. 2 and 3).
A gap (max. 10 mm) between the backstop and the upper barrier surface shall allow for unimpaired sliding of the energy absorber cover (see 3.3).

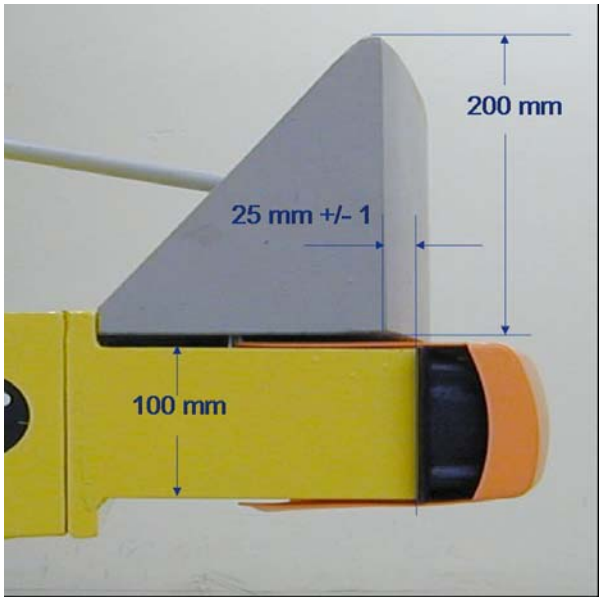

Fig. 2: Bumper barrier with backstop and energy absorber (side view)

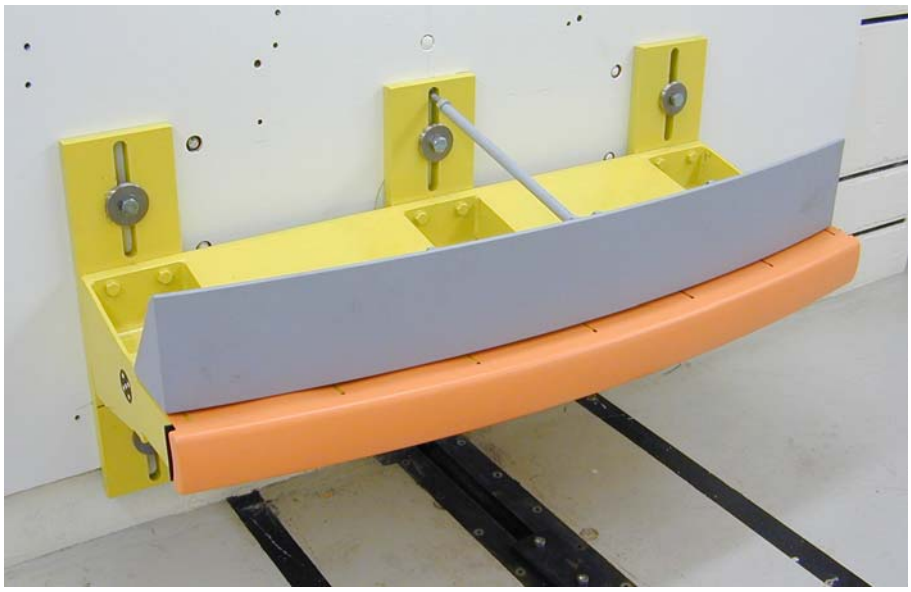

Fig. 3: Complete bumper barrier with backstop and energy absorber

3.0 ENERGY ABSORBER

3.1 General

Several different energy absorbers were used in the development of the RCAR bumper system including aluminum honeycomb, aluminum egg-crate, and thermo-plastic materials. The test results using these various energy absorbers were found to be largely independent of the material. Thus, the energy absorber properties for perpendicular loading and specifications in this document encompass the properties of all the absorbers used in the test development process. The energy absorber does not have to be one piece, as long as the dimensions, crush strength, surface hardness and coefficient of friction are within the specified ranges. One current design [1]) consists of two components: an energy absorber and a separate cover. If the system consists of more than one piece, the entire assembly shall be used when evaluating the crush strength.

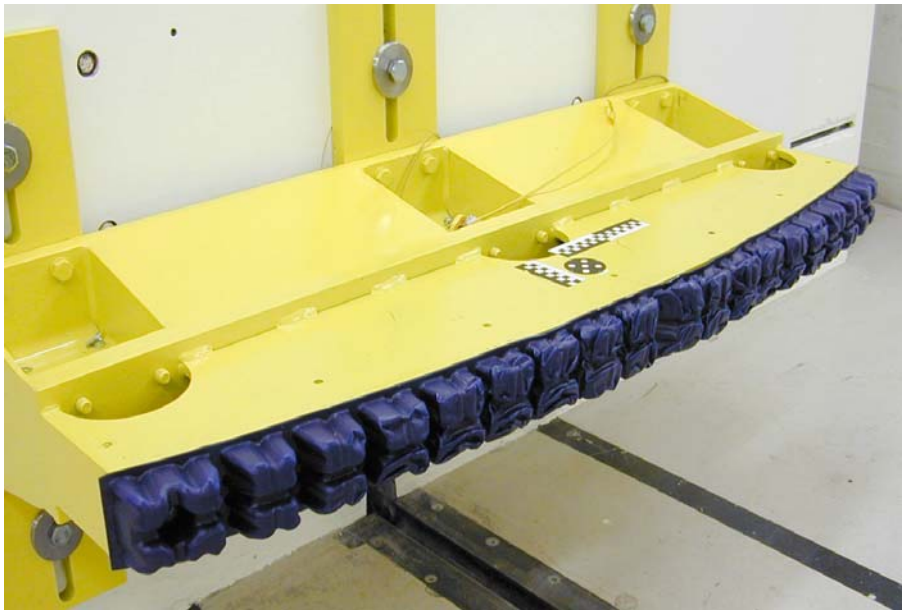

Fig. 4: Energy absorber without cover

3.2 Dimensions

The energy absorber shall be as long as the bumper face, 50 mm deep and is curved along its length to a radius of 3400 mm to allow for mounting on the barrier face. The front face of the absorber has a 150 mm ± 2 mm top-to-bottom radius, see drawings in section 4.0, figure 9 and 10.

