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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Operating Characteristics of Home Reverse Osmosis Devices[1]

This standard is issued under the fixed designation D 5615; 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 test method covers determination of the operating characteristics of home reverse osmosis devices using standard test conditions. It does not necessarily determine the characteristics of the devices operating on natural waters.

1.2 This test method is applicable for spiral-wound devices.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 512 Test Methods for Chloride Ion in Water[2]

D 1125 Test Methods for Electrical Conductivity and Resistivity of Water[2]

D 1129 Terminology Relating to Water[2]

D 1193 Specification for Reagent Water[2]

D 1293 Test Methods for pH of Water[2]

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water[2]

D 4194 Test Methods for Operating Characteristics of Reverse Osmosis Devices[3]

D4516 Practice for Standardizing Reverse Osmosis Performance Data[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology D 1129. For descriptions of terms relating to reverse osmosis, refer to Test Methods D 4194.

4. Summary of Test Method

4.1 This test method consists of determining the permeate flow rate and sodium chloride rejection for reverse osmosis devices at 345-kPa (50-psi) feed gage pressure, 25°C and 22 % conversion using an aqueous 300-mg/L sodium chloride solution.

5. Significance and Use

5.1 Home reverse osmosis devices are typically used to remove salts and other impurities from drinking water at the point of use. They are usually operated at tap water line pressure, with water containing up to several hundred milligrams per litre of total dissolved solids. This test method permits measurement of the performance of home reverse osmosis devices using a standard set of conditions and is intended for short-term testing (less than 24 h). This test method can be used to determine changes that may have occurred in the operating characteristics of home reverse osmosis devices during use, but it is not intended to be used for system design. This test method does not necessarily determine the device's performance when solutes other than sodium chloride are present. Use Practice D 4516 and Test Methods D 4194 to standardize actual field data to a standard set of conditions.

5.2 This test method is applicable for spiral-wound devices.

6. Apparatus

6.1 The apparatus for the test method is described schematically in Fig. 1. A conductivity meter can be used to determine the salt concentration in accordance with Test Methods D 1125.

6.2 *Installation*:

6.2.1 Materials of construction shall preferably be of plastic or stainless steel (use 316 or better to minimize corrosion) for all wetted parts to prevent contamination of the feed solution by corrosion products. Do not use reactive piping material such as plain carbon steel, galvanized or cadmium-plated carbon steel, and cast iron for piping. Ensure that no contamination will occur from oil films on new metal piping, release agents on raw plastic components, or feed solutions used in the system previously. Whether stainless steel or plastic, all pressurized components should be designed based on the manufacturer's working pressure rating. Review the manufacturer's rating for compliance with standard engineering practice.

6.2.2 The reverse osmosis testing apparatus is represented schematically in Fig. 1. It consists of a feed holding tank equipped with a thermostated heat exchanger system to maintain the feed solution at the desired temperature, a centrifugal

[1] This test method is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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[2] *Annual Book of ASTM Standards*, Vol 11.01.

[3] *Annual Book of ASTM Standards*, Vol 11.02.

