

# uptime

the magazine for PdM & CBM professionals

oct/nov 2005

## SAVING BIG WITH PdM

GOOD VIBRATIONS: NEW TECHNOLOGY

KEYS SUCCESS **ALIGNING** THE **BIGGEST**

**GAS TURBINE** IN US **IR:**

**SEEING** THE **HEAT**



# Why is this guy deliriously happy?

Well, you see, it all started when Fred put our proactive reliability program in place on temperamental unit 7 which caused the normally staid supervisor to put on a happy face because his manager could report that the plant was running at a rate unprecedented in the history of the universe which tickled no end the vice-president of operations who saw \$1.8 million of annual costs evaporate which made the CEO almost giddy with delight because he could declare a whopping big dividend which made a certain shareholder so crazily jubilant that he couldn't help tipping the guy who parked his car \$500.

And that's why.

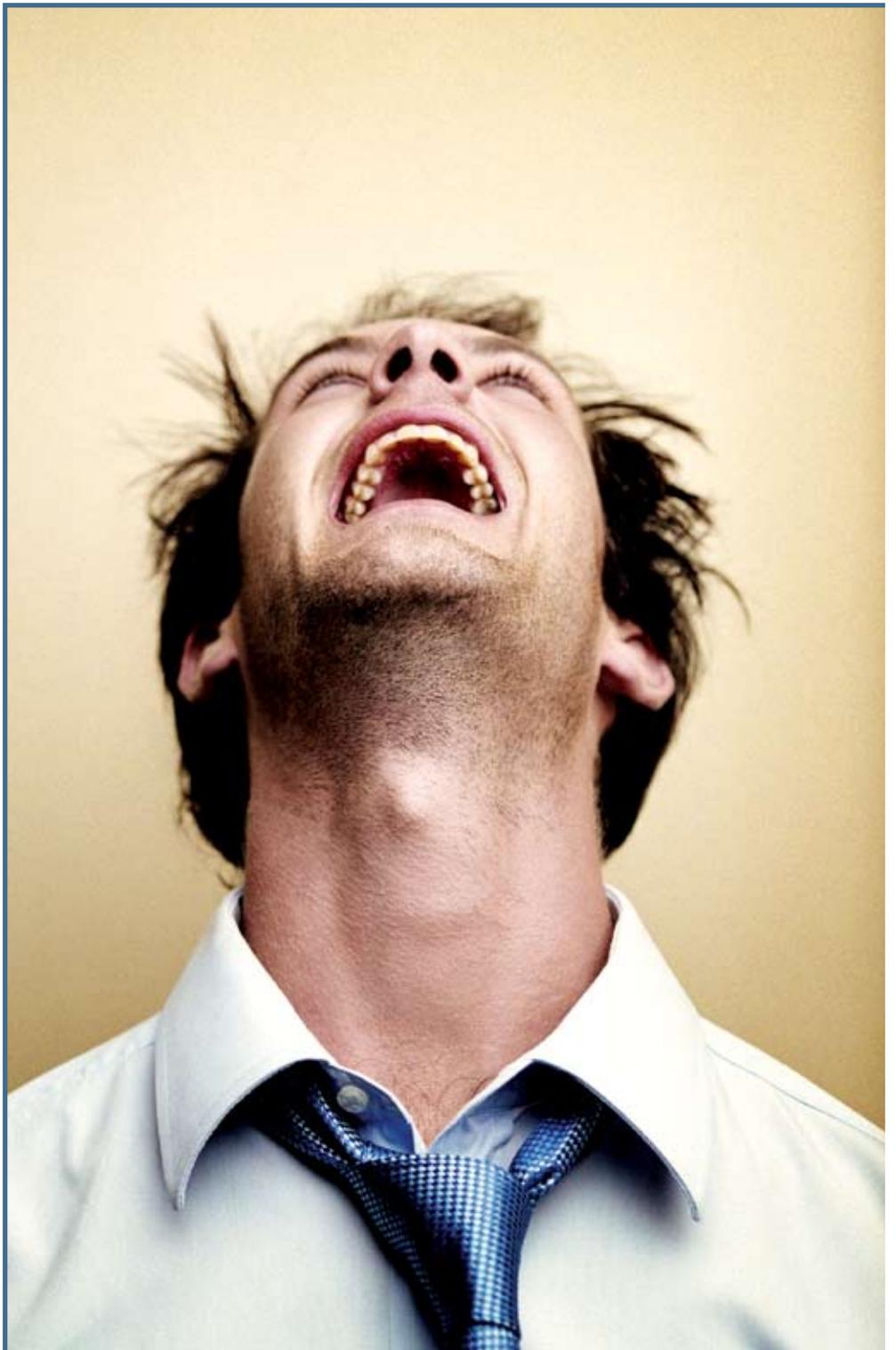
Ivara

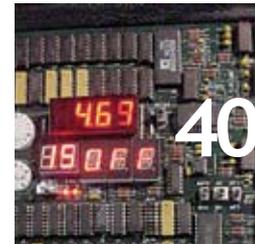
Work Smart. Work Happy.



[www.ivara.com](http://www.ivara.com)

Ivara is a registered trademark of Ivara Corporation





2 **upfront** the power of d

4 **upclose** pdm- the key to big savings

## **upload**

26 infrared **oh the possibilities**

30 lubrication **time is the essence**

32 motor testing **right work right time**

34 precision maintenance **checking the big kahuna**

38 ultrasound **listen, your valves have something to say**

40 vibration **healthy maintenance helps hospital**

45 **upgrade** products for improvement

# The Power of d

Welcome to Uptime Magazine!

Our industry has lacked a Predictive Technology based publication for far too long. So here we are, a magazine dedicated to providing information that will help you get what you - and your organization - really want....more Uptime. In fact, our goal at Uptime is simple...

To help Predictive Maintenance and Condition Based Monitoring professionals perform their jobs better and increase uptime in industries worldwide.

I couldn't dream of a better feature article to summarize why we created Uptime magazine. Bob DiStefano has eloquently put into words what everybody who reads this magazine will be glad to hear. Predictive Technology can, and should, play a major role in your company's success. One thing is certain, if your organization is not incorporating a healthy dose of predictive technology into its maintenance program, then your organization is wasting money.

What struck me most as I was reading Bob's article is what incredible power a small 'd' has. Moving your maintenance program's focus from PM (Preventive Maintenance) to PdM (Predictive Maintenance) will unlock an enormous amount of savings for your company. In fact, in the US alone, if incorporated by all industries on all of their fixed assets, that small 'd' would generate over \$180 BILLION dollars in annual savings.

That is a rather expensive 'd' to leave out of maintenance programs. And that 'd' is what Uptime is all about.

Predictive Technologies are both the present and the future of the Maintenance and Reliability industry. Uptime magazine is here to educate, to entertain and to inspire the professionals who, either directly or indirectly, use Predictive Technologies.

If you are a manager reading this, I urge you to have your entire PdM/CBM team subscribe. More knowledge leads to better performance.

I'll be traveling to as many maintenance and reliability conferences as I can. It's going to be fun learning from you and other readers, how we can improve Uptime with each issue. I definitely consider Uptime a work in progress, so please feel free to contact me with any ideas and suggestions you have for us.

It's a privilege for us to bring this magazine to you. I hope you enjoy!



All the best,



Jeff Shuler  
Editor In Chief

[jshuler@uptimemagazine.com](mailto:jshuler@uptimemagazine.com)

# uptime

volume 1, issue 1

PUBLISHER  
Terrence O'Hanlon

EDITOR IN CHIEF  
Jeffrey C Shuler

EDITORIAL ADVISORS/  
CONTRIBUTING EDITORS

Ron Eschleman	James Hall
Joseph Petersen	Alan Johnston
Greg Stockton	Jay Lee, PhD
Ray Thibault	John Mitchell
Jack Nicholas, Jr.	Jason Tranter
Howard Penrose, PhD	

ADVERTISING SALES

Bill Partipillo  
888-575-1245 x 114  
[sales@uptimemagazine.com](mailto:sales@uptimemagazine.com)

EDITORIAL INFORMATION

Please address submissions of case studies, procedures, practical tips and other correspondence to

Jeff Shuler, Editor In Chief  
Uptime Magazine  
PO Box 07190  
Ft. Myers, FL 33919  
888-575-1245 x 116  
[jshuler@uptimemagazine.com](mailto:jshuler@uptimemagazine.com)

SUBSCRIPTIONS

to subscribe to Uptime, log on

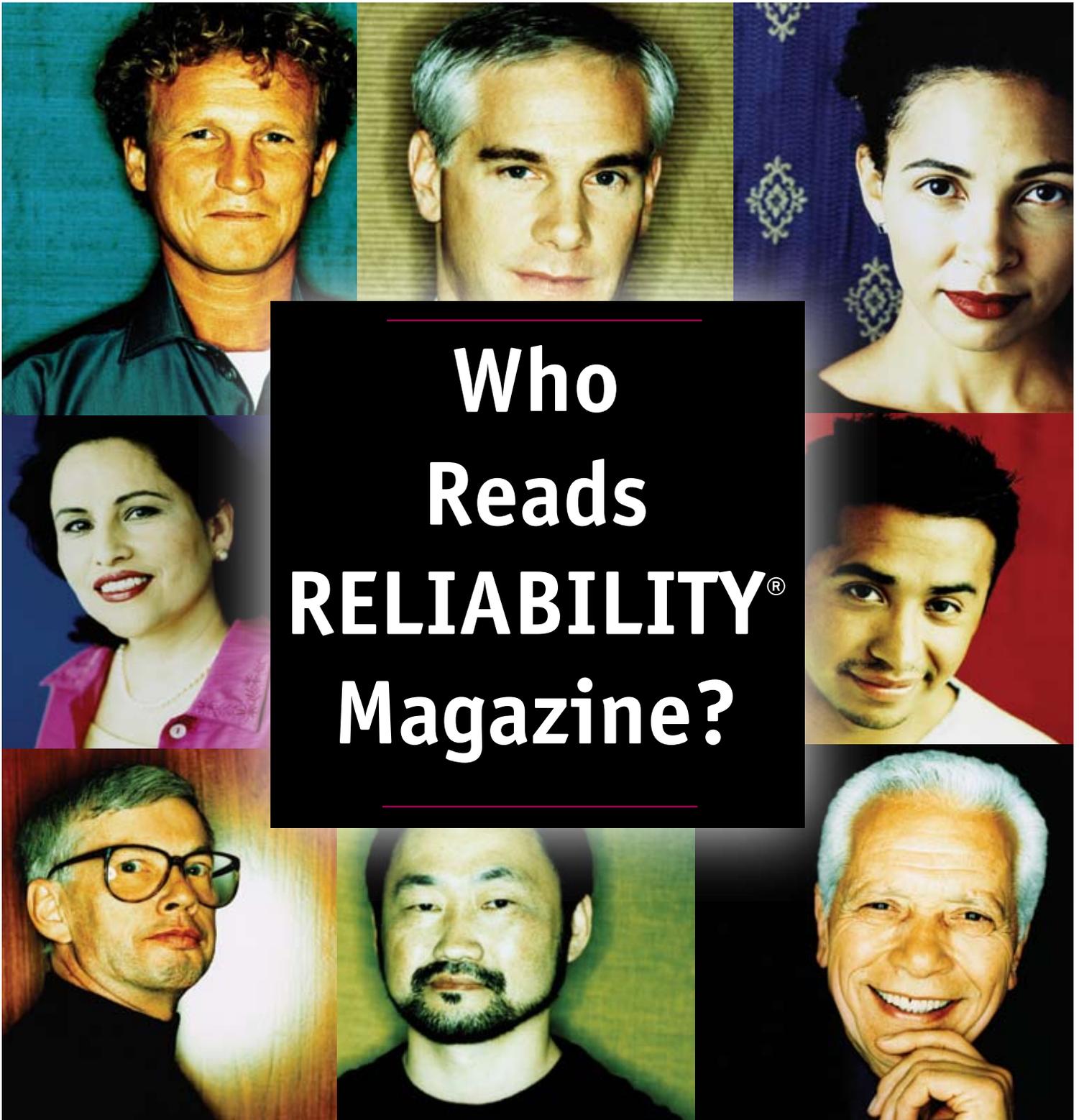
[www.uptimemagazine.com](http://www.uptimemagazine.com)

Uptime® is published monthly by NetexpressUSA, Inc., PO Box 07070, Ft. Myers, FL 33919, 888-575-1245. In the U.S. Uptime is a registered trademark of NetexpressUSA, Inc. No part of Uptime may be reproduced in any form by any means without prior written consent from NetexpressUSA, Inc.

Uptime is an independently produced publication of NetexpressUSA, Inc. The opinions expressed herein are not necessarily those of NetexpressUSA, Inc.

Copyright© 2005 by NetexpressUSA, Inc. All rights reserved.

POSTMASTER: Send address changes to:  
Uptime Magazine PO Box 07070, Ft. Myers,  
FL 33919.



# Who Reads RELIABILITY<sup>®</sup> Magazine?

**O**ver 4,000 maintenance & reliability decision makers from some of the largest companies in the world! Our subscription base is expanding rapidly with help from our new partners at Reliabilityweb.com.

Our readers tell us they are seeking "solutions" that they don't find in traditional free trade magazines... but they do find them in RELIABILITY<sup>®</sup> Magazine, featuring how-to articles and solution oriented case studies.

Providing bonus distribution at over 20 major maintenance & reliability related events throughout the year, RELIABILITY<sup>®</sup> Magazine is the premier publication to reach professionals in the maintenance and reliability market.

*To learn more about advertising options please contact Bill Partipilo at 239-985-0317, ext 114 or email [bp@reliability-magazine.com](mailto:bp@reliability-magazine.com).*



**RELIABILITY<sup>®</sup>**  
THE MAGAZINE FOR IMPROVED PLANT PRODUCTIVITY

# Unlocking **BIG** Benefits



## **Predictive Technologies Increase Bottom Line**

*by*  
**Bob DiStefano**  
**CMRP**

**In this inaugural issue of Uptime Magazine, it is my distinct pleasure to write this feature article that will attempt to put the technical and engineering aspects of maintenance and reliability into business terms – essentially into the context of a financial business case that is hopefully interesting and natural for the readers of this magazine and for the most senior-level executives in industrial corporations world-wide. Hopefully, this article will help you to make the translation and adjust your language, strategy and tactics to communicate to top executives and people not directly involved in maintenance, the tremendous business value associated with elevating maintenance and reliability practices in your company.**

## Current State, Awareness & What Good Looks Like

As recently as five years ago, I think it is fair to say, there was very little awareness at the corporate executive suite level of the contribution to financial and business performance improvements that can come from improved levels of physical asset reliability. I also think it is fair to say that five years ago we did not enjoy an accepted consensus among industry experts about what good maintenance and reliability practices look like. If we asked what characteristics were exhibited by top performers who increased operational performance of their physical assets - while reducing the overall cost of production (including reducing the cost of maintenance) - we were likely to get varying answers depending on who was asked. In fact, as recently as five years ago, there were no true success stories in this arena. There were some spotty, incremental achievements, but no enterprise-wide success stories.

Today, there are only a handful of companies that have, in fact, seriously elevated their maintenance and reliability practices, and seen improved business performance as a result. But those few companies provide ample data that paints a very consistent picture of what good looks like and what results can be expected. Companies like Rohm and Haas, Allied Signal/Honeywell, Dofasco Steel, and, more recently, Cargill Corporation, among a few others, have made dramatic shifts in their physical asset management strategies that have driven significant financial results in many parts of their businesses. Several lessons should be taken from these success stories.

First, the characteristics exhibited by these “Early Adopters” are remarkably consistent regardless of the industry in which they operate. These characteristics generally but clearly show:

- Annual maintenance spend below 2-3% of Replacement Asset Value (RAV)
- Significant use of a variety of Predictive Maintenance (PdM) and condition monitoring technologies on the majority of the candidate equipment population
- LESS time-based, invasive preventive maintenance (PM) – less than 25% of the equipment population in a top performer is covered by time-based invasive PM

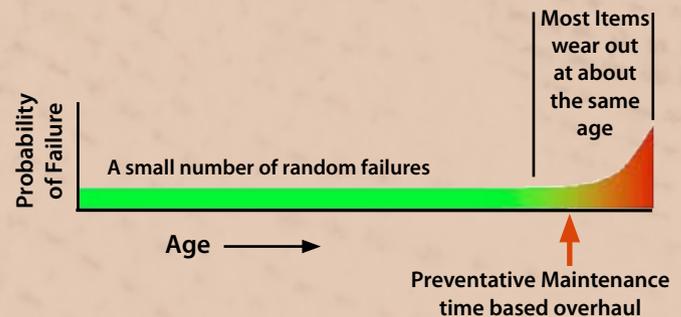
Of note in the top performers is the depth into the asset population to which these multiple PdM technologies are applied. For example,

- From 63% to 95% of rotating machines (depending on the industry) are included in a robust vibration analysis program – not just the critical equipment!
- 91% to 100% of electrical equipment is included in a robust thermography program (incidentally, 58% to 79% of mechanical equipment is also included in the thermography program at top performers, particularly smaller motors and gearboxes in packaging and similar operations)
- Lubrication analysis and contamination control practices are extensive and comprehensive
- Use of Motor Circuit/Current Evaluation (MCE) technology for drivers is extensive
- Extensive use of ultrasonics (airborne and contact) and various non-destructive testing (NDT)

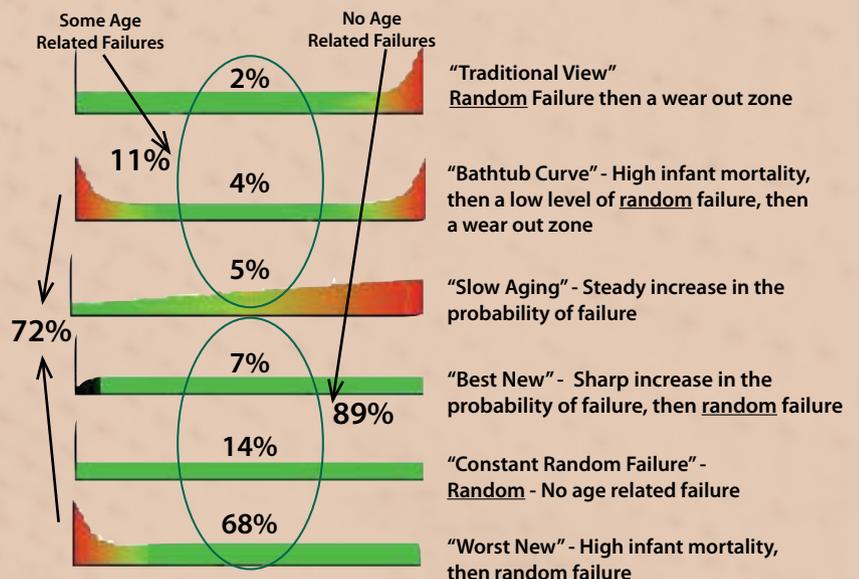
technologies for piping and pressurized assets is also present at top performers

- And again, only 20% to 25% of the equipment population in a top performing plant is covered by traditional, time-based, invasive PM

This last bullet is worth emphasizing a bit. After World War II, it was believed in general industry (despite knowledge to the contrary in the aerospace and airline industries and some branches of the United States military) that most equipment behaved in a time-based predictable pattern – that is, that the probability of failure was relatively low and constant until a so-called “wear-out” zone was reached, at which time rapid and exponential increase in failure probability occurred. Traditional time-based Preventive Maintenance was designed to intervene into the equipment right before the wear-out zone was reached. See the diagram below taken from RCMII by John Moubray:



In reality, a precious small percentage of equipment actually behaves in this fashion. In fact, as the following diagram below (again taken from RCMII by John Moubray) shows, there are many failure patterns of machinery behavior, and only about 11% of the equipment in a typical industrial plant has a time-based predictable “wear-out” zone:



Note the phenomenon of infant mortality, depicted above by the initial high probability of failure upon commissioning an asset into service. About 72% of equipment in a typical industrial plant (this of course varies by industry) experiences infant mortality, while, again, only about 11% has a time-based predictable wear-out pattern. By relying predominantly on PM as a maintenance strategy for most of our assets, we are potentially adding value on a small percentage of equipment, and potentially, and unnecessarily, introducing infant mortality on a

high percentage of our assets. In essence, we are doing more harm than good. I remember coming out of engineering school in the mid-1970's and arriving at a nuclear power plant full of vigor with great ideas, and being confronted by a school of thought that held "if it ain't broke, don't fix it". At the time, I thought these folks were unaware of the science of machinery behavior. It turns out that I was the one that was uninformed. They knew intuitively and based on their experience that machine failure was very likely shortly after doing work on that machine. They may not have known the engineering behind the expe-

**Eliminating unnecessary PMs and introducing PdM enhances our ability to proactively manage our assets to be more reliable, and reduces the cost of maintenance at the same time.**

rience, but they were right.

We are not saying that we shouldn't do anything to our machines until they fail. We are saying that while most of our machines do not have the time-based predictable wear-out pattern, failure is predictable on a large percentage of our equipment using predictive maintenance and condition monitoring. Eliminating the unnecessary PMs and introducing PdM enhances our ability to proactively manage our assets to be more reliable, and reduces the cost of maintenance at the same time!