1 **made by NetShape International, USA.** netshapecorp.com

3.3 Mounting

The energy absorber should be firmly affixed to the underlying bumper barrier face without gaps at the interface.
In case the cover of the EA element is wrapped around the metal barrier and fastened on the top and bottom plane of the barrier, the cover shall be able to slide rearwards without influencing the deformation of the EA element. For this purpose a gap between the metal barrier and the backstop is needed. One current design of the cover provides slotted holes to allow unrestricted sliding when the cover is fixed by mushroom type plastic fasteners. When screws are used they shall not squeeze the cover material. All fasteners should sit in the far end of the slots to keep the cover in position under slight tension and allow full travel through the slot under impact forces.
Other methods of fixing a cover are acceptable as long as they allow for unrestricted sliding. Horizontal forces needed to slide the cover rearwards should not exceed 50 N.

3.4 Material Properties – Crush Strength

3.4.1 Force Deflection Corridors – Perpendicular Loading

When subjected to quasi-static tests set forth in sections 3.4.3 through 3.4.5, the forces and deflections should fall within the corridors shown in Figure 5.

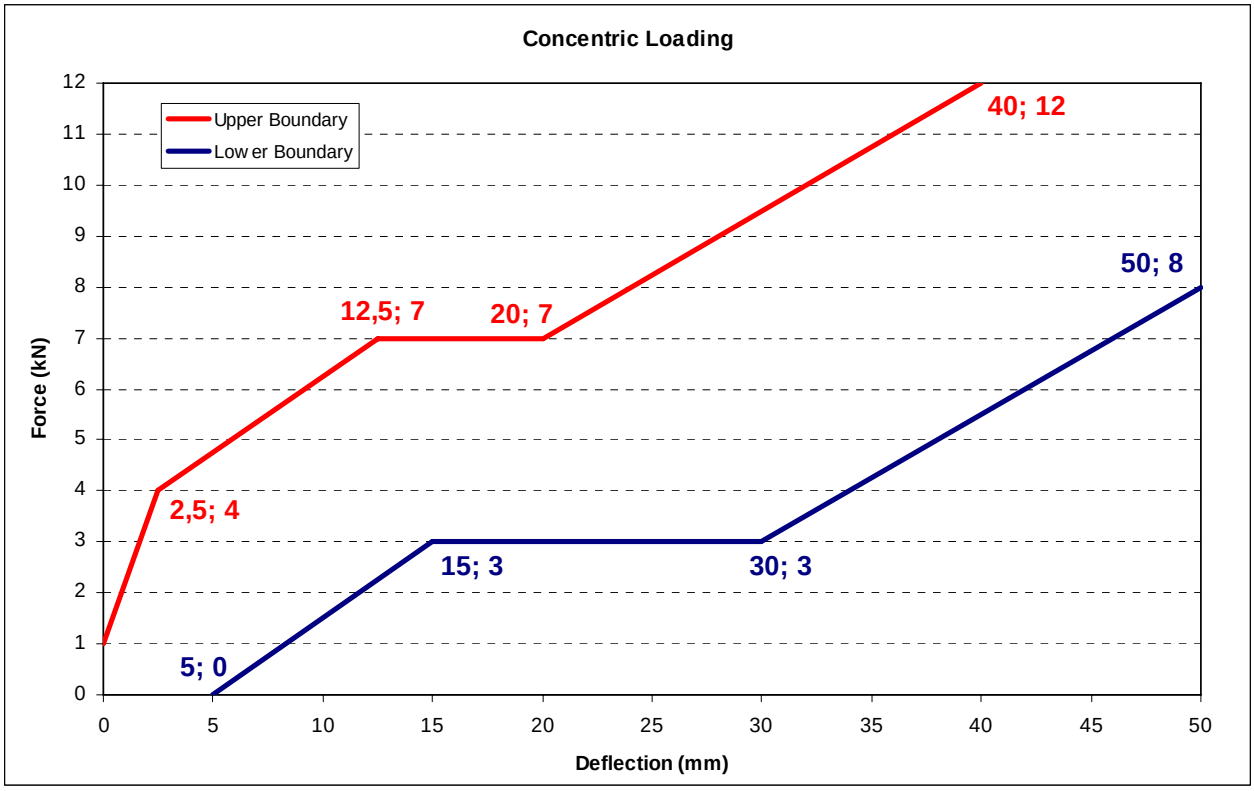

Figure 5: Energy Absorber Force Deflection Corridors – Perpendicular Loading

3.4.2 Force Deflection Corridors – Eccentric Loading

When subjected to quasi-static tests set forth in sections 3.4.3, 3.4.4, and 3.4.6 the forces and deflections should fall within the corridors shown in Figure 6.

