



Energy Conservation and Equipment
Reliability With Ultrasound

Vibration Institute – Piedmont Chapter
Rock Hill, SC

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SYSTEMS INC

UE Systems, Inc.

- UE Systems is the recognized global leader in the manufacture and support of hand-held ultrasonic instruments that are used for various maintenance, equipment reliability, and energy conservation applications.



*The World's Most Advanced
Ultrasound System*

UE Systems, Inc.

- Founded in 1973; 37+ years experience with *ULTRASOUND*
- Corporate Office & Manufacturing Facility in Elmsford, NY
- All instruments made in USA
- All instruments come standard with a 5 year warranty
- Direct Corporate support; 9 regional offices in US
 - South Carolina
 - Alabama
 - Texas
 - Colorado
 - California
 - New York
 - New Jersey
 - Minnesota
 - Missouri
 - Internationally in...
 - Canada
 - Mexico
 - Latin America
 - Amsterdam
 - Hong Kong
 - 200+ Corporately supported Distributors



UE Systems, Inc.

- Continuous Hardware and Software Development to meet customer demand
- Level I and Level II Certification training conducted to ASNT guidelines
- On site product demonstrations
- On site Equipment / Software Orientations
- On site Technology Implementation Courses



Why Are You Here Today?

- Improve the reliability of your equipment
- Increase your knowledge of inspection and analysis techniques
- Take your knowledge back to your facility
- Put some action on what you learned
- Reap the benefits...
 - *savings, increased uptime, decreased downtime, reduce waste, REMAIN COMPETITIVE IN YOUR INDUSTRY!*



Advancements In Ultrasound

- *In the early days...*
 - Analog Instruments
 - Basic troubleshooting instruments used for listening for sounds
 - No data storage
 - Had to manually calculate out the decibel level
 - No initial concern for the dB or for trending
 - Primary applications were for leak detection
 - “Search & Locate”



Advancements In Ultrasound

- *Then came...*
 - Digital Instruments
 - Provided a true decibel readout
 - Instruments had data storage for storing the decibel and trending the decibel over time
 - Sounds could be recorded – Spectral Analysis
 - New applications discovered
 - Considered a Non Destructive Test
 - Use of online & dedicated monitoring systems
 - Guidelines for training & certification established
SNT-TC-1A developmental practice UEQ-TC-1A by the ASNT

Advancements In Ultrasound

- *Today...*
 - Increased emphasis on the sound recordings and data collection
 - We recorded the sound, but now what do we do with that sound
 - We can use spectral analysis to determine electrical noises that we hear and mechanical problems in rotating equipment
 - The future of ultrasound is being able to view the spectrum in real-time and take the recorded sound and analyze the spectrum for fault frequencies ...failures can be detected earlier
 - Increased use for electrical inspections, condition monitoring , and predictive maintenance as we speak.