At the top performers, these PdM technologies are the primary work identification system. These PdM technologies are actually driving about 80% of the daily work. Again, the performance characteristics at top performers are remarkably similar regardless of industry. Keep in mind that the use of the PdM technologies objectively identifies corrective work based on real science and real data, and the

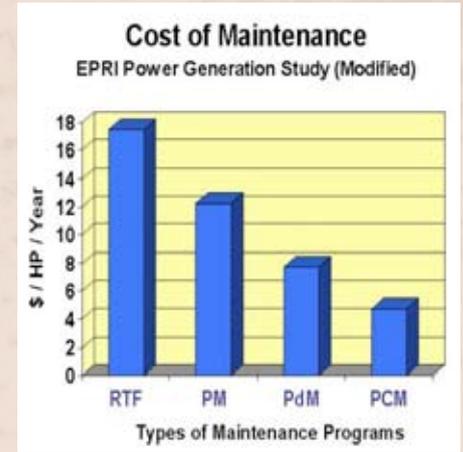
early and objective identification of machine faults, if acted upon properly, should avoid catastrophic failure and collateral damage, meaning that the repairs that are made are typically less extensive, using less labor and less parts. This all drives costs down.

Traditional work identification based largely on the "five-senses" of the equipment operators provides inadequate time to effectively plan corrective work, which handicaps schedule compliance, which undermines the credibility of and trust in maintenance on the part of the operators, and so on. The domino effect is clearly present here if the root cause of

the problem – work identification - is not addressed. A top-quartile objective work identification system, based on comprehensive PdM, allows the Planners to plan the "PMr" and "PdMr" Corrective work orders. By virtue

of early and objective machine fault identification, these work orders can be effectively planned because we have ample time. Once planned these work orders can be advanced to a ready-to-schedule status – feeding a more effective scheduling process. This in turn allows wrench-time of the maintenance workers to approach (and in some cases exceed) 50% (note that the average wrench-time in the United States industrial plant is about 28%). This will also eventually allow the equipment operators to trust the schedule and actually prepare the work-site and the equipment for the scheduled repair.

Of course there are many studies that prove planned work is significantly less expensive than unplanned work. In addition, a work mix more heavily weighted toward PdM will drive costs down, as the following chart summarizing one study shows:



In addition, a well-planned work order provides ample time for an experienced and skilled craftsperson to perform a precision repair that should result in more reliable operation once the machine is restored to service. A second lesson learned from the top performers is that you need to have a holistic approach to changing practices. You will need to inform and include all personnel in every department that will be affected by improving your practices. Otherwise, the full benefits will not be realized. If only the Maintenance people are involved in the process, it won't drive results. The entire organization must be involved to unlock the benefits. And, all aspects of the strategy must be addressed simultaneously. You cannot piecemeal your way to prosperity. For example, planning and scheduling cannot improve if we don't fix the work identification system. We can't identify work objectively and early (before collateral and catastrophic damage occurs) without extensive use of PdM and condition monitoring. "Results" work orders will never be slotted into the schedule unless the operators understand and trust the technology. This is just a small example of how every aspect of the strategy acts as a link in the chain. If any link is missing, or broken, the entire strength of the chain is compromised.

A third lesson we take from the success stories is that the culture change required to accomplish success is not always easy. The top performers recognized early that getting buy-in and creating culture change was critical. They incorporated all kinds of tools and methods to address this issue, including awareness training, consistent measurement systems, alignment of performance to rewards, etc. In fact, the top performers believe that the most challenging part of their journey was the "softer side" of the problem. If we think in terms of people, process and technology (which many companies do today), not surprisingly it is the people aspect that is the most challenging. Despite our intuition that

**Top-Quartile Companies' Work-flow**

Over 50% of the daily work order hours are related to the PdM program

-15% Collecting and Analyzing Condition Information

-35% Performing PdM "Results" Corrective Work (PdMr)

About 30% of the daily work order hours are related to the

PM program

- 15% Collecting and Analyzing Condition/Operating Parameters

- 15% Performing PM "Results" Corrective Work (PMr)

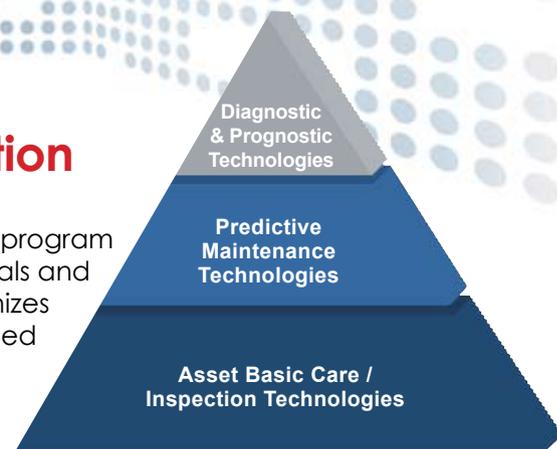
Less than 20% of the daily work orders were initiated via a traditional work request from equipment operators



# vision

## One Complete Solution

You have a vision for your reliability program—a vision of both the short-term goals and the long-term success. DMSI recognizes that vision; that's why we've designed the world's only all-in-one solution for managing all areas of your asset reliability program.



Built on a multi-tiered pyramid approach to reliability, **MAINTelligence™** starts with a solid foundation in Asset Basic Care, (operator inspections and total lubrication management), then allows you to expand into all predictive maintenance technologies. Intelligent agents for equipment health assessment and work scheduling are fully customizable to create a complete, integrated and automated equipment reliability system.

**MAINTelligence™** is One Complete Solution for realizing your vision.

DMSI's dedication to service helps bring all the tiers together—all the knowledge, capability and resources you need to ensure that your asset reliability program is designed, implemented and supported to meet 100% of your goals.

Talk to a DMSI reliability specialist to ask how we can assist you in meeting your reliability goals.

**MAINTelligence...the intelligent approach to maintenance.™**



**Design Maintenance Systems Inc.**

+1.800.923.3674  
info@desmaint.com  
www.desmaint.com

this is true, most companies fail to dedicate the proper amount of attention and resources to this aspect. Many companies complain that their CMMS system has not delivered the promised results, but the CMMS alone cannot deliver reliability. Concentrating primarily on the process and technology does not result in sustainable higher performance.

### Catch Phrases for Top Performers

- More predictive and less preventive
- PdM used broadly and applied deeply into the asset base
- Objective and early work identification
- Planning & Scheduling the PM/PdM Results
- Integrated, holistic approach—you can't piecemeal your way to prosperity
- Culture change is more than half the battle

### Performance Yet to Achieve

Despite the success stories that should guide us with their consistent practices, even the successful companies that have achieved great results have only done so in individual plants or business units. None of the case studies for success have demonstrated uniform elevation of these practices enterprise-wide, at every single plant. In addition, the success that is evident



is still somewhat (if not highly) dependent on influential leaders without whom the performance is not sustainable. In other words, in some of these companies, the changes have yet to be institutionalized for sustainable performance and continuous improvement. This of course takes time, resources and perseverance, and it should be pointed out that some of the companies recognize this and are actively addressing it. If we are looking for a parallel to guide us in institutionalized and sustainable change across the entire enterprise, we need look no further than the area of safety. Those of us who are old enough can remember a day when safety was a responsibility of a limited number of people in a department. Today, safety is knitted into the fabric of every indus-

trial company, and it is everyone's responsibility. It is part of the way we do business. Safe working practices are enabling other business performance improvements that would not be possible otherwise. The correlation established between injury rate and overall equipment effectiveness is remarkably direct.

I have been preaching for quite a few years that reliability needs to become knitted into the fabric of our companies much like safety has. Why do I believe this? Every corporate improvement initiative, whether it is related to Lean Manufacturing, TPM, Six Sigma, Quality Circles, Supply Chain Optimization, Market Share Increase, Cost-of-Goods Reduction, Value-added Services, Increase in Sales, Asset Utilization Leverage – no matter what it is - it is my belief that success in these initiatives is either directly or indirectly enabled and enhanced by the reliability, stability and dependability of our physical assets. My contention is that there are incremental benefits related to all of these programs that are “locked” without addressing a fundamental foundational aspect of our business – namely rendering our

**“Reliability, like safety, is a critical element of operational excellence and requires our constant attention.”\***

Mr. Dave O'Reilly  
Chairman & CEO - Chevron Corporation  
Chairman's Letter, April 29, 2005

physical assets reliable – and doing so efficiently. Could the injury rates at the companies that show

direct correlation have gone down to those levels without reliable assets? I say no. With particular regard to Lean, we have seen or heard of cases where significant lean principals were applied in manufacturing plants only to uncover previously hidden reliability issues. With all of the flexibility and wasted movements removed from the plant, unreliable or unstable assets result in larger production penalties because there is no flexibility to adjust and react. So I argue that business performance can actually degrade if Lean is implemented in the absence of establishing a reliable and stable asset base. In any event, if this foundation is in place, I believe that incremental benefits for the corporation can be unlocked, and the performance of the company,

in whatever part of the business the corporate suite is focused on, will improve.

Gladly, the people in the executive suites of our industrial companies are beginning to understand this – partly because they have witnessed dramatic business performance improvements in the early adopter companies. The Chairman and CEO of Chevron Corporation, Mr. Dave O'Reilly, said in a recent letter to employees that “Reliability, like safety, is a critical element of operational excellence

and requires our constant attention.” The Vice President of Operations at Anheuser Busch, Michael Harding, said in a recent public speech to the Society of Maintenance and Reliability Professionals, that “As goes Maintenance, so goes the business”. There are more examples of executives focusing on maintenance and reliability. If you want to develop a financial business case in your company, find out what initiative the CEO is concerned with, and I guarantee you that reliable assets will materially contribute to the results of that initiative – either directly or indirectly. This environment of increased awareness and understanding bodes well for a significant elevation of maintenance and reliability business practices.

Nonetheless, some obvious impediments stand in the way of uniform, enterprise-wide performance, including:

- Lack of Executive Initiating Sponsorship
- Lack of Executive Sustaining Sponsorship
- Lack of Defined Standards
- Lack of Consistent Basis for Measurement
- No Ties Between Performance and Compensation
- Lack of Systems to Efficiently Leverage Work Done at One Plant to Other Plants

We believe, whether you are a small company or a large corporation, the goal should be to elevate practices uniformly across the entire enterprise. Right now in a typical corporation, there is a wide variation of maintenance

***This environment of increased awareness and understanding bodes well for a significant elevation of maintenance and reliability business practices.***

spend across a fleet of plants. The goal in our view is to reduce the variation in your corporation. This would mean that there is less variation in performance from plant to plant, and, presumably, the level of performance is elevated beyond what it could be by simply attacking the opportunity plant-by-plant. For single plant companies, your goal would be to reduce variation in performance from machine to machine, and, in doing so, you would elevate your entire operation.

It should be noted that we know of no company in existence today that has achieved uniform elevated levels of reliability performance across the entire enterprise – fleet-wide. Several companies are vying for the notoriety, but more importantly, the business performance that will come if this is achieved.

**How Big Are The Benefits?**

Recently, we studied statistics from the United States Department of Commerce, including their measurement of what they call “Net Stock of Private Fixed Assets” in various industries. This measurement is a close proxy of Replacement Asset Value (RAV). In 2003 (the latest statistics available from the USDOC),

there were \$4.9 Trillion of physical assets on the ground in United States industry. We applied our Four Quartile Benchmark Statistics of Maintenance Spend as a percentage of RAV, and we dollarized the value of elevating Fourth Quartile plants to the First Quartile in maintenance spend, moving the Third Quartile plants to the First Quartile, and moving the Second Quartile plants to the First Quartile. As you can see from the following chart, industry wastes approximately \$184 Billion in excess maintenance spend annually in the United States alone!

Further, we can assume from numerous published case studies that three to seven times the maintenance spend reduction benefit is accomplished in operational benefits (including increased uptime, improved quality, more efficient production scheduling, reduced waste, reduced energy consumption, reduced inventories, etc.). Taking the conservative end of that statistic (three times maintenance spend reductions), you can see from the chart that another \$553 Billion in “Productivity Losses” can be re-claimed through the maintenance and reliability improvements, making the financial business case in the United States alone \$738 Billion in annual, recurring benefits.

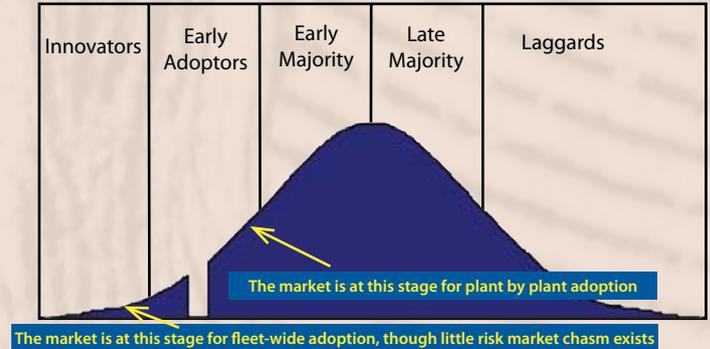
What is this number world-wide? Good question. We are currently trying to quantify that with good data, however our intuition is that, if the U.S. opportunity is conservatively esti-

mated at 3/4 of a Trillion dollars, the world-wide annual benefits could be \$2 Trillion or more!

The following chart depicts the Reliability Adoption Life Cycle.

Assuming that 25% of plants have figured this

Reliability represents a substantial ROI opportunity for 76% of plants in equipment intensive industries. Greatest ROI will come from a corporate wide approach.



**Reliability Best Practices Adoption Cycle**

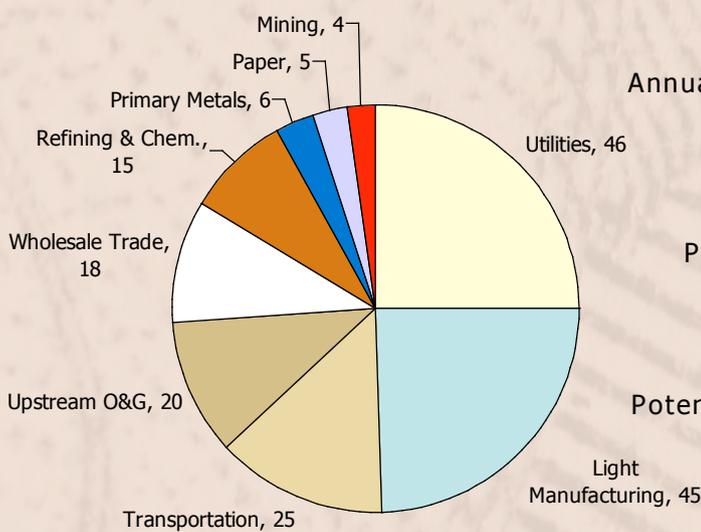
all out (top quartile), the market is at the Early Adopter/Early Majority stage. 75% of plants have improvements to make and work to do. If we look for an example of a company that has uniformly elevated their practices fleet-wide, there are no examples, so we are still looking for the innovators. It should be pointed out though, that attacking the opportunity fleet-wide will ease the journey by reducing the level of effort necessary to implement the practices and make the changes. Attacking this fleet-wide should leverage work done once for reuse avoiding the re-inventing of reliability over and over again. The resultant lower investment should make it easier to justify the expenditures for foundational and culture change work, enhance the Return on Investment and speed the Rate of Return.

**What are the Benefits in Your Company?**

Quantifying the potential benefits, as well as the likely costs to improve performance, in your corporation, is necessary.

Benefits - Here are some of the major benefit categories with some guidance on how to calculate the potential:

- Maintenance Spend Reduction: Calculate your maintenance spend as a percentage of Replacement Asset Value (RAV), and dollarize the improvement to top quartile performance (approximately 2 – 4% of RAV or better). If you are currently spending 5 – 6% or more, this benefit could be significant. The benefit comes from eliminating unnecessary work, working more efficiently, reducing the need for abundant stocked spares, eliminating collateral damage thereby reducing use of spare parts, reducing use of contractors, reducing overtime.
- Inventory Reductions: Calculate your



**Excess Maintenance Spending in Billions of Dollars**

**\$184 Billion Annual Excess Maintenance Spend**

**\$553 Billion Productivity Losses**

**\$738 Billion Potential Annual Reliability Benefit**

stocked inventory value (include satellite spares, etc.) as a percent of RAV, and dollarize the improvement to top quartile performance (approximately 0.5% - 1.5% of RAV). The actual reduction will yield on average \$0.20 cents on the dollar of reduction (some inventory will have to be scrapped). This is a one time benefit. In addition, the recurring annual avoided carrying costs will be on average 25% of the full inventory reduction value – annually.

- **Energy Consumption Reduction:** Published guidelines show us that smoother running rotating equipment and leak-free operation of water, steam and compressed gas handling equipment will consume from 3% to 14% less energy (electricity, fuel).

- **Increased Uptime:** Increased Asset Utilization can have a variety of substantial financial benefits to a company, including selling more product on the existing capital assets (assum-

ing the demand for the additional product is present), or reducing the cost of goods made on the capital assets through more stable operations (even if the demand for additional product is not present). Two downtime areas should be targeted: **Unscheduled Maintenance-related Downtime**, and **Scheduled Maintenance Downtime**. **Unscheduled Maintenance-related Downtime** can eventually be almost eliminated. **Scheduled Maintenance Downtime** in a plant heavily dependent on time-based Preventive Maintenance strategies can be reduced by from 30% to as much as 60% (depending on the starting point). Dollarizing the value of this varies from business to business, however remember that these benefits can be as much as 3 to 7 times larger than the maintenance spend reduction!

- **Improved Quality:** Typically, scrap material and rejected/returned off-spec product is measured accurately in most corporations. Calculate the value of the scrap material and assume that between 5% and 16% of that value can be eliminated through sound reliability practices. In addition, calculate the value of the rejected/returned product and assume that between 1% and 5% of that value can be eliminated through sound reliability practices. These statistics will vary business to business



## Data acquisition: PDA + Datastick module + sensors display and log data in real time with no bulky laptop!

The Datastick DAS-1294 data acquisition module attaches to the back of a Palm Powered™ PDA. Main illustration: shown with Garmin iQue 3200 PDA. Inset: Rugged case available. Shown with Palm Tungsten T3 PDA.

Using a PDA as a host computer is the next step in instrumentation. Today's PDAs are powerful handheld computers, which allow you to bring PC applications into the plant or the field without the bulk, weight, and expense of a laptop.

Attach a Datastick® data acquisition module to the back of the PDA, plug in up to eight analog sensors and you have an unbeatable combination for a wide variety of applications in and around your facility — or on the road.

- Troubleshooting
- Field testing
- Spot inspections
- Compliance testing and reporting
- Development of procedures
- Performance monitoring
- Equipment setup

The PDA's razor-sharp color screen allows you to see up to ten strip-chart displays at once, and Datastick's exclusive Take Note feature makes it easy to attach written observations to your data.

When you use the recommended Garmin® iQue® 3200 PDA, you also have the advantage of its built-in GPS.

At the end of the day, your data and notes — up to 23 MB — transfer to your PC and into Microsoft® Excel® in seconds.

### Datastick DAS-1294 Data Acquisition Module and Datastick Connection™ Plus Software

- 12 bit A-to-D
- 8 analog 0–5 VDC single-ended inputs (4–20 mA available)
- Up to 20 samples/sec with real-time display
- 5 VDC 20 mA sensor-power output
- Real-time stripchart, bar, gauge, or numerical views
- Programmable alarms and level-sensitive triggering
- Snaps onto the back of a Palm™ Tungsten™ T/T2/T3/C or Garmin iQue PDA



### Money-Saving Introductory Offer

Call us or visit [www.datastick.com/daskit-up](http://www.datastick.com/daskit-up) for more information, help with applications from our Solutions Group, and a special intro offer.



**Costs** – Top performers begin with some form of gap analysis to understand the current state of relevant practices and to measure gaps that exist between current state and top performance. From that point, calculating costs to close gaps is objective and fairly accurate. Major investment categories typically include:

- Development of Corporate Standards for work management, materials management, configuration change management and reliability excellence
- Development of a Roll-out and Implementation Strategy taking advantage of work done at one plant as appropriate for other plants
- Creation or Improvement of Foundational Information (Functional Location Hierarchy, Master Equipment List, Spares Materials Catalog, Bills of Material/Parts Lists)
- Objective Criticality Ranking of Equipment
- Methodical Analysis of Failure Modes, using combination of Reliability Centered Maintenance Analysis (RCM), Failure Modes and Effects Analysis (FMEA), and templating where appropriate, to determine the optimum PM and PdM activities that need to be deployed for your population of equipment
- Based on methodical analysis, perform PM Optimization, eliminating unnecessary PMs, deploying recommended PdM, and creating the PM/PdM work orders in the CMMS system

Toll-free: 888 277 5153 • Tel: 408 871 3300 • [www.datastick.com](http://www.datastick.com) • [findout@datastick.com](mailto:findout@datastick.com)

© 2005 Datastick Systems, Inc. Datastick is a registered trademark and Datastick Connection is a trademark of Datastick Systems, Inc. Garmin and iQue are registered trademarks of Garmin Ltd. or its subsidiaries. Microsoft and Excel are registered trademarks of Microsoft Corporation. Palm Powered is a trademark of PalmSource, Inc. Palm and Tungsten are trademarks of Palm, Inc.

to automatically schedule these activities

- Creation of Balanced Metrics Measurement system
- Training and Awareness
- Culture Change and Rewards System Alignment
- Compliance Monitoring and Continuous Improvement

There is a lot of guidance that can be used to estimate the costs of closing gaps, but for purposes of this article, suffice it to say that while these costs are not insignificant, in the context of the benefits and the financial business case, they are almost always easily justifiable, with typical Returns on Investment (ROI) from 8:1 to 16:1 and higher, and with Internal Rates of Return (IRR) from 50% to 250% or higher.

Well, in summary, what do we know and what do we believe?

We know what good looks like, and a big part of that picture can be summed up with the phrase "More Predictive and Less Preventive". We know that Predictive Maintenance is driving a large percentage of work on a daily basis at the top performing plants, and this, of course, is good news for the readers of this magazine. Our time has come!

We know that the top performers achieved their success using remarkably similar practices – regardless of their industry, so we shouldn't spend a lot of time debating what good looks like.

We know that you can't piecemeal your way to prosperity - the top performers attacked the opportunity holistically – weaving all of the aspects of a top-level practice carefully together to unlock the hidden benefits.