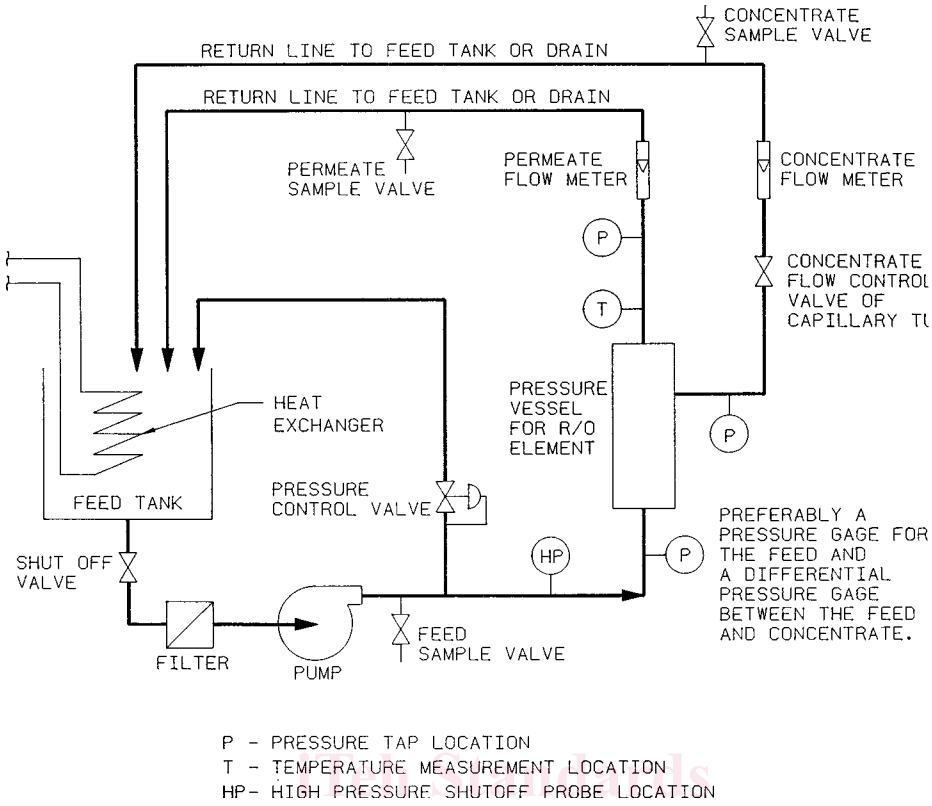

FIG. 1 Flow Schematic of Testing Apparatus

pump, and a home reverse osmosis device. The feed tank is at a higher level than the pump to keep the pump suction flooded. Use a valve with minimum flow restriction to prevent excessive pressure drop (for example, a ball valve or plug valve) for a shut-off valve. The filter can be either a strainer (100 mesh) or a 25-µm filter (based on the supplier's recommendation). The pressure control valve is a back pressure regulator but can be substituted with a manually operated needle valve. The concentrate flow is controlled with a needle valve or a capillary tube. The high-pressure shutoff should have a cutoff point at a gage pressure of approximately 690 kPa (100 psi) or lower if any part of the pressurized system cannot withstand this pressure. The testing apparatus shall be cleaned thoroughly before use to remove contaminants, including microorganisms.

6.3 *Instrumentation*:

6.3.1 See Fig. 1 for pressure tap locations. Locate these as close as possible to the reverse osmosis device. Use a calibrated transducer or a single gage equipped with a high-pressure "quick connect" or Taylor plug gage fitting for measuring individual pressures and the device pressure drop (ΔP). Individual gages are also satisfactory but are not as reliable as a quick-connect test gage or a special ΔP gage.

6.3.2 *Temperature*—The permeate temperature must be measured, and this should be accomplished close to the permeate port. The probe of calibrated dial thermometers or resistance thermometers should be immersed in the flowing permeate.

6.3.3 *Flow Meters*—Calibrated flow meters are used to measure the concentrate and permeate flows. Alternatively, the flows can be measured volumetrically using a calibrated graduated cylinder and a stopwatch.

6.3.4 *pH Meter*.

6.3.5 *Temperature-Compensated Conductivity/Resistivity Meter*.

6.4 *Operation*—Operate the apparatus by drawing the feed solution from the tank and pumping one part of it directly back to the tank by means of the pressure control valve and the other part through the reverse osmosis device under pressure. Return both the permeate stream and the concentrate stream to the feed tank so that its volume and solute concentration remain constant. Direct the return flows in the feed tank to provide adequate mixing. Use the heat exchanger coils in the feed tank to increase the feed to the specified operating temperature and thereafter to remove the energy load generated by the pump.

7. Reagents

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[4] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 *Purity of Water*—Unless otherwise indicated, references

[4] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.