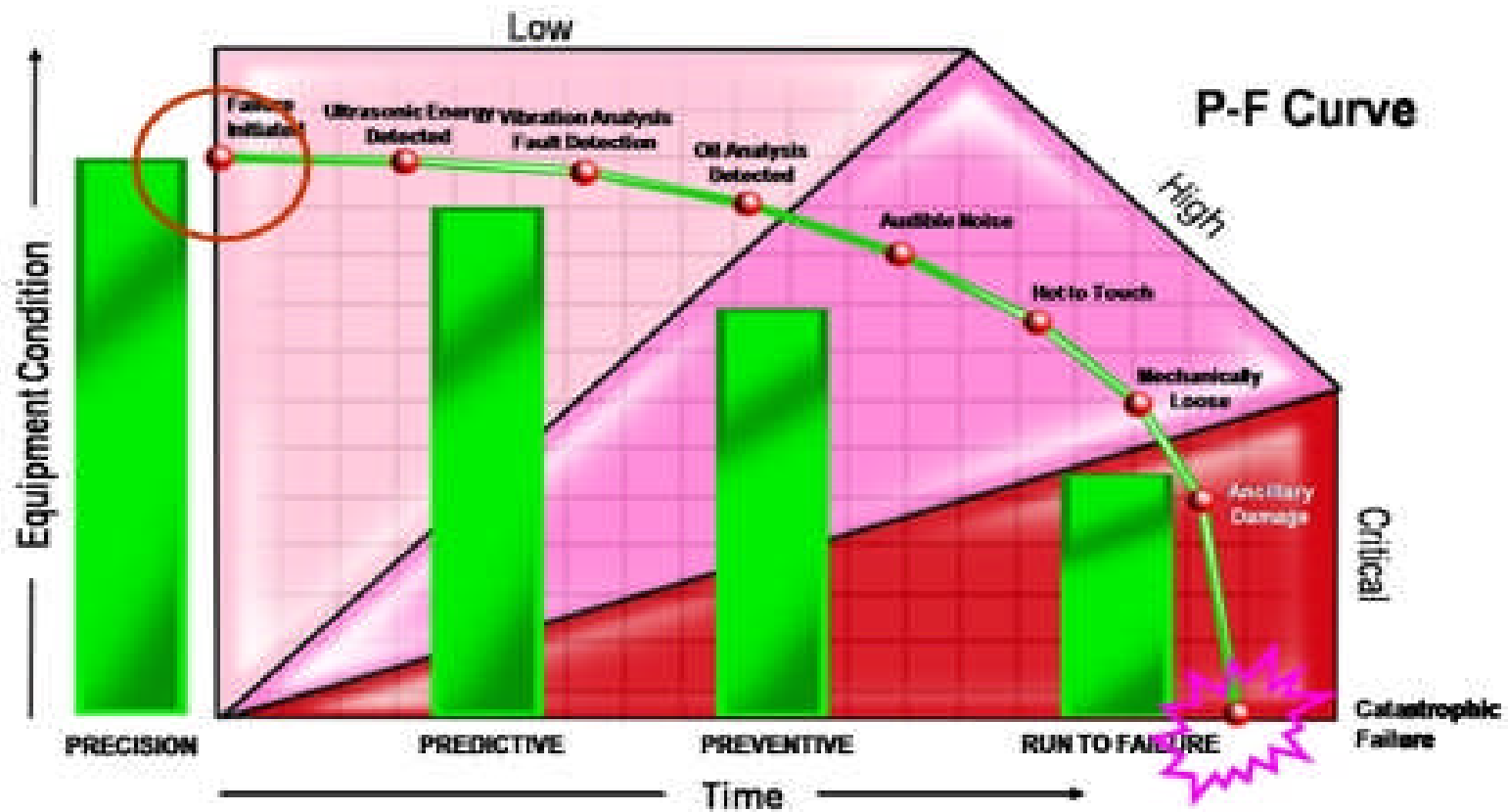
Predictive vs. Other Methods

- **Reactive** maintenance implements repairs upon Failure
- **Preventive** maintenance implements repairs on Schedule
- **Predictive** maintenance implements repairs only when a failure is Forecast
- **Predictive Maintenance** can also be called Condition Monitoring in that we monitor the condition/health of equipment and note changes in condition to plan ahead.



P-F Curve

Early Identification of a Defect



Source: Allied Reliability

Benefits of Predictive/Detective Testing

- Substantially less costly than breakdown or preventive methods
- Less unscheduled downtime
- No interruption of operations
- More problems found than with traditional methods
- Permits orderly planning of repairs and cash outlays



The Role Of Ultrasound In Your Maintenance Program

- To forecast failure
- To show trends
- To be used as a sorting tool
- To reduce waste
- To assist your lubrication program



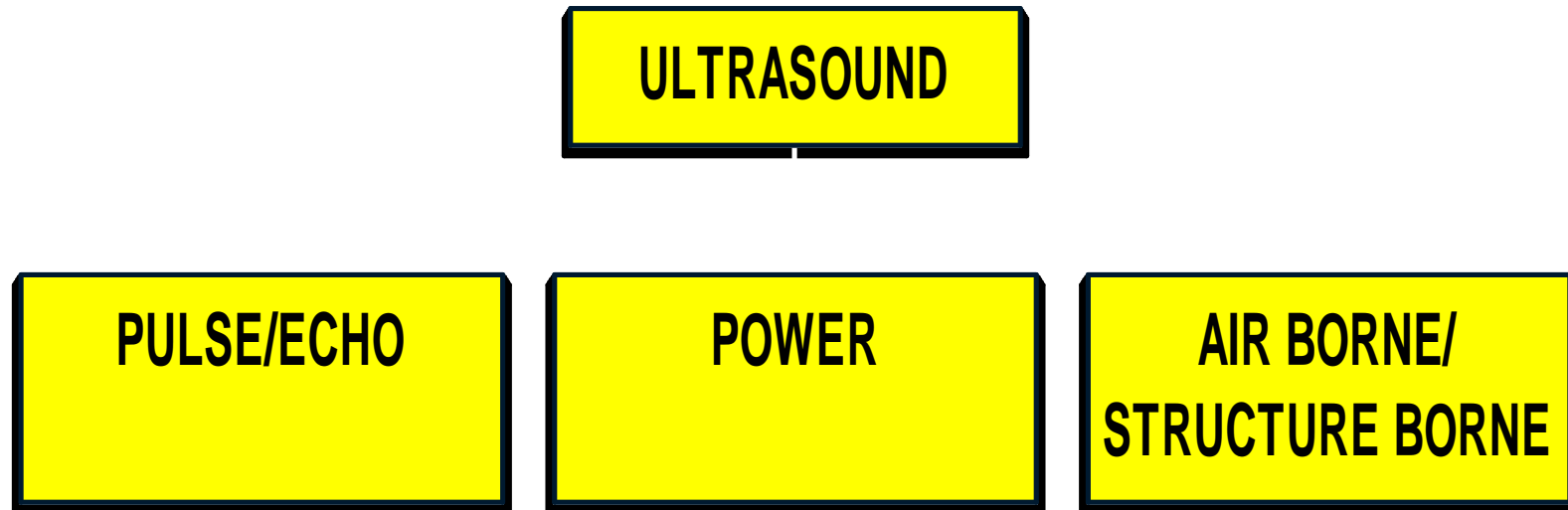


We offer the widest selection of high quality technologically advanced airborne/structure borne ultrasonic instruments. Backed by over 30 years of customer satisfaction.

- **ULTRAPROBE 10,000**
- **ULTRAPROBE 9000**
- **ULTRAPROBE 3000**
- **ULTRAPROBE 2000**
- **ULTRAPROBE 550**
- **ULTRAPROBE 100**
- **GREASE CADDY**
- **ULTRA-TRAK 750**
- **ACCESSORIES**

Technology & Applications

Generic Divisions Of Ultrasound



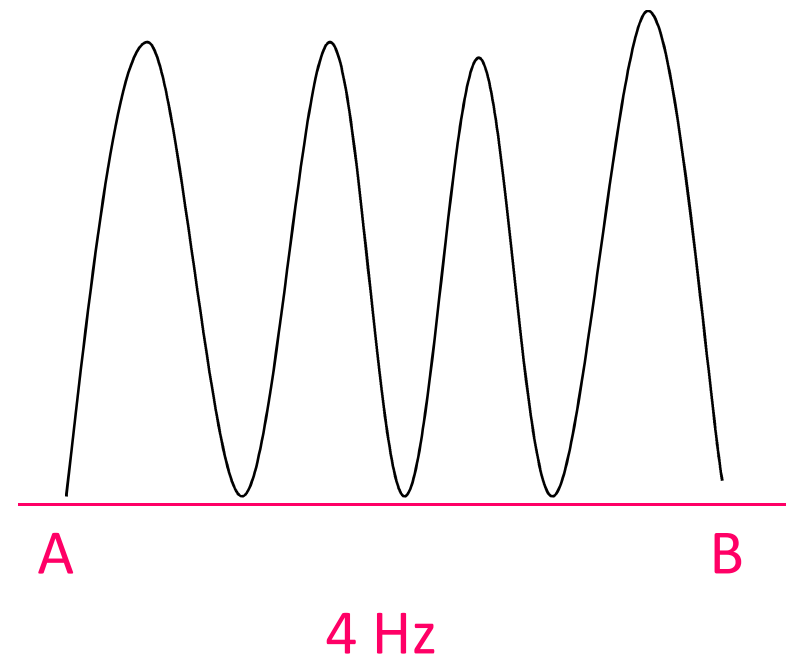
Sound Theory

- What is sound?
 - Sound is a traveling wave produced by a vibrating property that is transmitted through a medium such as a solid, liquid, or a gas.
 - The traveling wave is perceived by the listener as **SOUND!**

Sound Theory

- Components of Sound:

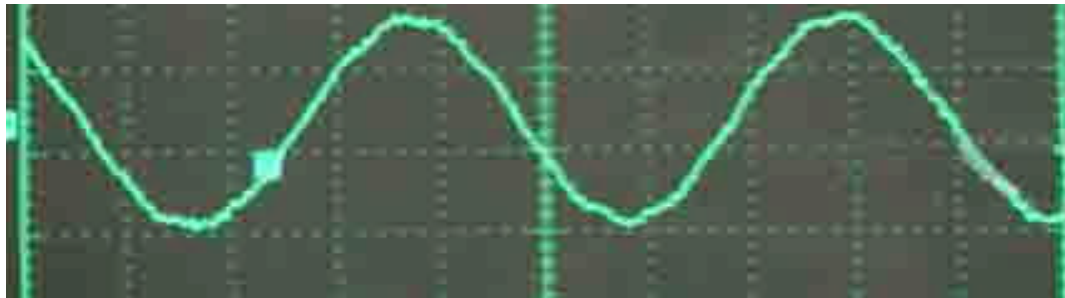
- Displacement
- Cycle
- Period
- Wavelength
- Frequency
- Decibels
- Amplitude
- Intensity
- Velocity



