ROTATING MACHINERY SERVICES, INC.

THE FINISH LINE

PHONE 908-859-8440 FAX 908-859-6088 WWW.ROTATINGMACHINERY.COM

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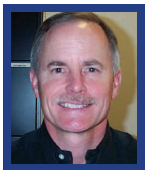
January—June 2005

RMS Newest Additions



Kurt Diekroeger
Sales Director

Kurt joined our staff in early 2004. He brings with him 23 years of turbomachinery experience, including application engineering, product development, project management and field support. His experience includes centrifugal, axial, screw and reciprocating compressors, nitric and FCCU expanders, power turbines and auxiliary systems. He is responsible for all Sales support functions. You can contact him at our Houston Office at 281-340-8520 or his cell phone at 713-898-1015. Email address - kdiekroeger@rotatingmachinery.com

Tony Rubino
Product Manager,
Axial Compressors

Tony joined our staff in December 2004. He brings with him 21 years combined engineering and management experience executing the design, test and manufacture of turbomachinery. Tony's specific areas of expertise include industrial axial compressors, hot gas expanders, frame gas turbine exhaust systems, overall equipment train performance analysis, train operation optimization and root cause failure analysis. He will be responsible for all industrial axial compressor activity at RMS, serving the refining and steel industries. You can contact him at our Phillipsburg Office at 908-859-8440. Email address – trubino@rotatingmachinery.com.

Rich Pittenger
Drafter, 3D/CAD Specialist

Rich joined our staff in March 2005. He brings to RMS, 19 years of drafting experience in rotating equipment, along with a strong background in AutoCAD and PRO/Engineer 3D software. Rich provides engineering support, entailing part inspection, layout (solid modeling) and detailing. You can contact him at our Phillipsburg Office at 908-859-8440. Email address – rpittenger@rotatingmachinery.com.

In The News...

Engineering Success

By Kathy Ehasz

On March 27, 2005, an article on RMS was featured in The Express-Times Newspaper entitled "Engineering Success".

"We saw a need for an independent company to service the refineries, chemical plants, pipelines and we had the experience to be able to do that," said Neal Wikert, Vice President of Projects.

Robert Hinton, a metallurgical engineer in Upper Saucon Township who has collaborated with RMS on jobs, says he has referred large corporations to the Alpha company. Hinton stated that he had just received a call from Sunoco who was very pleased with RMS work.

Rich Lohmann, a combustion turbine engineer with PSE&G Power LLC in Sewaren, NJ says, RMS did (cont pg 2)

Inside this issue:

Special points of interest:

- Bearings
- Steam Turbine Uprates
- Turbomachinery Symposium

Engineering Success (con't from pg 1)

reverse engineer work for parts, a process by which the company redesigns and reproduces pieces coming from an original equipment manufacturer-without the benefit of previous designs or specifications. Lohmann continued to say RMS' parts typically cost less than going to the original manufacturers. "But that's their specialty" he says, "*taking odd, one-of-a-kind stuff and revitalizing it. You get the machine companies, the quality is terrible, the sources are questionable, the expertise is scary,*" adds Lohmann. "*But these guys are very impressive.*"

Robert Klova, RMS President stated "*What we really trade on is our experience. We can provide the most experienced solution. That is what sets us apart.*"

Turbomachinery Symposium 2004

By Kurt Diekroeger

RMS would like to commend the Turbomachinery Symposium Advisory Committee and the Turbomachinery Laboratory on another outstanding event. The 33rd annual meeting included many technical sessions and papers that are very pertinent to our industry. We are thankful for the opportunity to spend quality time with old friends and the pleasure of meeting new ones.

We are looking forward to September 2005. Stop by our Booths 754 & 756 and say hello!

Rule of Thumb - Bearings

By Neal Wikert

Bearings – Tilt Pad
A minimum bearing clearance should be the shaft diameter plus .001". Another way of determining bearing clearance would be .00125" per inch of shaft diameter.

Bearings are considered worn when it is 140% of maximum clearance.

To determine the actual clearance of a tilt pad bearing use the following formula: Actual clearance = Bump check (x) .89

Bearings – Sleeve
The normal bearing clearance is .001" per inch of shaft diameter + .001", i.e. 5" shaft = .006" (5.006"). Alternately, the clearance should be .00125"/inch of shaft diameter.

