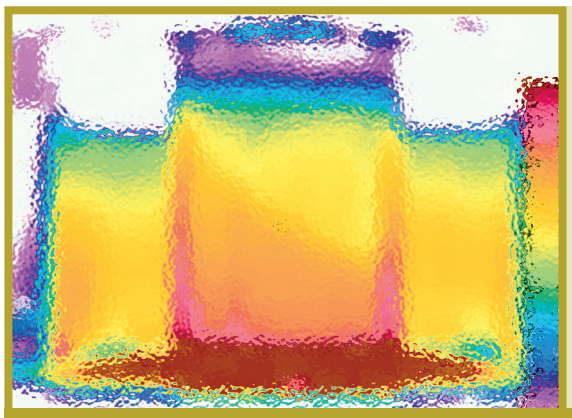

# RKA 5
# Automated Ring and Ball Tester with Extended Temperature Range

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*Innovative materials research represents a vital foundation for high technologies and cutting-edge products. Today more than ever, performance, economy and acceptance decisively depend on the materials used. Petrotest Instruments®, a company with over 50 employees, is one of the world's leading manufacturers of standardized automatic, semi-automatic and manual devices for materials testing, primarily in a petrochemical environment, and has representatives in over 120 countries.*


*Fig. 1: The RKA-5 automated ring and ball tester*

Already at the Petrotest booth at ACHEMA 2006, the functional model of a new fully-automated ring and ball tester was presented, which - with a state-of-the-art heater and an intelligent and robust sensor system - is capable of testing materials in special testing baths. The basis for this type of testing procedure has been already specified in comparable European and non-European standards such as EN 1427 or ASTM D36.

This instrument determines the R&B's expected softening point for the evaluation of material consistencies. For this purpose a steel ball is laid upon a poured testing sample that has been placed in the test ring (*Fig. 2*). Over the course of the experiment, the sample is heated evenly in a liquid bath. When the sample has developed a downward bend by a specified distance to the ring, the appropriate temperature is recorded. The RKA 5 by Petrotest *(Fig. 1)*, available since autumn of 2007, already completely fulfills the requirements of established standards up to roughly 200°C.

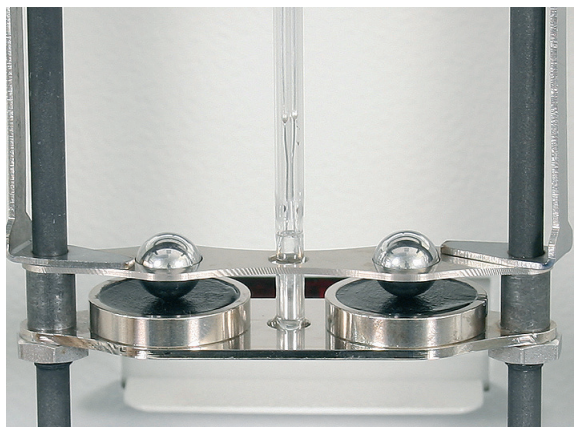

*Fig. 2: Testing configuration according to standard*

Based on the experiences of customers from the chemical and electrical engineering industries, it was discovered that there was a need for a testing system with a considerably expanded temperature range up to roughly 300°C. A testing device such as this can be used for testing the following industrial products:

- Seals for pipelines, e.g. used in plant machinery
- Insulation used in mechanical and electrical engineering
- Plastics and laminates in the chemical manufacturing industry
- Adhesives with a high melting point
- Components, especially in automotive engineering
- Casting and impregnating resins as well as thermosetting varnishes for electrical engineering
- Seal materials testing for shipping (corrosion protection)

In fact, the following raw or finished materials are at the focus of application for such kind of instrumentation:

| | |
|---|---|
| Alkyd and acrylate resins | Amorphous polyolefins |
| Cyanoacrylic acid ethyl ester | Epoxide emulsions |
| Epoxy and epoxide resins (EP) | Ethylene vinyl acetate (EVA copolymers) |
| Homo polymers and copolymers | Hydrocarbon resins |
| Phenol resins | Polyamides |
| Polyester | Polyester resins (UP resins) |
| Polyester imides (UPI) | Polyimides (PI) |
| Polytetrafluoroethylene (Teflon) | Polyurethane |
| Silicone varnishes and resins | Thermoplastic resins |

After three years of intensive development work, a prototype will be available in the near future, offering a testing environment using a high-temperature-resistant silicone oil bath for unrestricted use up to well over 260°C.

Given the different material composition of the samples, the specific requirements for such an instrument or testing procedure have been explored to include the realization of a significantly higher bath temperature than called for by the standards - with a technically-complex warming specification (linear differential gradient of 5 K/min over the temperature range of 5°C - 300°C, see *Fig. 3*) in consideration of specific and temperature related viscosity changes in the bath liquid.