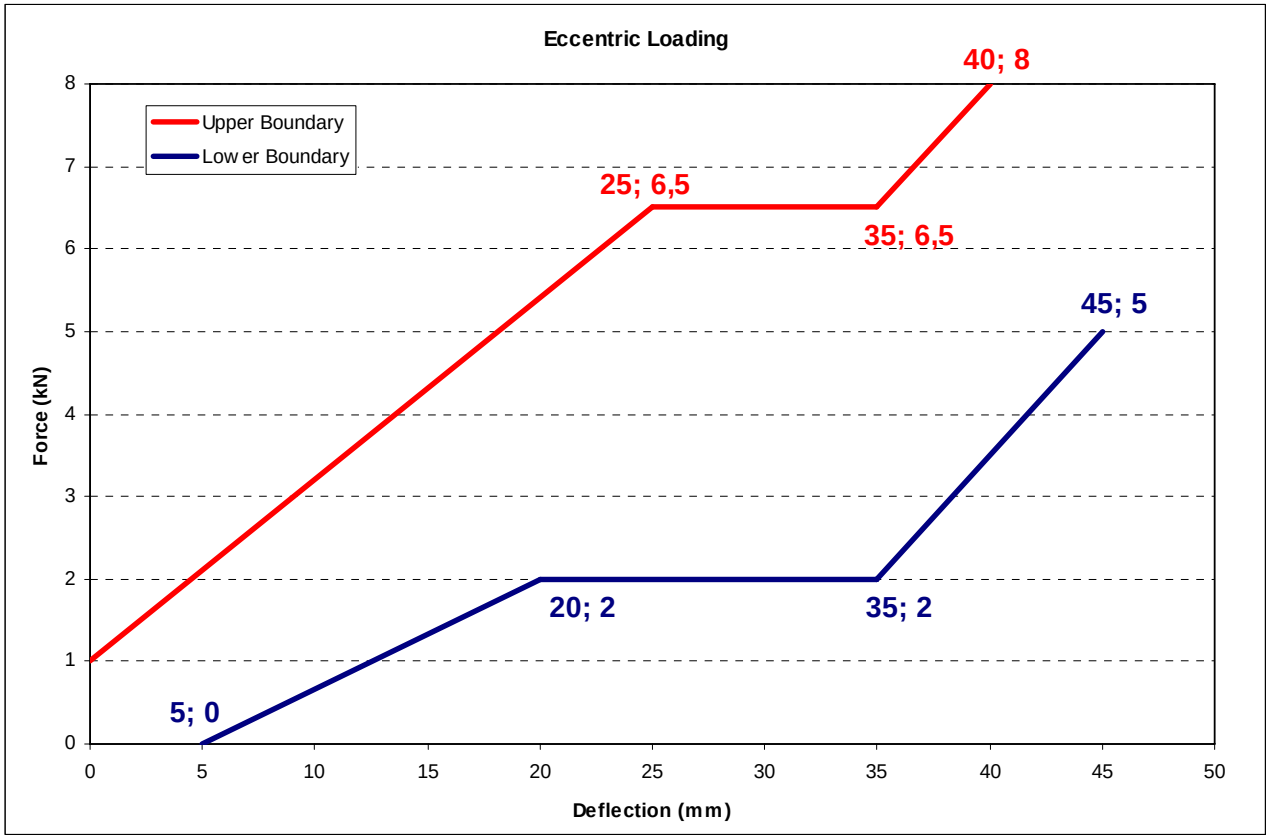

Figure 6: Energy Absorber Force Deflection Corridors – Eccentric Loading

3.4.3 Crush Strength Test Mounting

The crush strength should be evaluated with the absorber mounted to a rigid support in a fashion similar to its attachment to the bumper barrier.

3.4.4 Crush Strength Test Speed

The tests should be run at 450 ± 50 mm/min (e.g. Tinius Olsen Universal Test Machine).

3.4.5 Crush Strength Load Plate – Perpendicular Loading

The load plate should be a rigid rectangular piece of steel 160 mm long and wide enough to cover the entire height of the absorber (i.e. 100 mm).

3.4.6 Crush Strength Load Plate – Eccentric Loading

The load plate should be a rigid rectangular piece of steel 160 mm long and wide enough to cover half of the height of the absorber (i.e. 50 mm). The plate should be able to rotate along the impacting surface. An example load plate is shown in Figure 7.

Figure 7: An Example of an Eccentric Load Plate

3.4.7 Material Properties – Impact Surface

The impact surface of the energy absorber should have a hardness value between 30 and 150 Bhn[2] and have a dynamic coefficient of friction between 0.25 and 0.5.[3]

[2] Brinell Hardness Number. The Brinell Hardness Number is obtained using a 3000 kg load and a 10 mm standard ball. The range of 30 to 150 Bhn encompasses materials with hardness values between 25 and 100 Shore D and Rockwell Hardness values of zero to 80 Rb.
[3] The dynamic coefficient of friction is obtained against steel.

