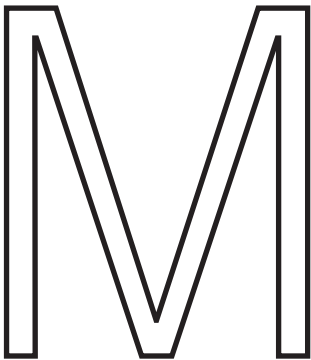


THE MISSING LINK?



DIMENSIONAL TOLERANCE IS CRITICAL COMPONENT OF ANILOX PERFORMANCE

■ By Art Ehrenberg



Most articles and technical presentations on anilox rolls seem to fall into four categories:

- Engraving (geometry, line screen, depth-to-opening ratios, etc.);
- Lasers (pulsed CO₂, constant wave CO₂, YAG);
- Ceramic coatings;
- Cleaning, care and maintenance.

All of these issues are very important and need to be studied and understood to develop a system around this component that will result in consistent printing. However, there is much more to anilox rolls that printers and anilox suppliers need to be concerned with in order for these critical components to perform correctly. The subject is dimensional tolerances.

In Part 1 of this two-part series, we will look at some basic aspects of anilox roll dimension tolerances: bearings, bearing surfaces, gears and balancing. In Part 2, total indicated runout (TIR), circularity, concentricity and cylindricity will be discussed, as well as how these aspects of anilox roll dimensioning are often confused.

No matter what cell geometry, line screen or depth-to-opening you're using, what type of laser was utilized to perform the engraving, what level of quality the ceramic is or how well you clean and maintain your rolls, these rolls will not perform without proper dimensional stability.

Components such as bearing surfaces diameters, gear step diameters, key ways, balancing, TIR (total indi-

cated runout), cylindricity, circularity (roundness), engraved surface diameters etc. all must fall into certain tolerances in order for the rolls to perform properly. Often these subjects are taken too lightly, or the effects of these areas being out of tolerance are not fully understood. Let's take a look at some of these dimensions and tolerances.

Bearings and Bearing Surfaces

Bearing surface diameter sizes need to be within the tolerance that is specified by the bearing manufacturer. These specifications can vary depending on the type of bearings used and the fit required. Different bearings have different tolerances in respect to the bore size (I.D.), the outer diameter (O.D), the allowable run-out, the load rating, etc. The run-out tolerance for a bearing is the allowance given for the bearing's inner race to run out of round or in an eccentric condition from its absolute center axis. This tolerance may be described in various ways, and we will address "run out" and "roundness" a little later.

Today there are a number of printers who do not have blueprints for their presses and do not know what the bearing surface outer diameter tolerance or run-out allowance of their rollers should be. Yes, this is the year 2002, and one would assume this not to be true, but it is. The easiest way to find out is to call the press manufacturer. Another way to find a bearing surface size is to locate the bearing manufacturer's name, which is usually stamped on the bearing housing along with the bearing number. Then call a bearing supplier to get the specifications. The table below is an example of the diameter tolerances for a particular brand of a flange-mounted bearing. With this information, you can determine the required tolerance of the size for the bearing to fit properly.

Shaft Tolerances

1/2" – 1-15/16"	Plus .0000" to minus .0005"
2" – 3"	Plus .0000" to minus .0010"
3-3/16" – Up	Plus .0000" to minus .0015"

Bearing Bore Tolerances

1/2" – 5/8"	Plus .0008" to minus .0000"
3/4" – 1-15/16"	Plus .0009" to minus .0000"
2" – 3"	Plus .0010" to minus .0000"
3 – 3/16" Up	Plus .0012" to minus .0000"

As an example, by using this table for this particular bearing, you can see that if you have a bearing with a bore size of 1/2 inches (.500 inch), then one possible tolerance for the bearing surface, called here the "shaft tolerance," would be .500-inch maximum diameter to .4995-inch minimum diameter. (The shafts on the ends of anilox rolls are also sometimes referred to as "journals.")