Sound Theory

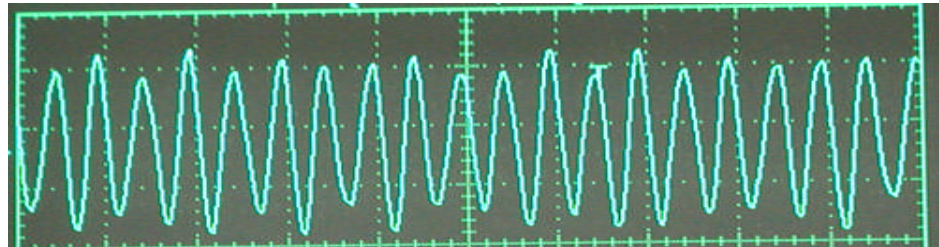
Low Frequency Sound Waves

- Range in size from $\frac{3}{4}$ " to up to 56' in length



High Frequency Sound Waves

- Range in size from $\frac{1}{8}$ " to $\frac{5}{8}$ " in length



Ultrasound Technology

The instruments are used for equipment reliability and energy conservation

Our instruments listen for sounds that could never be detected by human hearing.

Human hearing is around 16Khz-17Khz

Our instruments start listening at 20Khz...well above human hearing

Works in conjunction with other PdM technologies such as vibration analysis, infrared thermography, laser alignment, etc...

Why Ultrasound?

My Ears Work Just Fine!

- Ears
 - Human hearing is not directional
 - Can we hear through solid surfaces?
 - Can we hear everything going on in our facility?
- Ultrasound
 - Directional
 - Locatable
 - Quantify – using the decibel level
 - Trending – decibel level over time



Ultrasound Technology

- Multiple plant inspection applications
- Little training needed – short learning curve
- Used by all skill levels
- Integrates easily into existing inspection programs – vibration, infrared, alignment
- Detects sounds not heard by normal hearing
- Reporting & trending software



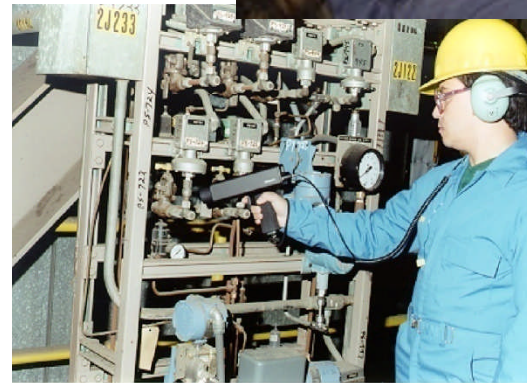
Advantages of Ultrasound

- ***Directional*** – Isolates the problem
- ***Locatable*** – Determines the source
- ***Multiple Applications***
- ***Utilizable In All Environments***
- ***Gives An Early Indication of Failure***
- ***Supports Other PdM Technologies***



Application Groups

- Airborne Applications
 - Compressed Air/Gas leak detection
 - Vacuum leaks
 - Heat Exchangers
 - Steam Leaks to atmosphere
 - Electrical Inspection
 - Corona
 - Tracking
 - Arcing



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Application Groups

- Structure-Borne Applications

- Bearings
- Valves
- Pumps
- Steam Traps
- Gearboxes
- Lubrication
 - Under/Over



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Leak Detection Applications

- AIR IS NOT FREE!
 - Economical
 - \$\$\$!!!
 - Environmental
 - Safety Issues



Leak Detection Applications

- COMPRESSED AIR SYSTEMS
- SPECIALTY GASSES- Argon, Nitrogen, Helium, Hydrogen, etc...
- VACUUM LEAKS
- VALVES
- STEAM LEAKS to atmosphere
- *Find Leaks...Find Savings!*



Leak Detection Applications

- Compressed Air Leak Detection
 - Leaks can now be quantified
 - Based on three factors: decibel level indicated on the instrument when a leak is detected, the pressure, and the cost per kilowatt hour
 - Example:
 - 60db leak @ 100psi .06/kwh = \$450/year & 4.3CFM loss
 - The included software does the calculations

[JTEKT.Leak.September Air Survey.xls](#)



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Electrical Inspection

- Electrical Inspection
- Can help to prevent an Arc Flash

– Corona



– Tracking



– Arcing



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ELECTRICAL INSPECTION

- Inspect enclosed systems while energized!
- Scan switchgear BEFORE opening to inspect with Infrared :
 - prevent ARC FLASH injuries
 - Sort equipment for further inspection



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Structure-Borne Applications

