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Apr. 14, 1996
BaBar TNDC-96-33

The Endplate/Support-Tube Joints on the BaBar Drift Chamber

This note presents preliminary thoughts on issues surrounding the joints between the endplates and the cylindrical support tubes.

1 Assembly Order

This discussion presumes a baseline plan in which the inner support tube is load bearing and is assembled together with the endplates before stringing. The outer support tube is joined only after stringing, when it slides over the rear endplate until it meets the front endplate.

2 Support Tubes

Given that the endplates are aluminum, the thermal stresses on the joints will be minimized if the support tubes are aluminum also. If possible, the central section of the inner tube should be beryllium, 1-1.1 mm thick. The outer support tube should be about 2.5 mm thick to have a factor of 10 safety against buckling under axial compression.

We advocate that the aluminum part of the inner support tube also be 2.5 mm thick so that the mechanics of the inner and outer joints are as similar as possible.

We strongly advocate that the inner and outer support tubes be simple cylinders with no lips, ledges, *etc.*, and that no holes or slots be machined into these large objects.

3 Glue Joints Should Not Transmit Bending Moments

To provide good helium tightness the joints between the endplates and the support tubes should be glued. Because the front endplate is relatively thin it will have non-negligible deflection under the wire load. If the inner glue joint is made before the endplate is deflected (and/or if the outer joint requires the support tube to conform to the outer surface of the endplate) considerable stress would have to be transmitted through the glue joint.

Figure 1 illustrates this via a finite-element analysis. While there would be large compression at the inside corner of the joint, the support tube tends to peel away from the tilted

