HOB QUALITY BASICS

Hob quality is critical to high-quality gear manufacturing, and this concept begins with the purchase of certified, high-quality hobs that meet AGMA standards.

By ADAM GIMPERT

The quality of a hob directly affects the final quality of the gear it generates. AGMA has developed a standard covering the allowable tolerances for fine and coarse pitch hobs. This standard is ANSI/AGMA 1102-B13, Tolerance Specification for Gear Hobs, which is the latest revision of AGMA120.1. If there is a quality problem in the hob, a manufacturer can usually identify it in the profile of the gear. Some considerations follow to help avoid and troubleshoot this problem.

Naturally, the price of a hob is directly related to its quality. Today's higher quality gear requirements demand the use of higher quality cutting tools, typically AGMA AA or AAA. For example, a AAA carbide hob may carry a 30 percent price premium compared to its AA version. Such high standards ensure no hob errors generate poor gears. When weighing the costs and benefits of high-quality hobs, manufacturers should analyze the per-part cutting tool cost based on tool life experience or estimates provided by the hob vendor.

HOB MOUNTING

The first item to consider when eliminating sources of error in a hobbed gear is the mounting of the hob. The condition and the cleanliness of the hob and hob arbor surfaces are critical, and these surfaces should be free of any particles, chips, grinding dust, nicks, burrs, or damage. Manufacturers must use high-precision hob arbors. Please keep in mind that something that was once high precision may lose all precision due to everyday wear. Hob arbors must be maintained with the utmost care. Any damage that occurs to this item could produce errors in sharpening and subsequent hobbing. If spacers are used, the faces must be parallel to within 0.0001". On arbors that use a threaded nut, the clamping face of the nut must be perpendicular to the threads to within 0.0001". It is also recommended that the threads be ground. (Figure 1)

When mounting a hob, the following procedure should be used: The hob should first be mounted on the arbor with the nut hand tight and checked for excessive runout. If the hob does not run true, the centers should be checked for particles or chips of any type. If there is nothing in the centers, the arbor should be checked for runout along its entire length, as it may be bent. The nut should next be tightened and the hob checked once again. If spacers are being used and the hob does not run true, the spacers should be rotated. After rotating the spacer, the nut should be tightened, and the hob should be checked again. If there is still runout after two or three times, the spacer should be checked for parallelism.

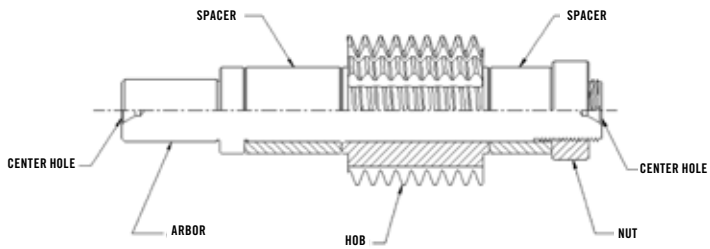

Figure 1: Arbor for hob.

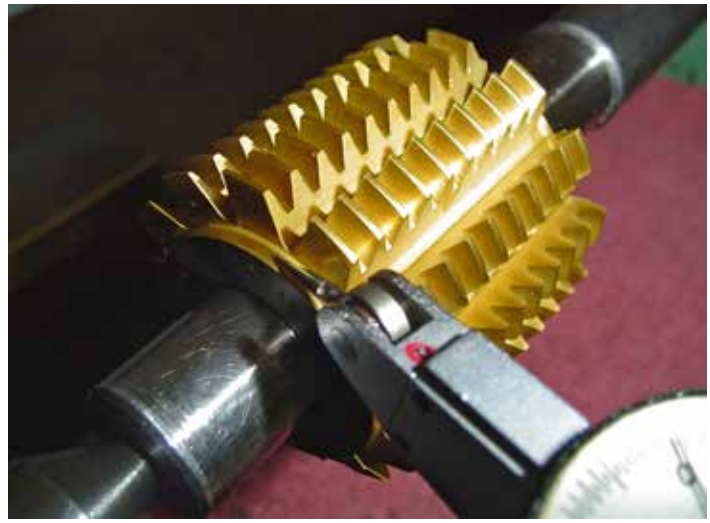

Figure 2: Example of indicating hub radial runout.

INSPECTION OF HUB DIAMETERS AND FACES

Hob manufacturers pay close attention to the hub diameters and the faces of the hubs. These features are the reference surfaces that are used during the manufacturing of the tools. Extreme care must be taken to ensure these surfaces are kept free from

nicks and other handling damage. The hubs and the faces are used to true-in the hob every time it is mounted in either the hobbing machine or the hob sharpener.

Hob manufacturers normally use the end faces to mark the hob data, such as diametral pitch, pressure angle, lead angle, quality, etc. This marking may be done using a chemical etching process or by burning the data into the face using a laser. In both cases, material buildup is avoided, unlike regular engraving or milling. The latter cases dig into the surface of the tool and will raise high spots in the surface in the process. In this case, manufacturers can make sure the surface is stoned smooth prior to mounting the tool onto any arbor. Any material buildup could cause the hob to not run true during mounting.

As shown in Figure 2, the radial runout of the hubs can be measured by mounting the hob on a test arbor between centers. A test indicator with a 0.0001" resolution is then placed so that its stylus is positioned on the outside diameter of the hub. The hob is then rotated, and the radial runout is measured. Both hubs should be checked to ensure that both hubs are running true.