We know that even the top performers have been unable to uniformly elevate their maintenance and reliability practices across the entire enterprise, and we believe there are good business reasons for trying to do so, including reduced cost of implementation company-wide (vs. taking a plant-by-plant approach) and increased ROI.

We believe the size of the opportunity is \$<sup>3</sup>/<sub>4</sub> Trillion annually in the U.S. alone, and could exceed \$2 Trillion world-wide!

We know the direct benefits will come from maintenance spend reduction, spare parts inventory reduction, reduced energy consumption, improved quality, reduced scrap and increased throughput/asset utilization.

We believe there is a correlation between success of any corporate improvement initiative – whatever it is - and improved reliability practices. The indirect benefits come from unlocking hidden benefits in other parts of the business previously thought to be unrelat-

ed to reliability, and they can be substantial. Finally, we know that the financial business case for reliability – including predictive maintenance - is here, and the awareness in your executive suite is emerging. If you are involved in predictive maintenance, I urge you to be confident in what you are doing because the role you are playing is essential for your corporation to achieve success – and the executives in your company are figuring that out!

*Mr. Robert S. DiStefano, CMRP, has nearly 30 years of engineering, maintenance and management experience. He is founder and CEO of MRG, Inc., a professional services company specializing in helping industrial companies elevate business performance through optimized physical asset reliability. Bob can be reached at 203.264.0500 or distefanor@mrginc.net*

*\* - Quote used with permission from Chevron Corporation*

## **FIND MOISTURE IN YOUR ROOF**

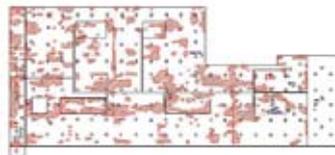
### **Reports include...**



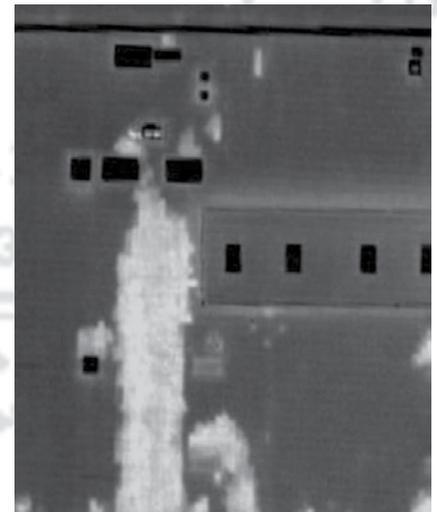
Photograph



Thermograph



CADD Drawing



*AITscan's  
Roof MoistureFindIR™  
method detects moisture  
inside roofs.*

Visit AITscan on-line at:  
[www.aitscan.com](http://www.aitscan.com)

or call toll-free  
(800) AIT-SCAN



AITscan™ is a division of Stockton Infrared Thermographic Services, Inc. Infrared Thermographic Services

# Subscribe to Uptime

# IF

You are reading this.

Your job depends on  
equipment running.

You have anything to do with  
Maintenance or Reliability.

You manage a PdM/CBM team.  
(Subscribe them all.)

Subscribe now by going to  
[www.uptimemagazine.com](http://www.uptimemagazine.com)

Reliabilityweb.com's 20th International Maintenance Conference

**December 7-8, 2005**

Pre- & Post-Conference Workshops:  
December 6<sup>th</sup> and 9<sup>th</sup>

Tampa Convention Center - Tampa Florida

[www.maintenanceconference.com](http://www.maintenanceconference.com)

**TWO  
EVENTS  
-  
ONE  
PRICE**



Co-Located  
with



**Strategies and Technologies for Improving Maintenance & Reliability**



- Learn everything you need to build a world class maintenance organization for enhanced reliability
- Advance your professional standing by sitting for the Certified Maintenance & Reliability Professional Exam by SMRP
- Discover exciting new ideas and learn helpful techniques to jumpstart your maintenance program
- Meet leading solution and service providers and test drive new products at the IMC expo
- Create your own learning agenda with 7 learning zones, short courses, keynotes, case studies, breakout sessions and full day workshops
- Learn how Maintenance & Reliability Professionals just like you are creating results with RCM, TPM, Lean and PdM



**CHECK OUT NASCAR AT IMC-2005**



Thanks to our sponsor, Chevron, Jamie McMurray's 42 simulator car will be at IMC-2005. Sit in the drivers seat and test your racing skills!

IMC-2005 is produced by: **NetexpressUSA, Inc.** and supported by the following:



## WHAT'S INCLUDED

### Two Day IMC-2005 Conference and Expo Pass Includes:

- 14 daily 90 minute short courses
- Two days of learning zone sessions
- Two Day Expo Hall Pass
- Keynote Session
- Expo Refreshments
- Daily Lunches
- IMC-2005 Welcome Reception
- IMC-2005 Hospitality Night
- IMC-2005 Proceedings CD ROM
- Bonus CD ROMs
- LubricationWorld Pass
- LubricationWorld Proceedings CD ROM
- Conference Program Guide
- Access to the Complimentary Cyber Café
- Entry in Alienware Laptop Giveaway
- Maintenance Conference Tote Bag

### Optional Pre- and Post-Conference Workshop Registration Includes:

- Meeting Materials (as provided) for the Workshop(s) you attend
- Refreshment Breaks
- Complimentary Lunch

### Expo Only Registration Includes:

- One Day Expo Hall Pass
- Access to the Complimentary Cyber Café

## PLANNING AHEAD

### Pre & Post Conference Workshops

This year at IMC you have a choice of 14 different full day workshops. Each workshop is presented by an author and/or highly experienced maintenance professional. Registration for workshops are limited and will be available on a first come first serve basis. To register for a workshop you would purchase a 3 or 4 day conference pass and indicate your desired workshop selection(s).

### Learning Zone Sessions

The two days of conference sessions (Dec. 7 & 8) are divided into seven learning zones. Plan ahead by reading the sessions descriptions included on the following pages. You may choose to stay in one zone or move around all seven zones to create a schedule to fit your specific needs. To register for the conference and expo only you would purchase the 2 day conference pass.

Each of the seven learning zones include sessions presented by today's best maintenance and reliability subject matter experts.

 RZ  
Reliability Zone

 MB  
Maintenance  
Business Zone

 PdM  
Predictive  
Maintenance Zone

 MM  
Maintenance  
Management Zone

 BT  
Bonus Track

 TI  
Tech & Commercial  
Innovations Zone

 LW  
Lubrication World Zone

# Learn to Succeed



Dear Maintenance & Reliability Professional,

Are you in the business of maintenance?

Maintenance is a business process like accounting, manufacturing, sales or human resource management and must be managed as a business to be effective. The Business of Maintenance is the special focus at IMC-2005 along with our traditional reliability and maintenance learning zones.

There is never a time to stop learning or to cease using your imagination to find better ways of make your professional efforts more successful. Your company depends upon you to ensure the proper functioning of physical assets and you need the latest strategies and technologies to deliver on that mission. That is why you will find an extraordinary group of people ready to share their expertise, knowledge and experience at the 20th International Maintenance Conference.

From day one, you will learn how to manage a Lean Maintenance program by Ricky Smith, Best Practices in Maintenance Management from Author and Maintenance Expert Terry Wireman. Keynote speaker and Author John Mitchell will lead the Physical Asset Optimization workshop. Dave Krings offers the 5 Pillars workshops based on the CMRP Certification Exam areas for maintenance and reliability professionals. Australian Phillip Slater will lead a Sustainable Inventory Reduction Workshop. For those more interested in technology and techniques, John Snell offers an Infrared Thermography course and Lubrication Specialist Ray Thibault leads a comprehensive Lubrication workshop.

Your IMC-2005 pass includes a selection of 28 special 90 minute short courses for subjects that require more time to explore topics that are important to the success of any maintenance and reliability program.

The rest of the conference is filled with 35 more unique learning zone sessions where maintenance and reliability professionals learn from each other by sharing success stories and discussing new ideas for solving the same problems you face everyday. The Society of Maintenance & Reliability Professionals is offering the Certified Maintenance & Reliability Professional Exam twice during IMC-2005 to enhance your professional standing. As a special bonus – your IMC-2005 also includes full access to LubricationWorld, a reliability focused machinery lubrication learning event.

The conference concludes a powerful Procedure Based Maintenance workshop led by Jack Nicholas, Jr. one of the most experienced and respected maintenance experts in the industry. Other workshops include Successfully Manage Change in Your Maintenance Organization from Author Steve Thomas, Root Cause Analysis by Robert Latino, Developing Key Performance Indicators by Terry Wireman and the Reliability Game by Tim White. For Predictive technology enthusiasts, IMC-2005 offers Integrating Airborne Ultrasound into a PdM program by Jim Hall and a special Oil Analysis workshop led by a team made up of Ray Thibault, Ray Dalley, Kevan Slater and Paul Goldman.

Networking opportunities abound in the exceptional Tampa Bay setting including the first ever IMC-2005 Hospitality Night at the Tampa Waterside Marriot on Wednesday December 7. In addition, numerous refreshment and snack breaks and meals will ensure you meet your contemporaries at IMC-2005.

Add over 100 maintenance and reliability solution providers offering the latest products, services, software and training at the IMC-2005 and LubricationWorld Expo and the week is sure to be one of the most productive maintenance events of the year. We hope you will join us in December.

Terrence O'Hanlon, CMRP  
Publisher, Reliabilityweb.com

P.S. Take advantage of advanced registration for \$100 savings before Nov. 1, 2005 or bring your team of 5 or more, every 5th registration is FREE!

## What Makes IMC-2005 Unique?

- **More than 50 learning zone sessions** covering Reliability, Maintenance Management, Preventive & Predictive Maintenance and Maintenance Business and Lubrication
- **14 different 90 minute short courses** each day at IMC-2005
- **14 Pre- and Post-Conference workshops** offering full day learning opportunities for you and your team
- **A wealth of solutions, services and technologies** in the full service IMC-2005 and LubricationWorld Expo featuring over 100 world class vendors
- **International Participation.** Last year IMC hosted 850 participants from 24 countries including Representatives from COPIMAN, the South and Central American Maintenance Organization
- **Professional Certification** exam offered by the Society of Maintenance & Reliability Professionals (SMRP)
- **Professional Societies** represented at IMC-2005 include the Society of Maintenance & Reliability Professionals, COPIMAN, Society of Tribologists and Lubrication Engineers, Association of Facilities Engineers, The Institute of Electric Motor Diagnostics, The International Society of Professional Thermographers, MIMOSA and The Institute of Industrial Engineers
- **Maintenance Web Sites** including Reliabilityweb.com, Maintenance-Tips.com, MRO-zone.com, Cmmcity.com & MaintenanceResources.com
- **Networking Opportunities.** Whether you're relaxing during a learning session break, attending the IMC-2005 hospitality night, getting a demo in the Expo Hall or taking part in a discussion group, you will find networking opportunities everywhere.
- **Special Group Rates.** Get a FREE 5th registration for every 4 paid registrants from the same company

## Win an Alienware Laptop

Each IMC-2005 attendee will receive an Alienware entry form to be used to enter to win this powerful laptop.



**ALIENWARE**  
HIGH-PERFORMANCE SYSTEMS

## Schedule at a Glance\*\*\*

### Tuesday, December 6

8:00am - 3:30pm.....Pre-Conference Workshops 1 - 7\*\*  
3:30pm - 5:30pm.....CMRP Certification Exam by SMRP\*  
3:30pm - 5:30pm.....IMC-2005 Welcome Reception & Expo

### Wednesday, December 7

7:30am - 9:00am.....90 Minute Short Courses  
9:00am - 3:30pm.....Expo Hall Open  
9:00am - 10:00am.....Break-Expo Hall Open  
10:00am - 11:45am.....Learning Zone Sessions  
11:45am - 1:00pm.....Lunch-Expo Hall  
1:00pm - 2:30pm.....90 Minute Short Courses  
2:30pm - 3:30pm.....Break-Expo Hall  
3:30pm - 4:15pm.....Keynote Address  
4:15pm - 5:00pm.....Audience meeting with Expert Panel  
6:00pm - 10:00pm.....IMC Hospitality Suites\*

### Thursday, December 8

7:30am - 9:00am.....90 Minute Short Courses  
7:30am - 9:30am.....CMRP Certification Exam by SMRP\*  
8:30am - 11:30am....CLS & OMA Certification Exam by STLE\*  
9:00am - 3:30pm.....Expo Hall Open  
9:00am - 10:00am.....Break-Expo Hall Open  
10:00am - 11:45am.....Learning Zone Sessions  
11:45am - 1:00pm.....Lunch-Expo Hall  
1:00pm - 2:30pm.....90 Minute Short Courses  
2:30pm - 3:30pm.....Break-Expo Hall  
3:00pm - 4:00pm.....Council of Certifying Organizations  
3:00pm - 4:00pm.....Alienware Giveaway

### Friday, December 9

8:00am - 3:30pm.....Pre-Conference Workshops 8 - 14\*\*

\* Location: Marriot Waterside, 2<sup>nd</sup> floor

\*\* Separate Registration Fee.

\*\*\* Schedule, session's time, session topics & speakers are subject to change. Visit [www.maintenanceconference.com](http://www.maintenanceconference.com) for details.

## Privacy Policy

All IMC-2005 attendees can be assured privacy! We do not sell, rent, trade or provide detailed attendee contact information to exhibitors any other third party vendors.



Just like all other Reliabilityweb.com conferences featured at MaintenanceConference.com we feel that each individual should be the one to choose who has access to their private contact information. In order to facilitate on-site networking, we have an attendee list available on-site which will include first/last name, company and general location (state or country if non-USA) however, no detailed contact information will be included. If needed, upon request, we would assist with specific introductions.

Have Questions? . . . Want to Register? . . . Call 888.575.1245

# IMC-2005 CERTIFICATE WORKSHOPS

Enhance your IMC-2005 learning experience by registering for pre- and/or post-conference workshops. These comprehensive workshops are lead by industry's top experts and authors. IMC-2005 already provides 12 hours toward CMRP and other professional Re-certification. Each workshop is valued at 6 additional hours of credit toward CMRP Re-certification. A certificate will be provided for each workshop you attend. You can register for each individual workshop or save money by choosing a 3 or 4 day IMC-2005 conference pass. **Space is limited, so register early!**

## Pre-Conference Workshops

Tuesday Dec 6, 2005

8:00 am - 3:30 pm

### **Workshop #1 [WS1] - 5 Pillars: Maintenance & Reliability Professional Review By Dave Krings, CMRP**



This workshop emphasizes proven techniques for building high performance maintenance programs. The course is based on the Society for Maintenance & Reliability Professionals (SMRP) 5 Pillars of required knowledge for maintenance & reliability professionals, and is backed by extensive benchmarking and real-world application. *Note: SMRP does not endorse any commercial activities including this training course. Completing this course does not ensure that you will pass the CMRP exam.* Students will gain valuable know-how for constructing and working in an exceptional maintenance organization.

### **Workshop #2 [WS2] - Best Practices Maintenance Management By Terry Wireman, CMRP**



Maintenance is a unique business process. To be successfully managed, it requires an approach different from other business processes. The Benchmarking Best Practices in Maintenance Management workshop at IMC-2005 provides a framework for managing maintenance with options that allow decision makers to select the most successful ways to manage maintenance.

### **Workshop #3 [WS3] - Sustainable Inventory Reduction Workshop By Philip Slater**



Take your business to World's Best Practice, reduce your inventory investment and increase your ROI. A recent survey by IndustryWeek found that 70% of organizations are challenged with reducing excess inventory. Another survey conducted by Reliability Web found that for more than half inaccurate information causes an expensive 'overstock' situation. These surveys show that the main issue for most organizations is not inventory management it is inventory reduction. If there is one great myth of inventory reduction it is that one technique will solve your problem. The truth is that no single technique or approach will solve all your problems. You need a range of techniques that can be applied together. Here is the good news, there are only seven!

### **Workshop #4 [WS4] - Physical Asset Optimization By John Mitchell**



Physical Asset Optimization is a "better way" of managing corporate equipment assets. It blends the best processes, practice and technology to assure highest effectiveness in your specific business, operating, organizational and material conditions. The purpose of Physical Asset Management is to ensure that the means of production/operation are available to meet mission, availability, yield, schedule, quality, and cost commitments at optimum effectiveness and return. This definitive workshop provides a practical overview for executives, managers, and team members charged with gaining maximum productivity and effectiveness from systems and equipment in response to stated mission/business/operating imperatives.

### **Workshop #5 [WS5] - Lean Maintenance By Ricky Smith, CMRP**



What is "Lean?" Whether referring to manufacturing operations or maintenance, lean is about doing more with less: less effort, less space, fewer defects, less throughput time, lower volume requirements, less capital for a given level of output, etc. The need to provide the customer more value with less waste is a necessity for any firm wanting to stay in business, especially in today's increasingly global market place. And this is what lean thinking is all about. This Workshop provides detailed, step-by-step, fully explained processes for each phase of Lean Maintenance implementation providing examples, checklists and methodologies of a quantity, detail and practicality that no previous publication has even approached.

### **Workshop #6 [WS6] - Lubrication Best Practices By Ray Thibault, CLS, OMA**



This one day comprehensive lubrication workshop is designed for people who need an overall understanding of lubrication best practices for all major equipment types and their components but don't have the time for weeks of training. This class will give you the knowledge to ask the right questions to optimize your lubrication program. A wide variety of subjects will be covered where you will be given the essential elements to broaden your lubrication knowledge in the correct selection and application of lubricants

### **Workshop #7 [WS7] - Introduction to Infrared Thermography for Managers By John Snell**



Reliability managers and technicians should attend this short course to learn more about infrared thermography. Whether you already own equipment, are "shopping around," deciding to add the technology or just want to find out more, spending a day to learn about infrared will pay large returns. Attendees will leave with information that will enable them to decide whether or not this is a technology they should pursue. In addition, those who participate will develop a solid foundation for selecting equipment, a clear understanding of what the technology can and cannot accomplish and an outline of a path to success.

## **Workshop #8 [WS8] - Root Cause Analysis-Improving Performance for Bottom Line Results**

By Robert J. Latino



This full day workshop will present an overview of the complete Root Cause Analysis (RCA) process. We are all often faced with the over-used term of RCA. What is RCA as opposed to RCFA? When do you apply RCA? How long does RCA take? When is an RCA over? What is the definition of a successful RCA? How do I justify to my boss that RCA is worth it? How much does it cost to do RCA? If you are like most, your time is precious and you cannot afford to waste it on activities that are not value-added to your operations. Learn how RCA will actually help reduce your need to do reactive work, instead of being viewed as an additional burden on your plate!

## **Workshop #9 [WS9] - Developing Key Performance Indicators for Managing Maintenance**

By Terry Wireman, CMRP



This workshop not only instructs on the use of basic indicators for managing maintenance and how to link them to a company's financials, it addresses further advancements in the management of maintenance. The Developing Performance Indicators for Managing Maintenance workshop utilizes techniques based on other management measurement systems, such as the balanced scorecard. What's more it presents a maturing of measurement technique for maintenance and asset maintenance and development techniques that will allow companies to be competitive into the future. It is a necessary learning event for any company that has a maintenance organization to learn how to effectively measure and manage the entire spectrum of maintenance activities.

## **Workshop #10 [WS10] - Procedure Based Maintenance Procedure & Checklist Development Workshop**

By Jack Nicholas Jr., CMRP



This workshop will develop the participants ability to prepare new and revised procedures and checklists in support of a new, revised or upgraded operations and maintenance program. The goal is to develop an in-house capability to create clear and effective procedures and checklists to support all types of operations and maintenance (preventive, predictive or corrective). During the workshop the participants will develop a model for the Operations and Maintenance Procedure and Checklist Process as it applies to their plant using the Process Modeling technique facilitated by the instructor. Several in-plant operations or maintenance procedures or checklists will be developed to various degrees by the participants during breakout sessions. Some will be discussed by the entire group.

## **Workshop #11 [WS11] - Integrating Ultrasonics into a PdM program** By James Hall



Airborne Ultrasound inspection and testing have become a major part of any predictive maintenance program. By using high frequency sound waves, early warning of many serious conditions may be detected. Join independent expert, Jim Hall in full day workshop that covers a Technology Overview, Applications for Airborne Ultrasonics, Bearing Testing, Steam Trap Testing, Lubrication Monitoring, Leak Detection, Electrical Inspection, Combining Ultrasound with Vibration Analysis, Combining Ultrasound with Infrared, Data and .wav Files and Personnel Qualifications and Certifications.

## **Workshop #12 [WS12] - Change Management for Maintenance & Reliability Professionals**

By Steve Thomas



There is no effort more difficult to undertake than to implement successful change in an organization and make it sustainable over the long haul. This workshop is for all of those managers who have been given this difficult task and want to learn about the tools that will make you successful. This workshop addresses the subject of change at the working level. It is a user's guidebook about change management that will provide you valuable insight into the problems associated with change and tools to overcome them.

## **Workshop #13 [WS13] - Everything You've Wanted to Know About Oil Analysis**

By Ray Thibault CLS, OMA and Kevan Slater and Paul Goldman and Ray Dalley



A one day comprehensive oil analysis workshop will give you the essential knowledge to understand how to optimize equipment reliability and lubricant life through the proper use of oil analysis. We have brought together a team of oil analysis experts for the workshop to provide you with the latest techniques in understanding and effectively using oil analysis.

## **Workshop #14 [WS14] - The Reliability Game** By Tim White, MRG



Whoever Says RELIABILITY Can't Be Fun...Hasn't Experienced The Reliability Game

The Maintenance Reliability Exercise is a very effective tool that demonstrates the financial impact and the importance of equipment reliability. It is used raise awareness of the need for rapid change - from a reactive to a proactive reliability environment.

