9.4 Non-metallic Minerals Industry

9.4.1 Wolomin (glass)

- (1) Glass Melting Furnace
 - a. Purpose of measurement

The purpose is to grasp the current state of operation in order to perform the heat balance of a glass melting furnace.

b. Measurement items, measurement time, measuring equipment and data processing

	Mea	surement items	Measurement time	Measuring equipment	Data processing
Raw material,	1	Batch consumption	24 h	Operation record	Memo
glass	2	Cullet consumption	24 h	Operation record	Memo
	3	Raw materials ratio	Moment	Operation record	Memo
	4	Batch & cullet temperatures	24 h	(Operation record)(*1)	Memo
	(5)	Water % in batch	Moment	(Operation record)(*2)	Memo
	6	Glass composition	Latest	Operation record	Memo
at e tra de la	Ø	Molten glass quantity	24 h	Calculation	Memo
Furnace	8	M.T. down temperature	30 min	Thermocouple (*3)	to Recorder
temperature	9	F.H. entrance glass temperature	30 min	Thermocouple	to Recorde
ter al terraria. L	0	F.H. exit glass temperature	30 min	Thermocouple	to Recorde
Fuel	0	Fuel consumption	24 h	Operation record	Memo
· ·	0	Fuel heat value	Latest	Operation record	Memo
	\odot	Fuel composition	Latest	Operation record	Мето
	(1)	Fuel temperature	24 h	Thermocouple (*4)	to Recorde
	G	Burner atomizing gas quantity	spot	(*5)	
. 4		& temperature			
. •	16	Electricity for booster	24 h	Clamp meter	to FDD
Combustion	0	Air consumption	24 h	(Operation record)(*6)	to Recorde
air	(13	Air suction temperature	spot	(*7)	Memo
	(19	Air preheat temperature	30 min	Suction pyrometer (*8)	to Recorde
Exhaust gas	Ø	Fuel quantity ratio at every port	Moment	Operation record	Memo
	Q)	Exhaust gas quantity	Calculation		Memo
		O_2 % in exhaust gas	30 min	O_2 meter + ceramic tube	to Recorde
		Exhaust gas temperature	30 min	Suction pyrometer (*8)	to Recorde
Preheating	24	Water quantity	30 min	Ultrasonic flowmeter	to Recorde
boiler	Ø		30 min	Glass thermometer	Memo

	Measurement items	Measurement time	Measuring equipment	Data processing
Radiation	6 Furnace wall temperature	spot	Surface thermometer	Memo
heat	② Port wall temperature	spot	Radiation pyrometer	Memo
	Regenerator wall temperature	spot	Surface thermometer	Memo
	(9) F.H. wall temperature	spot	Surface thermometer	Memo
	Opening parts inside temperature	spot	Radiation thermometer	Memo
Cooling	③ Cooling water quantity & temperature ΔT	spot	Stop watch and glass thermometer (*9)	Memo
	3 Cooling air quantity & temperature ΔT	spot	(*10)	Memo

Note: *1: If no operation record is available, measure the room temperature every hour for 24 hours as a substitute.

- *2: If no operation record is available, take samples at the inlet, dry them at 100 °C in a drying oven, and find their moisture content.
- *3: If there is no measuring hole, take a memo from the operation record.
- *4: If the fuel is not preheated, substitute it with room temperature as with item (4).
- *5: If the atomized gas is steam, it will be added to the volume of exhaust gas (wet), therefore the burner should be placed in a specified amount of water, and the amount of increase in moisture over a specified length of time should be obtained. If the value is listed in the burner's catalog or other reference material, that value can be used instead.
- *6: If operation meters are not available, measurements should be taken with an anemomaster at the suction part of the air blowers for combustion. If a straight pipe portion of sufficient length and a measuring hole are available, a Pitot tube may be used instead.
- *7: If air consumption (①) is measured with an anemomaster, the temperature should also be measured with the anemomaster. Or, it can be substituted with room temperature as with item ④.
- *8: If there are many blowoff openings, measure the other blowoff parts with a thermocouple.
- *9: Collect the drainage in a container (such as a bucket), and measure the length of time spent on the collection, and the amount of drainage collected. At the same time, measure the temperature difference compared with the water supply.
- *10: Measure it with an anemomaster at the suction part of the air blower. Or, the design performance value can be used as a substitute.

c. The measurement points for a glass melting furnace are shown in Figure 9.4.1.

