

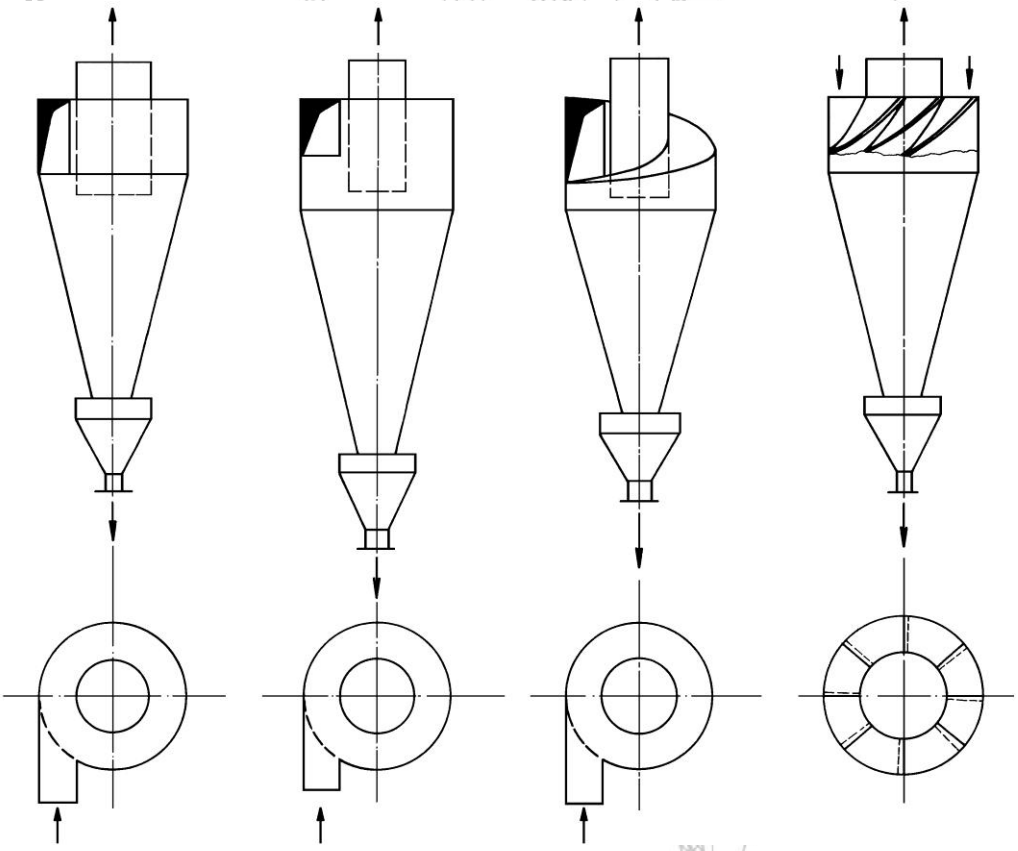
# CYCLONES and HYDROCYCLONES

**Cyclones** – for separation particles (solid or liquid drops) from gas

**Hydrocyclones** – for separation particles from liquid

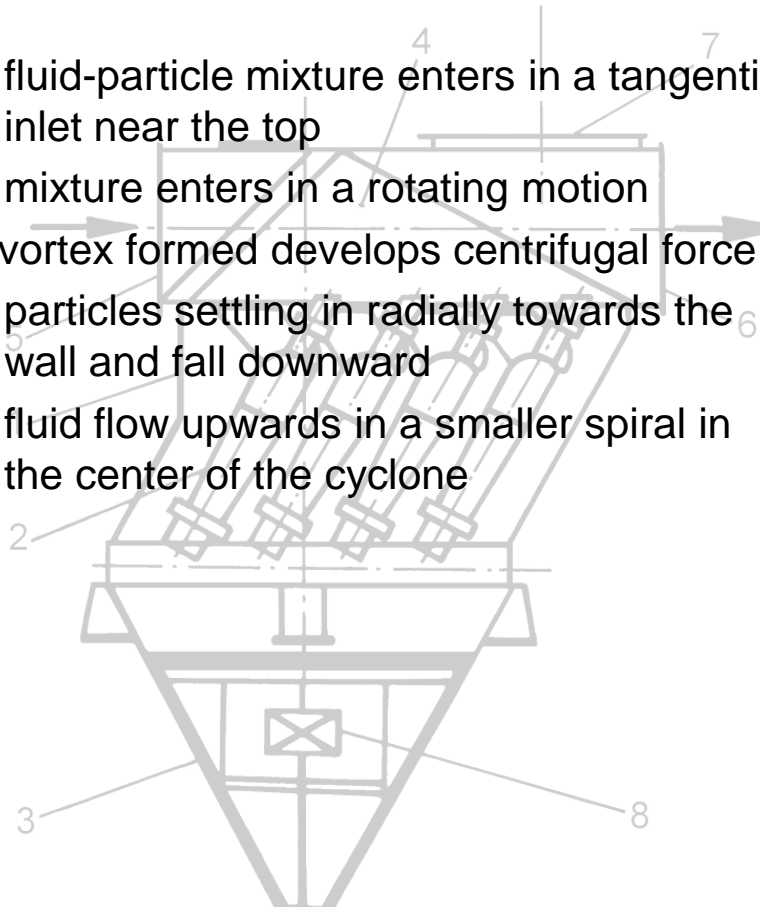
## Advantages of cyclones

- simplicity
- without moving parts
- high temperatures up to 500 °C
- with surface treatment also for abrasive materials

