Industrial Boilers: Energy Efficiency Measures

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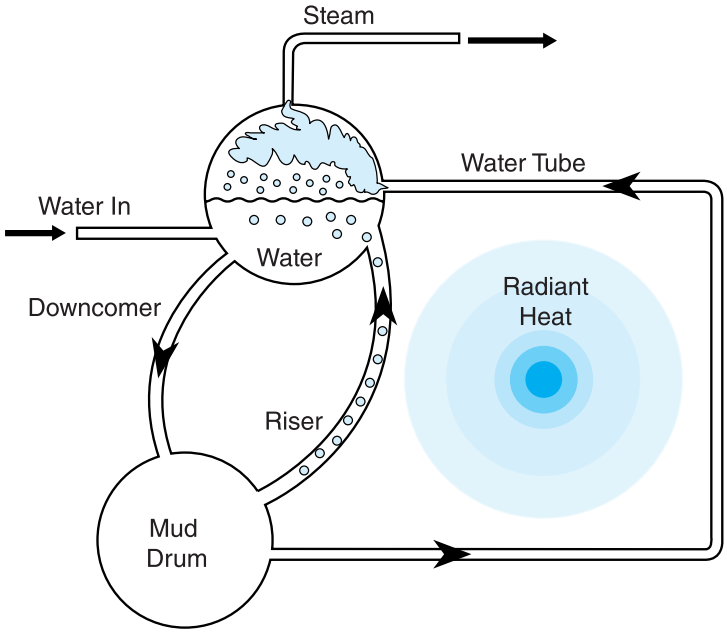
Training on
Energy Efficiency and Conservation
conducted by
Bangladesh Power Management Institute (BPMI)

Overview

Boiler



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A pressurized system in which water is vaporized by heat transferred from a source of higher temperature, usually the products of combustion from burning fuels.

Boiler: Classifications

Classification of boilers

Use
1. Stationary
2. Mobile

Tube contents
1. Fire tube:
   - Cornish,
   - Lancashire
2. Water tube:
   - Babcock Wilcox

Furnace position
1. Externally fired:
   - Lancashire,
   - Locomotive boiler
2. Internally fired:
   - Cohren,
   - Babcock Wilcox

Circulation
1. Natural (Example):
   - Lancashire,
   - Babcock Wilcox
2. Forced:
   - Lamont,
   - Velox,
   - Benson

Type of fuel used
1. Solid fuel fired
2. Liquid fuel fired
3. Gas fuel fired

Orientation axis of the shell
1. Vertical boiler
2. Horizontal boiler
3. Inclined boiler

Extend of firing
1. Fired boiler
2. Unfired boiler
3. Supplementary fired

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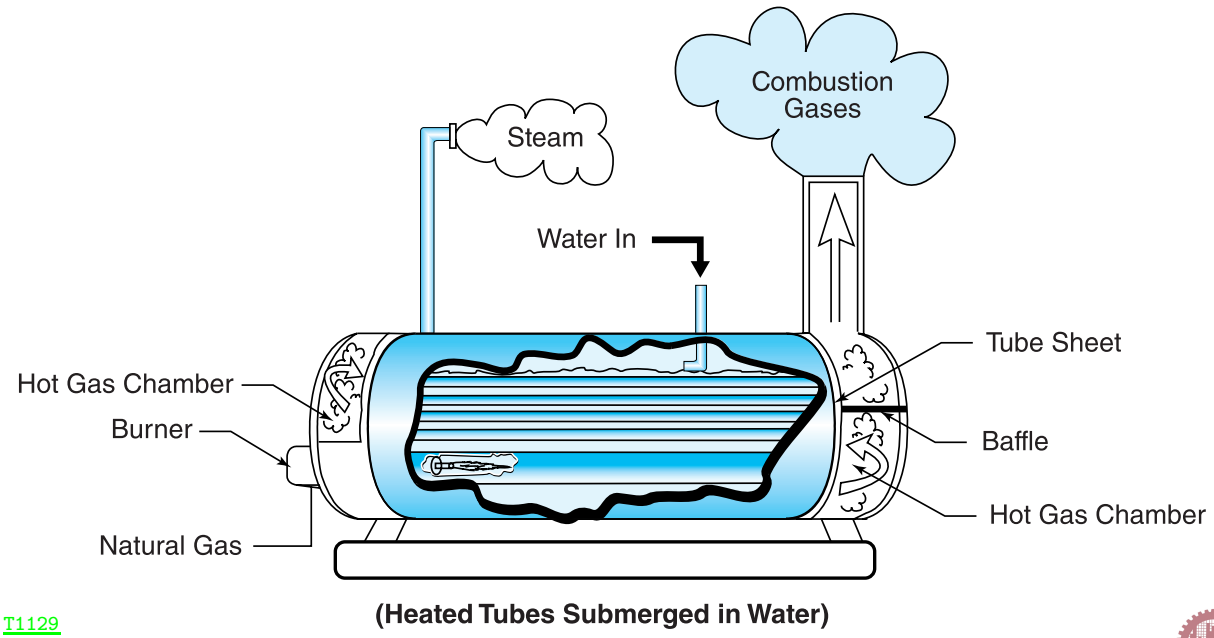
Fire-Tube Boiler(FTB)



