

Diamond dressing rollers

A grinding wheel in aluminum oxide (also known commonly in ceramic) very often to be dressed, that is, his profile should be re-shaped for two main reasons:

- *Why no longer cuts, ie cutting edges of individual grains were crushed and the interstices between grain and grain were filled with chips. The grinding wheel is no longer able to "bite" the piece, slides on the surface to be machined producing a large amount of heat, raising the temperature at the point of contact up to change the structure of the processed material (burns).*
- *Because the original profile has changed and the piece no longer has the right size.*

Keep in mind that in many cases the tolerances on the profiles of certain parts are of the order of a micrometer, and very often is required to dress the grinding wheel after each diamond piece. The grinding wheel can be dressed in different ways.

The simplest is to use a single-point diamond that follows the profile of the wheel.

Today with CNC machines this is no longer a problem. The problem becomes important if your profile is long and if it is a symmetrical radial plane.

In these cases the time of dressing becomes large and must also use two different diamonds. In addition there are almost always problems of durability of the diamond and a certain difficulty for its exact positioning when it must be replaced.

A more rational system for the dressing the profiles, is to use a diamond disc that has a much longer life, it is not difficult to replace, and can work on both sides of a profile. Also has the advantage of being able to perform different profiles without a change in its position.

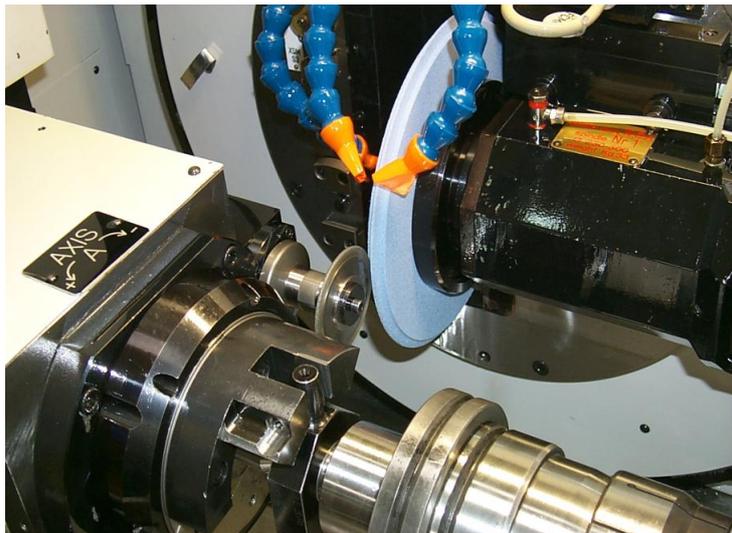


Figure N°1 – *Diamond disc mounted on the dressing unit of a gear grinding machine*

In figure N°1 you can see a diamond disc which is capable to dress a grinding wheel to execute the profile of a tooth of a gear (gear grinding with form method).

Even this system is good for simple profiles, with a short path, because otherwise the time of dressing become too large.

If you need to perform complex profiles of large production where time really is money, it is more convenient to use the diamond rollers.

They are of particular tools that are able to reproduce, in a very precise manner, their shape on the abrasive wheel, and this in a very short time thanks to the fact that with a short working radial stroke the whole profile is shaped at the same time.

The life of these rollers is very large and the profile is maintained perfectly for thousands of pieces, this allows a remarkable size uniformity on the pieces produced, what this essential in many types of pieces.

The most obvious case is for example the profile of the grooves of the bearings, where the balls are housed.

The production of bearings is very high for each model and the seat of the balls must be always the same, with tolerances of a pair of micrometers. Here you will normally use the diamond rollers for shaping the grinding wheels.



Figure N°2- Some types of diamond rollers

The production of these rollers, however, is far from simple and requires a effort particularly intense at design and testing.

In the figure N°3 are represented some types of profiles more or less complex that can be obtained on the diamond rollers.

