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LABORATORY TECHNIQUES

A Laboratory Thermocycling Installation for Test Operation in a Wide Temperature Range

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Abstract—A laboratory thermocycling installation that provides a possibility of test operation in a temperature range of 83–473 K is proposed. The installation is intended to reliably determine the resistance of devices and materials to the effect of temperature changes with a rate of up to 10 K/s.

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We designed, manufactured, and tested the laboratory thermocycling installation in a temperature range of 83–473 K for devices and materials. Two vertically located chambers are used in it. The tested samples are transferred from the cooling chamber to the heating chamber in the inert nitrogen atmosphere from the lower working temperature value (83 ± 5 K) to the upper working temperature value (473 ± 5 K) there and back.

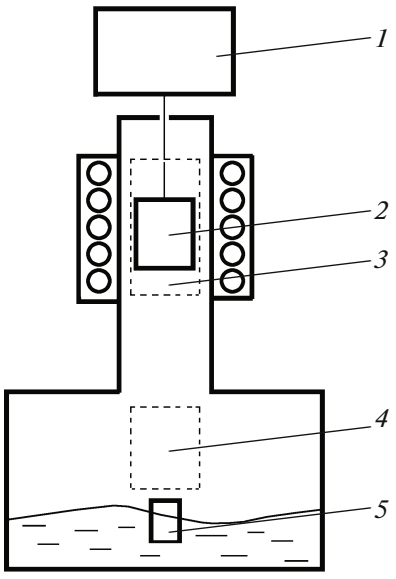
The installation (figure) consists of the heating chamber, cooling chamber, control rack, container-moving mechanism, and hanged container. The heating chamber is a sealed quartz tank, equipped with a contactless heater and a platinum temperature sensor. The cooling chamber is a reservoir for storing liquefied gases (Dewar vessel) with an evaporator and two platinum temperature sensors in the testing zone of devices and in the volume of the liquefied gas (monitoring of the presence of the liquefied gas). The control rack contains four reading-value converters of four platinum temperature sensors installed in the container with tested units, in the heating chamber, and in the cooling chamber; two timers of endurance tests in the heating and cooling chambers; and the test-cycle counter.

During the operation, the samples are exposed to a set of successive test cycles. The minimal carry-over time of a tested object is 30 s at maximum.

After the completion of the last cycle, the tested objects are held at room temperature until the thermal equilibrium is reached.

During the tests, the objects are held in an inert nitrogen atmosphere, thus allowing one to avoid the ice-crust formation and irreversible oxidation processes under the action of an elevated temperature.

The installation guarantees a temperature measurement accuracy of ±4 K; the overall dimensions of the tested objects are 40 × 40 × 50 mm, and the total mass is no more than 100 g. The temperature is measured by the temperature sensors with a measurement accuracy of ±0.2% in four zones (in the container with tested units and in the heating and cooling chambers).



Block diagram of the laboratory thermocycling installation operating in a wide temperature range: (*1*) container-moving mechanism, (*2*) container with samples, (*3*) heating chamber, (*4*) cooling chamber, and (*5*) evaporator.