CONDITION MONITORING

This module is designed to develop your awareness and competence in condition monitoring according to your current training objectives which are set out in your ROA.

Upon completion of all input, whether practical or theoretical, you will be asked to complete a written test that will verify your level of understanding.

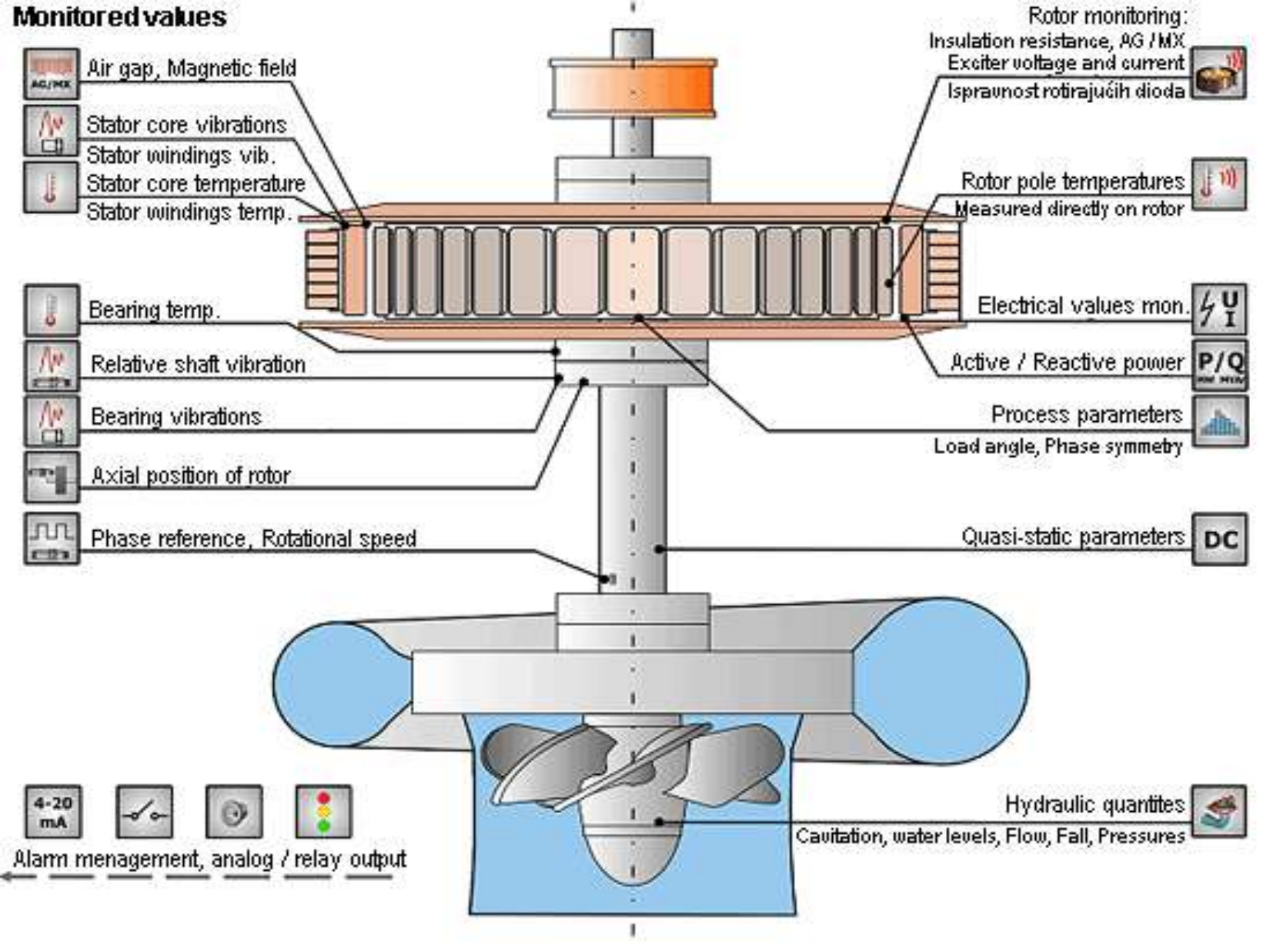
WHAT IS CONDITION MONITORING

Is the process of monitoring all parameters of condition in machinery, such that a significant change is indicative of a developing failure. It is a major component of

PREDICTIVE MAINTENANCE

The use of conditional monitoring allows maintenance to be scheduled, or other actions to be taken to avoid the consequences of failure, before the failure occurs. Nevertheless, a deviation from a reference value (e.g. temperature or vibration behaviour) must occur to identify impeding damages.