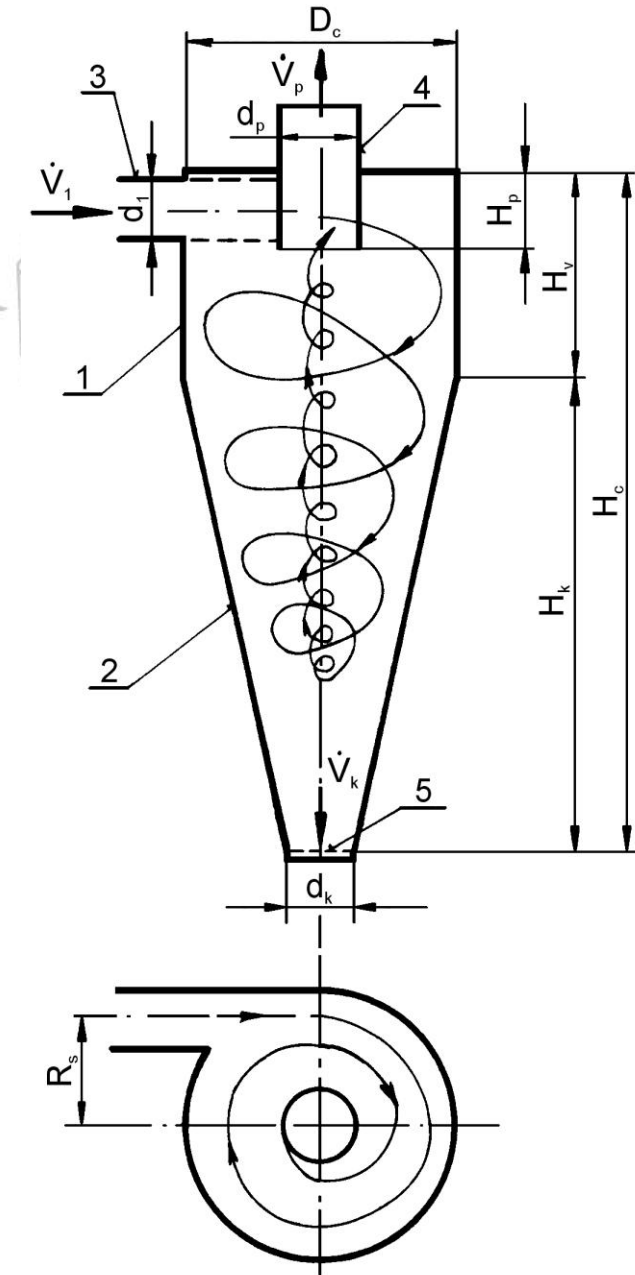


# Principle of cyclone

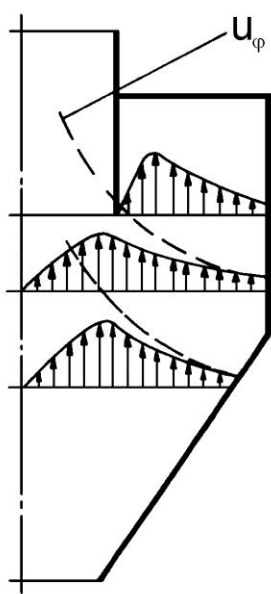
- fluid-particle mixture enters in a tangential inlet near the top
- mixture enters in a rotating motion
- vortex formed develops centrifugal force
- particles settling in radially towards the wall and fall downward
- fluid flow upwards in a smaller spiral in the center of the cyclone



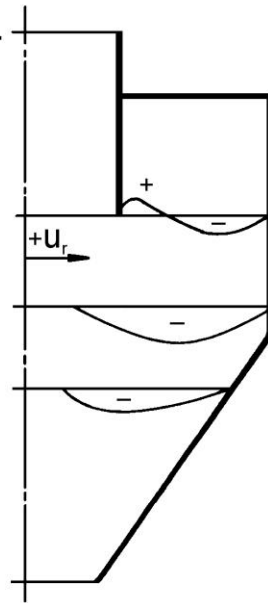
- 1** – cylindrical part
- 2** – conical parts
- 3** – inlet pipe – feed mixture
- 4** – outlet of clean fluid (overflow pipe)
- 5** – outlet of separated particles



