

# 7. TURBOMACHINERY: BASIC MEASUREMENTS

## 7.1. Fluid machinery - classification

- **Working fluid: Gas**

(Liquid)

(Multiphase)

- **Mechanical power input → increase of fluid enthalpy**

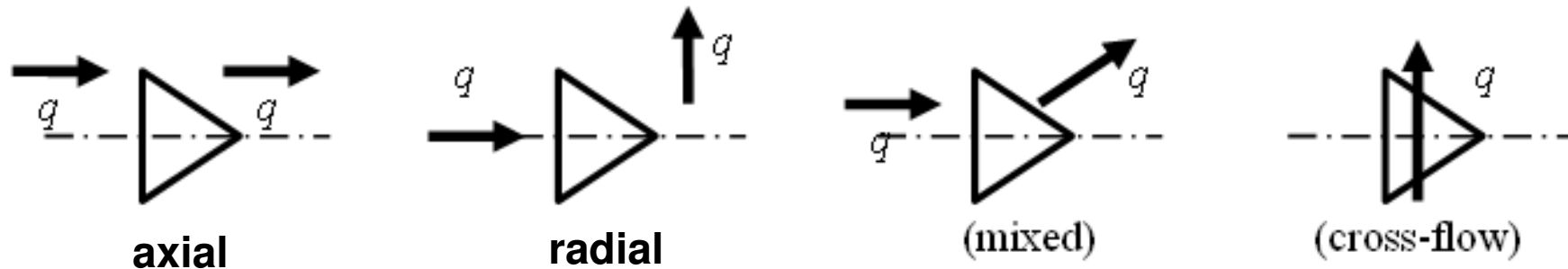
(Power output)

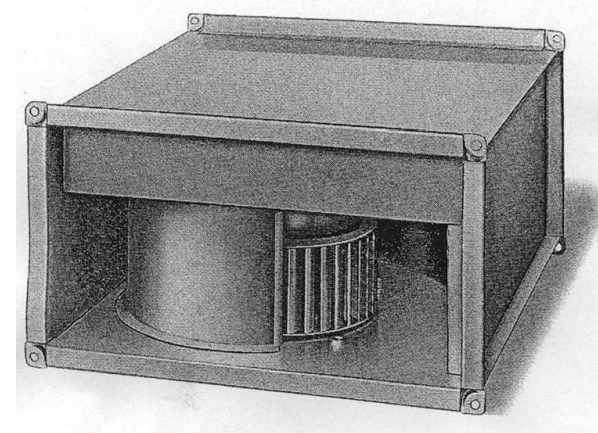
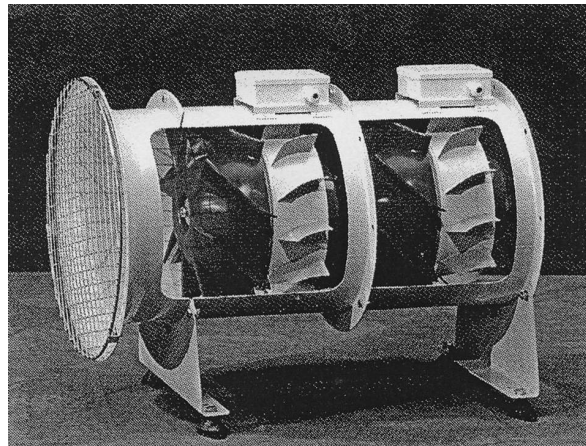
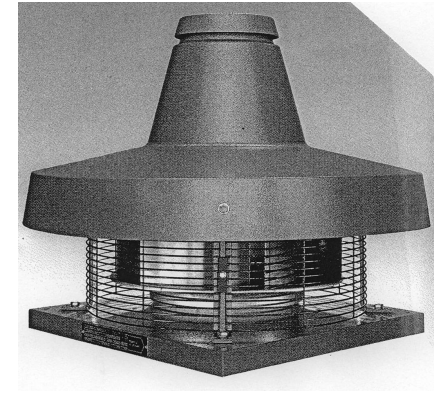
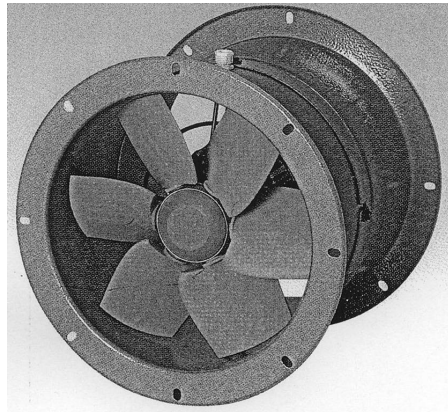
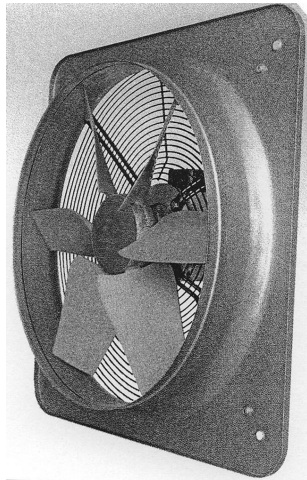
- **Operating principle: Euler principle: TURBOMACHINERY**

(Volumetric principle)

## 7.2. Turbomachinery - classification

- **Flow direction:**





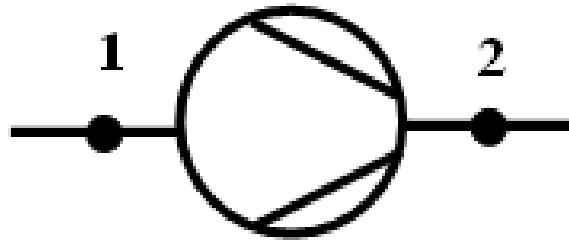
## **Axial fans**

## **Radial fans**

ISO 5801:2007 (E):