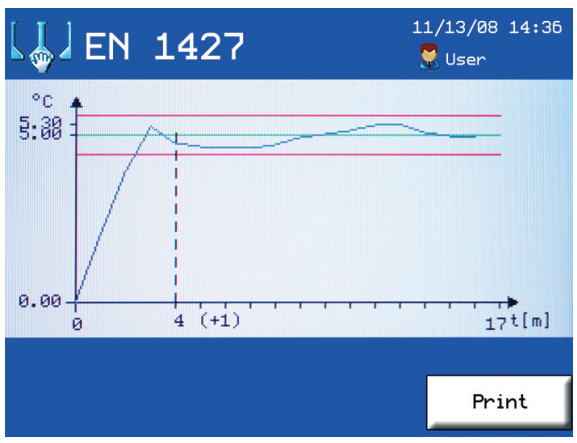


*Fig. 3: Gradient flow in water bath*

Thus according to normative requirements for the test, homogeneous temperature distributions in the testing bath are assumed, which due to a prescribed testing configuration places high demands on the heater control system. That is, for example, why an extensive thermal imaging study was performed to evaluate the testing configuration and streamline it accordingly within permissible parameters *(Fig. 4)*.

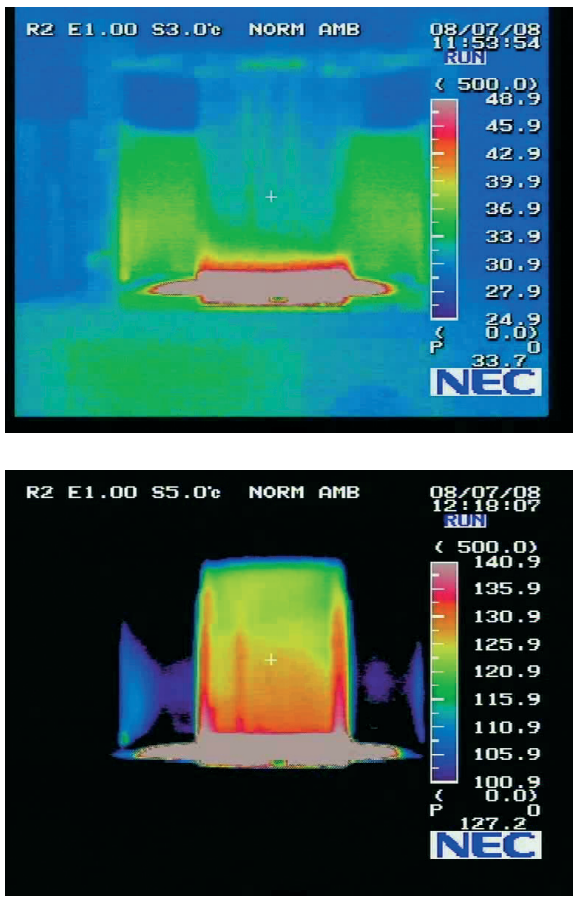


*Fig. 4: Thermal images of the testing configuration in various stages of testing*

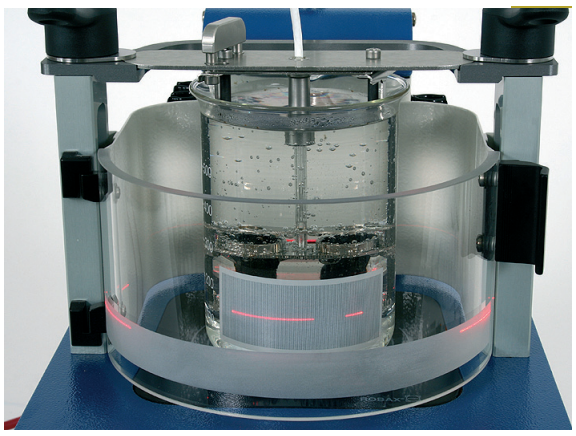

*Fig. 5: Wide-angle scanner used to measure the falling ball*

Crucial to the development of the prototype were not only basic analyses of the physical effects of the thermodynamics but also of the optics. The falling of the ball is typically recognized in today's automatic devices by means of infrared photometric optics. This of course depends upon the optical characteristics of the testing bath and is limited due to potential and progressive radiation interference with the heater system. Most testing baths may already be or become naturally opaque at higher temperatures, change their optical properties during the warm-up phase or have extreme refraction indices which significantly impair recognition. In this case, Petrotest is counting on a newly-developed and patented laser scanning procedure, which covers the maximum optical spectrum possible using a wide-angle laser, without requiring mirrors or having undesirable side-effects (i.e. the forming of bubbles or streaks can be compensated by numerical filtering usually processed in imaging software).

The instrument also features qualified evaluation logic of the test completed, the proven pmove® operating platform as a graphical and haptic menu concept, multiple data and network interfaces, virtually unlimited storage capabilities, multiple language capability as well as a comprehensive range of optimized testing and accessory equipment. The handling in comparison to earlier instruments has been streamlined significantly.

Please contact us. We will gladly assist you in solving your testing problems. The project was supported with funds from the Ministry of Commerce of the State of Brandenburg (FRG) and the EU.