



Designation: **D6807–02 (Reapproved 2009) D6807 – 17**

# Standard Test Method for Operating Performance of Continuous Electrodeionization Systems on Reverse Osmosis Permeates from 2 to 100 $\mu\text{S}/\text{cm}^1$

This standard is issued under the fixed designation D6807; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the operating characteristics of continuous electrodeionization (CEDI) devices, indicative of deionization performance when a device is applied to production of highly deionized water from the product water of a reverse osmosis system. This test method is a procedure applicable to feed waters containing carbonic acid ~~and/or dissolved silica~~ or dissolved silica, or both, and other solutes, with a conductivity range of approximately 2 to 100 microsiemens- $\text{cm}^{-1}$ .

1.2 This test method covers the determination of operating characteristics under standard test conditions of CEDI devices where the electrically active transfer media therein is predominantly regenerated.

1.3 ~~The~~This test method is not necessarily indicative of:

1.3.1 Long term performance on feed waters containing foulants ~~and/or~~ sparingly soluble ~~solutes~~; solutes, or both;

1.3.2 Performance on feeds of brackish water, sea water, or other high salinity feeds;

1.3.3 Performance on synthetic industrial feed solutions, pharmaceuticals, or process solutions of foods and beverages; ~~or~~ or

1.3.4 Performance on feed waters less than 2  $\mu\text{S}/\text{cm}$ , particularly performance relating to organic solutes, colloidal or particulate matter, or biological or microbial matter.

1.4 ~~The~~This test method, subject to the limitations described, can be applied as either an aid to predict expected deionization performance for a given feed water quality, or as a method to determine whether performance of a given device has changed over some period of time. It is ultimately, however, ~~the user's~~ the user's responsibility to ensure the validity of ~~the~~this test method for their specific applications.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 ~~This standard may involve hazardous materials, operations, and equipment. 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.~~

1.7 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D513 Test Methods for Total and Dissolved Carbon Dioxide in Water](#)

[D859 Test Method for Silica in Water](#)

[D1125 Test Methods for Electrical Conductivity and Resistivity of Water](#)

[D1129 Terminology Relating to Water](#)

[D1293 Test Methods for pH of Water](#)

[D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water](#)

[D4194 Test Methods for Operating Characteristics of Reverse Osmosis and Nanofiltration Devices](#)

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

Current edition approved ~~May 1, 2009~~ Dec. 15, 2017. Published ~~June 2009~~ February 2018. Originally approved in 2002. Last previous edition approved in ~~2002~~ 2009 as D6807–02: D6807–02 (2009). DOI: ~~10.1520/D6807-02R09~~ 10.1520/D6807-17.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

### 3. Terminology

3.1 *Definitions*—For definitions of general terms used in these test methods, refer to Terminology [D1129](#).

3.1 For descriptions of terms relating to reverse osmosis, refer to Test Methods [D4194](#). *Definitions*:

3.1.1 For definitions of terms used in this standard, refer to Terminology [D1129](#).

3.1.2 For descriptions of terms relating to reverse osmosis, refer to Test Methods [D4194](#).

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *cell—cell, n*—an independently fed chamber formed by two adjacent ion exchange membranes, or by a membrane and an adjacent electrode.

3.2.2 *continuous electrodeionization (CEDI) device—device, n*—a device that removes ionized and ionizable species from liquids using electrically active media and using an electrical potential to influence ion transport, where the ionic transport properties of the active media are a primary sizing parameter. ~~CEDI devices typically comprise semi-permeable ion exchange membranes and permanently charged ion exchange media. Examples include continuous deionization, electrodiagnosis, and packed-bed or filled-cell electrodiagnosis.~~

3.2.2.1 *Discussion*—

CEDI devices typically comprise semi-permeable ion exchange membranes and permanently charged ion exchange media. Examples include continuous deionization, electrodiagnosis, and packed-bed or filled-cell electrodiagnosis.

3.2.3 *current efficiency—efficiency, n*—the ratio, expressed in percent, of the net transfer of ionized and ionizable solutes per unit cell within a CEDI device, expressed in chemical equivalents transferred per unit time, to the number of coulombs transferred from an external DC power source to each electrode pair, expressed in faradays per unit time. ~~Calculation of current efficiency is described in 9.2.~~

3.2.3.1 *Discussion*—

Calculation of current efficiency is described in [9.2](#).

### 4. Summary of Test Method

4.1 This test method is used to determine performance capabilities of CEDI devices with regard to extent of ion removal, pressure/flow relationships and electrical power consumption at standard or nominal operating conditions, electrical current characteristics, and the relative ability of the device to remove ionized and ionizable species when fed reverse osmosis permeate water. On this type of feed, there is considerable water splitting and ion-exchange resin regeneration, causing certain species to become ionized within the device, either by the electromotive force or a localized pH shift. ~~The~~ This test method is applicable to both new and used devices.

4.2 Pressure loss data is obtained. This information provides information relating to possible particulate plugging, fouling, or internal damage of the device. Deionization performance, extent of silica and dissolved carbon dioxide removal, concentrating stream pH, and applied voltage are determined at a predetermined level of electrical current transfer. The ohmic (electrical) resistance is determined. This information in combination with concentrating stream pH provides basic design and performance information.

