CONGRESO DE MANTENIMIENTO & CONFIABILIDAD

MÉXICO

ORGANIZADO POR:

AMGA

A Framework for Asset Condition Monitoring in 2017?

MONTERREY - 2017

RELIABILITY WEB.COM

A Culture of Reliability®

Dave Reiber CRL / CMRP

Currently – *Senior Reliability Leader at Reliabilityweb.com*

***Recently** – Global Maximo Business Lead, Predictive Maintenance Lead, and Global Maintenance Business Process Leader*

- Maximo Site Project Manager
- North American Maximo Business Lead
- Global Maximo Business Lead
- Global Predictive Maintenance Lead
- Member of IBM Maximo Advisory Board
- Co-Lead for IBM Manufacturers User Group for Maximo
- Speaker at many Maintenance and Maximo Conferences
- Led Maintenance Webcasts for Reliabilityweb, Industry week, UE Systems, and Plant Engineering Magazine
- Member of editorial advisory board for Plant Engineering
- Hosted many Maximo & Predictive Webinars for General Motors
- Certified CRL – Certified Reliability Leader
- Certified CMRP – Certified Maintenance & Reliability Professional
- Certified – Infrared / Ultrasound
- Certified Maximo Deployment Professional

1. How will future maintenance assets look and act? (IIOT)
2. Do these factors significantly change how you perform operational activities?
3. What will be expected from maintenance professionals moving forward?

New tools and systems are available to provide better insight, and a path to faster and better decisions?

Significant advancements and challenges have emerged in the world of maintenance and reliability over the past few years. We are experiencing the age of the "Internet of Things, "industrially speaking, (IIOT), where traditional methods have become ineffective or inadequate.

Maintenance teams are looking for:

- Meaningful asset performance data
- Accurate predictive models
- Real-time asset health reports

What does the Future Reliability Leader Professional look like?

Skilled Maintenance and Engineering support people find their place. Some will just naturally rise to greatness. Others will go through life comfortably, making a contribution, but not stepping past their comfort zone. Both types of people are needed to make things work properly, but someone has to be willing to be the person who steps outside their comfort zone, always reaching for the next level. Those who are never satisfied with the end game, but seeking where do we go next. The future Maintenance Professional will have a strong imagination, willing to look past what is status quo, but seasoned with experience earned by doing the job. A person with drive for solving problems and getting better at their business

A professional person that acts with earned knowledge of what to do and when to do it. Continuously training, learning, and certifying in their craft.

They know when to call for help or outside influences to assure that the integrity of the Physical Asset, Scheduled Process, and Quality are all considered before action is taken.

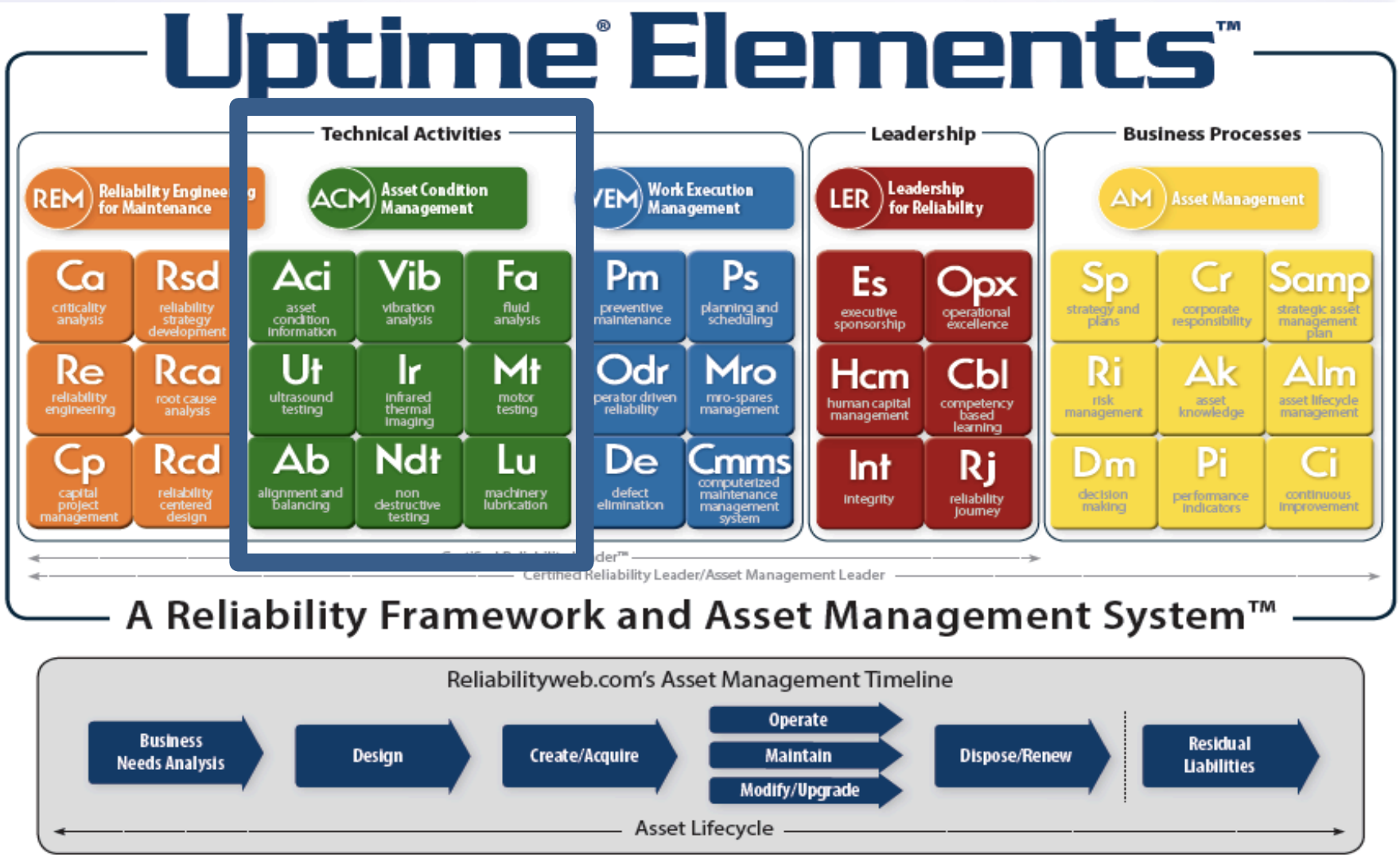
A person that is well versed in varied Maintenance Sciences. Open minded to innovation and adaptable in action plans, that support the current situation. Recognizing that all problems are not presented or solved equally.

Despite the concerns around data collection, there are real benefits to implementing connected IIoT systems. The increased use of mobile and intelligent sensor devices, along with integration of predictive analytics, and asset life cycle management, has a direct and significant impact on bottom line process improvement. Therefore, it's important to find an IIoT strategy that works for your organization, to optimize these improvements to ultimately provide a better return on investment capital.

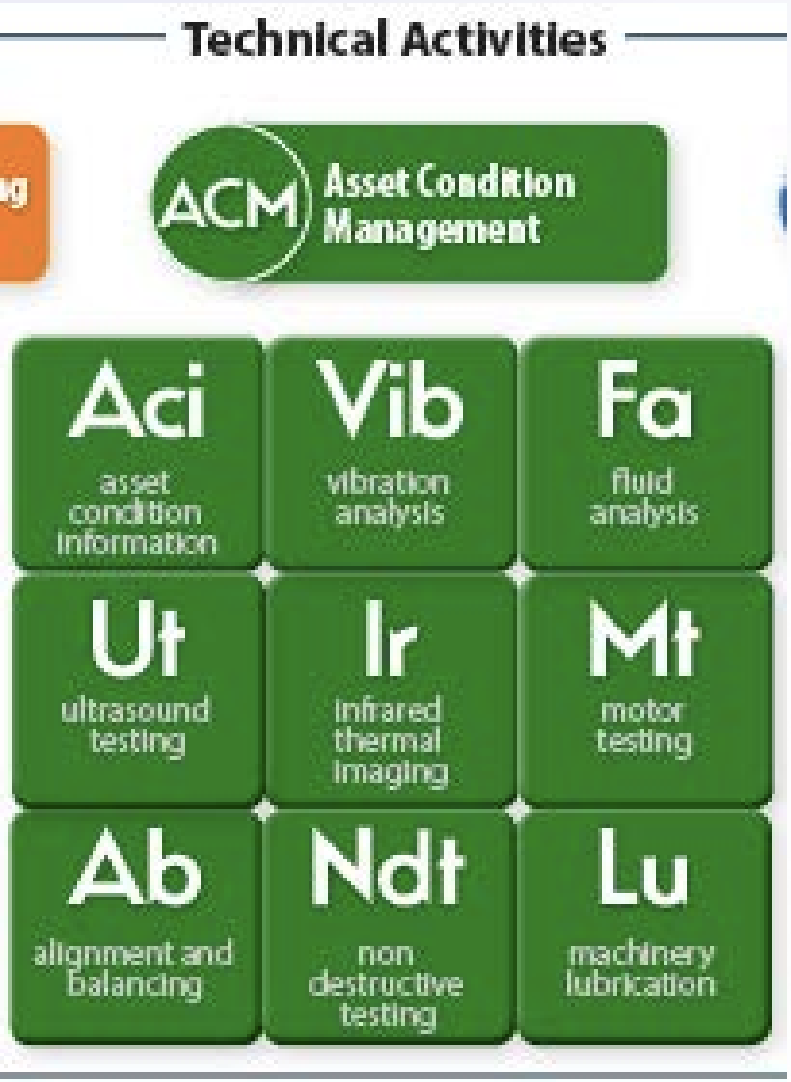
The primary goal of a maintenance team should be precision maintenance, where the organization is on a flightpath of continuous improvement.

