Basic Boiler Terminology

Learning Outcome
When you complete this module you will be able to:

Explain common terms relating to boilers.

Learning Objectives
Here is what you will be able to do when you complete each objective:

1. Apply the common terminology used in the description of boilers.
INTRODUCTION

The purpose of this module is to list and explain many of the common terms used by people who work with boilers. The list does not give all boiler terms, and regional names for certain items may vary.

Altitude Gage

A pressure gage commonly used on hot water heating boilers. The scale is graduated in metres or feet to indicate the height of a column of water corresponding to the given pressure.

Attended Boiler

A boiler that is only operated when a qualified operator is present to watch over and control the various boiler functions.

Baffle

A wall, barrier or panel used to change the direction of flow of a liquid or gas. On the waterside of a boiler, baffles may be used to direct the flow of water inside drums or headers. On the fireside of the boiler, baffles may be used to redirect the flow of hot combustion gases through banks of tubes. Fireside baffles are usually made of high temperature refractory material.

Blowoff Valves (also known as Blowdown Valves or Boiler Drain Valves)

Valves located on a line leading from the lowest part of the water side of a boiler. Power boilers usually require a fast opening valve (also called a guard valve) and a slow opening valve. Low-pressure heating boilers usually require only one blowdown valve.

Boiler Failure

Boiler failure is a term usually applied to the pressurized parts of the boiler. A ruptured tube or a crack which allows high-pressure steam or water to escape to the point of the boiler requiring shutdown is considered a boiler failure. Other failures to operate may not be classed as a boiler failure, for example, a no flame condition caused by fuel problems would be called a flame failure. Boiler shutdown caused by a broken feedwater pump would be called feedwater failure. Catastrophic boiler failure is observed when a combustion explosion, or rapid pressure release from the high-pressure side of the boiler, causes further destruction of the boiler and may cause devastation to surrounding buildings, equipment or personnel.
Check Valve

Check valve is a valve which has a hinged valve disk free to swing back and forth when pushed. If fluid passes in the flow direction, the disk is pushed open and flow is not hindered. If the flow tries to reverse, the disk is pressed against the valve seat and flow is not allowed to reverse. In other words this is a one way valve.

Combustion Chamber

The area of a boiler where air and fuel combine in a chain reaction to cause sustained burning. Most of the burning process occurs in the combustion chamber. However under heavy load flame may be observed in combustion gases as they sweep through or around tubes not considered an actual part of the combustion chamber. This area is also called the furnace or firebox.

Combustion Gases

Combustion gases are the hot gaseous products from the fire. These are also called “flue gases”.

Combustion Gas Pass

One pass is the travel of the combustion gases once along the length of the boiler. If the gases are reversed and passed through another source of the boiler, this is a second pass. For example, in a two pass boiler, combustion gases make two sweeps or passes through the boiler.

Condensate

When steam from a boiler is used for heating, processing, or power generation, heat energy is given up to the process and the steam condenses. The water formed from condensing steam is called condensate. Condensate is usually returned to the boiler to be converted to steam again.

Drum

The boiler shell together with the heads form a drum to contain the fluid being heated. The term shell and drum are often used interchangeably. Shell may be more common in terms of firetube boilers, where drum is more often used for watertube boilers.

Externally-Fired Boiler

Externally-fired boiler is a boiler with the combustion chamber outside the boiler drum. This type of furnace is not surrounded by water but is surrounded by brickwork.
Feedwater

Feedwater is the water that is fed into a steam boiler to replace water which has been converted to steam and drawn off from the boiler.

Firetube Boiler

Firetube boiler is a boiler consisting of a drum containing straight tubes through which the hot combustion gases from the fire travel. Water in the drum surrounds the tubes and the heat from the hot gases passes through the tube walls to the water.

Fitting

Fitting on a boiler means any valve, gage, regulating or controlling device, flange, pipe fitting or other attachment on the boiler.