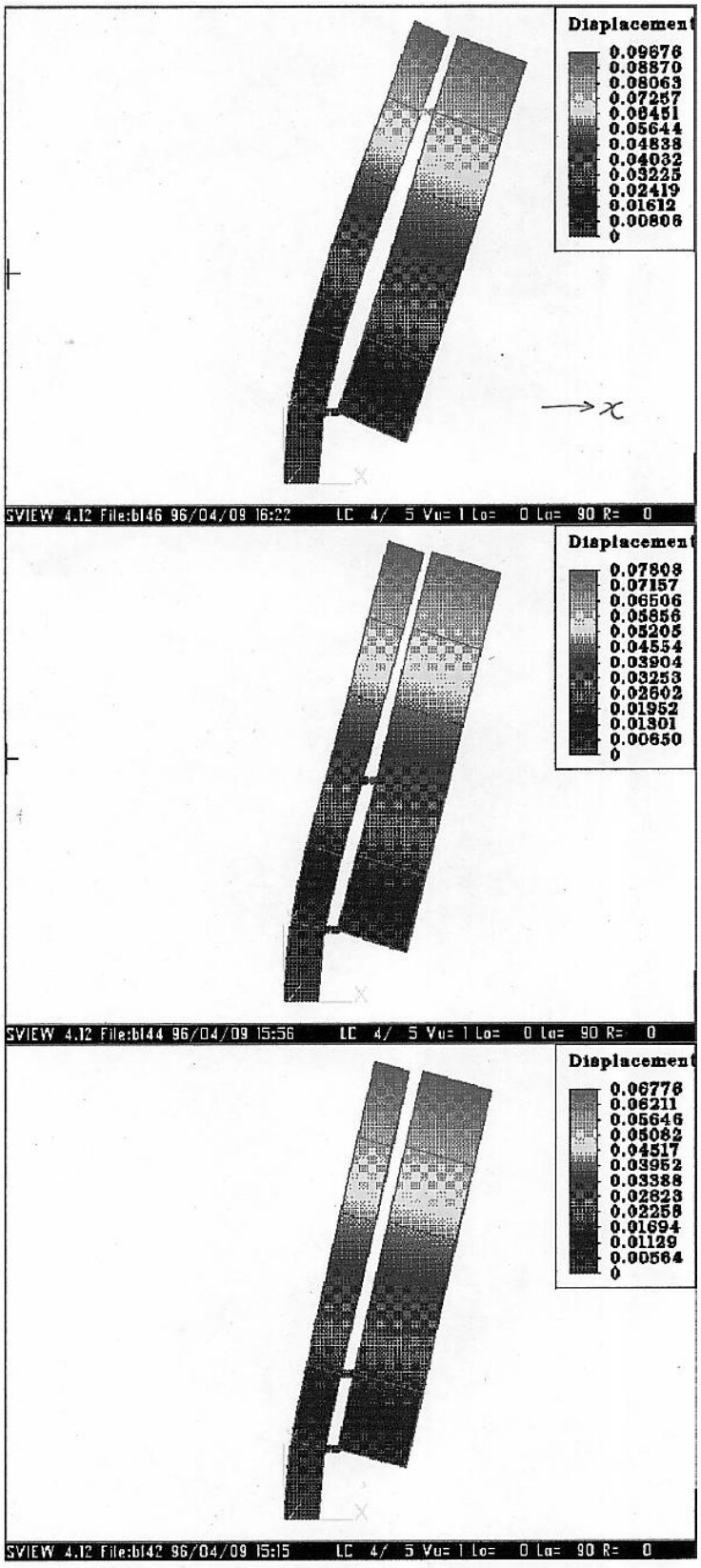

Figure 1: Finite-element analysis of a joint between an aluminum plate tilted by 26 mrad and a 2.5-mm-thick aluminum plate.

surface of the endplate. This would aggravate any peeling of the glue joint and seems very undesirable.

Hence we advocate that the glue joint be such that no (or very little) bending stresses need be transmitted across it. This can be arranged by making the glue joint only after the stringing is complete, but with the wire load already transferred to the support tube. For the latter to be possible, there should be a collar pinned to the endplates that can support the full axial load between the time the load is released from the stringing fixture and the glue has set.

Figure 2 presents a sketch of this joint concept, in which the 'end cylinder' that also forms the endcap Faraday cage plays the role of this collar.

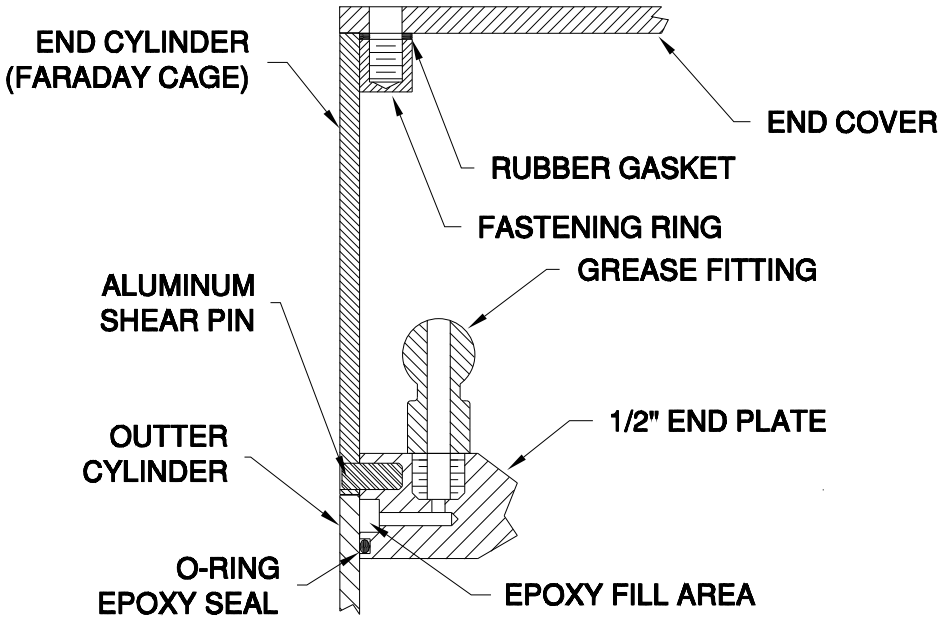

Figure 2: Sketch of the joint between the front endplate and 2.5-mm-thick outer support tube. A 2.5-mm-thick aluminum end cylinder is pinned to the endplate by at least 16 aluminum dowels to support the wire load during gluing. The glue is introduced into a slot in the outer edge of the endplate via several channels that can temporarily be connected to grease fitting. An O-ring in the endplate between the glue channel and the inside of the chamber prevents glue from seeping into the chamber.