Specifically:

1. More precise calls around condition failure probability
2. Available, real-time asset health scores of the most critical assets
3. Automated actions direct from the software system(s)


Uptime® Elements™
Technical Activities
Leadership
Business Processes
REM Reliability Engineering for Maintenance
ACM Asset Condition Management
WEM Work Execution Management
LER Leadership for Reliability
AM Asset Management
Ca criticality analysis
Rsd reliability strategy development
Re reliability engineering
Rca root cause analysis
Cp capital project management
Rcd reliability centered design
Aci asset condition information
Vib vibration analysis
Fa fluid analysis
Ut ultrasound testing
Ir infrared thermal imaging
Mt motor testing
Ab alignment and balancing
Ndt non destructive testing
Lu machinery lubrication
Pm preventive maintenance
Ps planning and scheduling
Odr operator driven reliability
Mro mro-spares management
De defect elimination
Cmms computerized maintenance management system
Es executive sponsorship
Opx operational excellence
Hcm human capital management
Cbl competency based learning
Int integrity
Rj reliability journey
Sp strategy and plans
Cr corporate responsibility
Samp strategic asset management plan
Ri risk management
Ak asset knowledge
Alm asset lifecycle management
Dm decision making
Pi performance indicators
Ci continuous improvement
Certified Reliability Leader/Asset Management Leader
A Reliability Framework and Asset Management System™

Reliabilityweb.com's Asset Management Timeline
Business Needs Analysis
Design
Create/Acquire
Operate
Maintain
Modify/Upgrade
Dispose/Renew
Residual Liabilities
Asset Lifecycle



Asset Condition Management Data

The ACM elements, provide a visual framework.
Easy to follow & set up to prioritize your plan, for a successful implementation.

On most modern industrial assets, there are many sensors constantly gathering information.

The emergence and relevance of asset intelligence and the IIoT will continue to deliver improved mechanisms to load any data from any approved or open source with an IP address. The term online means so much more today than just a few years ago. Devices no longer need to be hardwired, they don't even have to be in the same facility or location anymore.

Establishing an ACM Program

Action Plan

Assessment of Equipment

- Develop List of Plant Equipment
- Determine Criticality of Equipment
- Assign Criticality Number (9-7) Highly Critical (4-6) Critical (3-1) Normal (0) Run Failure
- Determine Appropriate Predictive Technology(s)
- Collection of Baseline Readings
- Develop Standard Procedures
- Create Routes, Workorders, T ask Instruction Sheets
- Determine Frequency of Inspections
- Establish Alert & Alarm Criteria

Condition Monitoring Equipment

- Evaluate current predictive tools
- Purchase new equipment from Standardized list
- Determine what Equipment can be shared
- Purchase equipment on a scalable level
- Computer System
- Office Space

Establishing an ACM Program (cont.)

Action Plan

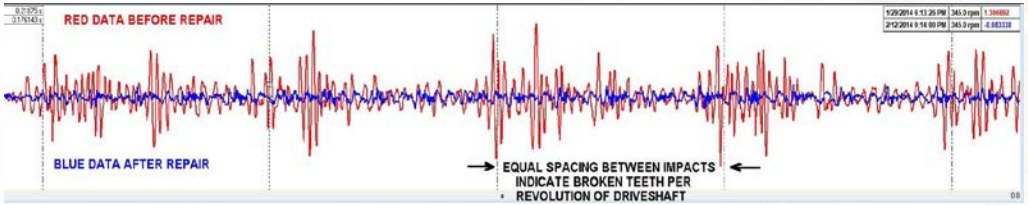
Personnel	Training & Technical Support	Measurements
Assign Personnel to ACM Team	Provide Certification classes	Baseline Current Maintenance Cost
Assign people full time to group. Scalable to plant needs.	Provide Software Classes	Show Return on Investment (ROI)
Maintenance Planner(s)	Train plant Personnel Report Writing	Document-ation / Reports
Engineering / IT / Quality	Train Plant Personnel to properly set up a database	Calculate Cost Avoidance
Maintenance Supervision	Train Plant Personnel to properly collect data	Establish costs per hour
Production	Establish Standards Committee(s) to support new teams	**Audit ACM Program for Continuous Improvement**

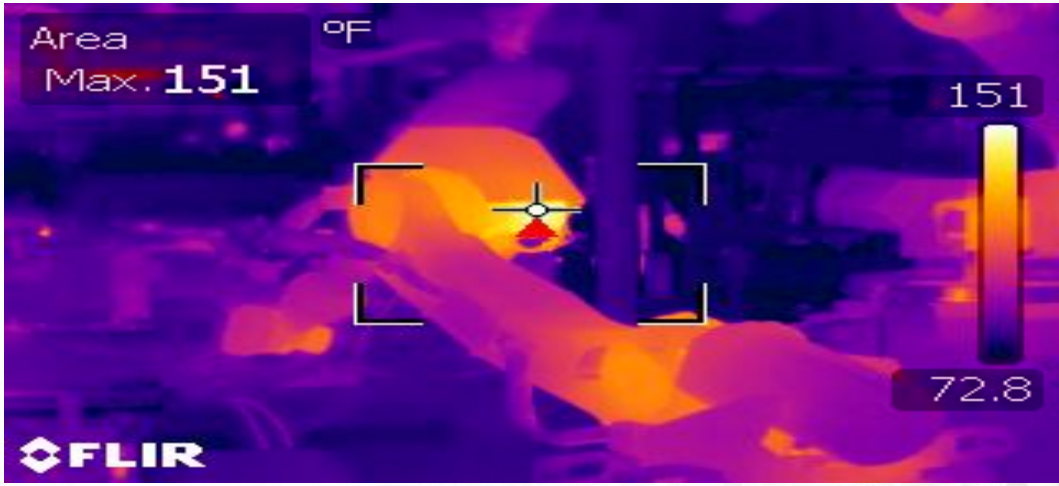
Condition Based Technologies

- Vibration Analysis
- Infrared Thermography
- Ultrasound / Shaft Ultrasound
- Electrical Motor Diagnostics
- Oil Analysis / Lube Training
- Laser Alignment
- Hi-speed Video
- Video Probes
- Optivibe / Bridgeview

Decisions around ACM Tools:

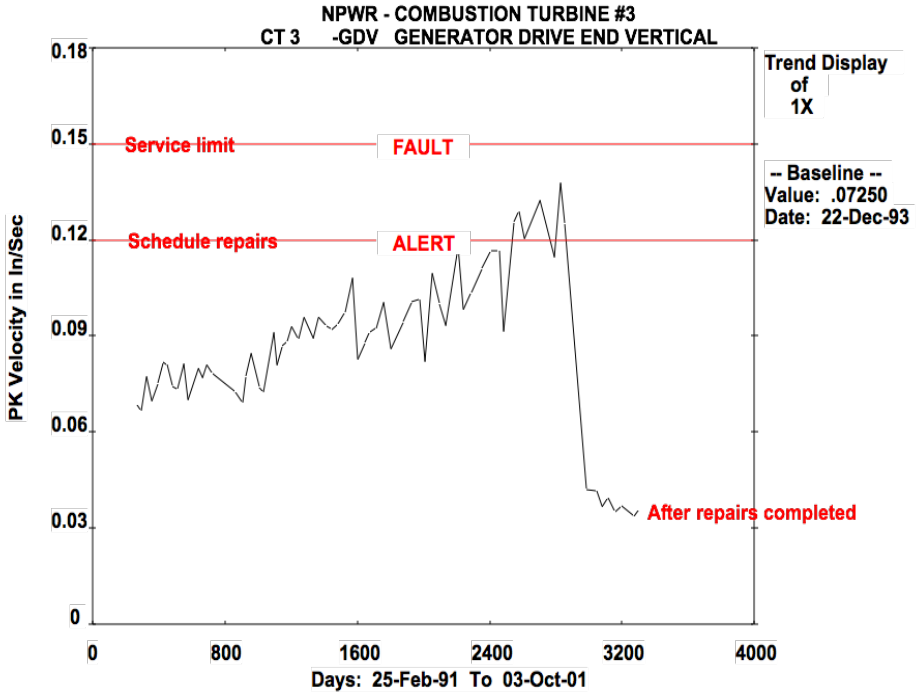
- Recognizing the ROI timeframe
- Assign the right Predictive tool(s) to the Asset





ACM - Asset Condition Based

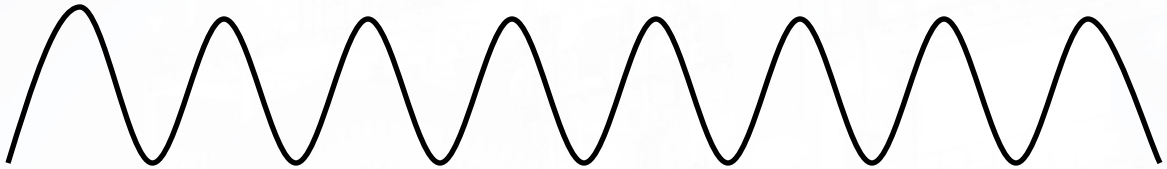
Asset Condition Maintenance



- Maintenance based on machine or asset condition.
- Scheduled downtime held to a minimum.
- Downtime, spare parts usage, & overtime can be minimized.