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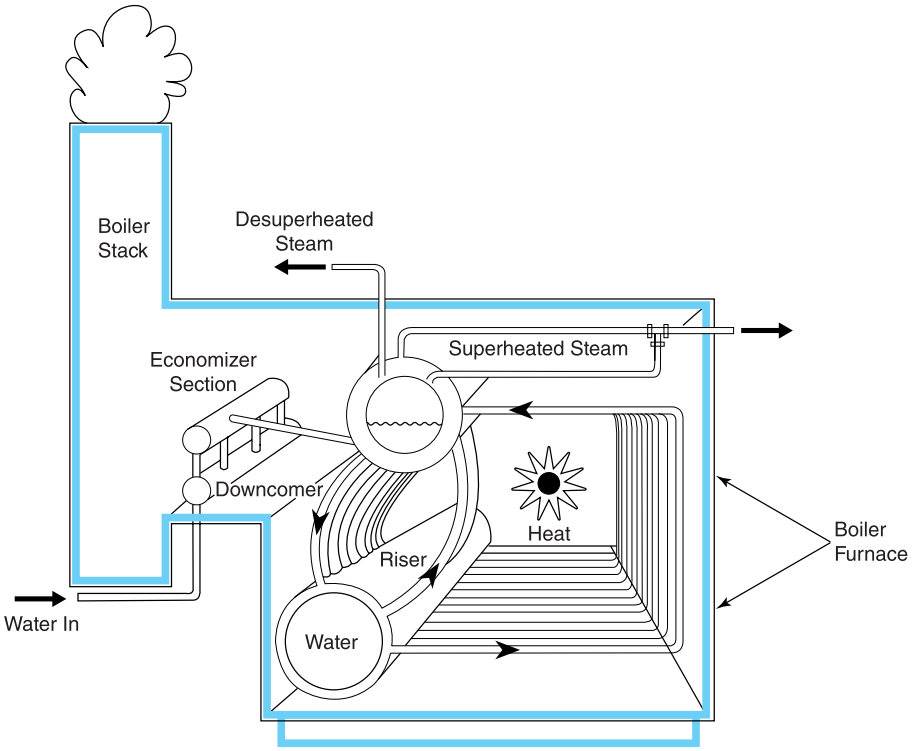
Water-Tube Boiler (WTB)



