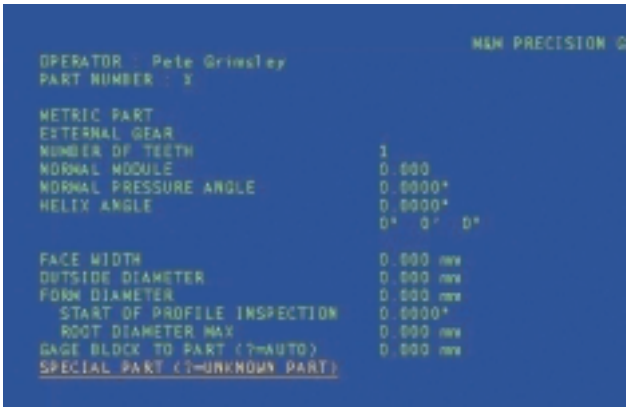
s?ftware s?lutions for UNknown GEARS

By Peter Grimsley

Ever have a gear that you wanted to inspect, but didn't have drawing data to define the part? M&M Precision Systems has developed a program for measuring gears with unknown parameters, otherwise known as an "unknown gear." It allows for the input of partial parameters or for a complete inspection, including counting the teeth and determining the outside diameter for gears whose parameters are unknown. While this is old news to certain M&M users who've been with us for the past 10 years, what's new is that this program has now been incorporated into the gear program as an optional feature.



▲ Gear input screen showing unknown part

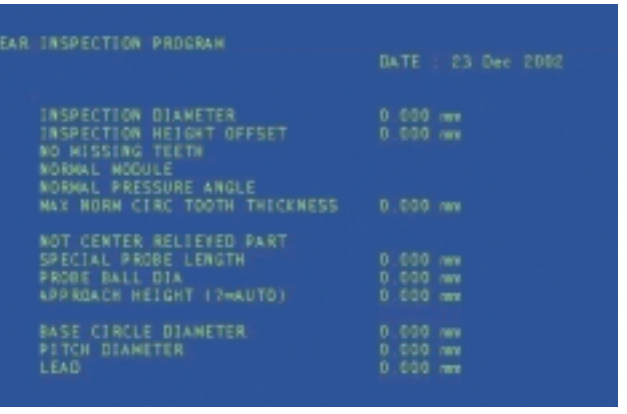
Using the M&M gear program as its base has several inherent advantages. For the Microtop and 3500 series machines, it allows a wide variety of one-D tip sizes to be used. This means that finer-pitch gears can also be measured and their parameters determined. For Sigma machine users, it allows all the functionality the gear program has to offer for 3-D probe utilities. This allows for various tip sizes, quick tip changeover, and calibration routines to be used in measuring the unknown gear. All of this adds up to additional capability and flexibility above and beyond the original program.

This program is available for purchase, and it will include a gear program update as well. However, it is limited to the latest PC version machines and is not compatible with older HP systems. You may wish to speak with one of our application engineers to determine what hardware upgrades you may require.

Where the unknown gear option has been installed, access is simple. In the part parameter screen, simply toggle from standard part to special part.

By simply inputting a question mark at the prompt for a special part, you will be transferred to the unknown gear program. This opens up the screen inputs for special gear parameters shown on the next page. There you will find options for setting up your inspection (see figure 2). As most of the gears run in this application are used, worn, or mounted in an assembly, flexibility is required in the test setup to allow for circumstances such as damaged teeth or top-and bottom-face interference. The options in the program that assist for these conditions are listed in the sidebar on page 20.

In full automatic mode, the program measures the number of teeth and the outside diameter of the unknown gear. It then uses this information to determine the diametral pitch and a location for entering between the teeth. It then touches on the tooth face and determines the helix angle of the lead, if any, and the form diameter of the profile. The machine shows the lead and profile traces and allows cutoff points to be set to establish the area that will be used for parameter determination. This is important, as it



allows the user to remove modified areas such as tip relief and tooth chamfer. Once the cutoff points are set, the program calculates only within the selected area.

