ROTATING MACHINERY SERVICES, INC.

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THE FINISH LINE

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RMS POWER SOLUTIONS

By Charles (Chot) Smith

We have some exciting news from the RMS Power Solutions Service Shop. We pulled the shop expansion project plans off the shelf, dusted them off, renewed all of the permits and are due to break ground by mid fall and be under roof prior to any bad weather.

The expansion will consist of an additional 10,000 sq. ft. of floor space. Included in this space in addition to four assembly bays will be an abrasive blast cleaning facility, a weld shop, and a non-destructive (NDT) testing bay. The expansion will also have an additional 10 feet under the hook of a 35 ton crane.

Bullard Dynatrol

We also have recently commissioned our Bullard 90" swing vertical boring mill and are in the process of locating a large horizontal boring mill. As usual, our rotor shop is overflowing with axial and centrifugal compressor, expander, and steam turbine rotors which are in various stages of inspection and refurbishment.

POWER RECOVERY TRAIN (PRT) ROUND TABLE

Rotating Machinery Services will be hosting a Power Recovery Train Round Table scheduled for October 29 and October 30, 2013. A welcome reception will be held on Monday, October 28th.

If you are interested in attending, you can download the registration form on our website at http://www.rotatingmachinery.com/conferences.html or you can contact Don Shafer or Kathy Ehasz at 484-821-0702.

If you have a topic, question or problem area for the Round Table, please email Don Shafer at dshafer@rotatingmachinery.com.

We have a few seats available. RSVP as soon as possible!

What's Inside

RMS IMPORTANT NUMBERS

HOUSTON SALES OFFICE:
Kurt Diekroeger
281-340-8520 (O)
713-898-1015 (C)

TENNESSEE SALES OFFICE:
Mike Spangler
865-981-9831 (O)
484-896-8438 (C)

LOUISIANA SALES OFFICE:
Remus Creel
225-291-4974 (O)
225-939-4680 (C)

UPCOMING CONFERENCES

42ND TURBOMACHINERY SYMPOSIUM

George Brown Convention Center in Houston, TX
OCT. 1 - 3
BOOTH 740

GMRC GAS MACHINERY CONFERENCE

Albuquerque Convention Ctr.
Albuquerque, NM
OCT. 6 - 9
BOOTH 643

RULES OF THUMB - TURBOMACHINERY

By Neal Wikert

Flange Slotting	The purpose of keyhole slotting the O.D. of a flange in high temperature machinery is to eliminate the ability of the outer portion of the flange to carry hoop stress. Doing this reduces thermal stresses by allowing the cooler outer portion of the flange to expand less than the hotter bore region. The end result is less long-term distortion. Slotting every third bolt hole is a good rule of thumb and slotting more often provides safety margin.
SHCS removal:	Heat the head of the cap screw until cherry red. Allow cap screw to cool momentarily so that heat can soak down the threads. Turn to remove. Cap screw will loosen.
Hex nut removal:	To remove hex nuts, heat one of the hex flats until red and break nut loose. On Allen head bolts, heat down in the Allen head and break loose. This heat effectively loosens the nut and gives room for corrodents to move.
Large Joint nuts	(Hex Cap nut with heater hole) In the absence of a stud heater, shield casing joint with insulation. Aim torch heat down the center stud heater hole. After heating, quickly break nut while stud is elongated from heat.
Gears – Helical	Gears are generally manufactured from 4340 through hardened to a Brinell range of 340 – 370. Above a surface speed of 7000 ft./min. the gear teeth need to be ground to give the part the accuracy needed for spinning at these speeds.
Performance	Standard conditions: ISO: 59 deg. F, Sea Level (14.696 psia), 60% R.H. NEMA: 80 deg. F, 1000 ft (14.17 psia) API: 60 deg F, 14.7 PSIA, Dry (0% RH)

TURBINE STEAM PURITY

By Scott MacFarlane

When it comes to steam turbines, the steams purity is a prevailing concern to the turbine's functionality and life expectancy. Steam purity is defined as the amount of solid, liquid or vaporous contaminates found in the steam.

Basically, any particles beside the pure steam are considered contaminates and these particles can have a severely detrimental effect to the overall operation of the turbine. These contaminates can originate from many different sources throughout the process of converting the feed water to steam. Boiler carryover, feed water impurities and vaporization of silica and other compounds are just a few examples. There are industrial steam contaminate limits set by manufactures that should be followed to determine if the steam is acceptable. The chart on the right is an average turbine manufacturers recommended limit for some commonly found contaminates.