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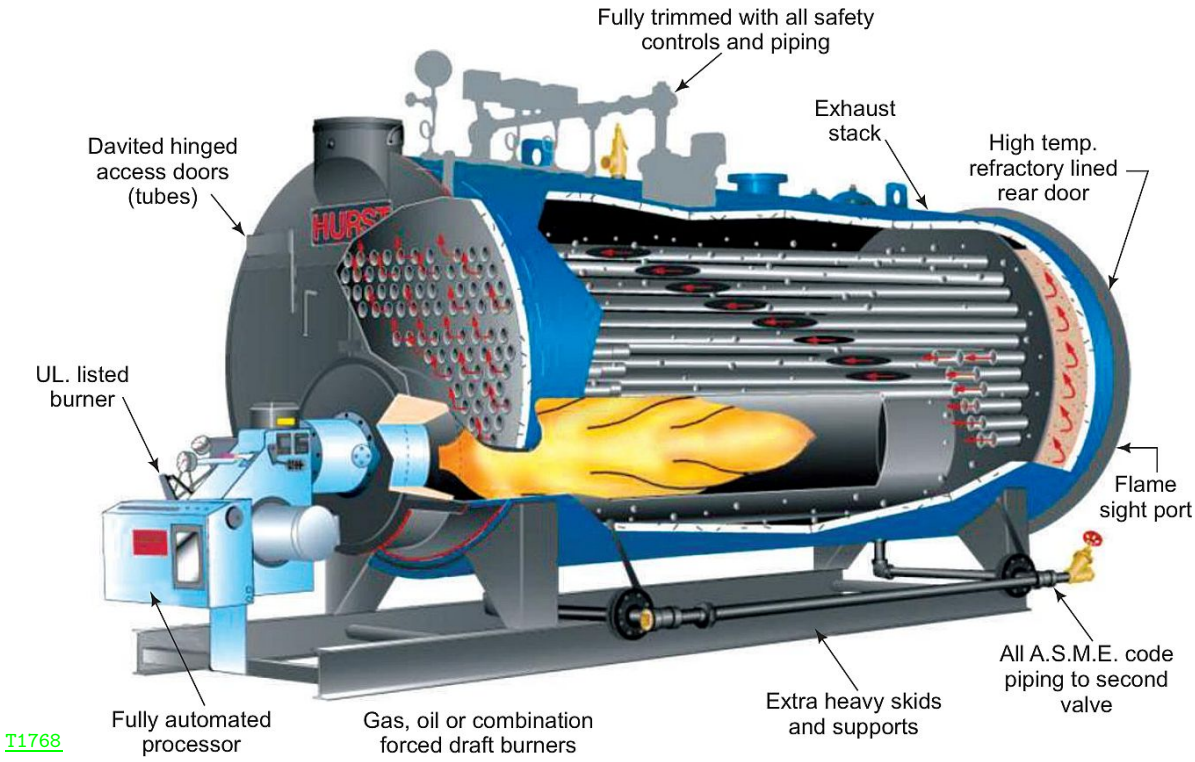
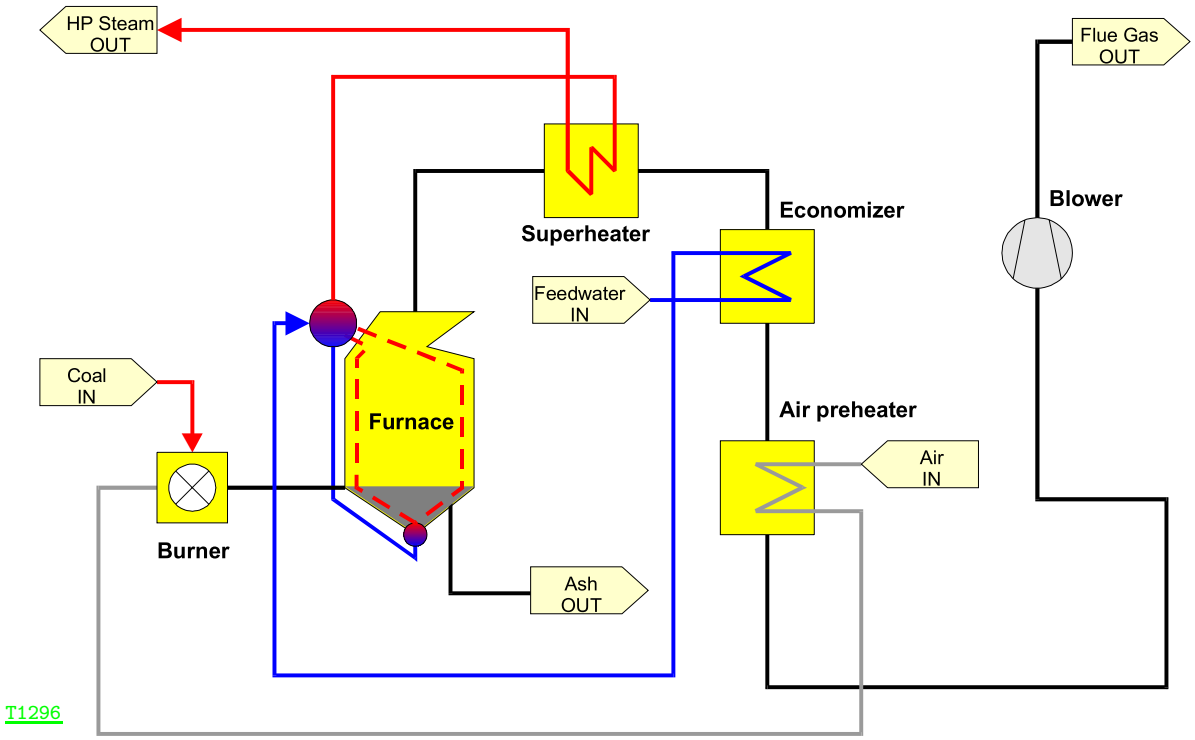