A Closer look at the Condition Based Technologies

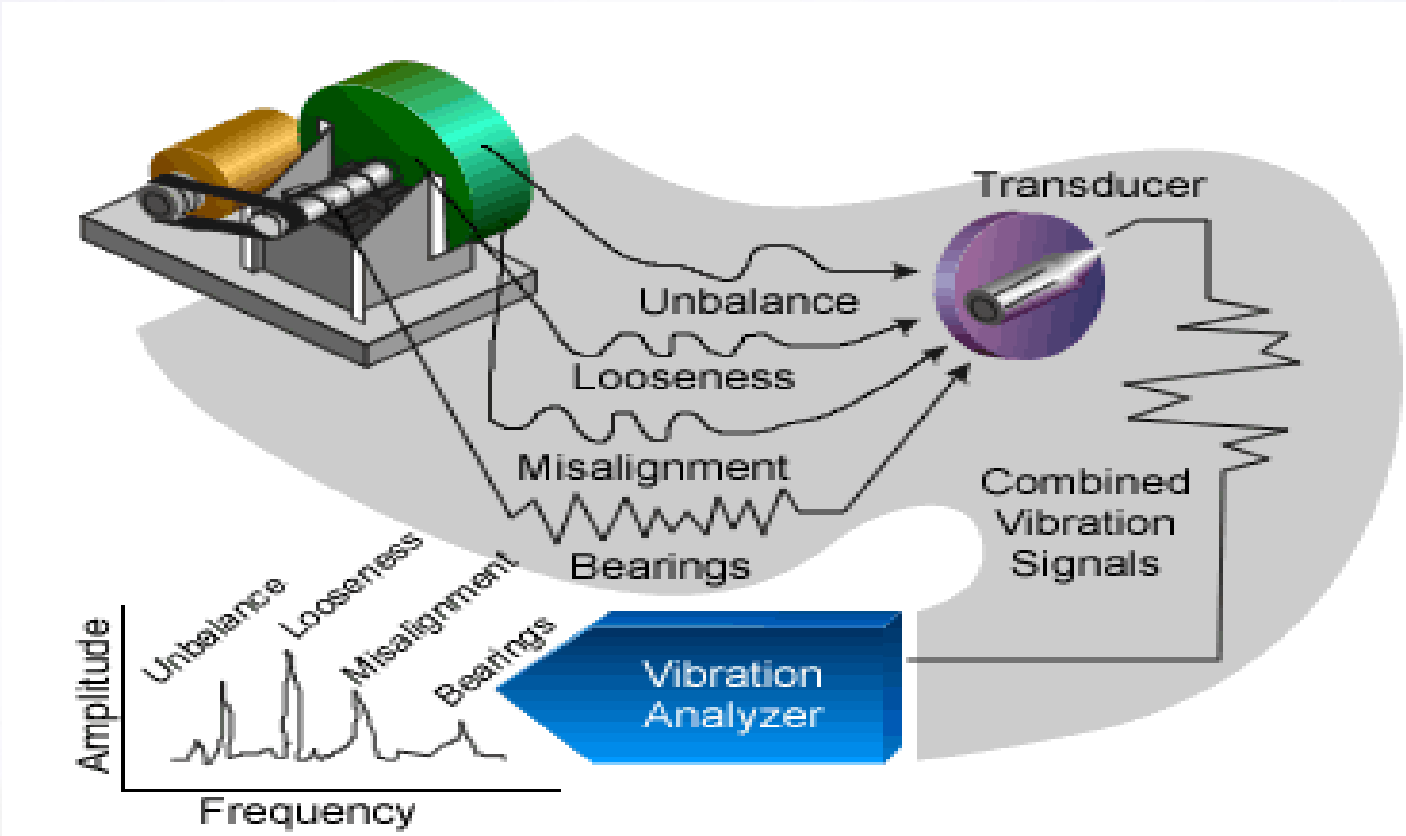
Vibration Analysis



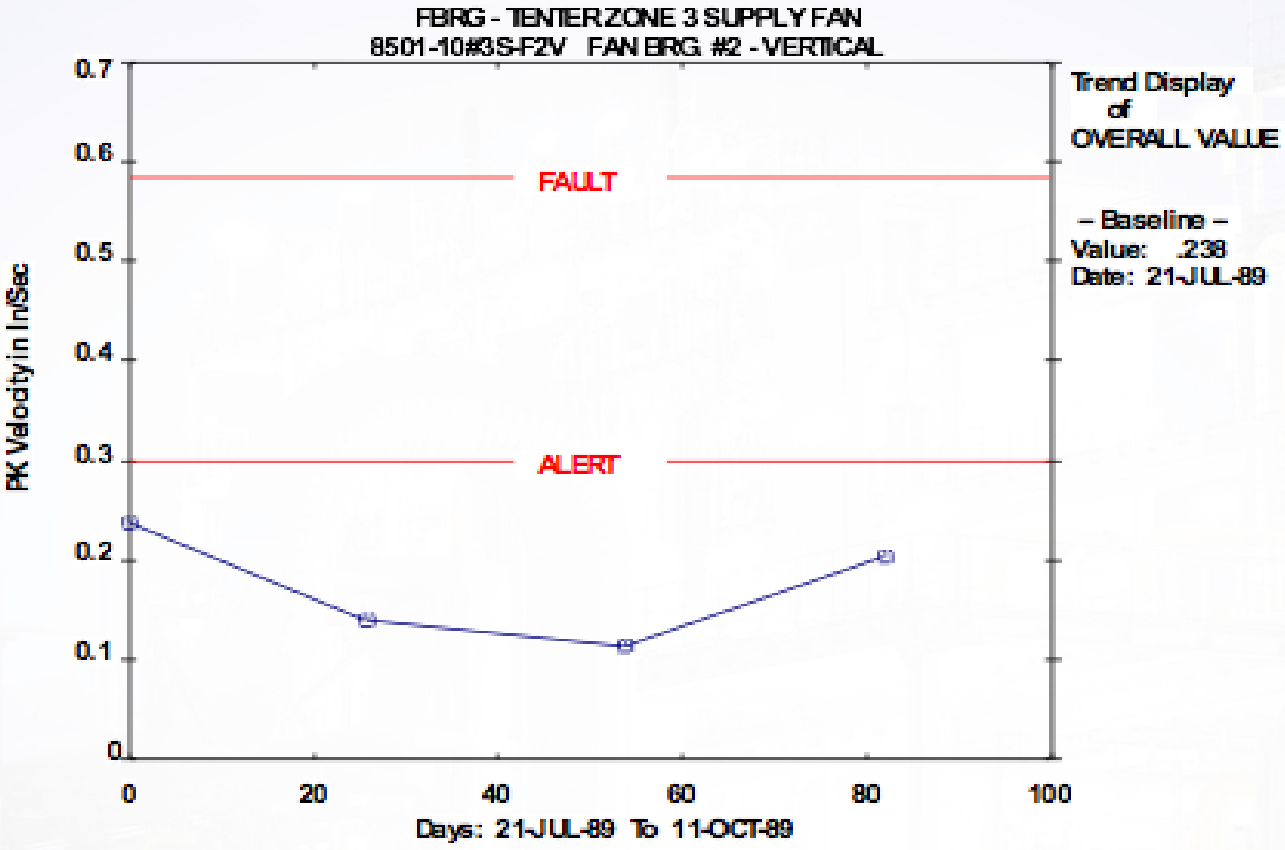
ALL MACHINES VIBRATE

EXCESSIVE VIBRATION IS A PROBLEM

System Depiction



Overall Vibration Trend



Vibration Standard

GM Specification No. V1.0-1999

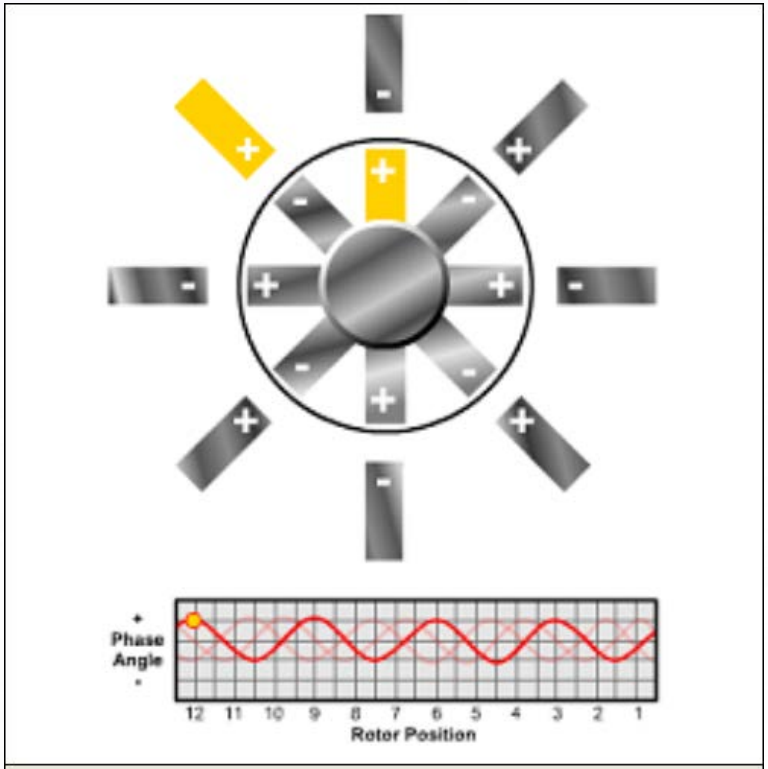
GM

GENERAL MOTORS CORPORATION
VIBRATION STANDARD
FOR THE PURCHASE OF
NEW and REBUILT
MACHINERY AND EQUIPMENT

GMNA *QRCOI*

GM Specification V1.0 is issued under the direction of the General Motors Corporation Vibration Standards Committee.
GM-1761

