



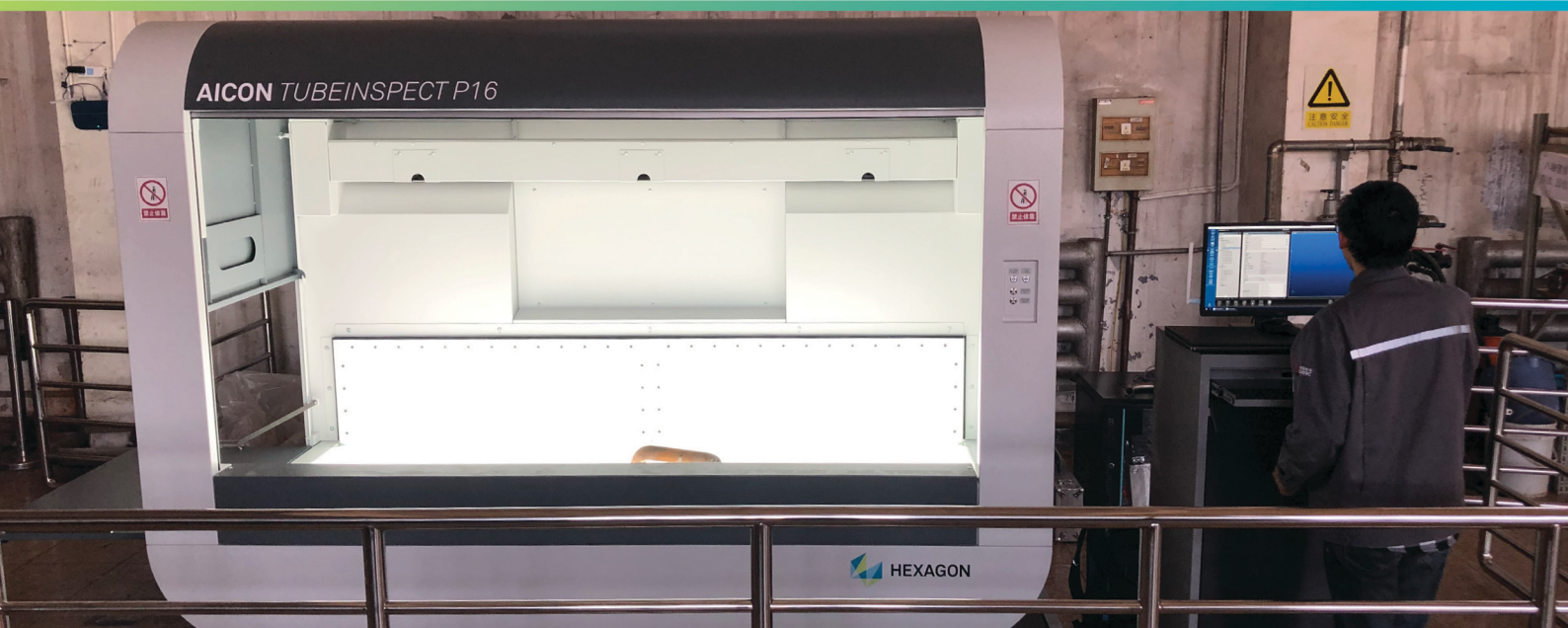
HEXAGON

Accurex
Dimensional Measurement Systems

Case study

Innovative tube measurement supports rail manufacturing

CRRC Group, China



TubeInspect increases the efficiency in tube measurement for the construction of modern locomotives.

Whether in the roof, in the passenger cabin, in the bogie or in the engine room: mostly invisible to the passengers but indispensable for operation, tubes can be found everywhere in modern trains, both gas-carrying as air supply lines or liquid-conducting, for instance in the control or brake line systems.

The CRRC Group is one of the largest manufacturers of rail vehicles in the world and therefore knows about the importance of tubes in the production of modern locomotives and wagons. At the same time, it also aware of the challenges posed by modern tube production.

Efficiency in production: as in all modern production lines, many individual processes must interlock smoothly to guarantee the efficient production of rail vehicles. Just-in-time production of the necessary tubes is a requirement for a trouble-free process.