4.0 BUMPER BARRIER ASSEMBLY AND COMPONENTS DRAWINGS

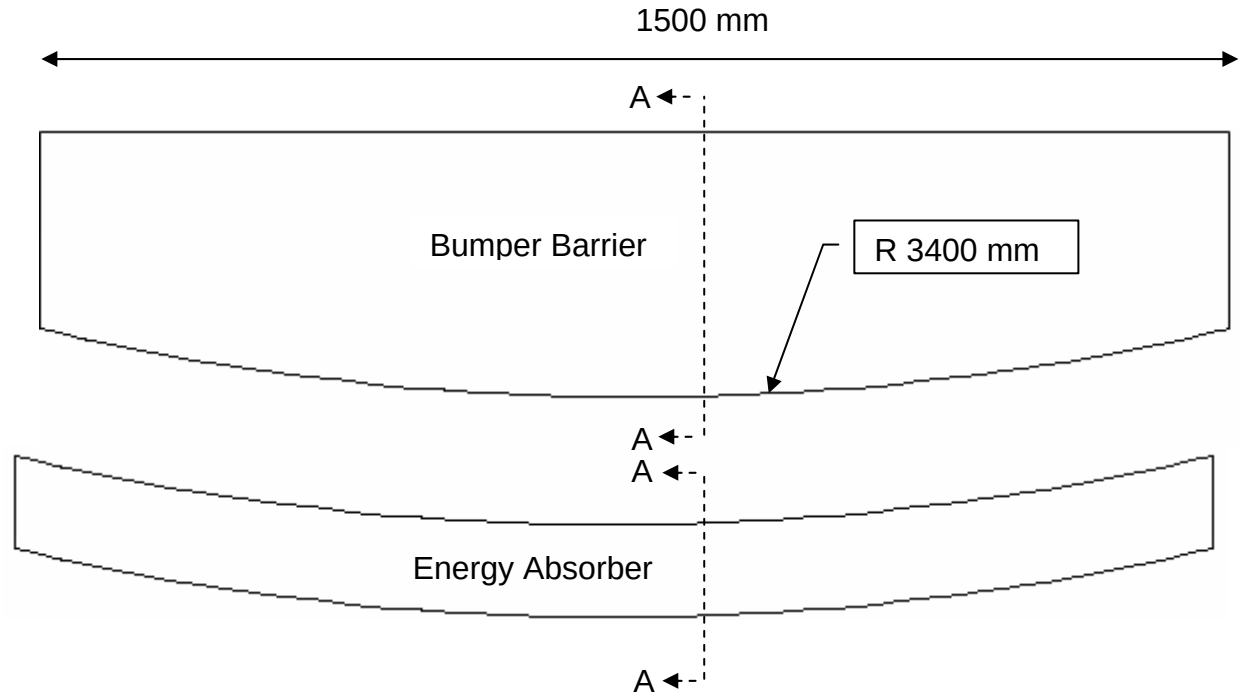

Figure 8: Bumper Barrier and Energy Absorber, Top View

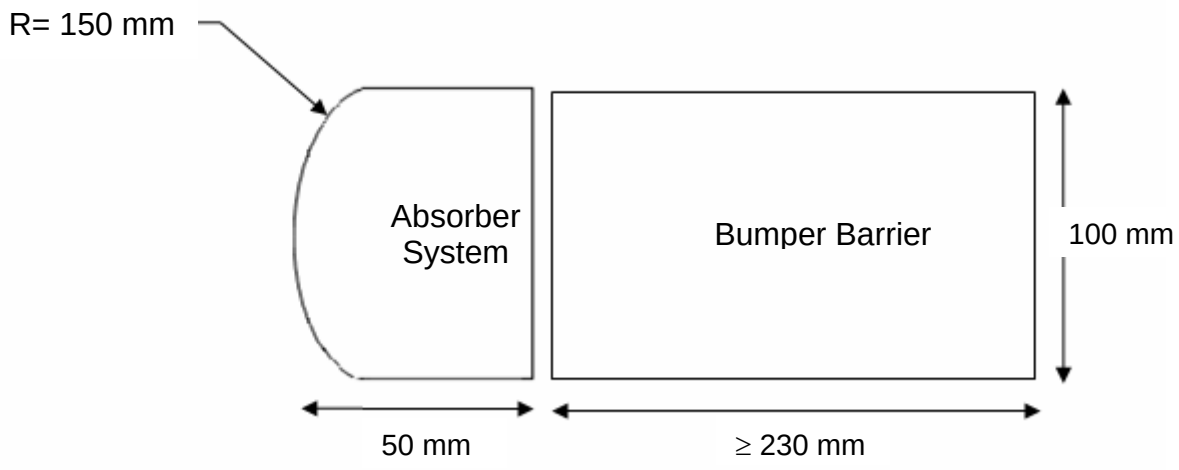

Figure 9: Bumper Barrier and Energy Absorber, Section A-A