PREDICTIVE MAINTENANCE DOES NOT PREDICT FAILURE


Monitored values
Air gap, Magnetic field
Stator core vibrations
Stator windings vib.
Stator core temperature
Stator windings temp.
Bearing temp.
Relative shaft vibration
Bearing vibrations
Axial position of rotor
Phase reference, Rotational speed
Rotor monitoring:
Insulation resistance, AG / MX
Exciter voltage and current
Ispravnost rotirajućih dioda
Rotor pole temperatures
Measured directly on rotor
Electrical values mon.
Active / Reactive power
Process parameters
Load angle, Phase symmetry
Quasi-static parameters
DC
Hydraulic quantites
Cavitation, water levels, Flow, Fall, Pressures
4-20 mA
Alarm menagement, analog / relay output

WHAT IS CONDITION MONITORING (CM)

In the 21st Century CM includes, but is not limited to, technologies such as:-

- Vibration Measurement and Analysis
- Infrared Thermography
- Oil Analysis and Tribology
- Ultrasonics - Covered Previously
- Motor Current Analysis - Electrics

RECAP OF PREVIOUS LESSONS

- You should recall that some areas of CM have been taught in previous lessons.
- DYE PENETRANT DETECTION
- MAGNETIC PARTICLE DETECTION
- ULTRASONIC DETECTION
- X-RAY (RADIOGRAPHIC) DETECTION

Vibration Measurement and Analysis

- Ninety percent of all machine failures are signaled months, even years, in advance by changes in machine vibrations. Some future failures are even predictable upon initial start-up.
- By understanding a machine's vibration "signature," you can diagnose, solve, and prevent problems, as well as reduce the cost of maintenance.

Vibration Measurement and Analysis

- We monitor the condition of machinery for the following reasons:-

Less Downtime

Less Spare Parts Inventory

Better Management Time Allocation

Less Overhaul-Overkill

Longer Production Runs

Better Quality

How to monitor

- Although the recording of vibration data can be performed with equipment as basic as a meter and a pencil and paper, advances in technology enable computer assisted data collection which provides much more detail in a fraction of the time .

Vibration Analysis

- Using a vibration analyser, and some skill, personnel can pinpoint the causes of rough machinery condition. Such problems as rotor imbalance and misalignment make up a great proportion of mechanical deficiencies and can be identified and rectified. Other problems such as bearing wear are not only detected, but also qualified as to the severity of wear. In many instances, a historical case study can prognose the remaining life of bearings so that scheduled repairs can be prioritised.

Corrective Measures

- By far, the most predominant utilisation of vibration corrective measures are that of balancing. More than a trial and error method of achieving dynamic trueness, balancing with an analyser is a stepped process. It is one of very few techniques where machinery which is deemed "rough" can be corrected in place, without disassembly and where the results can meet any level of precision in almost all cases. This is especially helpful when one considers that the same analyser pinpoints imbalance conditions so that the cause and cure are achieved with the same instrument.

Corrective Measures

Vibration analysers can be used for running alignment. We have seen cases where an analyser is used throughout the alignment procedure to detect the source of high vibration or to detect the effects of fastening. Also, soft-foot conditions can be detected and corrected while the machine is operational. This creates a fast diagnosis-correction situation without having to stop and start the machinery.

Myths

"***We don't have a vibration problem***"

That is because "vibration" is not a problem - it is a physical manifestation of machinery imperfection. It is used to help find obvious and subtle deviations in machines. No machine runs perfect.

Myths

"Balance that machine"

This is a request that is made before a condition of imbalance is established. It is not just a matter of semantics either. If in fact, the machine is imbalanced, corrective action can be taken and the machine can operate within tolerances. If it is not imbalanced, the vibration analyst will advise the corrective action but cannot use the analyser to fix the problem directly. It is a matter of expectations and in some cases, disillusionment.

Myths

"That machine is fine - we've just changed the bearings"

This is stated as a reason for not analysing a machine. Bearings do fail as a matter of fact. After a certain amount of time, maybe a month, maybe a decade, bearings will finally succumb to slight or severe wear criteria and will fail. Assuming however, that bearing replacement is the final solution is a folly.