**CHECK THE WEB FOR DETAILED WORKSHOP DESCRIPTIONS**

# Learning Zone Sessions and Short Courses

IMC-2005  
Conference Day 1

**Wednesday December 7, 2005**

7:30am - 9:00am 90 Minute Short Courses		Session 1
	<b>An introduction to Reliability-centered Maintenance</b> by Alan Katchmar, STI	RZ1
	<b>Introduction to Asset Management through Technology Integration</b> by Kevin Balsan & Debbi Gray, Wyle Laboratories	MM1
	<b>10 Steps to a Lower Cost Business</b> by Phillip Slater, Initiate Action	MB1
	<b>NFPA 70E &amp; Arc-Flash Hazards</b> By John Klingler, P.E., Lewellyn Technology	PdM1
	<b>Reliability Scorecard - Part 1- Overall Scorecard Review</b> By John Mitchell	BT1
	<b>Contamination Control</b> By Dr. Leonard Bensch, Pall Corp.	LW1
	No Session Scheduled	TCI1
9:00am - 10:00am Snack & Refreshment Break in Expo Area		
10:00am - 10:45am Learning Zone Sessions		Session 2
	<b>A Business Solution to the Economics of Preventive Maintenance</b> by Glenn R. Hinchcliffe and Dr. David H. Worledge, Asset Performance	RZ2
	<b>The Managing System: How to Get Your Dreams to Work</b> by David A. Army, CMRP, Strategic Asset Management Inc.	MM2
	<b>Maintenance Iraq</b> by Ricky Smith, CMRP, Maxzor	MB2
	<b>Using PdM indicators to define Maintenance Activities</b> by Kevan Slater Schematic Approach Inc.	PdM2
	<b>Establishing an ISO Certified Asset Management Process</b> by Ramesh Gulati, CMRP AEDC/ATA	BT2
	<b>Determining the Root Cause of Lubrication Varnish</b> by Greg Livingstone and Brian Thompson Analysts Inc.	LW2
	<b>Static and Dynamic Motor Testing as Part of a Predictive Maintenance Program</b> by Timothy M. Thomas, Baker Instrument	TCI2
11:00am - 11:45am Learning Zone Sessions		Session 3
	<b>Best Practices for Performing Effective Reliability Analysis</b> By Ken Latino, Meridium	RZ3
	<b>The Seven Pillars of Maintenance Excellence</b> by Robert Baldwin, CMRP, www.edtron.com	MM3
	<b>Incident Tracking &amp; Trending Analysis to Improve Safety Performance and Culture</b> by Dr. M. Sam Mannan Texas A&M	MB3
	<b>FMEA-based methods for cost/benefit analysis of on-line scanning condition monitoring solutions</b> by Rob Bloomquist, GE Energy	PdM3
	<b>The great profitability potential in manufacturing Industry</b> by Bo Hägg The Swedish Center for Maintenance Management	BT3
	<b>Lubrication Program Management Case Study</b> by Eric Bevevino, Chevron	LW3
	<b>How to get a technical article published</b> by Joe Petersen, Editor RELIABILITY Magazine	TCI3

# Learning Zone Sessions and Short Courses

IMC-2005  
Conference Day 1

## Wednesday December 7, 2005

11:45am - 1:00pm Lunch in the Expo Hall

1:00pm - 2:30pm 90 Minute Short Courses Session

Session 4

	<b>Getting Ready For RCM</b> by Doug Plucknette, Reliability Solutions	RZ4
	<b>Writing a Maintenance &amp; Reliability Mission and Vision Statement</b> by Terry Wireman, CMRP, MasteringMaintenance.com	MM4
	<b>The Business Side of Reliability</b> by Bruce Hawkins, CMRP, Life Cycle Engineering	MB4
	<b>Motor Bearing Lubrication</b> by Howard Penrose Ph.D. T-Solutions	PdM4
	<b>Reliability Scorecard - Part 2 - Overall Program Effectiveness</b> by John Mitchell	BT4
	<b>Recent Advances in Synthetic Lubricants</b> by Dr. Tim Nadasdi, ExxonMobil	LW4
	<b>The New Generation of High Speed Cameras</b> 45 Min. by Rusty Leonard, 20/20 Hindsight	&
	<b>Conquering contamination: Exploring pragmatic &amp; profitable technologies</b> 45 Min. by Brian Gleason, Des-Case	

2:30pm - 3:30pm Snack & Refreshment Break in Expo Area

3:30pm - 4:15pm Keynote

### Mastering the Maintenance Process

By John Mitchell

John Mitchell retired from Fluor Corporation in mid 2004 upon completion of an assignment as Site Manager where he led the implementation of a comprehensive, site-wide asset productivity improvement initiative in a large petrochemical complex. Prior positions include Vice President Maintenance Operations and Engineering with ABB, Inc.; industry consultant; founder and president of MIMOSA, the Machinery Information Management Open Systems Alliance; Manager, Condition Monitoring Systems, Brüel & Kjær, AS and President and CEO, Palomar Technology International.

During his more than 35 years professional experience Mitchell has been a strong advocate for the development and implementation of business, technical, and operating strategies for optimizing the lifetime performance and utilization of industrial equipment. He has authored over 100 technical papers and articles and delivered numerous presentations and workshops throughout the world detailing the technology, financial, and business benefits of Asset Optimization, Profit-Centered Maintenance and condition assessment.

Mitchell authored the books "An Introduction to Machinery Monitoring and Analysis" and the "Physical Asset Management Handbook", currently in a Third Edition. The latter details processes and best practices for optimizing the utilization and performance of physical assets and is currently the only book published on the subject. He is a graduate of the US Naval Academy, Annapolis Maryland.

4:15pm - 5:00pm Audience meeting with Panel

Please join panelists and experts John Mitchell, Ricky Smith, Robert Latino, Jack Nicholas and Ray Thibault who will lead a discussion and pose a series of thought provoking questions to IMC-2005 and LubricationWorld attendees moderated by Robert Baldwin and Terrence O'Hanlon.

7:00pm - 10:00pm Hospitality Suites Marriott Waterside 2nd Floor

Join IMC-2005 Sponsors Chevron, SAP, AssetPoint, MRO-Zone.com, Uptime Magazine and Reliabilityweb.com for a night of food and fun including real casino games, music, prizes and more. IMC-2005 Hospitality Suites start at 7 pm. Be sure and visit sponsor booths in the IMC-2005 EXPO for details on each Hospitality event. All IMC-2005 attendees are invited.



# Learning Zone Sessions and Short Courses

IMC-2005  
Conference Day 2

Thursday December 8, 2005

7:30am - 9:00am 90 Minute Short Courses		Session 5
 <b>Using The RCM Scorecard To Justify RCM</b> by Jack Nicholas Jr., CMRP		RZ5
 <b>Strategy for Improving a Basic Maintenance Program</b> by Dave Schrader, Michael Eisenbise, and Rex Weinbender, Fluor		MM5
 <b>Creating A Culture of Change</b> by Steve Thomas, MasteringMaintenance.com		MB5
 <b>Root Cause Bearing Analysis</b> by Stuart Courtney, SKF		PdM5
 <b>Reliability Scorecard - Part 3 - RCM, FMEA, RCA</b> by John Mitchell		BT5
 <b>Lubrication Selection Strategies &amp; Guide for Improving Enclosed Gearbox Reliability</b> by Lawrence Ludwig, CLS. OMA, CMFS, Schaeffer Oil		LW5
 No Session Scheduled		TCI5
9:00am - 10:00am Snack & Refreshment Break in Expo Area		Session 6
10:00am - 10:45am Learning Zone Sessions		Session 6
 <b>From Maintenance Management to Asset Management</b> by Jack Huggett, The Woodhouse Partnership		RZ6
 <b>Developing Business Plans to Support Maintenance/ Reliability Improvements</b> by Dave Schrader, Michael Eisenbise and Rex Weinbender, Fluor		MM6
 <b>Contractor Management: Key to Controlling Cost</b> by Dave Abecunas, CMRP Lehigh Cement Company		MB6
 <b>Phases of PM</b> by John Kravontka Fuss & O'Neill TPM Services LLC		PdM6
 <b>Outsourcing Maintenance? Learn how to protect the intellectual property of your assets' reliability programs</b> by Andrew Boushy, Ivora Corporation		BT6
 <b>Engine Oil Trends and Drivers</b> by Larry Ludwig, CLS. OMA, CMFS, Schaeffer Oil		LW6
 <b>The Difference Between "Monitoring Condition" and "Monitoring Conformance"</b> by Robert Collyer, SKF		TCI6
11:00am - 11:45am Learning Zone Sessions		Session 7
 <b>Getting to Operational Excellence</b> by S. Bradley Peterson, Strategic Asset Management Inc.		RZ7
 <b>Corrective Maintenance Task Generation</b> by Robert Apelgren, CMRP		MM7
 <b>Sarbanes Oxley and Maintenance Inventory Optimization</b> by Ron Schroder, Prudent Advantage		MB7
 <b>Strategic Maintenance Planning</b> by Brad McCully, ATS		PdM7
 <b>Delivering Profits to the Company through Compressed Air Projects</b> by Paul Edwards & Dave Abecunas, Lehigh Cement		BT7
 <b>Compressor Lubrication Best Practices</b> by Darrel Beatty Dow Chemical		LW7
 <b>PM Optimization Using IR Thermography</b> by Ron Lucier, FLIR		TCI7

# Learning Zone Sessions and Short Courses

IMC-2005  
Conference Day 2

## Thursday December 8, 2005

11:45am - 1:00pm Lunch in the Expo Hall

1:00pm - 2:30pm 90 Minute Short Courses

Session 8



**Integration of Key Technologies for Asset Management**  
by Kevin Balsan & Debbi Gray Wyle Laboratories

RZ8



**Reliability Incident Management** by  
Steve Turner, MBA, OMCS

MM8



**Design The Maintenance Business**  
by Terry Wireman, CMRP, MasteringMaintenance.com

MB8



**Acoustic/Ultrasonic Lubrication**  
by Jim Hall, Ultra-Sound Technologies

PdM8



**Reliability Scorecard - Part 4 - Reliability analysis, Operator Performed Maintenance, Capital Projects**  
by John Mitchell

BT8



**Hydraulic Troubleshooting**  
by Ricky Smith, CMRP, Maxzor

LW8



**Automated Bearing Wear Detection**  
by Alan Friedman, DLI Engineering

45 Min.



**Identifying Motor Defects Through the Six Fault Zones**  
by Noah Bethel PdMA

45 Min.

TCI8

2:30pm - 3:00pm Snack & Refreshment Break in Expo Area

3:00pm - 4:15pm Council of Certifying Organizations and Alienware Giveaway

Please join us for a special session where we will provide a whirlwind tour of some of the best professional development and certification organizations related to lubrication, maintenance and reliability including SMRP, STLE, NAME, Vibration Institute, IEMD, ISPO, IPMUG, AFE and ISA. The Alienware laptop drawing and prize presentation will follow



## PdMA Sponsored Plant Tour

Friday December 9, 2005

9:00 am - 12:00 pm PdMA Plant Tour

PdMA Corporation opens its doors for a tour of the lab and brunch. For several years PdMA Corporation has offered predictive maintenance solutions for motors and oil analysis. At the Tampa facility they engineer, and manufacture motor testing equipment and have an onsite oil analysis laboratory. The tour will view the entire facility and then break into two separate groups. Tour A will focus on the motor testing division of the company and tour B will be for those interested in the oil analysis division. Reservations must be made early, due to the limited number of spaces available. To register for the plant tour [contact PdMA directly](#).

**PdMA Corporation - Corporate Office**  
Phone: (813) 621-6463 Toll-free: (800) 476-6463  
Fax: (813) 620-0206 Email: [pdma@pdma.com](mailto:pdma@pdma.com)



## MRO-zone.com

### Maintenance Focused Search

MRO-Zone.com was created to serve plant engineering and maintenance professionals as a focused search engine for maintenance and repair products, services, software and training.

The MRO-Zone.com search engine is not as large as Google, Yahoo! or MSN but it is much more focused. It is also managed by human beings to ensure that relevant search results are returned. Please let us know how it is working for you. We hope you will bookmark this site or add it to your favorites.

If you are a supplier or solution provider in this market, you are invited to submit your web site(s) as part of the MRO-Zone.com directory at no cost.

**MRO-zone.com**  
Search engine

## Expo Hours

**Tuesday Dec 6, 2005**

**3:30 pm - 5:30 pm**

IMC-2005 Welcome Reception  
Exhibits Open

**Wednesday Dec 7, 2005**

**9:00 am - 3:30 pm**

Exhibits Open

*Morning Snack/Refreshment*

*Break in Expo Area*

*9:00 am - 10:00 am*

*Afternoon Snack/Refreshment*

*Break in Expo Area*

*2:30 pm - 3:30 pm*

**Thursday Dec 8, 2005**

**9:00 am - 3:30 pm**

Exhibits Open

*Morning Snack/Refreshment*

*Break in Expo Area*

*9:00 am - 10:00 am*

*Afternoon Snack/Refreshment*

*Break in Expo Area*

*2:30 pm - 3:00 pm*

## **HANDS-ON LEARNING LABS**

**Learning Labs** are a regular feature at the IMC-2005 Expo.

Some organizations choose to expand beyond the traditional boundaries of an exhibition booth to provide visitors with a richer, hand's-on learning experience. Labs typically include scheduled presentations, interactive hand's on testing opportunities and specially trained personnel to support your individual learning goals.

## IMC Expo Solution Providers

No other maintenance and reliability focused event brings more products, services, software and training providers than the International Maintenance Conference & LubricationWorld Expo. No other event does as much to help you make sense of the numerous purchasing options available to you. The IMC-2005 Expo is the place to find solutions as you make, develop and build your own best practices.

24/7	Maintenance Resources
ABB	The Manufacturing Game
Academy of Infrared	MasteringMaintenance.com
Allied Services Group	MAXZOR
ALL-TEST Pro division of BJM	Meridium, Inc.
Analysts, Inc.	Mikron Infrared
AREVA	MIMOSA
ARMS Reliability Engineers	Maintenance-Tips.com
Asset Performance Technology	Management Controls
AssetPoint	Management Resources Group
Atlas Inspection	MRO-Zone.com
Invensys Avantis	National Reliability Systems
Baker Instrument	Performance Consulting Assoc.
BE&K Industrial Services	PdMA Corporation
Chevron	OMCS International
Commtest Instruments	POLARIS Laboratories
Des-Case Corporation	Reliability Direct
Design Maintenance Systems	RELIABILITY Magazine
Dexsil Corp.	Reliabilityweb.com
DLI Engineering	RMG
Easy-Laser	SAP
Electrophysics Corp.	SDT North America Inc.
Framatome ANP	SKF
FLIR Infrared	SMRP
Fluke	Snell Infrared
GE Energy	SPM Instrument, Inc.
Henkel Loctite	STI
Hy-Pro Filtration	STLE
ifm efector	Technology Evaluation Center
Indus International	Thermoteknix
Industrial Press	TrackSoftware
Iris Power Engineering	Trico
ISA	Woodhouse Partnership
ISG Thermal Systems	UE Systems
ISPoT	Ultra-Sound Technologies
Ivara	Universal Technologies
LeakZone.com	Uptime Magazine
Life Cycle Engineering	UT Maintenance Reliability Center
Lewellyn Technology	VibrationSchool.com
Lord Corporation	Wilcoxon Research
Lubrication Systems	WorkTech
LUDECA, INC.	Wyle Labs

*Note: Please visit [www.maintenanceconference.com](http://www.maintenanceconference.com) to get an updated expo and learning lab list*

## **Expo Learning Labs**

**Learning Lab B** - PdMA will feature motor testing and oil analysis technology and instruction

**Learning Lab C** - SDT will feature airborne ultrasonic technology and instruction

**Learning Lab E** - ALL TEST Pro will feature motor testing technology and instruction

**Learning Lab F** - MIMOSA will be conducting a Open O&M demonstration and presentation

## WHERE IS IMC-2005 BEING HELD?

IMC-2005 is being held at the Tampa Convention Center located directly on the waterfront in the heart of downtown Tampa. The Center is conveniently located within walking distance to the official IMC-2005 hotel, The Tampa Marriott



Waterside Hotel and Marina, as well as numerous restaurants and clubs. So...after a busy day of lectures, seminars or classes, attendees have the convenience to hop a trolley to visit Ybor City, Channelside (movie theaters, restaurants, shops and nightclubs) or the Florida Aquarium, located just a few steps away.



Tampa Marriott Waterside Hotel & Marina  
700 South Florida Ave  
Tampa, Florida 33602 USA

**Reservations: 1-813-221-4900**

Special IMC-2005 | \$145/night  
attendee room rate | single or double

*To receive the special IMC-2005 hotel group rate attendees must make their reservations prior to November 6, 2005.*

## MaintenanceConference CONNECTION

**Your conference experience begins as soon as you register!**

All Reliabilityweb.com events feature your front seat pass to link you directly to some of the most experienced maintenance and reliability professionals in the world. This year-round online community will include:

-  Email Discussions
-  Audio Interviews
-  Q & A
-  Surveys
-  and much more

You can opt in or out of this community as it suits your own schedule and needs.

## Certification for Maintenance and Reliability Professional Exam

The Society for Maintenance & Reliability Professionals, or SMRP, is an independent, non-profit society by and for practitioners in the Maintenance & Reliability Profession. With global penetration, SMRP are nearly nearly 2,000 members strong.

The SMRP Certifying Organization (SMRP) has developed an industry recognized Certification for Maintenance and Reliability Professionals.

IMC-2005 offers two convenient times to sit for the CMRP Exam

Tuesday December 6th, 2005 - 3:30pm -5:30pm

Thursday December 8th, 2005 - 7:30am - 9:30am

**To Register for the exam please contact SMRP directly:**

Society for Maintenance & Reliability Professionals  
PO Box 51787 Knoxville, TN 37950-1787  
Headquarters Office: 800-950-7354 or 865-212-0111  
FAX: 865-558-3060 e-mail: info@smrp.org



*As a special bonus, mention IMC-2005 when you register for the CMRP exam and get the CMRP Study Guide Free (a \$35 value).*

## Are you reading the leading magazines for Maintenance & Reliability?



**RELIABILITY Magazine**

[www.reliability-magazine.com](http://www.reliability-magazine.com)



**Uptime Magazine**

[www.uptimemagazine.com](http://www.uptimemagazine.com)

## Mark Your Calendar!

### Other Reliabilityweb.com Co-Located Events

Please join us next spring in exciting Las Vegas as we present two focused reliability learning events for one price in one location. RCM-2006 will focus on Reliability Centered Maintenance methods, derivations, case studies, lessons learned and the RCM Scorecard. EAM-2006 addresses the challenges relating to maintenance and reliability information management including EAM, CMMS, Handhelds, Bar Codes. EAM-2006 will also offer specialized workshops and short courses for SAP, Maximo and Indus in addition to global courses and workshops. The Manufacturing Game® will also be offered.

March 8-10, 2006 RCM-2006

The Reliability Centered Maintenance Managers' Forum

March 8-10, 2006 EAM-2006

Enterprise Asset Management Forum

The Orleans Hotel has offered a limited amount of \$60 per night single/double rooms (normally \$300+) so book early before this offer runs out.

For more details or visit [www.maintenanceconference.com](http://www.maintenanceconference.com) or Call toll free (888) 575-1245 or (305) 735-3746

*PS: Stay over for the NASCAR Vegas 400 immediately following RCM-2006 ad EAM-2006*

Have Questions? . . . Want to Register? . . . Call 888.575.1245



20th International Maintenance Conference  
 December 6-9, 2005  
 Tampa Florida USA

The name and details provided below will be printed on your registration badge. Please provide the exact details that you would like to have used on your badge during the conference.

**IMC-2005 Registration Form - Please print clearly**

Name:	Title:
Organization:	Industry:
Address:	
City:	State/Province:
Zip/Postal Code:	Country:
Work Phone:	Fax:
Email:	CC Email:

**International Visitors! Get a \$100 discount if registered before November 1, 2005. Email info@reliabilityweb.com for more info.**

**IMC-2005 Conference Pass Fees - includes LubricationWorld Pass**

Conference pass fees include the IMC-2005 Proceedings on CD-ROM, admission to the IMC-2005 expo and the following meals during the two days of conference Learning Zone Sessions: The IMC-2005 welcome cocktail reception Tuesday evening, lunch, snack/refreshment breaks and individual sponsored hospitality suites Wednesday evening. Three or four day conference pass fees will also include the lunch and snack/refreshment breaks on the day of your chosen workshop. The conference fees do not include hotel room or travel expenses. The host hotel has a discounted room rate available to all IMC-2005 attendees, be sure to request the IMC-2005 special group rate when making your hotel reservations.

**Note: Registration and payment received after November 1, 2005 will be subject to a \$100 increase**

<input type="checkbox"/> <b>IMC-2005 Two Day Conference Pass</b> Dec. 7 & 8, 2005 - Learning Zone Sessions and Expo Only	<b>\$795</b>
<input type="checkbox"/> <b>IMC-2005 Three Day Conference Pass</b> (circle workshop code below) includes the above & choice of one pre-conference <b>or</b> one post-conference workshop	<b>\$1190</b>
<input type="checkbox"/> <b>IMC-2005 Full Four Day Conference Pass</b> (circle workshop code below) includes the above & choice of one pre-conference <b>and</b> one post-conference workshop	<b>\$1485</b>
<input type="checkbox"/> <b>IMC-2005 Individual Workshop</b> (circle workshop code below) Pre- and/or Post-Conference Workshop only. Conference sessions and workshops are not included.	<b>\$495</b>
<b>WS1   WS2   WS3   WS4   WS5   WS6   WS7   WS8   WS9   WS10   WS11   WS12   WS13   WS14</b>	

**Group Discount** Check here if you are part of a group of five or more. Buy 4 passes get the 5th of lesser or equal value FREE!

