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American National Standard

Fossil Fuel Plant Steam Temperature Control System — Drum Type



The International Society for Measurement and Control

ANSI/ISA-S77.44, Fossil Fuel Power Plant Steam Temperature Control System — Drum Type

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ISA
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709

Preface

This preface is included for informational purposes and is not part of ANSI/ISA-S77.44.

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The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards, recommended practices, and technical reports. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, which has been published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Std. 268-1992, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors. Certain metric units that are not a part of the SI system are in common accepted use. This standard uses bar as a pressure measurement that is convertible to kilopascals by multiplying by 100.

The information contained in the footnotes and annexes are included for information only and are not a part of this standard. Functional drawings in [Annex C](#) are provided using [ANSI/ISA-S5.1](#) symbology and established power industry conventions.

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This standard is part of a series of standards resulting from the efforts of ISA-SP77.40, Boiler Controls. It should be used in conjunction with the other SP77 series of standards for safe, reliable, and efficient design, construction, operation, and maintenance of fossil-fired power plants. It is not intended that this standard establish any procedures or practices that are contrary to any other standard in the series.

A variety of steam temperature control systems have been developed and used over the years to maintain steam temperature within limits and at the required setpoint. This standard is intended to establish minimum requirements for steam temperature control.

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Contents

Section Title	Section Number
Scope	1
Purpose	2
Definitions	3
Minimum design requirements for a superheat steam temperature control system	4
Process measurement requirements	4.1
Control and logic requirements	4.2
Final control element requirements	4.3
System reliability and availability	4.4
Minimum alarm requirements	4.5
Operator interface	4.6
Minimum design requirements for a reheat steam temperature control system	5
Process measurement requirements	5.1
Control and logic requirements	5.2
Final control element requirements	5.3
System reliability and availability	5.4
Minimum alarm requirements	5.5
Operator interface	5.6
 Annexes	
A — References	
B — Steam temperature control	
Purpose	B.1
Requirements	B.2
Principles and methods of steam temperature control	B.3
Saturation protection/water induction	B.4
Two-stage attemperation	B.5
Use of cascade spray valve control	B.6
No _x control	B.7
Redundancy	B.8
Reset windup prevention	B.9
 C — Figures	
C.1a — Typical superheater single-stage attemperator arrangement	
C.1b — Typical superheater two-stage attemperator arrangement	
C.2 — Typical single-element superheat steam temperature control	
C.3 — Typical two-element superheat steam temperature control	

- C.4 — Typical three-element superheat steam temperature control
- C.5 — Typical two-stage attemperation superheat steam temperature control
- C.6 — Typical two-element fuel nozzle tilt control
- C.7 — Typical two-element flue gas pass damper control
- C.8 — Typical two-element flue gas recirculation control
- C.9 — Typical compartmented windbox temperature control
- C.10 — Typical single-element reheat steam temperature control

Table B.1 — Summary of typical control systems

1 Scope

The scope of this standard addresses the major steam temperature control subsystems in boilers with steaming capacities of 200,000 lb/hr (25 kg/s) or greater. These subsystems include, but are not limited to, superheat temperature control and reheat temperature control. Specifically excluded from consideration are turbine bypass control, motor control logic, combustion control, sootblower control, and controls associated with fluidized bed- and stoker-fired furnace combustion units.

2 Purpose

The purpose of this standard is to establish the minimum requirements for the functional design specification of steam temperature control systems for drum-type fossil fuel power plant boilers.

3 Definitions

3.1 attemperator: A mechanical device used for maintaining and controlling the temperature of superheated steam.

3.2 attemperator (direct contact type): A mechanical device in which the steam and the cooling medium (water) are mixed.

3.3 boiler: The entire vessel in which steam or other vapor is generated for use external to the vessel. This includes the furnace, consisting of waterwall tubes; the firebox area, including burners and dampers; the convection area, consisting of any superheater, reheater, economizer sections or any combination thereof, as well as drums and headers.

3.4 cascade control system: A control system in which the output of one controller (the outer loop) is the setpoint for another controller (the inner loop). The outer loop is normally a slow responding process as compared to the inner loop.

3.5 control: Maintaining a desired setpoint of steam temperature during operation.

3.6 control loop: A combination of field devices and control functions arranged so that a control variable is compared to a setpoint and returns to the process in the form of a manipulated variable.