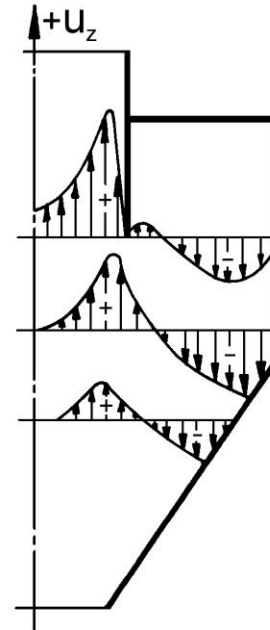
# Flow in cyclones



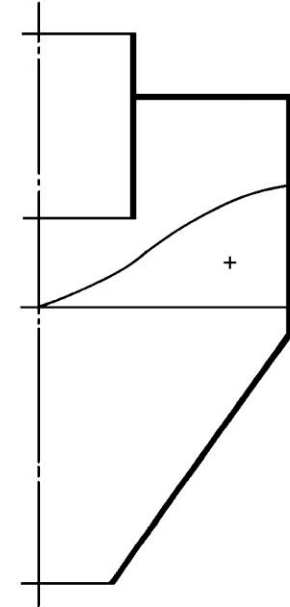
a)



b)

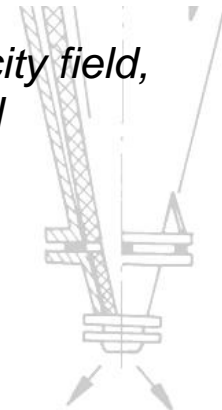
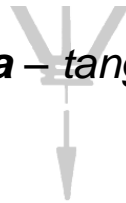


c)

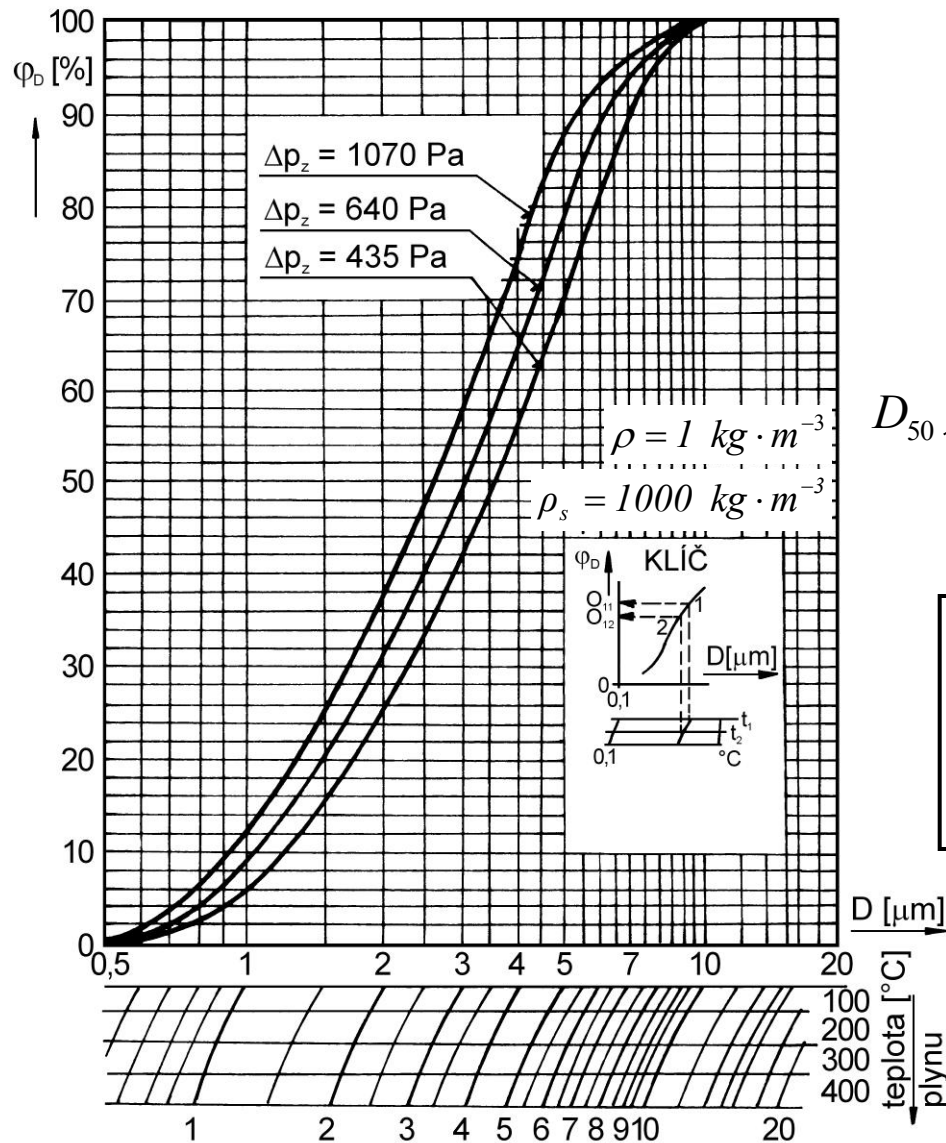


d)