- Bearings:
 - Historical Trending (trending decibel level)
 - A good bearing will have a much lower dB level than a bad bearing
 - Very effective on slow speed bearings
 - Condition Based Lubrication versus Time Based Lubrication
 - Supports Other Technologies
 - vibration & infrared



Friction & Ultrasound



- Friction
 - Largest factor to efficiency loss
 - Too much
 - Not enough



**** Friction Creates A Source of Ultrasound!***

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Structure-Borne Applications

- Good Bearing 🔊
- Bad Bearing 🔊
- Bearing being lubricated 🔊



Bearing Inspection

- Warning Levels
 - 8 – 10dB Increase over baseline represents lack of lubrication
 - 11 – 15dB Increase over baseline represents pre-failure mode for the bearing
 - 16dB and up, bearing has failed

Condition Based Lubrication

- Acoustic Assisted Lubrication
 - *Condition based lubrication vs. Time based lubrication*

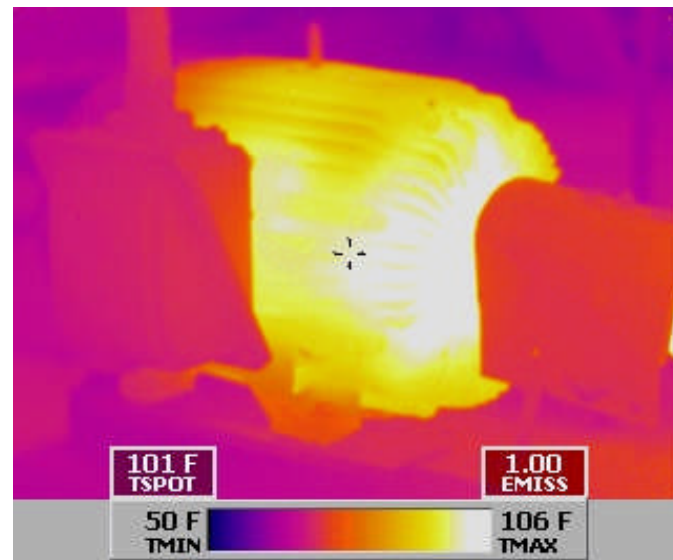
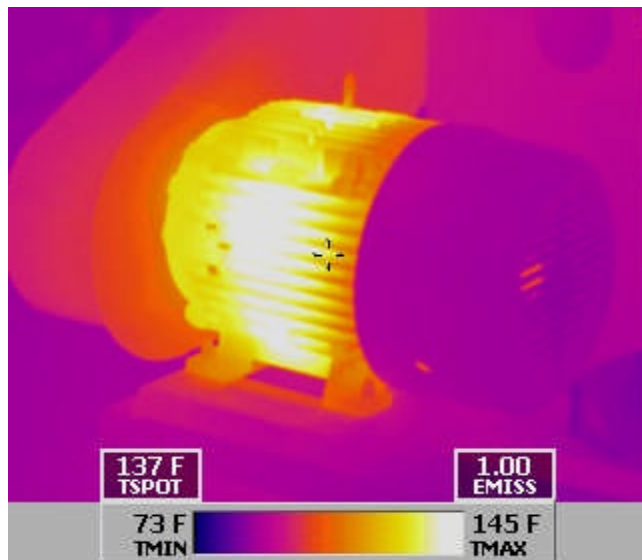
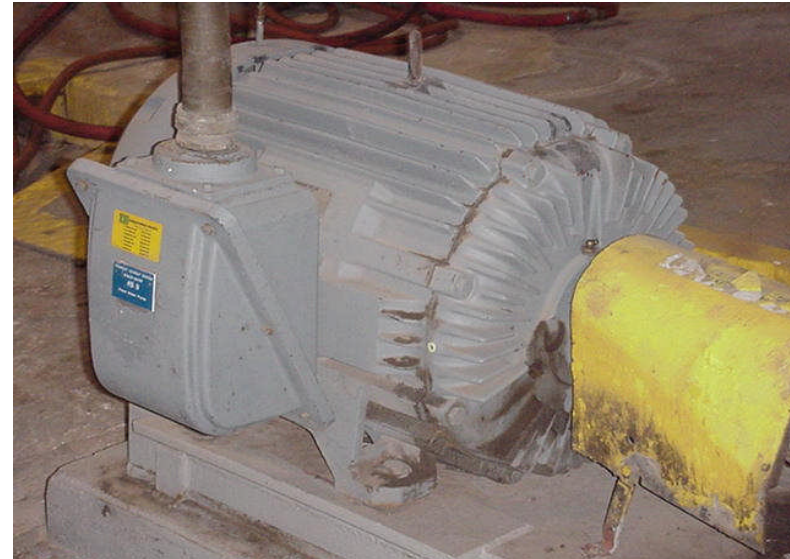
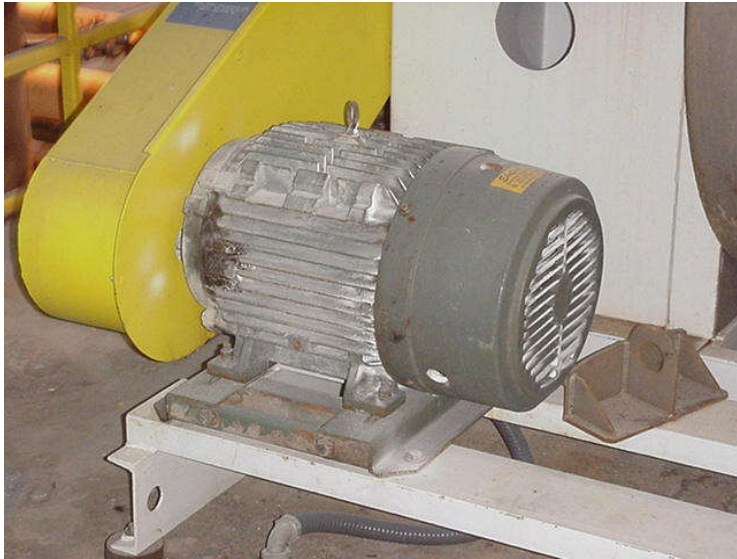


