

SEMI F40-0699^E (Reapproved 0918) PRACTICE FOR PREPARING LIQUID CHEMICAL DISTRIBUTION COMPONENTS FOR CHEMICAL TESTING

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NOTICE: This Document was reapproved with minor editorial changes.

1 Purpose

1.1 This Document defines component preparation and pretreatment procedures for chemical test methods used to evaluate liquid chemical distribution system components.

2 Scope

2.1 This Document includes preparation procedures that can be applied to components such as tubing, piping, valves, regulators, fittings, gaskets, O-rings, and filter housings.

2.2 This Document defines and specifies all of the component pretreatment and analyze preparation procedures for liquid chemical distribution system components common to the test methods listed (see Table 3). Each type of component should be pretreated and prepared according to the procedures of this Document before it can be tested using the identified chemical test methods.

2.3 This Document defines preparation and pretreatment procedures used for the evaluation of liquid chemical distribution system components in test fluids. This Practice is intended for use with 49% hydrofluoric acid (HF), 30% hydrogen peroxide (H₂O₂), 29% ammonium hydroxide (NH₄OH), isopropyl alcohol (IPA) and ultrapure water (UPW). The Document defines the purity of chemicals that can be used for leaching and rinsing liquid chemical distribution system components.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Although ozonated water is commonly used in UPW systems, no provisions are made in this Document for evaluations using ozonated water. Therefore, some of the procedures may not be directly applicable to ozonated water.

3.2 The preparation procedures described in this Practice primarily involve static testing including agitation. Dynamic testing (i.e., continuous flow), may alter the chemical test results. Static component preparation procedures are not directly applicable to dynamic testing.

3.3 This preparation procedure applies to ambient temperature only with the exception of UPW which may be tested at ambient temperature and up to 85°C.

3.4 Filter cartridges are not covered in this Document due to the requirement for dynamic testing.

4 Referenced Standards and Documents

4.1 None.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *DSC* — differential scanning calorimetry

5.1.2 *FEP* — fluorinated ethylene-propylene

5.1.3 *FTIR* — Fourier transform infrared spectroscopy

5.1.4 H_2O_2 — hydrogen peroxide

5.1.5 HF — hydrofluoric acid

5.1.6 IPA — isopropyl alcohol

5.1.7 NH_4OH — ammonium hydroxide

5.1.8 NVR — nonvolatile residue

5.1.9 PFA — perfluoroalkoxy

5.1.10 PP — polypropylene

5.1.11 TGA — thermal gravimetric analysis

5.1.12 TOC — total organic carbon

5.1.13 UPW — ultrapure water

5.2 Definitions

5.2.1 *blank extraction* — a container of test fluid which does not see the component under test. It follows the entire procedure and is handled in the same manner in order to show the background of the lab or test area.

6 Summary of Practice

6.1 This Document describes two different component preparation procedures (see Figure 1):

1. procedure for preparing components and collecting a sample for extraction analyses.
2. procedure for pretreating or preparing components for bulk polymer analysis.

6.2 Table 1 specifies the flush time, soak time, and container material for extracting leachable contaminants. Sample size requirements for bulk analyses are listed in Table 2.

6.3 This Practice should be performed before analysis by industry standard extraction and bulk test methods used to evaluate liquid chemical distribution component. Available industry standard test methods are listed in Table 3 and the Related Documents section.

7 Apparatus and Materials

7.1 *Containers* — As defined in Table 1.

7.1.1 All containers and caps used in component and blank extraction should be thoroughly cleaned. A typical recommended cleaning procedure is outlined in § 11.3. However, any cleaning procedure is acceptable as long as the subsequent blank extraction yields impurity concentrations that do not exceed 10% of the specification for the material being tested. For example, if a given impurity is specified for a maximum of $1.0 \mu\text{g}/\text{cm}^2$, the blank extraction concentration should not exceed $0.1 \mu\text{g}/\text{cm}^2$.

NOTE 1: In situations where the detection limit is greater than 10% of the specification for the polymer material, the detection limit of the instrument converted into $\mu\text{g}/\text{cm}^2$ will suffice, provided it does not exceed the specification for the material being tested.