**a** – tangential flow velocity field, **b** – radial flow velocity field,  
**c** – axial flow velocity field, **d** – pressure field



# Characteristics of cyclones



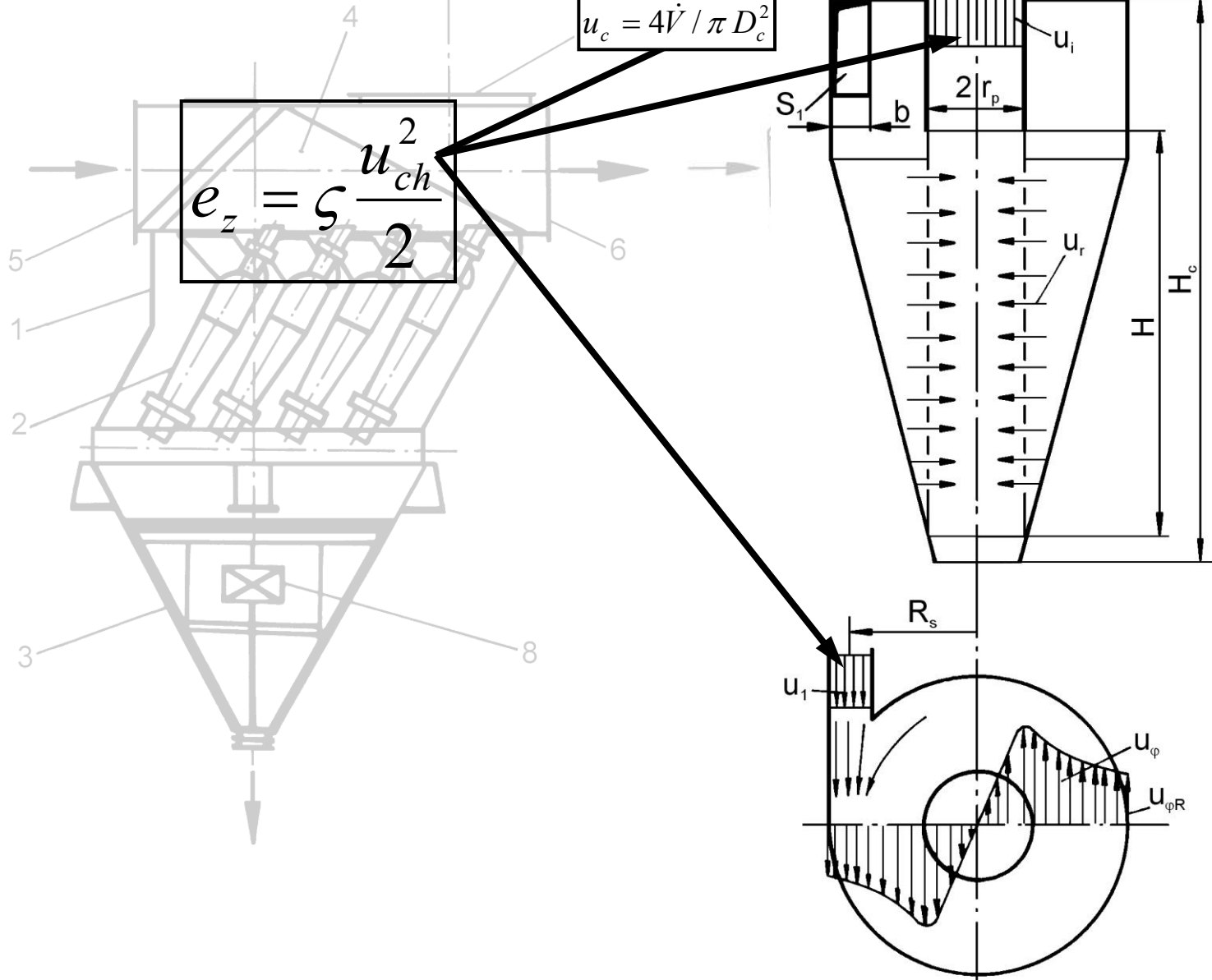
## Cyclone efficiency

### Stokes number

$$D_{50} \sqrt{\frac{(\rho_s - \rho)u_1}{\mu D_c}} = \frac{3}{\sqrt{\pi}} \sqrt{\frac{S_1}{D_c H_o}} \left( \frac{\alpha D_c}{2R_s} \right) \left( \frac{d_p}{D_c} \right)^n$$