**IMC-2005 Expo and Spouse Fees**

<input type="checkbox"/> <b>IMC-2005 Expo Pass - 1 Day Only</b> Exhibition area only. Conference sessions, meals and workshops are not included with an expo pass	<b>\$25</b>
<input type="checkbox"/> <b>IMC-2005 Full Spouse Pass</b> includes all meals as in conference pass above. excludes any sessions or workshops	<b>\$75</b>
<input type="checkbox"/> Full Name to print on spouse pass:	

**Fax registration form to 309-423-7234 or call 888-575-1245/305-735-3746 [Int'l callers]**

**Mail registration form to NetexpressUSA Inc. c/o IMC-2005 PO Box 07070 Ft. Myers FL 33919**

**IMC-2005 Billing Information**

MASTERCARD   VISA   AMEX   DISCOVER	Billing Address:
Name on credit card:	City:
Credit Card #:	State:                      Zip/Postal Code:
Exp. Date:                      CVV2:	PO#:                              Check #:

CVV2 code: 3-digits found on back of card after credit card number.  
 Amex is 4-digits on the front of the card.

Please provide the exact address as printed on your credit card statements.  
 Credit cards may be declined with wrong address.

**Payment Instructions:** If paying by check or purchase order please print a copy of your unpaid invoice and include it with your check or fax it with your wire transfer advice. Send Checks to NetexpressUSA Inc. c/o - IMC-2005, PO Box 07070, Fort Myers FL 33919 USA. Email customerservice@netexpressusa.com or fax 309-423-7234 for bank wire fees and instructions.

**Refund Information:** Cancellation/Substitutions: In the event that the IMC-2005 attendee notifies NetexpressUSA Inc. of the attendees intent to cancel by November 5, 2005, a full refund of monies received, minus a \$150 administrative fee, will be made. No refunds will be made for cancellations accepted after November 5, 2005. All cancellation requests must be made in writing. You can substitute a person from the same company by request.

**Receipts/Invoicing:** Receipts and invoices will be delivered to the email addresses provided on your registration form.

**Hotel Reservations:** Tampa Marriott Waterside Hotel & Marina - Phone: 1-813-221-4900 - IMC-2005 special group rate: \$145 per night

**Solution Oriented Asset Reliability** **RELIABILITY™**  
 Toll Free: 888.575.1245  
 Phone: 305.735.3746 Fax: 309.423.7234  
 www.reliabilityweb.com **WEB.COM**

**Benchmarking Surveys**

**White Papers**

**Exclusive Articles**

**Web Based Seminars**

**Reliability E-Mail Discussion List**

**Maintenance & Reliability Best Practices**

*Delivered Weekly To  
Your E-Mail Inbox*

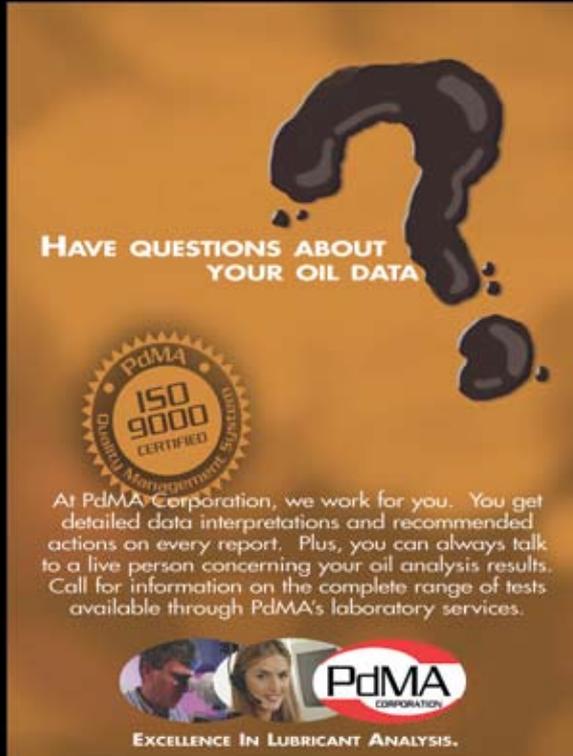
**Stay up to date on:**

- ▲RCM
- ▲TPM
- ▲PMO
- ▲Root Cause Analysis
- ▲Maintenance Planning
- ▲Vibration Analysis
- ▲Infrared Thermography
- ▲Motor Testing
- ▲Oil Analysis
- ▲Ultrasound

**Subscribe now at:**

**FREE**

[www.reliabilityweb.com/newsletter.htm](http://www.reliabilityweb.com/newsletter.htm)



**HAVE QUESTIONS ABOUT  
YOUR OIL DATA**

At PdMA Corporation, we work for you. You get detailed data interpretations and recommended actions on every report. Plus, you can always talk to a live person concerning your oil analysis results. Call for information on the complete range of tests available through PdMA's laboratory services.

**PdMA CORPORATION**  
EXCELLENCE IN LUBRICANT ANALYSIS.

5909-C Hampton Oaks Parkway, Tampa, Florida 33610  
813-621-6463  
[www.pdma.com](http://www.pdma.com) • [oil@pdma.com](mailto:oil@pdma.com)

**Vibration Institute**

A NOT-FOR-PROFIT CORPORATION



**INFORMATION ON MACHINERY EVALUATION AND DESIGN**

- **MEMBERSHIP**  
Corporate and Individual
- **TRAINING**  
basic to advanced machinery vibration analysis, balancing and rotor dynamics
- **PUBLICATIONS**  
proceedings, books, papers and notes
- **CERTIFICATION**  
four levels of Vibration Analysts  
two levels of Balancing

Contact the Institute for catalogs and brochures

Vibration Institute  
 6262 S. Kingery Highway, Suite 212  
 Willowbrook, Illinois 60527  
 Telephone: 630/654/2254  
 Fax: 630/654-2271  
 Email: [vibinst@anet.com](mailto:vibinst@anet.com)  
 Web Site: [www.vibinst.org](http://www.vibinst.org)

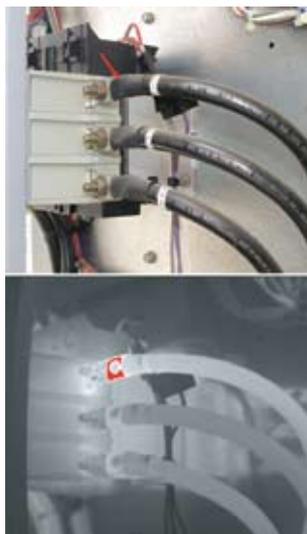
# See The Heat Before You Get Burned

by Gregory R. Stockton

Think of the world as a radiator...infrared thermographers do. Thermal energy travels at the speed of light in all directions. An infrared (IR) camera detects this [heat] energy and converts it into pictures or thermographs of heat. You can learn a lot about the world by looking through the lens of an infrared camera.

## Infrared Predictive Maintenance (IR/PdM)

If you are trying to maintain electro-mechanical equipment, you might be interested in knowing that heat kills. But you probably already know this. Ever had a piece of equipment burn up? Think back to all those components that went into the dumpster last year, like fuses, switches, breakers, motors, bearings, couplings and the like. Unless the forklift operator ran over it, it probably died a death of heat. Here's the good news...it got hot first. Maybe it burned in a millisecond, but chances are better that it happened over a much longer period of time. If you are inclined to watch it with an infrared camera, it will let you know it is failing. Now, just watching it is not remedial in any way and even if it is adjusted it may still fail,



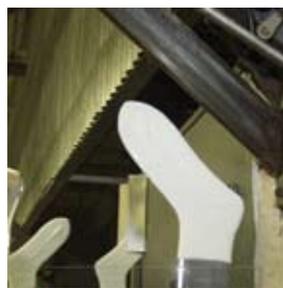
because the damage is done. But since downtime is so very expensive these days, detecting the heat early with thermography will allow you to get another component and change the hot one out before it fails at an inopportune time and costs really big money.

Excess resistance is usually what causes failures in electrical components and excess friction with mechanical devices (see fig 1). The practical use of IR/PdM then, in a nutshell is: seeing the thermal energy emitted from all objects, knowing normality and reporting only abnormality in a graphic, usable and easy-to-understand fashion, so that someone can act to fix whatever is wrong. This works on heat emissions from all types of objects not just electro-mechanical. There are many uses for infrared thermography other than inspecting electrical switchgear and mechanical components.

### Process Improvement

Use IR to make your machines run just 10% faster with

just 10% less waste and profits will soar. If you can fix a problem at the beginning of the manufacturing process, you will eliminate waste, eliminate product returns and promote customer goodwill. Infrared surveys are very inexpensive compared to throwing away product that you sent all the way to the end of the



line before discovering a flaw...or worse, sending a defective product to your valued customer, only to have it returned at your expense. Even if it is not possible to look directly inside a machine, the effects of the machine on the product can almost always be seen using IR after it exits (see fig 2). The key to process improvement infrared is to get the machine designers, operators and industrial engineers involved in the process. They usually know all about the machine and the process. They just need to "see" in the infrared waveband. On-line IR monitoring of manufacturing lines is becoming more popular as manufactures seek more efficient methods of

producing goods in a competitive marketplace.

## Non-Destructive Testing

IR/NDT is used to find out characteristics of an object without damaging it. In general, there are two ways to get information about what is going on inside any object:

1) Don't do anything, just watch the object radiate self-generated heat, or 2) create the conditions needed to see what you want to see. Apply heat [or cold] to the object and monitor the results, or, apply heat to the object and monitor what happens when the object cools, or, put a heat source behind the object and watch what happens when the heat comes through it. There are variations on these, like vibrating the object and looking for the friction that a crack creates.

## Research & Development

# Top 10 Reasons

## HotShot Will Be Your Next Infrared Camera

10. Lightweight (1.9 Lb)
9. Great image quality
8. 4-hour battery
7. Very easy to learn
6. Motorized focus
5. Optional lenses
4. Data logger software
3. Automatic report writing
2. Superior value
1. Visit us online to find out!

Go to [www.electrophysics.com/top10up](http://www.electrophysics.com/top10up)



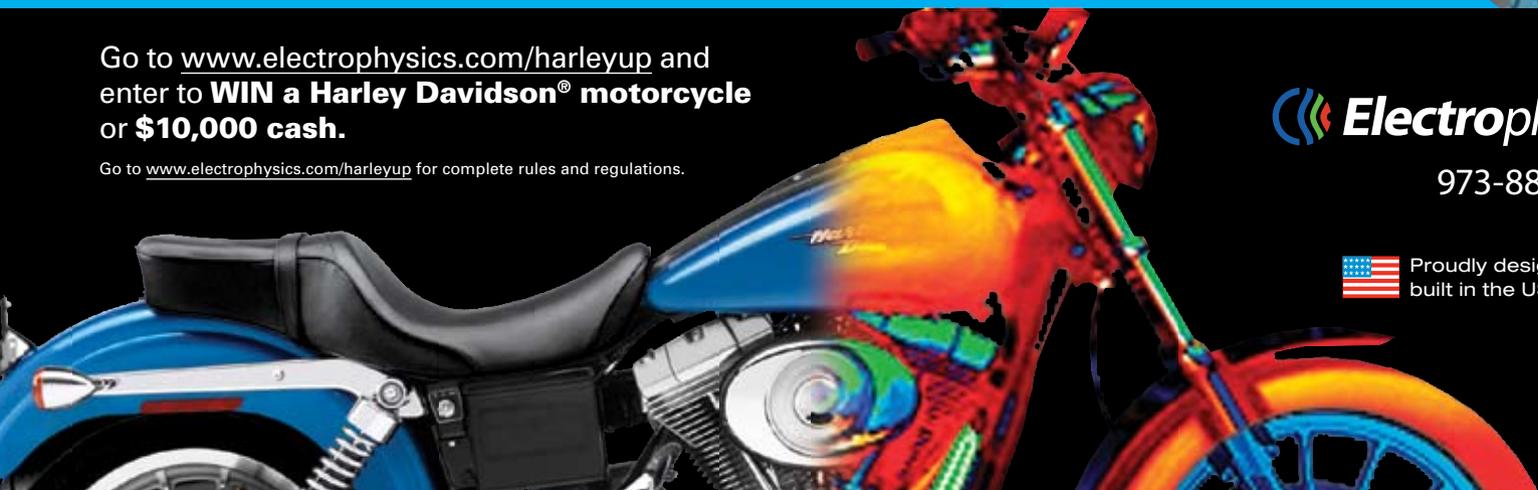
Go to [www.electrophysics.com/harleyup](http://www.electrophysics.com/harleyup) and enter to **WIN a Harley Davidson® motorcycle or \$10,000 cash.**

Go to [www.electrophysics.com/harleyup](http://www.electrophysics.com/harleyup) for complete rules and regulations.

 **Electrophysics®**

973-882-0211

 Proudly designed and built in the USA.



R&D applications are literally worth millions of dollars. Only a small percentage of these techniques and applications are published, because they are tightly held and legally protected secrets. Often it is not as simple as looking at something and seeing a defect. Instead, these techniques have been developed over the course of years and refined by scientific scrutiny at a cost of hundreds of thousands of dollars.

### Facilities

There are four types of buildings by use: residential, commercial, industrial and institutional. All types of buildings benefit from IR surveys of heat loss, moisture and quality control.

### Building Thermal and Moisture Envelope

Inspecting buildings for heat loss was one of the first commercial uses for infrared thermography. As we decide to become less dependent on fossil fuels, IR will again be used as it was in the 1980's to monitor the energy efficiency of buildings. In very cold climates, poorly installed insulation and vapor barriers can lead to condensation problems and

the degradation of the building itself. Badly designed, poorly constructed, poorly maintained, leaky buildings are not energy efficient and often have moisture and mold problems. In some cases, damage to the building is caused by insufficient ventilation and/or an under-designed or over-designed HVAC system. Preventive/predictive maintenance in buildings of all types is very uncommon. First, all buildings should be kept dry during the construction process. Then, all buildings should also be tested within a few months after construction or major renovations to the structure, the thermal envelope, the moisture envelope and the HVAC system.

### Building Quality Control

Infrared thermography can be used as a building quality assurance tool. Almost all



building materials will retain heat energy and therefore can be checked for quality of installation. Improper installation of insulation and/or seals in buildings can be seen in the form of heat loss and air leaks. Also, building components "inside" the walls, ceilings and floors are recognizable because of their differences in mass. For example, infrared thermography can be used to determine the presence and correct placement of grouted cells in concrete block wall. If the

## Skilled Maintenance Workforce Shortage?

Training Solutions to Your Skill Problems by Ricky Smith



Sign up for our FREE Weekly Skills Newsletter!

**MAXZOR**  
maximizing total plant performance

843-762-3168 www.maxzor.com

## vbSeries® Vibration Analyzers



Simply everything you need.

Commtest vbSeries Analyzers with **ascend** software make vibration analysis and balancing easy and affordable. Suitable for users with no prior experience, as well as advanced features for veteran analysts.

- Fully automated analysis based on ISO 2372, 10816, and Technical Associates' "The Proven Method."
- Drag & drop route & advanced alarm editing
- Dual plane balancing
- Cross channel phase analysis
- Advanced waveform analysis tools
- Run up & coast down tests
- Automated statistical methods for updating alarm thresholds
- Email data from remote locations
- Customizable SQL/HTML reports
- 5-year hardware warranty & free software service pack updates

**commtest**  
Master Distributor - 3dB Global Inc

jdichner@commtest.com  
www.commtest.com  
Tel: 865-588-2946

owner of a new block building spends a little money checking their [low-bidder's] work with infrared thermography, the contractor will be forced to build the building per specifications or face the added direct cost of repairs and resulting loss of schedule repercussions.

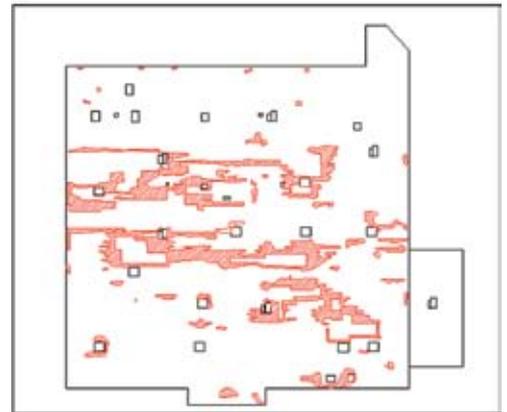
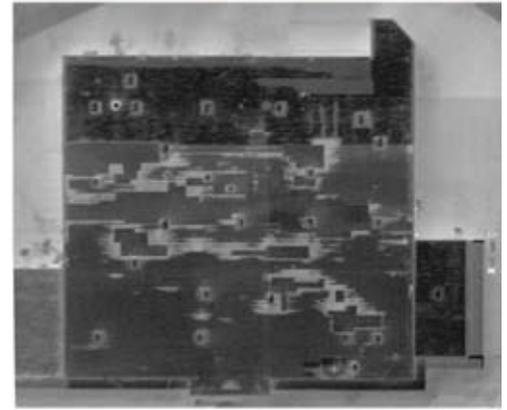
### Roof Surveys

A well prepared, graphic and accurate map of the infrared signatures of a roof can be of tremendous benefit to a building owner at all stages of the roof's limited life. Knowing where the subsurface moisture is located will help the roof owner manage his assets. This form of predictive maintenance works well on many types of flat and low-slope roofs. Here are the basics: At night, areas of roof moisture are warmer, because the accumulated heat (from daylight sunshine and heat) in the trapped water mass is greater than in the dry, functioning insulation or roof substrate. After sunset, as the roof's structure cools down, the wet areas of roof insulation and other materials maintain higher temperatures because of their higher mass, allowing the infrared cameras to detect the sources of heat and record them for

later analysis. There are two ways to perform IR roof moisture surveys: on-roof and aerial. On-roof thermographers walk from roof to roof looking for subsurface moisture patterns and when found, mark the extremities of these areas on the roof with paint. Aerial IR is used when the owner wants to document the wet areas with straight-down photos, IR and CADD drawings (see figure 6). The biggest advantage of aerial infrared is not its use on roofs that have well-defined areas of moisture at all, but those roofs that are the most difficult to image from any distance or angle. I am referring to the roofs that, for instance, have a lot of ballast, are covered with reflective coatings or ones that for whatever reason are impossible to image from the roof. With high-resolution aerial imagery, slight nuances of temperature can be seen from far enough away to recognize the pattern of heat.

### IR Possibilities

The list of other, industry-specific applications, (i.e., auto, steel, etc.) is far too lengthy to go into here. In fact, with modern infrared cameras, software and computers, today's infrared thermographers are almost



**Airborne Ultrasound**  
**Predictive Maintenance**  
**for the Masses**

Find leaks, grease bearings  
test steam traps  
Monitor **EVERYTHING**

**free**

**PdM Presentation**  
**Call today**  
800-667-5325 or 905-349-2020  
[www.sdtnorthamerica.com](http://www.sdtnorthamerica.com)



never limited by the infrared equipment's ability to measure temperatures or discern differences in temperature. Rather, we are only limited by our imaginations. So, get an IR camera and look at the world in a different wavelength. You will be amazed at what you see!

*Gregory R. Stockton is president of Stockton Infrared Thermographic Services, Inc. The North Carolina-based Corporation operates seven application-specific divisions performing many different infrared services in the US, Canada, Central and South America. Greg has been an infrared thermographer since 1989, and has published fifteen white papers and numerous articles on infrared thermography. Greg can be reached at 336-498-4734 or by e-mail at [gregs-its@northstate.net](mailto:gregs-its@northstate.net).*

## Time - The X Factor

It's a Must for Quality Oil Analysis

by Jason Popacek

One of the most important pieces of information in oil analysis is the amount of operating time on the lubricant, which is typically reported in hours or miles/kilometers. Lubricant time is vital to determining the severity of a wear or contamination condition and whether maintenance action is warranted.

Consider the following scenario: A mobile hydraulic system has 50 parts per million (ppm) of silicon/Silica (Dirt), which would be a cautionary level for a lube in service for 500 hours. However, if the lubricant time reported was 25 hours, the 50ppm of silicon is a more severe condition. A recommendation of investigating and correcting the source of contamination would be appropriate.

Scenario #2: The lubricant in a diesel engine is changed and tested regularly every 10,000 miles and no abnormal conditions are identified. A decision is made to increase the drain and testing interval to 40,000 miles. The corresponding oil analysis report shows a remarkable increase in bearing metal. Knowing the lubricant miles quadrupled, a recommendation to monitor the oil pressure, reduce the drain interval, and re-sample in 10,000 miles would be in order. If lube miles had not been reported, the analyst may have recommended that the bearings be inspected – a much more costly and time-consuming maintenance recommendation.

Scenario #3: After 250 hours of service, the oil is drained from a diesel engine and sent to a laboratory for testing. The spectrometals test reveals the engine has a severe coolant leak (Sodium/Potassium). A month later, another oil sample is taken and sent to the laboratory for analysis. The second test reveals a fifty percent reduction in coolant indicators (Sodium/Potassium). Depending on the number of hours on the lubricant, several conclusions can be drawn from the significant drop in coolant metals.

First, if the amount of time on the lubricant is equal to the number of hours on the prior sample (250 hours), then the coolant leak was most likely rectified. Some residual coolant metals would still be present if the system was not flushed thoroughly. Draining the oil and thoroughly flushing the system would be recommended to remove any residual coolant.

A second possibility also exists. If the amount of time on the lubricant is reported to be significantly less



– for example, 75 hours – a much more severe condition exists. The reduction in coolant metals could then be attributed to less time on the lubricant and the assumption made that, most likely, the coolant leak was not corrected. The recommendation would then be to perform further diagnostics to determine and correct the source of coolant contamination. Again, the key factor in determining the proper course of action is dependent upon knowing the amount of time on the lubricant.

