598. *Proposed by H. Tracy Hall, Brigham Young University*

PROBLEM:

Given a flexible, thin walled cylinder, such as a soda straw, of diameter D, what is the edge length L of the largest regular tetrahedron that can be pushed through the straw?

ANSWER:

$$L = \frac{pD}{2}$$

The regular tetrahedron is pushed through the soda straw edgeways with an axis through the mid points of two opposite edges of the tetrahedron coinciding with the cylinder axis. The straw is squeezed flat at one end for initial entry of the tetrahedron's leading edge. As the tetrahedron passes through the straw, the straw "flows" over the tetrahedron "skin tight" conforming completely to the tetrahedron's shape. The property of the tetrahedron that makes this possible is the constant perimeter (πD in this case) of any section made by a plane passing through the tetrahedron perpendicular to two opposite edges. This section varies continuously in shape from a line to a rectangle to a square to a rectangle and back to a line as the plane is moved from one edge to the opposite edge of the tetrahedron.

The above relationship was discovered while contemplating how to construct an electrical resistance heater-container for a tetrahedrally shaped sample for the author's Tetrahedral Press high pressure/high temperature apparatus.[1] A skin tight, electrically heat metal "soda straw" which surrounded the tetrahedron and was pinched flat where it extended beyond the two opposite edges of the tetrahedron proved to be an excellent heater-container for the sample. In practice a "straw" is not used but, rather, a strip of metal (the equivalent of a longitudinally slit straw) is wrapped around the tetrahedral sample to give the same end result.

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[1] H. T. Hall, Rev. Sci. Instr., 29, 267-275 (1958).