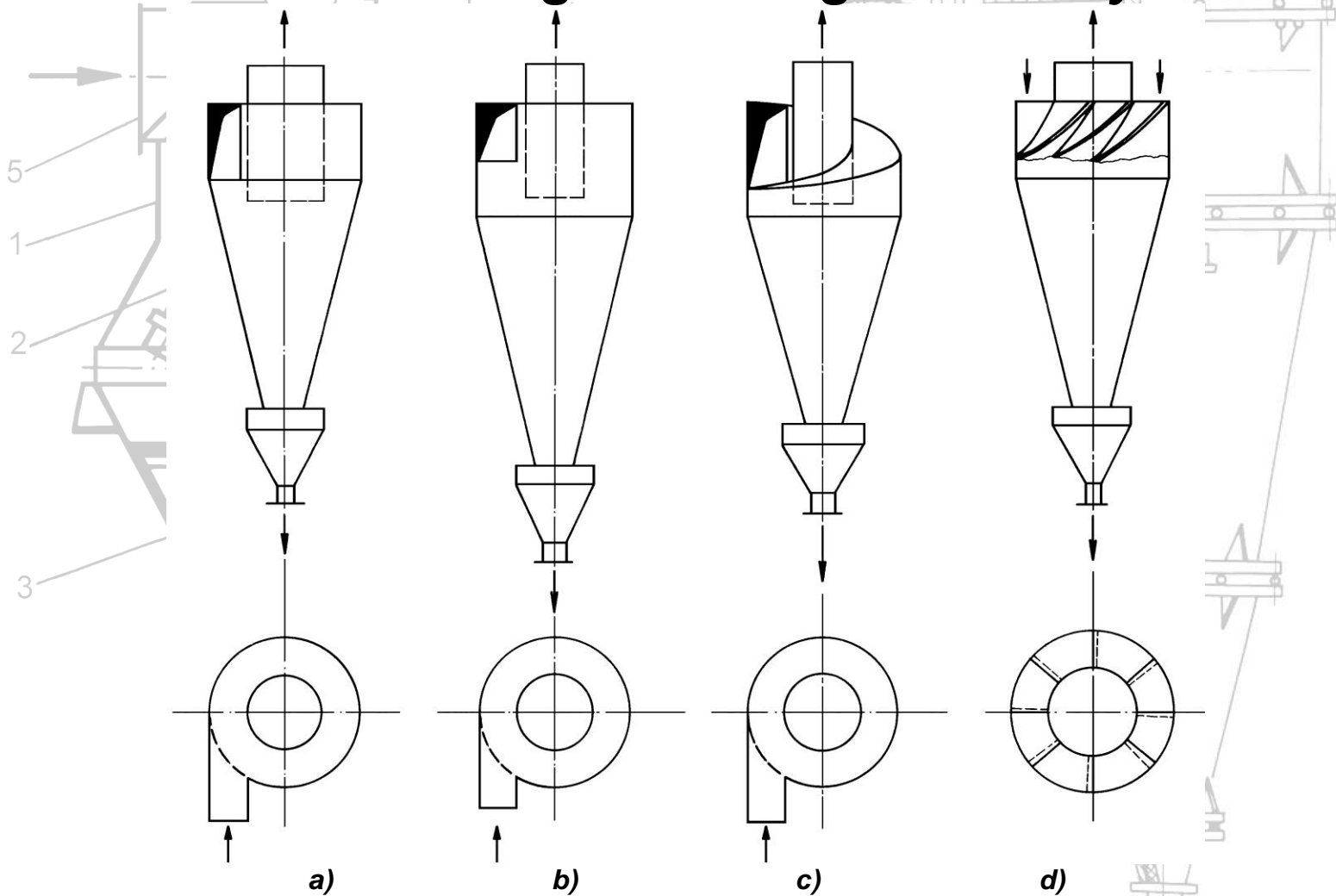
$$Stk = D_{50} \sqrt{\frac{(\rho_s - \rho)u_1}{\mu D_c}}$$