Packaged boiler

Boiler Accessories

- Air-Preheater: air supplied to the boiler is heated using the hot flue gases in the chimney.
  - Some waste heat is recovered, so system efficiency improves.
  - Better combustion and low-grade fuels can be burnt.
- Economiser: feed-water is heated using the hot flue gases.
  - Recovers energy leaving with flue gases, so system efficiency improves.
  - Hot feed water is supplied to the boiler drum, so thermal shock is minimized.
- Super-heater: steam is superheated to increase system efficiency.



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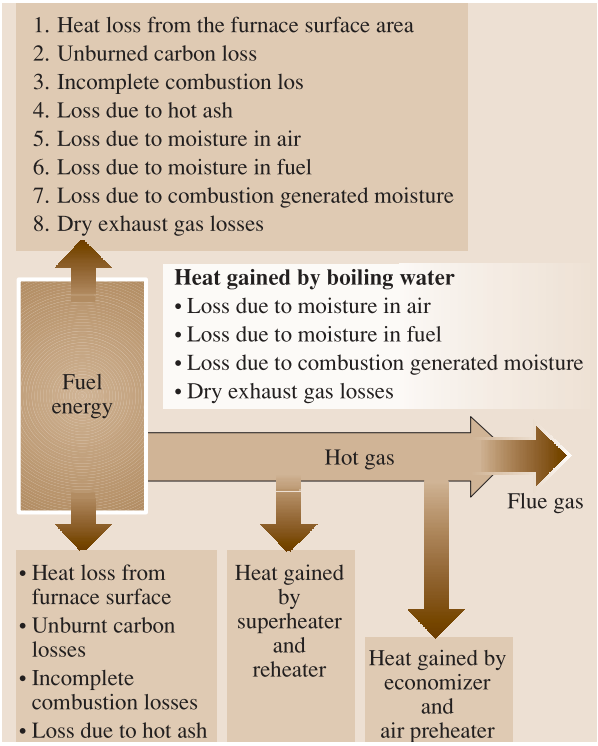
Typical steam and gas circuit showing the locations of some boiler accessories.

