Hydroclone G-force Calculation

$$a_r = \frac{v^2}{r_h}$$

$$F_r = ma_r = \frac{mv^2}{r_h}$$

$$f = \frac{V}{t} = \frac{A \times l}{t} = \pi r_i^2 \times \frac{l}{t} = \pi r_i^2 v \Rightarrow$$

$$v = \frac{f}{\pi r_i^2}$$

$$G_{\max} = \frac{F_r}{F_g} = \frac{mv^2}{r_h} \times \frac{1}{mg} = \frac{v^2}{r_h g}$$

$$G_{\max} = \left(\frac{f}{\pi r_i^2}\right)^2 \times \frac{1}{r_h g} = \frac{f^2}{\pi^2 r_i^4 r_h g}$$

$$G_{\max} = \frac{f^2}{\pi^2 \left(\frac{d_i}{2}\right)^4 \left(\frac{d_h}{2}\right) g} = \frac{32 f^2}{\pi^2 d_i^4 d_h g}$$

$G_{max}(f_{GPM})$:

$$G_{\max} = \frac{32 \times \left(\frac{231 in^3}{gal}\right)^2 \times \left(\frac{gal}{\min}\right)^2}{\pi^2 d_i^4 d_h \times 1{,}388{,}620.8 \, in/\min^2} \Rightarrow$$

$$G_{\max} = \frac{0.125 \times f_{GPM}^2}{d_i^4 d_h}$$

$G_{max}(f_{LPM})$:

$$G_{\max} = \frac{32 \times \left(\frac{61.01 in^3}{L}\right)^2 \times \left(\frac{L}{\min}\right)^2}{\pi^2 d_i^4 d_h \times 1{,}388{,}620.8 \, in/\min^2} \Rightarrow$$

$$G_{\max} = \frac{\left(8.69 \times 10^{-3}\right) \times f_{LPM}^2}{d_i^4 d_h}$$

a_r	=	centripetal acceleration
F_r	=	centripetal force
g	=	gravitational acceleration
F_g	=	gravitational force
v	=	velocity of fluid
m	=	fluid mass in pipeline or hydroclone
r_h	=	hydroclone inner radius
d_h	=	hydroclone inner diameter
r_i	=	inlet inner radius
d_i	=	inlet inner radius
f	=	flow rate
GPM	=	gallons per minute
LPM	=	liters per minute
t	=	time
V	=	volume of fluid
A	=	cross-sectional area of inlet
l	=	length traveled by fluid
G_{max}	=	maximum force at hydroclone wall (in terms of g-force)

$$1\,\text{gal} = 3.786\,\text{L} = 231\,\text{in}^3$$

$$1\,\text{L} = 61.01\,\text{in}^3$$

$$g = \frac{9.80 m}{s^2} \times \frac{(60 s)^2}{\min^2} \times \frac{3.28 ft}{m} \times \frac{12 in}{ft} \Rightarrow$$

$$g = 1{,}388{,}620.8 \, in/\min^2$$

d_h	d_i
2”	0.63”
3”	0.88”

Hydroclone specifications

For $0 \le G < 1$, the force of gravity is greater than centripetal force.