Electrical Motor Diagnostics



motor function.avi

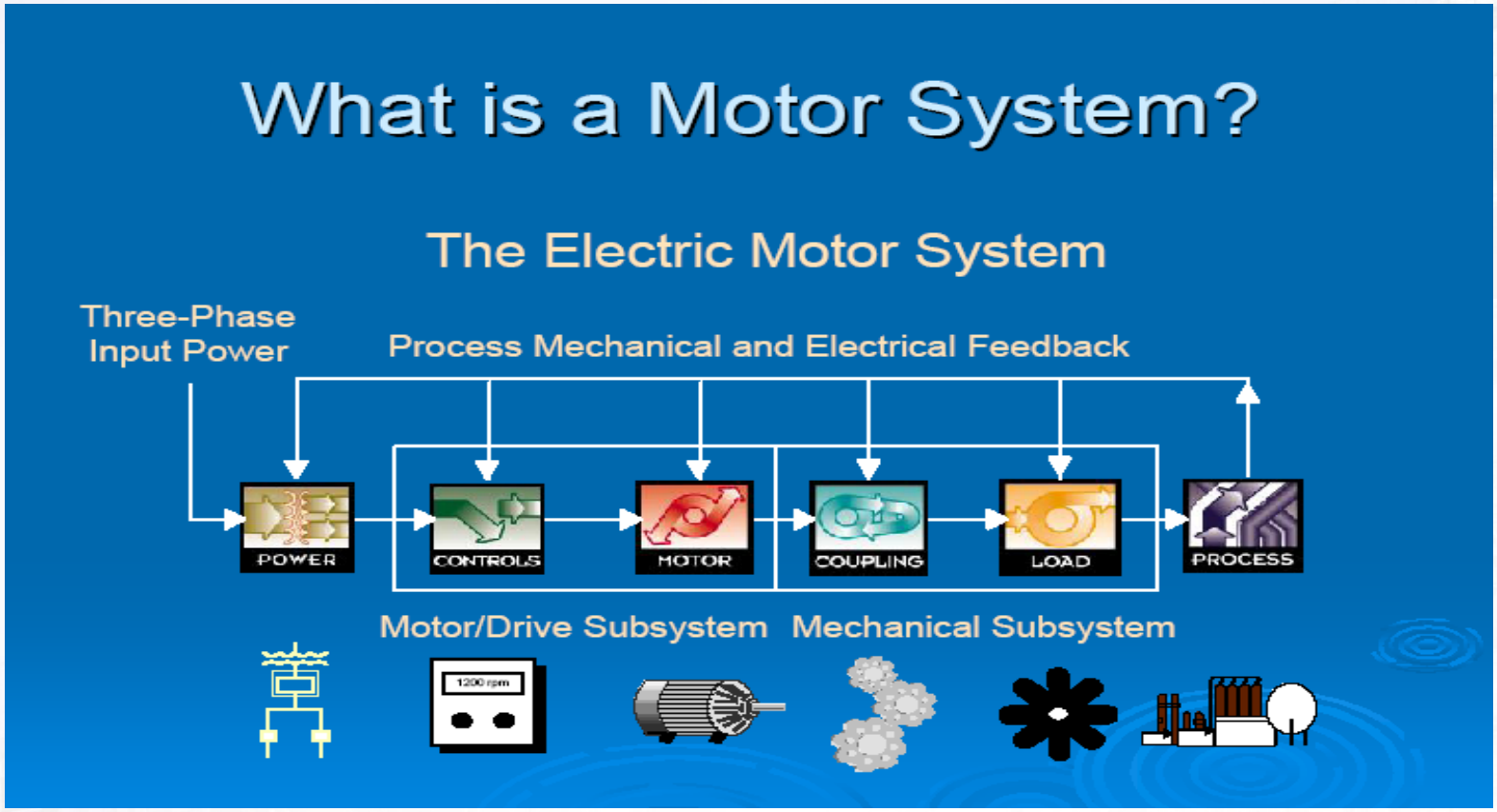
Electric Motor Diagnostics

A non-intrusive, safe and accurate method of testing electric motors for a variety of common faults

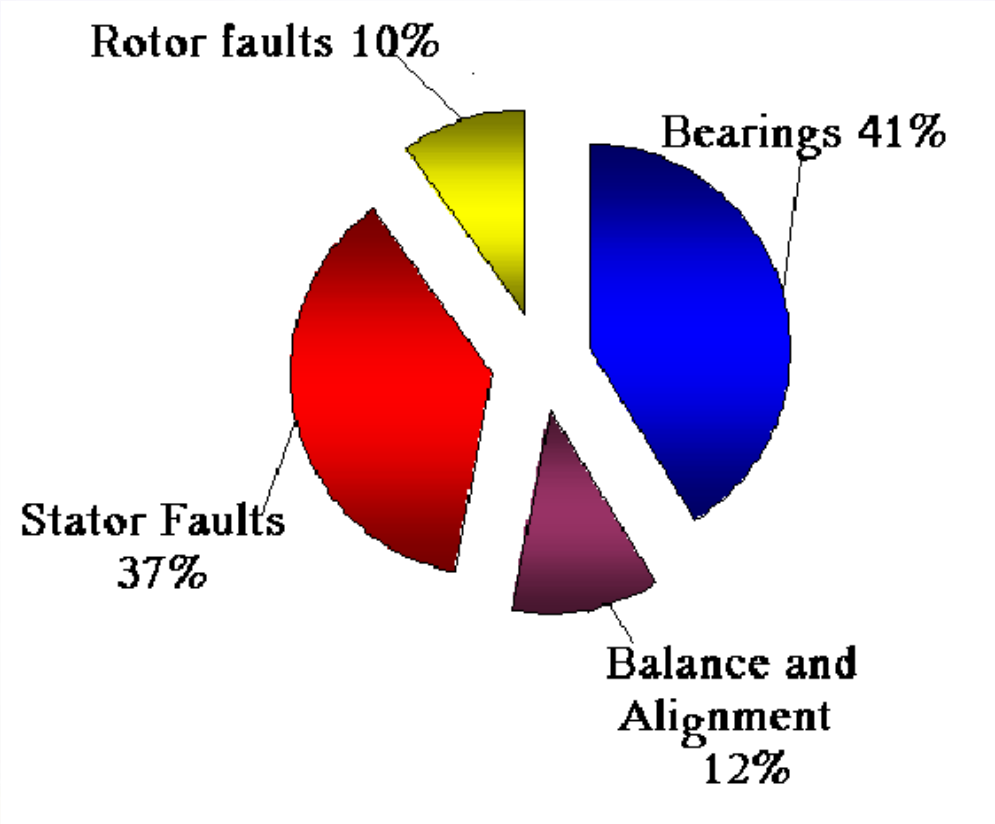
IT INCLUDES: **Motor Circuit Analysis**
Fault Zone Analysis
Electrical Signature Analysis

IT COMPLIMENTS: **Vibration Analysis**
Thermography
Ultrasound

Electric Motor Diagnostics



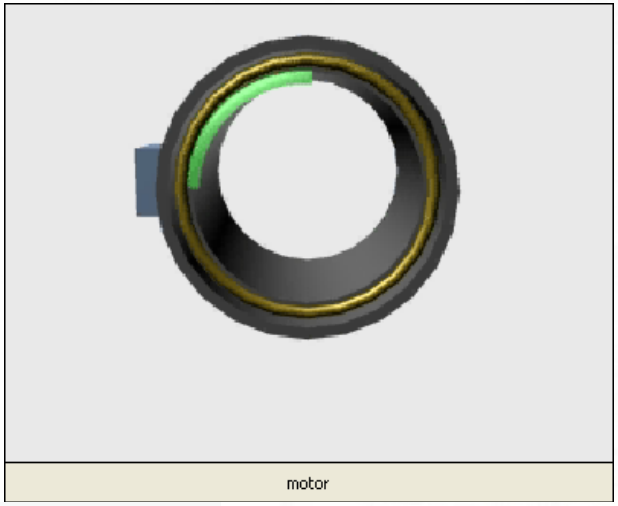
Main contributors to motor failure



Motor Quick Check

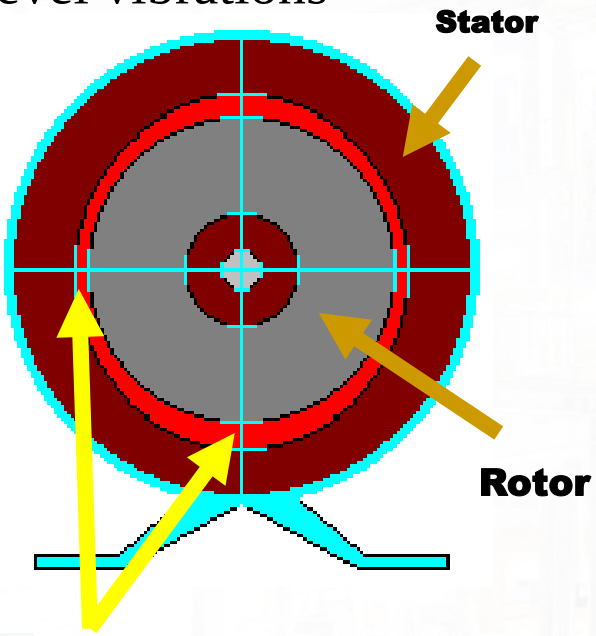
A **“quick check”** of a motor before it goes into service will identify and isolate:

- Resistance Unbalances
- Impedance & Inductance variations between phases
- Phase Angle and I/F



Uneven Air Gap

- An even air gap between the stator and rotor windings must be maintained
- Uneven air gaps will cause low level vibrations
  - –May cause bearings to fail
- Can be seen by measuring inductance/capacitance



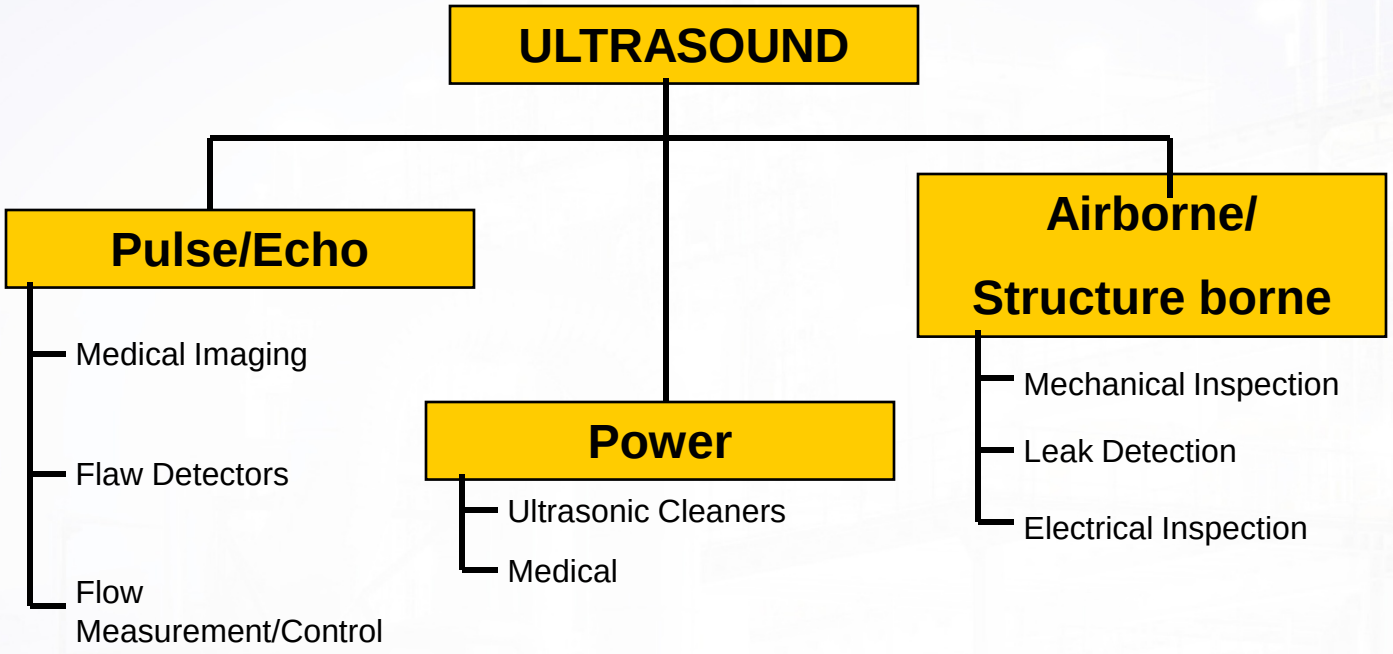
Airborne Ultrasound

Ultrasonics is ……

- The study and application of high frequency sound waves inaudible to human ears

