

Formerly  
DOE-HDBK-1012

DOE FUNDAMENTALS  
**THERMODYNAMICS, HEAT TRANSFER,  
AND FLUID FLOW**



**U.S. Department of Energy**  
**Washington, D.C. 20585**

Distribution Statement A. Approved for public release; distribution is unlimited.

## **ABSTRACT**

The *Thermodynamics, Heat Transfer, and Fluid Flow Fundamentals Handbook* was developed to assist nuclear facility operating contractors provide operators, maintenance personnel, and the technical staff with the necessary fundamentals training to ensure a basic understanding of the thermal sciences. The handbook includes information on thermodynamics and the properties of fluids; the three modes of heat transfer - conduction, convection, and radiation; and fluid flow, and the energy relationships in fluid systems. This information will provide personnel with a foundation for understanding the basic operation of various types of DOE nuclear facility fluid systems.

**Key Words:** Training Material, Thermodynamics, Heat Transfer, Fluid Flow, Bernoulli's Equation

## FOREWORD

*Thermodynamics, Heat Transfer, and Fluid Flow* was prepared as an information resource for personnel who are responsible for the operation of the Department's nuclear facilities. A basic understanding of the thermal sciences is necessary for DOE nuclear facility operators, maintenance personnel, and the technical staff to safely operate and maintain the facility and facility support systems. The information contained in this text is by no means all encompassing. An attempt to present the entire subject of thermodynamics, heat transfer, and fluid flow would be impractical. However, this text does present enough information to provide the reader with a fundamental knowledge level sufficient to understand the advanced theoretical concepts presented in other subject areas. This knowledge will help personnel more fully understand the impact that their actions may have on the safe and reliable operation of facility components and systems.

*Thermodynamics, Heat Transfer, and Fluid Flow* consists of three modules. The following is a brief description of the information presented in each module of the handbook.

### **Module 1 Thermodynamics**

This module explains the properties of fluids and how those properties are affected by various processes. The module also explains how energy balances can be performed on facility systems or components and how efficiency can be calculated.

### **Module 2 Heat Transfer**

This module describes conduction, convection, and radiation heat transfer. The module also explains how specific parameters can affect the rate of heat transfer.

### **Module 3 Fluid Flow**

This module describes the relationship between the different types of energy in a fluid stream through the use of Bernoulli's equation. The module also discusses the causes of head loss in fluid systems and what factors affect head loss.