

Technical Guide On “Industrial Boiler”



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1.Disclaimer

This information memorandum is to introduce the subject matter and provide a general idea and information on the said matter. Although, the material included in this document is based on data/information gathered from various reliable sources; however, it is based upon certain assumptions, which may differ from case to case. The information has been provided on AS IS WHERE IS basis without any warranties or assertions as to the correctness or soundness thereof. Although, due care and diligence has been taken to compile this document, the contained information may vary due to any change in any of the concerned factors, and the actual results may differ substantially from the presented information. SMEDA, its employees or agents do not assume any liability for any financial or other loss resulting from this memorandum in consequence of undertaking this activity. The contained information does not preclude any further professional advice. The prospective user of this memorandum is encouraged to carry out additional diligence and gather any information which is necessary for making an informed decision; including taking professional advice from a qualified consultant/technical expert before taking any decision to act upon the information.

2. Introduction to SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with an objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in Employment Generation and Value Addition to the national income, through development of SME sectors, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out 'sectoral research' to identify Policy, Access to Finance, Business Development Services, strategic initiatives and institutional collaboration & networking initiatives.

Preparation and dissemination of prefeasibility studies in key areas of investment has been a successful hallmark of SME facilitation by SMEDA.

Concurrent to the prefeasibility studies, a broad spectrum of Business Development Services is also offered to the SMEs by SMEDA. These services include identification of experts and consultants and delivery of need-based capacity building programs of different types in addition to business guidance through help desk services.

For more information on services offered by SMEDA, please contact our website: www.smeda.org

2.1 Industry Support Program

In order to enhance competitiveness of SMEs and achieve operational excellence, SMEDA established an Industry Support Cell (ISC) for provision of foreign technical support and knowledge transfer in collaboration with International Development Organizations. SMEDA's Industry Support Program (ISP) initially launched with Japan International Cooperation Agency (JICA) and actively engaged in reducing energy inefficiencies and improving production and quality of products with the support of Japanese Experts. Later on, similar activities with other international partner organizations like German Corporation for International Cooperation (GIZ), Training and Development Centers of the Bavarian Employers' Association (bfz), Germany, and United Nations Industrial Development Organization (UNIDO) were also successfully implemented

3.What are Boilers ?

A Boiler is a closed vessel in which water or other suitable liquid is heated to generate steam or vapor. The steam or vapor is then exited and is used for various purposes like heating, power generation and other purposes which could be domestic or industrial.

Boilers used in industry are water-containing vessels that generate heat with the help of a fuel source. It is then transferred to various tubes connecting to the various industrial equipment. The steam energy is used for running the machinery, giving industries a cost-effective way of powering their production.

The heat source and the water vessels are placed in different compartments. The metal rods that connect to the water vessel and then the heat helps in steam production. The steam is then collected in a dome to condense it before releasing it from the boiler. This increases the pressure, and the energy produced helps in powering your production processes.

For safety purposes, boilers come with a safety valve to ensure zero mishaps because of the increased pressure.

3.1 Basic Components of Boilers

Burner: The burner is the starter of the combustion reaction inside the boiler. There is a mechanism that sends the message to start the process of producing heat. A nozzle in the burner that turns the fuel pumped from the fuel source ignites it to create the combustion.

Combustion Chamber: The combustion chambers are made of cast iron and can have a temperature of several hundred degrees in minutes. It burns the fuel and generates heat which is transferred to the heat exchanger.

Economizer: it is responsible for increasing the efficiency of the boiler. The heat exchanger is placed before the air heater in the fuel gas path.

Superheater: The Steam Superheater is a coil type heat exchanger which is used to produce superheated steam or to convert the wet steam to dry steam, generated by a boiler.

Evaporator: is a boiler component that functions to convert water into saturated steam. It is able to change the whole or part of a solvent from a solution in the form of liquid to steam. So that it only leaves a denser or thick solution. The process that occurs in the evaporator is called evaporation.

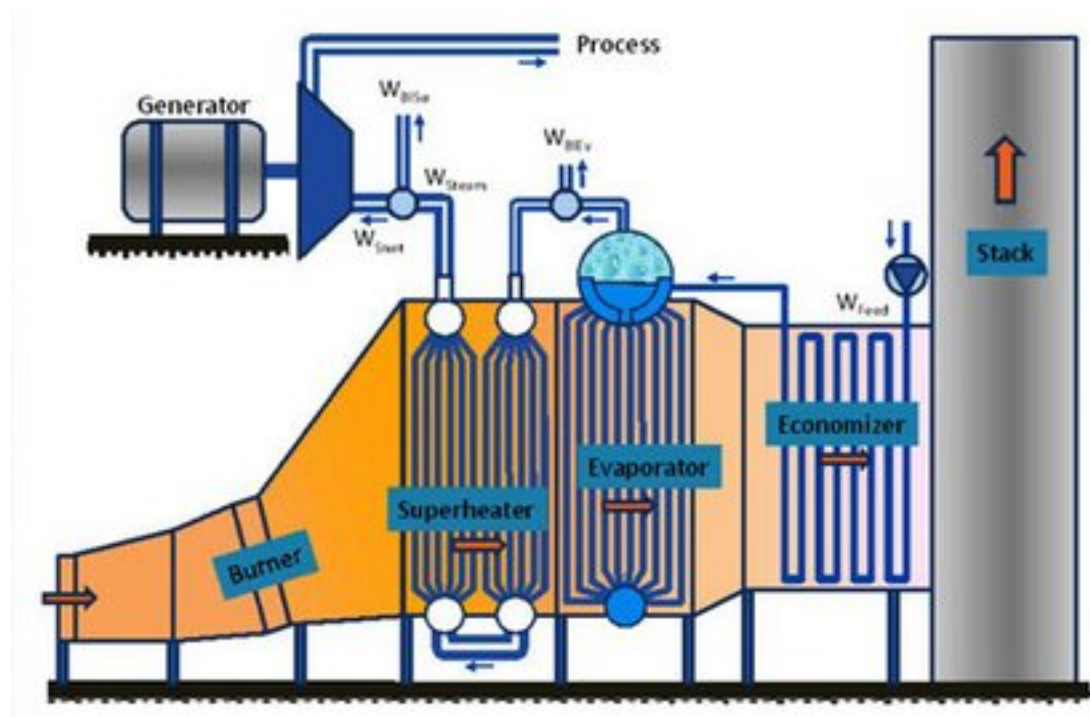
Steam Drum and Mud Drum: The steam drum collects the steam while the mud drum is placed beneath the steam drum and collects the solid which is removed periodically.