# Pressure drop in cyclones



# Types of cyclones

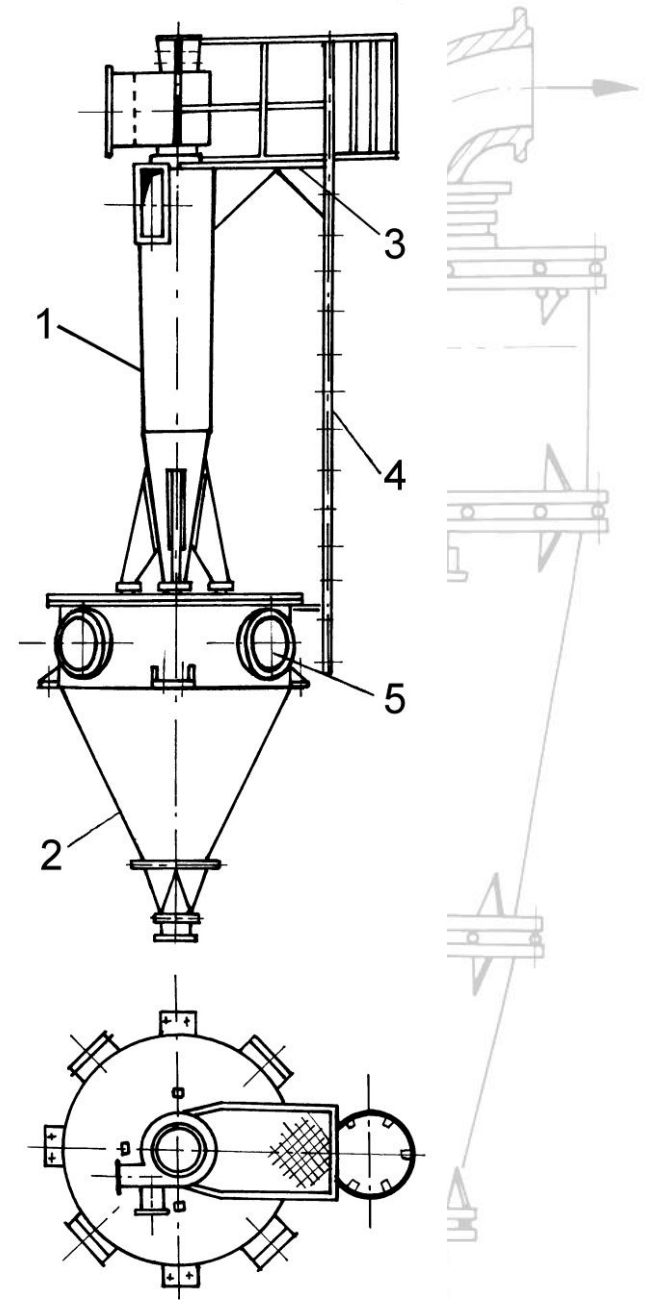
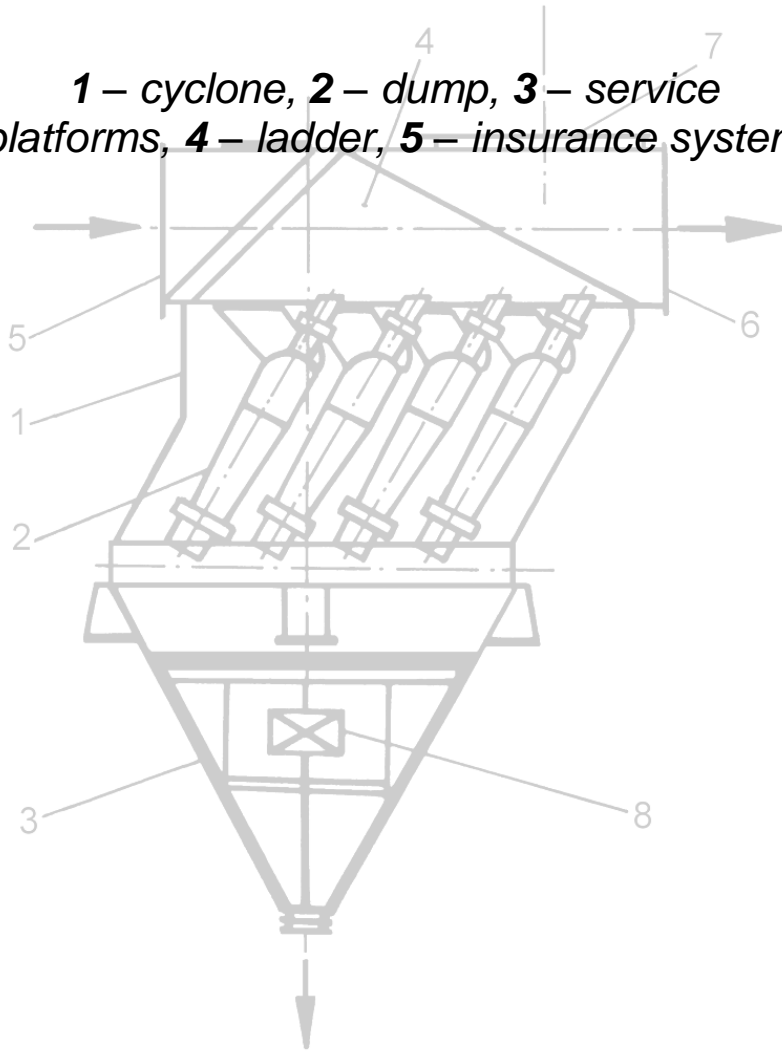
## Geometrical arrangement of gas-solid cyclones



