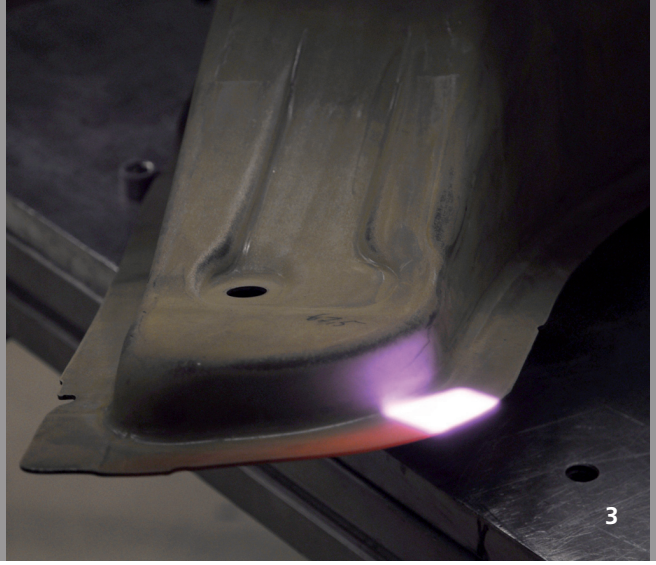

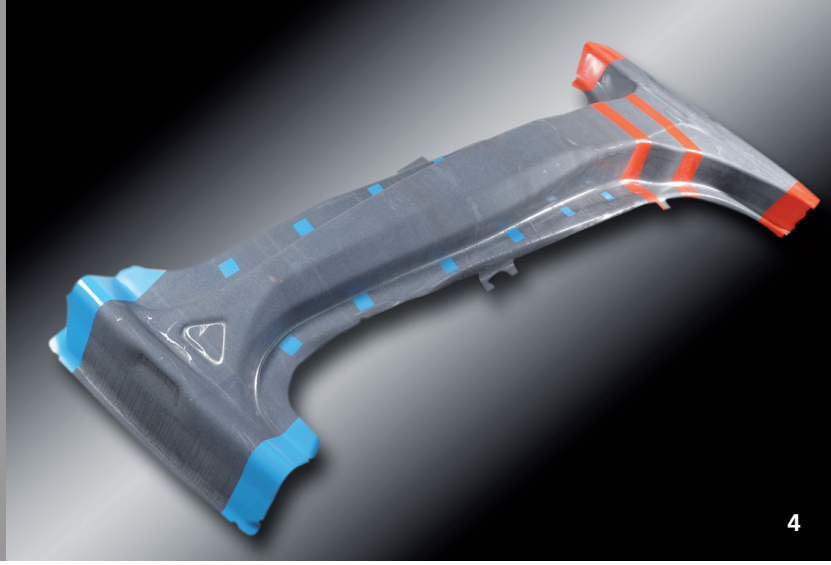

LOCAL HEAT TREATMENT OF HOT-STAMPED COMPONENTS USING LASER RADIATION

Task

Lightweight construction is an effective method of reducing fuel consumption and CO_2 emissions in the automotive industry. At the same time, however, crash safety specifications for vehicles are constantly being tightened. High-strength steels meet both requirements. Hot stamping allows complex components to be hot-formed, and these exhibit high strength through subsequent hardening in the cooled tool. In the case of the widely used steel 22MnB5, the tensile strength of the hot-stamped components is up to 1600 MPa. The brittleness associated with this high strength is, however, not advantageous or acceptable in the entire component. Achieving good crash behavior or joints with no crack formation in deformation zones and joining areas requires ductile material behavior.

As part of the »LOKWAB« project (reference number 02PU2020) for Germany's Federal Ministry of Education and Research (BMBF), local softening using laser radiation on hot-stamped components was investigated to improve crash behavior and subsequent joining operations.

Method

A temperature-controlled, fiber-coupled 12 kW diode laser and zoom optics with a rectangular laser spot size up to 52 x 52 mm^2 are being used for laser heat treatment.

Result

In the heat-treated area, the martensitic microstructure is modified (annealing or complete transformation); the elongation at rupture increases from 4 percent to up to 19 percent as strength decreases. In order to minimize distortion, a suitable heat-treatment strategy (sequence, position and dimension of the paths) was developed. In this way the maximum distortion of a heat-treated B-pillar was reduced from 10 to 1.7 mm. The AlSi protective coating of the components is not affected by the laser heat treatment. With maximum laser output power, processing rates of up to 15 cm^2/s are achieved.

Applications

The process can be used inline in automotive manufacturing to locally soften hot-stamped components.

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3 Laser heat treatment of a hot-stamped component.
4 B-pillar with softening areas marked in color.