Tracking and reporting lubricant time on industrial equipment was once difficult to monitor. This information has become more conveniently attainable with Programmable Logic Controllers (PLC's). A simple counter circuit can be programmed to monitor the amount of time a lube pump operates. It can then be reset every time a lubricant is changed. However, lube time can still be monitored even if the equipment does not have a lube pump. The counter could be programmed to count the number of hours the main motor operates – the rational being that as long as the main motor is operating, lubricant is being used.

LUBE/FLUID: KENDALL  
 LUBE TYPE: HYKEN 052 FARM TRACTOR LUBE  
 GRADE: SAE 10W20  
 FILTER TYPE:  
 SUMP CAPACITY:  
 HYD SYS PRESS:  
 MICRON RATING:  
 LUBE TIME: 371  
 UNIT TIME: 18978  
 LUBE ADD:  
 DATE SAMPLED: 7/15/2005  
 DATE RECEIVED: 7/19/2005  
 DATE COMPLETED: 7/21/2005  
 ACCT #: 000000 0000 0000  
 LAB #: I 793366 JDIT

**COMMENT**  
 Suggest unit's vital signs and fluid levels be observed closely between sample intervals; Copper is at a SIGNIFICANT LEVEL; COPPER sources in hydraulic systems can be from BUSHING/THRUST metal, LUBE COOLER metal (as applicable), PISTON SHOE metal (as applicable); REDUCED VALUES may be due to REDUCED TIME on oil;

**TEST REPORT**  
 VALUES EXPRESSED IN PARTS PER MILLION (PPM) BY WEIGHT

Z03H	WEAR METALS							CONTAMINANT ELEMENTS							MULTIELEMENTS							ADDITIVE ELEMENTS								
	SC-ZO3H	FMXON-Z	SC-ZHCTA	DMR000	OPAF	ZHT	SC-HZCAP	DMCF-H0	SC-HZHT	SC-HZANA	ZOH-H0	SC-H000	SC-H000A-H00	SCZM00-KZ0	SCZM00-KZ1	SCZM00-KZ2	SCZM00-KZ3	SCZM00-KZ4	SCZM00-KZ5	SCZM00-KZ6	SCZM00-KZ7	SCZM00-KZ8	SCZM00-KZ9	SCZM00-KZ10	SCZM00-KZ11	SCZM00-KZ12	SCZM00-KZ13	SCZM00-KZ14	SCZM00-KZ15	
7	0	2	700	13	0					10	5	3	0	6																
3	0	0	1	543	1	0	1	2	0	0	8	12	1	0	7	0	0	108	75	3340	0	1175	1509							
3	0	0	0	426	0	0	1	0	0	0	10	7	0	0	2	0	0	79	33	3310	0	1129	1253							
7	0	0	1	805	2	0	1	2	0	0	14	10	5	0	3	0	0	94	36	3362	0	1217	1434							
3	0	0	1	370	1	0	0	1	0	0	11	5	1	0	1	0	0	101	22	3360	3	1168	1370							

TEST DATA		LUBE FLUID	RUBIC OMOZ-ZIT	FMCT	TODS	KONI	VIS	VIS	TAN	TBN	I-H	I-H
SAMPLED RECEIVED	UNIT											
02	1567	UNK			0.0	0.0	8.10					
2/ 8/02	15455											
03	1305	UNK			<.1		6.9					
8/ 8/03	16760											
1/19/04		NO			0.1		8.4					
1/23/04	17260											
4/20/05	1347	NO			0.3		2.3					
4/22/05	18607											
7/15/05	371	NO			<.1		7.2					
7/19/05	18978											

The preceding examples illustrate not only the importance of tracking and reporting lubricant time for oil analysis but also the difference that omitting this information can make. In the first example, a cautionary contamination condition is determined to be more severe because of low lubricant time. In the second example, a potentially costly equipment inspection is avoided because the significant increase in wear is qualified by increased lubricant time. Reducing the drain interval is determined to be the more appropriate maintenance action to take. The third example illustrates the significance of lube time in detecting a contamination condition that might otherwise be allowed to continue. By providing lube time, premature failure is avoided with a proper maintenance recommendation.

*Jason Papacek is the Data Analysis Manager at POLARIS Laboratories. Jason has 5 years experience as a Reliability Engineer in Industrial Maintenance and holds a Bachelor of Science Degree in Mechanical Engineering from Purdue University. Jason can be reached at (317) 808-3750 or by e-mail at jpapacek@polarislabs.com.*

**"I prefer to spend my downtime fishing! Thanks, MCEMAX!"**

Why wrangle with your motors all weekend when you could be reeling in a fish or two? MCEMAX™ by PdMA makes it easy to monitor motor conditions. Track, trend and analyze test data from both dynamic and static operations. Plan or avoid motor downtime. Plus, because it is portable, you can test motors all over the plant—even those in 3 foot crawl spaces and 80 foot towers—and have all the data in one place.

MCEMAX is an indispensable tool for predictive maintenance managers. Call for a demonstration today . . . and start spending your downtime differently!

**PdMA** *Revolutionizing Electrical Reliability*  
 (800) 476-6463 • (813) 621-6463 • www.pdma.com

ISO 9001 CERTIFIED

## Shaft Alignment

**ROTAGN® ULTRA**, the first laser alignment system with a backlit color display plus USB & Bluetooth® technology! Alignment results in 3 easy steps: Dimensions - Measure - Results. Soft foot measurement, diagnosis and correction. Machine train alignment. Outputs reports in full color.

**LUDECA, INC. • (305) 591-8935 • www.ludeca.com**

# Your Maintenance Program Is Effective...Isn't It?

A simple evaluation to ensure you're performing the right work at the right time

by Howard W. Penrose, Ph.D.

Perhaps you've performed a Reliability Centered Maintenance (RCM) analysis of your system and the program is underway. You may have had an existing condition-based maintenance program in place for years. How do you know if your program is effective? What process can you use to find out if your system is performing at a high level?

The US Military has a concept known as a Maintenance Effectiveness Review (MER) in which maintenance programs are periodically reviewed for effectiveness. It is a continuous improvement opportunity to upgrade and streamline your program without the intensity and costs required to perform continuous RCM. There are several techniques that can provide the necessary rules. One of these techniques, which we will cover here, is called the Backfit Process.

## The Process

The Backfit Process requires only a simple series of questions on a machine or series of machines. In this case, we will walk through, in order, the process of a standard set of questions that will help you determine if your system of maintenance practices is functioning well.

1. Identify the failure mode(s) associated with this component or system. For instance, with a motor it might be a seized bearing and winding short.

2. Does a significant rate of age degradation exist? (Are the components worn down)? Do the failure mode(s) actually occur?

With our motor example, have the bearings actually seized or windings actually shorted before?

(Capturing and keeping historical data on all failures in your system will help you answer these questions. If you haven't been keeping data on failures, start now. It will help you in the future.)

There is no substitute for actual historical data and/or valid practical experience to support the answers to these questions.

3. Identify the functional failures:

- a. Is the functional failure evident to the operator? If the motor stops due to a seized bearing or winding short, will anyone notice?
- b. Determine what type of task is used to identify the

failure:

- i. Time Directed - periodic maintenance tasks performed regardless of condition;
- ii. Condition Directed - tests or inspections based solely on the condition of the system; or,
- iii. Failure Finding - tasks used to find faults that are not normally observed, such as sticking pressure relief valves.

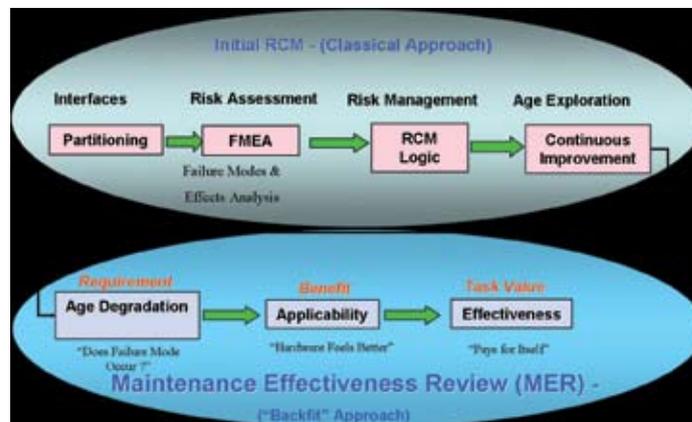
In the case of our motor example, condition directed vibration analysis and motor circuit analysis could be used.

c. Identify and measure the characteristic or parameter that accurately reflects the health of the system/component. In our example, these would be the vibration frequencies and the motor circuit analysis measurements.

d. Outline the acceptable and unacceptable tolerances for the measured characteristics.

4. Is the maintenance task actually effective? Each type of task has different measures to determine its effectiveness.

a. Time Directed: The probability of failure increases at a specific wear-out age, a large population survives to that age and the maintenance task restores the original



resistance to failure;

b. Condition Directed: The characteristics corresponding to the failure mode can be identified, they can be measured accurately and with consistency, and the task provides ample time between detection and failure;

c. Failure Finding: The failure is not evident to personnel and no preventive task exists.

If the maintenance task is not effective, you need to either modify it so that it becomes effective or delete it.

## 5. Identify the Failure Consequences-

a. Identify whether the failure consequences are related to safety or regulations, production or cost of the system or component;

b. Does the existing maintenance task add overall value? To determine if the task adds value, use different measures for each category that the failure consequences fall into:

- i. Safety or Regulation: Reduced probability of failure to an acceptable level.
- ii. Production: Reduces risk of failure to an acceptable level
- iii. All others: Cost of the preventive maintenance task(s) is less than the cost of repair plus the cost of lost capability.

For instance, if insulation to ground testing is performed, and failures occur that are not detected before failure, then the existing task is not adding any value.

## 6. Make Recommendations for Changes (if needed):

- a. Keep procedure the same, if it's effective
- b. Delete the procedure if it is ineffective
- c. Modify the procedure so that it is effective
- d. Change the frequency of testing
- e. Add a new procedure
- f. Change the measurement of system or component age
- g. Combine with another procedure
- h. Other

In the case of our example, if insulation resistance is ineffective, but motor circuit analysis and vibration analysis would be effective, then change the preventive maintenance task.

## 7. If you decide to recommend change the procedure, describe any changes and the rationale behind the changes.

Following these simple steps, or just following the process, will provide a quick method of evaluating maintenance practices on your systems. The process can be applied to any system of any size, and maintains the concept of continuous improvement of your reliability program.

*Howard W Penrose, Ph.D. is the Vice President of Electrical Reliability Programs for T-Solutions, Inc., a military and industrial maintenance and reliability consulting firm. Dr. Penrose has over 20 years experience in the electrical maintenance and reliability field. He is the Executive Director of the Institute of Electrical Motor Diagnostics (IEMD.org). Howard can be reached at [howard@motordoc.net](mailto:howard@motordoc.net).*

## NO MATTER WHOSE ULTRASOUND YOU ARE USING, WE CAN TRAIN YOU!

ONSITE  
ONE & TWO DAY  
WORKSHOPS  
CERTIFICATION  
LEVELS I & II

- ◆ Leak Detection
  - ◆ Compressed Air
  - ◆ Cryogenics
  - ◆ Wind/Water Leaks (Aviation, Automotive)
- ◆ Bearing Analysis

- ◆ Acoustic Lubrication
- ◆ Steam Trap T/S
- ◆ Electrical Scanning (Arcing, Tracking & Corona)
- ◆ Switchgear
- ◆ Substations

Let Ultra-Sound Technologies  
"Re-Implement"  
your Airborne Ultrasound program while  
integrating today's technologies!



"REAL WORLD ULTRASOUND"  
"VENDOR NEUTRAL TRAINING"



Contact: Jim Hall  
(770) 517-8747  
[jim.hall@ultra-soundtech.com](mailto:jim.hall@ultra-soundtech.com)

(770) 517-8747

| [www.Ultra-SoundTech.com](http://www.Ultra-SoundTech.com)

# Laser Alignment Verification

On Site At The Largest Gas Turbine in the US

by Alan Luedeking

Recently, Ludeca, Inc. was contracted to perform a laser alignment verification on a 250 MW 3600 RPM Siemens-Westinghouse Model W501G Gas Turbine, the largest operating gas turbine in the United States, if not in the world. The chief objectives were to measure the shaft alignment between the gas turbine and the generator, and to evaluate whether any realignment of the turbine was necessary. We performed the procedure during a maintenance outage in which the gas turbine was destedacked, its rotor repaired, and reassembled with at least 90% of the static load on the foundation.



**Largest Operating Gas Turbine in the United States**

uncoupled and that the respective coupling surfaces (both axial and radial) were in excellent condition. Based on the information given to us, we formulated our plan of action. Call it Plan A.

**PLAN A**

When we arrived at the work site, we found the coupling hubs uncoupled and separated by exactly 0.5", in order to allow the rabbit to disengage its seat. We tapped a brass wedge into the gap at the top in order to preserve the axial clearance between the hubs. When we

The gas turbine was required to be set high with respect to the generator by a positive vertical offset target specified by the customer, with no vertical angularity, and no horizontal offset or angularity. We input the target spec into the ROTALIGN® ULTRA laser shaft alignment system which we decided to use for this job, in part to take advantage of the system's automatic tolerance evaluation function.

The client had informed us in advance that the gas turbine and generator shafts could not be rotated.

The machines were coupled by a solid steel rabbet-fit coupling that had 36" hub diameters, so we decided to perform the alignment measurements utilizing special stainless steel magnetic sliding brackets, which are designed to slide or move around the circumference of the solid coupling hubs. Of course, when the shafts cannot be rotated, the quality of the coupling's surfaces becomes extremely important because it directly affects the quality of any alignment readings obtained. The primary challenge facing the aligner in the quest to obtain good data is to overcome any eccentricities or out-of-roundness on the coupling's surface. Before we arrived, the client had told us that the coupling hubs would be

inspected the coupling surfaces, we saw that they were not as 'excellent' as we had hoped, and worried this might affect the quality of readings we would get. On-site personnel offered to clean and file away the dings and burrs on the surfaces of the coupling that would come in contact with the magnetic sliding brackets. Unfortunately, even after working for about an hour, we didn't see much improvement to the coupling's surfaces. We decided to set up and attempt to take an initial set of readings anyway, to see if we could get any meaningful data at all.



**coupling surfaces**

We installed the laser alignment system's components, including the magnetic sliding brackets. Since both brackets would have to be individually slid or moved by hand to each measurement position, we de-



**magnetic sliding brackets**

ecided to use the manual Multipoint measure mode, instead of the automatic Pass Mode for uncoupled shafts.

We took two sets of readings with this setup, resulting in poor repeatability, which confirmed our fears about the poor surface conditions of the coupling. Both sets of readings also displayed a very high Standard Deviation value (above 20 mils), which we considered totally unacceptable. Essentially, even after cleaning and filing it, the coupling's surface was just too rough to collect any meaningful data. It was time for Plan B.

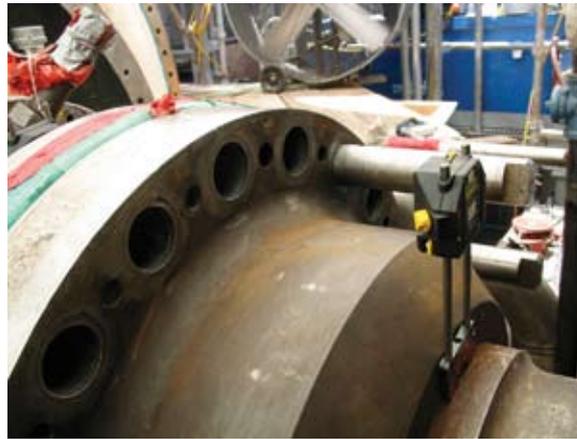
#### PLAN B

After discussing our dilemma with on-site personnel, they told us that the generator shaft *could*, in fact, be independently rotated, but that the gas turbine shaft probably could not. This new information improved our outlook considerably. We decided to take uncoupled readings by letting the laser emitter ride with the generator shaft as it was turned, while we manually moved the receiver's sliding bracket around the gas turbine coupling hub to each measurement position. This would be a vast improvement over Plan A because any surface imperfections would no longer affect the emitted laser beam, and, hopefully, would result in far better data being collected. We continued to use the Multipoint measure mode for these readings since it took us over half an hour to break the generator shaft free and rotate it one full rotation. Another reason we chose to stay with the Multipoint mode was because it can increase the sampling rate averaging to compensate for the hot or unstable air surrounding the coupling in the bright sunshine. The first hurdle to overcome in rotating the generator shaft was to break it free of static friction. Once it broke free and came up on oil it could be rotated very slowly and smoothly, without undue force. We accomplished this by pulling on it with a 3-ton chain-fall an-

chored to a building column and attached to a heavy cable wrapped around the generator coupling hub and secured on a turning pin inserted into one of the coupling's bolt holes. This was extremely arduous work in a very hot summer environment; a full shaft rotation required at least three re-positionings of the sling and turning pin, with frequent pauses for rest and hydration on the part of millwright personnel.

This third measurement would also require changing the measurement setup in order to move the laser emitter away from the outer coupling hub where it could be bumped by the turning mechanism. We decided instead to attach it against the face of the generator coupling, further back and out of harm's way, using special compact magnetic brackets.

This also meant bringing the bracket down



**compact magnetic brackets**

radially, much closer to the shaft surface. So we wouldn't have to use really long support posts to come up over the coupling's OD, we opted to shoot the laser beam through one of the unoccupied bolt holes of the coupling. This, in turn, required moving the Receiver's bracket back and down on the gas turbine coupling in similar fashion, so we could lower it enough to receive the laser beam through the bolt hole. At this time, we also decided to switch from a cabled connection between the laser alignment system's receiver and computer to a wireless connection, utilizing the Bluetooth® communications module. This would free the operator from having to look out for the communications cable becoming snagged.



**wireless connection**

## Alignment Tip

For alignment measurements to be meaningful, the rigidity of the laser alignment system's brackets and measurement components must be ensured. Furthermore, the shafts or solid coupling hubs that these components are attached to should both be rotated (not necessarily together). Otherwise, the quality of any alignment measurements obtained will always be at mercy of the surface conditions.

***In principle, if it is at all possible to rotate a shaft, it should be, regardless of the effort that it takes, in order to obtain good data.***

Two key indicators of the quality of the data obtained are the repeatability and Standard Deviation values.

After all the work involved to reposition the alignment components, we were discouraged when the third measurement we obtained had an unacceptably high Standard Deviation (over 8 mils). (See the third reading in the Measurement Table near the end of the article.) However, we needed to come up with a plan that worked, so on to Plan C.

#### PLAN C

Again, we discussed the dilemma we faced with on-site personnel. In these discussions, they said there was a possibility of rotating the gas turbine shaft, but only by using a very large overhead crane with a sling arrangement on it. In view of the unacceptable readings gained so far, we decided to request that both shafts be rotated, regardless of the difficulties involved. When plant management approved the request, we were rolling with Plan C. We joined the coupling hubs with three fitted steel pins inserted through three of the coupling's bolt holes, having approximately a 0.010" or greater clearance. After some rather intense conversations among Millwright personnel, they decided how best to proceed with breaking the gas turbine shaft free, causing it to come up on oil. Since no lift oil

system exists in this gas turbine, they poured a heavy duty lubricating oil directly into the turbine's bearings. Since using the overhead crane in the past had caused the Gas Turbine shaft to suddenly break free and rotate very quickly before stopping again, we decided to first try to turn the shafts with our already installed chain-fall mechanism.

Turning both shafts together would be a huge advantage in taking the alignment readings. However, this would now subject the Receiver to hitting an oil drain line as well as another

obstruction to rotation, one radial and one axial. We overcame this difficulty by using the compact magnetic brackets with offset support posts, in order to allow the obstructions to be cleared while still allowing the Receiver to be brought down low enough to receive the laser beam through the coupling's bolt hole.

Now for the first attempt at rotating both shafts together. We applied the maximum load to the chain fall, but the gas turbine shaft did not break free. After this attempt failed,

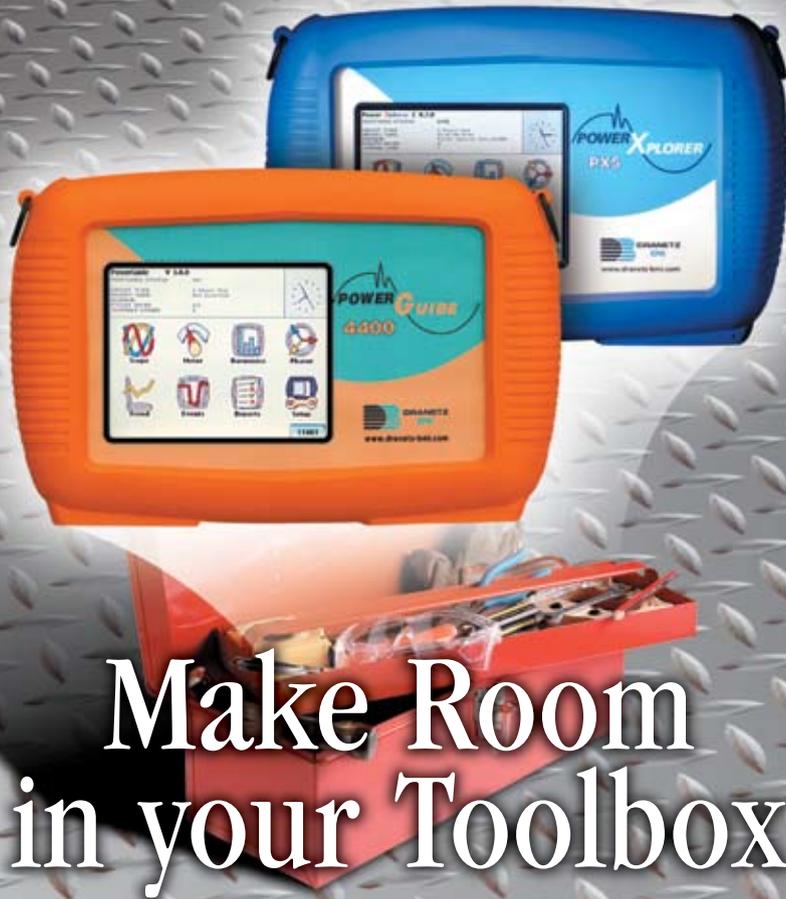
we decided to utilize a 5-ton hydraulic jack to push up against one of the turning pins leveraged with a very heavy steel prying bar, in addition to the 3-ton chain-fall sling wrapped around another of the turning pins. To everybody's great relief, this combined attempt succeeded and the gas turbine shaft finally broke free and began to turn very slowly. We had earlier asked that the shafts be rotated at least two full rotations before taking readings, in order to allow most of the rotor sag in the gas turbine shaft to bleed out and to allow the turbine shaft to come up on oil. However, considering that we were exhausted, had time constraints and that it took us about an hour to complete the first full rotation of both shafts, we decided to start taking readings immediately with the second rotation. The photo at right illustrates an overview of the wireless communication setup utilized for these readings taken while rotating both shafts together. (The orange object seen at the top of the coupling is the brass wedge fitted with a string and inserted between the coupling faces to preserve the axial clearance between the hubs while rotating them. This would slide and remain at the top.)

