Hegewald & Peschke
Meß- und Prüftechnik GmbH

Product Information

Hot hardness testing system for tests with up to 1500°C

for tests with up to 1500°C SHP1-HV01-30-1500°C

zertifiziert nach DIN EN ISO 9001
TÜV CERT
Zert. Nr. 08/100/9044/3

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Product description

Applications

The hot hardness testing system for up to 1500°C with manual handling has been designed for hardness tests on high temperature-resistant material samples, such as ceramics and sintered metals, under temperature stress in a vacuum or in a limited temperature range under a nitrogen atmosphere. The testing system is intended for the use in research by qualified personnel in material testing laboratories.

Basic concept

The system is made up of two basic components: The hot hardness testing device and the evaluation unit. The cooperation of both elements allows for a high testing capacity. The test preparations and evaluations including the log preparation can be done parallel to running tests in the kiln with the help of the evaluation unit. The dataset with all testing para-meters, including the positions, is compiled and saved at the evaluation pc with the optionally connectable measuring microscope. The sample is introduced into the hardness tester and the dataset is loaded. The heating programme of the kiln is set independently from the hardness testing parameters. Figure 1 shows the basic work steps in the right order.

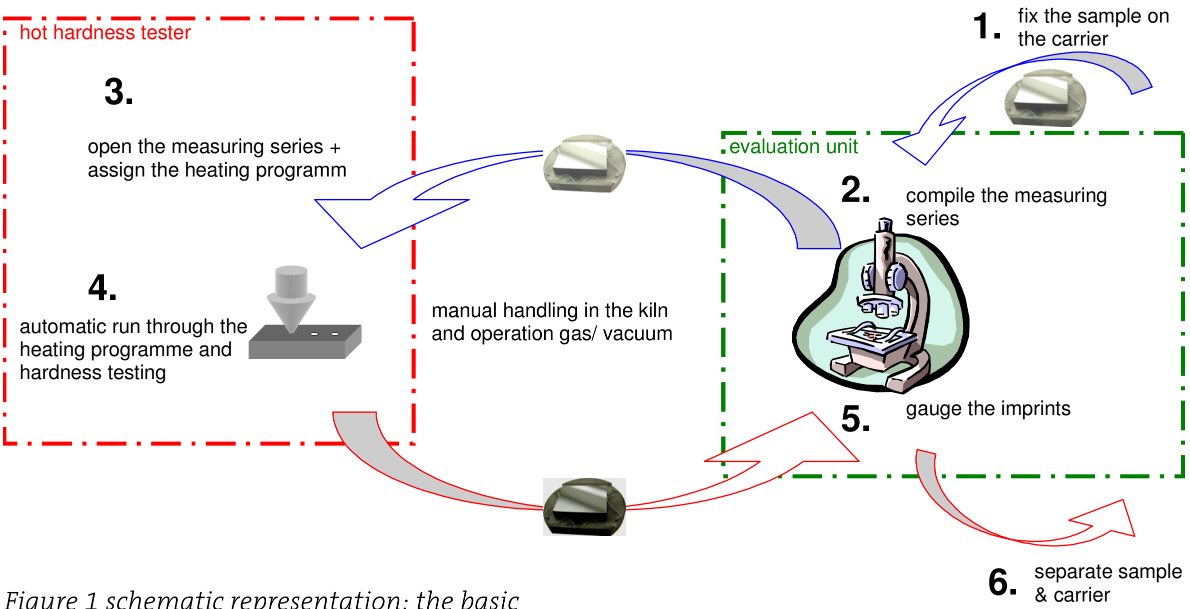

Figure 1 schematic representation: the basic concept of hot hardness testing

The basis for this concept is a sample carrier. Such a carrier with a sample can be seen in Figure 2

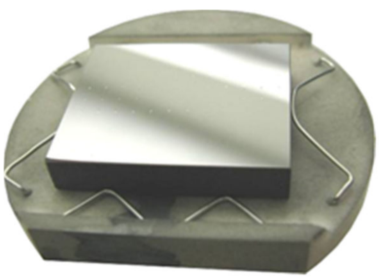

Figure 1 carrier with sample

The sample plates are fixed with the help of temperature-resistant wire cramps or adhesives. The reference position is transmitted from the evaluation unit to the hardness tester and back again. The hardness tester works semi-automatically. The handling of the samples with the activation of the vacuum, gas setup and the starting of the test are done manually. The procedure of heating with hold times, movement to the testing position and setting of imprints is done automatically. The combination of multiple measuring series in one dataset allows for working at different temperature steps in one test run. The basis for this is the manual connection to the heating programme.

