

MEASUREMENT TECHNIQUES

Absolute vibration

Absolute vibration monitoring is perhaps the primary method of machine health monitoring on steam turbines. The type of transducer used is seismic (ie vibration of turbine relative to earth) and can either be a velocity transducer or an accelerometer.

The choice of transducer has been the subject of debate for many years and often the final decision is purely subjective. A number of factors however should be taken into account.

The steam turbine is a fairly simple machine when considering vibration signatures. The frequencies of interest are normally from one-half to five times running speed (broadly 25 to 300Hz). The unique high frequency detection capability of the accelerometer is not often used.

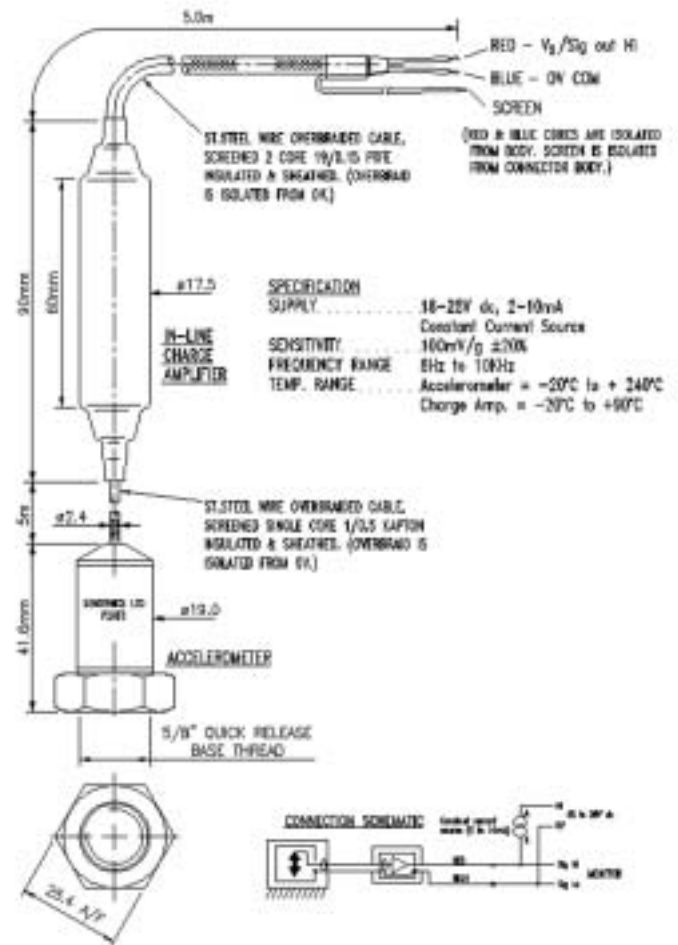


Pedestal vibration monitoring

Vibration monitoring is nearly always in terms of velocity or displacement and can therefore be obtained by an accelerometer or a velocity transducer. Particular care needs to be taken when double integrating an accelerometer signal to provide a displacement measurement. Problems usually occur below 10Hz when double integrating and 5Hz when single integrating. In the frequency ranges normally monitored on steam turbines this is not a problem. These measurement issues can be reduced by integrating the signal at source rather than after running the signal through long cables (ie having picked up noise on route). Accelerometers with built-in stages of integration are available to perform this task as discussed in the previous section.

Pedestal vibration is normally measured in the two axes perpendicular to the shaft direction where the bearing is under load, providing complete measurement coverage. In some instances the thrust direction is also monitored depending on turbine configuration.

Gas turbines demand high temperature transducers for absolute vibration monitoring (>400° typ). For this reason, a separate charge amplifier is normally utilised, located away from the high temperature environment.



Accelerometer with external electronics for high temperature applications

Difficulties can be encountered when monitoring the HP turbine pedestals using accelerometers. The high frequencies generated by steam noise can saturate the amplifier electronics. Filtering the signal prior to the charge amplifier will eliminate the problem but this must be incorporated into the amplifier circuit of an accelerometer with built in electronics.

In summary, the velocity transducer is simple and easy to fit to a turbine but has limited frequency and phase response (not a problem in the range 10 to 1000Hz) and requires periodic maintenance. The accelerometer on the other hand requires more careful installation but can then be left without maintenance.

The velocity transducer has the advantage over the accelerometer of being self generating and not requiring any power supply. On the other hand, the accelerometer has no moving parts and should not require frequent calibration.