Dilatometer (DIL)

Temperature changes lead to thermal expansions in materials. In addition to undesirable changes in shape, these thermal expansions can lead to a critical increase in stresses or even thermo-mechanical fatigue of components. Precise knowledge of the coefficient of thermal expansion is essential for the design of corresponding components. For this purpose, the ZHAW Institute for Mechanical Systems (IMES) offers corresponding measurements with its high-temperature dilatometer (Fig. 1).

Fig.1: High temperature dilatometer DIL 402 Expedis® Supreme from NETZSCH.

Applications:
Experimental determination of
- Linear thermal expansion
- Coefficient of linear thermal expansion
- Volume expansion / density change
- Phase transformation
- Softening point, glass transition temperature
- Anisotropy
- Rate controlled sintering (RCS)
- Force control possible (constant forces, force modulation up to 1Hz)

Technical data:

• Temperature range:	room temperature up to 2000 °C (graphit furnace, AlO_2 + graphite holder)
• Heating rate:	max. 100 K/min
• Measuring range:	± 25 mm
• Resolution in lenght change:	0.1 nm (NanoEye® displacement measuring system)
• Contact force on sample:	10 mN bis 3 N (resolution: 0.001 mN)
• Gas atmosphere:	inert, oxidising, vacuum

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Sample requirements:

- Materials: metals, glasses, ceramics, polymers, composites or other construction materials. Thanks to a force-controlled push rod, measurements with soft, fragile or brittle materials are also possible
- Length: 25 mm (max. 25 mm)
- Diameter: 6 mm (max. 12 mm)
- Tolerances: plane-parallel end faces

Norms: DIN 51045, DIN EN 821, ASTM E228, ASTM D696

How it works:
The push rod is pressed against the sample with a constant or modulated force. With the help of an optical encoder, the thermal expansion of the sample is detected. From the measurements, conclusions can be drawn about the coefficient of linear thermal expansion (CTE), the change in volume, the phase transformation, anisotropy, sintering properties, etc.

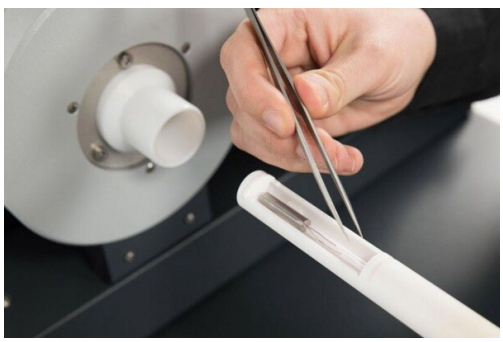

Fig.2: Sample preparation in AlO_2 holder.

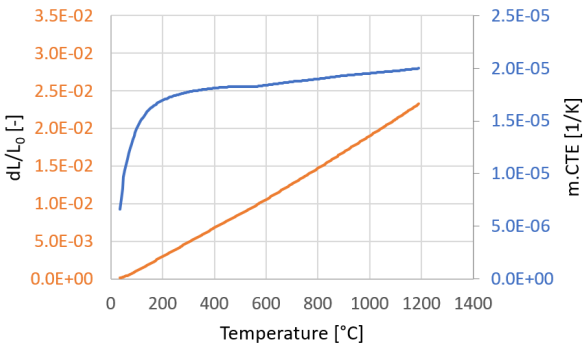

Fig.4: Thermal expansion and (average) coefficient of linear thermal expansion of stainless steel 1.4404 (PBF-LB/M printed).

In addition to the high-temperature dilatometer, the Institute for Mechanical Systems offers further devices for the complete thermo-physical characterisation of materials. This includes a density scale, a laser flash analyser (NETZSCH LFA 467 HyperFlash) for determining the thermal conductivity and thermal diffusivity, and a differential scanning calorimeter (in collaboration with the ZHAW Institute for Materials and Process Engineering) for determining the heat capacity.

For further questions regarding possibilities, costs, etc., please contact the address below.

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