Energy Losses From Boilers



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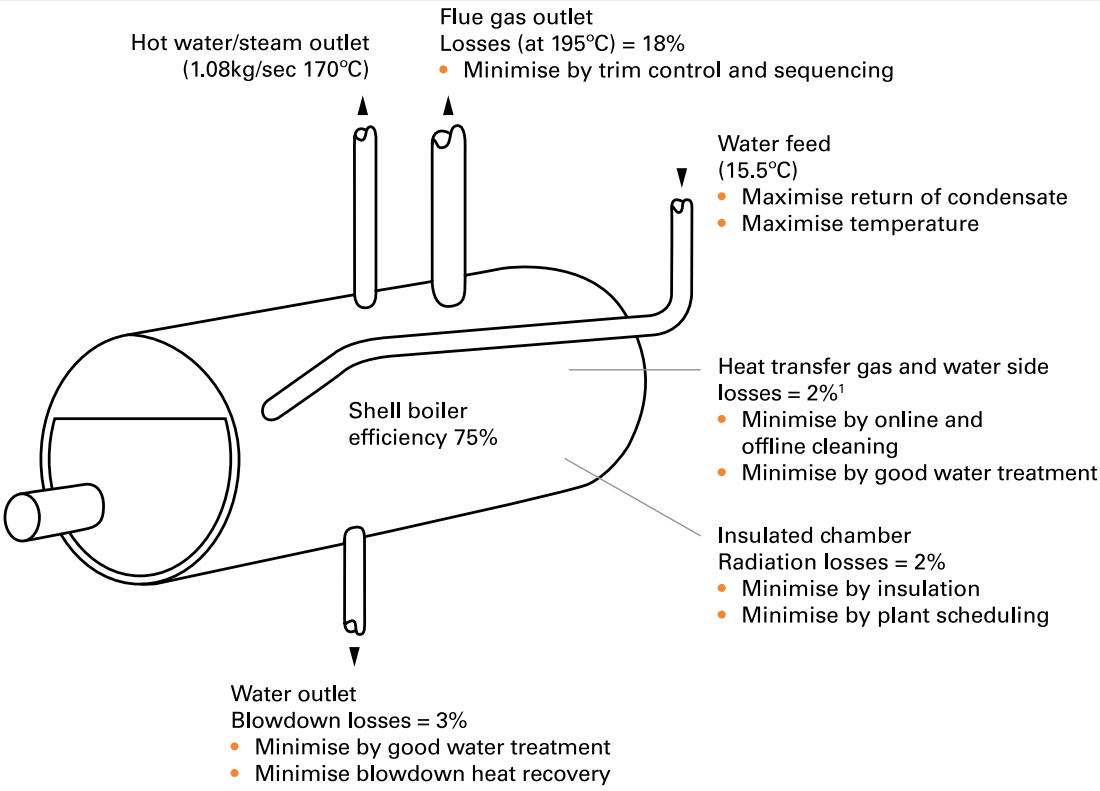
Typical Energy Losses From Boilers



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Energy Saving Potentials of Boilers

Technique/method	Energy saving potential*
Operation and maintenance of boilers	Up to 5%
Boiler and burner management systems, digital combustion controls and oxygen trim	Up to 5%
Economisers	Up to 5%
Blowdown heat recovery	Up to 4%
Combustion air preheating	Up to 2%
Water treatment and boiler water conditioning	Up to 2%
Total dissolved solids (TDS) control and boiler blowdown	Up to 2%
Flue-gas shut-off dampers	Up to 1%

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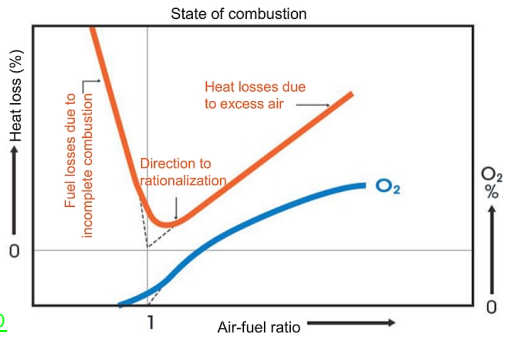

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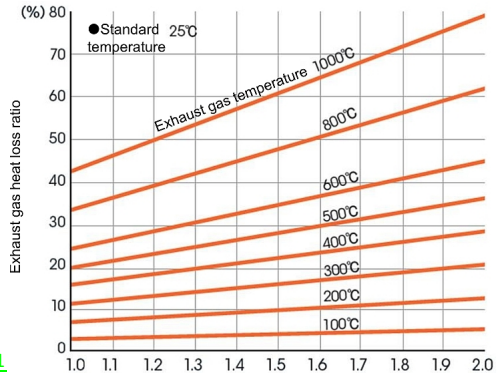

