7. TURBOMACHINERY: BASIC MEASUREMENTS

7.1. Fluid machinery - classification

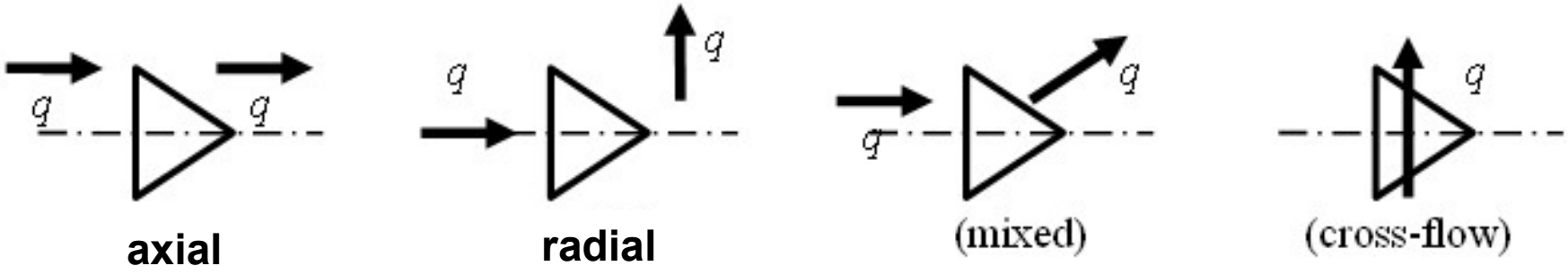
•**Working fluid: Gas**
(Liquid)
(Multiphase)

•**Mechanical power input → increase of fluid enthalpy**
(Power output)

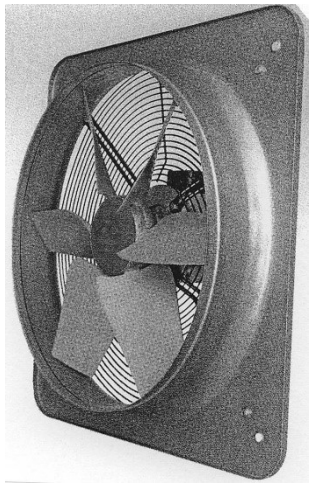
•**Operating principle: Euler principle: TURBOMACHINERY**
(Volumetric principle)