For this reading (No. 4 in the Measurement Table) we decided to continue utilizing the Multipoint measure mode. We could have used the Continuous Sweep mode, which would have needed only a 70-degree rotation to get accurate results. We preferred to rotate the shafts a full turn, even if this took more time to complete. We were concerned that the clearance in the fit of the pins might be larger than anticipated, and could allow sufficient rotational play to slightly affect the readings' accuracy. This was unlikely, but still possible. In any case, the Multipoint measure mode would allow utilizing a higher sampling averaging rate than would be possible in Continuous Sweep mode and would also permit extending the measurement range during the readings in the unlikely event this might be necessary.

The gas turbine shaft again had to be broken free, and we proceeded to take readings as soon as the second rotation started. For these readings the Bluetooth® communications module was a godsend, since a cabled connection would cause at least eight feet of cable to be wrapped around the hub in each full rotation. Also, the laser alignment system's computer could be comfortably held and readings taken from as far as 30 feet away, allowing the operator to stay out of the way of the crew laboring to rotate the shafts.

#### RESULTS – PLAN C WORKED

We saw a dramatic drop in the Standard Devi-



# Make Room in your Toolbox

## Meet Dranetz-BMI's POWERGUIDE and POWERXPLORER

Designed to fit in your budget and your toolbox, these 3-phase, 8-channel power monitoring instruments have intuitive touch screens, "super smart" setups, and a report card annunciator that instantly characterizes power quality events. Ideal for troubleshooting, PQ and energy surveys, motor inrush and load balancing, as well as complex analysis of fast transients and harmonics, the PowerGuide and PowerXplorer now feature a unique motor quality health panel—a first line of defense for identifying and solving motor problems.

<b>RMS Voltage</b> R 120.3 B 120.3 C 120.3	<b>RMS Current</b> R 30.07 B 30.07 C 30.07	<b>U RMS Imbalance</b> R 0 B 0 C 0
<b>True Power Fact..</b> R - 0.882 B - 0.858 C - 0.858	<b>Horsepower</b> R 4.276 B 4.159 C 4.159	<b>Derating Factor</b> 0.800
<b>Voltage THD (Fu..)</b> R 0.055 B 0.050 C 0.050	<b>Current THD (Fu..)</b> R 0.052 B 0.051 C 0.052	<b>Negative Sequen..</b> Tot 5.285
Clear	Options	Exit



### successful setup

ation values immediately (down to 1.37 mils) and we considered this fourth set of readings to be entirely accurate and reliable. However, some coordination issues between the starting and stopping of rotation and measuring points early in the readings led us to believe that the quality of the readings could be improved even further, and we considered it imperative to establish repeatability. So we decided to make one more complete revolution of the shafts and take one more set of readings. This fifth and final set of readings took less time to complete since both the gas turbine and generator shafts had by now fully risen up on oil. We observed a further significant improvement in the Standard Deviation of the readings (down to just 0.72 mils). We considered this excellent, and the results also proved repeatable with the fourth set of readings.

The fifth and final reading is highlighted in the Measurement Table below. We presented

proof of how essential it is, if at all possible, to rotate the shafts when taking alignment readings, no matter how difficult or time consuming this task is. Even if coupling surface conditions are excellent, results will never be as good as those that will be obtained when actually rotating the shafts. Rotating the shafts permits the true relative alignment of the actual centerlines of rotation to be established. Another lesson learned is that when critical and complex machinery is to be aligned, it is extremely important to have a good, solid plan going into the

project. When alignment contractors get on-site, they should know exactly what they want to do. But, equally important to a project's success, is the ability to adapt, to be flexible, and to just solve problems. Good laser alignment equipment is essential. A measurement table that permits comparison of results for repeatability and accuracy, as well as the averaging of results, is also imperative. On this particular project, specialty brackets and hardware, wireless communication capability and a true multipoint measure mode with automatic angle recognition all played a vital role in capturing meaningful data.

After this alignment check was concluded, the gas turbine reassembly process was completed and the turbine-generator train put back in service, there has been a significant drop in overall vibration values.

### measurement table

	Vertical	Horizontal	Additional	Sensor						
	Gap	Offset	Gap	Offset	Std. dev	Distance	Serial	Averaging	Extend	Date & time
1	-43.4	21.7	-43.6	2.8	20.26	4.875	5098 128 (0.78 s)	None		22-7-2005, 9:29:15
2	-40.2	24.3	-66.1	-0.3	20.28	4.875	5098 128 (0.78 s)	None		22-7-2005, 10:23:02
3	13.2	9.5	-6.2	-11.2	8.11	7.250	5098 128 (0.78 s)	None		22-7-2005, 14:53:25
4	3.4	3.9	-1.8	-1.3	1.37	7.250	5098 128 (0.78 s)	None		22-7-2005, 17:23:49
5	3.7	5.0	-1.9	-1.2	0.72	7.250	5098 128 (0.78 s)	None		22-7-2005, 18:01:11
Average	3.7	5.0	-1.9	-1.2	---	---	---	---	---	---

this to plant management and they accepted the findings as satisfactory. Since these values fell within the customer-specified alignment tolerances with regards to the target specification, plant management decided not to require any re-alignment moves to be performed on the gas turbine.

### LESSONS LEARNED

The most interesting lesson of this job is the

*Alan is manager of training and tech support at Ludeca. He has a Bachelor's degree from the University of Colorado at Boulder and over 20 years of field experience in machinery shaft alignment and training. He enjoys technical writing and editing and speaks four languages. He is married with four young children and his principal hobby is numismatics. Alan can be reached at 305-591-8935 or by e-mail at alan@ludeca.com.*

## PRACTICAL OIL ANALYSIS & COOLING SYSTEMS MAINTENANCE

FOR MAINTENANCE AND RELIABILITY PROFESSIONALS

Practical Oil Analysis and Cooling Systems Training by POLARIS Laboratories will teach you how to set attainable fluid analysis program goals, select the proper testing and take good, timely samples at the right intervals. Newcomers to fluid analysis and longtime professionals alike will learn how to select a quality laboratory, interpret results, manage the data and take decisive maintenance action.

### HOUSTON

Oct 31-Nov 3, 2005

#### REGISTER TODAY FOR:

- Oil Analysis Training (2 days)
- Cooling Systems Training (2 days)
- Oil and Cooling Systems Training (4 days)

online at [www.polarislabs.com](http://www.polarislabs.com)

OR call 317-808-3750 ext. 229

Early Bird Discounts Available!

Attendees will receive:

- Fluid Analysis Reference Manual
- Laboratory Tour
- \$200 credit toward testing services
- COMPASS, PC-based data management software (\$499 value)
- Spectrometric Metals Guide
- Coolant Testing and Analysis Guide

PRESENTED BY:



POLARIS Laboratories, LLC



RELIABILITY

Lubrication Fluid Power

MAINTENANCE TECHNOLOGY

COOLANT

# Is that valve actually working?

## Valve Inspections Using Airborne Ultrasound

by Jim Hall

Many technicians have been puzzled about whether a valve is operating properly or not. When performing an operational check on valves, technicians can rely on airborne ultrasound as a means to inspect a valve for proper operation.

Airborne ultrasound is most commonly thought of as an instrument used to find air leaks. But, today's ultrasonic equipment is much more than just a leak detector. An airborne ultrasound instrument today can incorporate the use of a handheld pyrometer (contact or infrared), an RPM sensor, a Mass Air Flow sensor, and can be integrated with other predictive maintenance technologies such as a vibration analyzer and/or an infrared imager.

Today's predictive maintenance technicians have a world of predictive maintenance instruments at their disposal but airborne ultrasound is the one that is the least expensive, has the shortest learning curve and is the most applicable to today's maintenance tasks. Valve inspections for leakage or "flow or no-flow" are the most recognized use of airborne ultrasound for valve maintenance.

However, any technician who knows the workings of his or her valve can easily diagnose operational problems using an ultrasonic instrument.

Depending upon the valve use and environment, a valve can fail due to chemical buildup, bent or broken valve stems, packing leakage, ruptured diaphragms and/or degradation of valve seats causing flow through a closed valve. Continuous inspections of valves can save your company money due to emergency shut-downs and/or loss of production.

A few months ago I had contracted with a company in Canada to provide equipment orientation and applications training for an instrument



they had purchased but were not using. While instructing the technicians in valve inspections with their instrument, I noticed that I was not able to pick up the sound of a butterfly valve

the instrument from hearing the valve operation. In today's airborne ultrasound market there are basically three instruments at the top. Since I am a "vendor-neutral" company I will not divulge those product names here. While the company had purchased one of the top instruments, the other two top rated instruments were also available that day (as training instruments). Both of the other instruments had absolutely no problem hearing the valve operating as well as hearing the valve leaking past its seats during closure.

**Continuous valve inspections can save your company money by helping to eliminate emergency shut-downs.**

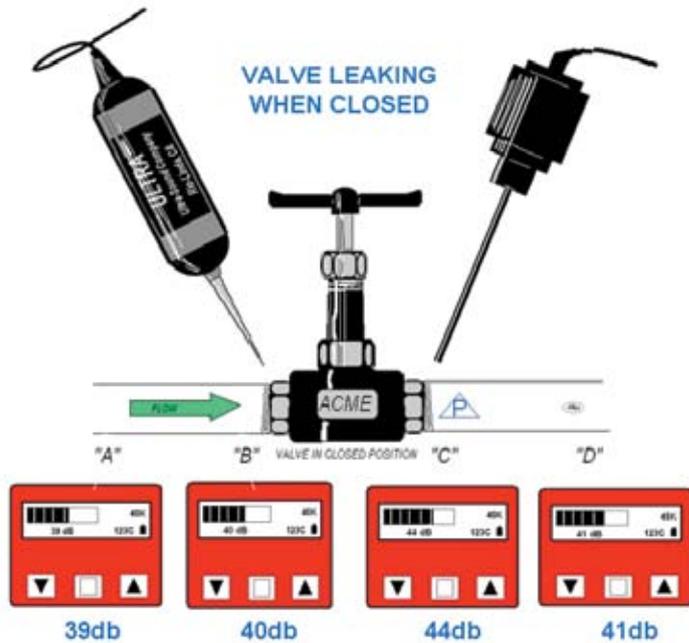
during operation. The technicians had wanted to listen to a particular valve for leakage when closed. This particular valve is located in a very corrosive environment (methane gas) and has had previous failures due to the valve seats being worn or eroded away due to this harsh environment.

The instrument this company had purchased had "no-gain". In other words the sensitivity of the contact probe could not be raised or lowered. The level at which it was calibrated was so low that background noise prevented

the instrument they had purchased but were not using. While instructing the technicians in valve inspections with their instrument, I noticed that I was not able to pick up the sound of a butterfly valve

### Valve Inspection Procedure:

1. Always observe local safety rules and regulations.
2. Observe valve size, valve rating and part number for proper use and installation.
3. Complete a visual inspection of the valve before proceeding to an operational check. Check for:
  - Bent or broken valve stems
  - Build-up or chemical deposits that might hamper valve operation
  - Observe flow arrow for proper installation
4. Always "stroke" the valve during the inspection (fully open to fully closed).
5. Observe the "visual indicator" for valve positioning (when applicable).
6. Check the valve for ease of operation by feel and/or by using an ultrasonic device to hear the movement of the valve (sticking or binding valve stems can typically be heard).
7. Using the ultrasonic instrument, listen for leakage at the weep hole or bleed port indicating a ruptured diaphragm (when applicable).
8. With the valve fully closed and using a "four point check" A, B, C & D (A & B, two points upstream of



valve and C & D, two points downstream of valve).

Listen for liquid or gas leakage past the valve seats. Note: The pressure differential or deltaP will be greater at point "C" than the other three points if valve is leaking.

Let's look at some key points to keep in mind about your ultrasound equipment.

**Know your instruments model and manufacturer.**

When you find yourself in need of accessories, parts, calibration or you just need to talk to someone about the operation of an instrument, you need to know whom to call.

**Be familiar with the operations of your instrument.**

Having spent 15 years in the field as a salesman, I would frequently find instruction manuals still in the original packaging with warranty cards and other information that would have benefited the end-user. It takes just a few minutes to read most instruction manuals.

**Know the limitations of your instrument (positives & negatives).**

Except for a handful of individuals, "sensitivity" of an instrument was never a concern of most of my customers. Most believed, if the instrument cost \$4000.00 "it must be pretty sensitive". Most customers had no previous experience in airborne ultrasound and relied on the integrity of the salesman to provide them with the right answers if the application for which they were purchasing, the instrument could not be used for.

There is no standard of sensitivity, nor, are these instruments built by following a world wide standard.

**Know the applications that are applicable to your instrument.**

As with the valve mentioned earlier, not all instruments are the same. There are other applications such as electrical scanning for radio interference, corona, arcing and tracking. Some instruments have a wider field-of-view, others have a bigger parabolic dish, and still

Non-Vendor or vendor-neutral training is just that....they sell no equipment and therefore are not bound to one particular instrument. They can train you no matter whose instrument you are using.

Manufacturer's train you in the use of their instrument. This can be misleading sometimes when explaining applications, especially if their instrument cannot perform certain applications or doesn't have enough sensitivity to provide adequate inspections for your particular use.

Seek training through an on-site workshop. Hands-on training in your plant is highly recommended. Equipment orientation and using your equipment in your environment is always best.

Level I or II Certification can be rewarding, especially if your plant or organization has incentives in place for those that become certified.

A source which has several different makes and models of ultrasound instruments is typically more objective than a source with only one make or model.

Airborne ultrasound is one of the most versatile diagnostic tools for preventative and predictive maintenance you will ever own. However, the most expensive, the most sensitive, the one with the most reputation means nothing, if you cannot pickup the instrument

## Key Points Regarding Equipment

- Know your instrument's model and manufacturer
- Know the applications that are applicable to your instrument.
- Be familiar with the operation of your instrument
- Know the calibration cycle
- Know the limitations of your instrument (positives & negatives)
- Seek training.

others may have wider frequency bandwidth. Know the calibration cycle of your instrument.

Most instruments have a two-year cycle. However, if your instrument has been dropped or otherwise roughed-up, calibration is recommended.

**Seek training.**

There are two kinds of training offered today. Training from a "non-vendor" and training from the manufacturer of an ultrasound instrument.

and operate it.

*Jim Hall, President of Ultra-Sound Technologies was previously with Naval Aviation Engineering Service Unit (NASEU). Jim has over 16 years experience training and selling airborne ultrasound instruments for predictive maintenance applications. Jim can be reached at 770-517-8747 or by e-mail at jim.hall@ultra-soundtech.com.*

# Maintenance Gets Healthy

New Technology Is The Thermometer

By James Campoli

The University of Medicine and Dentistry of New Jersey (UMDNJ) is the largest freestanding institution of higher education in the health professions in the United States. UMDNJ is comprised of seven schools on five campuses located on six different sites throughout New Jersey.

"Maintenance is serious business at the University, as evidenced by a Physical Plant staff of more than 700 craftsman, technicians and engineers throughout the state," according to Frank Watts, Director, Physical Plant, "We are always on the lookout for the latest technology to help give us an edge in providing the best possible service to our customers including the staff, patients, students and visitors to the university."

"Senior management insists that we operate from a 'continuous improvement' mode and has been very supportive of our efforts to remain state-of-the-art in maintenance management", says Watts.

The Newark Campus has a 550-bed teaching hospital with a Type 1 Trauma Center, Cancer Center, Medical School, Dental School and Power Plant. The critical nature of UMDNJ's activities has put equipment reliability and cost effectiveness high on the list of priorities. Over the past 15 years we have made routine use of predictive and reliability technologies. These included portable and continuous on-line vibration, motor current, infrared and air quality monitors.

While the technology was powerful, the supervisors and managers were drowning in data that did not clearly aid in their decision-making. In many cases managers did not really understand the technology jargon and often had to employ specialists to make repair decisions. CMMS reports simply added to the data overload. The technology was good but the connection to required maintenance action needed improvement.

In an attempt to improve the information flow, we implemented a system to streamline the flow of facilities condition data and complex technical data into clear metrics that would be more useful in the decision making process. In short, we wanted to put in place a system that would provide our decision makers with information, not just data.

## The Total Facility Maintenance Approach

The new system that we installed in Physical Plant is called Total Facility Maintenance (TFM) and like most good ideas it is simple in concept. TFM identifies all assets (offices, restrooms, corridors, labs, patient rooms, equipment, machines, etc.) considered important enough to control in a maintenance program. It then creates and utilizes tour/inspection/PdM procedures to gather and reduce the data on the condition of the facility to usable and easily understood metrics. Our supervisors can then correct the deficiencies identified by the TFM metrics and we can track and trend the facility's condition.

## Building Maintenance Success Story

In April, 2004, we started a University Hospital-wide "Maintenance Services Improvement Initiative" to improve the services that Physical Plant provided to the



hospital on the Newark campus and to upgrade the look, cleanliness and functionality for our patients, staff and visitors.

The first step was to have our Condition Monitoring Unit conduct a hospital-wide TFM tour to establish a "Condition" baseline. We also established a "Customer Service" baseline by surveying administrative and nursing staff selected by the hospital administration.

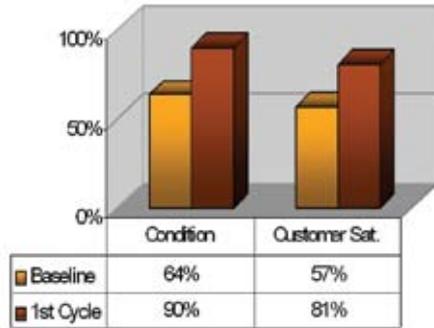
The baseline TFM results showed a 64% rating for "Condition" and a 57% rating for "Customer Satisfaction" for the hospital.

After establishing the baseline metrics with the TFM program, a comprehensive cleaning and repair program was initiated based on the "Failed Steps" discovered during the tours and reported on the TFM "Exception Report".

After the repair and cleaning deficiencies were addressed, another TFM tour was conducted (Cycle 1). The Cycle 1 tour resulted in a 90% "condition" rating and an 81% "Customer Satisfaction" showing 26% and 24% improvements respectively. This improvement ini-

tiative was successful because we were able to direct our resources to the previously identified deficiencies as well as quantify the before and after “Condition” and “Customer Satisfaction” levels to our senior management. We are no longer guessing at the effectiveness of our efforts, we have the hard facts (metrics) to prove it!

Baseline vs 1st Cycle Results



Informational metrics (not raw data) provides a quick overview of the facility operation and trends. If more detail is needed, you can drill down from the “Enterprise” through “Campus”, “Building”, “Floor”, “Room” or “Machine”. This approach allows negative trends, problems or ‘bravo’ results to be quickly spotted and is an excellent way to benchmark the effectiveness of one facility to another.

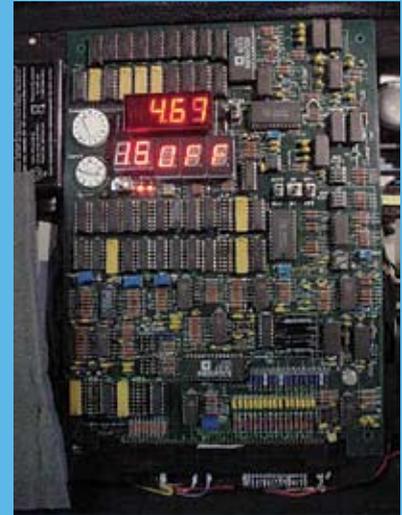
### Machinery Success Story

The TFM program utilizes an interesting method of tracking the condition of equipment and machinery. It uses a new Multiple Discriminant Analysis (MDA) approach to machinery monitoring that focuses on optimizing machine bearing life. It accomplishes this by providing three easily understood metric indicators. These three indicators, tell us: 1) how well we are controlling the dynamic forces that shorten bearing life, 2) the actual Bearing Condition, and 3) the Expected Life of the monitored bearing. The benefit of this system was illustrated quite dramatically in a recent situation involving a centrifugal gas compressor, part of our Cogeneration equipment located in the Power Plant that supplies utilities to the Newark campus, including the University Hospital. The MDA numbers indicated a 90 % probability of bearing failure. The Power Plant supervisors were reluctant to take the gas compressor out of service because of its critical contribution to the Cogeneration operation. However, after we reviewed the MDA information with the Director of Utilities, he ordered an immediate scheduled shutdown and bearing replacement. The bearing was in fact very near a catastrophic failure and

# Multiple Discriminant Analysis

The Multiple Discriminant Analysis (MDA) system is an innovative new technique for determining rolling element bearing condition. It offers the maintenance mechanic a tool that focus’s attention on extending bearing life by providing three important metrics: Extended Bearing Life, Bearing Condition, Estimated Remaining Life.