Stack: The exhaust stack is designed to safely expel spent fuel away from the building's exterior. An exhaust stack may look like a traditional brick built chimney, or it might be a series of metal pipes.

Induced Draft Fan: It removes flue gases from the combustion chambers and creates a vacuum of negative air pressure with a blower to suck the air out of the combustion chamber. These air or flue gases are discharged from the boiler through a stack or chimney

Forced Draft Fan: The primary function of Forced Draft Fans is to supply air for combustion in steam boilers. FD Fans create air pressure mechanically in the combustion chamber of a boiler.

Scrubbers: A scrubber is a device or process for removing pollutants from industrial exhaust streams. It is an air-stream pollution control device which uses liquid spray to remove solid and liquid particulate matter (which washes out) and gaseous pollutants (which are either absorbed or chemically neutralized).



Basic Components of Boilers

3.2 Types of Boilers

Boilers are classified on the basis of type of fuel used , type of tubes used , boiler axis direction and working pressure. Here , boilers based on type of tubes used are discussed below:

a- Fire Tube Boilers

Fire Tube Boilers are used widely in small and medium-sized industries. They come with pumps and control systems, all set to start operations as soon as connected to a fuel and water supply. They are often called the packaged boilers. These kinds of boilers are befitting for low to medium pressure steam requirements. Here, the combustion gases flow outside the water pipes.

They also have the capacity to produce steam with up to 2200 horsepower pressure but comes with a tremendous risk of explosion. It might be a little expensive for companies that do not need steam energy at all times.

b- Water Tube Boilers

The Water Tube Boiler is multifaceted. They are significantly different from the fire tube boilers. Water Tube boilers are usually used in large manufacturing factories where there is a need for high-pressure requirement. There is a circulation of water between the mud and the steam drum, ensuring more control over the circulation by density differences. They are perfect if there is a need to change the steam quantity because of their lower water content. The water tube boilers are often built on sites and are usually not available in a packaged unit.

3.3 Losses in Boilers

- **Dry flue gas losses** occur due high temperature of exhaust
- **Wet flue gas losses** are due to the presence of moisture in the flue gases which takes away heat with itself.
- **Insulation losses** occur due to poor insulation of the boiler surface.
- **Combustion efficiency losses** are due to improper mixing or uneven mixing of fuel with air in the burner.

4.Recommendations

4.1 Recommended Exhaust Air

The purpose of combusting fuels in any thermal utility is to produce heat and transfer this heat into some useful form of energy like steam. The efficiency of this heat transfer can be increased by properly utilizing the heat in fuel and exhausting the flue gases at minimum possible temperatures. Ideally to utilize the heat in fuel more efficiently it should be exhausted at the atmospheric temperature, but due to thermodynamic limits we cannot exhaust the flue gases at atmospheric temperature, also there are certain limits of temperatures to the fuels below which the sulphur and other corrosive contents in the exhausts starts condensing which can cause damage to the chimney and other components of the heat recovery systems.

The recommended exhaust temperature for different fuels are listed below in the table.

Fuel	Min exhaust temperature °C	Max exhaust temperature °C
Natural gas	110	130
Light oil	150	180
Heavy oil	180	200
Coal	200	250

4.2 Recommended Air Level Exhausts

For proper combustion of fuel stoichiometric amount of air is required. Any extra amount of air in addition to the stoichiometric air is called excess air. The more excess air is favorable for proper mixing of air but there should be a limit to the amount of allowable excess air in the flue gases as the excess air could take away extra amount of heat with the flue gases. The recommended percentages of excess air and oxygen in the flue gases are listed below in the table:

Fuel	Min excess air %	Max excess air %	Min O ₂ %	Max O ₂ %
Natural gas	10	15	2.0	2.7
Light oil	12.5	20	2.3	3.5
Heavy oil	20	25	3.3	4.2
Coal	30	50	4.9	7.0

4.3 Recommended Boiler Surface Temperature

Poor insulation of the boiler may cause increase in the fuel consumption because of heat losses from the boiler surface through radiation and convection. To reduce the radiation and convection losses from the boiler surface it should be properly insulated and the outer surface temperatures of the boilers should not be allowed to exceed the maximum limit.

Equipment	Min surface temperature °C	Max surface temperature °C
Boiler	80	100