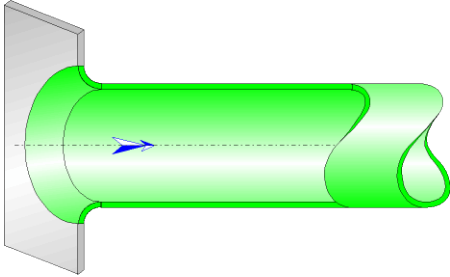




Flush-mounted rounded entrance Circular Cross-Section (CRANE)



Model description:

This model of component calculates the minor head loss (pressure drop) generated by the flow in a flush-mounted rounded entrance of piping.

The head loss by friction in the piping is not taken into account in this component.

Model formulation:

Hydraulic diameter (m):

$$D_h = D$$

Pipe cross-sectional area (m²):

$$A = \pi \cdot \frac{D^2}{4}$$

Mean velocity in pipe (m/s):

$$v = \frac{q}{A}$$

Mass flow rate (kg/s):

$$G = q \cdot \rho$$

Reynolds number in pipe:

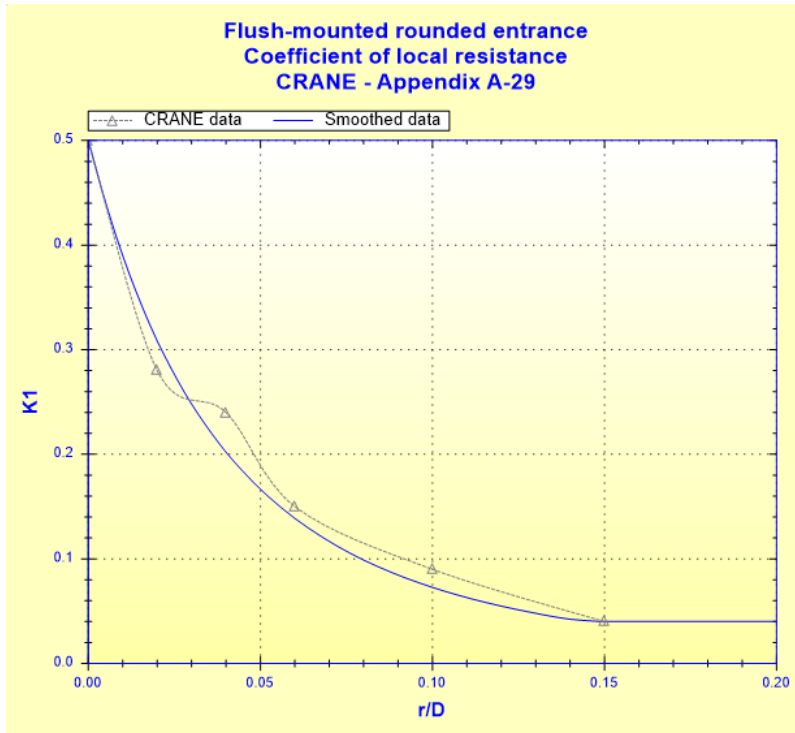
$$Re = \frac{v \cdot D}{\nu}$$

Local resistance coefficient ($Re \geq 10^4$):

■ $r/D \leq 0.15$

$$K_1 = f\left(\frac{r}{D}\right)$$

([1] Appendix A-29)



■ $r/D > 0.15$

$$K_1 = 0.04$$

([1] Appendix A-29)

Total pressure loss coefficient (based on mean velocity in pipe):

$$K = K_1$$

Total pressure loss (Pa):

$$\Delta P = K \cdot \frac{\rho \cdot v^2}{2}$$

Total head loss of fluid (m):

$$\Delta H = K \cdot \frac{v^2}{2 \cdot g}$$

Hydraulic power loss (W):

$$Wh = \Delta P \cdot q$$

Symbols, Definitions, SI Units:

D_h	Hydraulic diameter (m)
D	Pipe diameter (m)
A	Pipe cross-sectional area (m^2)
q	Volume flow rate (m^3/s)
v	Mean velocity in pipe (m/s)
G	Mass flow rate (kg/s)

Re Reynolds number in pipe ()
 r Radius of the round (m)
 K_1 Local resistance coefficient ()
 K Total pressure loss coefficient (based on mean velocity in pipe) ()
 ΔP Total pressure loss (Pa)
 ΔH Total head loss of fluid (m)
 Wh Hydraulic power loss (W)

ρ Fluid density (kg/m³)
 ν Fluid kinematic viscosity (m²/s)
 g Gravitational acceleration (m/s²)

Validity range:

- turbulent flow regime in pipe ($Re \geq 10^4$)

Example of application:

The screenshot shows the HydraulCalc 2019b software interface. The title bar indicates the calculation is for a 'Flush-mounted rounded entrance - CRANE (1999)'. The interface is divided into several sections:

- Fluid characteristics:**
 - Fluid: Water @ 1 atm [HC]
 - Ref.: IAPWS IF97
 - Temperature: 20 °C
 - Pressure: 1.013 bar
 - Density: 998.2061 kg/m³
 - Dynamic Viscosity: 0.00100159 N.s/m²
 - Kinematic Viscosity: 1.00340E-06 m²/s
 - Selected: Density
- Geometrical characteristics:**
 - Pressure loss: $\Delta P = 0.0009476559$ bar, $\Delta H = 0.0097$ m of fluid
 - Mass flow rate: 4.9910 kg/s
 - Volume flow rate: 0.005 m³/s
 - Mean velocity: 1.288 m/s (Turbulent)
 - Hydraulic diameter: 0.0703 m
 - Radius of the round: 0.005 m
- Complementary results:**

Designation	Symbol	Value	Unit
Hydraulic diameter	Dh	0.0703	m
Pipe cross-section area	A	0.003881508	m ²
Reynolds number	Re	90251	
Relative radius of the round	r/D	0.07112376	
Coefficient of local resistance (Appendix A-29)	K1	0.1144252	
Pressure loss coefficient (based on the mean pipe velocity)	K	0.1144252	
Hydraulic power loss	Wh	0.473828	W

References:

[1] CRANE - Flow of Fluids Through Valves, Fitting and Pipe - Technical Paper No. 410 - Edition 1999