7.2 Test Fluids

7.2.1 For purposes of this Practice, references to water shall be understood to mean UPW as defined by maximum individual metal and anion impurity levels of 0.1 parts per billion by weight 1×10^{-9} (ppbw) or less, total organic carbon (TOC) levels of 10 ppbw or less, nonvolatile residue (NVR) levels of 0.1 parts per million by weight 1×10^{-6} (ppmw) or less, resistivity of 18 megohm-cm or greater, and reactive silica impurity of less than 1.0 ppb.

7.2.2 References to HF , NH_4OH and hydrogen peroxide (H_2O_2) shall be understood to refer to chemicals with a minimum of a semiconductor grade purity and meet the criteria in § 7.1.1. The impurity concentrations of the chemical must not exceed 10% of the lowest anticipated concentration for the analyte(s) of interest.

7.2.3 *Ultrapure Nitric Acid* — Less than 1 ppb for each trace metal.

7.2.4 *Ultrapure Hydrochloric Acid* — Less than 1 ppb for each trace metal.

7.2.5 *Ultrapure Isopropyl Alcohol* — Less than 1 ppb for each trace metal.

8 Precautions

8.1 *Safety Precautions*

8.1.1 This Practice may involve hazardous materials, operations, and equipment. This Practice does not purport to address the safety considerations associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before using this Practice.

8.2 *Technical Precautions*

8.2.1 The component preparations must be conducted in clean environments that prevent contamination of the components and containers at the parts per trillion level for the analyte(s) of interest. A clean environment may require the use of a cleanroom (for those procedures which can be performed in a cleanroom).

8.2.2 For all testing other than differential scanning calorimetry (DSC), thermal gravimetric analysis (TGA), and Fourier transform infrared spectroscopy (FTIR), the component preparation should take place in a controlled environment to minimize contamination.

9 Sampling and Test Specimens

9.1 The components selected for testing should reflect the current manufacturing capabilities of the supplier.

10 Procedure for Preparing Components and Collecting an Extraction Sample for Analysis

10.1 Component preparation for contaminants that can be leached from liquid chemical distribution components is different from component preparation for bulk polymer analysis. Components are flushed and then soaked to extract surface contamination. Refer to Table 1 for procedures for handling specific components.

10.2 The liquid chemical distribution system components described in this section are divided into two groups:

1. Components that require capping (see § 10.5).
2. Components that require a container (see § 10.6).

10.3 Each group is discussed individually. Use Table 1 to determine the appropriate group for each component.

10.4 *General Procedure*

10.4.1 The blank extraction is a container of test fluid without a component which follows the entire procedure and is handled in the same manner. Please consult the specific test method for the number of test fluid samples to be prepared and the statistical treatment. This would include a number of containers for both component and blank extractant. Use cleaned containers that meet the criteria specified in § 7.1.1. An example of a cleaning procedure is outlined in § 11.3.

10.4.2 Use UPW to fill and then drain the component or container 10 times. After each fill, leave the water in the component or container for two minutes before draining.

10.4.3 Fill an 11th time with the appropriate test fluid (see § 2.3); use this fill for the test. Refer to Table 1 to determine the soak time for each component or container.

10.4.4 Agitate once a day for one minute. Orbital shakers or manual agitation can be used, but no foreign materials may contact the test fluid; therefore, stir bars cannot be used. Components and/or containers are to remain sealed during agitation to prevent splashing or spilling. Components in containers (such as gaskets) should remain completely submerged throughout the extraction.

10.5 *Components that Require Capping (Tubing, Piping, Valves, Regulators, and Filter Housings)*

10.5.1 This Practice is appropriate for static samples with one end permanently sealed and one end loosely capped. Since the sealing process may contaminate the sample, one end should be sealed prior to precleaning. Use cleaned caps meeting the criteria specified in § 7.1.1. The cap must be manufactured from the same material as the component or from a compatible material that will not contaminate the sample.

10.5.2 As surfactants and solvents may leave a residue that could alter the test results, do not use them for precleaning.