- Sound waves above 20,000 Hz
  - (20,000 Cycles/second)

Generic Divisions of Ultrasound



Sound Penetration

- Low Frequency Sound Waves
  - –Range in size from ¾” to 56’
  - –Vibrate solid surfaces
  - –Large objects appear transparent

- High Frequency Sound Waves
  - –Range in size from 1/8” to 5/8”
  - –Cannot penetrate solid objects
  - –Short
  - –Weak

Typical Equipment

- Ultrasound receiver
- Headset
- Scanning module
- Contact module
- Tone generator

Typical Applications

- **Leak Detection**
  - Compressed Gas
  - Heat Exchangers
  - Vacuum
- **Electrical Inspection**
  - Corona
  - Tracking
  - Arcing
- **Mechanical Inspection**
  - Leaking Valves
  - Efficiency of Steam Traps
  - Bearing Health
  - Gear Mesh
  - Lubrication Excellence

Leak Detection

- The ultrasound instrument can be used to locate leaks
  - –Pressure system
  - –Vacuum system

- During a leak, liquid, air, or gas moves from a high pressure to a low pressure

- As it passes through the leak, turbulent flow is generated
  - –The turbulence has strong ultrasonic characteristics

Steam Trap Inspections

- Three basic types of traps
  - –Mechanical
  - –Thermostatic
  - –Thermodynamic
- Be familiar with the operation the trap
- Use the contact module

Bearing Inspection

- Two basic methods for ultrasonic bearing monitoring
  - Comparative
  - Historical
- The Contact module is used

Condition Based Lubrication

- When a bearing exceeds 8 dB over a baseline, it is scheduled for lubrication

- A technician can use the dB readout as a guide to determine when to stop applying grease and prevent over lubrication

Electrical Inspection

Arcing:

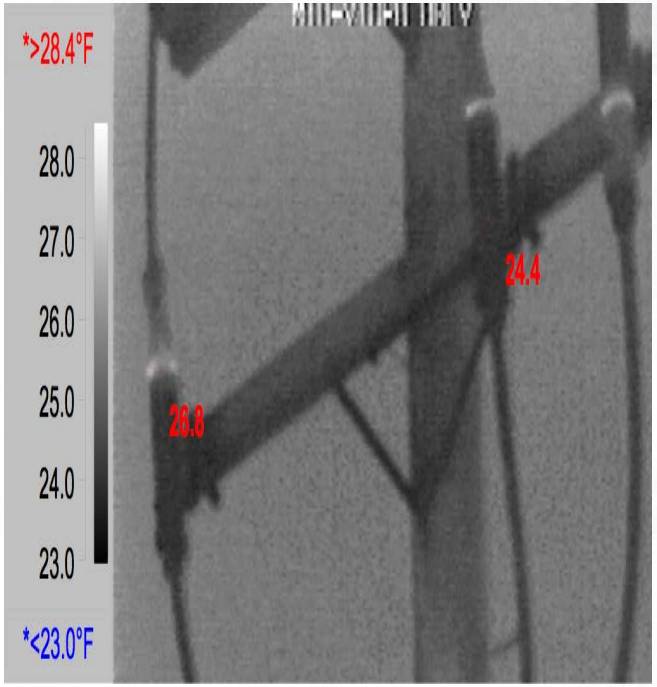
An arc occurs when electricity is conducted to “ground”

Corona:

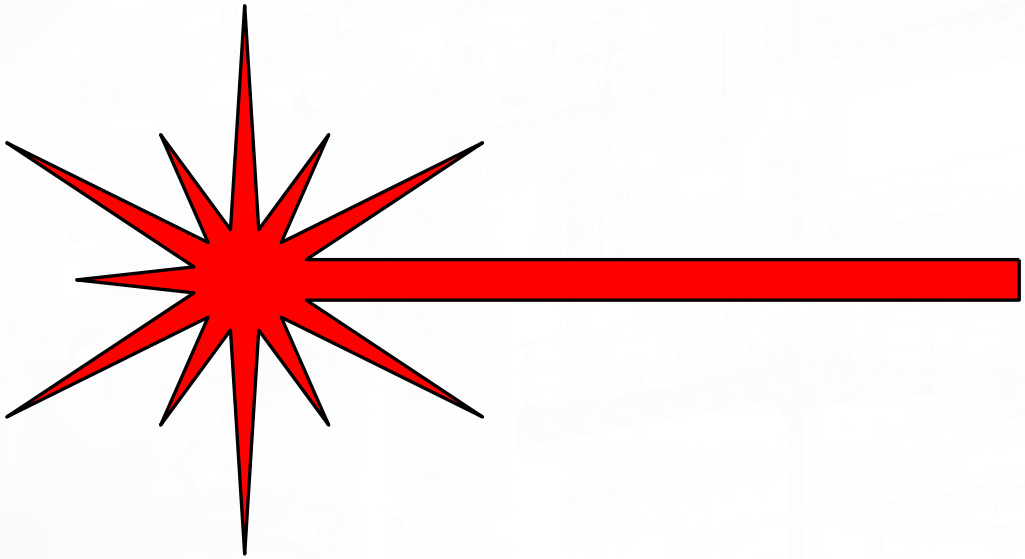
Voltage on an electrical conductor exceeds the threshold value

Tracking:

Often referred to as “baby arcing”, it follows the path of damaged insulation

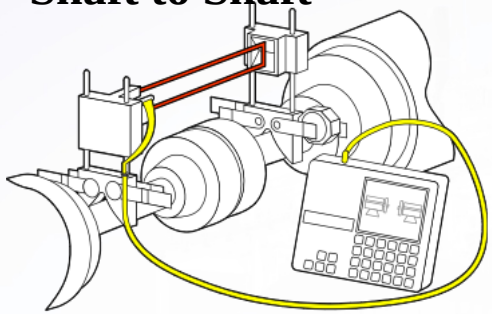


Laser Alignment

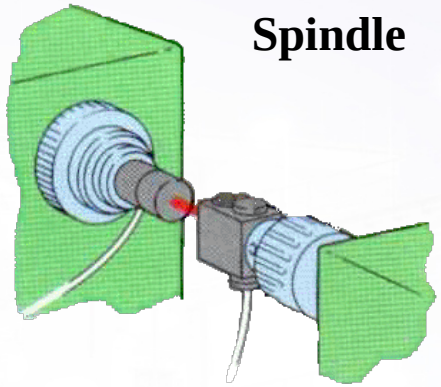


Laser Alignment – 4 Disciplines

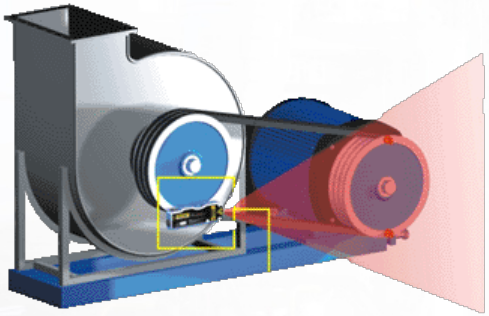
Shaft to Shaft



Spindle

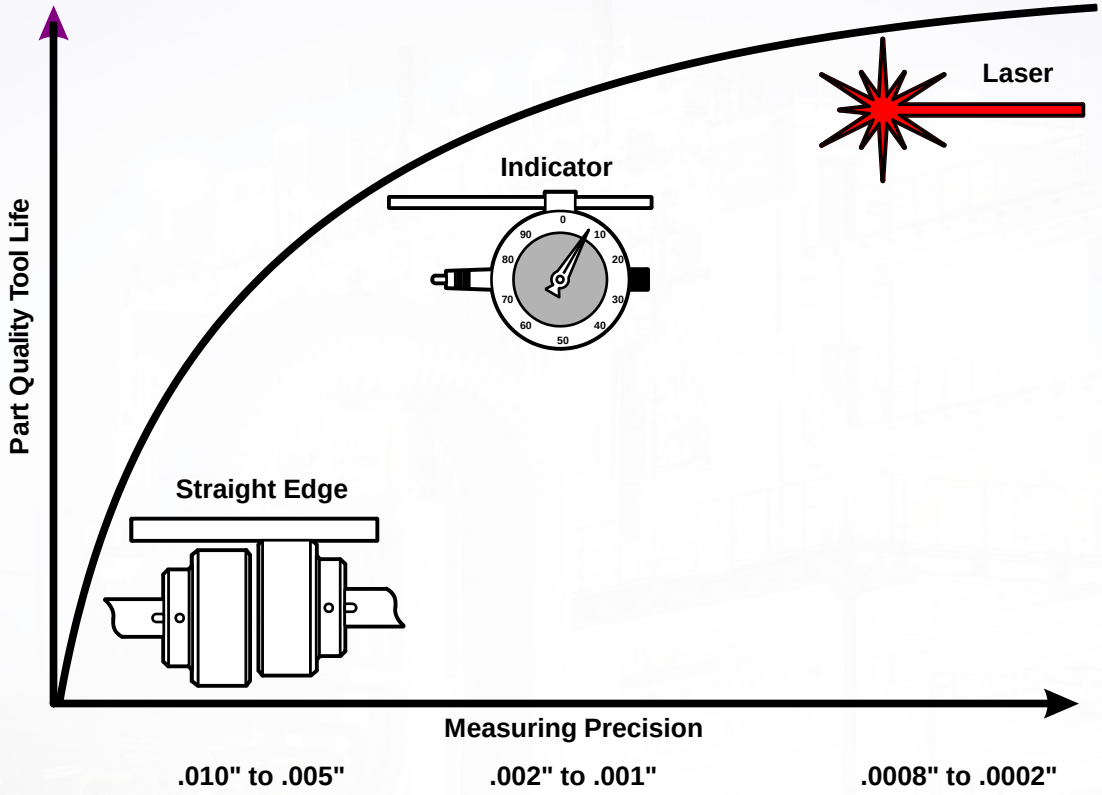


Belt & Sheave



Geometric

Laser Alignment Methods



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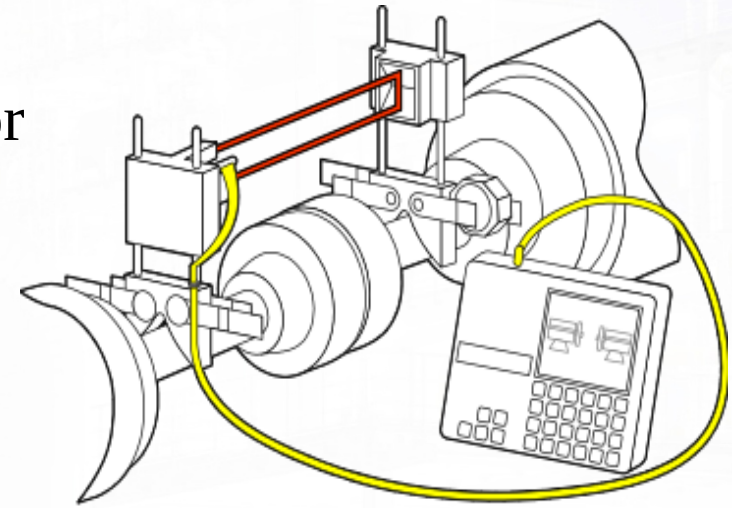
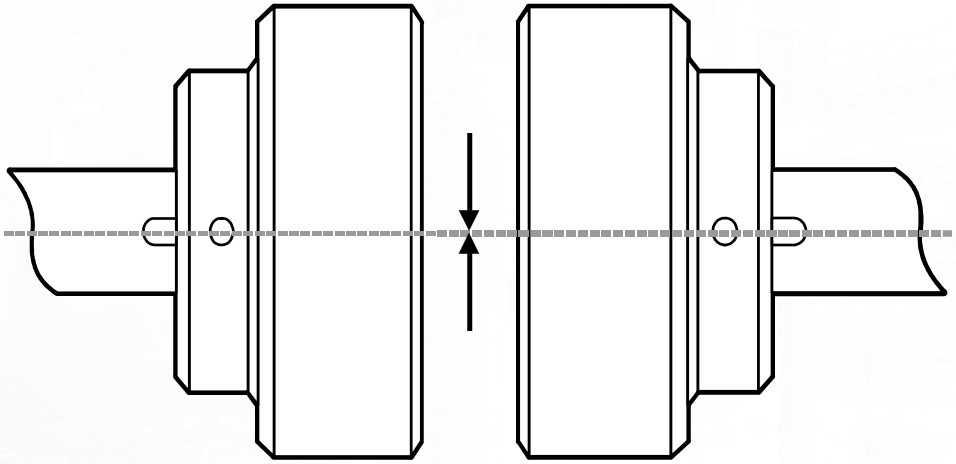
Laser Components

- Data collector
- Emitter/Detector
- Prism



Laser Alignment

Shaft Alignment



Finish Alignment

1. If feet are no more than .020” to .030” from final horizontal position, make the vertical correction first. If not, get the system closer horizontally before shimming.

2. Once close to final horizontally, make vertical correction.

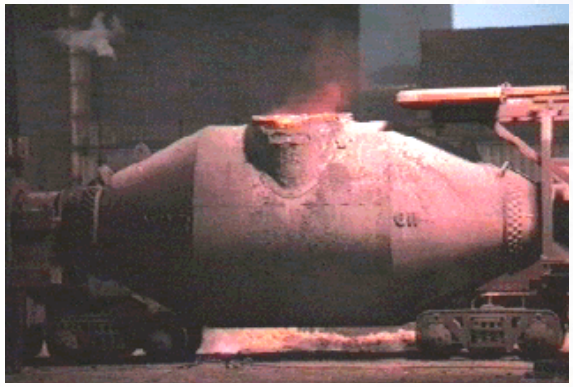
3. Adjust the horizontal position within tolerance and take measurement to verify both axis are within tolerance.

INFRARED THERMOGRAHPY

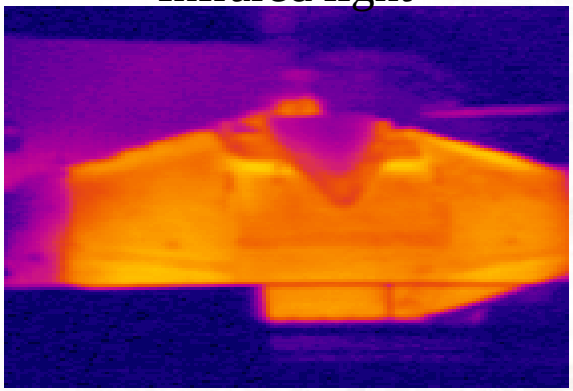
Infrared Thermography – What is it?

- Takes the invisible and makes it visible
  - –Makes infrared visible
- Able to observe the effects of heat
  - –All objects emit heat
  - –A form of energy
  - –Travels from hot to cold
- Measure temperature
  - –Temperature is crucial
  - –The intensity of heat
  - –Measured by Non-contact

Visible light



Infrared light



Benefits of IR Inspections

- It is non-destructive
- Reduces repair costs
- Extends equipment life
- Averts catastrophic failures
- Increases efficiency saving energy $

Infrared Thermography

Various disciplines that make up thermography

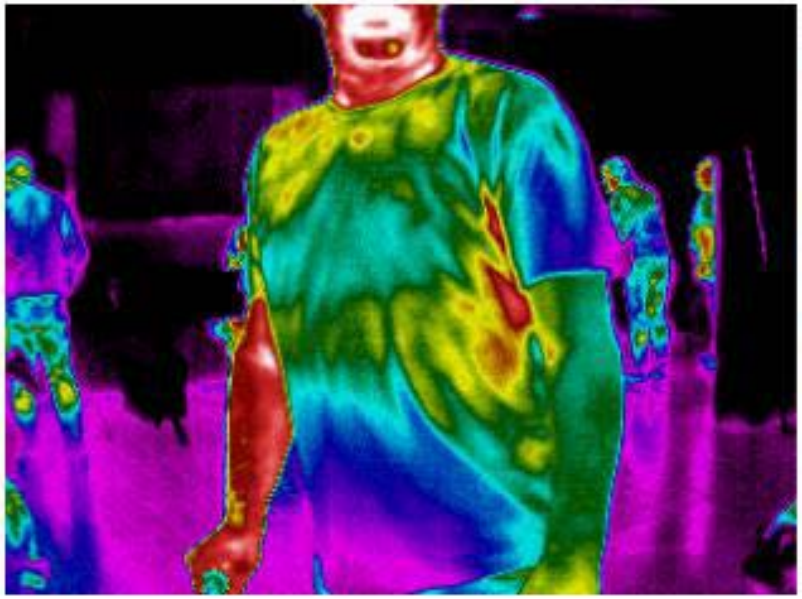
- Analysis techniques
- Camera handling
- Thermal & radiation science
- Applications
- Inspection routines and reporting

Thermal Science

- **Energy:**
  - Cannot be created or destroyed
  - Can be converted from one form to another
    - –Mechanical
    - –Chemical
    - –Heat
    - –Radiant
    - –Electrical
    - –Nuclear
- **Heat:**
  - A form of energy
  - Travels from hot to cold
  - Measured in “Btu’s”

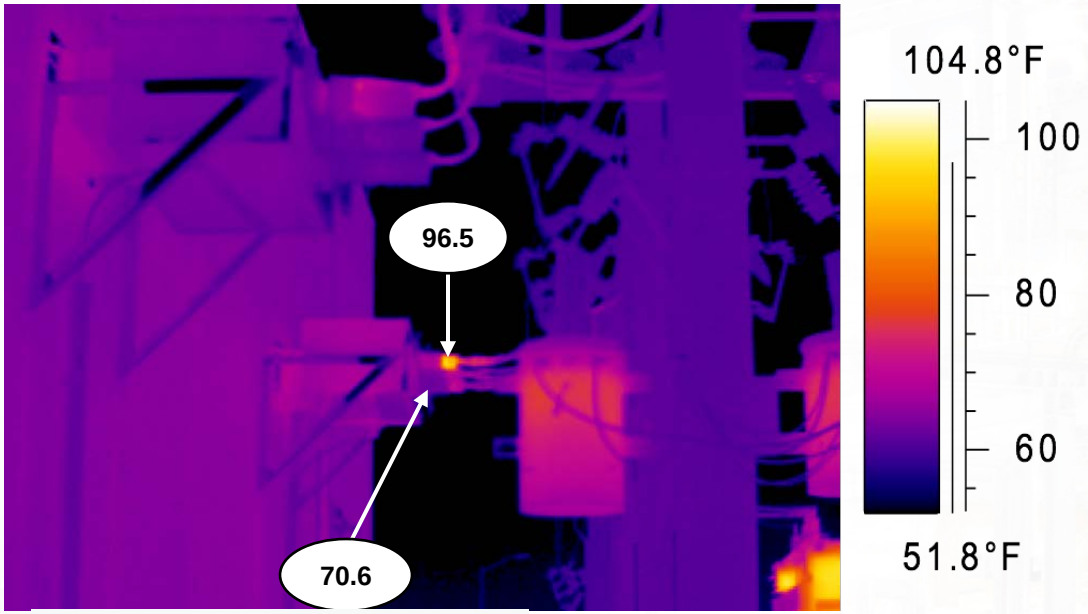
Qualitative Analysis

- Image analysis
- Cannot measure temperature



Quantitative Analysis

- Measure temperatures
- A true radiation picture
- Not necessarily true temperature