Myths

- The bearing replacement trap occurs when the old bearings are noisy or fail. The engineers are charged with replacing them and the new ones are now quiet - problem solved -

WRONG

Myths

"That machine always runs like that"

And it always will until you fix it! Vibration analysis can tell you how.

Myths

"When it fails, we repair it"

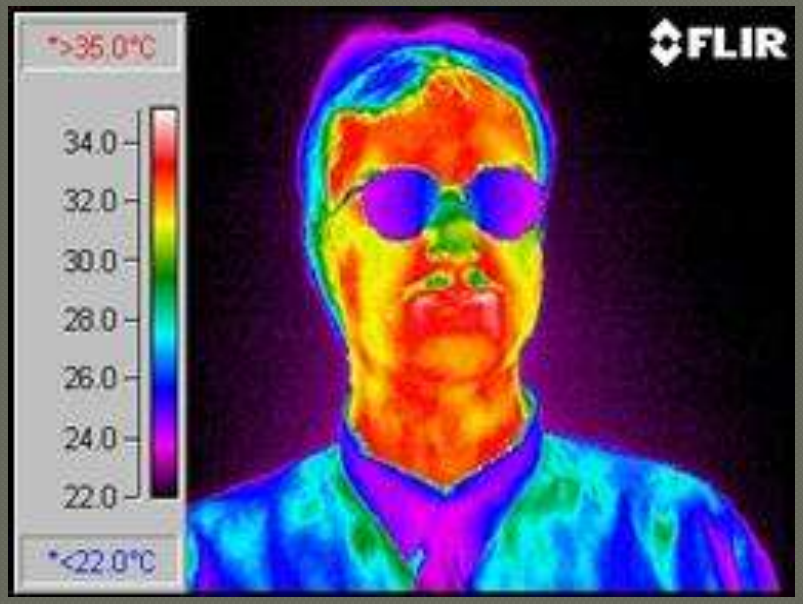
The fact is, the machine will fail at its discretion (if it had any) and not to your schedule. When it fails, it will cause secondary damage. The parts for many machines must be kept on hand ahead of time to minimise the time it takes to repair.

Infrared Thermography

Infrared Thermography is the technique for producing an image of invisible (to our eyes) infrared light emitted by objects due to their thermal condition.

