FERMILAB ENGINEERING NOTE	SECTION PPD/ETT	PROJECT BTeV/C0	SERIAL - CATAGORY	PAGE 1
SUBJECT Design of Low-Mass Flange for Beam Pipe			NAME Mayling Wong	
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Summary: The BTeV beam pipe has a low-mass welded flange at the change from a 1-inch inner diameter pipe to the 2-inch inner diameter pipe. The flange is designed to withstand an axial force of 30-pounds with a safety factor of 3 for material yield stress. The source of the axial stress is the pull of the Pixel Detector's end window when the chamber and beam pipe are under vacuum. The bellows reduces the stress by 90% of the stress that would occur at the flange if the bellows did not exist. The total thickness of the flats of the flange when assembled is 0.080-inch. The flange is 5.2-inches in outer diameter. When the beam pipe must be disassembled, the weld is cut away. The flange diameter is designed for disassembly up to five times.

Beam pipe assembly description

The BTeV forward beam pipe at the end closest to C0 is attached to the end window of the Pixel Detector's vacuum vessel. The other end of the forward beam pipe is attached to a bellows, which is then attached to the low-mass flange. The flange marks the transition from the 1-inch inner diameter forward beam pipe to the 2-inch inner diameter RICH beam pipe. Figure 1 shows the drawing of the beam pipe assembly. The entire assembly is aluminum.

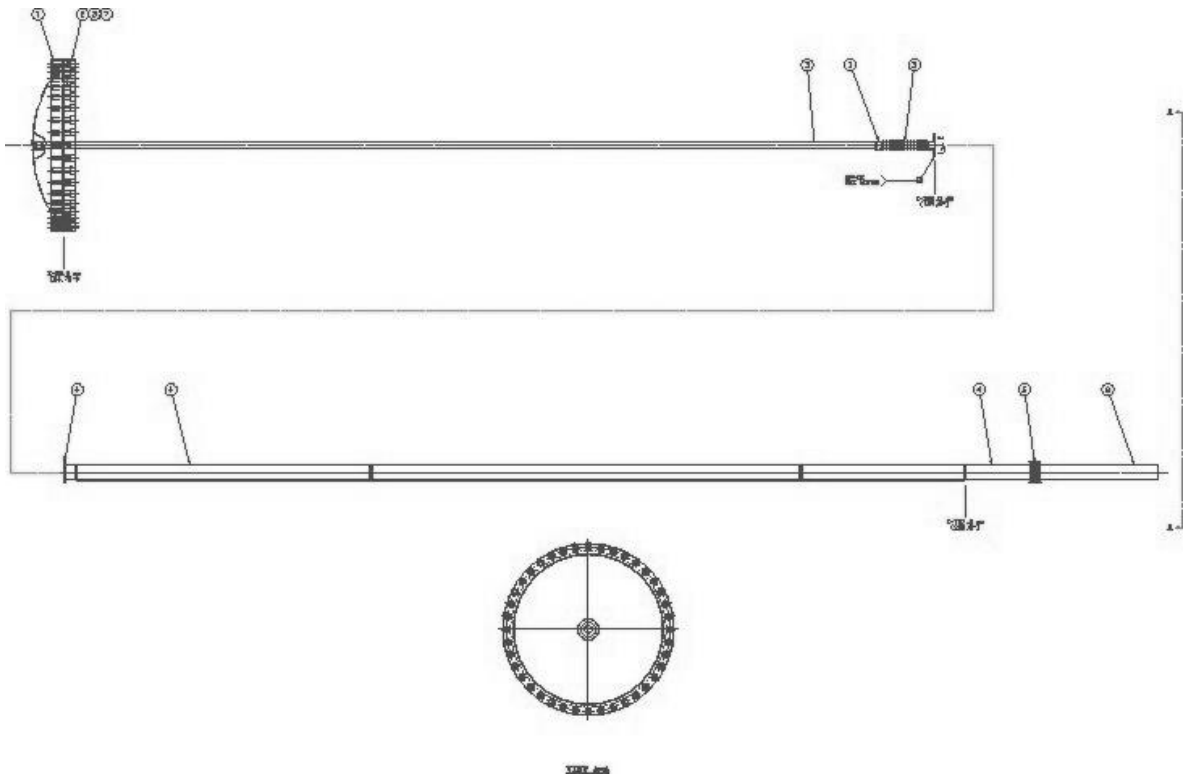

Figure 1 – Drawing of BTeV Beam Pipe Assembly (P/N 407236)

A bellows is attached to the far end of the forward beam pipe and acts to take up the majority of the axial load through the beam pipe when the pixel chamber and beam pipe are under vacuum. The low-mass flange is attached to the other end of the bellows. The bellows is designed to have a spring rate of 6000 inch/pound and an elastic stroke of 0.050-inch. When the beam pipe and the pixel chamber are under vacuum, the window is pulled towards C0, causing the beam pipe to move axially about 0.005-inch. With the design spring rate and the total displacement, the total load extending the bellows is 30 pounds. Thus, the low-mass flange must be able to withstand 30 pounds.

Welded low-mass flange

The amount of flange material must be reduced from the standard pipe flange configuration in order minimize particle interaction. A first-order design iteration is to weld two thin flange halves. When the beam pipe needs diassembling, the weld is cut off. Based on previous experience in welding aluminum that is 0.035-inch thick, the amount of material that would be cut away and prepared for the next weld is 0.5-cm. It is assumed for now that the maximum number of times that the beam pipe would be disassembled at the low-mass flange is 5.

Figures 2 and 3 show the dimensions of the flange halves.

