Recess Concentricity Becomes More Critical in the Age of Automation

Automatic screw feeding and driving equipment cannot use screws with recesses too far off center. New gaging equipment provides the measurement.

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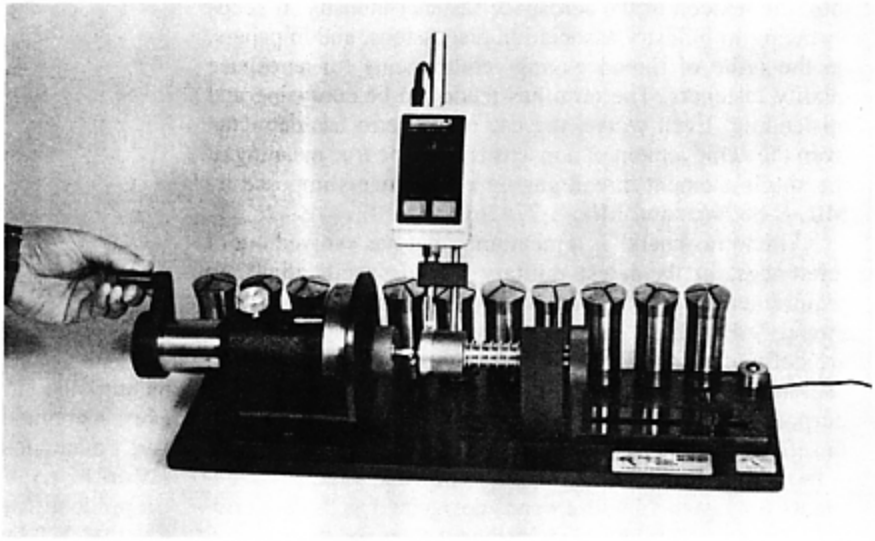


Recess TIR Gaging System.

World competition is placing pressure on most U.S. manufacturers to increase production efficiency to maintain or gain market share. A major contributor to assembly efficiency is the use of automatic screw feeding and driving equipment. This trend is placing greater demands on fastener suppliers to provide more dimensionally constant screws within smaller tolerances.

Automatic screw feeding and driving equipment is very expensive. The only way its cost can be justified is if it operates consistently and efficiently. Inconsistent screws cannot be tolerated in this equipment because of the close tolerances required in the construction of the equipment itself. It has been found that in some cases screws which meet the industry specifications, but are made at their outer limits, do not perform properly in some automatic assembly equipment.

The allowable tolerance on recess-to-shank concentricity is one area where this is frequently the case. ANSI B18.6.4 allows the concentricity of the recess to shank to be 0.030" or 12% of the basic screw size, whichever is greater. This means that all 1/4" dia and smaller screws can have a recess off center by up to 0.030". If this total allowable tolerance is used in a single manufacturing lot of small screws a driving problem is likely to occur in automatic assembly equipment.

Most automatic screw feeding and driving equipment blows the screws through a feed tube into a pair of jaws which grasp the screw's shank. While the screw is in the jaws a rotating driver bit comes from above and engages the screw's recess. The driving bit is fixtured so that it is precisely centered above the center of the holding jaws. If the recess is too far off of the centerline of the screw's shank the driver bit may not be able to engage, thus stopping the operation of the automatic assembly equipment. Every stop deteriorates the efficiency of the equipment. Users of automatic screw feeding and driving equipment will not tolerate these kinds of problems from their screw suppliers.

High Quality Is in Demand

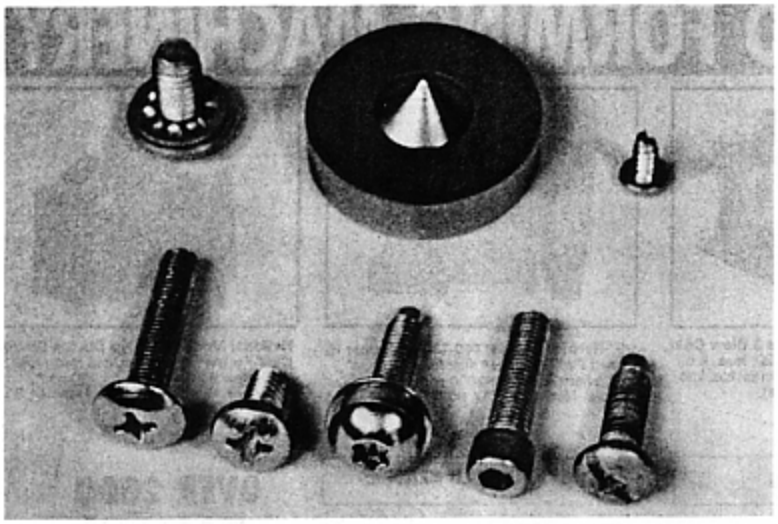
During the past several years we have been watching the trends of fastener users toward increasing their demands for more consistent quality in the fasteners they use. We have responded to these observations by developing new types of fastener measuring and testing equipment. This has resulted in being awarded eight U.S. patents since 1989, with applications pending for three more.

