ISSUE 0506

SCHENCK
Balancing and Diagnostic Systems

balancing news

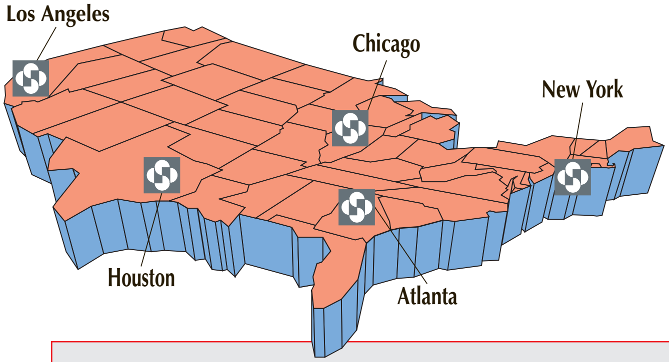
Information for the quality and performance of rotating equipment - From the Schenck Balancing & Diagnostic Systems Group

Complete Balancing Services... Nationwide!

The previous issue of *Balancing News* spoke about our new Balancing & Vibration Analysis Service Center in Santa Ana, CA, which was a "new milestone in Schenck Trebel's continuous endeavor to expand its operational base and become an even more customer–oriented company."

Bertram Dittmar, President /CEO

Since then, the members of our organization have been working hard to establish similar service centers at other key locations around the country. We are proud to report that there are now five regional Schenck Balancing and Vibration Service Centers around the country that are staffed, fully-equipped and at your service.



In the past few years, the dynamics of a changing economy have forced nearly all manufacturers to reevaluate and restructure their business models to remain competitive. You, as our valued customer base, have changed the composition of the market that we serve, and we in turn are responding to your needs.

The manufacturers, overhaul shops and service providers that we provide our equipment to have become more dependent on the services that we provide in an effort to streamline their balancing operations and reduce cost. Many have decided to outsource their balancing needs so they can focus on their core business more effectively.

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Reducing The Time And Cost Of Balancing Pump Impellers

by Keith Donaldson

Balancing pump impellers is necessary to ensure a quality product with a long life cycle free of problems and down time. Among other things, balancing is critical for minimizing vibration and increasing bearing life.

However, as most people familiar with balancing can attest, it can be a time consuming and costly operation if modern equipment is not used.

To get started, a typical balancing operation consists of physically setting up the balancing machine to accommodate the rotor at hand and setting up an electronic file in the instrumentation. The impellers then are typically mounted on a tooling arbor, loaded onto the balancing machine and run up to obtain unbalance correction data. High production facilities are able to streamline the balancing process by using one setup and storing electronic files for high quantities of the same rotors.

However, repair and maintenance shops do not have that luxury. They must repair an assorted variety of

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Reducing The Time And Cost Of Balancing Pump Impellers

by Keith Donaldson (Continued from page 1)

impellers on an as needed basis and most often the quantities are very low. There are other ways, however, to streamline the process and reduce time and costs.

HARD BEARING BALANCING MACHINES

Proper selection of a balancing machine should be first and foremost when implementing a sound and efficient balancing operation. There are two types of balancing machines on the market: hard-bearing and soft-bearing.

The main difference between the two technologies is the characteristics of their suspension systems. A soft-bearing balancing machine refers to a flexible vibratory system and determines unbalance by measuring displacements in the pickups. A hard-bearing machine is characterized by a rigid suspension system and measures unbalance forces caused by the unbalance. Hard-bearing balancing machines were developed in the early 1950's to overcome the shortfalls of soft-bearing technology. There are advantages to balancing impellers on hard-bearing balancing machines versus their soft-bearing counterparts.

Schenck hard-bearing balancing machines are permanently calibrated for an entire range of impellers, and the calibration becomes a built-in

Hard-bearing balancing machine saves time by eliminating the need for numerous calibration runs

function of the machine. Accordingly, a significant amount of time is saved by eliminating a series of calibration runs for each impeller. In contrast, a soft-bearing machine requires a new calibration for each impeller type. In a repair shop, where there are very low quantities of like rotors, the time and cost savings becomes especially apparent. It should be noted that not all hard-bearing balancing machines are capable of permanent calibration over a wide range of speed. The user should verify the manufacturers claims prior to selecting a balancing machine.

Hard-bearing balancing machines also have a more rugged design. Although extremely sensitive, the hard-bearing suspension system contains no loosely fitted joints, bridge locks, or other moving parts subject to damage by windage, wear, chips or dirt. They can withstand forces caused by large initial unbalances in the rotor that could otherwise damage a soft bearing machine. Thus, costs associated with downtime and replacement parts are kept to a minimum. Additionally, the hard bearing design is typically more suitable for measuring unbalance at lower speeds. Especially for larger rotors, this is a big advantage in saving acceleration time and drive power.

TOOLING REQUIREMENTS

Significant cost savings can be realized by the proper selection of tooling arbors used to balance the impellers.