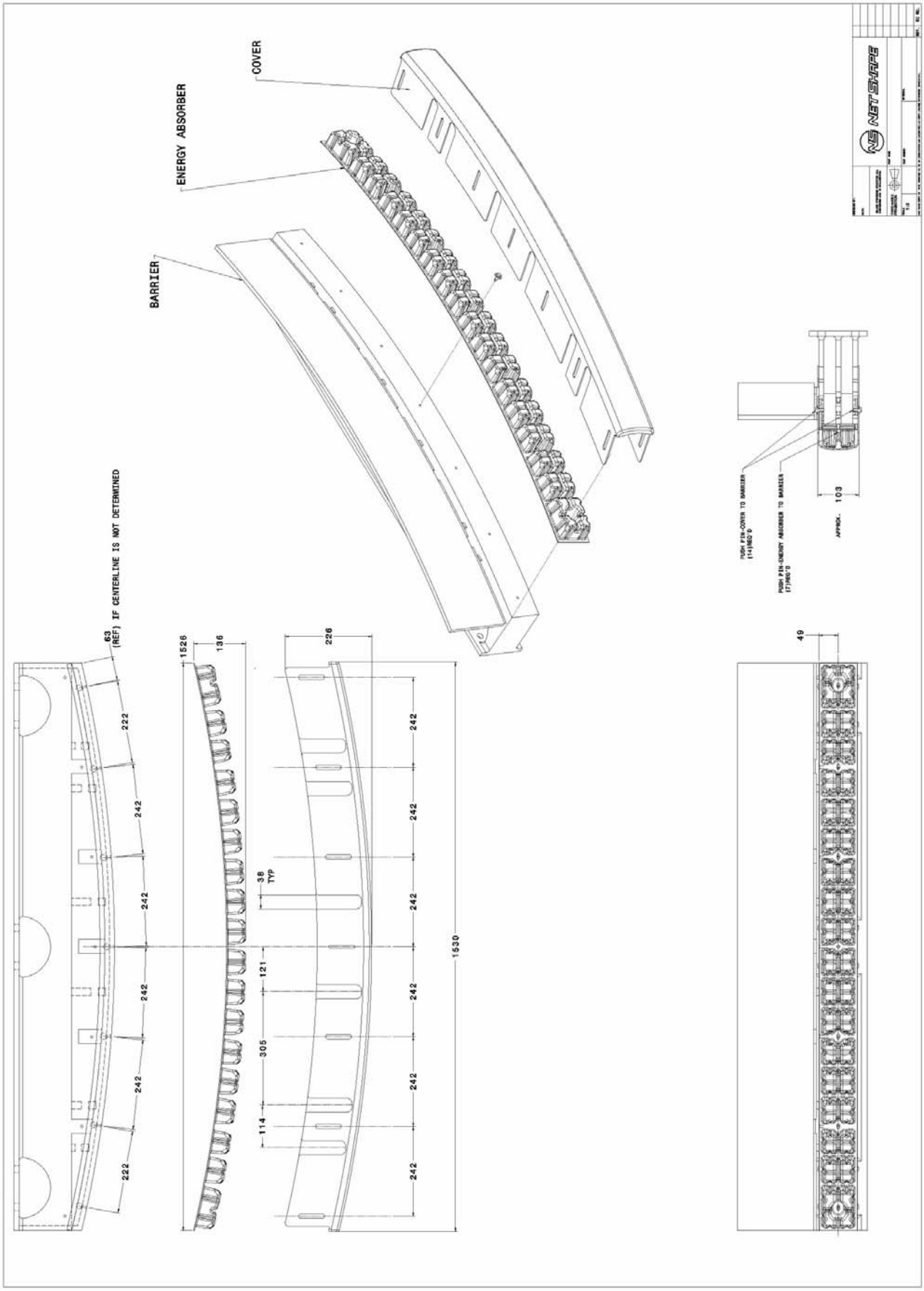

Figure 10: Dimensions of the NetShape Energy Absorbing Elements

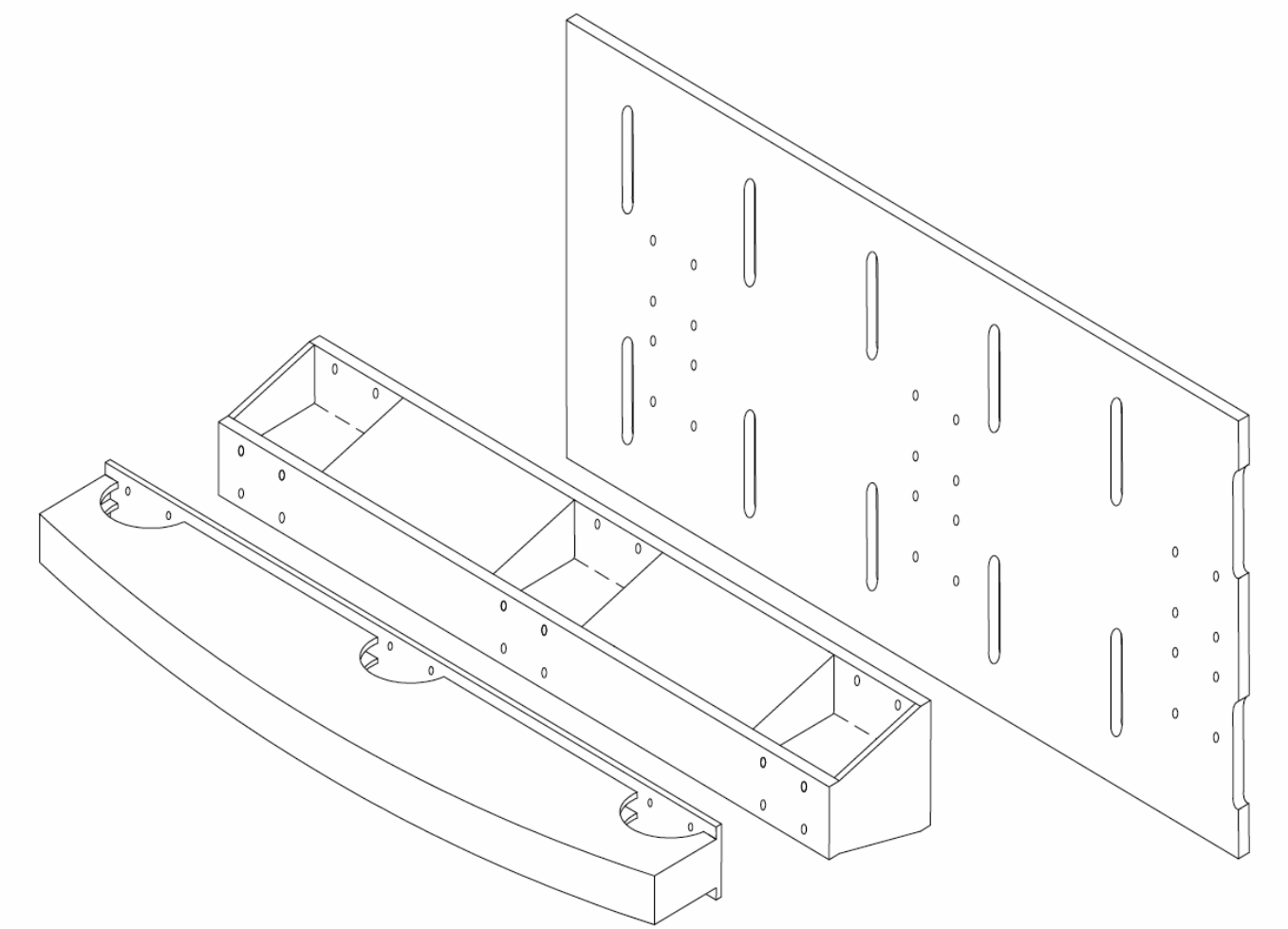

Figure 11: Steel Barrier Layout (without backstop) (IIHS)