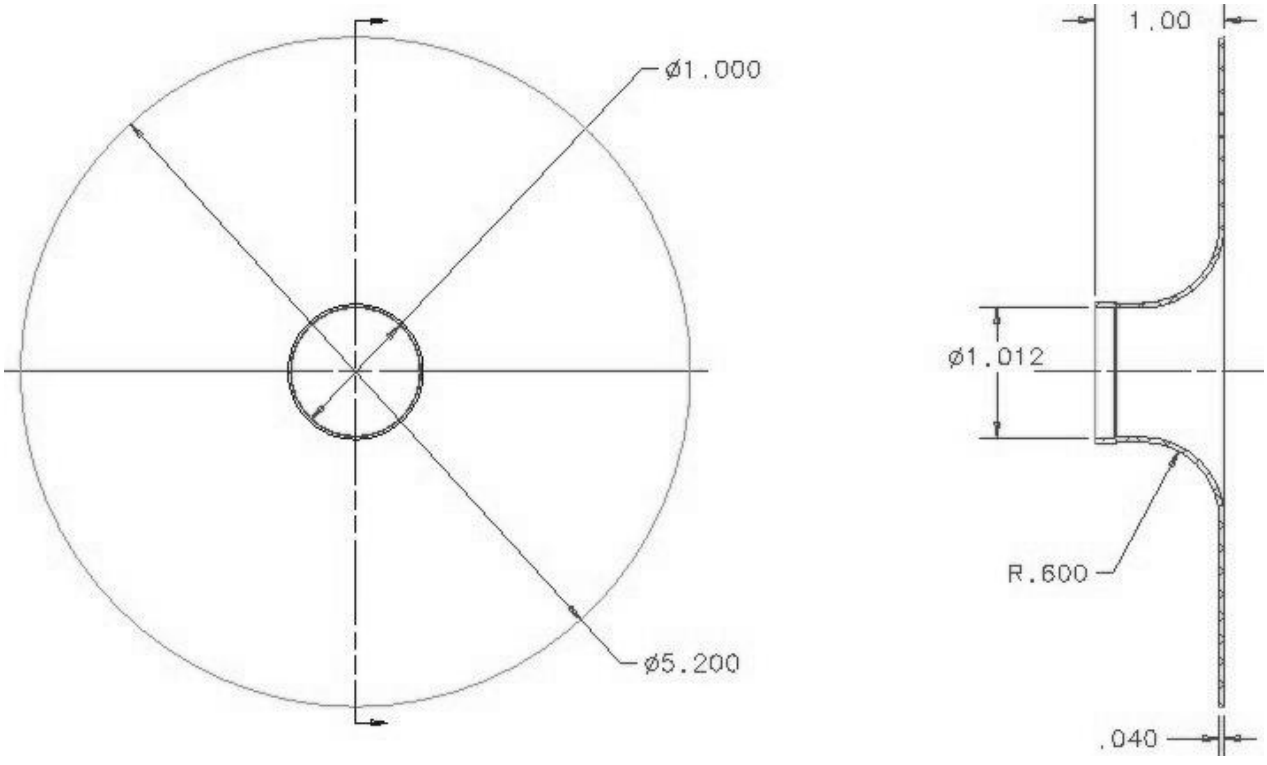

Figure 2 – One-inch InnerDiameter Flange

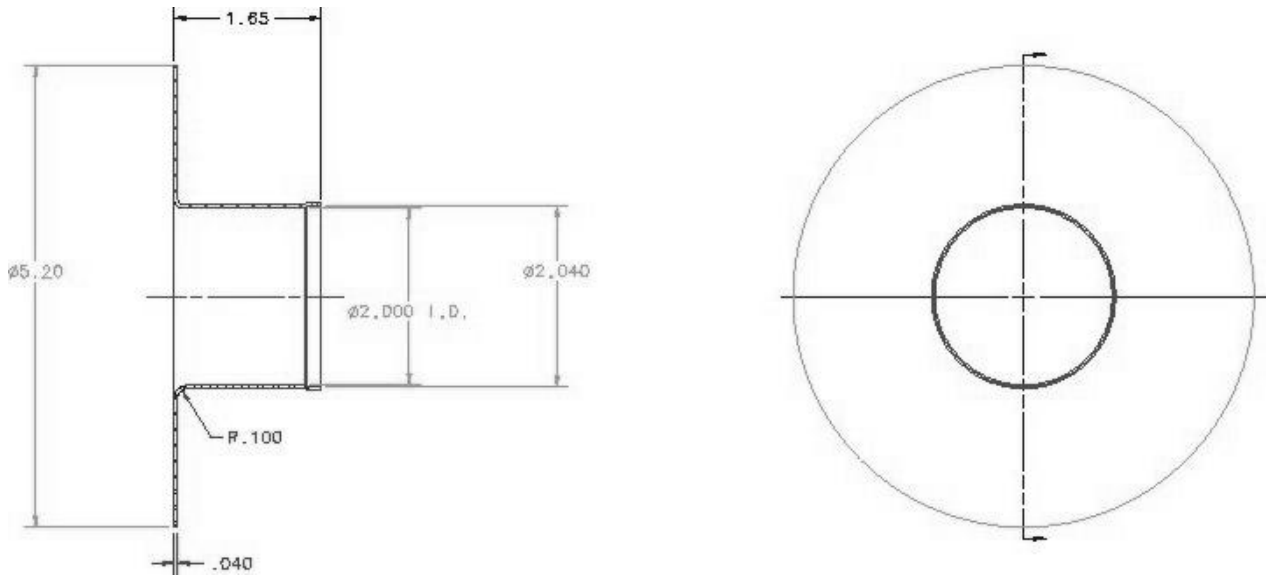

Figure 3 – Two-inch Inner Diameter Flange

The dimensions of the flange can be modified to minimize the amount of material.