Design and functioning of the hot hardness

Functional characteristics of the probe

The hot hardness tester is characterised by its compact, two-part design. All components for heating, vacuum technology, media control and sample handling can be found in the lower part, the furnace chamber. The loading unit with measuring sensors and XY-positioning can be found in the upper part, the probe.

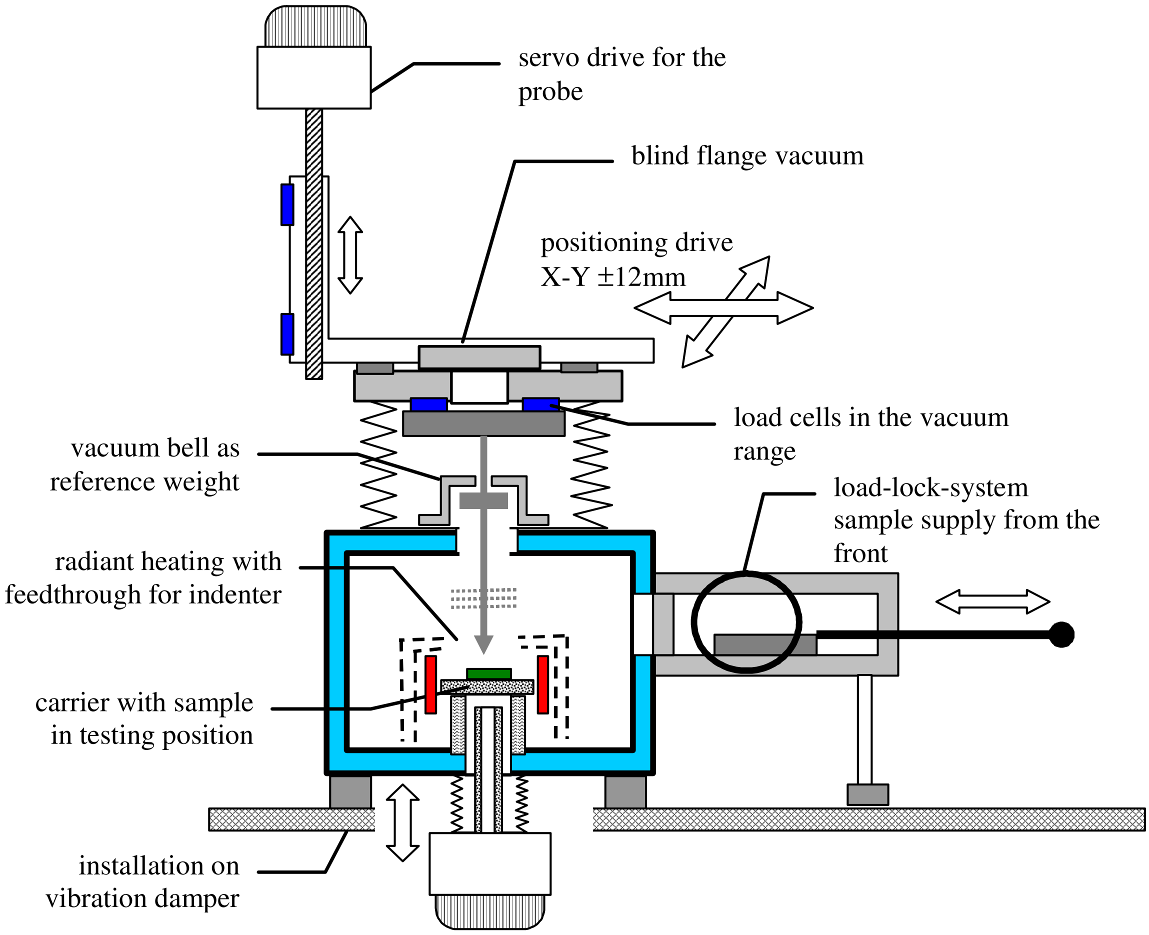

Figure 2 sketch of the basic construction of the hot hardness tester

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The necessary test loads are generated with the help of a servo-controlled spindle drive and can be actuated with the controller. The necessary load measurement for the control of loading is integrated on the vacuum side of the probe. Thus, no shunt forces, as might occur in feedthroughs and bellows, can influence the test. With this design it is also possible to apply small test loads. A reference weight is automatically analysed with every new measuring series for a permanent control of the load sensors. This ensures that no driftings of the sensors due to vacuum and high temperatures falsify the measuring results unnoticed. The probe is designed in such a way that the vacuum chamber can be extended in the test axis with the help of an ISO63 flange. Additionally, the connecting flange in the hardness test probe can be water-cooled, if needed. Thus, the device offers an interface for optional enhan-cements with measuring sensors in the sphere of the chamber. Usually, this interface is used for the introduction of nitrogen into the kiln, if wanted. To avoid unintended interventions in the media connections, motors and sensors of the probe, it is equipped with an autonomously closing casing. When the device is moving to the maintenance position for an indenter exchange, the casing opens automatically (see Figure 4).

