Shock Pulse Monitoring…A Snapshot

Unless an individual is involved with some form of machinery vibration analysis, the term "Shock Pulse" (Monitoring) is unknown and somewhat foreign. Officially, and accurately, it is a technology relying on the physical principle that sound travels undiminished through metal objects for great distances. The second principle involved is that of resonance. The measuring instrument is equipped with a 30,000 Hertz electrically tuned device, which resonates and records certain shock frequencies emitted by roller bearings.

This explanation, while accurate, loses most people, and leaves them cold. A simpler, if somewhat inaccurate, illustration enables an easier visualization, and invites very good credibility.

Using a freight train as an example, visualize sitting at a rail crossing waiting for the train to pass. We've all done this at one time or another. As the train cars pass, you hear the usual sound of the wheels rolling against the steel tracks, and the normal "clickety-clack" as the wheels cross the rail joints. The sound varies, louder as the heavier cars pass, less intense as the empty cars pass. That is the usual sound, and can be called in Shock Pulse terminology as "Decibel Carpet". Floor, bottom, average sound of a freight train rolling by, if you will.

While the train is passing, a car, loaded with coal approaches. This particular car has a flat spot on one of its wheels. Rail car wheels get flat spots when the car is empty, has been sitting in the yard for a long time, and a brake shoe sticks to a wheel rim. The car is coupled to a train for use, and when it starts to move, the wheel can't turn because of the stuck brake shoe. Eventually, speed, vibration and sheer impact will tear the brake loose and the wheel begins turning. However, after being dragged for some distance on a steel rail unable to turn, the wheel now has a flat spot.

It is easy to imagine how this flat spot will sound as it hits the rail with each revolution. This sound, a repetitive "banging", heard well above the "Decibel Carpet", now becomes "Decibel Max", (maximum), the second term to be understood in Shock Pulse terminology.

The third term is "Decibel Initial", and this is a factor, which can be likened to calibrating the listener's ear as the train passes. This "calibration" regulates the intensity with which ear perceives Decibel Max, and Decibel Carpet. These terms are abbreviated, "DBI", "DBM", and "DBC".

Applying the technology to steel roller bearings requires only reasonable access to the outside diameter of the monitored bearing through an uninterrupted metal path. Permanently attached metal studs are best for this purpose. A mechanical "clip-on" accelerometer is used to anchor to and read the acoustical signature from the bearing, through the housing to the studs.

A hand held, contact probe can also be used with good results.

The Instrument, which reads the shock pulse DBM/DBC values and displays them as two numerical values is called the "IR-30". Any type of steel roller bearing can be monitored. The technology has no application to sleeve bearings.

Data acquisition is a simple process. First, Decibel Initial value for the particular bearing(s) must be determined. For this, the inside diameter of the bearing must be known. Shaft diameter upon which the bearing is mounted is usually easiest to determine. Where two different diameter bearings are used on a shaft with near equal loads on both ends, an average of both diameters is used. Shaft rotative speed is also needed. Entering these figures into the IR-30 yields the Decibel Initial (DBI) value for those bearings.

The sites on the machine for bearing probe points are then determined. We try to use bearing housing flange edge surfaces, since these areas have ample depth, are free of air or oil passages, and provide a direct (if somewhat curving) solid metal path to the outer race of the subject bearing. Studs are fitted by drilling and tapping sites with M8 or 5/16" - 18P threads, 1/2" deep, with a 90 Degree entering chamfer.

Manual data acquisition consists of operating the machine in loaded and in unloaded condition, while measuring DBM/DBC values with the instrument. As each site value is determined, it can be electronically stored in the instrument for later downloading to a PC and printing. Electronic recording requires use of "CondMaster Pro" software provided by Ingersoll-Rand with purchase of the instrument.

Manual recording of the data can also be done on paper logs, designed by the user to suit the purpose. Normally, data is taken monthly for the first three months of operation of a new machine, then quarterly.

DBM/DBC values are indicators of bearing condition, and of bearing deterioration. As a general rule, DBM values, on new equipment of oil flood/ oil free compressors, will run in the 20 to 40 range. DBC, about half DBM. Data is reviewed, and DBM values which rise in the 45 range and above, particularly when unit is loaded, are to be noted. DBC will also rise, coming close to DBM. Two consecutive DBM readings at or above 55 in 700 hours signal need to consider bearing overhaul.

Sudden changes are to be especially noted, and monitor frequency "doubled up". A cracked or loosened inner race will result in such drastic changes, and must receive immediate attention.

Oil Free Compressors will display consistent DBM as 10, 15 points higher than DBC in normal running condition, loaded or unloaded.

Oil flooded single stage units seem to display closer DBM/DBC points than oil free, and when running unloaded DBM/DBC will be equal to or higher than loaded. When gas load is relieved, rotors seem to become more unstable and "rattle around" in the bearing clearances more.

Oil flooded two stage units display DBM/DBC loaded points consistent with single stage and oil free machines. However, unloaded DBM/DBC seem to run at or considerably higher than loaded figures. Therefore, on oil flooded units, loaded DBM/DBC figures are to be considered dominant decision points. Drive motor bearings behave in similar manner.

Two stage units have four bearing points per casing. The shock pulse emission from the four points radiates and overlaps as it is read from the casing flanges. However, trending, and observing loaded DBM/DBC using these guidelines should yield accurate indications of repair requirements.