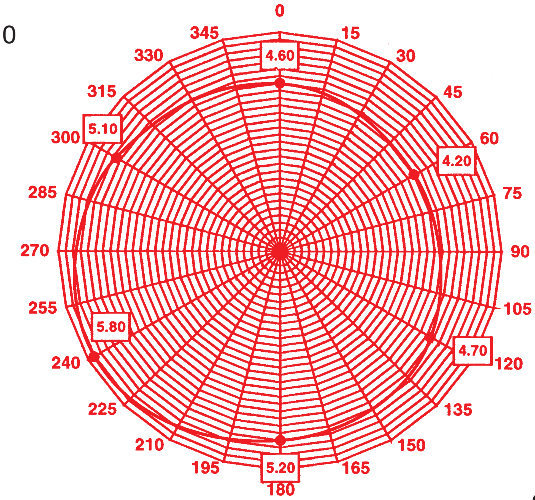
Mechanically expanding tooling avoids the need to make custom arbors

It is not uncommon for pump repair shops to repair a wide variety of size and shaped impellers. Accordingly, the bore sizes and corresponding tolerances also vary from part to part. Because of these variations, shops may be forced to machine a new arbor for a particular impeller, which needless to say, can incur a significant cost to the balancing operation. Over time, a shop can make many different sized arbors and come to have quite a collection of tooling. The collection of such a wide array of tooling can then pose its own set of problems associated with their inventory and storage.

Mechanically expanding tooling arbors can be a simple solution to this dilemma. Mechanically expanding tooling is very easy to use and can save a significant amount of time for loading and unloading the impellers. The tooling consists of a tapered arbor and a mechanically expanding collet. The gripping force comes from the collet as it slides up the tapered shaft to fit into the bore. A tooling package of this kind can consist of five individual arbors that can cover a bore range of several inches. By accompanying such a wide range of bore diameters, a shop can significantly reduce up front capital expenditures on tooling and decrease the time and costs associated with tracking and storing tooling arbors. As with all tooling, however, proper evaluation of tolerances and repeatability should be evaluated prior to implementing into the balancing operation.

API STANDARDS

API Standards, in particular, API 610 and API 617, outline a procedure for the determination of residual unbalance. The test requires the operator to attach a trial mass to the rotor sequentially in 6 (or 12) equally spaced radial positions for each plane and record the unbalance results. The unbalance results must then be plotted in terms of amplitude versus angular location. The polar plot is then used to indicate the actual residual unbalance present on the rotor correction plane. Comparing the actual residual unbalance to the maximum allowable residual unbalance determines if the actual residual unbalance is acceptable. Anyone familiar with the test will agree that while this is an effective tool to ensure that an impeller is within tolerance, it can also add considerable time to the balancing operation.



Residual Unbalance Poler Plot from API 617 (Reproduced courtesy of the American Petroleum Institute) with "best fit circle," the center of which represents the residual unbalance.

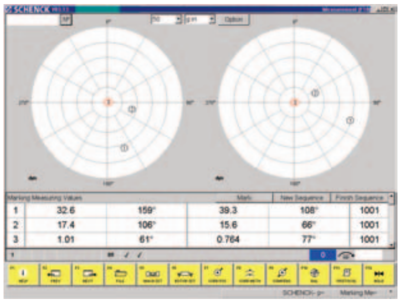
A residual unbalance software package can streamline this procedure. The software will automatically calculate the maximum allowable residual unbalance for the rotor, populate the charts with the unbalance data, plot the data, and give a pass or fail indication at the end of the procedure. Relatively inexpensive, the software will save countless hours in performing this procedure and provide a quick return on investment. In addition, the software has the added benefit of reducing human errors associated with data entry, calculations, and plotting. It also allows the test data to be stored and transferred electronically.

UNBALANCE CORRECTION SOFTWARE

Balancing operations usually require an unbalance correction – the addition, removal, or shifting of mass – in order to bring an unbalanced rotor into a specified balance tolerance. Most common among impellers is some form of mass removal such as grinding, milling or drilling. In order to minimize the time to correct a rotor, it is imperative that the operator brings the rotor into tolerance in as few correction steps as possible. To do so requires the operator to have the ability to make accurate corrections in terms of both precisely locating the angle of correction on the rotor and removing accurate amounts of material. These two factors have a direct impact on the number of correction steps and therefore the time needed to balance the rotor. Fortunately, there are tools at our disposal designed specifically to assist the operator with these aspects of the correction process and thus minimize time.

Precisely locating the angle of correction is very important considering that an unbalance angle correction error of only 6 degrees would create an overall amount error in excess of 10 percent. Of course this error will result in additional time to complete the balancing task. An electronic protractor aims to minimize these errors. It works by providing an indication when the correction location on the rotor is top dead center, or some other pre-established correction reference angle with an accuracy of 1 degree. With such an accuracy, the number of correction steps can be greatly reduced making the protractor an important time saving aid.

A mass recalculation program is useful for automatically calculating the amount of material to remove based upon the unbalance measurement readings. For drilling or milling corrections, the software will automatically calculate a precise drill depth or plunge of the end mill to correct the unbalance. For hand grinding corrections, which is a more common correction method used in repair shops, it is helpful to mark the correction steps as numbered dots directly on the instrumentation display, like waypoints of a node.



A mass recalculation program provides an effective visual to fine tune the correction process.

These time-and money-saving software features are available on all modern Schenck instrumentations with vector meter displays. This feature will initially mark an unbalance reading so that after the hand grinding operation the operator can see the effect of his correction. Adjustments in the amount and angle can then be made to any subsequent corrections.

IN SUMMARY

It will always be necessary to balance impellers because of the impact balancing has on the quality of the final product. However, just because it is necessary to perform a balancing operation does not mean that we should accept inefficient methods because previous practice dictates. Instead, we should be continually analyzing the operation and looking for ways to improve. In many cases, small upfront investments can reap big benefits in the long run.