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Standard Specification for Gravity-Convection and Forced-Circulation Water Baths[1]

This standard is issued under the fixed designation E715; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the performance requirements for general-purpose water baths ordinarily used in testing operations. It is applicable to gravity-convection and forced-circulation water baths operating in the range from 5°C above ambient to 100°C and having a water volume up to 100 L.

1.2 This specification covers unloaded, covered water baths.

2. Classification

2.1 This specification covers the following four types of water baths:

2.1.1 *Type IA*—A gravity-convection bath having a uniformity of temperature not greater than ±2 % of the differential between ambient and operating temperature.

2.1.2 *Type IB*—A gravity-convection bath having a uniformity of temperature not greater than ±4 % of the differential between ambient and operating temperature.

2.1.3 *Type IIA*—A forced-circulation bath having a uniformity of temperature not greater than ±1 % of the differential between ambient and operating temperature.

2.1.4 *Type IIB*—A forced-circulation bath having a uniformity of temperature not greater than ±2 % of the differential between ambient and operating temperature.

NOTE 1—Uncovered water baths will generally have uniformities broader by an additional 0.1°C.

3. Performance Requirements

3.1 The temperature within the bath chamber shall be controllable by an automatic device and shall be uniform within the tolerances given in Table 1 for the particular type of bath when tested in accordance with 4.1.

3.2 The "time constant" is an arbitrary measure of the rate at which a standard specimen is heated following the procedure of 4.2. The value of the time constant shall not exceed the maximum value given in Table 1 for the particular type of bath.

4. Test Methods

4.1 *Temperature Uniformity:*

4.1.1 Place five calibrated temperature sensors in the unloaded water bath with diffuser plate in place and at lowest position and water level approximately 38 mm (1.5 in.) from the top. Temperature sensors may be platinum resistance elements or thermistors having a time constant of 2.5 s or less, or thermocouples made of iron or copper-constantan wire approximately 0.5 mm (24-gauge) in diameter and having a junction size not larger than 2 mm (0.08 in.). Locate one sensor in each of the four corners of the bath approximately 50 mm (2 in.) from each wall and midway between the diffuser plate and the water surface. Locate the fifth sensor within 25 mm (1 in.) of the geometric center of the bath. Cover the bath either with the standard cover used with the bath or a flat sheet of stainless steel. If necessary, holes may be made in the cover, in the proper locations to accommodate the sensors. Rubber stoppers shall be used to plug the holes in order to minimize vapor loss.

NOTE 2—If calibrated thermocouples are not available, five thermocouples made from the same spool of wire may be used, provided they give the same value for temperature when placed adjacent to one another in the bath at test temperature.

[1] This specification is under the jurisdiction of ASTM Committee E41 on Laboratory Apparatus and is the direct responsibility of Subcommittee E41.06 on ~~Weighing Devices~~Laboratory Instruments and Equipment.

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TABLE 1 Performance Requirements for Baths

Characteristic	Type IA	Type IB	Type IIA	Type IIB
Uniformity (differential between ambient and test temperature), ± %	2	4	1	2
Maximum time constant, min	26	26	20	20

4.1.2 Bring the bath to the desired temperature and allow it to reach a steady state. Record the temperatures of the five sensors for a period of 3 h. Determine from the record the maximum deviation in both plus and minus direction from the desired temperature. Ambient temperature shall not vary by more than a total of 4°C and the line voltage shall not vary by more than a total of 5 % during the test.

4.2 *Time Constant:*

4.2.1 Heat the bath to 60°C and allow it to stabilize for 1 h. Prepare a differential thermocouple using 24-gauge iron-constantan thermocouple wire. There should be approximately 1 m (39 in.) between junctions.

4.2.2 Fill two 500-mL Erlenmeyer flasks with water. Place one junction of the differential thermocouple in each flask. The junction should be about 35 mm (1⅜ in.) from the bottom and centered. Stopper each flask.

4.2.3 Connect the differential thermocouple to a strip chart recorder. Start recorder and establish a steady base line. Immerse one flask in the approximate center of the bath. Record the time required to reach the new steady state. This is the time constant.

5. Keywords

5.1 forced circulation; gravity-convection water baths