**An Introduction into Fault Diagnosis and Condition Monitoring**

A Statement of the Nature of a Condition Made after Observing It’s Signs and Symptoms

What are the results of un-rectified faults

BREAKDOWN

Serious equipment failure

FINANCIAL

Cost of replacement

Lost revenue

SAFETY

Environment

Personal injury

SHUTDOWN

Plant malfunction

Decontamination

**Six Steps to Identify & Rectify**

**1 SYMPTOM**

**2 FAULT & LOCATION**

**3 CAUSE**

**4 INVESTIGATE CAUSE**

**5 CORRECTIVE ACTIONS**

**6 MONITOR**

**SYMPTOM:-**

A sign of the existence of a condition, especially a perceptible change from what is normal.

**FAULT:-**

A defect or imperfection.

A break in the continuity of a system.

**CAUSE:-**

A person or thing that makes something happen or produces an effect.

**EXAMPLE:-**

A car is continually overheating when in slow moving traffic.

Use the diagnostic system to provide some possible solutions.

If we use this example of a car, a very common piece of equipment and then analyse the fault circumstances we should be able to come up with a plan to resolve the issues with it. Use the following sheet to develop a plan.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Group\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_

List the possible causes that fit with the overheating problem and then produce a solution based on the six steps.

 **1 SYMPTOM**

Overheating

**2 FAULT & LOCATION**

Lose of coolant in system

**3 CAUSE**

Radiator, hoses, engine block or heating system leakage

**4 INVESTIGATE CAUSE**

Observation, inspection

**5 CORRECTIVE ACTIONS**

Repair, replace or change

**6 MONITOR**

Check and record

**Why Monitor?**

To avoid unplanned losses of production.

To give maintenance time to plan activities.

To prevent expensive breakdowns on equipment.

**When?**

Carried out as part of routine checks.

**How do we use our senses to monitor situations**

Eyes: - Amps, Pressure

Hands: - Temp, Vibration

Ears: - Noises

Mouth: - Tell Someone

**The Disadvantages**

Subjective - No standard

Design - Does not gather quality information

**By using modern condition monitoring equipment and systems we can achieve excellent reliability.**

**Vibration Monitoring Advantages**

Easy to use

Can detect faults early

Can analyse root cause

Many Applications

Cheap

**Measuring Points**

Must represent machines vibration pattern

On or near nearing housing



As many points as practical

Mark locations for consistency of results

Good contact between probe and housing surface

**Considerations**

Speed Of rotation

Motion: - Recip/Rotating

Foundation design

Machine Size – Classes

Vibration is the physical movement or oscillation of a mechanical part about a reference position.

Why do we care about vibration?

Wasted energy

A major cause of premature component failure

Before looking more closely at vibration, it is important to first understand the common terms used for vibration analysis and their applications.

**Amplitude**

Amplitude is an indicator of the severity of a vibration. Amplitude can be expressed as one of the following engineering units:

Velocity

Acceleration

Displacement

**Velocity**

Velocity is the rate of change in position

Typical velocity units are: IPS (Inches Per Second), mm/sec (millimeters per second)

Velocity is the most accurate measure of vibration because it is not frequency related. 0.5 IPS @ 1000 rpm is the same as 0.5 IPS @ 10000 rpm.

**Acceleration**

Acceleration is the rate of change of velocity and is the measurement of the force being produced.

Acceleration is expressed in gravitational forces or “G’s”, (1G = 32.17 ft/sec/sec)

Acceleration is frequency related, in that 1 g @ 1000 rpm is not the same as 1 g @ 10000 rpm.

**Displacement**

Displacement is a measure of the actual distance an object is moving from a reference point.

Displacement is expressed in “mils” 1 mil = .001 inch

Displacement is also frequency related, in that 10 mils @ 1000 rpm is not the same as 10 mils @ 10000 rpm.

**Frequencies**

The rate of mechanical oscillation in a period of time. Frequency can be expressed in one of the following units:

* + RPM - Revolutions per Minute
	+ CPM - Cycles per Minute
	+ CPS - Cycles per Second
	+ Hz - Hertz,
	+ 1 Hz - 1 Cycle per Second (to convert from Hz to RPM or CPM, apply the following formula: Hz \* 60 = RPM.

**Types of Vibration**

Vibration can be classified into one or more of the following categories:

Periodic

Random

Resonant Harmonic

**Periodic**

Repeats itself once every time period

Result of a mass imbalance in a component or disc.

As the component rotates, it produces a “bump” every rotation which is referred to as the once-per-revolution or “1P” vibration.

This vibration is usually correctable by balancing.

**Random**

Do not repeat themselves

Not related to a fundamental frequency.

An example - the shock that is felt as a result of driving down the road and hitting a pothole

**Resonant**

The natural frequency at which a mechanical system is inclined to vibrate. All things have one or more resonant frequencies.

Resonant vibrations are the result of a response in a mechanical system to a periodic driving force.

Harmonic

Exact multiples of a fundamental frequency

Classified in terms as 1st, 2nd, 3rd…..

**Other Monitoring Methods**

Temperature

Radial & Axial probes

In house or contract survey systems

Lube oil analysis

**RADIOGRAPHIC TESTING**

USES:-

Internal Defects

METHOD:-

Similar to medical x-Rays. Radiation passes through the material and exposes a piece of photographic film.

Defects show up as darker spots on the film, due to the difference in density of the fault.

**ULTRA SONIC INSPECTION**

USES:-

Thickness Measuring

Vessel Inspections

Crack detection

METHOD:-

A probe sends ultra sonic waves through the material until they come into contact with another medium. The waves are then directed back towards the probe. The time taken is in relation to the thickness.

**MAGNETIC PARTICAL INSPECTION**

USES:-

Crack detection

METHOD:-

A white background paint is applied to the area to give contrast. The area is sprayed with a solution containing suspended iron partials and then a large magnet is used to bridge the area. If a crack is present then the iron partials will align along the affected area. This type of inspection is only suitable for ferrous metals.

**DYE PENETRANT INK**

USES:-

Crack detection

METHOD:-

The inspected area is cleaned with a solvent degreaser and then sprayed with a coloured ink that will search into any defects. The ink is left to soak for a period of time the removed using the solvent spray. A contrasting developing spray layer is then applied and any ink that has seeped into a defect shows up on the development spray. This type of inspection is suitable for both ferrous and none ferrous metals.