

Table : Standards and Target Values for Operating Equipment in Factories etc.

(1) Air ratios for boilers

Classification			Air ratio					
Item	Load factor (%)	Solid fuel		Liquid fuel	Gas fuel	Byproduced gas such as blast furnace gas		
		Fixed bed	Fluidized bed					
Standard	For electric utility *	75-100	-	-	1.05-1.2	1.05-1.1	1.0	
	General boilers (evaporation volume)	30t/h or more	50-100	1.3-1.45	1.2-1.45	1.1-1.25	1.1-1.2	1.2-1.3
		10 to less than 30t/h	50-100	1.3-1.45	1.2-1.45	1.15-1.3	1.15-1.3	-
	5 to less than 10/t	50-100	-	-	1.2-1.3	1.2-1.3	-	
		Less than 5t/h	50-100	-	-	1.2-1.3	1.2-1.3	-
	Small once-through boilers	100	-	-	1.3-1.45	1.25-1.4	-	
Target	For electric utility *	75-100	-	-	1.05-1.1	1.05-1.1	1.15-1.2	
	General boilers (evaporation volume)	30t/h or more	50-100	1.2-1.3	1.2-1.25	1.05-1.15	1.05-1.15	1.2-1.3
		10 to less than 30t/h	50-100	1.2-1.3	1.2-1.25	1.15-1.25	1.15-1.25	-
	5 to less than 10/t	50-100	-	-	1.15-1.3	1.15-1.25	-	
		Less than 5t/h	50-100	-	-	1.15-1.3	1.15-1.25	-
	Small once-through boilers	100	-	-	1.25-1.4	1.2-1.35	-	

* The classification "for electric utility" above refers to boilers installed by electric power companies for power generation.

< Standard >

Note 1 : The standard values of air ratio mentioned in the table above define those to be obtained in measurements at the boiler outlet when fired at a constant level of load after regular inspection and in a stable state.

Note 2 : Turbine load factor shall be used for boilers installed for power generation, and the load factor of the boiler itself for those installed for other purposes.

Note 3 : The air ratio value of each boiler should be calculated using the following expression. Round the result to one decimal place if the corresponding standard value as defined above is significant down to the first decimal, and to two decimal places if it is significant down to the second decimal.

$$\text{Air ratio} = 21/[21 - (\text{Oxygen concentration in the exhaust emission in percentage})]$$

Note 4 : As to the pulverized coal fired boiler included in the fixed bed solid fuel types, standard air ratio values of 1.15-1.3 shall apply to electric utilities, and 1.2-1.3 to other applications (those having the quantity of evaporation of 30 t/h or more, and of 10 to less than 30 t/h only).

< Target >

Note 1 : The target values of air ratio mentioned in the table above define those to be obtained in measurements at the boiler outlet when fired at a constant level of load after regular inspection and in a stable state.

Note 2 : Refer to Notes 2 and 3 of the above < **Standard** > for calculation of load factor and air ratio.

Note 3 : As to the pulverized coal fired boiler included in the fixed bed solid fuel types, target air ratio values of 1.15-1.25 shall apply to electric utilities, and 1.2-1.25 to other applications (those having the quantity of evaporation of 30 t/h or more, and of 10 to less than 30 t/h only).

Note 4 : Target air ratio values shall be 1.2-1.3 for boilers firing black liquor at a load factor between 50 and 100%.

(2) Waste gas temperatures for boilers

Classification			Waste gas temperature				
Item	Load factor (%)	Solid fuel		Liquid fuel	Gas fuel	Byproduced gas such as blast furnace gas	
		Fixed bed	Fluidized bed				
Standard	For electric utility *	75-100	-	-	145	110	200
General boilers (evaporation volume)	30t/h or more	50-100	200	200	200	170	200
	10 to less than 30t/h	50-100	250	200	200	170	-
	5 to less than 10/t	50-100	-	-	220	200	-
	Less than 5t/h	50-100	-	-	250	220	-
	Small once-through boilers	100	-	-	250	220	-
Target	For electric utility *	75-100	-	-	135	110	190
General boilers (evaporation volume)	30t/h or more	50-100	180	170	160	140	190
	10 to less than 30t/h	50-100	180	170	160	140	-
	5 to less than 10/t	50-100	-	300	180	160	-
	Less than 5t/h	50-100	-	320	200	180	-
	Small once-through boilers	100	-	-	200	180	-

* The classification "for electric utility" above refers to boilers installed by electric power companies for power generation.

< Standard >

* The classification "for electric utility" above refers to boilers installed by electric power companies for power generation.

Note 1 : The standard values of waste gas temperature mentioned in the table above define those to be obtained in measurements at the boiler outlet when fired at 100% of load factor (turbine load factor shall be used for boilers installed for power generation, and the load factor of the boiler itself for those installed for other applications) after regular inspection, with its inlet air temperature set at 20°C. The boiler outlet may be the outlet of a waste heat recovery plant or a flue gas treatment system for environmental protection if such equipment is in use.

