VENTILATION

TECHNICAL NOTE ■ STA BE 16-28 GB

On machines (either commutator or slip ring) most of the brush heat losses are dissipated by convection and, generally, it is the air which serves as a cooling agent.

The air flow should be proportional to the losses to be dissipated and to calculate this air flow one generally uses the formula:

$$Q = \frac{W}{1.1 \times \Delta T}$$

where:

Q = Air flow in m^3 per second,

W = Losses to evacuate (for losses in brushes only see Technical Note STA BE 16-8),

ΔT = Difference in the air temperature in °C between the inlet and outlet of the machine.

Actually, a ventilation system is considered as being efficient when the temperature difference ΔT between the inlet and the outlet of the air is between 10 to 25 °C (20 to 45 °F).

The necessary air flow can also be estimated according to the machine power since the losses are proportional to the power.

This calculation method is used for traction machines.

Therefore for a motor with forced ventilation, one usually considers 0.12 to 0.14 m^3/min. for each power kW in continuous operation.

For self-ventilated motors the air flow distributed by the ventilator is directly proportional to the rotor speed; for heavy motors the following relationship is often used:

$$Q\ (m^3/s) = 0.10\ N\ (t/s)$$

In fact, according to the operation conditions, the power and environment, **the heat losses can be dissipated as follows**:

– Directly:

In this case the air for cooling the windings and brushes enters at one end and leaves at the other one. The motors are self-ventilated or equipped with motor-fans with filters to trap the dust in the circulating air.

It is recommended that the air should cross the motor in the winding commutator direction, and thus prevent wear dust from being drawn into the windings.

– By an aero-cooling system:

The cooling air of the windings and brushes is recycled through filters (see Technical Note STA BE 16-48) and an air-air exchanger. The outer air is forced into the exchanger by a motorised fan.

The aero-cooling system is often equipped with an auxiliary air device in order to produce overpressure and ensure the replacement of the air which corresponds to the losses that can be very important.

Experience shows that brush wear is often reduced when the air is partially renewed.

– By an hydro-cooling system:

The cooling air of windings and brushes is recycled through filters (see Technical Note STA BE 16-48) and a water exchanger similar to an automobile radiator.

As in the previous case and for the same reason the hydro-cooling system is equipped with an auxiliary air device.

Whatever the cooling method the following should be borne in mind:

– A cold commutator does not always build up skin under the brush. An excess of cool and dry air leads to the effect of streaking or stripes in the brush tracks as well as irregular wear of the metal of the ring or commutator.

– The most favourable temperature for a commutator (in operation) is between 50 °C and 70 °C (120 ° and 160 °F). It is not recommended to work under 40 °C.

– Too cold air, besides the disadvantages stated above, will be too dry. In fact, under 2 or 3 g water per m^3 air (see Technical Note STA BE 16-29) the skin does not develop and the brush wear increases.

– From 90-100 °C although this operating area is seldom found in industrial machines, we generally admit that the skin is modified due to low humidity. It leads to an increasing brush wear.

– Excessive humidity also disturbs the brush operation. The skin gets thicker, preferential areas for air flow appear and generate streaking and stripes on the commutators.

– Disturbances appear when air humidity is about 20 g water per m^3 air, but this rate can vary according to brush grades and their eventual impregnations.

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