Thus we have a joint design with separated functions; the axial load is carried primarily by the end cylinder, while the gas seal is made between the support tubes and the endplate. The joint between the end cylinder and the endplate need not be helium leak tight, and the end cylinder could even be fabricated in pieces rather than being a single continuous object.

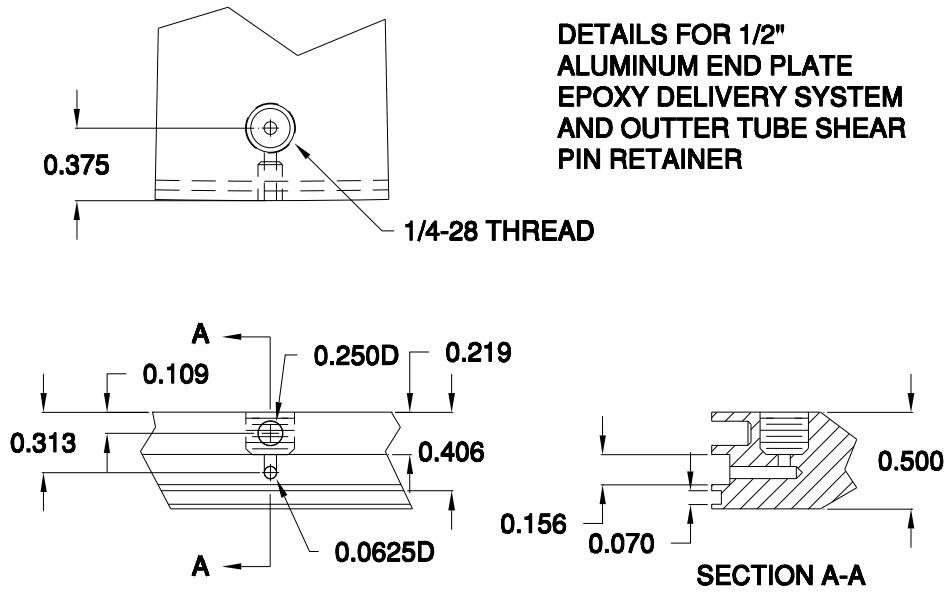

Figure 3: Some details to the proposed glue channels in the endplates.

4 Shear Pins

The end cylinder must be joined to the front endplate so as to carry the wire load but leave room for the glue joint along the 1/2″-thick surface. This can be done with 1/8″-diameter aluminum pins. We calculate that the number of pins required is 8 times the desired safety factor. Thus 32 or 64 pins would be appropriate.

Unlike the arrangement shown in Figs. 2 and 3, the shear pins need not line up with the glue feed channels.

5 Glue Feed Channels

Because the outer support tube will be slid over the read endplate before gluing it would be very awkward to have the glue in place before this step. Rather, we need a system whereby the glue can be delivered to the joint after the support tubes are in place. This requires a set of feed channels, as well as the main channel for the glue.

All of these channels are to be in the endplates, not in the support tubes. Figures 2 and 3 illustrate a scheme for such channels. The grease fitting would be removed after the glue has set.

The gluing could probably be done with the chamber horizontal, by pumping the glue in through a channel at the bottom until it appears out the top.

To keep the glue from seeping into the main chamber volume the should be an O-ring in the endplate between the main glue channel and the inner face of the endplate.