Tube Strength: Multi-Chamber vs. Standard Hollow

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Tri-Chamber:

Tri-chamber tubes vary from our standard tubing by a webbed design that splits the tube into three separate chambers. These chambers are divided by webs that are spaced by 120-degree intervals. The addition of these webs causes an increase in geometric properties, therefore increasing the overall strength of the tube. Figure 1 illustrates the general cross-section of both types of tubes.

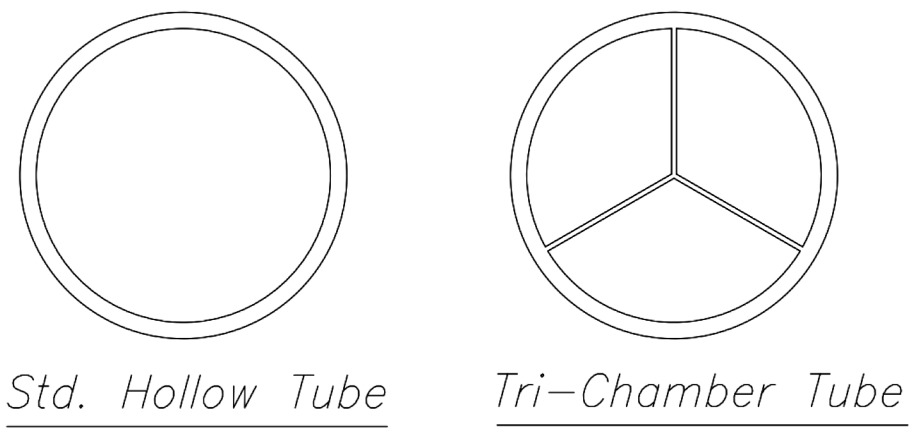

Figure 1. *Tube Cross-Sections*

For engineering record keeping, the equations for deriving the moments of inertia of each tube type are shown below in Equations 1-7. Please note that these equations are derived about the weakest orientation of the webs.

$$I_1 := \int_0^{2\pi} \int_{R-t_1}^{R} r^3 \sin(\phi)^2 \, dr \, d\phi$$

Eq. (1) General Hollow Tube Moment of Inertia

$$x_1 := \frac{t_2 \cdot \sin\left(\frac{\pi}{3}\right)}{2}$$

Eq. (2) Offset from Center Triangle

$$I_2 := \int_{x_1}^{R-t_1} \int_{-t_2}^{t_2} y^2 \, dx \, dy$$

Eq. (3) Top Web Moment of Inertia

$$I_3 := \frac{1}{\cos\left(\frac{\pi}{3}\right)} \cdot \int_{-t_2}^{t_2} \int_{x_1}^{R-t_1} y^2 \, dx\, dy$$

Eq. (4) Lower Right Web Moment of Inertia

$$I_4 := \frac{1}{\cos\left(\frac{\pi}{3}\right)} \cdot \int_{-t_2}^{t_2} \int_{t_1-R}^{-x_1} y^2 \, dx\, dy$$

Eq. (5) Lower Left Web Moment of Inertia

$$I_5 := \frac{t_2^{\,4}}{36}$$

Eq. (6) Center Triangle Moment of Inertia

$$I_{tri} := \sum_{i=1}^{5} I_i$$

Eq. (7) Tri-Chamber Tube Moment of Inertia

Evaluating Equation 1 yields the moment of inertia for the standard hollow tube. Evaluating Equation 7 yields the moment of inertia for the tri-chamber tube. Using an example of a 10"x0.250" tube, with the option of a 0.156" thick web, the geometric properties are greatly increased. For details, see Table 1 below.

Table 1. *10"x0.250" Tube Example*

Property	Standard Hollow Tube	Tri-Chamber Tube	Percent Change
Moment of Inertia (in^4)	91.054	102.247	12.3 %
Cross-Sectional Area (in^2)	7.658	9.861	28.8%
Section Modulus (in^3)	18.211	20.449	12.3%

By increasing the three properties shown in Table 1, a tri-chamber pole has greater resistance to shear, bending, and axial loads, causing it to outperform standard tubes when high capacity loading is required.