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COPING WITH THOSE LESS-THERAN PERFECT SPECIFICATIONS

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If you are looking for reliable process plant machinery, please realize that almost any machine can be made more reliable by expending additional design, engineering, fabrication, installation and maintenance effort. Unfortunately, with equipment vendors generally being evaluated on as-proposed costs alone, manufacturers are often under pressure to leave off desirable reliability enhancements. A sensible approach to machinery procurement would, therefore, invoke compliance with well thought-out design, manufacturing, and installation specifications [1].

Many purchasers and users of machinery are, of course, opting for this specification approach. However, even such well-known standby specifications as API 610 (Centrifugal Pumps for General Refinery Services) are not always sufficient. First, the user of this specification should realize that, like other API specifications, API 610 contains a large number of clauses which require that the purchaser exercise an option. The pertinent paragraphs typically start with: “When specified ….”, or “With the purchaser’s approval……,” etc. Obviously, these caveats should compel the specifying authority to take a very close look at this or, for that matter any other, API specification for process machinery.

An owner’s review is beneficial since it will impart to the specifying engineer an awareness of what it is he or she is asking for and hopefully, what might be missed by not asking for enhancements.

API or other industry specifications are not, however, used as stand-alone specifications by the best petrochemical and refining plants in the Western World. The leading users of, say, centrifugal pumps recognize that specification supplements or amendments may be in order. These users are cognizant of the various qualifying clauses given in the FOREWORD to one of the typical editions of API: “The purchaser may desire to modify, delete, or amplify sections of this standard…,” or “standards are not intended to inhibit purchasers or producers from purchasing or producing products made to specifications other than those of API.” Appropriately, the American Petroleum Institute expressly disclaims any liability or responsibility for loss or damage resulting from the use of its standards or for the violation of any regulation with which the standards publication may conflict.

We consider the API’s stance entirely reasonable and simply wish to bring to the user’s attention that even a well-written industry specification may merit amendments and additions if extended life of machinery, reduced maintenance frequency and lower equipment repair costs are desired.

A case in point would be API Ninth Edition (January 2003) Paragraph 3.33, which does not list oil rings among the wear parts to be replaced during pump overhauls. Of course, The API standard also doesn’t mention the locations where oil rings are not the preferred solution of reliability-focused users. The standard thus leaves the choice to the pump manufacturer.

Experience shows, however, that unless a shaft system is installed perfectly horizontal, oil rings run downhill and often make intermittent contact with a stationary interior part of the bearing housing. Then they slow down and become unstable. Worse yet, they will now abrade—-you can see loss of chamfer after a few months of operation. The wear product contaminates the lube oil, which causes bearings to fail very rapidly. Often, the lube oil turns gray in color, which is due to fine oil ring debris. Note that not even laser optic alignment tools ensure horizontality. And aren’t we putting shims under part of the assembly? What does that do to horizontality?

Moreover, oil rings become unstable at certain linear speeds which causes reliability-focused users to question the applicability of oil rings in modern pumps. Oil rings are "immersion-sensitive"----more oil, more drag. They are "viscosity-sensitive," meaning thicker oil results in more drag. They are also extremely sensitive to both out-of-roundness and rough RMS surface finish.
Combine all of the above and you'll probably end up with a "safe" DN-limit (inches of shaft diameter times rpm) of somewhere around 6,000. That's an experience-based limit; it was also used in a major multi-national oil company's lube marketing-internal training courses. Invoking this “safe” limit will perhaps allow a certain amount of deviation from perfect shaft horizontality, ideal ring depth of immersion, oil viscosity, ring concentricity and ring I.D. surface finish (recommended to be 32 RMS). Unfortunately nobody knows how of a deviation from ideal values occurs in operating equipment, or what combination of deviations will bring on ring instability.

We cite this as just one of hundreds of examples of why it is often to the purchaser’s advantage to amend or add specification paragraphs. In such areas as cooling of bearings and pedestals, an up-to-date user would perhaps even see fit to go beyond the point of questioning the vendor on the need or effectiveness of the pertinent API clause. We know of many reliability-focused users who have improved equipment life and / or substantially reduced the risk of pump fires by disallowing the use of cooling water in rolling element bearing housings and pump support pedestals.

As regards pedestal cooling, the January 1977 issue of Hydrocarbon Processing carried an article which stated: “Over eight years experience has proved that pedestal cooling is not required for any centrifugal pump in petrochemical plants. Pumping services with fluid temperatures as high as 740°F (393°C) require only hot alignment verification between driver and pump.” [2] Note again that these reliability improvement measures were known 30 years ago and openly published in 1977!

Bottom line: To stay on top of cost savings and reliability improvements, look to the industry leaders and supplement your equipment specifications by making use of their experience.

References:
