

DØ SOLENOID UPGRADE PROJECT

**Rectangular liquid helium tube,  
miscellaneous information**

D-ZERO ENGINEERING NOTE # 3823.111-EN-343

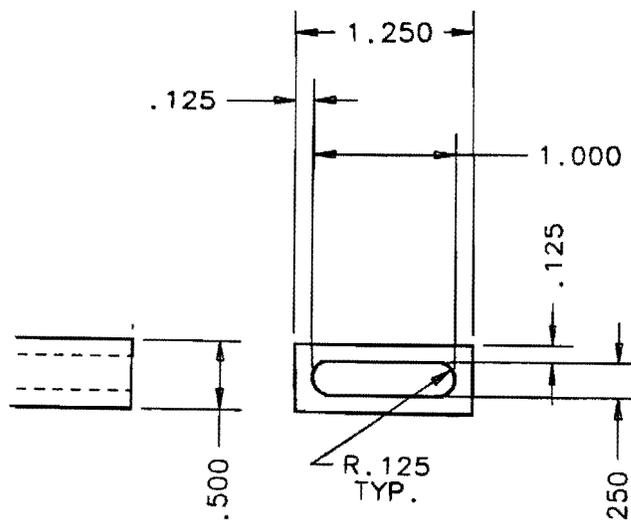
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This engineering note contains miscellaneous information about the rectangular liquid helium supply tube for the D-Zero solenoid. The information is fairly superficial, but could be used as a starting point for a future engineer who is going to specify and purchase the tubing.

The chimney contains 4 conductors attached to an aluminum liquid helium supply tube. Because good thermal contact is desired, the tube will have flat sides. Aluminum is chosen to match the thermal contraction coefficient of the superconductor's aluminum stabilizer. The type of aluminum is chosen as 6061-T6 because its allowable stress in ANSI/ASME B31.3 is higher than for other alloys. A different alloy could be chosen for extrusion reasons. The highest pressures this tubing should see will be during a quench. Current calculations predict the peak pressure during a quench to be 520 psia for one-way relieving and 250 psia for two way relieving.<sup>1</sup> Whatever the final alloy selection, the tubing needs to have a high enough allowable working pressure.

There is very little room in the obround section of the chimney. In that portion the shape is rectangular, 12.7 mm (0.50") x 31.8 mm (1.25"). The drawing below shows the flow path cross section. This also could be changed for extrusion reasons if necessary. The important thing here is to estimate the pressure drop and make sure it is acceptable. Pressure drop estimates for this cross section are acceptable since it is only about 10 feet in length.



<sup>1</sup> Peak pressures obtained from DØ Solenoid design report draft chapter 4, 5/7/93, authored by Bruce Squires. I believe this calculation came from work done by Andrew Stefanik.

In the larger circular pipe portion of the transfer line, the tube is square, 31.8 mm (1.25") x 31.8 mm (1.25") with 19 mm (0.75") inside diameter. The transition from rectangular to square is thought to occur at a machined elbow located at the corner where the obround vacuum shell makes a transition to a circular shape.

Stock square and rectangular aluminum tubing from such vendors as Kilsby Roberts company, or Tube sales is not made for pressure service applications. The specifications for the stock shapes is for structural applications per ASTM-B-249.

A more indepth vendor search would be warranted when the time comes for actual purchase of this tubing. The specifications for extruded aluminum tubes in pressure service are ASTM-B-210 or ASTM-B-241. The other option is to have the tube specially extruded. The die cost for an extrusion is on the order of \$1000 per shape.