Bore of normal babbitt bearings carries a 32 finish and is turned. No grinding is done on babbitt because it will clog the grinding wheel. Babbitt begins to melt at 450 degrees F, creeps at 275 degrees F.

Bearings - Thrust
Copper backed shoes and offset pivots can add 20% to typical load capability because of better heat transfer.
Thrust Float – Use .0015" (x) the bearing O.D. For example a 12" O.D. thrust bearing should have .018".

Lubrication
Most common oil is an ISO 32 (150 SSU at 100 degrees F.)

Oil is usually supplied at 110-120 degrees F. and 15-25 psig. Bearings are designed/orificed for specific oil supply temperatures and pressures. Off design supply conditions can starve the bearing and cause overheating.

Temperature Monitoring
Temperature detector placement should located 1/16th inch below the babbitt bond line – Avoid placing into the babbitt.

Alarm at 235 deg. F., shutdown at 250 deg. F.

Quote:

When a train goes through a tunnel and it gets dark, you don't throwaway the ticket and jump off. You sit still and trust the engineer. --Corrie Ten Boom

Steam Turbine Uprates, Preliminary Checks

By Sydney Gross

In the last issue we raised two questions the turbine engineer would ask when looking to rerate a steam turbine. Since you've already decided whether the inlet and exhaust flanges are large enough to pass additional steam at a reasonable velocity, you must now ask, is the shaft suitable for the higher power?

Question 2 deals with the shaft end and its ability to transmit the higher torque. You can conservatively calculate the torque capability of the shaft end, provided you know the geometry and a few other bits of information. Our focus here is shearing the shaft end off from torsion loading. We will calculate a value for the torsional shear stress and compare it to a conservative value for the shear stress limit of the material.

What is a conservative limit for the shaft shear stress? Our experience has shown that using one fifth of the material tensile strength provides a suitable preliminary value. So, if the shaft has a tensile strength of 90 ksi, you would use 18 ksi as the limit. In fact, if you don't know what the shaft is, a 90 ksi tensile strength is a reasonable assumption.

If you're just dealing with a straight, solid shaft of diameter *d*, the equation relating power to torsional shear stress is:

$$\tau = 321{,}000 \times \frac{\text{horsepower}}{N \times d^3}$$

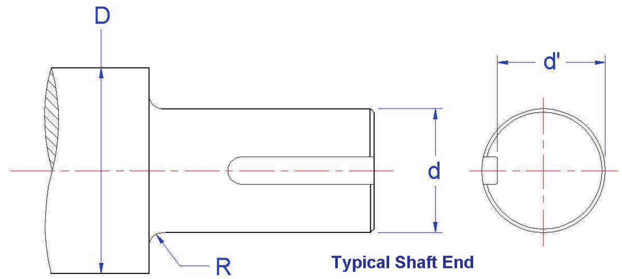
where:
τ *is shear stress in lb/in²*
N *is speed in rpm and*
(cont pg 3)

Steam Turbine (con't from pg 2)

d is shaft diameter in inches.

However, shaft ends are generally not featureless cylinders. They often have keyways and steps in diameters. Calculate the shear stress separately for each area of the shaft. For instance, calculate τ for the area with the keyway first then calculate τ for the area with a step up in diameter. Compare the two and the higher value will be the limiting area.

In order to conservatively calculate the shear stress in the area of a keyway (or two), use the largest diameter circle that will fit completely within the cross-section of the shaft metal. Therefore, if you have a 5" diameter shaft with one ½" deep keyway, use a shaft diameter of 4½". A step up in diameters with a fillet radius is a little more complicated because you need to multiply τ by a stress concentration factor. The factor depends on the two shaft diameters and the fillet radius between them. The most common source of the stress concentration factor is from *Peterson's Stress Concentration Factors*. *Peterson's* is a book of graphs of stress concentration factors for various configurations of stress concentrating features. Stress concentration factors for most applications range from about 1.1 to 2. Rather than go to *Peterson's*, an assumed stress concentration factor of 1.5 is reasonable for a quick calculation.



