Designation: D7601 – 19

# Standard Practice for Pressure Driven Membrane Separation Element/Bundle Evaluation[1]

This standard is issued under the fixed designation D7601; 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 practice covers the inspection, performance testing, autopsy, and analytical work associated with evaluating pressure driven membrane separation elements (microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO)).

1.2 This practice is applicable for elements when newly manufactured or at any time during their operation in a water treatment facility. The Analytical section (6.4) covers only membrane surface and foulant analyses.

1.3 The data derived from these tests should be evaluated versus newly manufactured elements/bundles or against operating systems when they were initially brought on-stream, or both. Industry norms can also be used for comparative purposes.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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.*

1.6 *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:*[2]

D1129 Terminology Relating to Water

D3923 Practices for Detecting Leaks in Reverse Osmosis and Nanofiltration Devices

D4194 Test Methods for Operating Characteristics of Reverse Osmosis and Nanofiltration Devices

D4472 Guide for Recordkeeping for Reverse Osmosis and Nanofiltration Systems

D4516 Practice for Standardizing Reverse Osmosis Performance Data

D5090 Practice for Standardizing Ultrafiltration Permeate Flow Performance Data (Withdrawn 2016)[3]

D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration, and Reverse Osmosis Membrane Processes

D6908 Practice for Integrity Testing of Water Filtration Membrane Systems

D7285 Guide for Recordkeeping Microfiltration and Ultrafiltration Systems

## 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this standard, refer to Terminologies D1129 and D6161.

## 4. Summary of Practice

4.1 This practice discusses the inspection of the pressure driven membrane separation elements required for individual units to be readied for a visual inspection or an autopsy that can be performed to ascertain structural integrity (Practice D6908) and cleanliness. Visual inspection is non-destructive testing; autopsy requires the dismantlement of the element.

4.2 Performance testing of an element are discussed that can be accomplished on or off line, in a single or multi-element housing under conditions proscribed by the user or element

[1] This practice 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.

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

[3] The last approved version of this historical standard is referenced on www.astm.org.

manufacturer or Test Methods D4194. The data collected (Guides D4472 and D7285) must then be normalized (Practices D4516 and D5090) to a set of conditions that permit the element's performance to be compared to an as-new unit.

4.3 Laboratory analyses are presented that include visual, usually non-destructive, as well as specialized instrumentation, usually destructive testing.

## 5. Significance and Use

5.1 Water treatment membrane devices can be used to produce potable water from brackish supplies and seawater as well as to upgrade the quality of industrial water. This standard permits the evaluation of the integrity and performance of membrane elements using visual observations and standard sets of conditions and are for short-term testing (<24 h). This standard can be used to determine changes that may have occurred in the operating characteristics of elements but are not intended to be used for plant design.

## 6. Tests

6.1 *Physical Inspection:*

6.1.1 *Spiral Wound Elements:*

6.1.1.1 Disconnect element housing from the operating system and remove element to be inspected from housing, placing it on a work table.

6.1.1.2 Examine the element for cracked or dislodged, or both, end caps, telescoping, discolored scrolls, fiberglass discoloration and cracks, contaminants on fiberglass surface and in product tube, and any other abnormalities.

6.1.1.3 Weigh element and compare to the nominal as-new unit weight supplied by the manufacturer.

6.1.1.4 Record findings.

6.1.1.5 If element is to be reinserted into operating system or other flow tests are to be performed at a later time, visual testing should not be too long as to dry out the element.

6.1.2 *Hollow Fiber Elements:*

6.1.2.1 *Visual Inspection:*

*(1)* Disconnect element from the operating system, placing it on a work table.

*(2)* Examine the element for cracked nub or tube sheet, or both, telescoping, outer wrapping discoloration and cracks, contaminants on outer wrapping surface and in feed tube, and any other abnormalities.

*(3)* Weigh element and compare to the nominal as-new unit weight supplied by the manufacturer.

*(4)* Record findings.

*(5)* If element is to be reinserted into operating system or other flow tests are to be performed at a later time, visual testing should not be too long as to dry out the element, thereby, adversely affecting the membrane continuity.

6.1.2.2 *Rod Test (when it is proper):*

*(1)* The rod test is used to detect a collapse or obstructed feed tube, brine tube or distributor. For this test, a simple rod that is at least the length of the bundle(s) and has a diameter slightly smaller than the tube(s) to be tested is employed. The test can be accomplished without dismantling the bundle.

*(2)* Remove the plugs or connections, isolating the tube to be tested.

*(3)* Insert the rod into the tube to the maximum penetration possible.

*(4)* An unobstructed tube will allow full penetration. An obstructed tube will not allow full penetration indicating damage. Repair, if possible, will require disassembly of the element/housing.

6.2 *Performance:*

6.2.1 *Probing of Spiral Wound Elements:*

6.2.1.1 Test is performed for identifying which spiral element in a multi-element housing is defective. It is performed on a system that is operating by assessing radical changes in conductivity from one end of the element to the other. The location of the flaws further back from the permeate tube can be obscured by the permeate mixing before the permeate reaches the tube.

6.2.1.2 A typical probe design is seen in Figs. 1 and 2 and can also be obtained from element manufacturer.

6.2.1.3 Product conductivity data collection should be obtained every 2 to 6 in.

6.2.1.4 Look for abnormal or discontinuous changes in conductivity.

6.2.1.5 Assess integrity of membrane and glue lines from this information.

6.2.2 *Wet-Test (Refer to Test Methods D4194 and Guides D4472 and D7285):*

6.2.2.1 Disconnect element housing from operating system and remove element to be inspected from housing, placing it on a work table.

6.2.2.2 Insert element into single unit housing and appropriately connect the utility lines.

6.2.2.3 Wet test element at standard conditions for the element. Test conditions can be determined by using the membrane manufacturer's product data sheets. The as-new performance (flow, rejection, differential pressure drop) of

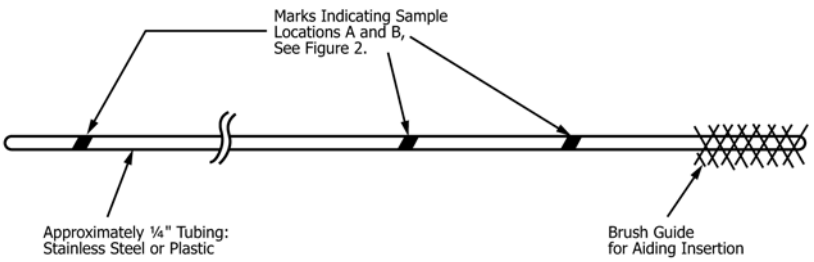


**FIG. 1 Product Sampling Probe**