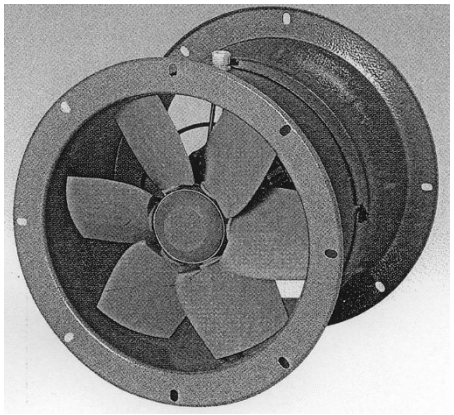
7.2. Turbomachinery - classification

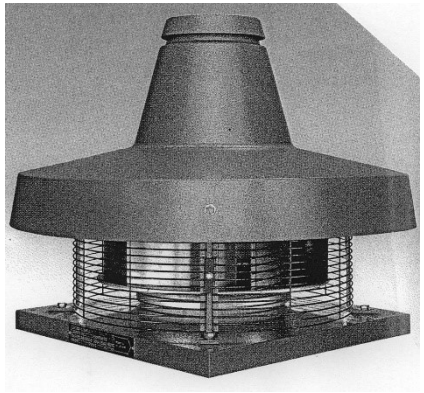
•***Flow direction:***

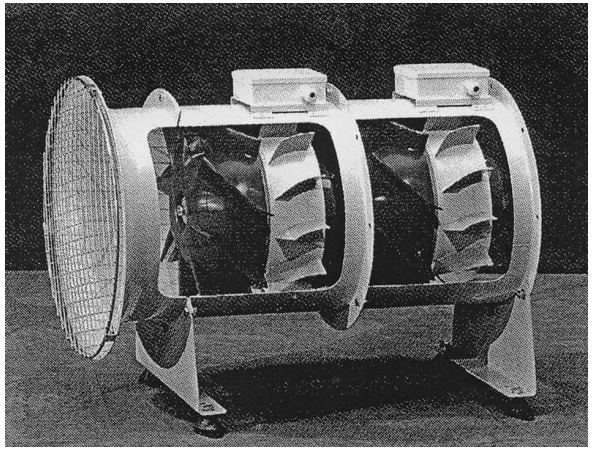


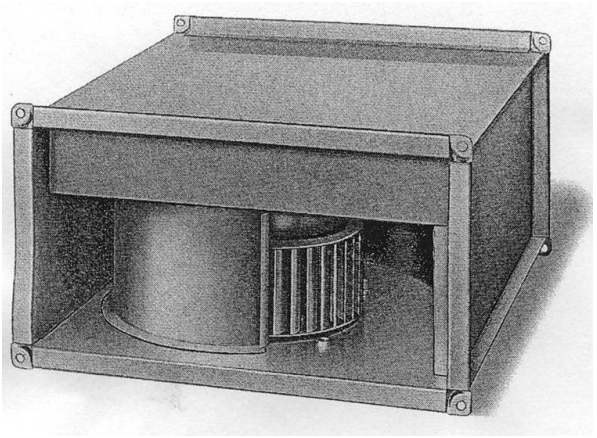
axial **radial** (mixed) (cross-flow)









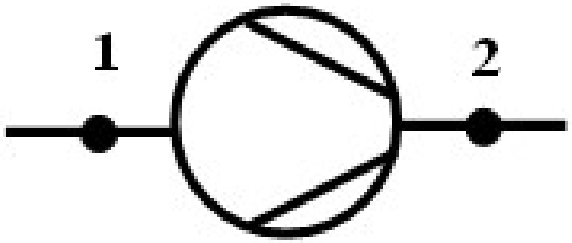


Axial fans

Radial fans

ISO 5801:2017:
„Industrial fans – Performance testing using standardized airways”

