EQUATIONS FOR PIPE STIFFNESS AND RELATED TERMS

The ability of flexible pipe to perform under certain load conditions has historically been identified within the flexible pipe industry as a function of the pipe stiffness. This value, 46 psi minimum, has been the long established bench mark for minimum pipe strength in the thermoplastic industry.

Pipe stiffness (PS) is determined by conducting a parallel plate test in accordance with ASTM D 2412, which measures the load required to deflect the pipe 5% when loaded at a maximum rate of 0.50 ± 0.02 in/min.

Recently, some manufacturers have introduced alternate terms which differs from the long established term (pipe stiffness), which mask the true pipe stiffness values. These new terms are often confused with the old, resulting in much reduced pipe stiffness. These terms are: Stiffness Factor (SF), Flexibility Factor (FF), and Ring Stiffness Constant (RSC).

Listed below are the equations for calculating these four terms and how one has to adjust the Stiffness Factor, Flexibility Factor and Ring Stiffness Constant in order to properly relate them to Pipe Stiffness:

TERM	**EQUATION**
Pipe Stiffness, psi	$PS = \frac{EI}{0.149r^3}$ or $PS = \frac{F}{\Delta Y}$
Stiffness Factor, psi	$SF = \frac{EI}{r^3}$ or $PS = 6.711\ SF$
Flexibility Factor, in/lb	$FF = \frac{D^2}{EI}$ or $PS = \frac{53.692}{FF \times D}$
Ring Stiffness Constant, lbs/ft	$RSC = \frac{6.44\ EI}{D^2}$ or $PS = \frac{C \times 8.337\ RSC}{D_m}$

Where:

C = Material Adjustment Factor (Use 0.8 for HDPE)

E = Modulus of Elasticity, psi

I = Moment of Inertia of Wall Cross Section Per Unit Length of Pipe, in^4/Lin.

r = Mean Radius of Pipe, in.

D_m = Mean Diameter of Pipe, in.

F = Force, lbs/Lin.

ΔY = Vertical Deflection, in.

The Engineer should realize and understand the significance of the difference in stiffness terminology currently being stated. A more detailed discussion of pipe stiffness is presented in Rinker Materials Info Series #202.