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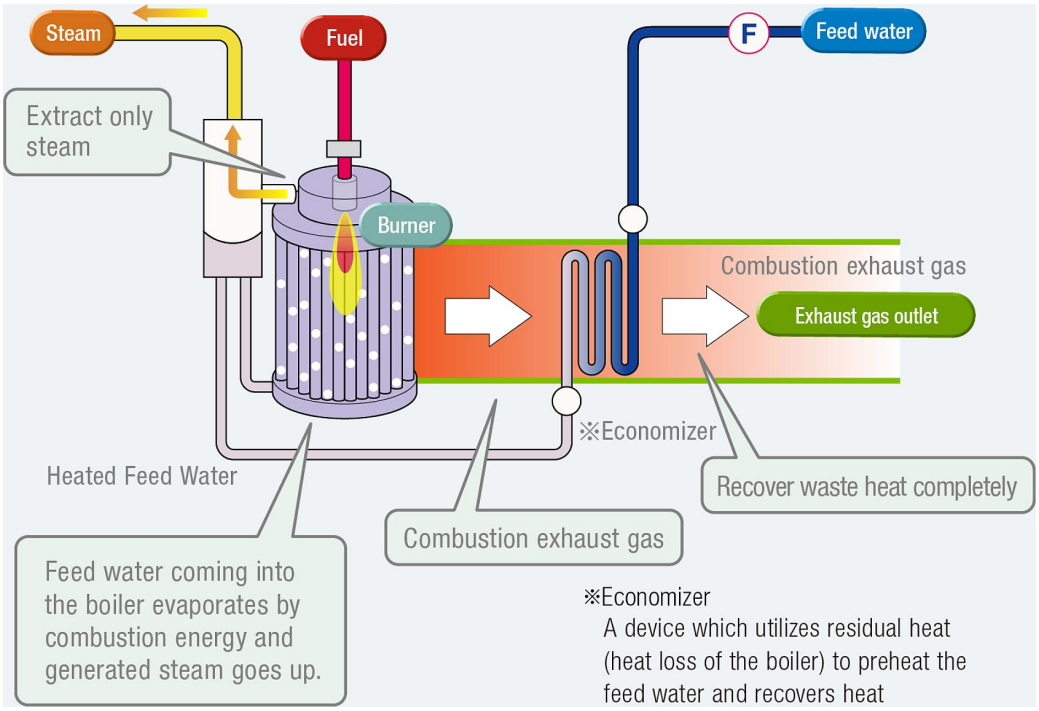
- Minimise flue gas oxygen levels without producing smoke or excessive levels of unburned carbon.
- A 2% point reduction in flue gas oxygen level leads to fuel saving of 1.2%.
- Efficiency is reduced by around 1% if flue gas temperature is increased by 20°C over the normal operating temperature.
- Consistent and accurate TDS control reduces boiler blow-down. Saves 1-2% of fuel.

One-through Boilers



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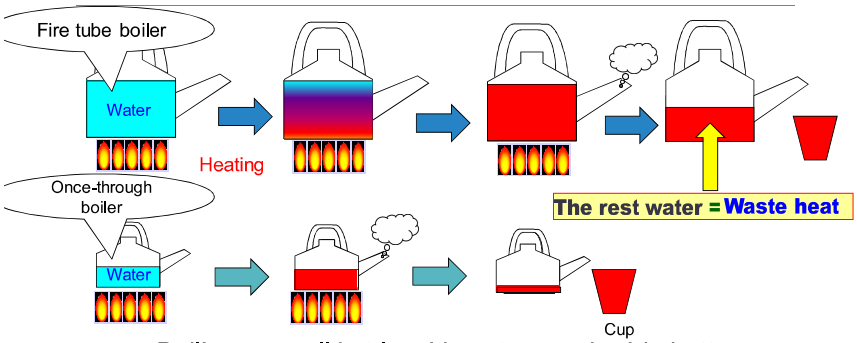