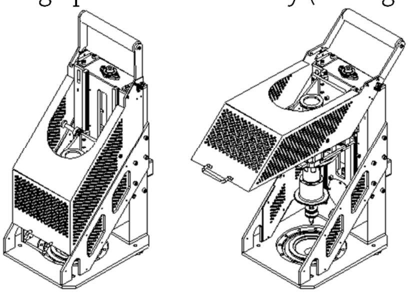

Figure 4 hardness testing probe with protective casing

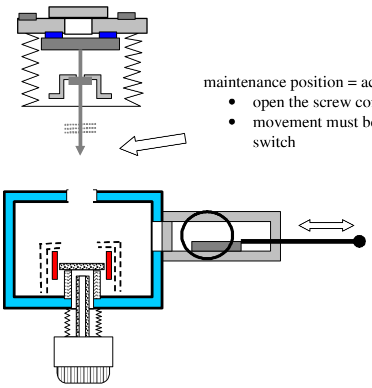

Figure 3 sketch of the probe in maintenance position

The top of the chamber with the hardness testing probe is positioned above the sample with a motor-driven X-Y-unit. The bottom part of the chamber system includes a water-cooled module with the radiant heating, the sample carrier, thermal shielding and a feedthrough for the hardness testing probe. The entire device as well as the control cabinet are integrated in a supporting frame.

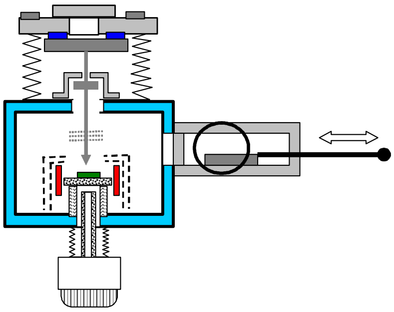

Figure 6 sketch of the hardness tester in testing position

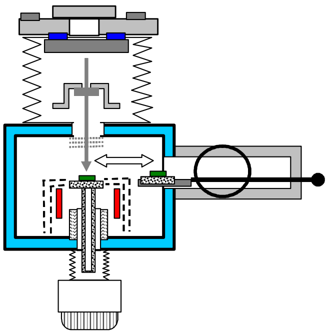

Figure 7 sketch of the hardness tester in zero position for sample handling

In order to secure a quick and effective performance, the system is equipped with a lock and handling system. With this option it is possible to exchange samples without the need of cooling and venting the heating chamber. For the exchange of samples, the heating is cooled to a standby temperature of 600°C. The sample is cooled in the lock chamber with nitrogen until it can be withdrawn by hand. Thus, the lifetime of the indenter determines when the heating chamber needs to be opened. By default, the carriers are made of Al_2O_3. However, the choice of materials can be adjusted to the samples and their thermochemical and physical characteristics. In the furnace chamber there is no direct contact between the sensitive thermal elements and the sample. For the actual test, the carrier is lowered into the heating pot after it was introduced through the handling system. This ensures evenly distributed heat irradiation.

Hardness testing system

Servo-motor-driven loading in a closed control circuit for up to 300N

- Loading steps for Vickers between HV0.1 and HV30 according to DIN EN ISO 6507-1 are stored by default
- Load tolerances for Vickers according to DIN EN ISO 6507-2
- Setup of hold times in the testing programme (between 5 and 60 sec.)
- Setup of lowering and approximation speed by default
- Automatic lowering and lifting to the reference height after hold times
- Automatic control of load measurement with a reference weight at the beginning of each measuring series

Shut-off thermocouple for the control of the maximum operation temperature of 80°C on load sensors

Programme-controlled motor-driven X-Y positioning of the indenter

Monitoring of the positions of handling and lifting systems to prevent collisions during manual loading

Enhancement of vacuum components of the hardness testing system is possible with the help of ISO63 flanges

Vacuum system with heating

- One-piece cylindrical vacuum chamber made of stainless steel, 200 mm DN, glass be-ad blasted
- Upper intermediate floor as flange ISO200 with water cooling, removable to the hard-ness testing probe for maintenance works directly in the furnace chamber
- Complete enclosure, water-cooled body (inner section with multiple thermal shielding) with sealable openings for handling and visual control
- Lower floor flange with support for the standpipe for sample support
- Tungsten resistance heating for up to 1500°C
- Temperature deviations 5K alongside samples of 30mm x 30mm, height 3 to 8mm
- Operating temperature between +300°C and +1500°C, 5K, it is also possible to run tests starting with room temperature
- The kiln is equipped with 3 thermocouples type “S“ (for tolerances see DIN EN 60584-2). TC1 is situated at the heating control. TC2 monitors the shut-off temperature of >1550°C independently from TC1 and shuts off the device if a safety shutdown is necessary. TC3 is a comparison element which is only displayed but not evaluated.
- Rectangular flange for the connection of the lock (load-lock-system is an option)
- Pumping system with booster pump and turbomolecular pump
- Venting valve with N2 connections
- Vacuum measurement with full-range gauge head
- Operation by PC, keyboard with integrated touchpad in a 19" drawer, 17" TFT-monitor
- Interlocks for ensuring the system’s security, e.g. pressure monitoring, cooling water monitoring etc.

