Boiler Operation & Control

SERIES SPECIFICATIONS & COURSE OUTLINE

CONTENTS
Produced in cooperation with ISA – The Instrumentation, Systems, and Automation Society (ISA™) – this mechanical maintenance series is designed to help participants understand the evolution of the boiler system from the first century to modern day. The series provides an overview of the operation of the boiler plate system, including the basic principles of steam energy, how the boiler plate system is designed and constructed, the different types of fuel it burns, and the operating procedures of such an invention.

AUDIENCE
The Boiler Operation and Control series is designed for mechanical maintenance technicians possessing an understanding of boilers, electricians, mechanics, process operators, and other instrumentation and control professionals.

LEARNER EXPECTATIONS
This series is intended to be used as an essential component in your mechanical maintenance curriculum. Each lesson has specific objectives that identify the anticipated level of understanding associated with the information presented. Our experience indicates that those who complete the training are likely to accomplish the stated objectives. Furthermore, if these lessons are built into a total curriculum which includes practice in the working environment, it will help provide participants with the knowledge necessary to master the subject.
Introduction to Boilers: An Overview

**Purpose:** This course covers the functions of the components of the steam, feedwater, fuel, and air systems. Participants are shown how components (such as pipes and tubes delivering the steam) maximize heat energy and how they can use this information to help determine the most effective and least costly means of using steam production in the work setting.

**Objectives:** Identify the definition of terms associated with steam; identify the components of a steam system; describe the role the steam system plays in the function of a boiler system; identify the components of a feedwater system; describe the role the feedwater system plays in the function of a boiler system; identify the components of the fuel and air systems; describe the roles the fuel and air systems play in the function of a boiler system; and analyze conservation of heat energy by various components to maximize effectiveness and minimize cost.

Boiler Design & Construction

**Purpose:** This course discusses the differences and similarities between the boiler types.

**Objectives:** Identify the characteristics and uses of a firetube boiler; recognize the advantages of a Scotch Marine boiler; describe the features and applications of a wetback Scotch Marine boiler and a dryback Scotch Marine boiler; identify the characteristics and uses of a watertube boiler; describe the features and applications of the steam and waterside components of the watertube boiler; describe the features and applications of the fuel layer or fireside of the watertube boiler; and analyze how the components of a watertube boiler function as a whole.

Boiler Feedwater & Steam

**Purpose:** In this course, participants are shown the multiple ways to control boiler water and boiler water chemistry. It also explains the three basic approaches to feedwater control.

**Objectives:** Explain why feedwater must be treated before it enters a boiler; explain how chemical treatment is used to inhibit scale and corrosion in a boiler; explain how to minimize impurities in boiler water and why shrink and swell occur; identify components and their functions in a single-element feedwater control system, a two-element control system, and a three-element control system; and describe how a three-element cascaded feedwater control system differs from other means of controlling drum level.

Boiler Fuel & Air

**Purpose:** The various fuels used in boilers today and the equipment that enables the fuel use is discussed in this course.

**Objectives:** Identify the three general groups of boiler fuels and the byproducts of each; identify the physical characteristics of liquid and gaseous fuels and how their heat values are an efficient means for boiler systems; describe the operating characteristics of the systems and equipment used for burning fuels to include stoker, bunker, and hoppers; and describe combustion control to include the proper rate of combustion, maintaining the proper air-fuel ratio, and responding to changes in steam demand.

Boiler Operation

**Purpose:** In this course, students will learn proper boiler startup and shutdown procedures. Students will review the operator’s basic responsibilities and be exposed to the abnormal and emergency conditions that can arise during boiler operation.

**Objectives:** Identify the basic startup procedures for boiler system operation; describe the actions conducted in the pre-start check; describe the actions conducted in a system purge; describe the actions conducted during lightoff of the burners; recognize the consequences of the heatup phase; describe the actions conducted during initiating feedwater flow; explain the purpose of each of the steps to the shutdown procedure; identify the boiler operator’s responsibilities; and recognize abnormal and emergency conditions that may arise during boiler operation.