The system in use at the University of Medicine and Dentistry in New Jersey currently includes five sixteen channel multiplexing systems operating on fixed and variable speed rigid and belt driven machines running from 900 to 7200 CPM. The system accepts inputs from standard 100mv/g constant current industrial accelerometers that were already installed on machinery. The sensors are wired back to the wall mounted MDA monitor box. The system sequences through the sixteen sensors and, derived from five key diagnostic discriminants, produces a 1-10 factor for each of the three major metrics. Using these factors the system provides an estimated probability of failure within the next 90 days. These factors are uploaded via

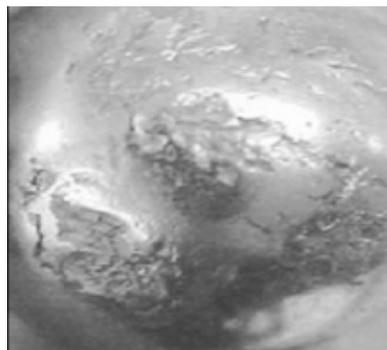


phone line into the overall Total Facility Maintenance program computer and provide pass/fail PdM metrics on general facility machinery condition.

On Action requests, TFM calculates cost of repair and avoided cost, then kicks off information to maintenance supervisor where action is required. The system also makes available raw acceleration signals and spectra for detailed analysis if required. MDA converts raw data into usable, actionable information.

was replaced at an estimated avoided cost saving of over \$200,000 including a probable avoided service interruption to the Cogeneration operation.

The TFM system implemented at UMDNJ over the past several years has been a positive improvement in the way that we operate and maintain the facilities. The program works well, was implemented with existing personnel with service support and required minimal training. The system provides operation and



damaged bearing surface

maintenance personnel with information on “Condition”, “Customer Satisfaction”, “Maintenance Costs”, “Work Completion Ratio”, “Machinery Condition” and much more. Information is provided in a hierarchal format from the “Enterprise” level down to the “Room” and “Machine” levels so that the information can be useful to senior management as well as managers, supervisors and mechanics. We find that it allows us to track good situations and identify sub-par or degrading conditions quickly. At UMDNJ it has paid off in real cost savings and improved management effectiveness.

*James Campoli is the Group Manager at the UMDNJ Physical Plant, Newark, New Jersey. He oversees the operation, maintenance and environmental services of the UMDNJ Northern Campus with a total staff of 402.*

*Jim has 25 years experience in Operations, Facility Maintenance and Construction, 22 of which have been spent in the operation of Higher Education and Health Care Facilities.*

Co-Located with  
IMC-2005,  
2 Events for 1 Price



# Mastering Excellence in Machinery Lubrication

A learning event designed exclusively for You - the Lubrication Professional who wants to:



December 6-9, 2005  
Tampa Convention Center  
Tampa, Florida

- Learn everything you need to know to build a world class machinery lubrication program for enhanced reliability
- Advance your professional standing by sitting for the Certified Lubrication Specialist (CLS) Exam by STLE
- Discover exciting new ideas and learn helpful techniques to jump-start your machinery lubrication program
- Meet over 100 leading solution and service providers and test drive new products in the LubricationWorld Expo
- Create your own learning agenda with 7 learning zone sessions, short courses, keynotes, case studies, breakout sessions and full day workshops
- Learn how Lubrication Professionals just like you are improving results
- Network with your peers at the free receptions and hospitality night
- Drive the NASCAR simulator
- Win an Alienware Laptop Computer

MRO-ZONE.com



## Drive the Havoline 42 Car!



Our friends at Chevron have arranged a special Nascar driving experience at LubricationWorld with the Havoline Nascar Simulator.



Select your favorite Nascar track and see what it's really like to be behind the wheel!

## lubrication world/imc session topics

Session Chair:

LubricationWorld session chairman Ray Thibault, Certified Lubrication Specialist, is a leading authority on industrial lubrication and has taught best practices to thousands of students and leading companies from around the world.



Lubrication Best Practices for Managers	Lubrication Program Management Case Study	What's New in Lubrication	Gearbox Lubrication Revolution
Contamination Control	Compressor Lubrication Fundamentals	Motor Bearing Lubrication	What's New in Engine Oil
QSA Varnish Potential Case Study	Hydraulic Troubleshooting	Lean Maintenance	Oil Analysis
Acoustic/Ultrasonic Lubrication	Establishing a Motor Maintenance Program	Procedure Based Maintenance	Root Cause Analysis
Maintenance Task Generation	Operational Excellence	Outsourcing Maintenance	Developing Key Performance Indicators
Phases of PM	Creating a Culture of Change	Reliability Scoreboard	Getting Ready for RCM
Strategy for Improving a Basic Maintenance Program	The Business Side of Reliability	Lean Maintenance	Contractor Management
The Seven Pillars of Maintenance Excellence	Solution to the Economics of Preventative Maintenance	Using PdM Indicators to Define Maintenance Activities	The Managing System: How To Get Your Dreams To Work
ISO Certified Asset Management Process	Best Practices Maintenance Management	Sustainable Cost Reduction	NFPA 70E & Arc-Flash Hazards

LubricationWorld Attendees can also attend over 45 IMC-2005 presentations and short courses. For more details, see

<http://www.lubricationworld.com>

## MaintenanceConference CONNECTION

Your LubricationWorld experience begins as soon as you register. The Maintenance Conference website will link some of the most experienced maintenance & reliability professionals in the world. As soon as you register to attend any conference at MaintenanceConference.com, you will gain access to an active online community that includes presenters, workshop leaders, industry experts, solution providers and your industry peers.

This year round community includes:

- E-mail discussion group - allowing you to ask questions and gain knowledge before the conference even begins
- Audio Interviews with IMC-2005 & LubricationWorld Presenters
- Online surveys - to tailor expert sessions to your specific questions

### Tour PdMA Corp's Oil Analysis Lab



Fri, Dec 9th, 9am-12pm

Learn about the testing process for elemental analysis, viscosity, acid numbers, particle counting and analytical ferrography.

**Space is Limited!** If you are interested please PdMA toll free (800) 476-6463 or email [info@pdma.com](mailto:info@pdma.com)

Mastering  
**Excellence** in  
Machinery Lubrication

## lubricationworld learning zone agenda

### Wednesday, Dec 7th - Short Courses & Learning Zone Sessions\*

7:30am - 9:00am	90-Minute Short Course - Contamination Control by Dr. Leonard Bensch, Pall Corp
9:00am - 10:00am	Refreshment Break in Expo Hall
10:00am - 10:45am	Learning Zone Session - Case Study: Detecting Varnish Potential by Greg Livingstone and Brian Thompson, Analysts, Inc.
11:00am - 11:45am	Learning Zone Session - Lubrication Program Management Case Study by Eric Bevevino, Chevron
11:45am - 1:00pm	Lunch in Expo Hall
1:00pm - 2:30pm	90-Minute Short Course - What's New in Synthetic Lubricants by Dr. Timothy Nadasdi, ExxonMobil
2:30pm - 3:30pm	Refreshment Break in Expo Hall
3:30pm - 4:15pm	Keynote Speaker - John Mitchell
4:15pm - 5:00pm	Town Hall Meeting Panel - John Mitchell, Terry Wireman, Ricky Smith, Robert Latino, Ray Thibault, Jack Nicholas, Jr. Moderated by Terrence O'Hanlon
7:00pm - 10:00pm	Hospitality Suites Marroitt Waterside 2nd Floor

### Thursday, Dec 8th - Short Courses & Learning Zone Sessions\*

7:30am - 9:00am	90-Minute Short Course - Lubrication Selection Strategies & Guide for Improving Enclosed Gearbox Reliability by Lawrence Ludwig, CLS, OMA, CMFS
9:00am - 10:00am	Refreshment Break in Expo Hall
10:00am - 10:45 am	Learning Zone Session - Engine Oil Trends and Drivers by Lawrence Ludwig, CLS, OMA, CMFS
11:00am - 11:45am	Learning Zone Session - Compressor Lubrication Fundamentals by Darrel Beatty, Dow Chemical
11:45am - 1:00pm	Lunch in Expo Hall
1:00pm - 2:30pm	90-Minute Short Course - Hydraulic Troubleshooting by Ricky Smith, CMRP
2:30pm - 3:00pm	Refreshment Break in Expo Hall
3:00pm - 4:00pm	Conference Wrap-Up and Alienware Giveaway

\* - subject to change

See <http://www.lubricationworld.com> for more details

To Register: Log On to Website above  
**Automated Fax:** 309-423-7234 or 305-735-3746  
 Call Toll Free 800-575-1245 or 305-735-3746 (Outside the US)

## HotShot

We recently caught up with Art Stout of Electrophysics during a whirlwind product introduction for HotShot, a new Infrared Thermal Imaging System.

Infrared systems have become a mainstay of almost all industrial predictive maintenance programs as prices drop and system become easier to use. Here is what Art had to say:

***T***he infrared market is heating up (no pun intended) with a number of low cost producers offering infrared cameras. What makes HotShot different?

Great question. After talking with numerous thermographers, we continued to hear the same story. People wanted cameras that were easier to use and took less time to generate reports.

HotShot began as a market research project. We visited and interviewed thermographers in the field and made detailed observations of their practices while not being influenced by how they used any particular brand of camera. We discovered that thermographers have to operate cameras in tight spaces or look at equipment at different heights and from difficult angles. Secondly we learned that thermographers spent a great deal of time taking field notes, either by writing notes in a small notebook or trying to use the voice recording

feature in some camera models. The need to transpose written and voice recording into reports resulted in significant inefficiency during report generation.

To solve the tight space and difficult inspection point problem Electrophysics designed HotShot with a unique rotating infrared eyeball that makes it possible to image objects from floor level to over head while maintaining the optimal LCD display viewing angle and hand position on the camera. This, combined with a close up focus distance of 11 inches (2 inches with the wide angle lens), allows users to get into places other systems simply can't.

Once we understood how much time users spent manually recording field information and transposing the data into PC based report generation software we came up with our infrared data logger concept.



# upgrade

HotShot's design is basically a micro tablet PC and features very simply yet powerful data logger functionality that enables users to record data such as equipment type, a diagnosis, a repair recommendation and assign a severity rating to an infrared incident. When generating reports most of the text fields are automatically populated with the data taken in the field basically automating report generation.

**What is the advantage of having a computer on board?** While all infrared cameras have embedded computing capabilities, the HotShot utilizes Windows CE, as it's operating system. The first time you use HotShot and do simple things like saving images you'll notice familiar Pocket PC screens, making file management within the camera very familiar. Secondly, we give the customer a powerful expansion path. Because we use Windows CE we can easily add features and functions. We can also integrate a wide range of PDA accessories such as a visible light camera, Wi-Fi, or other items.

**How long will it take before an average person can learn to capture an image with HotShot?**

First let's be clear - there is a distinct difference between knowing how to operate a thermographic camera and being a thermographer. HotShot is one of the most intuitive and easy to use cameras available. In about 15 minutes you can be familiar enough with HotShot to operate it pretty well. However, proper use of a camera requires formalized training. Today, more than ever, issues like safety compliance require training. A number of training programs are offered and most don't even deal with camera operation.

**Does the system include software?**

Yes our HotShot XL, LT and Pro models include ReportIR, our report generation and analysis software package.

**Is software used for creating reports or for image management and post processing?**

Both. Electrophysics has some of the finest

image processing software available, which we offer with our R&D cameras. For HotShot, we also have a very user friendly and intuitive report writing package. This package takes all of the data from the camera (including the "data-logging" information about target location, status, repair recommendation, etc.) and populates the report automatically. Fast, simple, easy.

**Inspection of electrical systems has always been a primary application for infrared. What are some of the other industrial maintenance**



Although not taken by the HotShot, we thought you'd enjoy this cool infrared photo.

**applications you are seeing?**

Well, infrared cameras continue to be used for inspecting mechanical systems like rotating equipment, steam systems, refractory condition of boilers and other furnaces, building systems like insulation and roofing systems and web process applications like paper machines. We are always amazed at the new ways customers use their cameras and much of this is industry specific. The process industry is always finding new applications since they are one of the largest consumers of power and temperature is a critical parameter everywhere you look.

**Will use of infrared continue to expand in the predictive maintenance area?**

Absolutely. The applications for infrared are fairly well understood and perhaps within certain types of facilities new niche applications will be developed. The big expansion is happening in the number of plants that

are adopting infrared imaging as part of a machinery health management program. As costs for cameras fall, the ROI (return on investment) continues to improve for a growing number of operators. With the products being easier to use and costs coming down, the PM usage for thermography will certainly increase.

**Why are infrared cameras so much more expensive than standard digital cameras?**

Two primary factors affect price. The sensor in your digital camera is produced in a standard integrated circuit foundry, or fab. These devices are produced in the millions of units. By contrast infrared detectors are made in the low thousands and require non-standard silicon processing to build. The finished image sensor must then be packaged in a vacuum enclosure. It's basically a Catch 22: the systems won't get less expensive until the sensors get less expensive. And the sensors won't get less expensive unless there are a lot of them built and sold. The second factor is the cost of the lens material. The raw material costs for lens elements is nearly \$2000 a pound. After cutting, polishing and mounting, infrared lenses become very expensive.

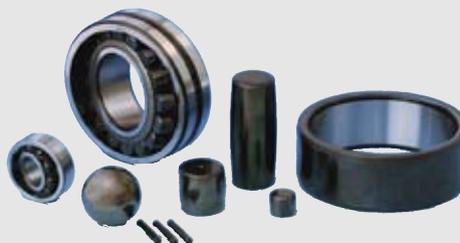
**Can you share a HotShot success story?**

A very large cement plant was retrofitting its electrical service and their contractor has run high voltage temporary cables to power equipment during the switch over. During a routine inspection an overheating cable extension connection was found to be overheating. Not only was the potential for the electrical service to be interrupted, the cable was lying on a walkway and represented a significant hazard to plant workers.

To learn more about HotShot, go to: [www.electrophysics.com](http://www.electrophysics.com)

A first in infrared imaging technology for PdM applications, Mikron's new M7800 and M7815 cameras introduce a high-resolution 320x240 UFPA detector with a 60 Hz refresh rate in a package starting under \$12,000.

**Jon Chynoweth**  
**Mikron Infrared, Inc.**  
 888.506.3900  
 Fax: 906.487.6066  
 jon@mikroninfrared.com  
 www.irimaging.com



**Al Martin**  
**SKF USA Inc.,**  
 800-440-4SKF  
 skfusainfo@skf.com  
 www.skfusa.com

Patented NoWear® coated bearings from SKF can withstand severe operating conditions due to sudden load variations, high operating temperatures, poor lubrication, vibration, smearing, and/or contamination.



MRC® hybrid ceramic ball bearings ideally serve in large variable-speed electric motor applications and offer key performance benefits over standard steel ball bearings. Hybrids can prevent electrical arcing, resist wear, run at higher speeds and lower operating temperatures, and promote extended service life.

**Jay S. Carlson**  
**MRC Bearing Services**  
 716-661-2727  
 www.mrcbearingservices.com



New Digital LCD Viscosity Tester - Battery Operated with one button operation- Large Display of ½" High by 2 ½" Long. Features: Measuring range: 0.3 to 4000dPa-s (30 to 400,000cP), Accurate to 5% of reading, Handheld or with optional lab stand with base, sample temperature to 300EF (150EC)

**John Kelly, Sales Director**  
**Kernco Instruments Co., Inc.**  
 contact@kerncoinstr.com

**915-852-3375**  
**Fax: 915-852-4084**  
 www.kerncoinstr.com

**Sean M. Feyrer**  
**SKF Linear Motion**  
**& Precision Technologies**  
 800-541-3624  
 Fax: 610-861-3737  
 www.linearmotion.skf.com



Patented SKF® compact linear ball bearings promote reliable and long service life in linear guidance systems and can serve ideally where available space for components may be minimal. Their recirculating balls reduce friction and provide unlimited stroke to deliver optimized performance.



The new VarioTHERM™ head™ is the first reasonably priced real-time thermographic camera system for the 1.8 – 5 μm spectral range for challenging applications in industrial and scientific research and development. The camera is easy to use and of robust industrial design. The standard FireWire interface means the camera can connect to any Windows-based computer for real-time data transmission.

**Ingetraud-Ute Graupner**  
 +49 3641 65-3237  
 Fax: +49 3641 65-3658  
 ingetraud.graupner@jenoptik.com

Kernco Instruments Co., Inc's "Digital Pocket Stroboscope" is designed for use in all industrial and laboratory applications. It measures in a range of 30 to 12,000 RPM and it is a one-hand operation unit that will fit into a pocket or worn on a belt or in a holster. It is the world's smallest industrial stroboscope and it is battery operated.



**John Kelly, Sales Director**  
 915-852-3375 Fax: 915-852-4084  
 contact@kerncoinstr.com  
 www.kerncoinstr.com



A new SKF® Copperhead fault detection system provides a rugged and reliable solution for the mining, mineral processing, and cement industries with the capability to monitor low-speed machinery for abnormal conditions.

**Keith E. Meyers, SKF**  
 215-513-4849  
 Fax: 215-513-4480  
 www.skf.com

# uptime solution provider community

**Chevron**

www.chevron-lubricants.com

**Commtest**

865-588-2946

www.commtest.com

**Datastick**

888-277-5153

408-871-3300

www.datastick.com

**DMSI**

800-923-3674

www.desmaint.com

info@desmaint.com

**Dranetz**

800-372-6832

www.dranetz-bmi.com

**Electrophysics**

973-882-0211

www.electrophysics.com

**Ivara**

877-746-3787

905-632-8000 (Intl)

www.ivara.com

**Ludeca**

305-591-8935

www.ludeca.com

**Maxzor**

843-762-3168

www.maxzor.com

**Mikron**

906-487-6060

www.mikroninfrared.com

**PdMA**

800-476-6463

813-621-6463

www.pdma.com

**Polaris**

317-808-3750

www.polarislabs.com

**Reliability Magazine**

888-575-1245 x 114

www.reliability-magazine.com

**Reliabilityweb.com**

888-575-1245

www.reliabilityweb.com

**SDT**

800-667-5325

905-349-2020

www.sdtnorthamerica.com

**Stockton Infrared**

800-AIT-SCAN

www.aitscan.com

**T-Solutions**

888-924-9558

757-410-0233

www.tsoln-inc.com

**Ultra-Sound Technologies**

770-517-8747

www.ultra-soundtech.com



Offering the  
**knowledge,**  
**understanding,** and **experience**  
of the maintenance and reliability professional.



How healthy is your electrical, maintenance, and reliability program?  
Are you seeing profitable ROI?  
Is your program having a positive impact on Your bottom line?

T-Solutions, Inc. has a proven track record of improving maintenance and reliability programs for the U.S. Military and Industry. Whether it is fine-tuning and training maintenance and reliability professionals or completely developing or re-building your program, T-Solutions has the expert personnel and applied experience to assist you. We consistently exceed our clients' expectations.

Clients Include:  
NAVSEA  
SURFLANT  
U.S. COAST GUARD  
BAE Systems  
Boeing  
Morton Salt  
U.S. Steel  
General Motors

<http://www.tsoln-inc.com>

Take advantage of our proven capabilities. Call Today!  
T-Solutions, Inc. ■ 135 Hanbury Rd, C-1 ■ Chesapeake, VA 23322  
757-410-0233 Fax: 757-410-7809 info@tsoln-inc.com





**THE PLANT RUNS 24/7. YOU DON'T.**



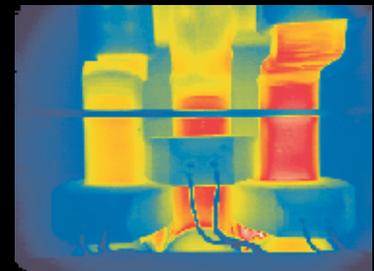
Chevron Lubricants. So reliable, you don't have to think twice about them.  
For more information, visit [www.chevron-lubricants.com](http://www.chevron-lubricants.com)



Sees through closed doors.  
With super thermal  
imaging powers. And  
it's UL approved.



## The Superhero of IR Cameras



*Mikron's patented and UL-approved Viewport™ and SpyGlass™ system can save millions of dollars in lost production caused by unplanned power outages.*

You'll have superhero powers using a Mikron camera with SpyGlass lens and Viewports for your electrical inspections. It's the only UL-approved system for closed-door electrical inspections that lets you measure the full 8-14 micron IR spectrum required for accurate temperature measurement and best image quality.

Dock the SpyGlass lens with the Viewport. Capture images through a 0.5" opening. It's the only system to focus from 3" to infinity.

No need to back off for close objects and limit your field of view. No IR sight glass to break or scratch.

Now, frequent inspections are fast, easy and safe – no longer requiring an electrician, bulky gloves and protective equipment or safety barricading. And it's affordable.

Give all your maintenance, safety and security monitoring programs a better image with Mikron.



**Mikron Infrared, Inc.** • Thermal Imaging Division  
1101 Elevation Street, Suite 3 • Hancock, Michigan 49930  
Tel: 906-487-6060 • Fax: 906-487-6066  
e-mail: [jon@mikroninfrared.com](mailto:jon@mikroninfrared.com) • [www.mikroninfrared.com](http://www.mikroninfrared.com)

*There's a free one-day PPM seminar coming to your area soon!  
Call 1-888-506-3900 or sign up at [www.irimaging.com](http://www.irimaging.com)*