Basic construction of the machine

The system components

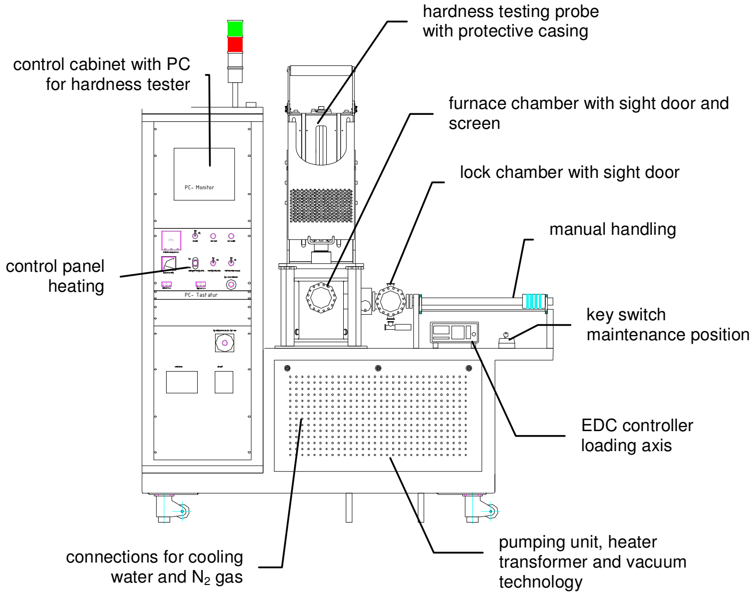

Figure 8 system components

Overview technical data

Connection data of the system

Power supply	400 V / 50 Hz / 16 A
Power consumption	max. 4.5 kW
Cover gas	N_2 / 0.5 to max. 5 bar / 1 l/min 6 mm gas inlet
Cooling water **supply temperature** **supply-pipe pressure**	 15-25°C 3-4 bar, max.100 l/min
Dimensions W x D x H, weight	2040 x 850 x 2500 mm, ca. 350 kg

Data hardness testing probe

Load	max. 300 N, motor-driven
Loading steps Vickers DIN EN ISO 6507-1 **Hold times (setup in the test programme)**	HV0.1 to HV30 5 to 60 sec
Maximum speed	300 mm/min
Drive	DC motor 160 W, 3000 rpm with encoder 2500 steps
Load resolution	± 60,000 digits
Internal data processing	2 msec
Data interface	RS232
Indenter receiver	according to customer demands
Indenter	Vickers, provision by customer
Material of indenter elongation in furnace chamber	Al_2O_3 99.9%
Shielding plates on indenter elongation	3 x molybdenum + 5 x stainless steel
Max. valid temperature at load sensor	80°C shut-off limit
Positioning X-Y cross table	25 x 25 mm, inclined table position 0.05mm

Data furnace chamber

Working temperature	300°C to 1500°C, ± 5K • in vacuum < 10-5 mbar — 1500°C • in N_2 with 0.5 l/min — max. 900°C • In air — max. 80°C
Heater	pot-shaped molybdenum resistance heating
Heating output	2.50 kW
Flow controller	in cooling water return flow
Overflow valve furnace and lock chamber	20 mbar
Thermocouples **TC1 controlling element** **TC2 redundant shut-off element** **TC3 comparing element**	type "S" (Pt10Rh/Pt -50°C...1767°C) emergency shut-off temperature > 1550°C
Deviation of temperature	± 5K along sample 30 mm x 30 mm, height 3 to 8 mm
Material used in the heated area (more than 100°C temperature stress)	molybdenum / Al_2O_3 / stainless steel / copper / platinum, rhodium in TC and lock wire
Material standpipe and lift pipe in furnace chamber	Al_2O_3 -99.9%
Standard sample carrier	Al_2O_3 -99.9%
Vessel design	stainless steel vacuum chamber 200 mm DN, double-walled, water-cooled opening, 100 DN, with inspection window and screen

Vacuum technology

Vacuum	• down to 10 – 6 mbar • pumping system with booster pump and turbomolecular pump • vacuum measurement with full-range gauge head
Handler with load lock	• manual transfer rod with check of end position • Manually activated slide valve

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