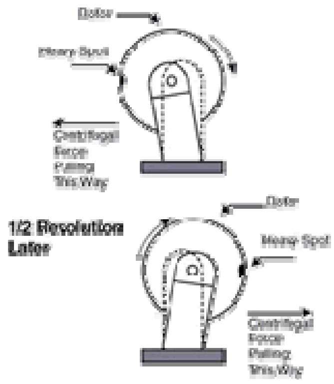
Application Note   Balancer

AS-440 Applications

What?

The International Standards Organisation defines unbalance as:

"That condition which exists in a rotor when vibratory force or motion is imparted to its bearings as a result of centrifugal forces."



A more popular definition is:

"The uneven distribution of mass about a rotor's rotating centre-line."

The rotating centreline can be defined as the axis about which the rotor would rotate if not constrained by its bearings.

A secondary centreline, often referred to as the geometric centre-line (the physical centreline of the rotor) also exists.

When these two centrelines coincide, the rotor will be in a state of balance.

Why?

Any component that rotates needs to be in a state of balance to ensure smooth running when in operation.

Benefits associated with a well balanced, smooth running rotor are:

- **Minimise vibration -** Unbalance is still the major source of machine vibration.
- **Minimise noise -** Airborne noise is often directly attributable to mechanical vibration.
- **Minimise structural stress -** The forces produced by unbalance have to be absorbed by the surrounding structure.
- **Minimise operator fatigue and annoyance -** Exposure to high levels of vibration and noise affects operator efficiency.
- **Increase machine life -** The time between outages can be extended if the machine is running smoothly.
- **Increase bearing life -** Bearings bear the brunt of the unbalance forces.
- **Increase product quality -** Minimum vibration, especially on machine tools, produces better parts.
- **Increase personnel safety -** Dangers associated with machine failure are minimised.
- **Increase productivity -** Machines running smoothly have more "uptime" availability
- **Lower operating costs -** Extra machines are not required "just in case" of breakdowns. Spare capacity is kept to a minimum. Energy consumption is reduced.

Everything that rotates needs to be in a state of balance to ensure smooth running when in operation.

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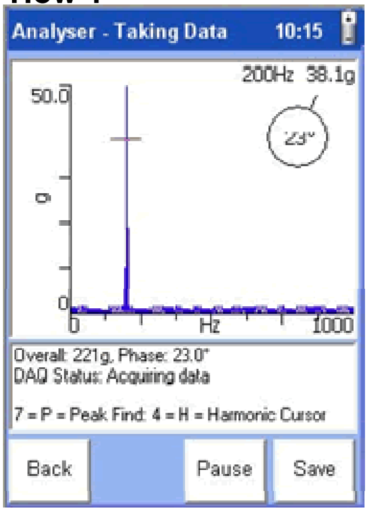
When ?

Signs that a rotating object requires balancing include:

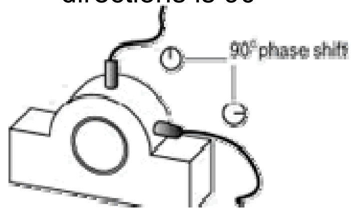
- A component fails a conformance test
- Increased levels of vibration are observed
- Increased airborne noise is observed
- Energy increase in normal operation of machine

How ?



Unbalance has been identified and quantified,:

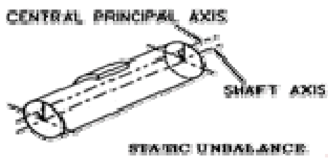
- When there is a high 1 X vibration amplitude.
- When the amplitude exceeds the ISO requirement for the class of machine
- When the phase shift between the horizontal and vertical directions is 90°



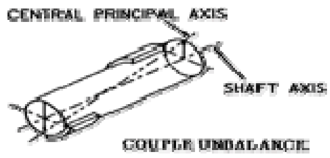
Weight has to be either added or removed from the rotating element. The ultimate aim being to reduce the uneven mass distribution so that the centrifugal forces and hence the vibrations induced in the supporting structures are at an acceptable level.

There are 3 types of unbalance:

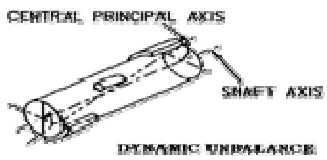
1) Static Unbalance - central principal axis is displaced parallel to the shaft axis



2) Couple Unbalance - central principal axis intersects the shaft axis at the rotor centre of gravity == Use Dynamic Unbalance to resolve.



3) Dynamic Unbalance - random combination of static and couple unbalance



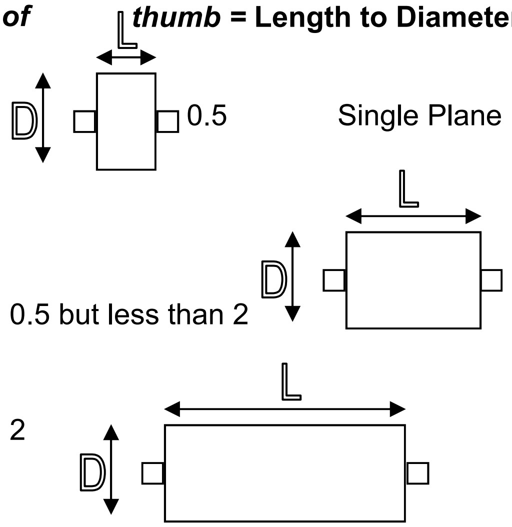
Which standard / acceptance limit should I test to?

There are various ways that limits can be chosen.

- A customer / end user of rotating machinery will specify an international standard that the machine must comply with as part of their documentation.
- A customer / end user will have their own noise & vibration expertise and will specify vibration limits in an internal technical document.
- If a customer does not know what levels to specify then they can seek the advice of a noise & vibration consultant to make recommendations.

How many Planes?

***As a rule of thumb* = Length to Diameter (L/D) Ratio Procedure**



Less than 0.5 — Single Plane

More than 0.5 but less than 2 — Single plane for >150 RPM
2 plane for faster machines
but try single plane first

More than 2 — Two plane

Avoiding Bad Data

A measurement will involve placing an accelerometer onto the measurement position and pressing the “start” key on the DI-440. Before doing so the operator should check the following;

- The magnet should be firmly screwed onto the accelerometer. Any looseness between the magnet and accelerometer will corrupt the reading.
- Gently slide the accelerometer onto the measurement position. Slamming the transducer onto the machine may cause data overload.
- The magnet should be in firm contact with machine’s surface. Any movement of the magnet will be falsely recorded as vibration data. Try sliding / rotating the magnet until a firm seating is achieved.
- Avoid knocking or disturbing the accelerometer while taking the measurement.

Data Retrieval and Analysis

Stored data can be transferred to a PC via USB, Infra Red (IrDA), RS232 serial ports or memory card. The data is in comma separated values (*.csv) but will appear as a Microsoft Excel spreadsheet.

The data can be used in various ways. For example;

- Plotting vibration data versus machines tested to trend changes in quality
- Viewing vibration spectra to make to diagnose a problem
- Archival of reference vibration signatures for future comparison with data taken after installation or service period