Manufacturers Recommended Steam Purity Limits

Sodium	**5 - 20 ppb**
Silica	**10 - 20 ppb**
Chlorides	**3 - 15 ppb**
Sulfates	**3 - 15 ppb**

TURBINE STEAM PURITY *(Con't)*

By Scott MacFarlane

Reduced steam purity can cause internal components of the turbine to accumulate deposits and cause severe corrosion. The more serious types of corrosion are stress corrosion cracking and corrosion fatigue. Stress corrosion cracking is the collaboration of corrosion and mechanical stresses to cause a failure by cracking the surface. Corrosion fatigue is the collaboration of corrosion and alternating or cycling stresses that causes a rupture of the surface, which in turn accelerates the corrosion. These specific cases of failure are particularly detrimental during cold startups due to large condensation of steam. When the turbine reaches its operating temperature, the condensate evaporates leaving concentrated contaminates on the surface. Unfortunately these concentrations of contaminates mainly form on hard to reach surfaces where the steam's flow cannot provide a washing effect. These surfaces also happen to be heavily stressed areas which will increase the chances for stress corrosion failures. Rotor blades and vanes manufactured from an AISI 403 12%Cr stainless steel is the most commonly used material to prevent these failures. Other potential hazards that are associated with the steam's purity come in the form of erosion, particle accumulation, flow obstruction, high thrust loading and sticking of valve stems. An example of flow path deposits from steam impurities can be seen in the photograph.

DON'T ABANDON THAT SHAFT JUST YET!

By Dirk Paraschos

RMS works at providing services to our customers that can often save thousands of dollars and months of down time. Recently, we have had quite a few projects where we have reassembled rotors with abandoned compatible parts. By reworking and providing a few new parts in a timely manner, RMS is able to meet customer needs.

This past month, we shipped a rebuilt compressor rotor to a customer one month ahead of their turnaround. We were able to accomplish this task by re-using an abandoned shaft, impellers from a second rotor, and reworking the existing sleeves and balance piston. By weld repairing the abandoned shaft's damaged journals we were able to make it reusable. The 5 impellers de-stacked in our shop needed to be weld repaired and re-riveted. The re-riveting was a huge job made manageable by our experienced machinists. Over 65% of the rivets needed to be replaced on three of the impellers, while the other two needed blending and weld repair. After reworking the sleeves and balance piston, designing and machining all new support rings we were ultimately able to deliver the customer a rebuilt rotor that met Engineering requirements. The whole project from start to finish was accomplished in 18 weeks by adhering to our Project Schedule and support from all the departments at RMS. This saved the customer thousands of dollars by not having to purchase all new components and not to mention the revenue that would have been lost due to additional down time.

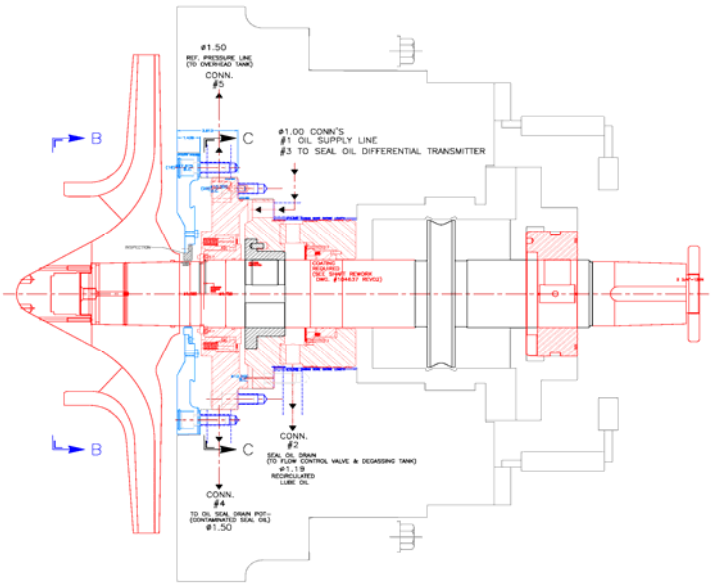
This is a just one successful example of many projects that are currently flowing through our shop. By paying constant attention to the details of the project schedules we have been able to deliver quality service to our many different customers all across the country and around the world.