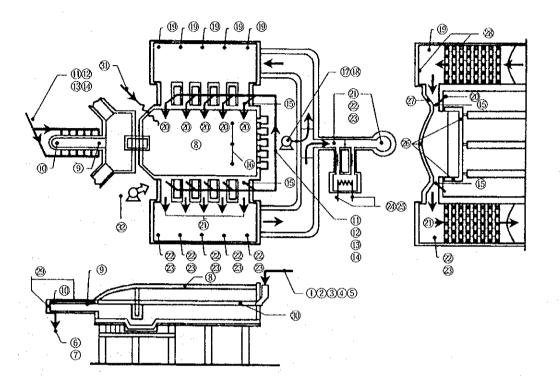


Figure 9.4.1 Measuring Points of Melting Furnace

(2) Glass Annealing Lehr

a. Purpose of measurement

The purpose is to perform the heat balance of a glass annealing lehr and thereby grasp the current operation state.

b. Measurement items, measurement time, measuring equipment, and data processing

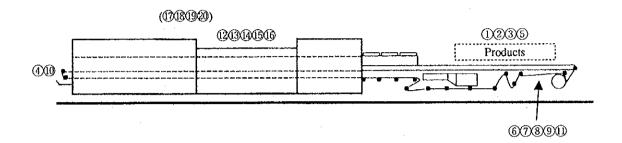
•	Meas	urement items	Measurement time	Measuring equipment	Data processing
Glass product		Product shape and thickness Product weight t/h	hearing 24 h	Operation record Operation record	Memo Memo
		Product strain μ m/cm	hearing	Operation record	Memo
н Молдон	(1)	Annealing lehr inlet temperature (*1)	spot	Bar thermometer, balance	Memo
	6	Annealing lehr outlet temperature (*2)	spot	Bar thermometer, balance	Memo
Chain belt	6	Weight kg/m ²	hearing	Operation record	Memo
	\bigcirc	Material	hearing	Operation record	Memo
	8	Width	hearing	Operatoin record	Memo
	9	Inlet temperature	spot	Surface temperature	Memo
		Outlet temperature	spot	Surface temperature	Memo
		Traveling speed	spot	stopwatch	Memo
Annealing	0	Dimensions and structure	hearing	Operation record	Memo
lehr	(13	Wall thickness and material	hearing	Operation record	Memo
		Ambient temperature (6 points)	24 h	Thermocouple	to Recorder
	Ð	Outside surface temperature	spot	Surface temperature	Memo
		Area of openings and furnace	spot	Thermocouple	to Recorder
		inside temperature		(at the same time as for (D)	
Energy	Ø	Fuel consumption and fuel temperature	24 h	Operation record	Memo
	(18	Power consumption	24 h	Operation record	Memo
		Combustion air flow rate and temperature	spot	anemomaster	Memo
	20	Cooling air volume	spot	anemomaster	Мето

Note: *1, *2: To be obtained from the difference, ΔT , in water temperature produced after putting the product into a specified volume of water (10 L).

c. Measuring points

Figure 9.4.2 shows the measuring points of the glass annealing lehr.