Note 2 : As to the pulverized coal fired boiler included in the fixed bed solid fuel types, standard waste gas temperature values of 150°C shall apply to electric utilities, and 200°C to other applications (those having the quantity of evaporation of 30 t/h or more, and of 10 to less than 30 t/h only).

< Target >

Note 1 : The target values of waste gas temperature mentioned in the table above define those to be obtained in measurements at the boiler outlet when fired at 100% of load factor (turbine load factor shall be used for boilers installed for power generation, and the load factor of the boiler itself for those installed for other applications) after regular inspection, with its inlet air temperature set at 20°C. The boiler outlet may be the outlet of a waste heat recovery plant or a flue gas treatment system for environmental protection if such equipment is in use.

Note 2 : As to the pulverized coal fired boiler included in the fixed bed solid fuel types, target waste gas temperature values of 140°C shall apply to electric utilities, and 160°C to other applications (those having the quantity of evaporation of 30 t/h or more, and of 10 to less than 30 t/h only).

Note 3 : Target waste gas temperature values shall be 180°C for boilers firing black liquor.

(3) Air ratios for industrial furnaces

Item		Gas fuel		Liquid fuel		
		Continuous type	Intermittent type	Continuous type	Intermittent type	
Standard	Melting furnace for metal forging	1.25	1.35	1.3	1.4	
	Continuous reheating furnace (billet, bloom, slab)	1.20	-	1.25	-	
	Metal heating furnace other the above	1.25	1.35	1.25	1.35	
	Metal heat treatment furnace	1.20	1.25	1.25	1.3	
	Oil heating furnace	1.20	-	1.25	-	
	Thermal decomposition furnace and reforming furnace	1.20	-	1.25	-	
	Cement kiln	1.30	-	1.3	-	*1
	Coal kiln	1.30	1.35	1.3	1.35	*1
	Drying furnace	1.25	1.45	1.3	1.5	*2
Target	Melting furnace for metal forging	1.05-1.20	1.05-1.25	1.05-1.25	1.05-1.30	
	Continuous reheating furnace (billet, bloom, slab)	1.05-1.15	-	1.05-1.20	-	
	Metal heating furnace other than the above	1.05-1.20	1.05-1.30	1.05-1.20	1.05-1.30	
	Metal heat treatment furnace	1.05-1.15	1.05-1.25	1.05-1.20	1.05-1.30	
	Oil heating furnace	1.05-1.20	-	1.05-1.25	-	
	Thermal decomposition furnace and reforming furnace	1.05-1.20	-	1.05-1.25	-	
	Cement kiln	1.05-1.25	-	1.05-1.25	-	*1
	Coal kiln	1.05-1.25	1.05-1.35	1.05-1.25	1.05-1.35	*1
	Drying furnace	1.05-1.25	1.05-1.45	1.05-1.30	1.05-1.50	*2

*1 Value of liquid fuel in case pulverized coal firing

*2 Burner portion only

< Standard >

Note 1 : The standard values of air ratio mentioned in the table above define those to be obtained in measurements at the exhaust port of kiln or furnace when fired at a level of load around the rated after inspection and repair.

Note 2 : Standard values for liquid fuel types shall apply to industrial furnaces that use by-product gases such as blast furnace gas as fuel.

< Target >

Note 1 : The target values of air ratio mentioned in the table above define those to be obtained in measurements at the exhaust port of kiln or furnace when fired at a level of load around the rated after inspection and repair.

Note 2 : Target values for liquid fuel types shall apply to industrial furnaces that use by-product gases such as blast furnace gas as fuel.

**(4) Standard and target rates of waste heat recovery for industrial furnaces
(including waste gas temperatures for reference)**

Exhaust gas temperature()	Capacity category	Standard waste heat recovery rate %	Target waste heat recovery rate (%)	Reference	
				Waste gas temperature ()	Preheated air ()
Less than 500	A ·B	25	35	275	190
500 - 600	A ·B	25	35	335	230
600 - 700	A	35	40	365	305
	B	30	35	400	270
	C	25	30	435	230
700 - 800	A	35	40	420	350
	B	30	35	460	310
	C	25	30	505	265
800 - 900	A	40	45	435	440
	B	30	40	480	395
	C	25	35	525	345
900-1,000	A	45	55	385	595
	B	35	45	485	490
	C	30	40	535	440
1,000 or more	A	45	55	-	-
	B	35	45	-	-
	C	30	40	-	-

* In the above table, A refers to the furnaces with the rated capacity of 84,000 MJ per hour or more. And B includes the furnaces with the rated capacity from 21,000MJ per hour or more to less than 84,000MJ. Finally, C refers to the furnaces that have the hourly rated capacity from 840MJ or more to less than 21,000MJ.

