CALCULATION OF DISTRIBUTING AND COLLECTING DUCTS OF VENTILATION

1.1.1. Basic Information

a) Static Pressure: Static pressure shows the potential energy which will occur in case of release of 1 m^3 of compressed air. Further, according to the power testing rules in fans, it may be defined as "the internal pressure of a fluid flowing in the correct way" and such pressure may be shown by a pressure measuring device moving in the fluid at the same speed. Static pressure is the effect of a fluid running parallel to a duct on such duct. Such pressure is measured as kg/m² or mmSS.

b) Dynamic pressure: It is equal to the kinetic energy of the air and proportionate to the second force of the speed and to the first force of its specific gravity. Unit of measurement is just like that of the static pressure. Dynamic pressure is the greatest pressure increase occurring in front of an obstacle following the flowing fluid hits an obstacle or the pressure which is required so that the same fluid increases from its static state to its speed at flowing. It is calculated by the following formula.

$$\ell = \frac{Y}{g} \qquad P_{dyn} = \frac{\ell}{2} . W^2$$

States usually encountered:

At a temperature of T = 20° and a pressure of P=760 Torr, when Y=1,2 kg/m³,

P_{dyn} = 0.061 W^2 may be written.

a) Total Pressure: Total pressure is equal to the sum of the static pressure and the dynamic pressure. Just like the static pressure, the total pressure may be expressed either as absolute or as effective. In practice, atmospheric pressure is taken as a basis so that it will be easy to add the differences of altitude to the calculation when and if necessary.

b) Equivalent Diameter: Ducts used in the ventilation technique may not only be circular in cross-section but rectangular as well. However, as all charts and diagrams from which the R value is taken are prepared for ducts of circular cross-section, the duct of circular cross-section which will be equal to the duct of rectangular cross-section in terms of R value is found in the calculation of rectangular ducts.

Equivalent diameter for the same speed: $d_{gl} = \frac{2.a.b}{+}$ ———→ formula is used.

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Equivalent diameter for the same flow rate: $D_{gl}=1{,}27\sqrt[5]{\frac{a^3.b^3}{a+b}}$

Nomograms are prepared in order to avoid the necessity of using a formula in the determination of cross-section each time. We can easily calculate the equivalent diameter by using these.

c) Special Resistances: In any special piece, other than friction loss, a further pressure loss occurs due to change of direction and cross-section. In order to determine the Z resistance characteristic of any special resistance, ξ resistance coefficient should be known.

$$\xi = \frac{Z}{\frac{\ell}{2}.10^2}$$

It is not possible to distinguish friction and turbulence losses from the pressure loss found by tests in various special resistances. Therefore, coefficient ξ is the total resistance coefficient for special resistances with smooth walls. The problem of the effect of duct wall roughness on the special resistance pressure loss has not yet been sufficiently clarified. However, the effect of wall roughness on the pressure losses in special resistances is not so high and may be neglected in practice.

For sharp turns in elbows, resistances should be reduced by the use of retaining rings in case of circular cross-section and gradual elbows, directing valves and wings in case of angled cross-section. In order for the resistance at splits to be small, speeds should be equal at the inlet, transition and splits.

Resistance coefficients for the duct form pieces most used in the ventilation technique are given in Chart 1-1. Attention should be paid to the following issue in using the chart. Value provided for elbows are only valid for square cross-sections in angled cross-sections. For rectangular cross-sections, these values should be multiplied by the factor (n) found from Chart 1 by the proportion of edges (h/b).

