Cracks often form during collar forming.
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Inspection method detects cracks during collar forming

It can be rather costly if device defects such as cracks are not found in time. But for the deformation process known as "collar forming," existing inspection methods for crack detection have proven to be less than effective in practice. Fraunhofer researchers have now developed a new method that allows defects to be determined in a process-capable manner.

Collar forming is part of the standard repertoire of metal forming: tension pressure is applied to sheet metal or pipes to produce punctures, known as collars. They are required in sheet metal as thread holes for screw connections, to run cables through, or as bearings for shafts. Given the trend towards lighter and more cost-efficient materials, as well as more and more complex part geometries, the production process has seen an increase in cracks, micro-cracks, and constrictions. If defective parts such as these are then used in assembly, significant subsequent costs can ensue. The problem, however, is that conventional inspection methods cannot reliably identify these "NOK parts" (not OK parts). At a cycle duration of 20 to 30 parts per minute, a visual inspection is hardly realistic. Optical inspection systems have also been shown to be less than effective in series production.

Draw ring with sound sensors.
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All good things come in threes

Scientists at the Fraunhofer Institute for Nondestructive Testing IZFP in Saarbrücken and the Institut für Umformtechnik und Umformmaschinen IFUM (Institute for Metal Forming and Deformation Machines) in Hanover are therefore working on new non-destructive inspection methods to reliably detect cracks and micro-cracks before workpieces leave the production hall. The inspection concept is divided into three stages that cover the entire value chain. The first step starts even before the manufacturing process itself: in a pre-process monitoring stage, the engineers first take a close look at the material to evaluate whether it is even suitable for the collar forming process. For the production process itself, the engineers have integrated special sound-emission sensors directly into the collar forming tool. These work in a similar manner to a microphone and transmit any noises detected to a control station. The sound signals allow the engineers to determine precisely if and when a crack has started to form. In the post-process stage that follows, the parts can be checked for any cracks or constrictions after collar forming has taken place. To this end, special inspection systems based on electromagnetic ultrasound and induction thermography – developed at Fraunhofer IZFP – are used. The project is being funded by the German Federation of Industrial Research Associations "Otto von Guericke" and the European Research Association for Sheet Metal Working.

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Collar forming with pre-punctured sheet metal.
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