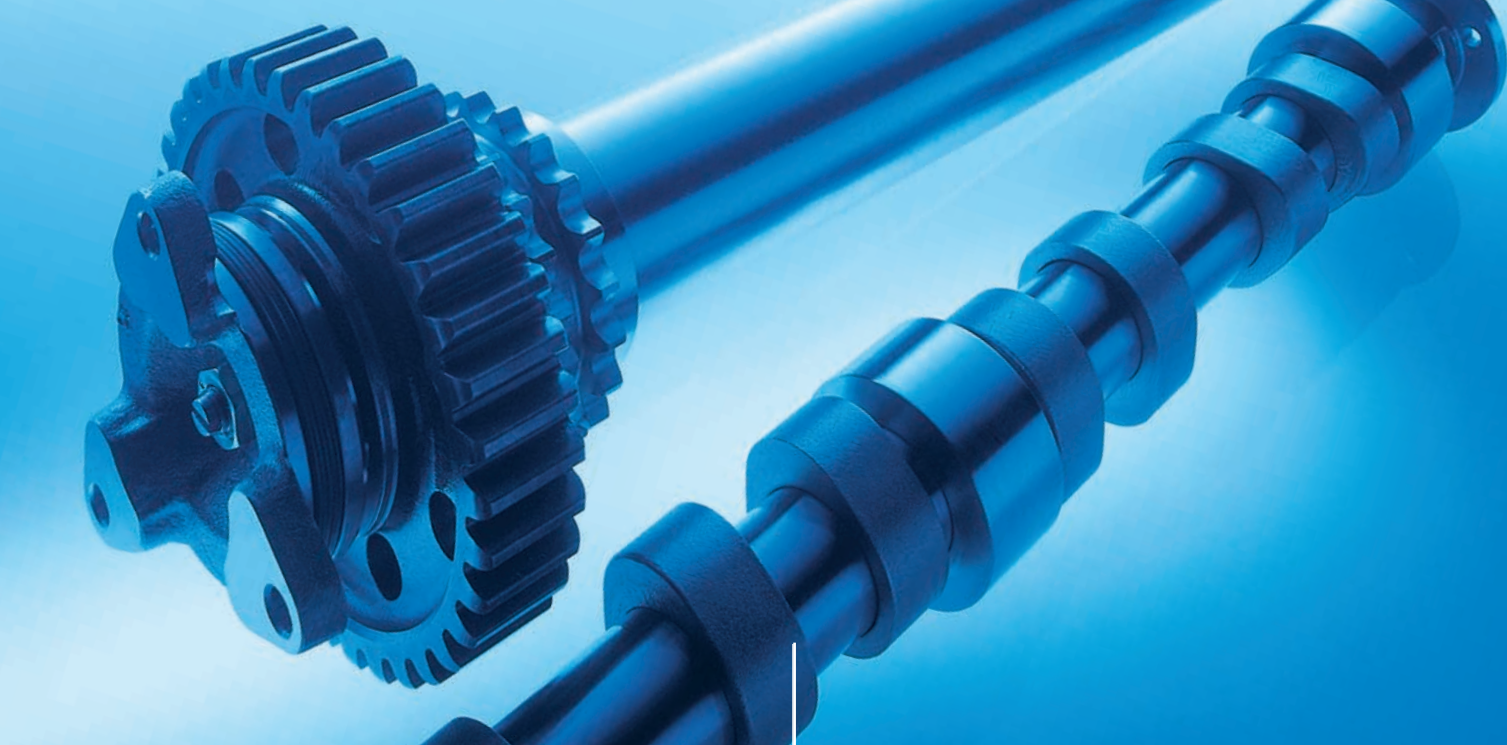


As a global partner to the automotive industry, Mubea has locations worldwide in all continents. We develop, manufacture, and market high-quality products like suspension springs and stabiliser bars, spring band clamps, disc springs, valve springs, belt tensioner systems, tubular shafts, camshafts and intermediate shafts, wire form springs, flat coil springs, headrest supports, wire springs, flat springs and components produced by Flexible Rolling.

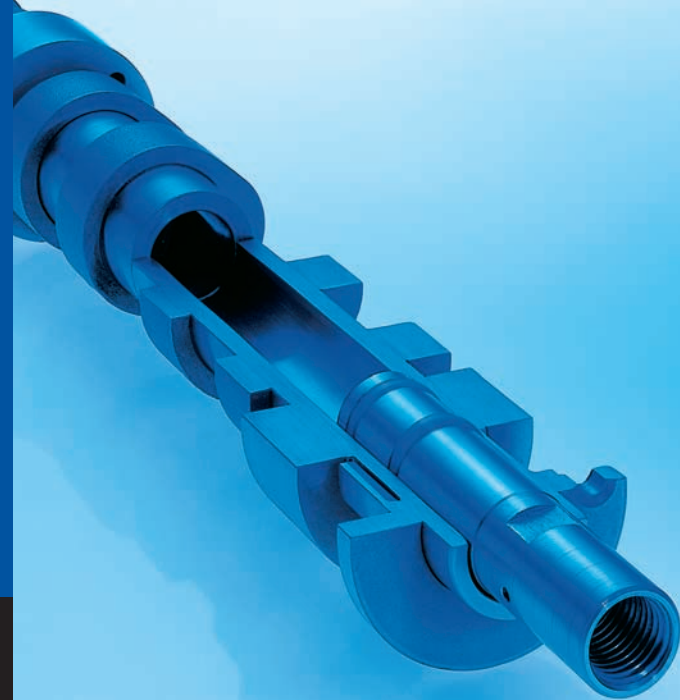


**New at Mubea:
Assembled camshafts and
intermediate shafts.**

Mubea

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Mubea
engineering for mobility



Lower weight, lower costs:
The Mubea weight reduction process for engines and gear boxes.

