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Air Processing Management

# Air Vision,

## Static and dynamic loads of fans on the foundations

The static load of the fan consists in its own weight in N (Newton).
However the fan is a rotating machine not perfectly balanced, even when it is new. Furthermore, during the rotation, the fan may be used with gases including corrosive, clogging or abrasive dust which are able to deteriorate the balancing of the fan and consequently cause an additional load on static one called dynamic.

The dynamic load is the cyclic force applied to the fan bearings when the gravity center of the dynamic parts (hub + shaft + coupling (or pulley)) does not match with the rotational center. Like any centrifugal force, the dynamic load is function of the rotor's mass, the square of the rotational speed and the distance between the center of rotation and the center of gravity called eccentricity.

**Dynamic load of new fan.**

We define the quality of a balancing, G, as the product of the rotor vibration velocity ω (rad/s) by the specific unbalance $e_{per}$ (µm or gr.mm/kg). For example, if an impeller rotates at 1480 RPM and the balancing quality is G 6.3; the angular velocity ω = 1480x2π / 60 = 155 rad/s and the specific unbalance is $e_{per}$ = G / ω x $10^3$ (µm) = 40.6 µm (or gr.mm/kg).
This equal to say that grade 6.3 allows a deviation of 40.6 µm between the center of rotation and the rotor's center of gravity at the speed of 1480 RPM.
If the rotor's mass is 530 kg, then the nascent centrifugal force due to the residual unbalancing is:
$F = m \times \omega^2 \times e_{per} = 530 \times 155^2 \times 40.6 \times 10^{-6} = 509$ N. (a)

**Realistic dynamic load**

This last value is however a theoretical value and the calculation of the cyclic centrifugal force must be assigned with a service coefficient taking into account a misalignment, corrosion or clogging during the period of service. All those last causes can potentially be the reason of a substantial increase of the forces applied cyclically to the bearings and therefore to the machine's frame. When calculating the foundations, a realistic dynamic load must be applied to ensure enough machine's resistance to the maximum vibration level. The formula (a) becomes:
$F = m \times \omega^2 \times e_{per} \times S$.
Some manufacturers are using the value corresponding at 1/3 of the rotor's weight. It is according our opinion not enough: the practice in heavy industrial environment shows that the fan can be subject to dynamical loads much more important. To ensure security the dynamical load that we use is equal to 3 times the rotor's weight and must be added to the static load for the calculation of the foundations.

Avenue Jean Monnet, 1 • Louvain-La-Neuve 1348 • Belgium • Tel: +32(0)10/47.00.80 • info@airvision.be • www.airvision.be