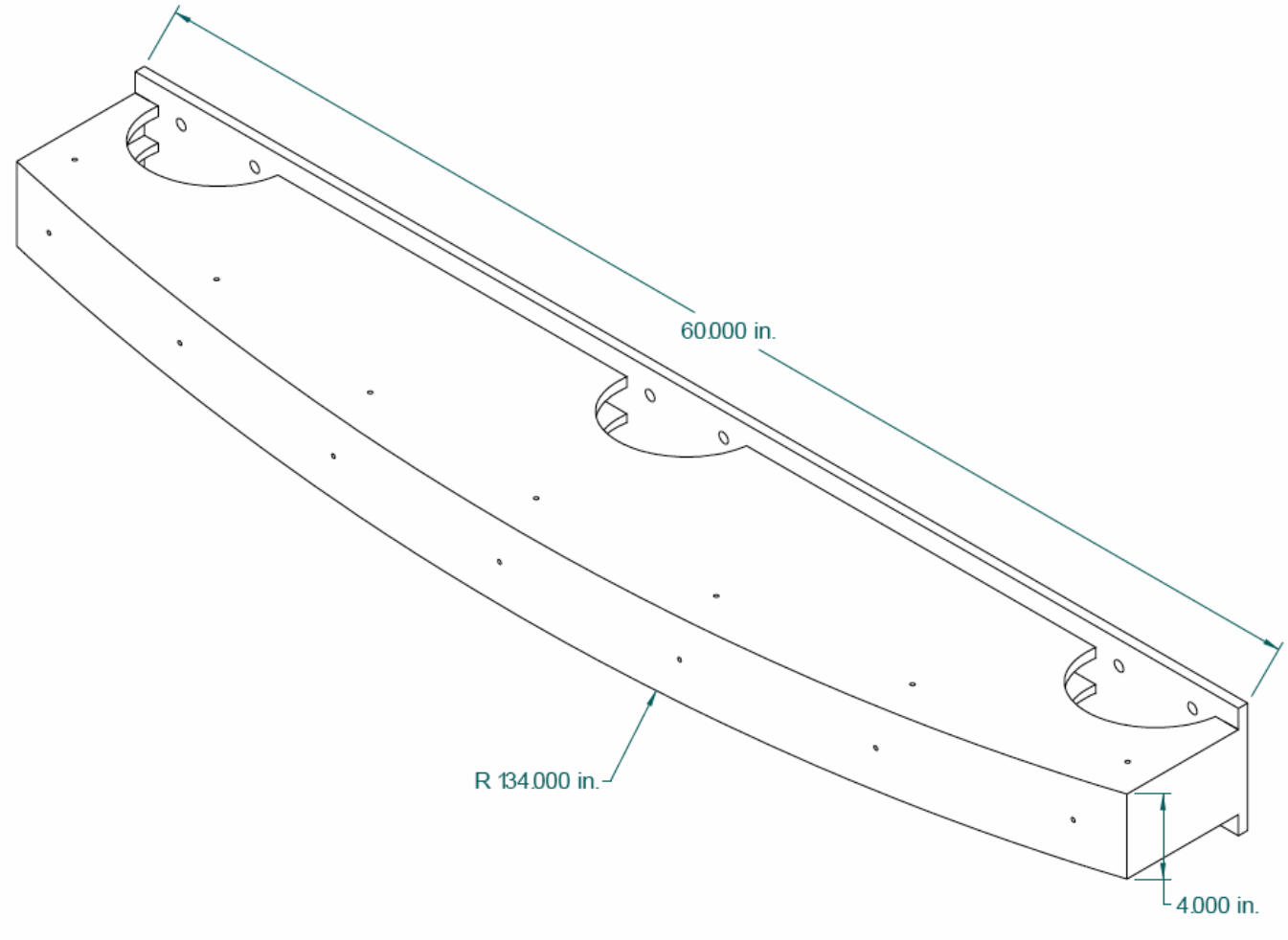

Figure 11: Main Barrier Dimensions (US), IIHS Barrier

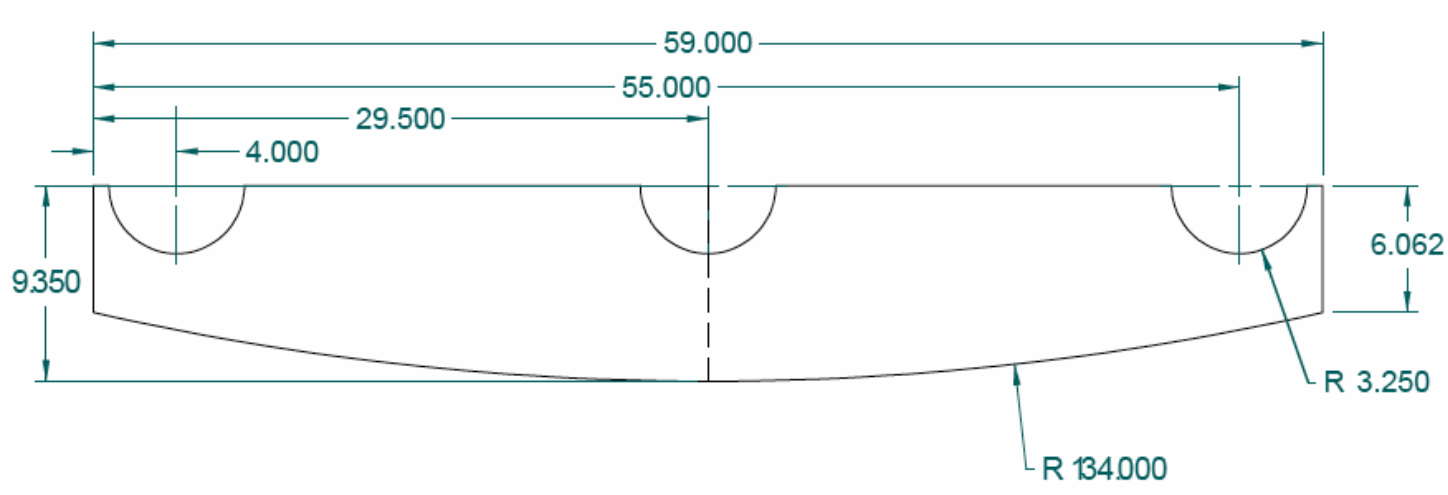

