A Primer in Master Ring Philosophy: AGD vs. DIN Style

George Schuetz, Mahr Federal Inc.

In today's manufacturing environment most people are comfortable working to the industrial standards that are applicable to their region. In the US, the standards might originate from any one of several groups with acronym names such as ANSI, ASME, AGMA, or other, depending on what products are being manufactured.

However, if a company wants to be a player in the global market they must be familiar with—and potentially use and manufacture products to—standards from other regions and countries. It's not uncommon for each country to have its own standards (often derived from other regions) and thus demand slight differences in products or features. For example, one would have to know DIN and ISO Standards for Europe, JIS Standards for Japan, and SAC for China.

As a manufacturer of precision rings, we manufacture and inspect the rings for the US to the ASME B47.1 Standard that defines the gage blanks, and then to another ASME Standard, B89.1.6, for final inspection and classification.

A master ring, or ring gage, is basically a bore of known dimension used as a setting master for variable inside-diameter gages such as bore gages, air tooling, and mechanical plug gages. The ASME standards define the rings in classes, with XXX indicating the tightest tolerances; XX, X and Y denoting intermediate grades; and Z the lowest. Class tolerances vary by size: larger sizes have more open tolerances since they are harder to manufacture.

For Example, for a 0.820" master ring the following tolerances would apply:
Class XXX = 0.00001"
Class XX = 0.00002"
Class X = 0.00004"
Class Y = 0.00007"
Class Z = 0.00010"

Of course, the better the class the more you have to pay. If you want to stay at a 5-star hotel or get the highest grade for your engagement ring, be ready to pay for it. It's the same with master rings. The XXX ring is manufactured to a tighter tolerance, and there is cost involved with this. It may take longer to manufacture, take the skill of a more highly paid technician, or if something goes wrong, may have to be remanufactured and take longer to deliver.

This Class philosophy comes from the way we tend to master our gages here in the US. The idea is to make a master as close to the nominal size as possible, and then set the gage display to read zero when the master is placed on the gage. Nice and easy. But as also noted, this can be a cause for added cost, longer delivery time and shorter life for masters when the highest grade of masters are specified.

In much of the rest of the world, DIN masters (or some derivation of these standards) have been adapted by industry. For master rings, DIN Standards DIN 250 A, B & C are pretty much used to manufacture and measure the precision rings. In both systems, a precision hole is bored in a piece of steel, and precisely refined to a known size, form and surface finish. But in the DIN world, things are a bit different, both in terms of physical dimension and mastering philosophy. As an example, let's look at some of the small differences between an AGD and DIN Type B ring that is used for mastering air gaging.

The size of the blank, or "hole holder," for example, is not too much different as seen in Figure 1. Note that there is a slight difference in the physical size of the ring blanks used for the masters. Not much, but even to the casual user, it's obvious that there is a difference between the two.

The real difference comes in the tolerances on the bore. This is very reflective of the way the master ring is used in the philosophy of the mastering routine. Look at the example in Figure 2.

As you can see, the diameter tolerance for the DIN ring is twice as much as a Class X AGD master ring: for this size, 2,5 μm for the DIN and 1,02 μm for the AGD. But on the other hand, the roundness is tighter in this area. So what is being said here is that it's really not important what the actual size of the hole is: so long as it's round, the surface finish is good, and the shape is cylindrical, then by knowing the size and using it as part of the mastering routine you can get the best results from the mastering process. What's also different is that the deviation from the nominal (within the spec) is marked on the master ring. This way, the user knows what the deviation is and can use it as part of the mastering routine.

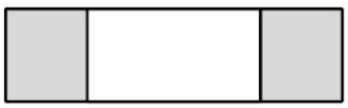
Thus, the difference in the mastering philosophy is a result of the way the standards are used. With the DIN philosophy, the deviation of the master itself is used to improve the performance of the mastering process, rather than trying to build greater accuracy into the master. In a sense, the DIN master is more like a known reference point than an absolute mark.

However, it also requires more capability of the gage users on the shop floor. It takes a little more awareness and calculation to use these master deviations. That's something we may not want machinists to have to worry about here in the US. Our philosophy is to make it as simple as possible. Thus, we use the grades and high precision masters rather than a high precision technique

Something that we have discussed in the past is the way tolerances keep shrinking. Maybe we will get to the point in the future where we can't make the masters good enough, or the cost of that quality will simply become too prohibitive, and the mastering technique using the deviation will eventually catch on.

Figure1.jpg

- DIN Ring Dimensions
  - For 51 mm ring



    - OD = 100 mm
    - *Type B Thickness* = 32 mm
  - For 12 mm ring
    - OD = 38 mm
    - *Type B thickness* = 14 mm
- AGD Ring Dimensions
  - For 51 mm ring

    - OD = 102 mm
    - Thickness = 38.1 mm
  - For 12 mm ring
    - OD = 34.9 mm
    - Thickness = 19 mm

Figure 1 shows that there is a slight difference in the physical size of the ring blanks used for the masters. Not much, but even to the casual user, it's obvious that there is a difference between the two.

Figure2.jpg

- DIN Master Rings
  - We will look at *Type B* rings used for Pneumatic applications
  - Example 51 mm
  - Mahr Model *6105* Standard DIN Spec
    - Cylindricity tol = 0,1 IT4 = 0,8 µm
    - Rz = 0,4 µm
    - Size tolerance for Dia = JS 3 = ± 2,5 µm
  - Mahr Model *6107* Better than DIN Spec on cylindricity
    - Cylindricity tol = 0,1 IT3 = 0,5 µm
    - Rz = 0,4 µm
    - Size tolerance for Dia = JS 3 = ± 2,5 µm
- AGD Master Rings
  - Example 51 mm
  - Class X
    - Surface Ra = 0,2 µm
    - Diameter Tolerance = ± 1,02 µm
    - Roundness = 1,02 µm
  - Class XX
    - Surface Ra = 0,1 µm
    - Diameter Tolerance = ± 0,5 µm
    - Roundness = 0,51 µm
  - Class XXX
    - Surface Ra = 0,1 µm
    - Diameter Tolerance = ± 0,25 µm
    - Roundness = 0,25 µm

Figure 2. The diameter tolerance for the DIN ring is twice as much as a Class X AGD master ring: for this size, 2,5 µm for the DIN and 1,02 µm for the AGD. But on the other hand, the roundness is tighter in this area. So what is being said here is that it's really not important what the actual size of the hole is: so long as it's round, the surface finish is good, and the shape is cylindrical, then by knowing the size and using it as part of the mastering routine you can get the best results from the mastering process.