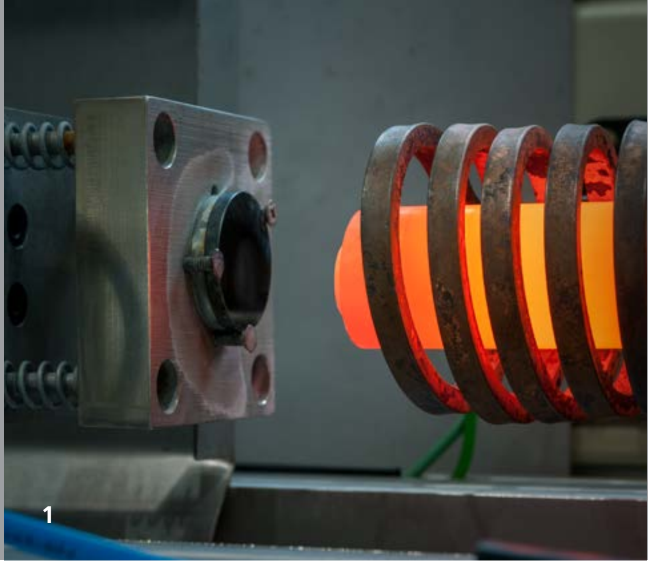

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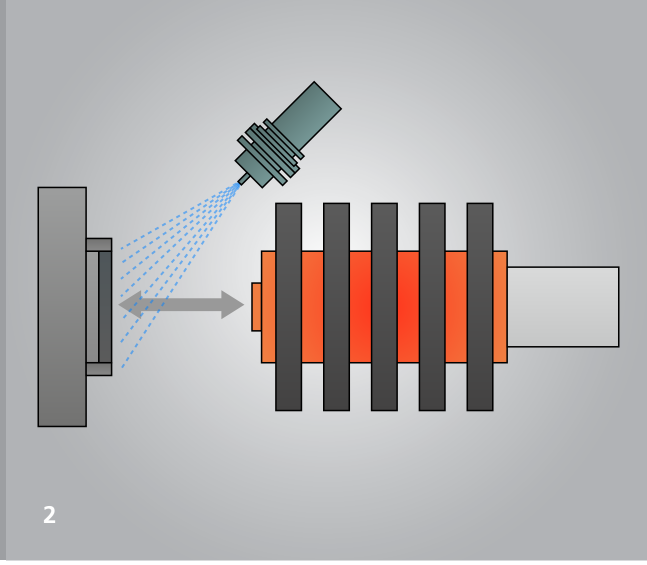

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# THERMAL SHOCK TESTERS FOR LIGHT METAL CASTING AND FORGING TOOLS

Minimization of wear on tools is a key criterion for economical series production, in particular for light metal casting and forging. Thermal shock loads frequently result in thermal shock cracks that are a major cause of failure of these tools. However, tool life can be increased through suitable edge layer treatments, such as diffusion treatments (nitriding, boriding) or coatings. A suitable testing technology is indispensable for evaluation of the edge layers with regard to their resistance to thermal shock. Consequently an innovative thermal shock test stand has been developed at Fraunhofer IST.

**The thermal shock test stand**

Simple test methods for the film and material testing with a variety of adjustable parameters are of crucial importance for an economical tool design. The thermal shock test stand developed at the Fraunhofer IST relies on the specific failure mechanisms of light metal castings and forged tools. Thus, with the thermal shock tester many scenarios of real tools in laboratory scale can be simulated. This means that a cost-effective and temporally attractive pre-characterization of materials and edge layer treatments is possible prior to the actual coating of the series production tools.

**The functional principle**

Via a high-performance induction coil a punch is heated up to maximum 1000 °C. The sample to be examined moves cyclically against the heated-up punch with an individually adjustable holding period. After the reverse movement of the sample it is quenched with a sprayed-on cooling medium at a defined cool-down rate. In order to simulate the temperature curve on a series production tool as precisely as possible, the temperatures on the sample and on the punch are recorded. The adjacent graphic shows a sample temperature curve.

**The possibilities**

Through the varied possibilities offered by the test stand a high level of flexibility is provided for a wide variety of applications. Thus it is possible to precisely adjust the essential parameters, such as contact time and punch temperature, and through this to work with different spray cooling concepts. Among other things, in this regard different spray parameters such as cone shape, pressure, direction, and duration can be changed. Moreover, the sample temperature has an essential influence on the spray cooling concept. With spray cooling under 300 °C the surface of the sample is completely moistened and cools off quickly. With vaporization cooling above the so-called Leidenfrost temperature of 450 °C, the liquid vaporizes completely when it hits the sample and the cooling effect is reduced.

For the most part the test stand works in an automated procedure, so that even extensive test cycles can be implemented. After the test cycle the effects on the samples, such as scale formation, corrosion of the surface, crack formation, annealing effects, or changes in the grain boundaries can be characterized in detail.


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1 *Glowing punch with sample in the thermal shock test stand.*

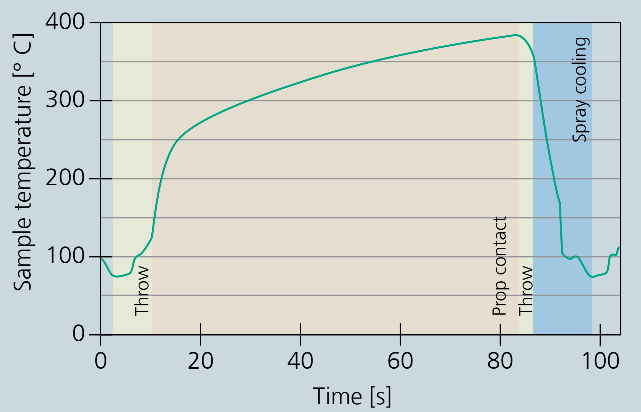
2 *Schematic setup of the test stand.*

3 *Microscopic image of a tool surface with signs of wear.*

**The advantages**

Minimization of wear on tools for light metal casting and forging is of central significance for the industry. Frequently these tools are quite costly, so that testing of new tool materials and edge layer treatments in production constitutes an extremely high risk. Consequently, the possibilities for extending the service life of tools are not often used. The test stand offers the alternative of enabling pre-series tests with realistic stresses.

Heat-up and cool-down curve of the sample in the thermal shock test stand.

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