Figure 12: Main Barrier Dimensions (US), IIHS Barrier

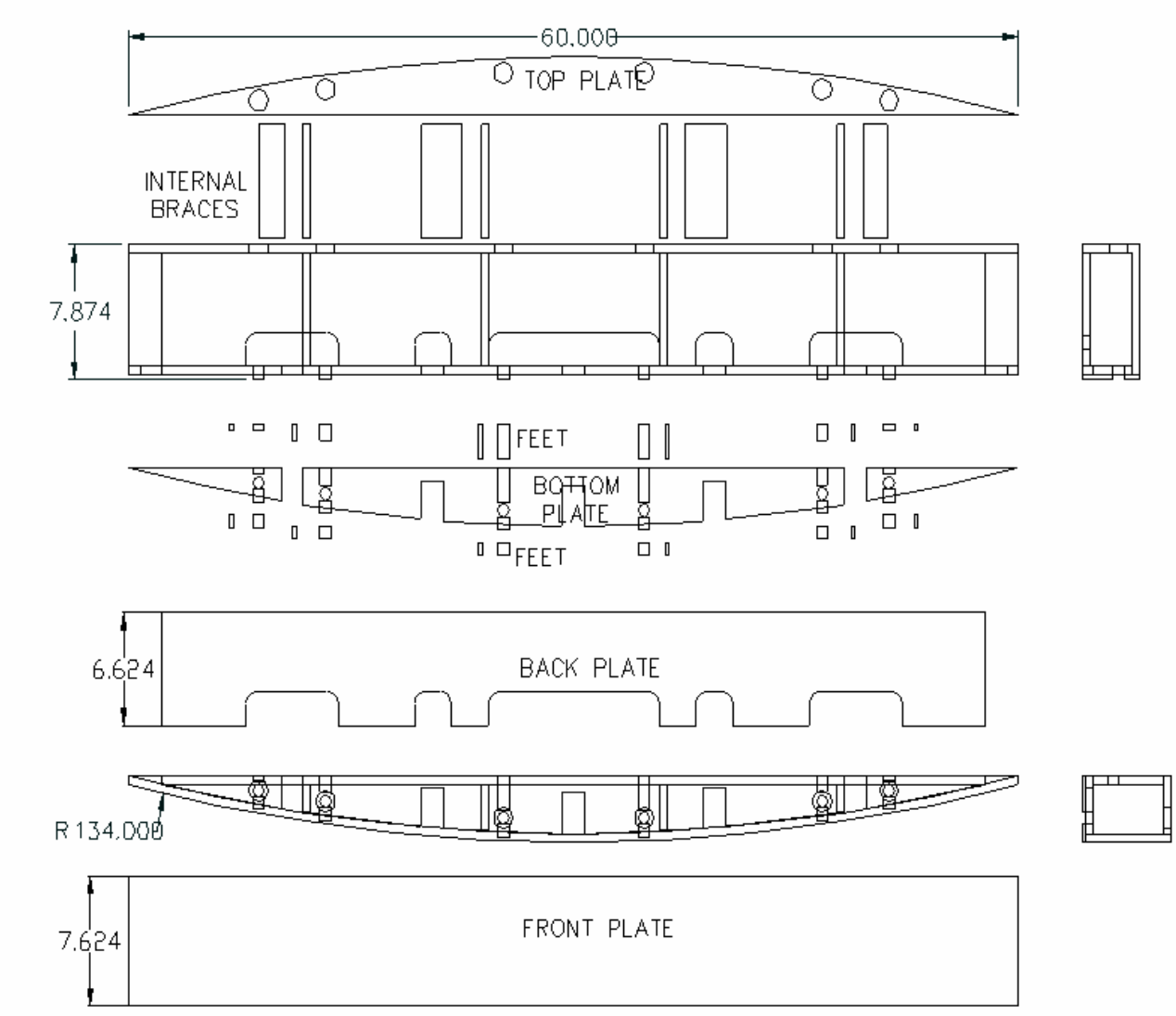

Figure 13: Backstop Dimensions (US), IIHS Barrier

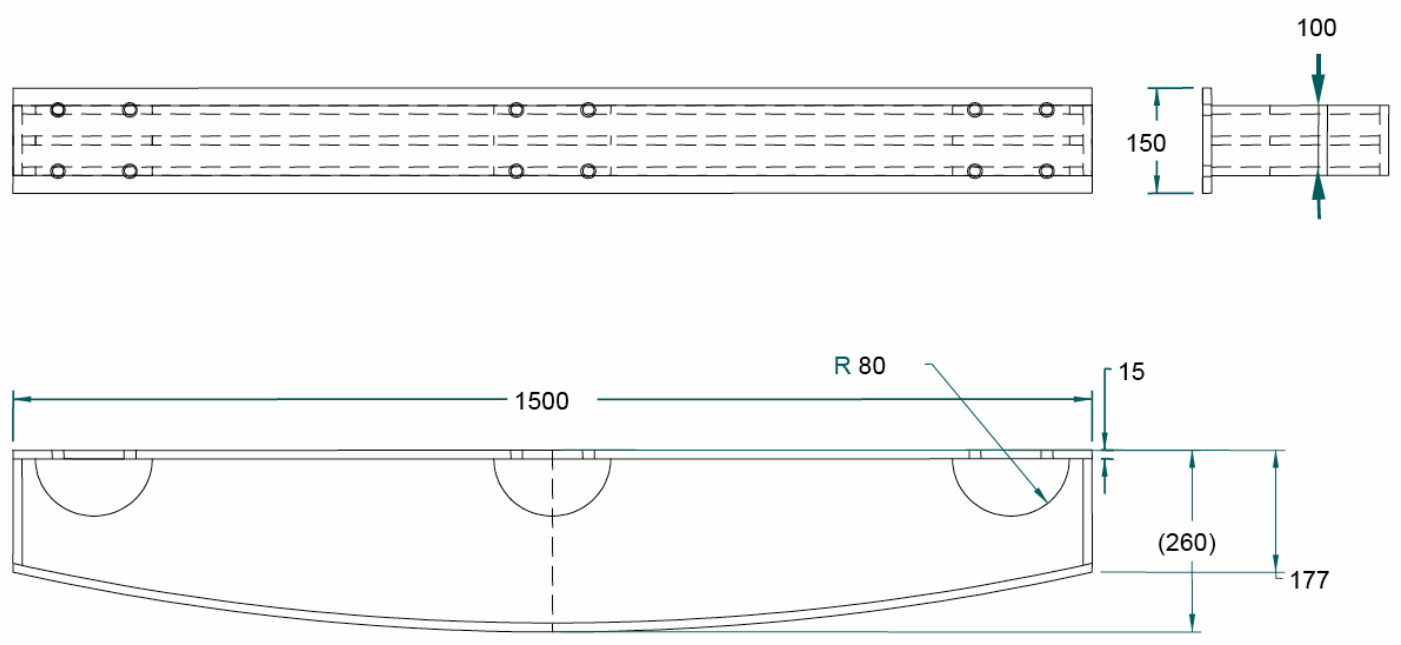