Once this information is known and the cutoff locations are set, the selected number of teeth are inspected. The program then uses this information to establish the final values of diametral pitch (module) and helix angle. The result is then presented in the output format seen in figure three. The output of unknown gear represents the measured values of the gear tooth, or teeth, depending on the test selection within the uncertainty of the measuring instrument, and including all errors in the gear itself. This is an important concept because pressure angles, helix angles, and other design features are given at measured values, not design values. For example, the pressure angle measure in figure three is 21.11 degrees. This is probably a standard 20-degree pressure angle with manufacturing errors. The software allows values of diametral pitch and pressure angle to be varied, while the program maintains a constant base circle diameter.

The M&M "unknown gear" software program is intended to be an investigative tool for your gear inspection arsenal, allowing you to stay on top in the ever-tougher gear manufacturing industry.

▲ Fig. 2—Test selection features of unknown gear

CONTROLS FOR INSPECTION SOFTWARE

F1—*Number of teeth to test selectable from one to all teeth*

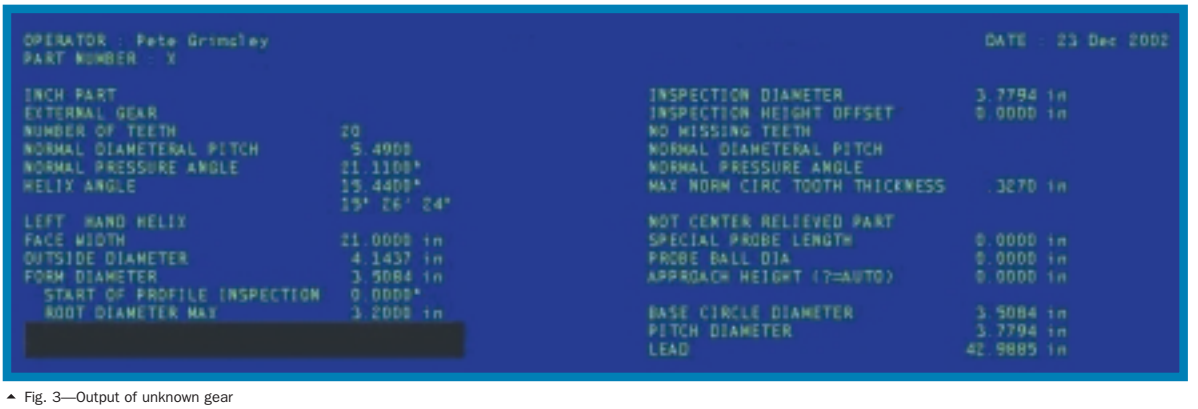
F2—*Flank to inspect; right, left, or both*

F3—*Enter manually, or allow the program to find number of teeth and OD*

F4—*Enter root diameter manually, or allow the program to determine from measurement*

F5—*Is the part a gear or involute spline?*

F6—*Specify whether the top and bottom of the tooth has any interference to prevent measurement*



▲ Fig. 3—Output of unknown gear

This program is invaluable for determining the actual aftermarket manufacture and competitive analysis, and for recreating replacement gears for older machinery, whose manufacturer may be out of business.

This allows you analyze the part using standard values of pitch and pressure angle and to separate the errors in the part from its original design. It is also important to remember that the part may be metric. Other measurements such as face width and outside diameter may provide clues to whether the part is by inch, or metric if they are exact metric values. As in the gear program, you can toggle between metric and inch to also look at parts in terms of module. Sometimes an oddball diametral pitch value is actually a metric part with a standard module.

Involute splines can also be determined with the same method described above. Inputting standard DP and pressure angles—30 degrees, for example—allows spline design intent to be separated from manufacturing errors.

Whenever possible, selecting a four-tooth average is also a good way to minimize single-tooth errors and to get a better overall interpretation of the design intent. In worst-case scenarios, a partial tooth can be used to determine the gears' parameters, if that's all that is available. Fully automatic inspection is not possible with partial gear teeth, but by using the test select options, a suitable setup can be accomplished and the data acquired.

As you can see, this program is invaluable for determining the actual aftermarket manufacture and competitive analysis, and for recreating replacement gears for older machinery, whose manufacturer may be out of business. The program is intended to be an investigative tool for your gear inspection arsenal, allowing you to stay on top in the ever-tougher gear manufacturing industry.

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