Fuel Cells (General)

Fuel cells convert the energy of a fuel directly into electricity, eliminating the combustion stage that is characteristic of heat engines. The fuel cell stack does not require any moving parts. Instead, the fuel molecules (usually hydrogen often derived from hydrocarbon fuels) interact with the surface of an anode material to form reaction products, liberating electrons. The electrons flow through the electric load to the cathode where they react with an oxidant, typically oxygen from air. Ions migrate between the electrodes through the ionically conducting electrolyte to complete the circuit.

The product of this electrochemical energy conversion process is water, but unlike heat engines, the process can take place at close to ambient temperature, or can also be conducted at higher temperatures, depending on the types of anode, electrolyte and cathode materials.

In practice, fuel cell systems are designed to operate at a power density reflecting the most economical trade-off of fuel and capital costs. At the design point of the system the power output of the system is specified by the manufacturer for certain standard conditions of fuel and air.

It is the purpose of the ASME PTC 50 Code to define in a commonly acceptable manner how the power output and the energy input should be measured and how the efficiency should be calculated.

ASME International Codes and Standards
Fuel Cell Industry Activities

ASME is leading a worldwide effort to develop standards for fuel cell power industry and hydrogen infrastructure. This is one of the most dynamic and innovative times in the history of mechanical engineering. Fuel cells have the potential to change the world in which we live. Associates of our fuel cell initiative-related committees include experts from U.S. Fuel Cell Council, U.S. Department of Energy, Argonne National Laboratory, Fuel Cell Energy, UTC Fuel Cells, Ballard Generation Systems, and Carnegie Mellon University.

Get Involved and Make History With Us

ASME PTC 50 – Performance Test Code for Fuel Cell Power Systems Performance – ASME’s flagship fuel cell standard, which evaluates stationary fuel cell performance in terms of their power and efficiency...a critical issue in the future of fuel cell technology.

Contact: Bill Nothofer, nothoferw@asme.org

ASME CSTI – Codes and Standards Technology Institute, providing the world with research and technology development needed to establish and maintain the technical relevance of codes and standards. Join us. Fund a project – participate!

Contact: John Koehr, koehrj@asme.org, or visit our website at www.csti.asme.org.

ASME Hydrogen Steering Committee – identifying ASME codes and standards currently used or potentially useful for hydrogen infrastructure applications, assessing standards development needs, coordinating with other standards developers, and maintaining involvement in global regulations related to standards for hydrogen infrastructure. Hydrogen codes and standards are key to establishing the infrastructure and protecting public safety as we move toward commercialization of this new fuel source.

Contact: John Koehr, koehrj@asme.org.

Other ASME Codes and Standards
www.asme.org/codes

Purchasing an ASME Code or Standard
ASME Information Central
Phone: 800-THE-ASME (800-843-2763)
Email: infocentral@asme.org
The importance of developing fuel cell standards was recognized during the 1990’s. Potential applications including vehicular power, on-site power generation, and larger scale dispersal power generators were on the horizon. Demand for this technology was increasing due to the undeniable benefits of fuel cell technology. Fuel cells were seen as one path to a cleaner and more efficient method of producing power and energy.

During this time, ASME had a very active Fuel Cell Power Systems technical committee within its Advanced Energy Systems Division. Through its volunteer membership it recommended the formation of a standards committee to work on developing a fuel cell performance standard. The ASME Codes and Standards Directorate undertook this task. On October 14, 1996 the Board on Performance Test Codes voted to approve the formation of a performance test code committee, PTC 50.


What is PTC 50?

A “PTC” is a Performance Test Code. Performance Test Codes are published by ASME to provide guidance for evaluating a wide range of products and systems using standardized procedures to ensure rigorous results.

ASME PTC 50 provides guidance for evaluation of fuel cell power systems to determine their power output and efficiency in several ways. Corrections for site conditions and deviations are allowed, but the intent is that any fuel cell power system tested in accordance with ASME PTC 50 can be compared with other rigorous data from other standardized tests of similar scope.

ASME PTC 50 is a rigorous test that can be used to calculate power output, electrical efficiency, heat rate, heat recovery effectiveness, and other factors. ASME PTC 50 applies to all fuel cell power systems regardless of the electrical power output, thermal output, fuel cell type, fuel type, or system application.

The Code addresses combined heat and power systems, that is, the generation of electricity and usable heat at specific thermal conditions. It does not address the performance of specific sub-systems nor does it apply to energy storage systems, such as regenerative fuel cells or batteries. It is not applicable to automotive fuel cells. It also does not address emissions, reliability, safety issues, or endurance.

It contains methods and procedures for conducting and reporting fuel cell system testing, including instrumentation to be used, testing techniques, and methods for calculating and reporting results. ASME PTC 50 defines the test boundary for fuel and oxidant input, secondary energy input and net electrical and thermal energy output. At these boundaries, it provides procedures for measuring temperature, pressure, input fuel flow and composition, electrical power and thermal output.

ASME PTC 50 provides procedures for determination of electrical efficiency or heat rate and overall thermal effectiveness at rated or any other steady state condition. The Code also provides the method to correct results from the test to reference conditions.

PTC 50…

- Simplifies decision-making for fuel cell developers, customers and investors
- Helps to evaluate relative strengths of various fuel cell technologies
- Assists developers in understanding the performance of their technology versus their competitors’ technology
- Helps consumers identify and decide on the best performing product for their specific use

PTC 50 Code Contains…

Section 1 defines the objective and scope of the PTC 50 Code.

Section 2 is dedicated to defining a fuel cell system and to definitions of terms. It also contains a brief discussion of the major types of fuel cells.

Section 3 outlines the methodology of establishing test protocol.

Section 4 presents instrumentation for measuring the energy of the feed stream, and the energy of the exiting gases and liquids. In addition, the instrumentation for measuring electric power is specified.

Section 5 describes how the efficiency of the systems shall be calculated from the measurements, and how corrections for nonstandard conditions shall be made.

Section 6 lays out the requirements for the structure and content of the final test report.

Mandatory Appendix I serves as a guide for pretest and post-test uncertainty calculations.