As an anilox supplier, I have seen countless complications while trying to help customers with tolerance issues. Some rolls we see for reconditioning are from older or modified presses or acquired used presses, and no blueprints for the anilox are available. Since we as the anilox supplier are responsible for the performance of the entire roll, we have to know the size for verification. The response by many customers is, "Don't worry about repairing them, they looked good when we took the rolls out." Other customers get a little upset when we have to tell them the bearing surfaces need repair for being undersized, and that there will be additional charges for that service. Some customers won't pay the additional charges, and say "Let them go." Later, they wonder why they are going through bearings so quickly, or why they are having printing complications.

Undersized bearing surfaces can cause roll chatter and alignment problems, and they may reduce the life of the bearing and destroy the bearing surface on the shaft. Poorly maintained bearings can freeze up during operation, causing severe damage to shafts, sometimes to the point of requiring total replacement of shaft steps.

Maintenance crews or anyone removing old bearings and installing new ones should take care that no excessive damage is done to the bearing surface or the bearing itself. We see hundreds of rolls per year that have gouges, nicks and dings on critical shaft dimensions or roll face



edges caused by hammers, screw drivers, bar stocks and any imaginable tool that could be used to beat a bearing off a shaft.

A general rule of thumb is: **DO NOT BEAT BEARINGS ON AND OFF SHAFTS.** Mishandling during installation of bearings can also cause bent shafts, which can cause excessive TIR (total indicated runout) that can lead to printing problems and reduced bearing life. TIR, in respect to the anilox roll, is the comparison of how well the roller body (engraved area) runs concentric to the bearing surfaces on the roll shafts. Generally speaking, a bearing shaft should have a TIR of no more than .0005-inch. In Part 2 of this series, TIR will be discussed in greater detail.

Invest in a good bearing puller for the removal of bearings, and follow bearing manufacturer instructions for installing them. A bearing warmer can be used to expand the bearing race slightly before installation for more of a shrink fit, or to simply aid in the installation. When you are installing internal bearings, put the bearing in a freezer for an hour or so to shrink the bearing so it drops into the bore, then seals as it come to ambient temperature. In addition, take care that the bearing shaft surface is free of rough spots and burrs. Also make sure the bore of the bearing for O.D. fits – or the O.D of the bearing for I.D. fits – is clean. It is also a good idea to apply a very thin oil film to the matting surfaces before installation. A slight radius on the bearing surface step or chamfer on a bearing bore will also make the installation easier. If you improperly install a bearing, it can be damaged or can remove surface area from the bearing surface or bore surface. The result is that these surfaces will be out of round or improperly sized, which will affect future fits and possibly lead to TIR problems. This can affect print quality and add unnecessary costs to the reconditioning of your rolls.

Most "standard inch" bearings used for printing applications will be installed to an RC, or "running and sliding," fit. This fit does not require pressing or other means of excessive force for the bearing to be installed. It is typically used for high-precision fits, gauges, high-friction machinery and most all other moving parts.

No matter what cell geometry, line screen or depth-to-opening you're using, what type of laser was utilized to perform the engraving, what level of quality the ceramic is or how well you clean and maintain your anilox rolls, they will not perform without proper dimensional stability. (Photo courtesy of The Harper Corp.)

Gears

Gears on the anilox roller shafts follow the same handling, mounting and removal rules as bearings. As with bearings, when gears do not

fit properly, “chatter” or harmonic vibrations may result, which can damage shafts, keyways and gears.

When a keyway becomes excessively worn, it is usually acceptable to mill a new keyway 180 degrees from the old one in the same shaft. One crucial area to focus on when milling new keyways is centering: It must be exactly centered on the shaft. If not, the key will not fit. Proper length and width of the keyway is important for a snug fit, as is the use of proper mills for the correct keyway shape. Verification of keyway width should be done by gauge blocks and not dial calipers.