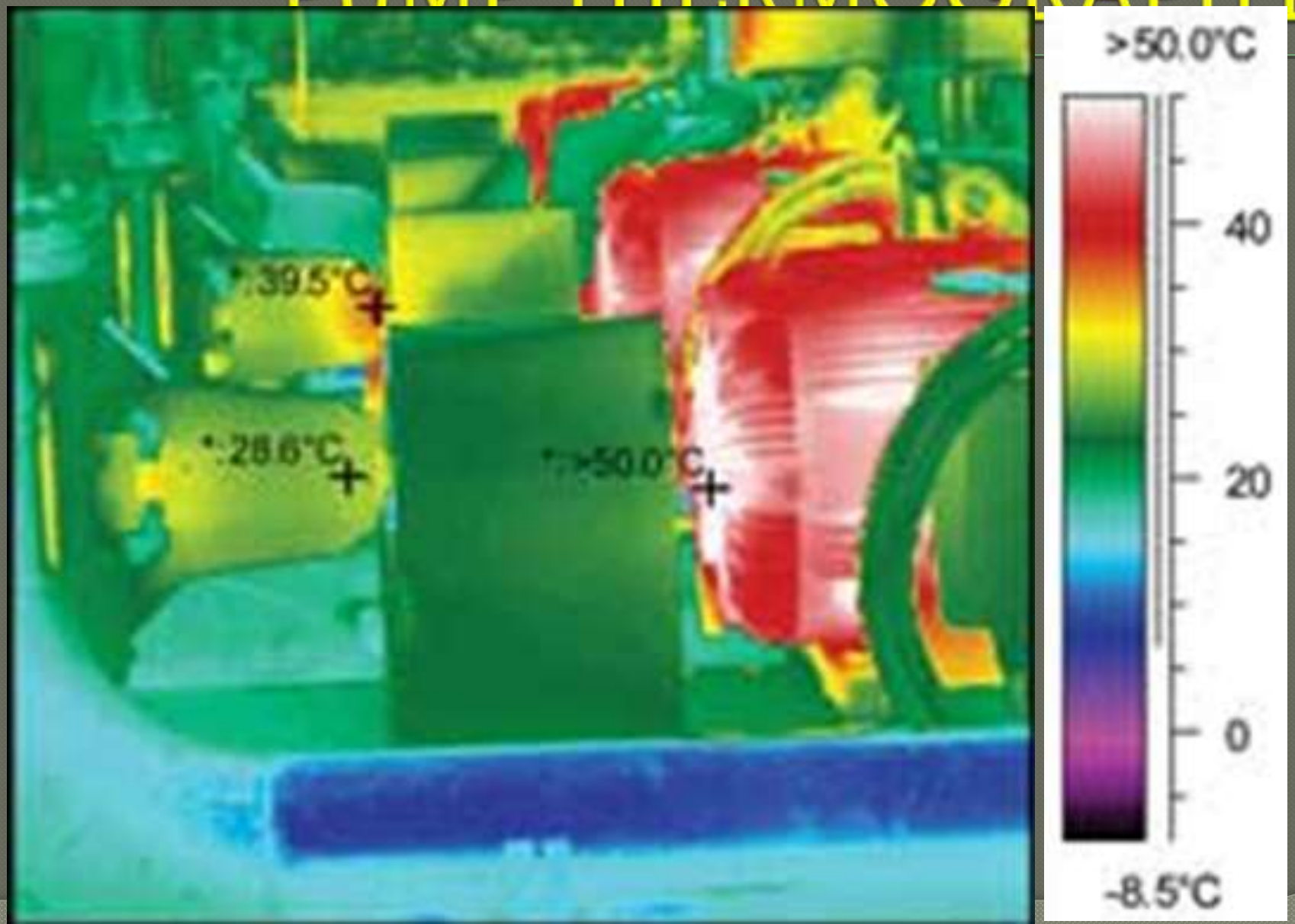
Infrared Thermography

An image produced by an infrared camera is called a thermogram or sometimes a thermograph.