< Standard >

Note 1 : The standard waste heat recovery rates mentioned in the table above define the percentage of recovered heat in relation to sensible heat of the exhaust gas emitted from the furnace chamber when fired at a level of load around the rated.

< Target >

Note 1 : The target waste heat recovery rates mentioned in the table above define the percentage of recovered heat in relation to sensible heat of the exhaust gas emitted from the furnace chamber when fired at a level of load around the rated.

Note 2 : The waste gas and preheated air temperature values indicated above as reference are those resulting from calculations of waste gas temperatures during waste heat recovery at the corresponding target rates and air temperatures during preheating using such recovered heat. The values have been calculated based on the following conditions:

- (i) Temperature drop due to heat radiation-diffusion loss between furnace outlet and heat exchanger: 60°C
- (ii) Heat radiation-diffusion rate from heat exchanger: 5%
- (iii) Use of liquid fuel (equivalent to heavy oil)
- (iv) Outside air temperature: 20°C
- (v) Air ratio: 1.2

**(5) Standard values and target values of furnace wall outer surface temperatures
(for industrial furnaces with furnace temperatures of 500 and higher)**

Item	Furnace temperature ()	Furnace wall outer surface temperature ()		
		Ceiling	Side wall	Bottom in contact with open air
Standard	1,300 or more	140	120	180
	1,100-1,300	125	110	145
	900-1,100	110	95	120
	Less than 900	90	80	100
Target	1,300 or more	120	110	160
	1,100-1,300	110	100	135
	900-1,100	100	90	110
	Less than 900	80	70	90

< Standard >

Note 1 : The standard values of furnace wall outer surface temperature mentioned in the table above define the average temperature of furnace wall outer surface (except specific parts) during its normal, steady operation at an outside air temperature of 20°C.

< Target >

Note 1 : The target values of furnace wall outer surface temperature mentioned in the table above define the average temperature of furnace wall outer surface (except specific parts) during its normal, steady operation at an outside air temperature of 20°C.

(6) Standard value and target value of power factor

< Standard >

The standard value of power factor at the power receiving end is 95% or more.

< Target >

The target value of power factor at the power receiving end is 98% or more and it is applied to the equipment listed below and electric power substation facilities.

Equipment name	Capacity (kW)
Cage-type induction motor	more than 75
Coil-type induction motor	more than 100
Induction furnace	more than 50
Vacuum melting furnace	more than 50
Induction heater	more than 50
Arc furnace	-
Flash butt welder (excluding portable type)	more than 10
Arc welder (excluding portable type)	more than 10
Rectifier	more than 10,000

(7) Target efficiencies of high efficiency motors

Totally enclosed types (0.2 – 160 kW)

Output (kW)	Efficiency Values (%)					
	2-poles		4-poles		6-poles	
	50Hz 200V or 400V	60Hz 220V or 440V	50Hz 200V or 400V	60Hz 220V or 440V	50Hz 200V or 400V	60Hz 220V or 440V
0.2	70.0	71.0	72.0	74.0	-	-
0.4	76.0	77.0	76.0	78.0	73.0	76.0
0.8	77.5	78.5	80.5	82.5	78.5	80.0
1.5	83.0	84.0	82.5	84.0	83.0	84.5
2.2	84.5	85.5	85.5	87.0	84.5	86.0
3.7	87.0	87.5	86.0	87.5	86.0	87.0
5.5	88.0	88.5	88.5	89.5	88.0	89.0
7.5	88.5	89.0	88.5	89.5	88.5	89.5
11.0	90.0	90.2	90.2	91.0	89.5	90.2
15.0	90.0	90.2	90.6	91.0	89.5	90.2
18.5	90.6	91.0	91.7	92.4	91.0	91.7
22.0	91.0	91.0	91.7	92.4	91.0	91.7
30.0	91.4	91.7	92.4	93.0	91.7	92.4
37.0	92.1	92.4	92.4	93.0	91.7	92.4
45.0	92.4	92.7	92.7	93.0	92.4	93.0
55.0	92.7	93.0	93.3	93.6	93.3	93.6
75.0	93.6	93.6	94.1	94.5	93.6	94.1
90.0	94.3	94.5	94.1	94.5	93.9	94.1
110.0	94.3	94.5	94.1	94.5	94.5	95.0
132.0	94.8	95.0	94.5	95.0	94.5	95.0
160.0	94.8	95.0	94.8	95.0	94.5	95.0

Protected type (0.75 – 160 kW)