Flame Scanner

Flame scanner is a device used to observe the flame in a boiler. If the flame is extinguished for any reason, the flame scanner sends a signal to close the fuel supply valve to prevent a possible explosion.

Flue Gases

Flue gases are the hot gaseous products from the fire. These are often referred to as “combustion gases”.

Forced Draft Fan

Forced draft fan is a fan which blows air for combustion into the furnace via the windbox.

Gage Glass

Gage glass is a strong glass tube used to indicate the water level in a steam boiler. Some high-pressure boilers use heavy flat glass sections firmly clamped to a hollow metal frame.

Generally Supervised Boiler

Generally supervised boiler means that the boiler can operate without continual control by an operator. The boiler may operate overnight or on weekends without an operator present. However, through the week someone must occasionally check the boiler and verify that all controls are working, that the boiler water is correctly treated, and that the boiler is working properly. Also known as an automatic boiler.

Handhole

A handhole is a small, hand-sized inspection, cleaning, and maintenance port leading from the outside of the boiler into the pressure area of the boiler. A handhole cover seals the port during operation.
Header

A header is a larger pipe which supplies to or collects from a series of smaller pipes or tubes. Also called a manifold.

Heads

Heads are the steel plates which close off the ends of the boiler drum. They are also referred to as end plates. If the shell contains tubes which are held in position by the heads, then they are usually called tube sheets.

Heating Surface

The heating surface of a boiler consists of all parts of the boiler through which heat from the burning fuel is transferred to the water side of the boiler. It includes all parts of the boiler plates and tubes which have water or steam on one side and are swept by fire or hot combustion gases on the other side.

High-Pressure Steam Boiler

A high-pressure steam boiler is a steam boiler which operates at pressures above 103 kPa (15 psig). These are also called power boilers.

Horizontal Return Tubular Boiler (HRT)

A horizontal return tubular boiler is a firetube boiler usually supported in a brick combustion chamber. The hot gases from combustion sweep along the underside of the shell then return through the fire tubes to the chimney connection.

Hot Water Boiler

A hot water boiler is a closed vessel completely filled with water to which heat is added to raise the temperature of the water. No steam is generated in this boiler. Types of hot water boilers include low-pressure hot water heating boilers, hot water supply boilers (commonly called water heaters or hot water tanks) and high temperature hot water boilers.

Hot water supply boilers are not considered as low-pressure heating boilers unless one or more of the following is exceeded:

- Capacity 454 L (120 U.S. Gallons)
- Temperature 93°C (200°F)
- Energy input 58.7 kW (200,000 BTU/hr.)

Low-pressure heating boilers are considered as such unless the temperature exceeds 121°C (250°F) or the pressure exceeds 1100 kPa (160 psi). Above this range they are classed as high temperature hot water boilers.
Induced Draft Fan

An induced draft fan is a fan used to draw combustion gases out of the boiler and blow them up the chimney.

Internally-Fired Boiler

Internally-fired boiler has the combustion chamber located within the shell of the boiler, or the furnace is surrounded by watertubes.

Limit Controls

Limit controls are controls which have their set point adjusted higher than the boiler operating controls setpoint. If, for any reason, the normal operating controls fail to limit the rise in temperature or pressure in a boiler, the limit controls will shut off the fuel supply to the boiler.

Lowest Permissible Water Level

The lowest permissible water level is the lowest water level at which the boiler can be safely operated without damaging or overheating any part of the boiler.

For heating boilers this level is specified and marked by the manufacturer. The lowest visible part of the water gage glass is at 25mm (1 inch) above this lowest permissible water level.

For power boilers the lowest visible part of the gage glass is set 50 mm (2 inches) above the lowest permissible water level.

For horizontal firetube type boilers the lowest visible part of the gage glass is set not less than 76 mm (3 inches) above the highest point of the tubes, flues or crown sheet.

Low-Pressure Steam Boiler

Low-pressure steam boiler is a boiler which operates at a pressure not above 103 kPa (15 psi).