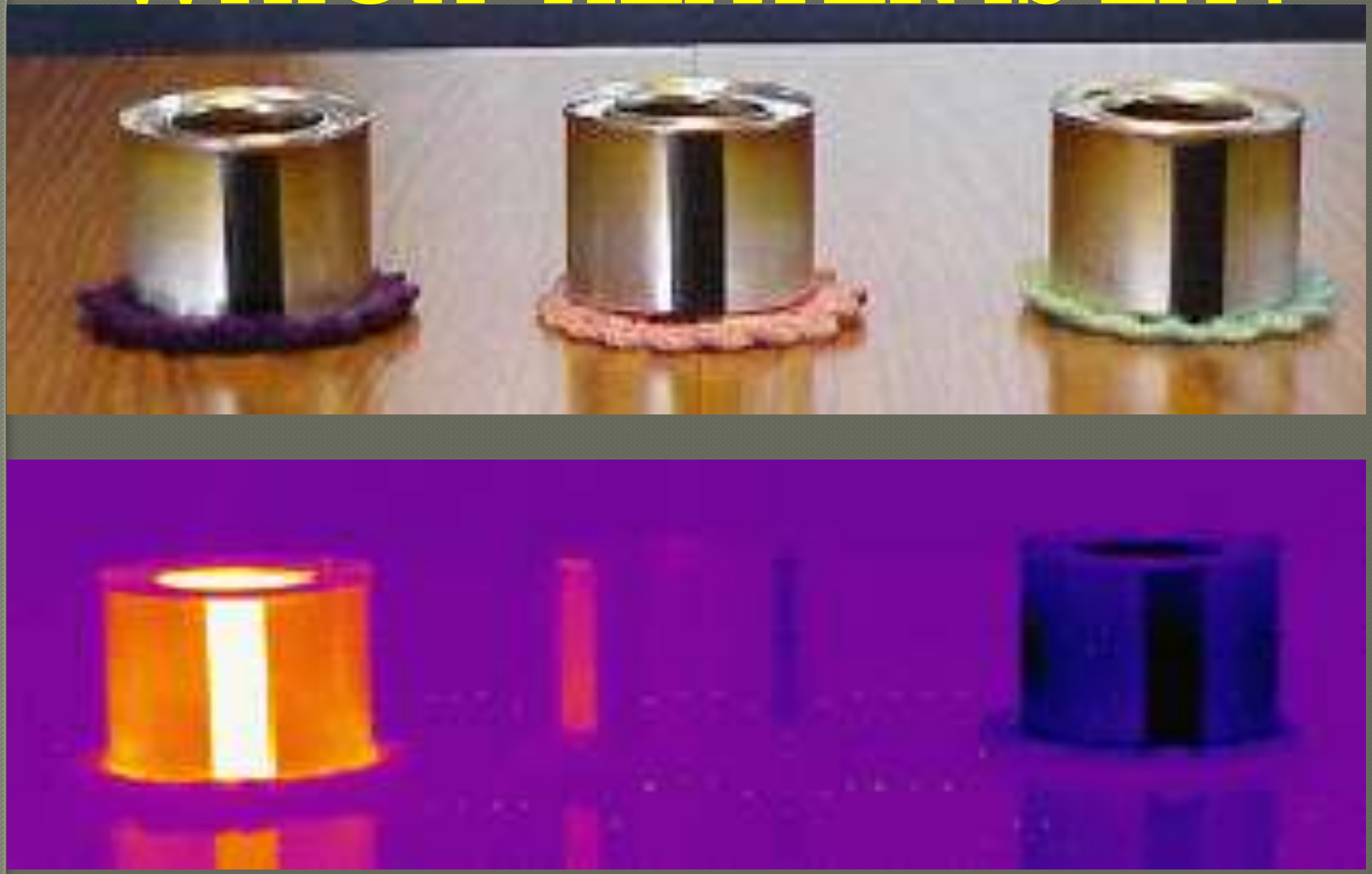


PUMP THERMOGRAPHY

PUMP THERMOGRAPHY



WHICH HEATER IS LIT?



WHY USE THERMOGRAPHY

Thermography can be applied in any situation where a problem or condition can reveal itself by means of a thermal difference.

This is why it is very quick and simple to use in CM, giving accurate results.

ADVANTAGES

Boiler Applications

- Inspect burners for flame impingement and burner management
- Look at combustion patterns of fuel
- Detect thermal patterns on boiler tubes and measure tube skin temperature during normal operation or when boiler is on standby
- Scan and record temperatures in areas of boiler not monitored
- Scan the exterior of boiler for refectory damage or locate warmer areas where potential refectory damage may occur

ADVANTAGES

- Detect coke buildup in crude oil furnaces
- Power Plant boiler flue gas leak detection
- Mechanical bearing inspections
- Heat ventilation air conditioning equipment evaluation
- Cold Storage cooling losses.
- Detect insulation leaks in refrigeration equipment

ADVANTAGES

Petrochemical Applications

- Refinery process line insulation loss or leak detection
- Refinery process evaluation
- Heat exchanger Quality and efficiency evaluation
- Furnace refractory (insulation) inspections
- Furnace Internal flame evaluation and tube inspections
- Flame propagation explosion analysis.

ADVANTAGES

Electronic Equipment Applications

- Printed circuit board evaluation and troubleshooting.
- Thermal mapping of semiconductor device services
- Circuit board component evaluation
- Production-type inspection of bonded structures
- Inspection of hybrid microcircuits
- Inspection of solder joints

ADVANTAGES

Environmental Applications

- Locate old waste disposal sites
- Locate old buried tanks on industrial sites
- Locate and monitor oil spills

Oil Analysis and Tribology

Oil condition monitoring is all about gaining an insight into what is happening inside your machine, be it the engine, gearbox or hydraulic system.

Taking a sample of oil is like taking a sample of blood and analysing it for illness.

For example a sample of motor oil can provide you with a glimpse into the future and allow you to take a proactive approach, and prevent extra costs associated with equipment failure.

What is Tribology?

Tribology refers to the study of friction, wear, lubrication and contact mechanics, particularly in an engineering and mechanical context. The definition of Tribology is: 'interacting surfaces in relative motion.