•***Pressure increase, <u>pressure ratio:</u>***



p_2/p_1 **pressure ratio**

<u>A/ $p2/p1 < 1.1$ (1.2) fans</u>

$\rho \approx$ constant, $\Delta T \approx 0$

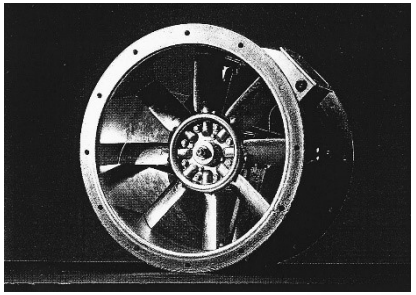
B/ $1.1 < p2/p1 < 3$ blowers

$\rho \neq$ const, $\Delta T > 0$, natural cooling

C/ $3 < p2/p1$ compressors

$\rho \neq$ const, $\Delta T >> 0$, artificial cooling

7.3. Fans: quantities to be discussed



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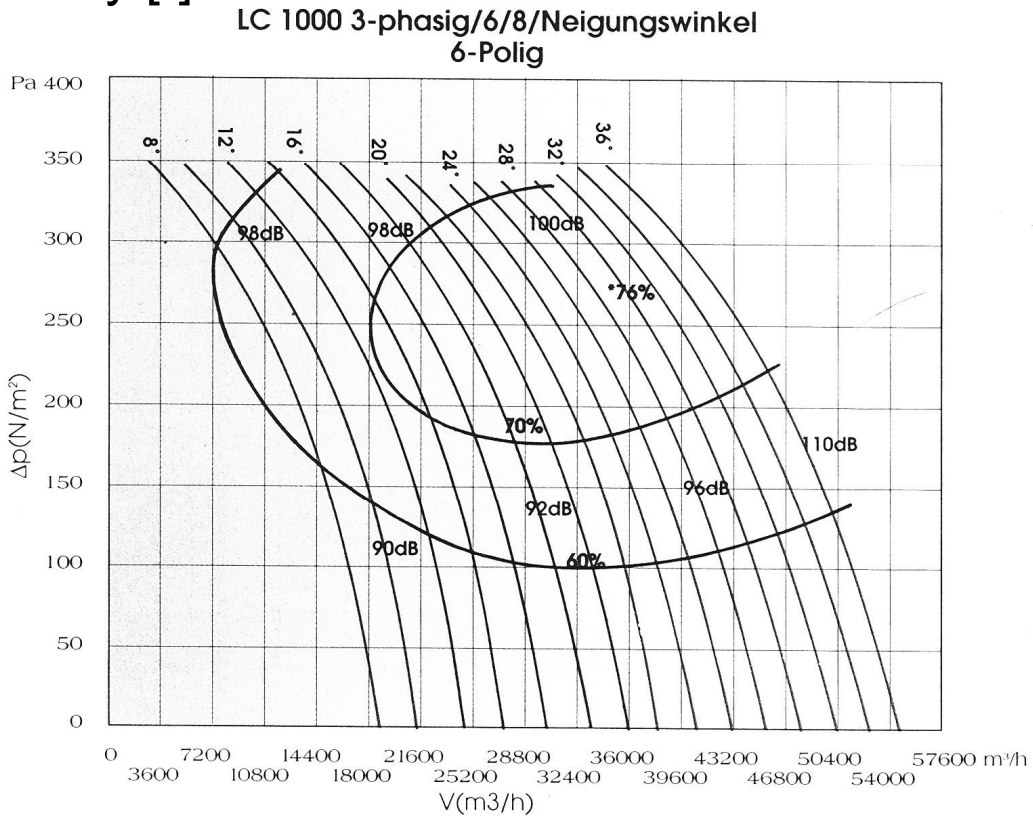
q_V – volume flow rate [m^3/s]
Δp_t – total pressure rise [Pa]
P – shaft input power [W]
$\eta_t = q_V \Delta p_t / P$ total efficiency [-]

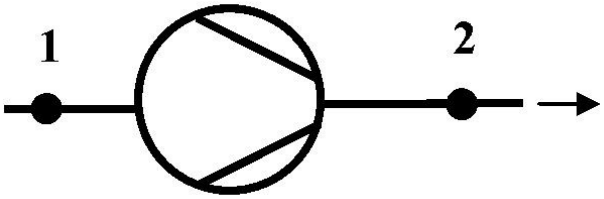
D = 1000 mm
ρ = 1.20 kg/m^3
n = 960 1/min

Characteristic curve: example

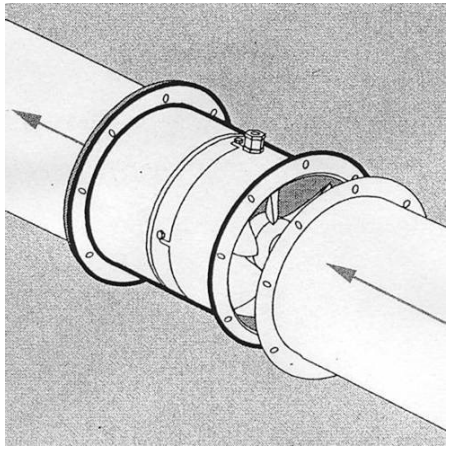


7.4. Fan configurations: examples

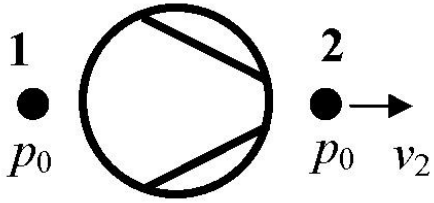
- ***From duct to duct: „ducted fans”***



$$\Delta p_t = \left(\rho \frac{v_2^{\,2}}{2} + p_2\right) - \left(\rho \frac{v_1^{\,2}}{2} + p_1\right)$$



- ***From the surroundings to the surroundings: „jet fans”***



$$\Delta p_t = \left(\rho \frac{v_2^{\,2}}{2} + p_0\right) - p_0 = \rho \frac{v_2^{\,2}}{2}$$

Static pressure rise:

$$\Delta p_s = p_2 - p_{t1} = p_0 - p_0 = 0$$