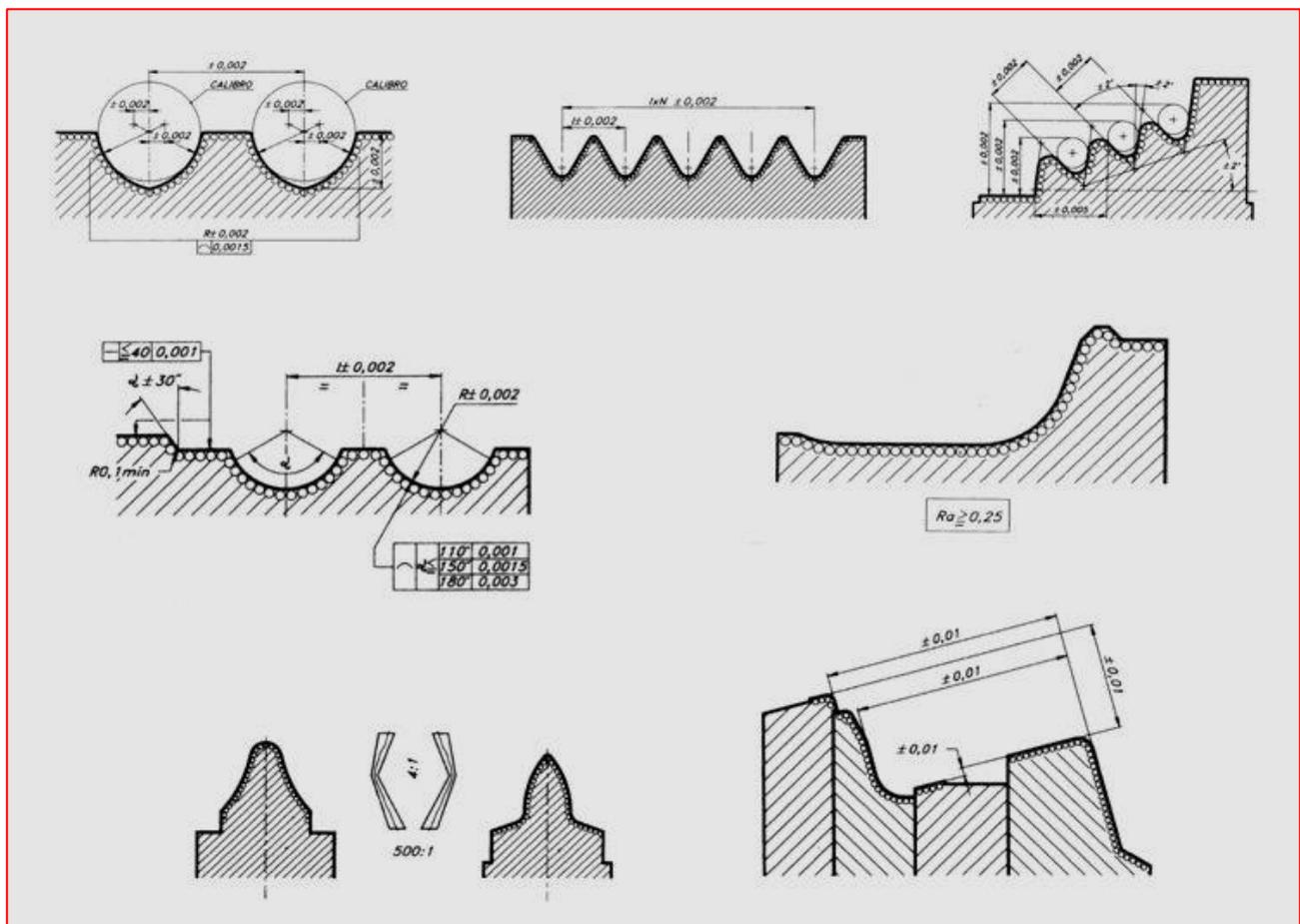


Figure N°3- Some types of profiles obtained on the diamond rollers.

There are several techniques of manufacture of diamond rollers that are applied according to the needs of working which they are dedicated.

Galvanic process positive

With this method one can obtain only coarse tolerances and are therefore used in all processes where a high accuracy is not required.