Low-Water Fuel Cutoff

Low-water fuel cutoff is a safety device which cuts off the fuel supply to the burner if the boiler water level drops below a safe level.

Manhole

Manhole is an opening or hatch through which a person may enter into the shell or drum of a boiler.
Operating Controls

Operating controls are the controls which operate the combustion equipment on a boiler. Changes in steam demand from the boiler require a corresponding change in the firing rate of the boiler.

Packaged Boiler

A packaged boiler is a boiler supplied by the manufacturer completely equipped and mounted on its own base.

Refractory

Refractory is the protective layer of material that is applied to various parts of the boiler to withstand high temperatures and abrasion. It usually has an appearance similar to cement or bricks.

Rupture Disk

A rupture disk is a safety device which acts like a safety valve to protect against excessive pressure buildup in a system. However, the disk shatters when its maximum pressure is reached and must be replaced each time it activates.

Safety Valve

This fitting prevents the pressure within a steam boiler from exceeding safe limits. When the pressure inside the boiler reaches a set point, the valve will pop open and reduce the pressure to another preset point and close. Safety relief valves are used where liquids are present. This type of valve does not “pop” open but only bleeds off enough liquid to relieve the excess pressure.

Setting

Setting is the brickwork used to support a boiler and surround the combustion chamber. This term is particularly used for such boilers as a horizontal return tubular boiler (HRT).

Soot Blower

Soot blower is a device used to blow accumulated soot off tubes and heating surfaces in a boiler. Air or steam issues from nozzles to dislodge the soot or fly ash as the soot blower traverses or is rotated to clear the deposit from a section of the boiler.
Stack

Stack is the hollow duct through which combustion gases are elevated for discharge to the atmosphere. The hot combustion gases rising through the stack cause a draft to be created in the boiler. A stack may also be called a smoke stack or chimney. Aboard ships they are called funnels.

Steam Boiler

A steam boiler is a closed container partially filled with water. The water is evaporated to steam under pressure by the application of heat. The steam is piped away for specific purposes.

Steam Gage

Steam gage is a fitting attached to a boiler to indicate the internal pressure of the boiler. All steam boilers must be equipped with an accurate steam gage.

Steam Space

Steam space is the space above the water line in a steam boiler where the boiling water and steam can separate from each other. The space also acts as a pressure reservoir to accommodate small load fluctuations.

Steam Stop Valve

Steam stop valve is the main valve on the steam line leaving the boiler. It must be able to positively halt the flow of steam from a boiler.

Syphon

Syphon is a protective device used to prevent steam from entering the internal works of a steam gage. Often a syphon only consists of a single coil of high pressure pipe with threaded ends.

Try Cocks

Try cocks are small valves installed directly on the water column. They allow the operator an alternative method of checking the water level in the gage glass.

Uptake

The duct used to convey the spent combustion gases from the boiler to the stack or chimney. Also known as the flue vent and breeching.
**Vertical Tubular Boiler**

Vertical tubular boiler is usually a smaller sized firetube boiler with vertical firetubes. Some hot water supply boilers are of the vertical tubular type.

**Water Column**

Water column is a chamber attached at top and bottom to a steam boiler. The water level in the column should be the same as in the boiler. A gage glass is normally attached to the column to give a visual indication of the water level.

**Water Line**

Water line is the actual level of water in a boiler. It is the point at which water and steam separate.

**Water Space**

Water space is the portion of the boiler which is normally filled with water.

**Waterleg**

Waterleg refers to a water-filled section extending from the shell, which surrounds the firebox of some types of boilers. Most locomotive boilers are equipped with waterlegs around the firebox.

**Watertube Boiler**

Watertube boiler is a boiler consisting of drums and headers that circulate water through tubes which are heated by fire and the products of combustion. The heat from the fire is transmitted through the tubes to the water.

**Windbox**

Windbox is the box surrounding the burner damper on a boiler. The fan blows combustion air into the box and the damper regulates and directs the air into the burners.