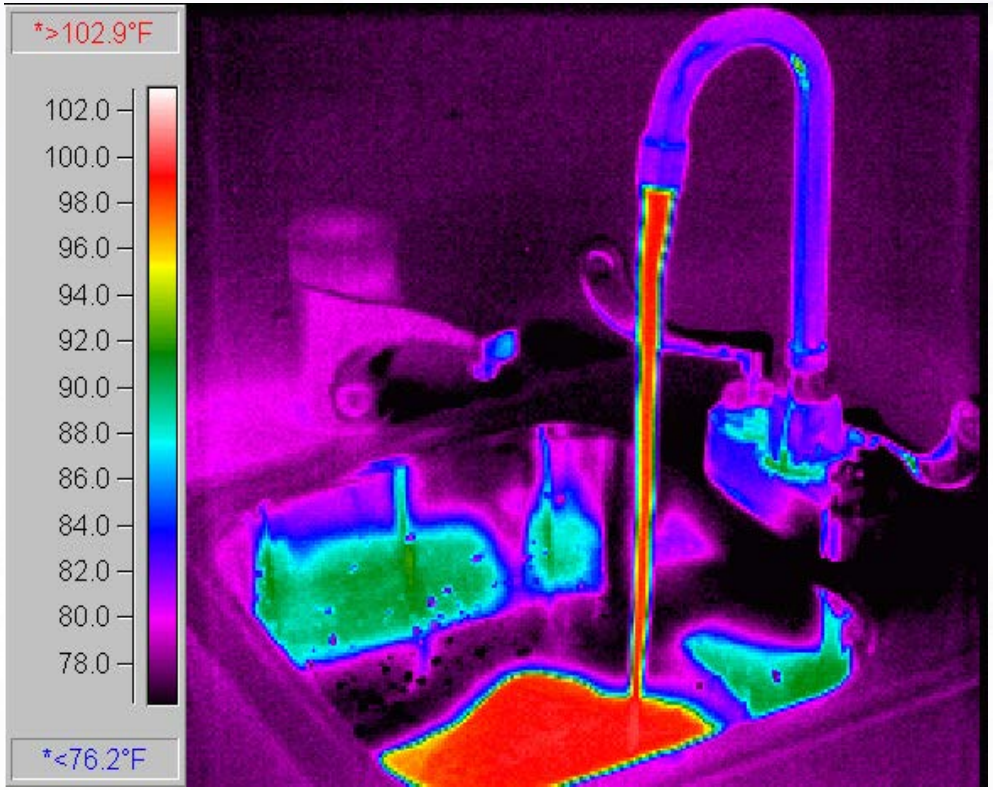
Camera Handling

FORD

- **FO – Focus**
  - –You must focus carefully before storing an image, because you can't refocus later
- **R – Range**
  - –The temperatures you plan to measure must be within the Range you choose for your image
- **D- Distance**
  - –The Distance to the target cannot be changed in post processing software

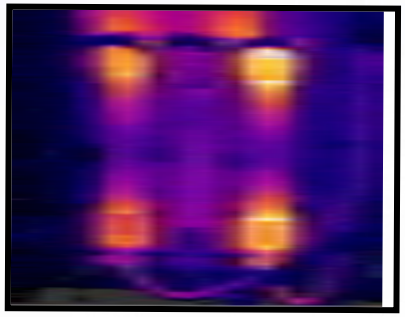
Infrared Image Test

- Radiation
  - –Emitted
  - –Reflected
- E+R=1



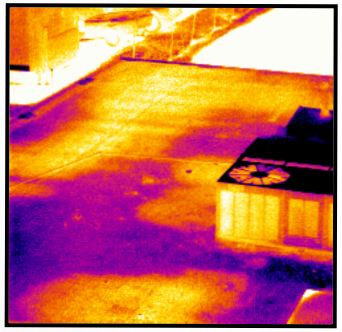
Infrared Thermography

Applications in all aspects of maintaining a facility

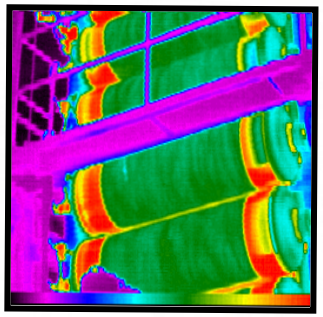


Electrical

Mechanical



Building Envelope & Energy Savings

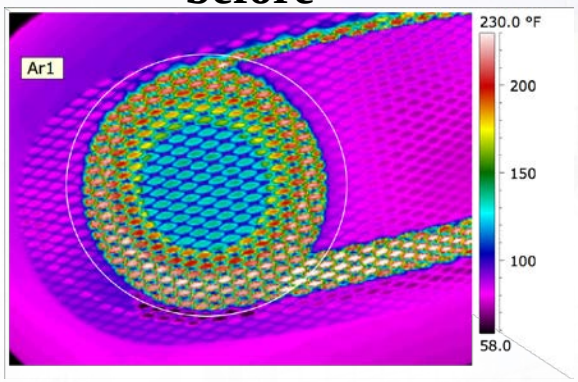


Process & Quality

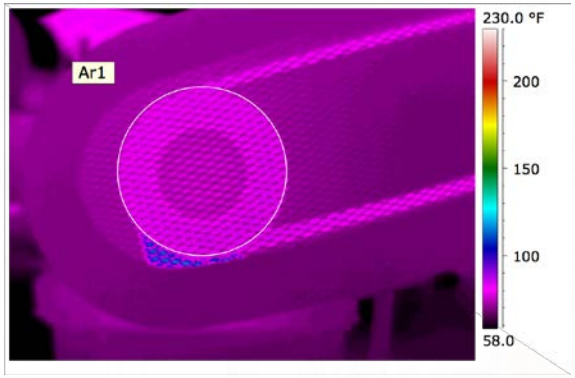
Mechanical Inspection

- Belts for a Large HP dust collector
- Inspection identified hot belts
  - –Before – 256deg.F
  - –After – 86deg.F
- If failed, would have stopped engine head line
- Cost avoidance – $12,000

before



after



Electrical Inspection

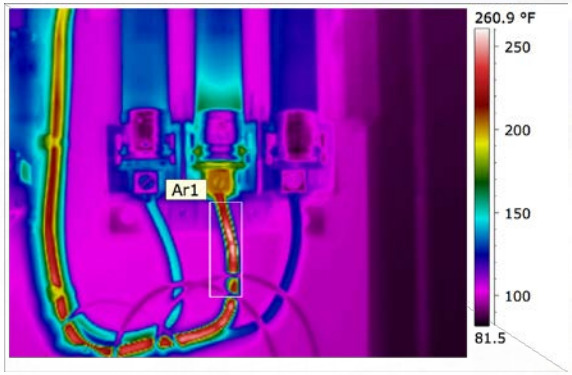
- Glue tank heater controls

- Loose connection at lug
  - –Before-258deg. F
  - –After-96deg.F

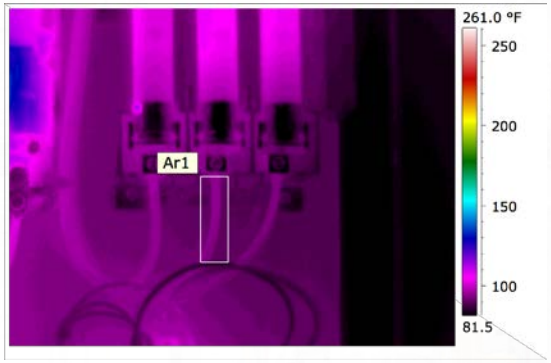
- If failed, would have stopped production for aluminum engines

- Cost avoidance - $22,000

before

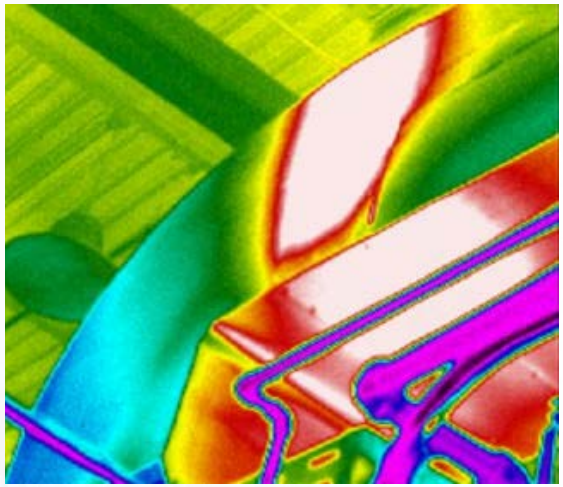


after

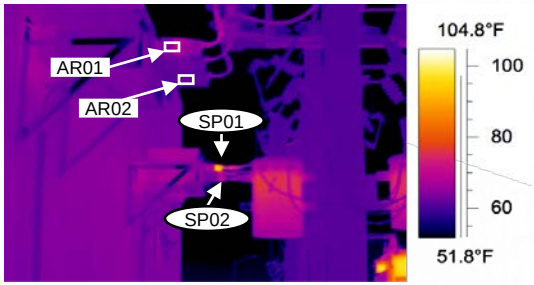


Energy Savings

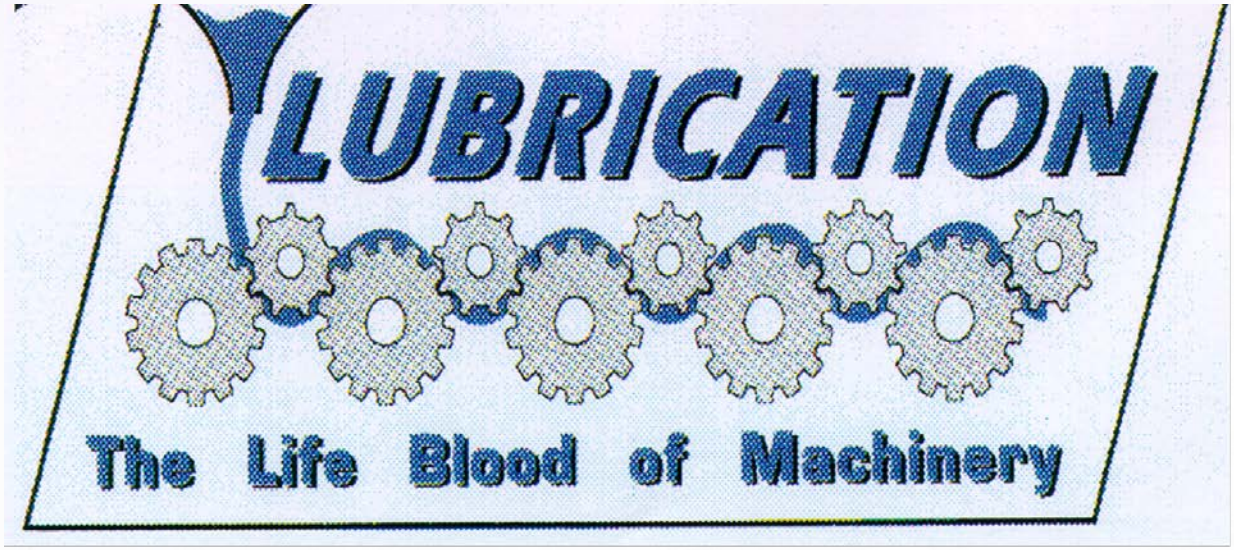
- Buy off of new equipment
- Pre-fabricated duct work was short
- Added section was made with no insulation
- Impact on energy savings