Condition Based Lubrication

- Doing so will prevent this...



Condition Based Lubrication



Structure-Borne Applications:

Testing Steam Traps

Sound Characteristics:

- **On/Off**
(Hold-Discharge-Hold)
 - Inverted Bucket
 - Thermodynamic
 - Disc
 - Thermostatic:
 - Bellows
 - Bi-Metallic
- **Continuous Flow**
 - Float & Thermostatic



Structure-Borne Applications

- Steam Traps & Valves
 - Leaks or Blow Through
 - Quantify Steam Trap Leaks
 - Example: 1/8" orifice trap @ 50psi has a leak 29.8lbs/hr at a cost of \$5.00/1000lbs of steam is costing \$1300/year
 - Leak Rate Table can be found on our website
 - Know your cost of steam



STEAM FLOW THROUGH STEAM TRAP ORIFICE TABLE

To establish the approximate dollar loss, take the lb./hr figure X 24 hours (for a year X 8760) and multiply by your cost of steam. Ex: 1/8" orifice @ 50 psi = 29.8 X 8760 = 261048. At a cost of \$5.00/1000 lb.: 261048 X .005 = \$1305.24.

Orifice Diameter	2 psi	5 psi	10 psi	15 psi	25 psi	50 psi	75 psi
Steam Loss, lb. / hr							
1/32"	0.31	0.49	0.70	0.85	1.14	1.86	2.58
1/16"	1.25	1.97	2.80	3.40	4.60	7.40	10.3
3/32"	2.81	4.44	6.30	7.70	10.3	16.7	15.4
1/8"	4.50	7.90	11.2	13.7	18.3	29.8	41.3
5/32"	7.80	12.3	17.4	21.3	28.5	46.5	64.5
3/16"	11.2	17.7	25.1	30.7	41.4	67.0	93.0
7/32"	15.3	24.2	34.2	41.9	55.9	91.2	126
1/4"	20.0	31.6	44.6	54.7	73.1	119	165
9/32	25.2	39.9	56.5	69.2	92.5	151	209
5/16"	31.2	49.3	69.7	85.4	114	186	258
11/32"	37.7	59.6	84.4	103	138	225	312
3/8"	44.9	71.0	100	123	164	268	371
13/32"	52.7	83.3	118	144	193	314	436
7/16"	61.1	96.6	137	167	224	365	506
15/32"	70.2	111	157	192	257	419	580
1/2"	79.8	126	179	219	292	476	660

Structure-Borne Applications

- Steam Trap Sound Characteristics:

- Continuous Flow – Float & Thermostatic



- On & Off – Disc, Inverted Bucket, Thermodynamic



Other Applications



RAS:

Remote Access Sensor for continuous monitoring of equipment that has limited access due to guards or hazardous areas.



ECM 586:

Provides continuous online monitoring of electrical cabinets. Output is 4-20mA & 0-10V DC. Continuous listening for corona, tracking, & arcing.



Ultra-Trak 750:

Stud mounted sensor for continuous online monitoring of rotating equipment, pumps, flow disruption, and valves. Output is 4-20mA.