### 5. Significance and Use

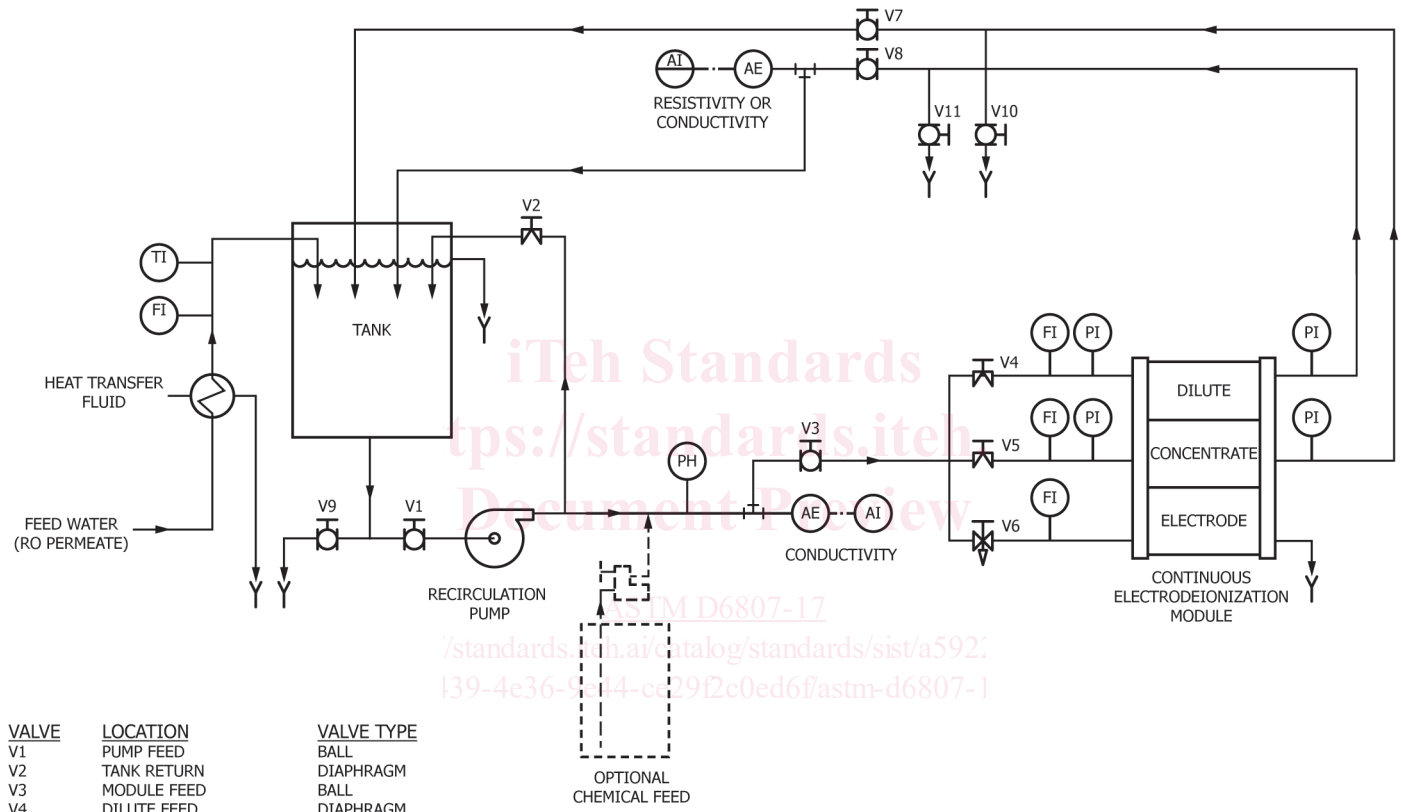
5.1 CEDI devices can be used to produce deionized water from feeds of pretreated water. This test method permits the measurement of key performance capabilities of CEDI devices using a standard set of conditions. The data obtained can be analyzed to provide information on whether changes may have occurred in operating characteristics of the device independently of any variability in feed water characteristics or operating conditions. Under specific circumstances, ~~the~~ this test method may also provide sufficient information for plant design.

### 6. Apparatus

6.1 *Description*:

6.1.1 The test apparatus is schematically represented in [Fig. 1](#). Feed water to the apparatus may be passed through a heat exchanger ~~and/or~~ other accessories to modify ~~and/or~~ control feed water temperature as desired. Alternately, data obtained from the operation of the apparatus may be normalized for temperature if normalization factors are known.

6.1.2 Feed water to the apparatus enters a holding tank (open or vented) of volume sufficient to maintain good control of water level and solute concentrations. The tank is unpressurized, ported to be capable of occasional cleanings or sanitizations, and incorporates needed safety features such as high temperature and overflow protection. The tank also incorporates a drain valve. During operation of the apparatus, the drain valve may be used in combination with a valve controlling the rate of feed water to



VALVE	LOCATION	VALVE TYPE
V1	PUMP FEED	BALL
V2	TANK RETURN	DIAPHRAGM
V3	MODULE FEED	BALL
V4	DILUTE FEED	DIAPHRAGM
V5	CONCENTRATE FEED	DIAPHRAGM
V6	ELECTRODE FEED	BALL
V7	DILUTE DISCHARGE	BALL
V8	CONCENTRATE DISCHARGE	BALL
V9	TANK DRAIN	BALL
V10	DILUTE TO DRAIN	BALL
V11	CONCENTRATE TO DRAIN	BALL

FIG. 1 Process Flow Schematic

iTeh Standards  
<https://standards.itih.org/catalog/standards/sist/a592139-4e36-4144-cc9f2c0ed6f/astm-d6807-1>  
 ASTM D6807-17