

# Standard Operating Procedure (SOP)

## PEM Thermal Stability

Test ID # LTE-P-5

Rev 3

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Date: 09/24/2019

*Revision History*

This page documents the revisions over time to the SOP. The most recent iteration should be listed in the row space, with consecutive versions following.

Date of Revision	Page(s)/Section(s) Revised	Revision Explanation
04/16/2019	All	First Release
09/24/2019	All	Formatting, minor edits
03/04/2020	All	Revised procedure with minor edits Distributed for review

## **Outline/Table of Contents**

1. Title Page
2. Procedures
  - a. Scope and Applicability
  - b. Summary of Method
  - c. Step by Step Procedure
    - Instrument or Method Calibration and Standardization
    - Sample Collection
    - Sample Handling and Preservation
    - Sample Preparation and Analysis
    - Troubleshooting
    - Data Acquisition, Calculations & Data Reduction Requirements
    - Computer Hardware & Software
  - d. Cautions
  - e. Personnel qualifications
  - f. Equipment and supplies
3. Quality Control and Quality Assurance Section
4. Reference Section

## 2. Procedure:

### a. Scope and Applicability.

The purpose of this SOP is to describe the method for measuring the thermal degradation of Proton Exchange Membranes (PEMs).

### b. Summary of Method.

Thermal degradation of the Proton Exchange Membranes (PEMs) is measured by thermal gravimetric analysis (TGA) using a TA Instruments, Q500 (or equivalent) on dry samples in SO<sub>3</sub>H form, which was dried a minimum of 12 h in a vacuum without heating, having a mass of 1-5 mg over a temperature range of 25 to 1000°C at a heating rate of 10°C/min under a N<sub>2</sub> environment.

### c. Step by step procedure:

1. TGA platinum pan is cleaned using propane torch.
2. TGA platinum pan is cooled down and tared by automatic taring feature of Q500.
3. Sample of 1-5 mg fully contained within pan is loaded in TGA pan, with gloved hands and clean forceps.
4. Sample is heated over a temperature range of 25 to 700 °C at a heating rate of 10 °C/min under a N<sub>2</sub> environment.
5. Degradation is defined as percent weight loss, or  $(\text{initial weight} - \text{final weight})/(\text{initial weight}) * 100$ .

6. Sample may also be degraded in air, depending on outcome desired by user; repeat steps 1-5, altering step 4 to be in an air environment at 50 mL/min, which can be changed within Q50 software.

d. Cautions – Allow TGA to cool to room temperature after experiment. Be sure to use platinum pan when exceeding 600 °C, although a platinum pan is always recommended. Be cautious using propane torch.

e. Personnel Qualifications / Responsibilities – users should have basic laboratory knowledge and skills and should be led through operations of TA instruments Q50.

f. Equipment and Supplies – TA Instruments Q500 (or equivalent), platinum sample pan, propane torch, compressed ultra-high purity N<sub>2</sub> or standard compressed air.

### 3. Quality Control and Quality Assurance Section

- QC/troubleshooting- TGA should regularly be calibrated according to TA Instrument procedures. Monthly calibration is recommended.

### 4. Reference Section

- Not applicable for this SOP.