Available Instruments

- **Analog Instruments**

- Ultraprobe 100
- Ultraprobe 550
- Ultraprobe 2000*
- Ultraprobe 201
Grease Caddy

- Used just as a “troubleshooting” type of instrument

- No data storage

- *UP 2000:

- Class I Div I groups A,B,C,&D



Available Instruments

- **Digital Instruments**

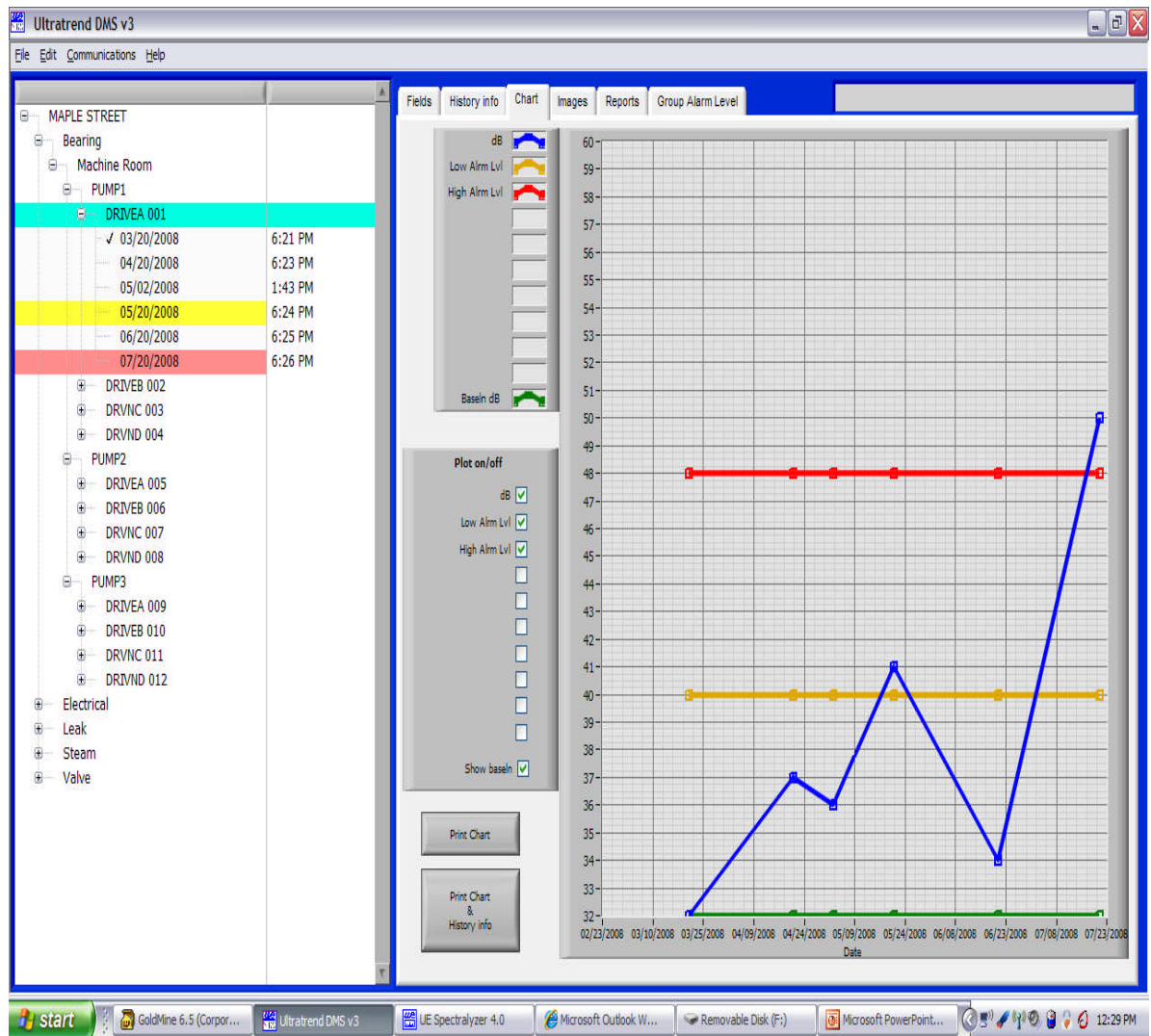
- Ultraprobe 3000
- Ultraprobe 9000*
- Ultraprobe 10000**
- Ultraprobe 15000**^

- Has data storage
- True dB readout
- Used for trending and analysis
- *UP9000:
 - Class I Div I groups C and D
- **Onboard Sound Recording
- ^ Onboard Spectral Analysis