3.7 controller: A manual or automatic device or system of devices used to regulate the boiler steam temperatures within defined parameters as set forth by a turbine/boiler manufacturer.

3.8 desuperheater: [See 3.2 attemperator.](#)

3.9 deviation: The difference between the loop setpoint and the process variable.

3.10 error: [See 3.9 deviation.](#)

3.11 feedback: A signal produced by a measuring device that is proportional to the magnitude of a controlled variable or position of a control element.

3.12 final control element: The component of a control system (such as a control valve) that directly regulates the flow of energy or material to or from the process.

3.13 fuel trip: The automatic shutoff of a specific fuel as the result of an interlock or operator action.

3.14 gas pass: An arrangement in which the convection banks of a boiler are separated by gas-tight baffles into two or more parallel gas paths isolating portions of the superheater and reheater surfaces. The proportion of total gas flow through each gas pass may be varied by regulating dampers.

3.15 gas recirculation: A method by which gas from the boiler, economizer, or air heater outlet is reintroduced to the furnace by means of a fan(s), duct(s), or both.

3.16 integral control action: An action in which the controller's output is proportional to the time integral of the error input. When used in combination with proportional action, it previously was called reset action.

3.17 integral windup: The saturation of the integral controller output in the presence of a continuous error, which may cause unacceptable response in returning the process to its setpoint within acceptable limits of time and overshoot.

3.18 interlock: A device or group of devices (hardware or software) arranged to sense a limit or off-limit condition, or improper sequence of events, and to shut down the offending or related piece of equipment, or to prevent proceeding in an improper sequence in order to avoid an undesirable condition.

3.19 intermediate (platen) superheater: A heating surface receiving steam from the primary superheater located between the primary and secondary superheater. ([See Figure C.1b.](#))

3.20 linearity: The nearness with which the plot of a signal or other variable plotted against a prescribed linear scale approximates a straight line.

3.21 master fuel trip (MFT): ([See 3.13 fuel trip.](#)) An event resulting in the rapid shutoff of all fuel.

3.22 primary air: Combustion air that enters the fuel-burning zone and directly supports initial combustion. On pulverized coal-fired units, the primary air is used to transport the coal from the pulverizers to the burners.

3.23 primary (convection or initial) superheater: A heating surface receiving steam from the drum. ([See Figures C.1a and C.1b.](#))

3.24 reheater: A heating surface receiving steam returning to the boiler from the high-pressure turbine exit.

3.25 secondary air: Combustion air introduced on the edge of the burning zone to supplement the primary air for support of the combustion process.

3.26 secondary (radiant or final) superheater: A heating surface receiving steam from either the primary or intermediate superheater. ([See Figure C.1a or C.1b.](#))

3.27 setpoint: The desired operating value of the process variable.

3.28 superheater: A bank of heating surface tubes contained within a boiler, and to which heat is applied to elevate the steam temperature to a desired value above saturation.

3.29 trip: The automatic removal from operation of specific equipment or the automatic discontinuance of a process action or condition as the result of an interlock or operator action.

3.30 transient correction: A control action specifically applied to minimize any process error resulting from a temporary process change; e.g., temperature control action applied to counter the effects of over- or under-firing during load changes.

4 Minimum design requirements for a superheat steam temperature control system

The control system shall meet all operational requirements and properly interface with the process. To accomplish these objectives, the following minimum system design requirements are defined as:

- a) Process measurement requirements
- b) Control and logic requirements
- c) Final control element requirements
- d) System reliability and availability
- e) Alarm requirements
- f) Operator interface

4.1 Process measurement requirements

4.1.1 Instrument installations for superheat steam temperature control

Instruments should be installed as close as is practical to the source of the measurement, with consideration being given to excessive vibration, temperature, and accessibility for periodic maintenance.

Recommendations for the location of instrument and control equipment connections can be found in the joint publication by Scientific Apparatus Makers Association (SAMA) and American Boiler Manufacturers Association (ABMA), "Recommendations for Location of Instrument and Control Connections for the Operation and Control of Watertube Boilers."

Thermowell installations for temperature measurements shall meet the requirements of ANSI/ASME B31.1, Section 1, "ASME Code for Pressure Piping."

Thermowell installations shall consider location, mounting, and velocity criteria in making a proper interface with the process.

Separate isolation valves and impulse lines shall be provided for head-type instrumentation.