TubeInspect at Daimler:

Tube measuring system closely linked to bending machines

Brake and fuel pipes for the E and S Class from Mercedes-Benz are manufactured in the tube production plant in Sindelfingen, Germany. The pipes, made from aluminum or steel, have diameters ranging from roughly 4 mm to 15 mm. Supplied in fixed sizes, ready-cut tubes are first provided with fittings on an automatic tube end processing machine, swaged if necessary, and then formed on bending machines. Despite their different makes and years of manufacture, the tube bending machines have one thing in common: their quality check takes place on the AICON tube measuring machine TubeInspect.

TubeInspect

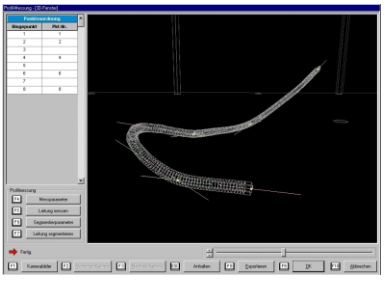
Each day about 1,400 vehicles are equipped with brake and fuel pipes from the tube production plant, in more than 400 model variants. Prototypes for vehicle development are also built here. High precision naturally plays a crucial role. “We install 11 to 12 brake lines per vehicle, and so every millimeter is important”, explains Siegfried Radegast, an engineer at the tube production plant. A method was sought what would make quality checks fast and uncomplicated, while enabling any detected errors to be corrected as quickly as possible on the tube-bending machines.

The days of expensive mechanical solutions are over

In the past, quality checks were carried out by placing formed tubes into mechanical calipers and then subjecting them to visual checks. Over time, however, this testing method proved to be extremely inflexible as well as expensive, because the calipers had to be specially built for each type of tube and altered whenever the smallest alteration in geometry occurred. Radegast estimates the cost of a single caliper at several thousand Euros.

It´s also easy to understand that the test result depends to a very large extent on the operator - and this is too imprecise and time-consuming for a department with 60 employees working three shifts, where products generally have to be delivered to assembly on a just-in-time basis.

The production hall contains over a dozen tube-bending machines, running all kinds of different bending programs depending on the requirements of vehicle assembly. As a result, machine retooling not only needs to be very fast, but the quality check also has to run smoothly - because a certain number of tubes from each part series must be tested and documented for dimensional accuracy.

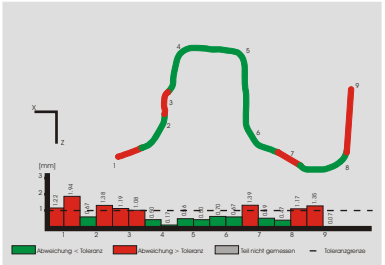


Tube Measurement

Precision measurement in seconds for all kinds of geometries

The tube measuring TubeInspect has been checking quality in the tube production plant at Daimler for a few years now. Instead of mechanical calipers, changes to individual tube sections can now be electronically sensed and further processed. But how does the optoelectronic measuring system work?

First, the tube to be measured is placed inside the optical measuring cell and its geometry is detected by 16 high-resolution CCD cameras. The measuring volume is roughly 2500 x 1000 x 500 mm and can be extended by repositioning the tube. Bends between 5° and 180° can be detected without problems, and there is also a new measuring function for bend-in-bend forms.



Deviation Graphics

A color graphic monitor running under Windows provides operator guidance and visual display of the measuring results. The measuring results can be recorded in a database and documented on a color inkjet printer during the actual measuring process.
“Operating the measuring system is quite easy, “ says Radegast. “Making bend corrections in the CNC program is the only thing that requires special training. “

Electronically transmitted corrections

Once the data has been detected, the software carries out a variance comparison. The target data is based either on a previously recorded specimen part or on Cartesian tube coordinates that also can be imported directly from a CAD system in VDA format.

Deviations from the target geometry are depicted on-screen in color, with the aid of a curved surface tolerance calculation - green areas lie within the tolerances, while other colors give the operator the chance to establish where and by how much the line is deviating from the target data.

Three measuring points are decisive for the test - the coordinates before the bend, at its center and at its end. With an average of 30 bends per tube, this results in almost 100 values, which formerly had to be entered manually into the control on the tube-bending machine and often corrected again later.

Today, the bending machines and also the TubeInspect measuring system are connected to the server via interfaces. If a measured tube requires corrections, the measuring system can transfer them directly to the CNC program on the tube-bending machine. This rules out any input errors.

Apart from optimizing quality testing with the TubeInspect (which, moreover, does not need to be set up in a special air-conditioned room), an additional positive result has been achieved - where a large number of different calipers were formerly used, tube production at Daimler is now saving on expensive testing equipment and resetting times, thanks to AICON measuring technology.

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