Chart 1 Factor (n) for ducts with rectangular cross-section

h/b	0,25	0,50	0,66	0,80	1,0	1,25	1,5	1,75	2,0	2,5	3,0	7,5
n	1,8	1,5	1,3	1,17	1,0	0,8	0,67	0,55	0,46	0,40	0,40	0,60

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CALCULATION OF DISTRIBUTING AND COLLECTING DUCTS OF VENTILATION

1.1 CALCULATION OF EXTRACTOR FAN AIR FLOW RATE

RECOMMENDED MINIMAL AIR SPEED VALUES FOR VARIOUS TYPES OF EXTRACTOR FANS AND LOCATIONS

Table:1

TYPE OF LOCATION	RECOMMENDED SPEED VALUE (M/S)	ACTIVE ZONE OF SPEED
Electrolysis workshops	0,75	Front of extractor fan aperture
Electric arc welding workshops	0,75	Front of extractor fan aperture
Kitchens	0,2 ila 0,5	Front of extractor fan aperture
Locations painted by means of a spray gun	0,75	Level at which employees aspirate
Locations where surfaces are cleaned by sandblasting	2,5	Downward at inlets
	0,4	In the location

Here:

Wh= Suction speed on a table, kitchen stove or bathtub (m/s)

h= Vertical distance to the extractor fan (m)

u= Periphery of the extractor fan (m)

F= Extractor fan surface area (m^2)

Amount of suctioned air:

F x W_0= 1,4 x U x h x Wh (m^3/s)

Wh; is selected from Table 1-1.

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Example: If Wh =0,25 m/s h=1 m and extractor fan size (1,5x1 m), then the speed on the lower surface of the extractor fan is W_0=1,4 x $\frac{5}{1,5}$ x 1x 0,25=1,17 m/s

and the amount of suctioned air is

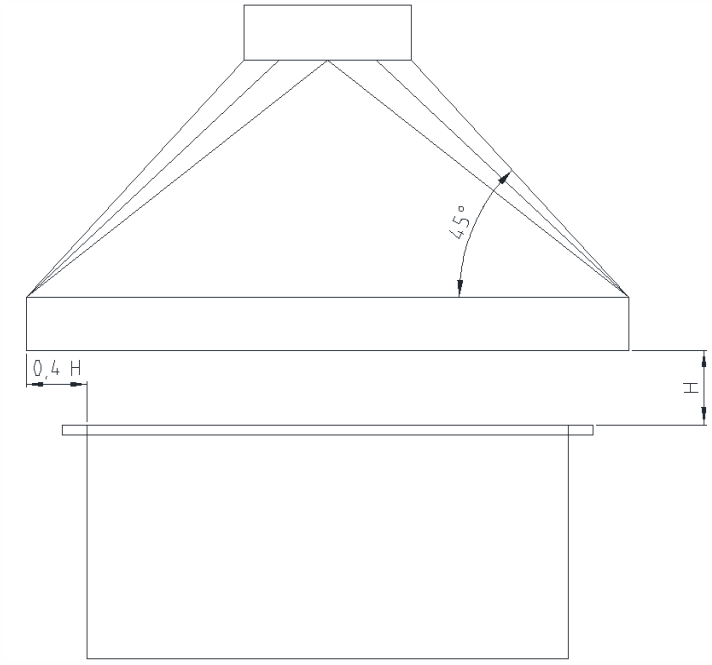
V_0=1,5 x 1,17 = 1,76 m³/s =6.350 m³/ h olur.

In case of suctioning above the kitchen stoves in the kitchen, it is more appropriate to calculate as follows.

$$\frac{W_0}{W_h} = \frac{V}{F}.h$$

$$V_0 = U.h.W_h$$

1.2.1. Extractor Fan Designing Principles



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1.2.2. Process Tank

1- If the material in the process is toxic, these types of extractor fans should not be used as employees bend over tanks.

2- If there is reciprocal air current, screening is necessary on side surfaces.

V=1,4 x P x H x W (for extractor fan type open on all four sides)

P= Tank periphery (m)

W=(0.254 2.54) m/s

V=(A+B) x H x W (for extractor fan type open on two sides)

Lengths of open sides A and B (m)

W= (0.254 - 2.54) m/s

V=A x H x W or V=B x H x W (for extractor fan type open on one side)

Length of open side A or B (m)

W= (0.254 - 2.54) m/s

Intake loss = 0,25 x dynamic pressure

Duct Speed = (5,08 – 15,24) m/s

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