Figure 9.4.2 Measuring Points of Annealing Lehr



(4) Energy Utilization Facilities

Equipment	Targeted equipment or location	Measuremen	it time
Electricity management	Booster (Shops A and B)	24 h	-
	Entire factory(Power receiving station)	24 h	
	Annealing furnace	6 to 8 h	
Fan/blower	132 kW \times 2 and others	spot	
Air compressor	$200 \text{ kW} \times 4$	spot	
	450 kW	24 h	
Electric motor	Main equipment for shops A and B	spot	
Transformer	TA1, 2	24 h	
	RNN1, 2	24 h	
	Annealing furnace	24 h	
Lighting	Various locations in the factory	spot	
Pump	Vacuum pump	spot	
Boiler	Boiler room	24 h	
Steam pipe	Various locations in the factory	spot	

For the measuring method and the measuring points, see "10. ENERGY UTILIZATION FACILITIES".

(1) Production (t	onne) / Operation (hou	rs) (Ani	nual data)			
		(0)	inder deter			
[Plant = Tank]					4007	
	Design Capa.	1992	1993	1994	1995	199
No.1 Plant				·	·····	
No.2 Plant					·	.
No.3 Plant				· · · · · · · · · · · · · · · · · · ·		
No.4 Plant	· · · · · · · · · · · · · · · · · · ·			·		
No.5 Plant						<u> </u>
No.6 Plant						ļ
No.7 Plant						
No.8 Plant						
Plant						
Plant						
Plant						
		+				
Plant	·· .			<u> </u>	<u> </u>	I • • • •
· ·	mption (Annual data)				1	
· ·	Imption (Annual data)	1992	1993	1994	1995	199
· ·		1992	1993	1994	1995	199
② Utility Consu Coal		1992	1993	1994	1995	199
 (2) Utility Consu Coal (t) Heavy Oil (ki) Kerosene (kl) 		1992	1993	1994	1995	199
 (2) Utility Consu Coal (t) Heavy Oil (ki) Kerosene 		1992	1993	1994	1995	195
 (2) Utility Consu Coal (t) Heavy Oil (kl) Kerosene (kl) Natural Gas 		1992	1993	1994	1995	199
 (2) Utility Consu Coal (t) Heavy Oil (kl) Kerosene (kl) Natural Gas (Nm³) Other Gas 		1992	1993	1994	1995	
 (2) Utility Consu Coal (t) Heavy Oil (ki) Kerosene (kl) Natural Gas (Nm³) Other Gas (Nm³) Electric Power 		1992	1993	1994		
 (2) Utility Consu Coal (t) Heavy Oil (ki) Kerosene (ki) Natural Gas (Nm³) Other Gas (Nm³) Electric Power (kWh) Water: 		1992	1993	1994		199

Check List for Glass Works (1)

Check List for Glass Works (2)

③ Quality and Price of Energy (Existing)

		Coal	H-Oil	Kerose.	Natu.G.	Other G.	Elec.
Sp. gr	^						
c	(%)						
Н	(%)						
S	(%)						
Hh	(Kcal/kg)						
HI	(Kcal/kg)	<u> </u>					
Price	(ZI)						

4. Ratio of Energy cost Product cost (Existing)

No.1 Plant	%,	No.2 Plant	%,	No.3 Plant	%
------------	----	------------	----	------------	---

(5) Chemical Composition of Products (Existing)

		Vacum bottle	TEMISIL -2	TEMISIL -3	TEMISIL -5	Packing glass	No.8 Tank
SiO ₂	(%)						
Al ₂ O ₃	(%)						
Fe_2O_3	(%)						
CaO	(%)					· · · · · · · · · · · · · · · · · · ·	
MgO	(%)						
Na ₂ O	(%)						
K₂O	(%)		<u></u>				
Li ₂ O	(%)						
B ₂ O ₃	(%)			ļ			
BaO	(%)						
	(%)						
	(%)						
	(%)						
	(%)	<u> </u>		ļ ļ	<u> </u>		
	(%)						