Typical Shaft End

Once you calculate τ, compare it to your shaft material limit. If you're under the limit, you should be OK. If it's over the limit but close, it warrants some more detailed analysis. If it's way over, well you know.

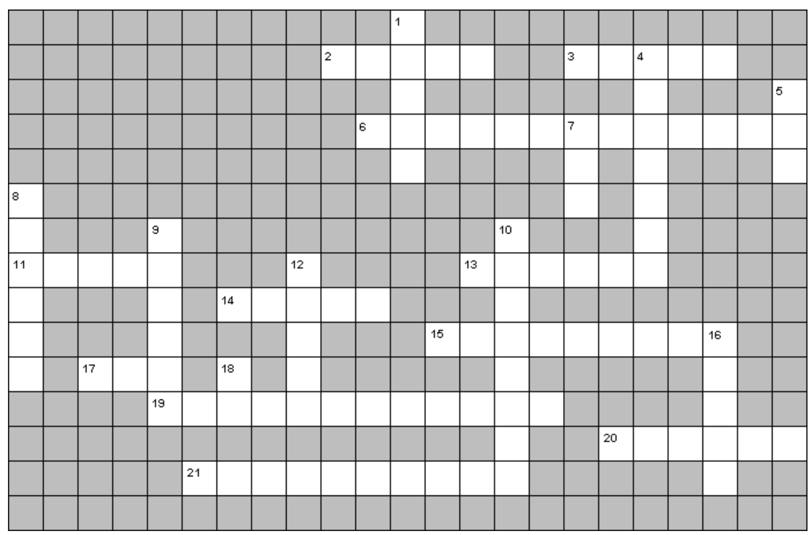
That should get you through the first steps of determining the rerateability of your turbine. Later we will get into some performance aspects of rerating the turbine.

Crossword Puzzle: The World Around Us

Brain Teasers!

1.	faredce	4.	no ways it ways
2.	cotaxme	5.	eeeeeeeeeec
3.	insult + injury	6.	aallll

answers:
1. red in the face
2. Income tax
3. adding insult to injury
4. no two ways about it
5. Tennessee
6. all in all



Down

1. The moon blocks out the sun's surface in a _ eclipse
4. Not reaction
5. Unit of energy
7. In 2004, the number of years RMS has been in business
8. The entire Universe
9. The capital of Montana
10. Changing from liquid to solid state
12. The capital of Afghanistan
16. Third planet from the Sun
18. The ratio between circumference and diameter

(Answers in Next Issue)

Across

2. Deep, lustrous black
3. Enamel
6. The input shaft power, free of mechanical losses which have no thermal effect on the gas
11. Dangerous compressor operating point or caffeinated soft drink
13. Labyrinth seals in an ammonia plant can not be made from ___ like material
14. Shaft of a column
15. Is a strong factor in labyrinth seal performance
17. Maximum number of stages for one compressor body
19. Casing joints that are parallel to the shaft centerline
20. Velocity compounded turbine stage
21. "Make me one with _" said the Zen master

Rotating Machinery Services, Inc.

50 Industrial Drive Bldg #4
Alpha Industrial Park
Phillipsburg, NJ 08865

Phone: 908-859-8440
Fax: 908-859-6088

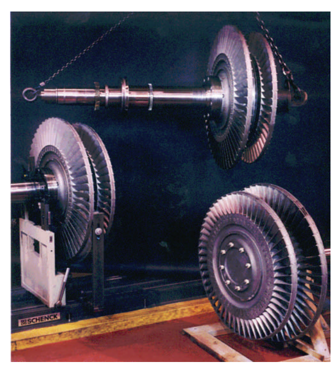
"Quality Service from Start to *Finish*"

We're on the Web!

www.rotatingmachinery.com

Rotating Machinery Services, Inc. provides a wide range of turbomachinery engineering, rerate, overhaul and field services to users of compressors, steam turbines, expanders and gas turbines. ***RMS*** serves the refining, chemical, gas transmission, power generation and steel industries. ***RMS***' experience, expertise and knowledge of a wide range of rotating equipment provides our customers with assurance that their work will be performed by recognized experts in their field who care deeply about their work. It is this dedication to our customers that allows us to provide

"Quality Service from Start to *Finish*"



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