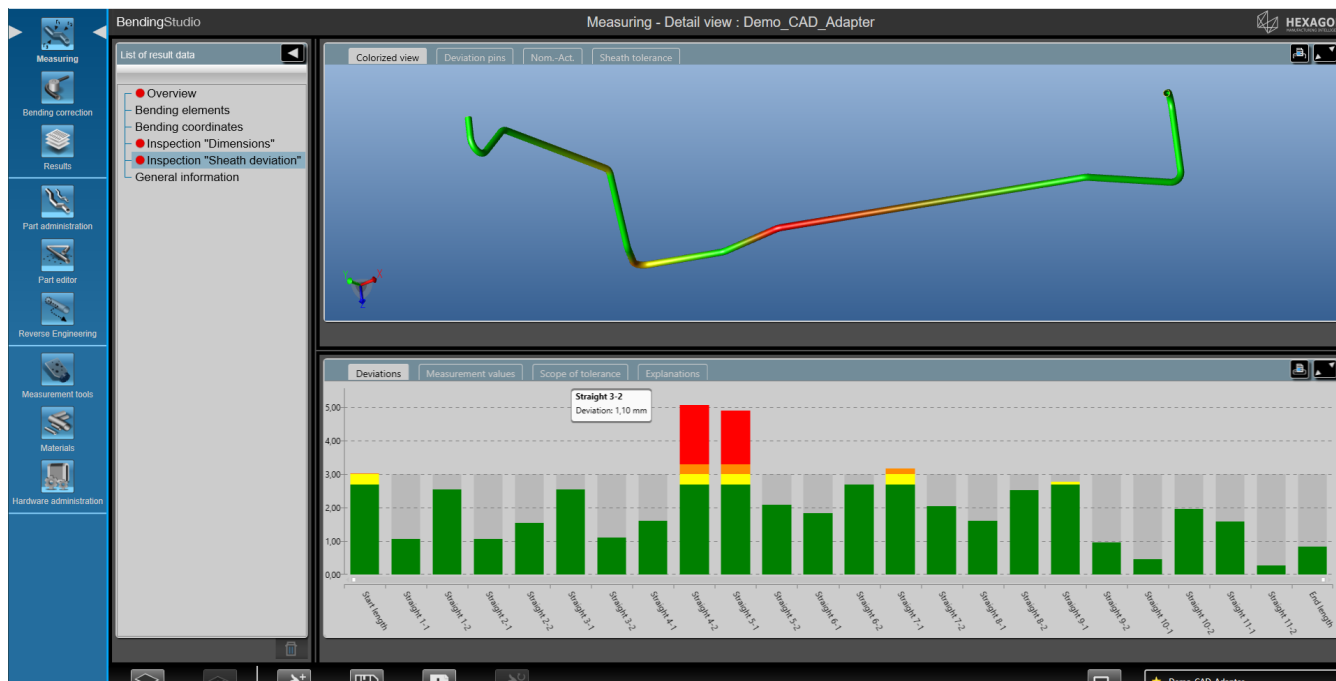
Highest-precision requirements: in complex machines, every component has its assigned place and often the scope for deviations from the norm is minimal. Therefore, even in the field of tube production, all tolerances, some of which are very tight, must be met at the first attempt.

Increasing variety of types: the number of different pipe types and variants continues to increase, and the acquisition and storage of many different gauges can quickly become a critical cost factor.

Reduction of material consumption: setting up and correcting bending machines doesn't only mean a standstill in production, it means increased material waste. Especially when using high-quality materials, it's important to produce as little scrap as possible in order to save costs.

The next level of pipe measurement

In order to ensure continued efficient tube production for their rail vehicles, the CRRC Group were looking for a suitable measuring system that could meet these



The dedicated software platform BendingStudio is designed to offer full communication and data handling across production, quality control and design offices, covering the entire bending production process.

challenges. In 2019, they finally acquired the TubelInspect optical tube and wire measurement system from Hexagon.

TubelInspect is a ready-to-use measuring cell that works with BendXtract technology. It's equipped with high-resolution digital cameras that scan tube geometry without contact. The component is simply placed in the measuring cell and after just a few seconds measurement is complete – with minimal user interaction thanks to BendXtract. In the background, the BendingStudio software platform has already processed and evaluated the acquired data and presented it in a clear report.

Optimal illumination of the measuring field is ensured by the long-life and low-maintenance LED lighting technology integrated into the system, which is automatically controlled by BendingStudio. TubelInspect's GigE camera technology ensures fast and detailed imaging as well as synchronous acquisition of the measurement object in milliseconds. An innovative high-precision three-dimensional glass reference serves as the basis for measurement, which ensures reliable stability within a manufacturing environment.

TubelInspect represents the height of what optical metrology can do for the tube and wire industry today and is an important building block for the CRRC Group to solve some of the most pressing challenges they face in tube manufacturing.

Many different tubes – one perfect solution

To reduce wheel and rail wear as well as noise during locomotive operation, wheel flange lubrication equipment is installed in the vehicle. Whereas in the past felt pieces soaked in lubricant were used, today controlled lubricators are installed instead. Depending on the time, distance or curve radius, this device then applies lubricating grease in

the form of a grease-containing paste to the wheel flange.

Different types of tubes with different lengths are installed in the CRRC Group's wheel flange lubrication equipment. These mostly thin and long pipes are made of high-quality stainless steel or carbon steel. The challenge is not only to manufacture the required tubes precisely so that they can be installed within the complex structure of the lubrication system without any problems; rejects that occur during the set-up of the bending machines can quickly become a cost factor that should not be underestimated given the high-quality materials being used.