Another troublesome issue with gear steps is a lack of attention to the steps TIR. Severe TIR on any step of an anilox shaft can be a problem. This can lead to “gear chatter” caused by gears bottoming out or uneven matting of gears, which, if severe enough, can result in the chatter effect transferring a pattern to the printed substrate. This condition will also wear gears prematurely.

Mishandling is usually evident by excessive scratches and gouges on the gear steps and possibly on neighboring steps (when the hammer slips). Scratches and dings on shaft steps may just be cosmetic issues and may not necessarily require extensive repair. They may just cause difficulty in removal or installation, and may simply require a filing to remove burrs or displaced metal. Where the anilox supplier has issues is when the damages, which may only be superficial, interfere with obtaining measurements for specification verification.

Gear steps can have a TIR of around .005-inch without affecting the performance of the roll, but this will vary depending on the press manufacturer and gear tolerances. Some OEMs have very tight tolerances on these steps due to designs that are vulnerable to shafts flexing. In this way, the tolerance will allow for some flexing without hindering the performance of the roller. All anilox suppliers should be checking for bent shafts and damages on all roll shaft steps during the initial and final inspection stages of the process, and should be documenting them. Particularly on the initial inspection of used rolls, alerting customers to bent and damaged journals will help them address the problem internally, which will hopefully result in modifying practices and procedures to reduce the damages and subsequent cost of repairs.

In most cases, the person ordering the anilox is not the person installing or removing it, so communication of these issues needs to be clear among all parties. Often, poor communication leads to finger-pointing sessions. This is all the more reason why good documentation/communication on the part of the anilox supplier and the customer is so important.

Balancing Procedures

Balancing of anilox rolls can be a critical factor, depending on the press tolerances and the nature and

quality of the printing required. There are two types of balancing procedures: static and dynamic. An analogy is the balancing of car tires. The old bubble balancing is the static procedure; spin balancing is the dynamic procedure.

An unbalanced roll can lead to harmonic vibration at different speeds, just as with a car tire, and can cause all sorts of problems on press. Anilox suppliers should be checking for this condition during the initial inspection stages of anilox reconditioning, and should report the findings to the customer. It is quite common (particularly on larger rolls, such as for corrugated) to see balancing weights welded on the inside of the tubing when the roll was manufactured. In some cases, the weights break loose, which will result in an unbalanced condition. In most cases, you can hear the weight rattling around inside the tube, alerting you to the condition.


Sometimes loose weights can get caught up in and be muffled by other debris left inside the tube during manufacturing. The more appropriate balancing technique would be to drill out amounts of material at each end of the finished roll face and either leave them empty to reduce weight in that area or insert a rod stock of steel to add weight if needed. Then tack-weld the rod in place. If the raw tube is too far out of balance, however, welded-in weights may have to be used. Proper dynamic balancing is usually done to a specific roll RPM or FPM (surface feet per minute).

Balancing is usually not required on narrow-web rolls because many are manufactured from solid stock rather than tubes. The size of the roll, construction practices and the nature of the running dynamics of most narrow-web presses are different from presses with larger rolls.

When manufacturing new anilox roll bases for any wide web or corrugated press, top-quality tubing should be utilized to reduce the amount of mechanical balancing required.

I prefer to see a “hot rolled seamless” tubing of a very high grade, which guarantees that the tubing wall thickness is uniform to a tighter specification, and in turn reduces the need for excessive balancing.

As with most everything in life, you get what you pay for, and high-grade tubing comes with a price. Pricing in high-grade tubing vs. low-grade can be significant. Your anilox supplier should have a specification for a high-grade tubing for all new anilox rolls.

Understanding your anilox rolls’ dimensional specifications and how they relate to your press, its print performance and anilox maintenance is key in reducing downtime, saving money and maintaining high quality. 

About the author...

Art Ehrenberg is vice president of operations for Harper Corporation’s Green Bay Division. He has held numerous titles within the organization, including plant manager at the company’s Charlotte, N.C., headquarters from 1990 to 1996. He has been associated with the flexographic industry for 21 years.