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(b) Grain	size Distribution of S	ilica sand					
		<125 [#]	125 ^{<i>µ</i>} ~	250 ^{<i>µ</i>} ~	500 ^{<i>µ</i>} ~	1190 ^{<i>µ</i>} <	
	Plant						
	Plant						
	Plant		<i>_</i>				
(7) Kind o	of Soda ash (Existing)				•	
	1 Oud dan (Existing	/					
	Synthetic		🛛 Natur	al			
	🗇 Dense		🗌 Heavy	y a	🗆 Light		
8. Batch	Composition (Existin	ng)					
	[T: Tank furnace]					(kg∕B	atch)
·		T - 1	T - 2	T – 3	T - 5	T - 7	T - 8
0	Silica sand						
Ŭ	Dolomite	<u> </u>		1			
	Lime stone						
0	Feldspar			1			
	Calumite, Slag					1	
0	Soda ash		-				
Ŭ	Salt cake	·		the second			
	Sodium nitrate		-				
	Spodumene				-		
0	Boric oxide,	-					
	Brax,Colemanite,			· · .			
	Ulexite				100		
	Carbon						
	Refining agent						
	Water in batch		-				
	(%)						
						-†	
0	Cullet(circulation)						

Check List for Glass Works (4)

(9) Melting Quality of Products (Existing)

·	Seed count	Stone count
acum bottle	PCS/gr	PCS/kg
TERMISIL - 2		
TERMISIL - 3		
TERMISIL - 5		
Packing glass	·	
No.8 Tank		

(1) Operation Progress (Bar Chart)

······································	1985	' 8	'87	' 88	'89	' 90	'91	' 92	'93	' 9	'95	'96
Example				┝							ļ	
T - 1												
T - 2 T - 3												
T - 3												
Τ – 5												
T - 7) 							
T - 8												

(1) Break - down of Energy Consumption (Estimate % 1995)

	Furnace			Forming				Annealing			Proce	Others	
	N- Gas	L- 02	Elec.	N- Gas	L 02	Elec.	N- Gas	L- 02	Elec.	N− Gas	L- 0₂	Elec.	
T - 1													
T - 2													
T – 3													
T - 5							1				·		
T - 7							1						
T - 8						,							
						· · · · · · · · · ·				1			N-Gas 100%
Total		· .	·										L-O2 100% Elec. 100%

Name	Туре	Rated C	apacity	Motor	No.	Actual
Natile	i ypo	Quant.	Press.	(kW)	(PCS)	load(%)
					· · · · ·	
			1			
	······································		· · · · · · · · · · · · · · · · · · ·			
<u>.</u>	<u></u>					
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Check List for Glass Works (5)

	(tonne)	Production	Sales	Import	Export
Flat glas	s total				
	Float glass				
	Sheet glass				
	Figured glass				··· <i>.</i> · · · · · · · · · · ·
Hollow g	lass total				
0	bottle glass				
0	Table ware glass	· · · · · · · · · · · · · · · · · · ·			<u> </u>
0	Oven proof glass				
0	Laboratory glass				· · · · · · · · · · · · · · · · · · ·
	Electric glass				······································
Ö	Vacum bottle glass				
	Other hollow glass		·		
Optical (glass				
Fiber gla	ISS				

Check List for Glass Works (6)

1996	Product (t)	Fuel (Nm ³)	Elec. (kWh)	Morton glass(t)	Cullet (t)	Room Temp A.V.(°C)
Jan.						
Feb.						
Mar.						
Apr.						
May.						
Jun.					· · · · ·	
Jul.						
Aug.						
Sep.						· · · · · · · · · · · · · · · · · · ·
Oct.				· · · · ·		
Nov.						···· .
Dec.		 		1		
Total						
· · · · · · · · · · · · · · · · · · ·		L	<u> </u>	``;		l
2. Furnace	•			· ·		
Z. Furnace			•	1. P.		
Furnace Life :					months	
Area of Melter :		(W :	mm)	×	.(1	_: mm)
Depth of Melter :					· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·
<u></u>		······	mm			o. PCS.
Port :	Width	<u>mm,</u>	Pitch	<u>mm,</u>		
Partition :		DC,		k, 🛛 Th	roat, 🔲	Skimmer
Area of Refiner, W	orking chan	<u>ıber :</u>		(W :	mm) × (L	: mm)
Depth of Refiner, \	Norking cha	imbe r :				
Canal, Forehearth	: No.		PCS			

