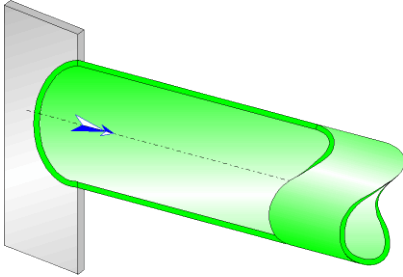




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**Flush-mounted sharp-edged entrance mounted at an angle  
Circular Cross-Section  
(IDELCHIK)**



**Model description:**

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

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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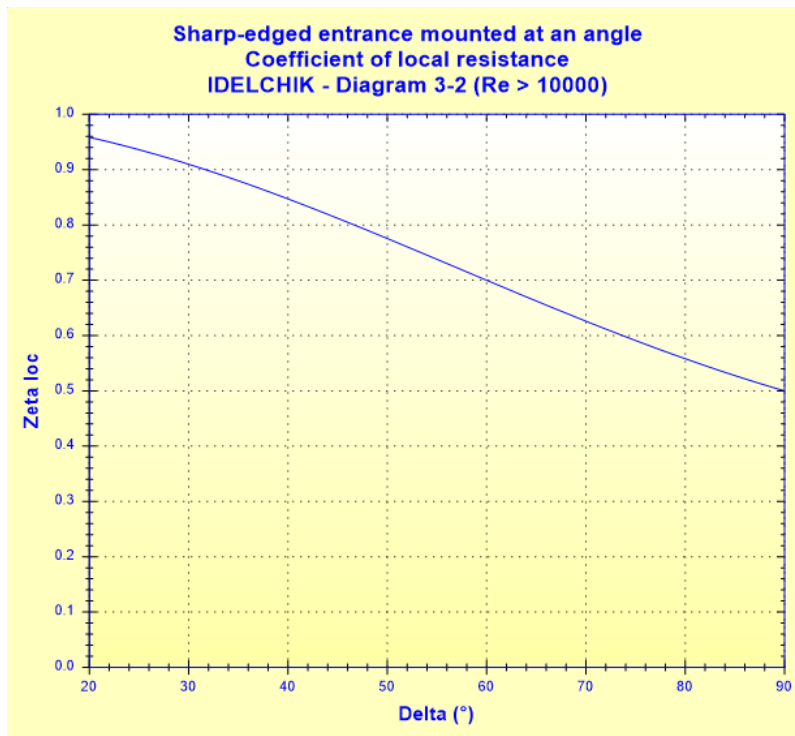
Reynolds number in pipe:

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

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Local resistance coefficient:

$$\zeta_{loc} = 0.5 + 0.3 \cdot \cos(\delta) + 0.2 \cdot \cos^2(\delta) \quad ([1] \text{ diagram 3.2})$$



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 ( )
$\delta$	Angle of inclination (°)
$\zeta_{loc}$	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)  
 $W_h$  Hydraulic power loss (W)

$\rho$  Fluid density ( $\text{kg/m}^3$ )  
 $\nu$  Fluid kinematic viscosity ( $\text{m}^2/\text{s}$ )  
 $g$  Gravitational acceleration ( $\text{m/s}^2$ )

### Validity range:

- turbulent flow regime in the pipe ( $Re \geq 10^4$ )
- angle of inclination ( $\delta$ ) between  $20^\circ$  and  $90^\circ$

### Example of application:

The screenshot shows the HydraulCalc 2019b software interface. The window title is "HydrauCalc 2019b - [Sharp-edged entrance mounted at an angle - IDELCHIK (3rd Ed.)]". The interface is divided into several sections:

- Fluid characteristics:**
  - Fluid: Water @ 1 atm [HC]
  - Ref.: IAPWS IF97
  - Temperature: T = 20 °C
  - Pressure: P = 1.013 bar
  - Density:  $\rho = 998.2061 \text{ kg/m}^3$
  - Dynamic Viscosity:  $\mu = 0.00100159 \text{ N.s/m}^2$
  - Kinematic Viscosity:  $\nu = 1.00340E-06 \text{ m}^2/\text{s}$
  - Graph: Density (kg/m³) vs Temperature (°C) showing a decreasing trend from approximately 998 kg/m³ at 20°C to 950 kg/m³ at 100°C.
- Geometrical characteristics:**
  - Pressure loss:  $\Delta P = 0.006725984 \text{ bar}$
  - $\Delta H = 0.0687 \text{ m of fluid}$
  - Mass flow rate:  $4.9910 \text{ kg/s}$
  - Volume flow rate:  $0.005 \text{ m}^3/\text{s}$
  - Mean pipe velocity:  $1.288 \text{ m/s}$  (Turbulent)
  - Pipe diameter:  $D_o = 0.0703 \text{ m}$
  - Inclination angle:  $\delta = 45^\circ$
- Complementary results:**

Designation	Symbol	Value	Unit
Hydraulic diameter	$D_h$	0.0703	m
Pipe cross-section area	$F_0$	0.003881508	$\text{m}^2$
Reynolds number	$Re$	90251	
Coefficient of local resistance (Diagram 3-2)	$\zeta_{loc}$	0.8121321	
Pressure loss coefficient (based on the mean pipe velocity)	$\zeta$	0.8121321	
Hydraulic power loss	$W_h$	3.362992	W

### References:

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