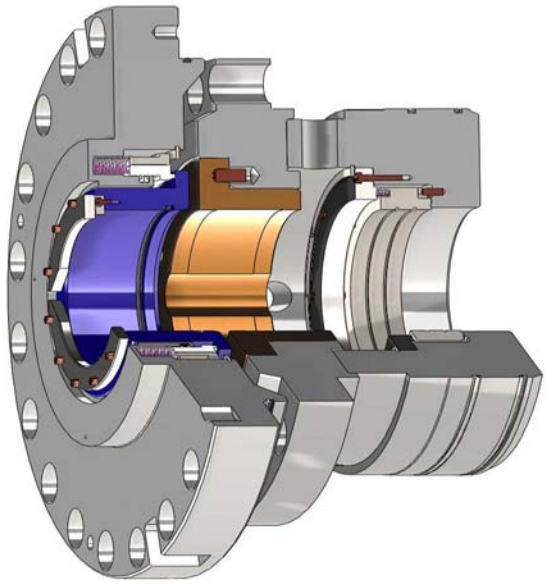
SHAFT SEAL STUDY

By Tony Rubino, P.E.

Rotating Machinery Services, Inc. was contracted to do a shaft seal improvement study for I-R CDP24 single stage pipeline compressors on natural gas pipeline service. The purpose of the study was to determine how to minimize or eliminate seal oil carryover into the pipeline. The customer reported that they were experiencing as much as 200 gal/day make up oil requirements with the existing bushing oil seal arrangement on some of the compressors. The customer also described complaints received from power plants along the pipeline that the seal oil carryover was the cause of combustion system fouling of their gas turbines drawing combustion gas from the pipeline.

The scope of the study included a site visit to perform compressor dimensional and documentation inspections by RMS during a maintenance outage performed by the customer. The customer's preference was to convert to a dry gas seal. The result of the study and the follow-on execution determined that a dry gas seal was not feasible due to space limitations. Working in cooperation with Kaydon (seal supplier), a suitable mechanical face seal was designed and manufactured. RMS also performed controls system and rotordynamics reviews to ensure proper integration of the new seals. New pressure dam journal bearings were provided to improve compressor rotor stability. After approximately one month operation, the customer could not provide oil usage data since the oil level had not changed appreciably. In the customer's words, "The seals are doing what they are supposed to be doing". The team approach and collaborative effort between the customer, Kaydon and RMS got it done right the first time.





QUALITY CONTROL

By Robert DeHart ASQ CQT

Portable Metrology – Co-ordinate Measuring Machine (CMM)

Portable measuring devices such as CMMs can facilitate the capture of heretofore unobtainable geometric attributes of measured parts. However, measurements acquired using a portable measurement device require an evaluation of the method and the process of taking the measurements to ensure the integrity of data and to understand the implications of measurement results for decisions made about the product or process.

Changes in the measuring process such as temperature fluctuations, vibration, the stability of the instrument and the fixturing of the part being measured can affect the assignment of a number to a measurement characteristic.

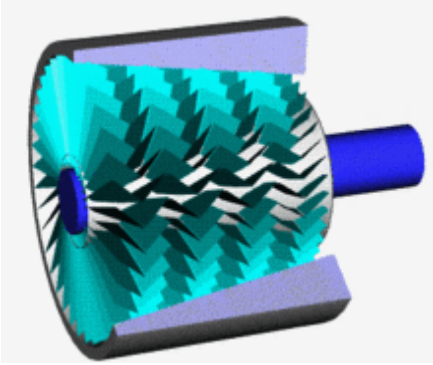
QUALITY CONTROL *(Con't)*

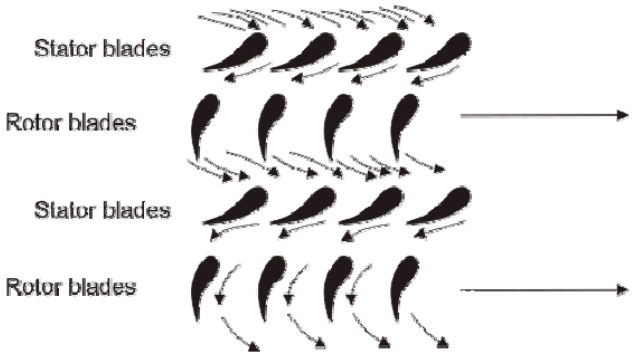
By Robert DeHart ASQ

For example, in situ measurement of blade cross sections and flow path characteristics of an axial compressor rotor must be preceded by the fixturing of the rotor and the CMM to ensure zero relative movement. A co-ordinate system is created using the system software to establish x, y zeros at both ends of the rotor. During the measurement process, these zeros are continuously monitored by re-measurement. Any significant change would require compensation, re-zeroing or re-starting the measurement process from scratch.