On a metallic basic body, having the shape of the roller, are applied the diamond grains with a galvanic process.

The size of the diamond grains (mesh or granulometry) and the complexity of the profile greatly influence the precision of the final profile.

But the rollers of this type are those more economical because obviously manufacturing costs are lower.

Galvanic process negative

In this manufacturing process is constructed previously one negative mold of the profile of the roller.

The internal surface of this mold is coated galvanically with a layer of diamond powder that is then distributed statistically.

This layer of diamonds will form the outer surface of the diamond roller.

The rollers of this type allow to obtain very tight tolerances without the need of a finishing operations.

Since the grain size is relatively very small, you can get profiles with minimum curvatures. For example, the concave curves may have a radius of 0.04 mm and those convex radii of 0.1 mm.

The concentration of diamonds is normally very high and thus also its life.

Negative galvanic process with diamonds placed by hand

In this method are used diamonds larger that are placed by hand according to a well-defined pattern inside a negative mold.

Figure N° 4 shows a phase of this operation.

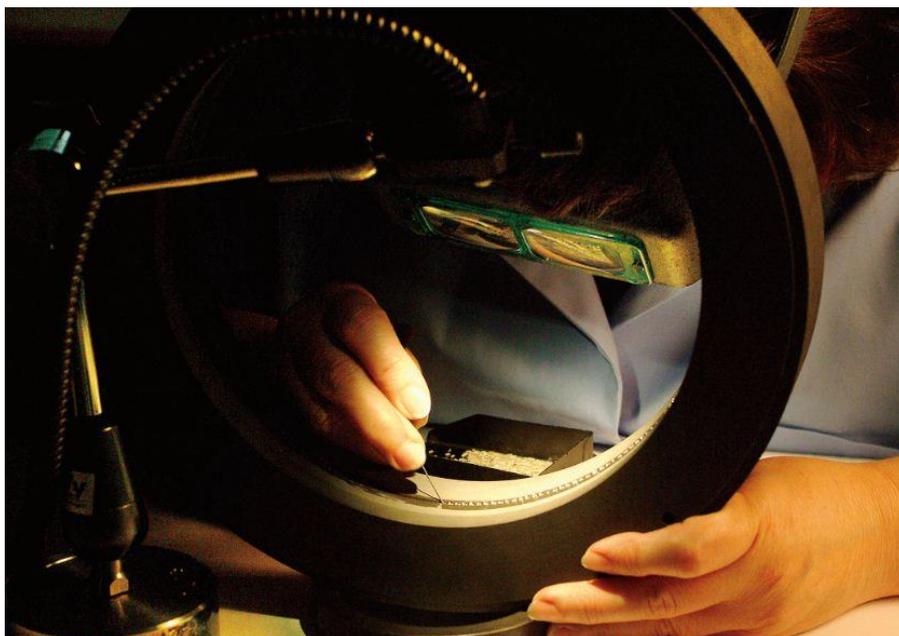


Figure N°4- Positioning by hands of diamond grains

Due to the size of the diamonds cannot be made profiles with small curvature (small radius).

Subsequently, with a galvanic process is applied a special powders that block the diamonds generating the surface layer of the roller; in this case is often required a finish operation of the surface in order to remove the peaks and correct any small imperfections. However, this operation removes only a few micrometers.

Negative galvanic process and statistically distributed with diamonds hand-applied

This method is the combination of the two precedent in terms of positioning of the diamonds.

In parts of the roller more subject to wear, the diamonds are placed by hand, while in the intermediate areas they are distributed statistically.

The deposition of the bonding layer is then performed with the plating bath.

Even in this case, a grinding operation of the profile is provided especially for regularize the possible asperities.

Sintering process for fixing the diamond

The sintered diamond rollers, from the technological viewpoint, are more flexible compared with electroformed, because they are used for less severe operations, where even small overloads during processing or small shocks that may suffer the roller does not compromise the efficiency of the roller itself and even accuracy, which on the other hand is never high, with this type of rollers.