The IHU joining process: technology with great potential.

Camshafts for motor car engines are frequently manufactured from solid or hollow-cast iron.

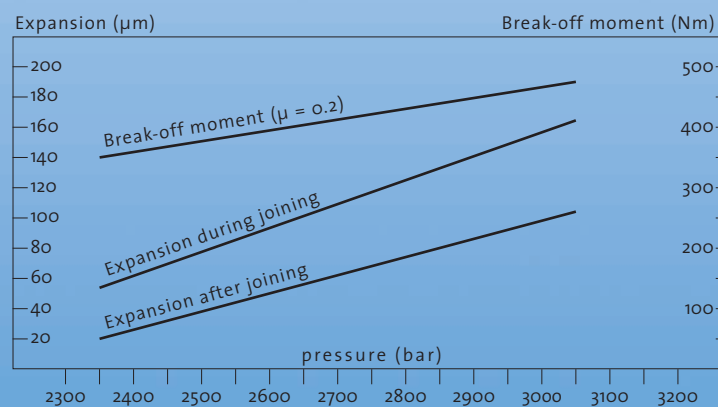
Mubea has developed an interesting alternative to this: assembled camshafts. These are produced of tubular material onto which the cams are pressed by means of special technology, the IHU joining process (IHU stands for "Innenhochdruckumformung" (internal high-pressure forming)). The pressure connections are generated in the pressure-release phase of an hydraulic expanding process, during which the cams spring back elastically onto the plasticised tubes.

The necessary process parameters, the elongation and stresses in the cams and other parts can be precisely defined. Through Finite Element Calculation at the early design stage ensures reliability of the production process.

Camshafts produced by this joining process have many advantages. Two of these should be specifically highlighted. Firstly, the camshafts are between 20 % and 30 % lighter than solid camshafts but equally transmit very high dynamic torques. Secondly, it is possible to combine high-grade, functionally appropriate cam materials with cost-effective materials for tubular and other less stressed additional parts. In combination with automated production systems built-up camshafts are, cost competitive as compared conventionally designed shafts.

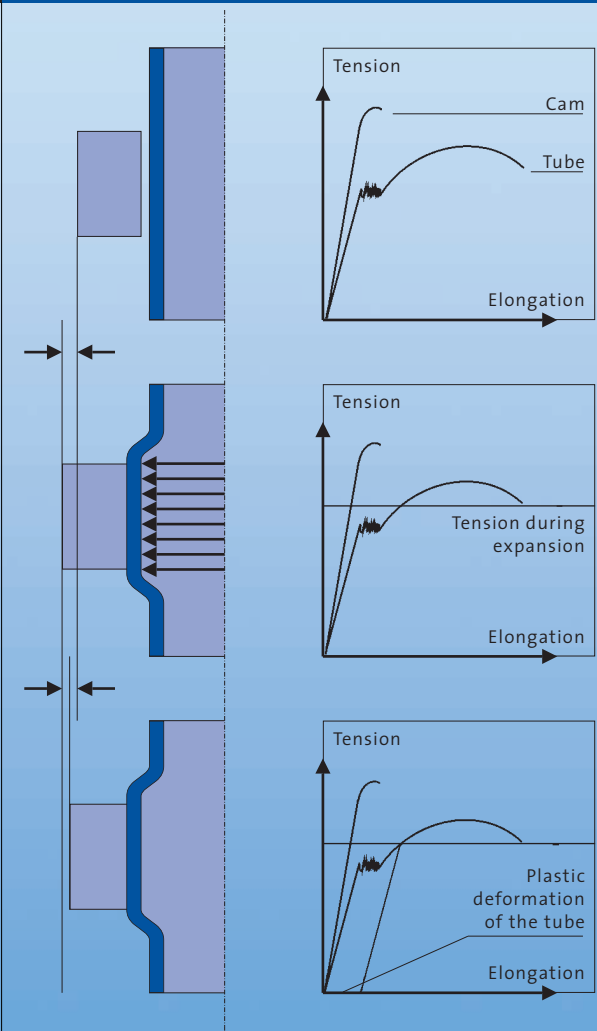
The production process itself is characterised by a high process reliability. During the joining process the expansion pressure and the maximum and permanent elongation are measured at the cam root circle and recorded for each cam. The permanent elongation is a direct value for the compression in the joining slot and stands in linear relation to the transmissible torque. Moreover, IHU joining technology, by means of numerically controlled axes, enables a very precise, force-free axial and radial positioning of the components on the tube. Then follows the pressure build-up for the actual pressure fit. After the joining process all the important geometrical features of the camshaft are measured with an optical measuring instrument. The results are then fed back automatically into the NC control system of the joining unit in order, if necessary, to correct the position values during the process. This enables very precise geometrical tolerances of the cams to be reliably achieved together with grinding allowances and thus production costs in the subsequent processes can be reduced.

As well as the manufacture of camshafts, there are many possible applications for IHU joining technology in the area of gear shafts. The joining of gears, flanges, etc., on tubular shafts by IHU technology makes simple but nevertheless rigid construction with a high level of functional integration. Many new opportunities are therefore opened up to designers in the area of lightweight construction. The application potential of this technology has certainly not been exhausted, and Mubea anticipates high growth in this field in the next few years.



Connection between pressure, expansion and break-off moment

The IHU joining process: technology with great potential.



Manufacturing principle of the IHU joining process.