# Hydrocyclone Scale-Up: Cut Size and Pressure Drop

Cut size and pressure drop of a larger hydrocyclone scaled from a tested one by flow and diameter, the diameter for equal cut size, and the hydraulic power.

**Method:** Wills and Finch; Wills' Mineral Processing Technology; ...

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Tested cyclone diameter | 10.000 | cm |
| Tested flow per cyclone | 120.00 | L/min |
| Tested pressure drop | 100.00 | kPa |
| Tested corrected cut size | 22.000 | µm |
| New cyclone diameter | 38.000 | cm |
| New flow per cyclone | 1,900.0 | L/min |
| Exponents | Practical (Wills): 1.54, 0.43, 0.72, 0.22, 2.0, 3.76 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| New corrected cut size | 52.417 | µm |
| New pressure drop | 165.64 | kPa |
| Diameter giving the tested cut size at the new pressure | 11.667 | cm |
| Hydraulic power per cyclone | 5.2452 | kW |
| Flow by Wills's approximation $9.5\times10^{-3}$ D_c² √P | 176.55 | m³/h |

**Notes for this case**

- Scale-up holds for geometrically similar cyclones on the same slurry; high solids raise the cut size and lower the pressure drop at a given flow. Cut size, flow and pressure must be considered together.

## Formula and method

$$\frac{d_{50c2}}{d_{50c1}} = \left(\frac{D_{c2}}{D_{c1}}\right)^{n_1} \left(\frac{Q_1}{Q_2}\right)^{n_2}, \quad \frac{P_1}{P_2} = \left(\frac{Q_1}{Q_2}\right)^{n_5} \left(\frac{D_{c2}}{D_{c1}}\right)^{n_6}, \quad D_c^* = D_{c1} \left(\frac{P_2}{P_1}\right)^{n_4/n_3}$$

### Variables

| | | |
|---|---|---|
| $D_{c1}$ | Tested cyclone diameter | m |
| $Q_1$ | Tested flow per cyclone | m³/s |
| $P_1$ | Tested pressure drop | Pa |
| $d_{50c1}$ | Tested corrected cut size | m |
| $D_{c2}$ | New cyclone diameter | m |
| $Q_2$ | New flow per cyclone | m³/s |
| $n_i$ | Exponents | - |
| $d_{50c2}$ | New corrected cut size | m |
| $P_2$ | New pressure drop | Pa |
| $D_c^*$ | Diameter giving the tested cut size at the new pressure | m |
| $P_2 Q_2$ | Hydraulic power per cyclone | W |
| $Q_{app}$ | Flow by Wills's approximation $9.5\times10^{-3}$ D_c² √P | m³/s |

### Method and standards

Power-law scale-up of geometrically similar cyclones.

### Assumptions and limits

- Geometric similarity; same slurry.

### References

• Wills and Finch
• Wills' Mineral Processing Technology
• 8th ed. (Butterworth-Heinemann, 2016)
• ch. 9
• eqs. 9.24-9.27

## Report details

| | |
|---|---|
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/civil/mining-minerals/hydrocyclone-scale-up

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.