The sintered powder around the diamond blocks them safely by eliminating the large deformation under abnormal stress, always of course within certain limits.

The roller type sintered, because of the manufacturing process, in which a matrix of metallic powders and diamond secured inside of a mold is heated to a temperature of about 1000 ° C, must be designed taking into account the withdrawal that occurs during the process, so as to obtain the finished profile with the desired dimensions.

It is clear that precisely estimate the amount of withdrawal, also with simple profiles, not neither easy, so it is almost always necessary to perform a remachining of the profile by removing a few hundredths of a millimeter.

Notes on the use and life of the rollers

The diamond roller is a tool very precise and very expensive. To achieve maximum precision and profitability should be used with some care.

The accuracy on the grinding wheel and therefore on the workpiece depend not only on the accuracy of the diamond roller, also on the accuracy with which it is mounted in the machine.

Must be absolutely avoided errors on the positioning of the axis of the roller that must be coherent with the axis of the workpiece.

Tolerances are a few micrometers. Any error in positioning the roll inexorably affects the profile of the workpiece.

To take a simple example, but it gives a good idea, if we are going to make copies with a photocopier and settle the original wrong on the copier, get copies that do not match the original.

The same thing happens with not accurate positioning of the roller: the wheel and then the workpiece will have a profile that does not match what you want.

As regards the duration of a diamond roller, which is measured with the number of dressing executable, it must be said that it is not easy, if not impossible, to say a priori which will be this number for each processing.

It depends on many factors that are independent of the roller itself.

What is perhaps more influence on the performance of the roller is once again the accuracy with which it is mounted in the machine.

If the roller turns eccentric, or with its axis not aligned with the axis of rotation, will remove the material of the grinding wheel with only a sector of its periphery and the wear of this sector will be very fast.

Other elements that determine the performance of the rollers are the type of grinding wheel to be dressing, the working conditions as the relative speed between the grinding wheel and roller and feed, the amount of grinding wheel to be removed for each dressing, refrigeration, the machine status etc..

Roughly speaking we can say that the diamond rollers with fine profile or with deep profiles and tight tolerances should perform from 10,000 to 50,000 dressing cycles.

As the rollers with wider tolerances and open profiles and surface finishes not too accurate can make 30,000 to 150,000 dressing cycles.

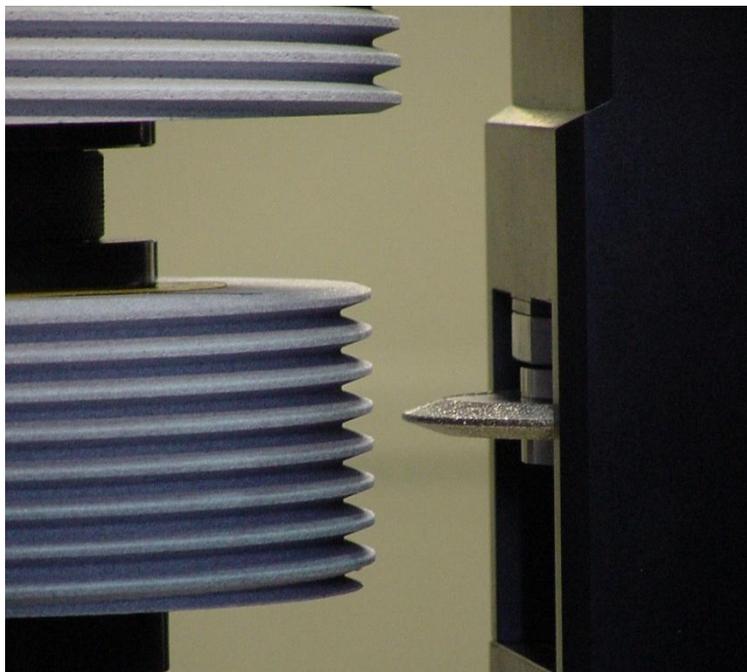


Figure N°5- *Dressing of a worm grinding wheel with biconical diamond disk electroplated*