TRIBOLOGY DEFINITION

INTERACTIVE
SURFACES
IN
RELATIVE
MOTION

WHAT'S NEXT

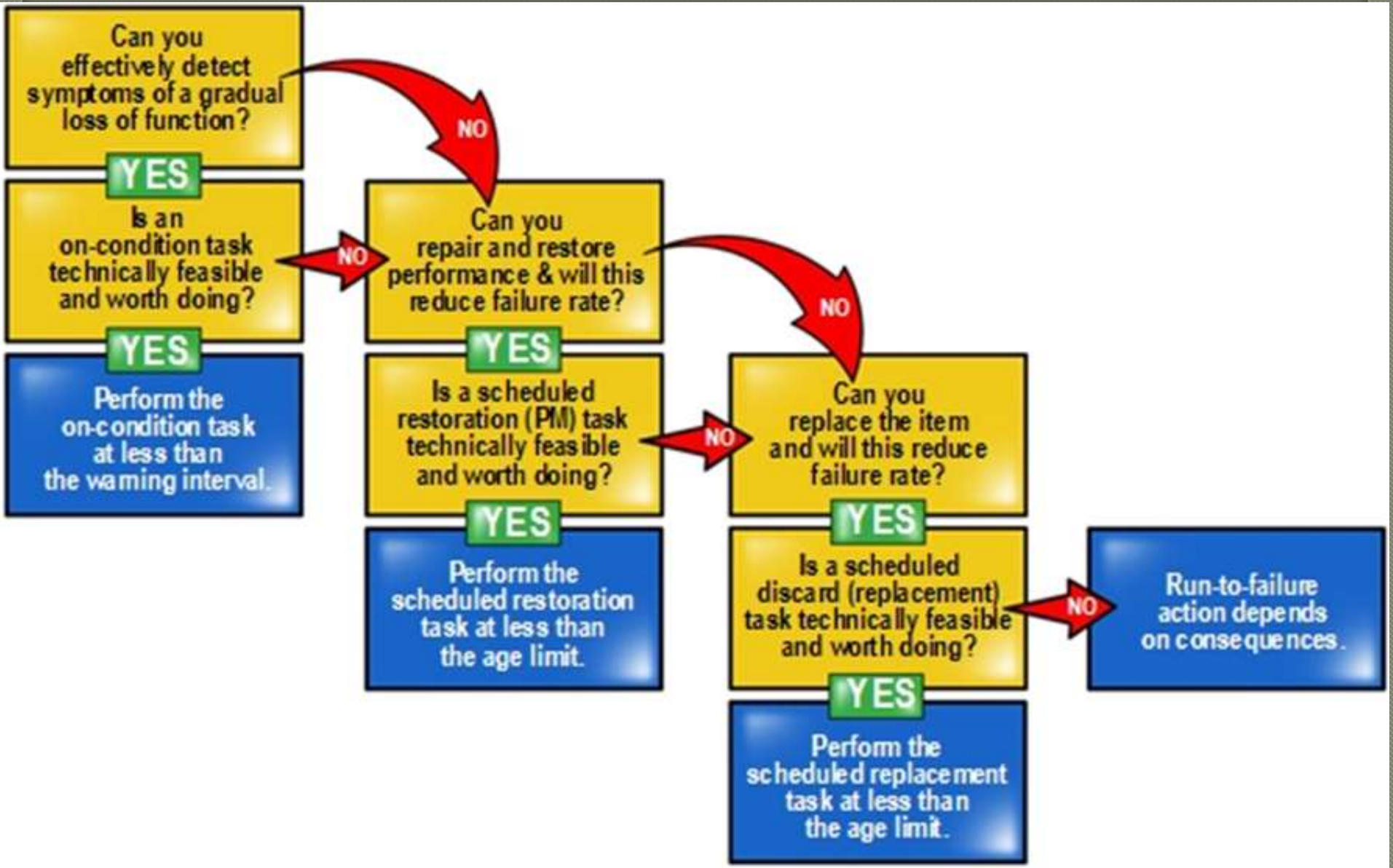
You will now require to go in to workshop number 05 (Alan's) and carry out CM data collection on the fan and bearing heater.

The data will be collect and recorded, from which you will produce a graph to prove your findings.

THERMOGRAPHY / VIBRATION

Choose a suitable axis and plot the results incrementally for EACH case.

SUMMARY


Can you effectively detect symptoms of a gradual loss of function?
NO
YES
Is an on-condition task technically feasible and worth doing?
NO
YES
Perform the on-condition task at less than the warning interval.
Can you repair and restore performance & will this reduce failure rate?
NO
YES
Is a scheduled restoration (PM) task technically feasible and worth doing?
NO
YES
Perform the scheduled restoration task at less than the age limit.
Can you replace the item and will this reduce failure rate?
NO
YES
Is a scheduled discard (replacement) task technically feasible and worth doing?
NO
YES
Perform the scheduled replacement task at less than the age limit.
Run-to-failure action depends on consequences.