TubelInspect is not only capable of measuring the produced tubes with high precision; the optical measuring cell also determines bending point coordinates, including the smallest bending angles, and transmits the tube parameter corrections directly to the bending machine. This not only makes set-up processes calculable and reduces downtime to a minimum, but also significantly reduces the number of defective parts.

Precise measurement for every bend

The transformer is the core component in AC electric locomotives. It converts the 25-kilovolts drawn from overhead lines into a suitable voltage for the traction motors and other motors and devices of the locomotive. To dissipate the waste heat generated in this process, the transformer is equipped with an appropriate cooling system.

The transformer cooling system manufactured by the CRRC Group mainly uses short tubes made of carbon steel with a diameter of about 60 millimetres. They employ U-shaped bend designs intended to reduce flow resistance and improve the cooling effect. For TubelInspect, even these tubes with 180-degree bends are no problem. Bending angles from 1 to 340 degrees can be

precisely measured with the optical measuring system, with even bend-in-bend measurement possible.

More safety thanks to optical measurement technology

The braking system of rail vehicles plays a central role in driving safety, the traction weight of the locomotive and the possible speed of the train. The CRRC Group mainly produces brake system tubes made of stainless steel pipes or rubber with lengths of 1.2 metres and diameters of 35 millimetres. These components usually not only have formed ends, but also require high dimensional accuracy.

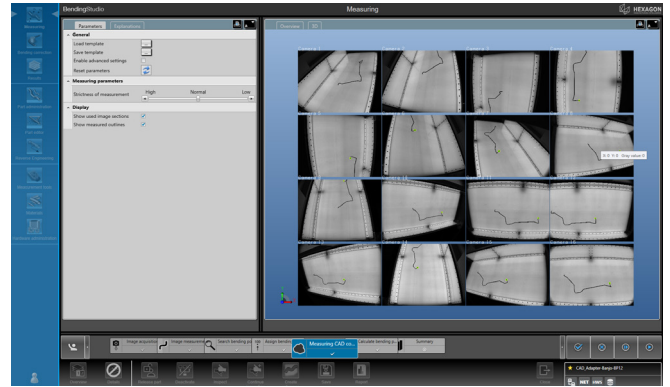
The measurement of attachment parts and holders such as flanges or formed ends is also possible with TubelInspect, with special adaptors attached to the components for this purpose. And with the new HRC TubelInspect models, which boast cameras with a resolution of 12 megapixels for a more detailed inspection, the measurement of attachment parts is even possible without mechanical adaptors by instead applying a digital CAD adaptor from a CAD model (IGES, STEP). Thanks to BendXtract technology, the inconvenience of attaching adaptors and the associated operator influence are easily and completely eliminated.

Modern production – modern trains

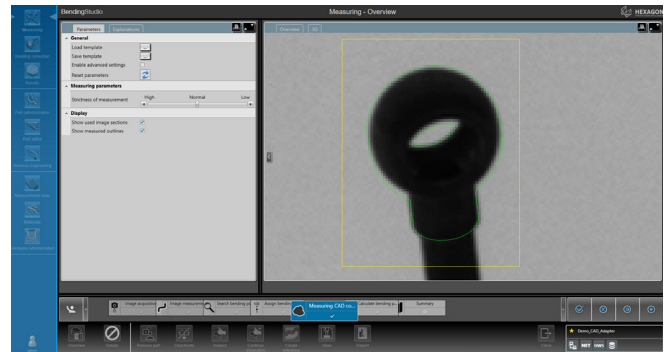
In addition to standard bent tubes, the CRRC Group also increasingly produces freeform tubes due to limited space or special requirements. These types of tubes cannot be measured with conventional measuring methods such as mechanical gauges.

TubelInspect has a unique function for measuring freeform tubes, with which the centre axis and bending parameters are determined thanks to reverse engineering. As an optical gauge, TubelInspect and BendingStudio also replace expensive mechanical gauges, whose procurement, maintenance, storage and provision can be costly.

For the CRRC Group, TubelInspect provides the manufacturing process reliability and efficiency that they need to continue to be one of the market leaders in the production of rail vehicles. Measurement processes are made fast, efficient, and reliable, and by connecting directly with bending machines, the system also actively supports manufacturing. Together with BendingStudio, TubelInspect is a powerful and indispensable collaborator for modern tube bending and production.



The 16 high-resolution cameras of the TubelInspect P16 capture the tube geometries within seconds



Digital CAD adaptors enable the measurement of holders, fittings or formed ends without attaching mechanical adaptors.



Thanks to its enclosed housing, TubelInspect is the perfect measuring system for the shop floor.



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