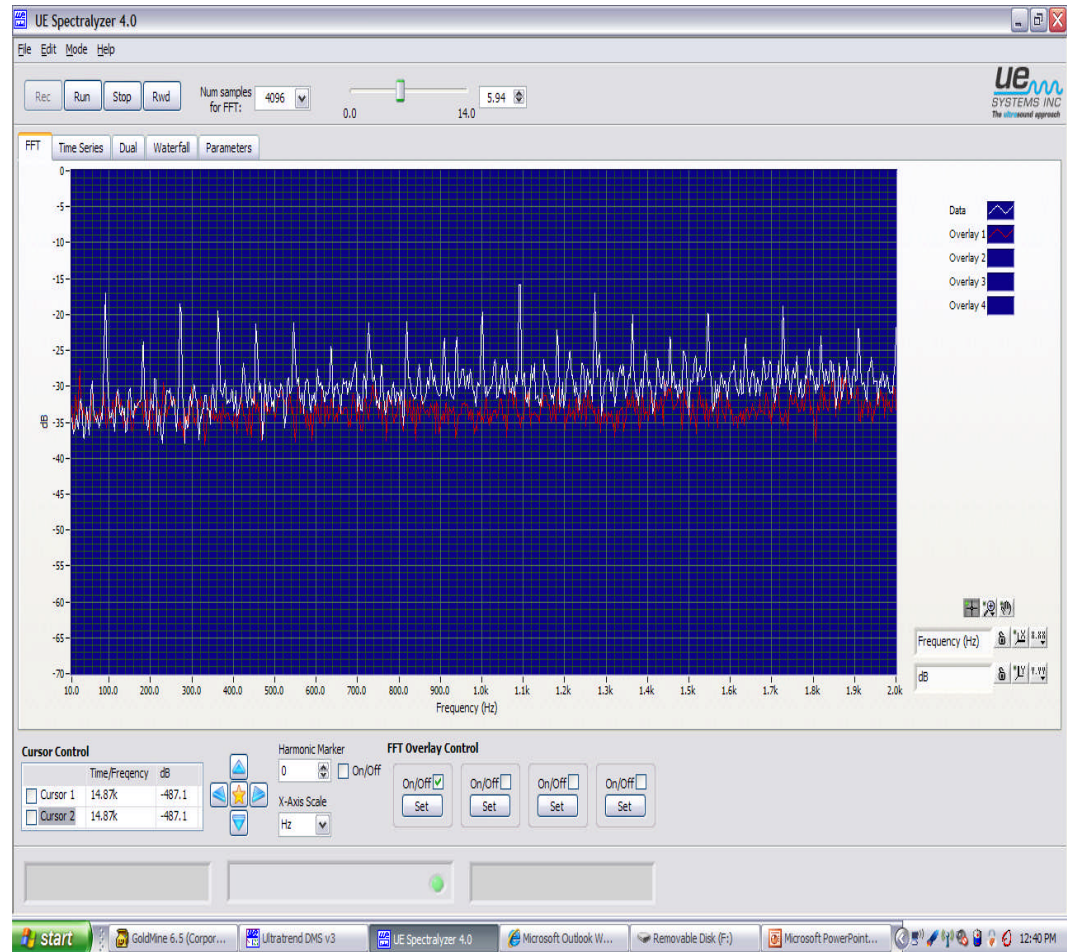
Trending & Data Management

- **Ultratrend DMS**
- Route Building
- Data Trending
- Trend the dB over time
- View data in a chart
- Import infrared images
- Generate compressed air/gas spreadsheet
- DMS Software is included with all digital instruments



Spectral Analysis

- **UE Spectralyzer**
- Spectral Analysis
- Record sounds
- Gives you the recorded sound along with a visual spectrum
- Pinpoint fault frequencies
- Compare readings
- This software is included with the Ultraprobe 10000 & Ultraprobe 15000



Training Courses Offered

- Level I Ultrasound
 - 32 hour course taught over 4.5 days
- Level II Ultrasound
 - 32 hour course taught over 4.5 days
- 2.5 Day Technology Implementation Course
- Webinars – free, located on our website
- Specialized One and Two Day Courses
 - One Day Compressed Air Survey Course
 - Two Day Level I Steam Trap Examiner Course

Ultrasound World VII

May 9-13, 2011 – Clearwater Beach, FL

- The only maintenance and reliability conference in the world that is dedicated to the many uses of airborne and structure-borne ultrasound.
- Workshops
- Learning Sessions
- Networking – Learn from your peers

Points to Take Away:

- Airborne & Structure-borne Ultrasound is used for condition based maintenance and energy conservation
- Small investment reaps big rewards
 - One instrument, many applications
 - A lot of “bang for your buck”
- A great way to jump start a maintenance program
- Anyone can use the technology



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