Figure 14: Main Barrier Dimensions (Metric), AZT Barrier

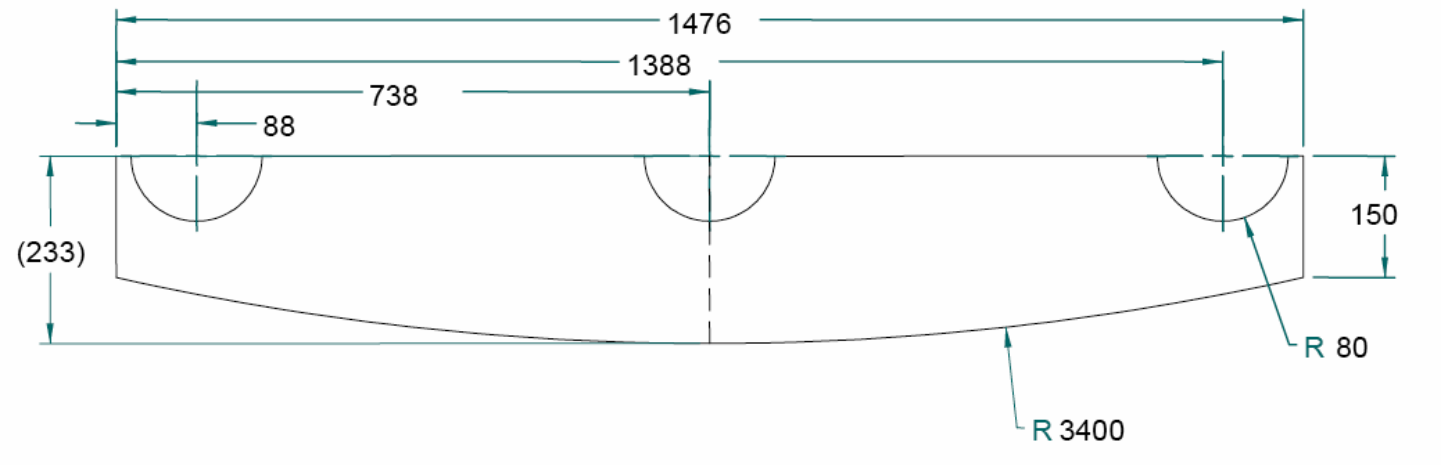

Figure 15: Main Barrier Dimensions (Metric), AZT Barrier