bending tool for high precision alignment.

DEMCON MULTIPHYSICS

CORE COMPETENCIES

1. Industrial machinery
2. Feasibility study
3. Structrural mechanics
4. Process optimization

Goal

CIREX develops complex steel components for the automotive industry and other industrial applications. These components are cast using the 'investment casting process' (lost-wax precision casting).

One of CIREX products is an injector clamp with two jaws which must be precisely aligned. With the casting process it is not possible to achieve this parallelism within the close tolerances required.

That is why the jaws have been bent manually where needed, by pressing them against a caliber of the correct size in a press. To continue meeting the automotive quality standards with high reliability, CIREX decided to automate both the bending, and checking the bending.

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The distance between the jaws are measured. Where needed they are bent further with presses, and then submitted to measurement for checking. If the distance is too small, the product will be rejected. If the distance is too large, the product will be subjected to a second bending session. All this has to occur with enormous accuracy and in a short time.

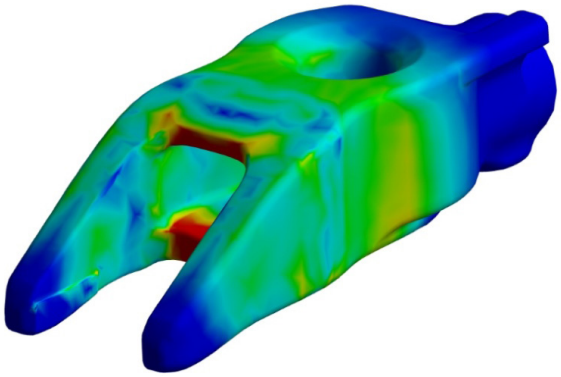

Figure 1 The injector clamp

Approach

In a feasibility study a concept for aligning the two metal jaws was generated. A concept with a caliber guarantees limited spring back, but limits the throughput.

The challenge was to automate the bending without a caliber repeatedly having to be inserted between the jaws. This is to keep the treatment as easy as possible, and to prevent wear. Demcon opted for an optical solution using a standard smart camera from Festo.

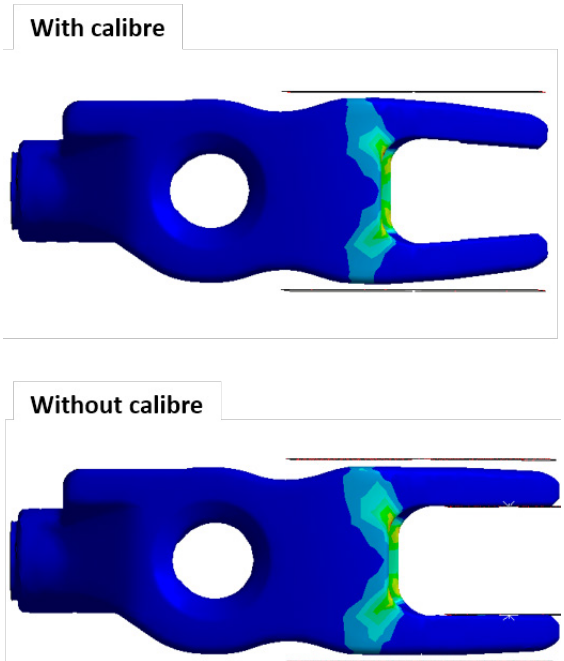

Figure 2 The injector clamp with and without calibre

Employing 3D FEM calculations, including nonlinear material behavior, the different concepts were analyzed and assessed on their possibility to achieve the necessary tolerances.

The exact orientation of the jaws could be determined with image processing. A check was performed with a virtual caliber positioned between the jaws in a 3D reconstruction of the product. Casting faults could also be detected in the 3D reconstruction.

Results

The feasibility study for the pressing required considerable attention. Clamping the product and pressing it with a hydraulic press of 10 kN had to occur with sufficient accuracy: deviation from the nominal measurement could not be greater than ±0.1 mm. Demcon demonstrated the feasibility with a proof-of-principle arrangement. A concept has been suggested without a physical caliber to bend the jaws. This concept has been realized and is able to bend within close tolerances.

An additional task was to reduce the cycle time for the procedure, so that an approved product would emerge every six seconds. Measuring and bending has now been automated, and the next step is the automatic introduction and removal of the product. That's right up Demcon's street, given that it can automate entire processes.

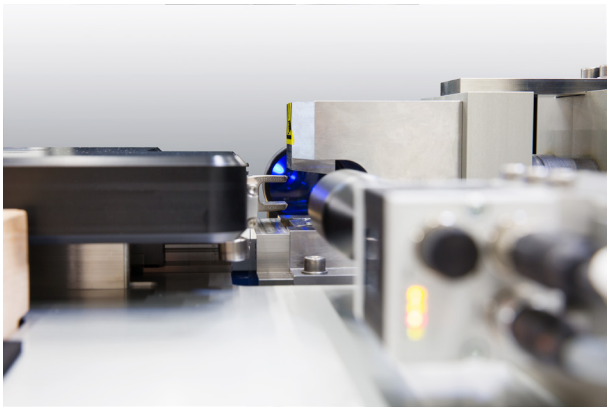

Figure 3 Demonstration with a proof-of-principle arangement