We became aware of the growing demand for a better method of measuring the concentricity of a screw's shank to its recess during 1990 and began development on a new gaging system to make this measurement accurately, repeatable, and fast. In early 1992, we applied for a patent on the Recess TIR Gage.

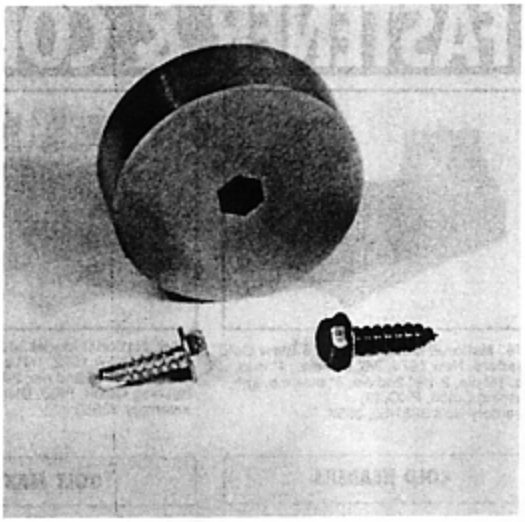
Simplicity Is the Key

Our emphasis in design is always on simplicity. We feel simple is always better. We usually build about three versions of our gages before we sell the first one. We find that as we build them and test their use that we can improve their performance and utility by simplifying the design. Things that are basic in design tend to be easier to use and are more stable because there are fewer components to adjust and wear.

The Recess TIR Gage meets the objectives of simplicity. The design now being introduced is very similar to our first prototype except for two sig-



Recess TIR Measuring Element.



Hex Head Measuring Element.

nificant improvements. The gaging system consists of a precision spindle mounted on a base plate with a spring-loaded tail stock, a series of collets for holding #4 through 1/4" (M3-M6) screws, a measuring element, and an indicator. The improvements in later prototypes which make the current design easy to use are the recess measuring element and the type of the indicator used.

We started designing the recess measuring element in a very logical way by making a series of types and sizes of elements for each type and size of recess. This presented immediate problems. First of all this required too many different elements to cover the wide range of recess types and screw sizes. Secondly, making precise recess elements which will always center in the recess and not introduce erroneous variation in measurements due to the fit between the recess and its element seemed a major, if not impossible, task.

Through the use of non-linear concepts, several different designs were tried. We discovered a single element that works accurately and repeatably in the most commonly used recess designs and sizes.

Details of the Fixture

This recess measuring element design consists of a single uniform cone having an included angle developed through experimentation. This single cone element will measure Phillips, POZIDRIV(R), Frearson, hex socket, square socket, and Torx(R) drive recesses in screw sizes between #4 and 1/2" (M3-M12). Also developed was a special hex element for measuring the concentricity of hex or hex washer heads to the screw's shank. In this case, a different size element is required for each hex size.

The gage was further simplified by incorporating an electronic indicator which has a total indicator reading (TIR) indicating mode. After the gage's spindle is rotated clockwise 360 degrees when measuring parts, the indicator displays the TIR of the recess to the screw's shank. This indicator capability eliminates the need for the operator to carefully watch the indicator and try to remember the highest and lowest reading he observed, and then determine the difference between them. The incorporation of this indicator in the gage design makes it extremely easy to operate virtually error free.

Gaging System Operation:

1. The correct size collet is selected for the screws to be inspected and is placed in the gage spindle. The screw is placed in the collet which is then tightened.
2. The movable tail stock is positioned about an inch away from the top of the screws's head.
3. The spring-loaded face plate of the tail stock is pulled back and the recess gaging element cone is placed in the screw's recess. The face plate is released placing it in contact with the back surface of the recess element. When the element is in proper position the indicator is contacting the outer diameter of the element.
4. The TIR mode button on the indicator is pressed to set the indicator reading to 0.000.
5. The gage's spindle handle is rotated clockwise 360 degrees after which the indicator displays the TIR of the screw's recess to its shank. No addition, subtraction, or other interpretation is required.

This gage can also be used to measure the concentricity of the screw's head diameter to its shank. If the recess element is left out of the gage setup, the indicator can be placed to contact the screw head's outside diameter. By doing so and otherwise using the gage in the same manner, the concentricity of the screw's head diameter to its shank can be measured if this is required.

Long form gage repeatability and reproducibility studies have shown this gaging system provides an 8.63% gage R&R.

Over the past few years it seems that the list of fastener characteristics which are considered crucial by users has become endless. "Good enough" in the past is not "Good enough" today. Fortunately, gage suppliers continue to introduce innovations like the Recess TIR Gaging System. This type of gage will help screw suppliers meet the needs of the users of automatic screw feeding and driving equipment.

For more information contact the author or **Circle 200.**