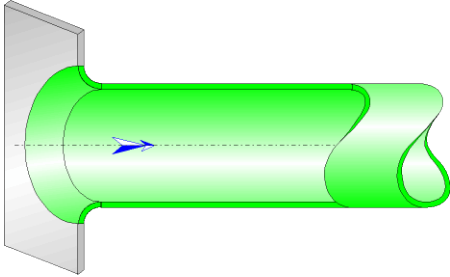




## Flush-mounted rounded entrance Circular Cross-Section (IDELCHIK)



### 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:

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Hydraulic diameter (m):

$$D_h = D_0$$

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Pipe cross-sectional area (m<sup>2</sup>):

$$F_0 = \pi \cdot \frac{D_0^2}{4}$$

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Mean velocity in pipe (m/s):

$$w_0 = \frac{Q}{F_0}$$

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Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

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Reynolds number in pipe:

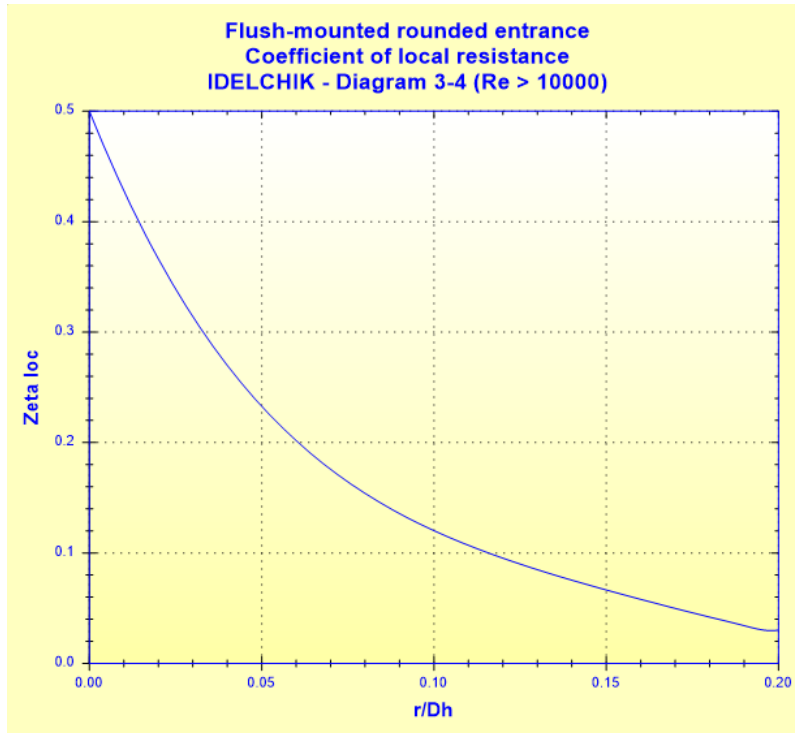
$$Re = \frac{w_0 \cdot D_0}{\nu}$$

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Local resistance coefficient:

■  $r/D_h \leq 0.2$

$$\zeta_{loc} = f(r/D_h) \quad ([1] \text{ diagram 3.4})$$



■  $r/D_h > 0.2$

$$\zeta_{loc} = 0.03 \quad ([1] \text{ diagram 3.4})$$

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

$$\zeta = \zeta_{loc}$$

Total pressure loss (Pa):

$$\Delta P = \zeta \cdot \frac{\rho \cdot w_0^2}{2}$$

Total head loss of fluid (m):

$$\Delta H = \zeta \cdot \frac{w_0^2}{2 \cdot g}$$

Hydraulic power loss (W):

$$Wh = \Delta P \cdot Q$$

**Symbols, Definitions, SI Units:**

$D_h$	Hydraulic diameter (m)
$D_0$	Pipe diameter (m)
$F_0$	Pipe cross-sectional area (m <sup>2</sup> )
$Q$	Volume flow rate (m <sup>3</sup> /s)
$w_0$	Mean velocity in pipe (m/s)
$G$	Mass flow rate (kg/s)

$Re$  Reynolds number in pipe ( )  
 $r$  Radius of the round (m)  
 $\zeta_{loc}$  Local resistance coefficient ( )  
 $\zeta$  Total pressure loss coefficient (based on mean velocity in pipe) ( )  
 $\Delta P$  Total pressure loss (Pa)  
 $\Delta H$  Total head loss of fluid (m)  
 $Wh$  Hydraulic power loss (W)

$\rho$  Fluid density (kg/m<sup>3</sup>)  
 $\nu$  Fluid kinematic viscosity (m<sup>2</sup>/s)  
 $g$  Gravitational acceleration (m/s<sup>2</sup>)

### Validity range:

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

### Example of application:

The screenshot shows the HydraulCalc 2019b software interface. The main window is titled "HydraulCalc 2019b - [Flush-mounted rounded entrance - IDELCHIK (3rd Ed.)]". The interface is divided into several sections:

- Fluid characteristics:**
  - Fluid: Water @ 1 atm [HC]
  - Temperature: 20 °C
  - Pressure: 1.013 bar
  - Density: 998.2061 kg/m<sup>3</sup>
  - Dynamic Viscosity: 0.00100159 N.s/m<sup>2</sup>
  - Kinematic Viscosity: 1.00340E-06 m<sup>2</sup>/s
  - Graph: Density (kg/m<sup>3</sup>) vs Temperature (°C) showing a decreasing trend from 1000 at 10°C to approximately 950 at 100°C.
- Geometrical characteristics:**
  - Pressure loss:  $\Delta P = 0.001432885$  bar,  $\Delta H = 0.0146$  m of fluid
  - Mass flow rate: 4.9910 kg/s
  - Volume flow rate: 0.005 m<sup>3</sup>/s
  - 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	$D_h$	0.0703	m
Pipe cross-section area	$F_0$	0.003881508	m <sup>2</sup>
Relative radius of the round	$r/D_h$	0.07112376	
Reynolds number	$Re$	90251	
Coefficient of local resistance (Diagram 3-4)	$\zeta_{loc}$	0.1730144	
Pressure loss coefficient (based on the mean pipe velocity)	$\zeta$	0.1730144	
Hydraulic power loss	$Wh$	0.7164426	W

### References:

[1] Handbook of Hydraulic Resistance, 3rd Edition, I.E. Idelchik