Boiling a small kettle with water required is better

	Once-through boilers	Fire tube boilers
Water holding capacity	Low	High
Time required to generate steam	Short	Long
Heat loss	Low	High
Energy saving / Design efficiency	High	Low

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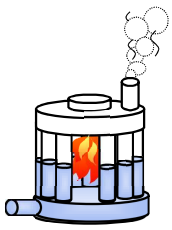
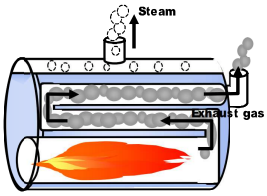
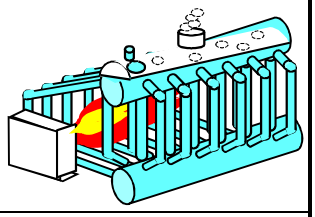
	Once-through boiler	Fire tube boiler	Water tube boiler
Outline drawing			
Design efficiency	98%	88 - 92%	85 - 92%
Load following capability	Multiple Installation with MI control enables the boilers to follow the load.	The boiler has a large water content. Because of its self-evaporation, it responses well to load changes and has a good stability.	The boiler has a large water content. Because of its self-evaporation, it responses well to load changes and has a good stability.
Qualified person (In Japan)	None	Required (Boiler engineer)	Required (Boiler engineer)
Operation Monitoring (In Japan)	Continuous monitoring is not required.	Continuous monitoring is required, by a qualified person in principle.	Continuous monitoring is required, by a qualified person in principle.
Performance check (In Japan)	None	Required	Required

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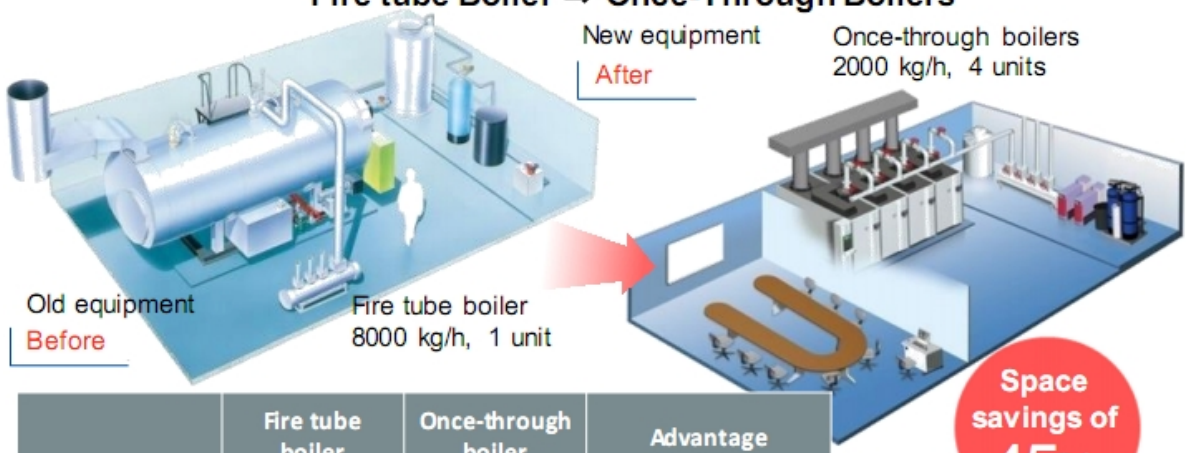
Fire tube Boiler ⇒ Once-Through Boilers



	Fire tube boiler	Once-through boiler	Advantage
Efficiency (%)	78	87.5	9.5 point increased
Fuel cost (yen/year)	43,020,000	38,350,000	4,670,000 reduced
CO2 emissions (t-CO2/year)	1,371	1,222	149 reduced

Space savings of 45%

★Calculation condition
Operation hours and days: 10 hours/day, 300 days/year
load factor : 30%
Fuel used : Natural gas (70 yen/m³)

Fuel cost and CO2 emissions reduced by 11%

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Thanks a Lot