Vibration and bellows

Bellows assemblies have no effective natural damping and is considered as a spring in dynamic systems. This means that it may not absorb energy (vibration) and the term **“vibration eliminator”** is misleading. The metal bellows will only transmit the vibration energy at a different frequency from the input frequency.

If the bellows is installed in such a way as it is not allowed to transmit vibration (for instance, between a vibration source and a solid fixed point), it will fail or cause another system component to fail.

In order to absorb some vibration energy, the bellows must have some damping capacity, i.e. it must have some material component capable of absorbing the vibration energy being transferred to the bellows and converting it into some other form, e.g. heat. Rubber dampers are the usual means of absorbing vibration energy.

However, if used to help with vibration in a pipeline it must be where it is of high frequency and low amplitude. They should not be used where the vibration frequency is low and the amplitude high, such as those from reciprocating machines.

Pressure pulse vibration cannot be removed by the installation of an expansion joint because the pressure pulses are transmitted beyond the expansion joints through the flow medium. In this case, a pulsation dampener is required. This usually converts the high amplitude, low frequency vibrations to less severe pulsations of higher frequency and lower amplitude.

When vibration is present and the frequency is known, the bellows should be designed so that its natural frequency and higher modes do not coincide with the system frequency. A resonant response in the bellows can be avoided by ensuring that the natural frequency of the bellows is either lower than the system frequency or at least 50% higher than the system frequency.

The piping system designer should ensure that vibration loads in the piping system will not be detrimental to the function of the bellows. In reducing or eliminating vibration effects, external dampening devices or system mass adjustments should be considered.

Turbulence can vibrate individual convolutions and cause dramatic failure. If flow velocities are high, turbulent flow may be generated within the bellows section or turbulence originating upstream of the bellows may induce vibration. To minimise this an internal liner should be used.

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