„Industrial fans – Performance testing using standardized airways”

• **Pressure increase, pressure ratio:**



**$p_2/p_1$  pressure ratio**

**A/  $p_2/p_1 < 1.1$  (1.2) fans**  
 **$\rho \approx \text{constant}, \Delta T \approx 0$**

**B/**  $1.1 < p_2/p_1 < 3$  blowers  
 $\rho \neq \text{const}, \Delta T > 0, \text{natural cooling}$

**C/**  $3 < p_2/p_1$  compressors  
 $\rho \neq \text{const}, \Delta T \gg 0, \text{artificial cooling}$

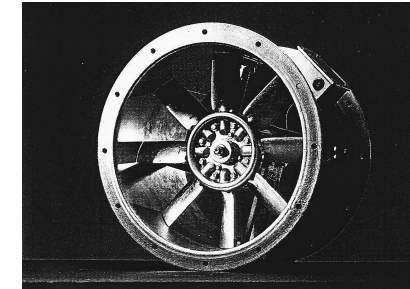
### 7.3. Fans: quantities to be discussed

$q_V$  – volume flow rate [ $m^3/s$ ]

$\Delta p_t$  – total pressure rise [Pa]

$P$  – shaft input power [W]

$\eta_t = q_V \Delta p_t / P$  total efficiency [-]



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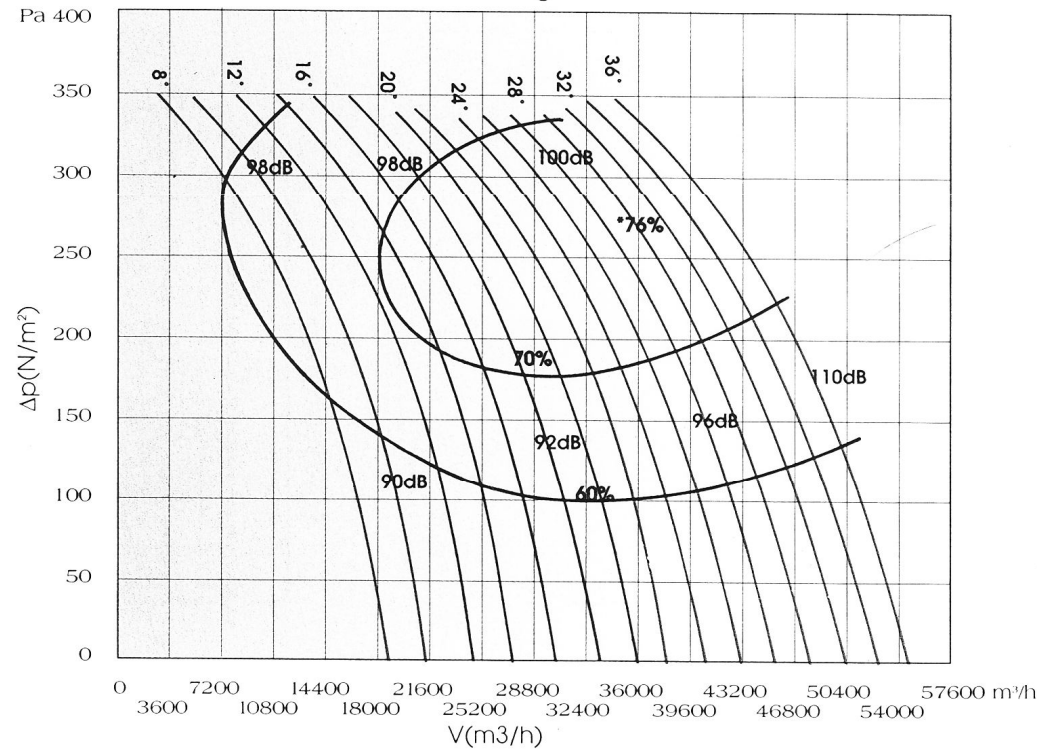
LC 1000 3-phasig/6/8/Neigungswinkel  
6-Polig

$D = 1000$  mm

$\rho = 1.20$  kg/ $m^3$

$n = 960$  1/min

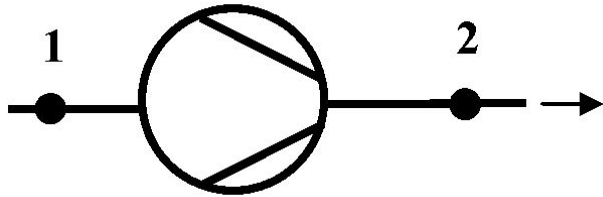
*Characteristic curve:  
example*



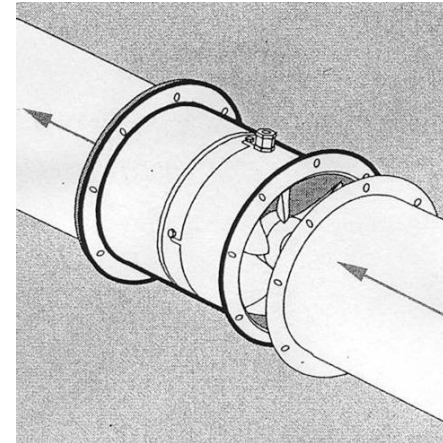
*Dr. János VAD: Flow measurements*

## 7.4. Fan configurations: examples

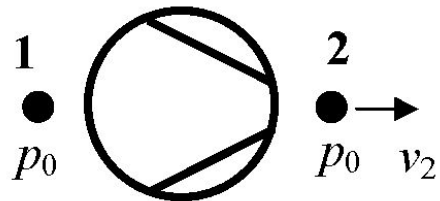
• *From duct to duct: „ducted fans”*



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



• *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:

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