AIRVISION
Air Processing Management

Air Vision,

Do not excite the fans! They can go wild…!

We often believe that to equip a fan with anti-vibration pads is the best thing to do. However, it is a mistaken belief because instead of preventing the fan from vibrating, this device gives more freedom of movement and additional flexibility to the machine.

Therefore the real goal of rubber isolators is to ensure an isolation of the fan from its external environment (upstream-downstream ducts, and its support) in order to do not propagate the vibrations made by it. Even, when they are weak and according their frequency, they may excite one element of the structure on its own main frequency leading it until self-destruction. This is particularly the case if the fan is placed on a metal frame. In case of a concrete slab, the efficiency of the rubber isolators is quite relative, and they can even give rise to nuisance disruptive phenomena.

Theoretical basis

It is sought that the pads have a good isolation power regarding the frequencies emitted by the fan. The main one is issued by the speed of rotation, with:

$f = N/60$ et $\omega = 2\pi f$.

Let's remember that any mechanical system is comparable to a stiffness spring K and with a mass K. Its own pulsation is:

$\omega = \sqrt{(k/M)}$.

If F is the deflection of the rubber isolator under the action of M, we got:

$F = Mg/k$

And then, the resonant pulsation of the isolator is :

$\omega_0 = \sqrt{(k/M)} = \sqrt{(g/F)}$.

The rubber isolators are made for example with natural rubber wedged between metal frames of variable stiffness depending on the model. Or in a form of springs, sometimes very flexible; particularly suitable for fans working at very low speed.

While selecting rubber isolator, we should care about the value ω_0 to be comprised between 3 and 4 times weaker than the exciter pulsation ω corresponding to the speed of the fan.

If we set φ the ratio $\omega/\ \omega_0$, then the isolation efficiency can be written as:

$\eta = 1 - 1 /(\varphi^2-1)$

From the speed rotation of the fan and the efficiency of the wished isolation, we are able to find φ, then ω_0 and finally to select the right rubber isolators, in order to fit the deflection condition F, knowing the mass M of the fan to split on a certain amount of rubber .

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Concrete applications

1. We observe therefore that more low is the rotation speed; more high will be the deflection of the isolator (very soft isolators). In opposite way, higher is the rotation speed, the deflection is very low (high stiffness) until they are no longer needed.

2. When it is not possible to understand the vibration behavior of the fan while well balanced; well aligned and equipped with new bearings. It is sometimes useful to detect the own vibration frequencies of each parts of the machine. They are defined by studying the response to vibration after a shock (hammer blow) using an accelerometer and a Fourier analyzer. It is enough then to increase the stiffness of the incriminated part, or to condemn any operation in the speed range exciting this part.

3. The « fan-concrete » system with rigid anchoring is solid and steady. This system has its own pulsation very far from the admissible rotation speeds. The isolators therefore are not necessary due to the very low risk of vibration transmission. In case of variable speed drive use, is it better to do not use it as they will not be able to cover all speed values with good efficiency. (This last remark does not apply if the fan is mounted on a frame).

4. The fan is constituted by an impeller, a casing and two bearings support, which are as many springs with their own resonance frequency directly proportional to thickness of the metal sheet used and inversely proportional to the free surface of the same sheet. This is why the importance of manufacturing fans with strong and suitably stiff plates, to keep far away the own frequencies of each element from the various exciting frequencies possible (fan speed, motor speed…).