In Figure 3, the axial, or face runout of the hubs, can be measured in the same way, except the stylus of the indicator is placed on the face of the hub instead of the outer diameter. Before any other inspections are made, you must ensure that these two checks are verified, and that the radial and face runout is within the tolerance limits set by the ANSI/AGMA 1102 standard for the hob's quality specification.

Figure 3: Example of indicating hub face runout.

RAKE INSPECTION

Most hobs are designed with a zero (radial) rake cutting face. Radial rake hobs are the easiest to sharpen and check for errors. After sharpening a hob, the rake should be inspected and conform to the hob's quality standard. While most hobs are designed with a radial rake, special application tools, such as skiving or dry hobbing, may require a negative- or positive-rake hob. When the hob is resharpened, the rake of the tool must be returned to the original rake design; otherwise, gear profile errors will be generated during hobbing.

Rake error affects the generated pressure angle that the tool will produce. Figures 4 and 5 show the results of a gear that is hobbed with a tool with rake errors.

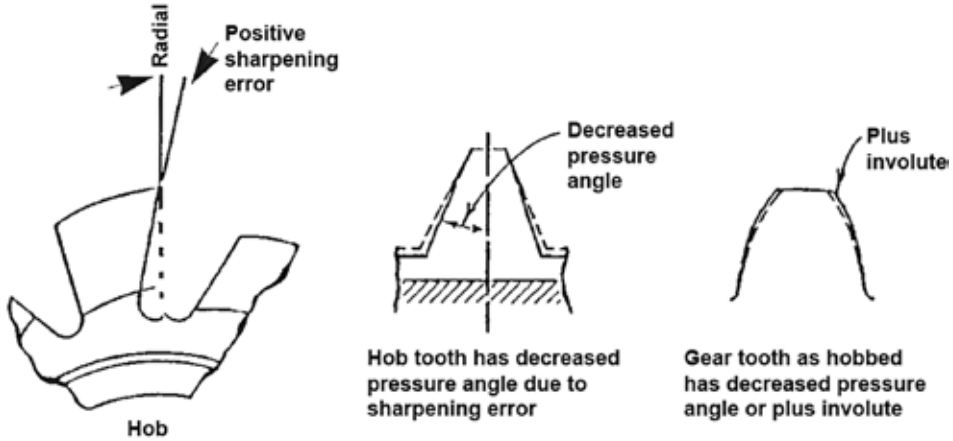

Figure 4: Hob with positive rake error.

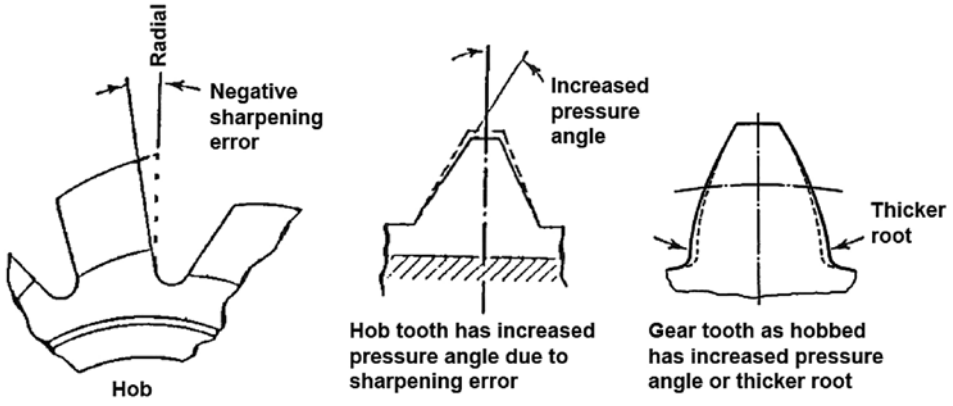

Figure 5: Hob with negative rake error.

If the rake error exceeds the hob's quality standard tolerance, the hob sharpening process should be adjusted and the hob sharpened again until the variation is brought within tolerance. On most hob sharpening machines, correcting the rake error is accomplished by moving the grinding wheel to the centerline of the hob for zero rake tools or moving to the correct offset for positive and negative rake tools.

HOB SHARPENING

A critical aspect of maintaining hob quality is proper resharpening

of the tool. If the hob is sharpened incorrectly, the original tool geometry will be lost. Since the correct tool geometry is what produces the desired profile, any flaws in the tool geometry will show up on the finished profile.

When hob sharpening, some areas to address are the grinding wheel spindle, work spindle, and tailstock. First, the grinding spindle should be extremely rigid and without any end play. If there is end play or rigidity problems in the system, the hob will most likely have a bad finish, and teeth could be chipped during grinding. A loose grinding wheel nut can cause the same problems. Second, the work spindle must run true. If there is any runout in this spindle, it will be transferred to the hob during grinding. Third, the tailstock must be in line with the work spindle. If the tailstock is out of alignment, there is a good chance the hob will be sharpened with gash lead error.

SUMMARY

In closing, the above issues do not exhaust the many issues important to hob quality, but they offer a good start for the novice gear manufacturer. Hob quality is critical to high-quality gear manufacturing. This concept begins with the purchase of certified, high-quality hobs that meet AGMA standards. Applying these hobs successfully requires proper inspection of the mounted hob before its use in a hobbing operation. Lastly, rake error and poor sharpening are straightforward errors to troubleshoot from their effects on inspected gear profiles.

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