Accurate measurements will enhance the designer's confidence in rerate recommendations such as:

- increasing pressure rise by adding stages, changing blade camber or increasing the speed.
- increasing the flow by adding a new stator casing, longer blading, stagger angle decrease, speed increase.





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RMS BLADERUNNERS - LEHIGH VALLEY HEALTH NETWORK VIA RELAY

For the third consecutive year, RMS participated in the Lehigh Valley Health Network Via relay race on September 8th. The race, which benefits children and adults with disabilities like Autism, Cerebral Palsy and Down syndrome, is a certified marathon course from Allentown to Easton PA along the scenic Lehigh Canal and River.

The RMS team Blade Runners this year were, in order of relay legs, Sydney Gross, Corey Jones, Joan Berg, Bob Klova and Neal Wikert. Sydney also went on from the first leg to complete the marathon.

The weather was beautiful and RMS, in the spirit of continuous improvement, bettered their last year's time by 20 minutes. There was a record turnout for the marathon this year in the wake of the Boston bombing owing to the fact that it is one of the last qualifying races of the season for the Boston Marathon.

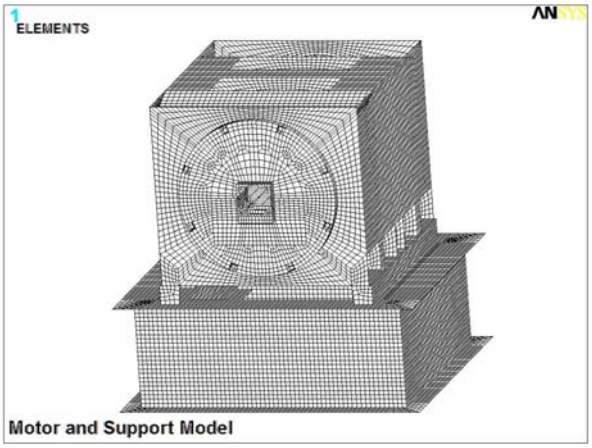
MOTORING ALONG

By William Sullivan, P.E.

Recently the structural analysis group at RMS stepped out of its turbomachinery paradigm and entered the electric world of motor vibration.

One of our customers was having chronic vibration problems with the drive motor for a power recovery train. Proposed solutions to the vibration issue included a coupling change and a motor bearing redesign. When field vibration data pointed to the possibility of a resonance condition close to operating speed, the customer, a major refinery, asked RMS to get involved.

Exploring the motor vibration problem was a perfect fit for our analytical capabilities and experience. We constructed a finite element structural model of the motor that consisted of the base structure, casings, end-walls, bearing housings and rotor (See Figure 1). We then ran a parametric analysis consisting of 25 different cases. Using the frequencies and deflected mode shapes as guides, we were able to identify some relatively inexpensive and easily implemented modifications that would reduce vibration response significantly.



Motor and Support Model

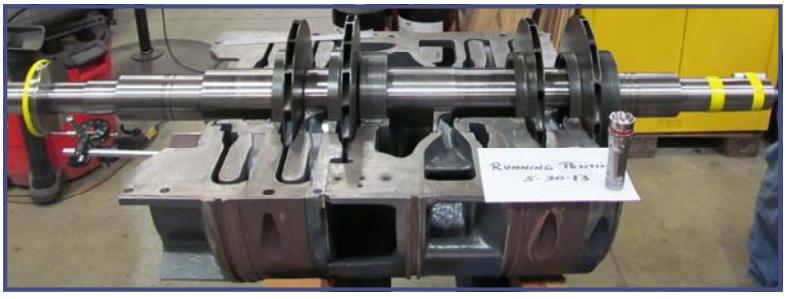
Some of the recommended modifications were implemented, the most significant being stiffer motor end bells of RMS design, and motor vibrations have been reduced to more typical levels and have remained consistently low since start-up over a year ago.