IR - Inspection Report



Description: This image is of the Orion Sunbird Substation, the power lines are 13,800 V, stepped down from 120,000 V. The bushing on Leg #1 of #2 Feed appears to be showing a hot spot as compared to the other 2 legs. A delta temp. of approximately 25.9 deg. F exist between Leg #1 (SP01) and Leg #2 (SP02). There also appears to be an elevated area temperature rise on Leg #1 of #1 Feed. A delta temp. of 4 deg. F exit between Leg #1 (AR01) and Leg #3 (AR02)

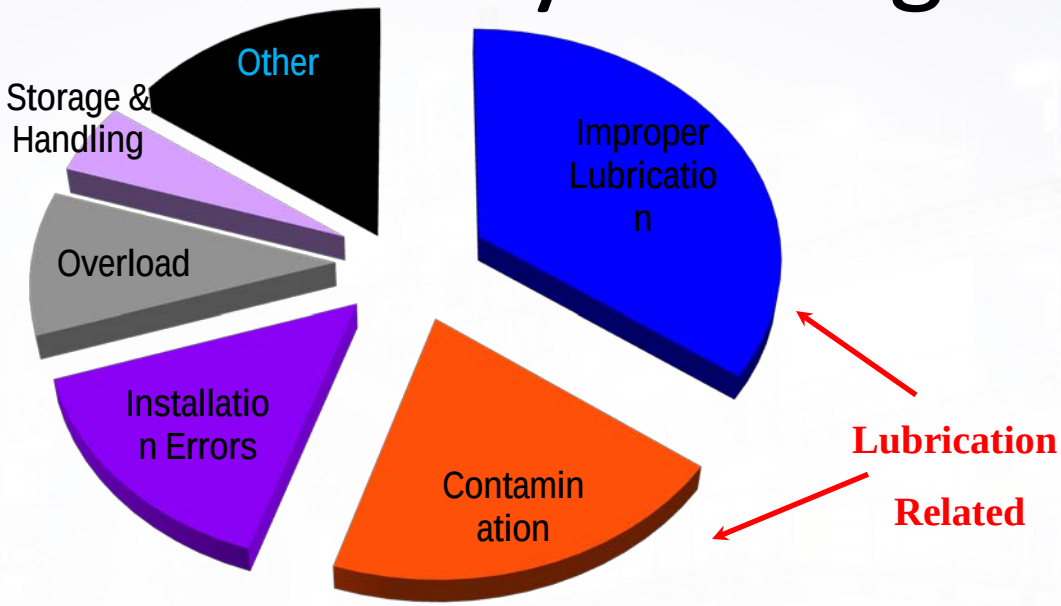


Oil Analysis

UP to 70% of Mechanical Failures are lube related

- **Too Much**
- **Too Little**
- **Wrong Type**
- **Contamination**

Why Bearings fail…



In a study conducted by the bearing manufacturer SKF, over 50% of bearing failures were the result of poor lubrication practices.

The 5 R's of Lubrication

It is important to remember the five R's of lubrication.
Keep in mind that the **"Right Person"** must be a person trained in lubrication techniques.

They are:
Right Person applies the
Right Amount of the
Right Lubricant in the
Right Place at the
Right Time.

Six Basic Purposes of Lubricants

- Reduce Friction
- Reduce Wear
- Dampen Shock
- Dissipate Heat
- Prevent Corrosion
- Seal out Dirt and other contaminants

Types of Petroleum Lubricants

The eight main types of lubricants are:

Physical Properties

- **Viscosity**
  - A Fluid's resistance to flow
  - Will change with temperature and pressure
  - Most important characteristic of lubricants

Physical Properties

- **Flash Point**
  - Temperature at which a fluid's vapor will flash when exposed to an open flame

- **Fire Point**
  - The temperature at which a oil gives off enough vapors that a spark will ignite them and maintain a flame for at least 5

Physical Properties

- **Cloud Point**
  - –The temperature at which crystals form a cloudy appearance

- **Pour Point**
  - –The lowest temperature at which an oil is observed to flow

Additives

- **Definition:**

  A substance added to another in relatively small amounts to enhance properties of a lubricant

- **Purpose of Additives**
  - Improve lubrication qualities
  - Lengthens life of lubricants
  - Improves corrosion resistance
  - Increases load carrying capabilities
  - Enhances other natural properties

Synthetic Lubricants

Definition:

A lubricant produced by chemical synthesis rather than Refinement of petroleum to produce a compound with Planned and predictable properties

Are used for:

–High temperature applications
–Low temperature applications
–In vacuums
–Where fire resistance is needed

They are:

–More expensive
–Incompatible with some seals
–Difficult on waste treatment

Mixed Lubricant Incompatibility Issues

- The wrong viscosity affects lubricant boundary separation

- Too heavy of a viscosity causes excess lubricant overheating and lubricant breakdown

- Base oils may not be compatible
- Additives interfere with the function of the original oil additives

- Oil is no longer compatible with the seals

Bottom line: Do not mix oils!

What is Grease?

Definition:

A lubricant composed of oil(s) thickened with a soap(s) or other thickeners to produce a semi-solid or solid consistency

5 Characteristics of Grease

- **Hardness**
- **Dropping point**
- **Pump ability**
- **Water resistance**
- **Stability**

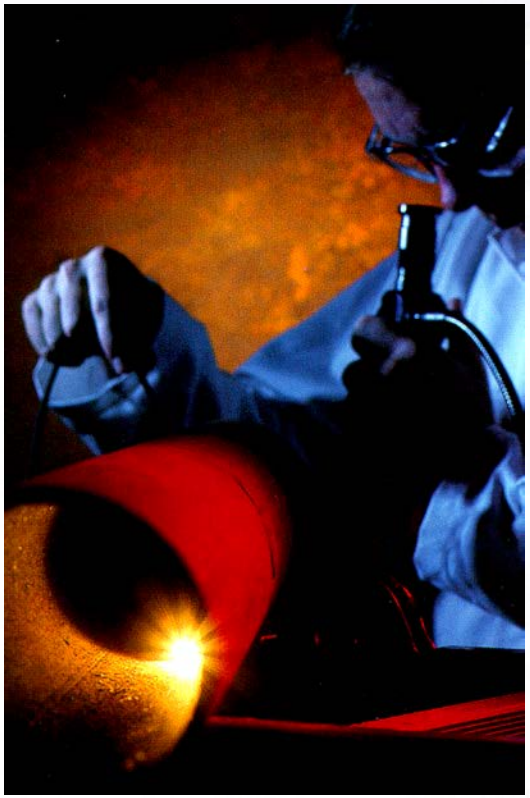
Remote Sensing/High Speed Video

Remote Sensing / High Speed Video

- Fiber Optics
  - Glass fibers are used to transmit light
  - Glass fibers are used to send an image back
- Video Probes
  - Flexible instruments for access to difficult areas
  - Can be used in conjunction with High speed video
- High Speed Video
  - Record fast events
  - Review at slow speeds to understand

Fiber Optics

Fiber optics uses glass fibers to transmit light to the point of inspection and then transmits the image back to the eyepiece.



Video probes

- Optical images are obtained by using a CCD camera and digital processor

- The advantages of video probes are:
  - –Highly portable
  - –Bright, High resolution images
  - –Easy to operate
  - –Interchangeable tip adapters
  - –Minimal user training required

High Speed Video – What is it?

- Diagnostics Tool
  - Helps engineers, researchers and skilled tradespersons analyze high speed events

- Sequential series of a visual inspection
  - Event recorded at a very high frame rate played back in slow motion

Allows ***detailed*** review, measurement and understanding of high speed processes.

High Speed Video vs. Standard Video

- High speed video events
  - Sequences normally captured at hundreds or thousands frames per second

- Standard camcorders/cameras can only capture 25 or 30 frames per second
  - i-SPEED 33,000fps (1,000fps at full resolution)
  - Information and detail will be missed

- Understanding high-speed motion is critical in many of today's industries

Cost Savings / Cost Avoidance

Definitions

- **Cost Savings**
  - Dollars that are currently spent but will not be spent in the future.

- **Cost Avoidance**
  - An estimated dollar amount that would be expected to be paid in the future if proactive events did not keep the machine, tooling, or system producing units

A detailed project guide for building an Asset Condition Monitoring Guide.

RELIABILITY WEB.COM

AUTHORS

Jack Nicholas, Jr.

Jack Nicholas, Jr. CRL, CMRP, has over 45 years' experience teaching, training and consulting in the fields of maintenance reliability in government, military, utility and commercial ven in Asia, Australia, North America and the Caribbean. Mr. Nich is author, co-author, editor and major contributor to many bo professional papers and magazine articles on maintenance subjects.

Dave Reiber

Dave Reiber, CRL, CMRP, is the Senior Reliability Leader of R Mr. Reiber has 20 years as a leader in enterprise asset mana condition monitoring as the former Global Training Lead for E Management & Predictive Maintenance Business Lead for G is a seasoned international trainer with deep experience in h cultures and languages. Mr. Reiber received a Chairman's Ho Leading Team in developing global maintenance business p award for successful Enterprise Asset Management deploym China.

Terrence O'Hanlon

Terrence O'Hanlon, CMRP, Chief Executive Officer of Reliabilit and Publisher for Uptime® Magazine, is an asset management specializing in reliability and operational excellence. He is cer in Asset Management by the Institute of Asset Management a SMRP Certified Maintenance & Reliability Professional. Mr. O'H a popular keynote presenter with the ability to deliver awaren the business advantages of asset management to top manag

Dave Reiber CRL / CMRP
Senior Reliability Leader at Reliabilityweb
Email – dave.reliabilityweb.com
Phone - 239-333-2500 - 126

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AMGA

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Insertar puesto actual

SI TIENES PREGUNTAS O COMENTARIOS…

¡No dudes en acercarte!