
Fuel Cell Standards

XVI. Fuel Cell Stack

XVI.a Fuel Cell Theory and Operation

Overview:

Classroom instruction on basic fuel cell history, theory and major component identification with emphasis on hydrogen PEM fuel cells

- History of fuel cells and fuel cells used to power vehicles
- Basic physics on how a fuel cell membrane functions
- Basic chemistry involved in a PEM fuel cell and definition of anode and cathode
- Basic operation of membrane, catalyst, diffuser media, field channels, gaskets and end plates
- The role of water in the PEM fuel cell
- POL curves, fuel cell efficiency and durability
- Poor fuel quality effects on stack performance
- Hydrogen PEM fuel cell stack components and functions
- PEM fuel cell failure modes and degradation
- OEM fuel cell system specific service documents
- Overview of basic components and locations
- Review of applicable DOT and FVMSS specifications
- Review shipping requirements for a hydrogen fuel cell stacks

Description:

An overview of fuel cell history, types, chemical processes and POL curves with emphasis on PEM fuel cells gives the student a basic theoretical understanding to support their ability to effectively troubleshoot and repair sub-systems and vehicles. PEM fuel cell can exhibit multiple temporary and permanent failure modes during operation or storage such as over temperature, freezing, water blockage and cell reversal.



Outcome (Goal):

Students will be able to describe hydrogen PEM fuel cell functions, inputs and outputs. They will be able to identify major subsystem components. Student will understand major fuel cell failure modes.

Objectives:

Student will be able to

1. Identify major fuel cell stack component and location
 2. Understand and plot a PEM fuel cell POL curve using fuel cell kit
 3. Calculate power and voltage output of a stack given basic data
 4. Locate and identify each component of the fuel cell system.
 5. Reference OEM service procedures to find critical information about the fuel cell stack such as operating temperatures.
 6. Define major failure modes and stack life reduction issues
 7. Explain what would be the effect of poor quality fuel on the system and how to mitigate the effects
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Tasks:

Students will

1. When provided with a schematic representation of a PEM fuel cell the student will be able to identify its primary parts such as anode, cathode, membrane, flow field plates, end plates, catalysts and diffusion media.
 2. Using a vehicle mechanization diagram or live vehicle determine the location of the fuel cell stack(s).
 3. Given basic data calculate the power and voltage of a fuel cell stack
 4. Conduct experiments on a model fuel cell and collect and record data
 5. Students will be able to use OEM service information to identify a vehicle's maximum and minimum temperatures for operation , storage and shipping
 8. Link a cause and effect diagram list stack failures modes and stack life reduction with possible causes
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To comment or offer suggestions on this standard, contact Ken Mays:

Ken Mays	NEVTEX
541-383-7753	kmays@cocc.edu