ANTI-FOULING COATINGS FOR COMPRESSOR FLOWPATHS

By Marc Rubino

Turbo compressors in petrochemical service are often subjected to gradual, destructive phenomena, such as corrosion and fouling, in the flowpath. Compressor fouling wanes efficiency since unwanted process particles accumulate on rotating and stationary flowpath components. In time, the build-up from fouling can impede flow capacity, negatively influence dynamic rotor balance, and obstruct running clearances. In addition to online performance degradation, fouling and corrosion damage will extend outage time and increase overhaul costs.

Anti-fouling corrosion resistant coatings are engineered to enhance online performance and prevent corrosion to the base metal. They are typically multi-layer systems consisting of a barrier, inhibiting, and sacrificial coating. The barrier or top coat prevents corrosion by isolating and sealing the base metal from damaging liquids. If the barrier coat remains intact, corrosion is unable to occur. Under the barrier coat, one or more inhibiting or intermediate coats are applied to chemically alter corrodants. The corrodants are essentially rendered inert as they penetrate into the inhibiting coating. And finally, a sacrificial or base coat is designed to "sacrifice" itself by corroding instead of the base metal. Once the base coat is depleted, it can no longer corrode in place of the base metal.



RMS was recently contracted to overhaul two Cooper-Bessemer model RA(6)-4B inner barrel assemblies. The overhaul for both barrels included rotor destacking, diaphragm disassembly, cleaning, non-destructive examination, flowpath component repair or replacement and reassembly. Major replacement parts included impellers, inlet guides, all interstage labyrinth seals and new/refurbished journal and thrust tilt-pad style bearings.

ANTI-FOULING COATINGS FOR COMPRESSOR FLOWPATHS *(Con't)*

Most relevant to this article, however, was the improvement coating of the impellers, diaphragms, inlet guides, and other flowpath components. Through a collaborative approach between RMS and Praxair, an anti-fouling coating system was specified and successfully applied to all critical parts. According to Praxair, the selected coating system, "…provides an aerodynamically smooth, non-reactive, non-stick outer surface that resists wetting and the fouling build-up it causes." The preventative multi-layer coating is designed to extend the time between outages, enhance performance, and reduce repair costs. With the expertise and quality provided by RMS and its dedicated suppliers, the overhauled compressors' aerodynamic assemblies are expected to exceed the OEM's performance and reliability.

CONGRATULATIONS KELLY HILL

By RMS Staff

We are pleased to announce the promotion of Kelly Hill to Staff Accountant. Kelly joined RMS in 2012 as an Administrative Assistant. She previously worked at Hoffman Manufacturing Inc., as their Accountant. Kelly brings with her 4 years Accounting experience in an industrial environment.

Kelly graduated from Northampton Community College in 2004 with an Associate' Degree in Business Administration. Her future plans are to pursue her Bachelors Degree in Accounting/Finance.

WELCOME RMS NEW EMPLOYEES

By RMS Staff

MAURY HENRICHSEN, P.E.
PRODUCT MANAGER - CENTRIFUGAL COMPRESSORS

Maury brings with him 34 years' machinery engineering experience in the process/industrial gas and power generation industry participating in OEM, aftermarket, service, and end user roles. He served various engineering and design roles with GE Energy, Bently Nevada, Conmec, and A-C Compressor. He also served as an internal machinery consultant for industrial gas companies Air Liquide America and Air Products and Chemicals. Primary experience includes centrifugal compressor design and rerates as well as field performance/mechanical integrity evaluation. He also has extensive experience with field vibration analysis and troubleshooting. Maury graduated with a BS in Mechanical Engineering from the South Dakota School of Mines & Technology and maintains a Professional Engineering license with the State of California.

BETH VETOVITZ
APPLICATIONS ENGINEER

Beth is a business professional who has 20 years of experience with meeting customers' needs. Her roles have included proposals, customer service and contract management related to equipment modifications and spare parts. She has spent her career supporting customers from many different manufacturing and service industries. She graduated from Temple University with a BBA in Marketing and from De-Sales University with an MBA in Management.

CHARLENE KRATZER
ADMINISTRATIVE ASSISTANT

Charlene Kratzer has joined RMS, Inc. as our Administrative Assistant. She brings with her 2 years of customer relations experience. She is currently continuing to work on getting her Associate's degree in Mathematics at Northampton Community College.