Output (kW)	Efficiency Values (%)					
	2-poles		4-poles		6-poles	
	50Hz 200V or 400V	60Hz 220V or 440V	50Hz 200V or 400V	60Hz 220V or 440V	50Hz 200V or 400V	60Hz 220V or 440V
0.75	77.5	78.5	80.0	82.0	78.0	80.0
1.5	83.0	84.0	82.0	84.0	82.0	84.0
2.2	83.0	84.0	85.0	86.5	84.0	85.5
3.7	85.0	85.5	86.0	87.5	85.5	87.0
5.5	87.0	87.5	87.5	88.5	87.0	88.5
7.5	88.0	88.5	88.5	89.5	88.0	89.0
11.0	89.0	89.5	90.0	90.6	89.0	90.0
15.0	89.5	90.2	90.2	91.0	89.5	90.6
18.5	90.6	91.0	90.6	91.4	90.6	91.4
22.0	90.6	91.0	91.4	92.1	91.0	91.7
30.0	91.0	91.4	91.7	92.1	91.4	92.1
37.0	91.4	91.7	92.1	92.4	91.7	92.4
45.0	91.7	92.1	92.1	92.7	92.1	92.7
55.0	92.1	92.4	92.4	93.0	92.4	93.0
75.0	92.4	92.7	92.7	93.3	92.4	93.0
90.0	92.7	93.0	93.0	93.6	92.7	93.3
110.0	93.0	93.3	93.3	93.6	93.0	93.6
132.0	93.3	93.6	93.3	93.9	93.3	93.9
160.0	93.9	94.1	93.6	94.5	93.6	94.1

Note : Efficiency values shall be measured according to the procedures set forth in Section 7.3 - “Efficiency Test” of JIS C 4212 titled “High-efficiency, Low Voltage Three-phase Squirrel Cage Induction Motors,” by applying the tolerance values provided in its Section 4.2 - “Applicable Tolerances.”

(8) Benchmark index and medium- and long-term target level

Classification	Business Field	Benchmark Index	Target Level
1A	Iron manufacturing using blast furnaces (business to manufacture pig iron using blast furnaces to manufacture products)	The value obtained by A/B A : Energy consumption in the blast furnaces for steel business B : Amount of raw steel	0.531 kl/t or less
1B	Common steel manufacturing using electrical furnaces (business to manufacture pig iron using electrical furnaces to manufacture rolled steel products, excluding iron manufacturing using blast furnaces)	Sum of (1) and (2) (1) The value obtained by A/B A : Energy consumption in the process to manufacture raw steel using electrical furnaces B : Amount of raw steel (2) The value obtained by A/B A : Energy consumption in the process to manufacture rolled common steel products from billet B : Amount of rolled steel	0.143 kl/t or less
1C	Special steel manufacturing using electrical furnaces (business to manufacture pig iron using electrical furnaces to manufacture special steel products (rolled special steel products, hot special steel pipes, cold-drawn special steel pipes, cold-finished special steel products, forged special steel products, casted special steel products), excluding iron manufacturing using blast furnaces)	Sum of (1) and (2) (1) The value obtained by A/B A : Energy consumption in the process to manufacture raw steel using electrical furnaces B : Amount of raw steel (2) The value obtained by A/B A : Energy consumption in the process to manufacture special steel products (rolled special steel products, hot special steel pipes, cold-drawn special steel pipes, cold-finished special steel products, forged special steel products, casted special steel products) from billet B : Amount of shipped (sold) steel	0.36 kl/t or less
2	Electrical supplier (industry that supplies electricity determined by 2.1 of Act on the Rational Use of Energy among general electricity industry determined by 2.1.1 of Electricity Utilities Industry Law or wholesale electricity industry determined by 2.1.3 of Electricity Utilities Industry Law)	The value obtained by A/B (thermal efficiency standardized index) A : Thermal efficiency obtained by a performance test of rated output at thermal electric power generation facilities of factories that run this business (excluding low power facilities) B : Designed efficiency of the rated output In the case of plural facilities in the factory, the value is determined by a weighted average method based on the rated output. The value obtained by A/B (thermal electric power generation efficiency) A : Total electrical energy generated by thermal electric power generation facilities of factories that run this business B : Higher calorific value of the fuel that was required to generate the total energy	100.3% or more of thermal efficiency standardized index
3	Cement manufacturing (business to manufacture portland cement (JIS R 5210), blast furnace cement (JIS R 5211), silica cement (JIS R 5212), fly-ash cement (JIS R 5213))	Total of (1) to (4) (1) The value obtained by A/B A : Energy consumption in the raw material process B : Production volume in the raw material part (2) The value obtained by A/B A : Energy consumption in the pyroprocess B : Production volume in the pyroprocess part (3) The value obtained by A/B A : Energy consumption in the finishing process B : Production volume in the finishing part (4) The value obtained by A/B A : Energy consumption in the shipping process, etc. B : Shipping volume	3891 MJ/t or less