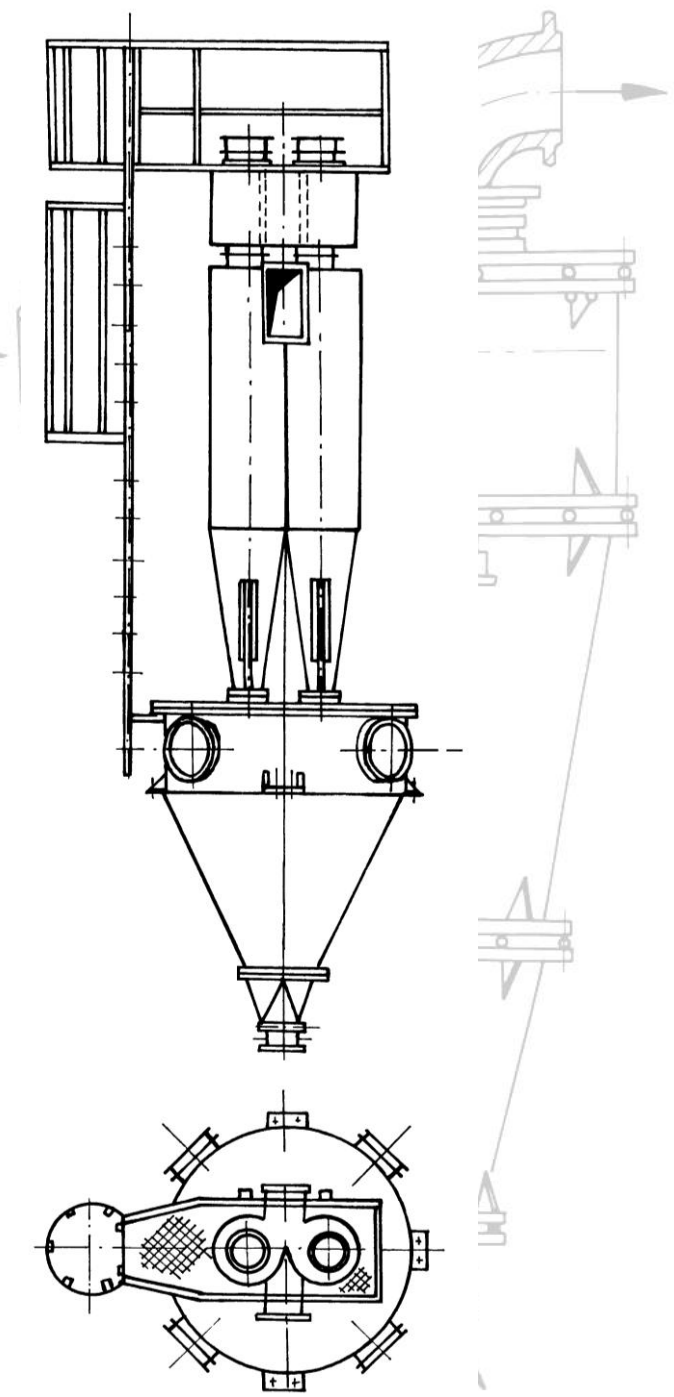
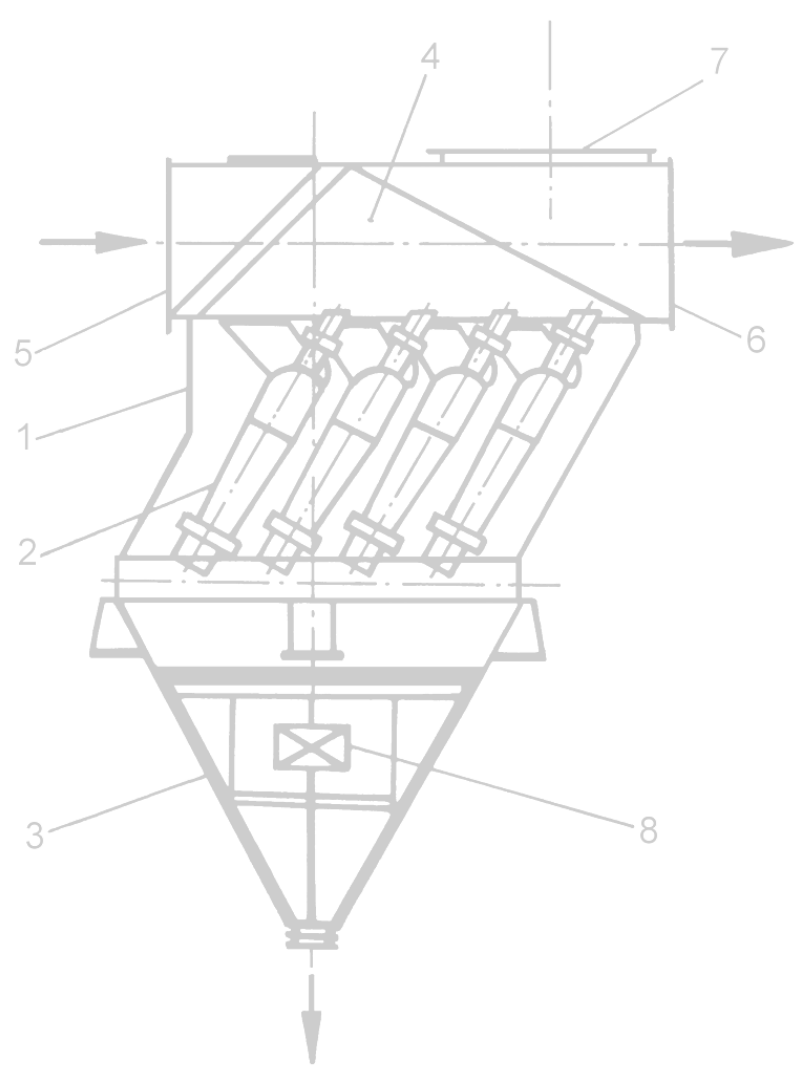
**a** – conical, **b** – cylindrical, **c** – cylindrical with screw-entry,  
**d** – cylindrical with axial entry (guide vanes)

# Arrangement of industrial cyclone

1 – cyclone, 2 – dump, 3 – service platforms, 4 – ladder, 5 – insurance system

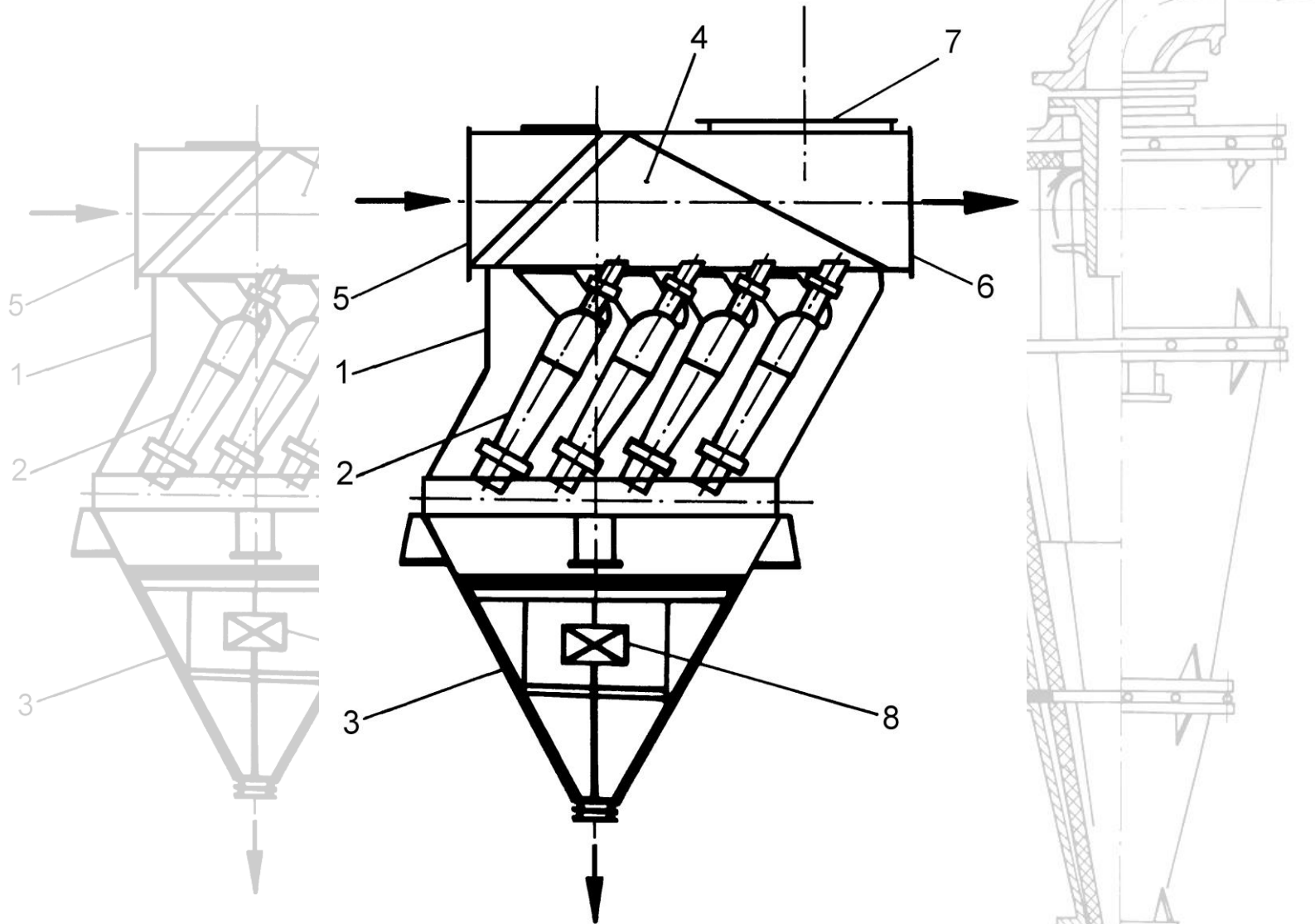


# Cyclone battery





## Arrangement of multi-cyclone



**1 – skříň odlučovače, 2 – článek (cyklón se šroubovým vstupem), 3 – výsypka, 4 – rozdělovací komora, 5 – vstupní komora, 6 – výstupní komora, 7 – zaslepovací víko, 8 – kontrolní otvor**

# Hydrocyclones

- smaller diameter, longer conical part
- greater resistance
- smaller driving force
- unsuitable for highly concentrated suspensions
- concentrated suspension through underflow orifice, maximum volumetric concentration –  $0,4 \div 0,5$
- exploitation – e.g. mineral treatment