Check List for Glass Works (7)

Outrie () Teaches None,Air,Steam,Nm³/h Purging Air or steam :Nn³/h Position of Burner :Top,Side,Under,Through Distribution Ratio :IP %2P %3P %4P %,	0	Burner P	ressure :		kg/o	cm ²			
Purging Air or steam : Nm³/h Position of Burner : I Top, Side, Under, Through Distribution Ratio : 1P %2P %3P %4P %, O2 % in Exhaust Gas : 1P %2P %3P %4P %,	Ŭ			one. I			m	Nm ³ /ł	
Position of Burner : I Top, Side, Under, I Through Distribution Ratio : 1P %2P %3P %4P %, O2 % in Exhaust Gas : 1P %2P %3P %4P %,						<u></u>			
Distribution Ratio : 1P %2P %3P %4P %, O2 % in Exhaust Gas : 1P %2P %3P %4P %, // Under Chimney % (4) Under Chimney % (5) Electrode Heating					<u>.</u> П	Side.	□ Under		
O2 % in Exhaust Gas : 1P %2P %3P %4P % // Under Chimney % O Oxygen Burner : No. PCS, Nm³/h (a) Electrode Heating		100 C	and the second						-50
"Under Chimney % Oxygen Burner : No PCS, Nm³/h (a) Electrode Heating Electrode : Capacity KW, Nor. kWh/h " Top Side Bottom, Total PCS 5. Temperature O M. T. Crown Arch °C, max. °C O M. T. Crown Arch °C, Bottom : M. T. Glass Glass : °C, Bottom Port End °C, °C, °C O Flue °C, °C, °C O Flue °C, °C O Flue °C, °C O Air Preheat °C, °C Bridge Wall °C °C Q Forehearth °C, °C									
O Oxygen Burner : No. PCS, Nm³/h ④ Electrode Heating				Under	Chimney	,	······································	· · · · · · · · · · · · · · · · · ·	· · · · · ·
 ④ Electrode Heating Electrode : Capacity kW, Nor. kWh/h <i>I</i> Top ☐ Side ☐ Bottom, Total PCS 5. Temperature O M. T. Crown Arch °C, max. °C O M. T. Glass Glass : °C, Bottom : M. T. Bottom Port End °C, °C, °C O Flue °C, °C O Flue °C, °C O Air Preheat °C, °C, °C Bridge Wall °C R. T. or °C, °C, °C Working Chamber O Forehearth °C, °C, °C, °C 	0	Oxygen E	Burner: No.				Nm ³ /ł	1	
Electrode : Capacity kW, Nor. kWh/h " Top Side Bottom, Total PCS 5. Temperature 0 M. T. Crown Arch °C, max. °C O M. T. Crown Arch °C, max. °C O M. T. Glass Glass : °C, Bottom : M. T. Blass Glass : °C, Bottom : Port End °C, °C, °C O Flue °C, °C O Flue °C, °C Bridge Wall °C, °C R. T. or °C, °C Working Chamber °C, °C, O Forehearth °C, °C,									
" Top Side Bottom, Total PCS 5. Temperature 0 M. T. Crown Arch °C, max. °C 0 M. T. Glass Glass : °C, Bottom : 0 M. T. Glass Glass : °C, Or, Or, Or, Or, Or, Or, Or, Or, Or, Or		④ Elect	rode Heating			¹			:
5. Temperature O M. T. Crown Arch °C, max. °C O M. T. Glass Glass : °C, Bottom : M. T. Blass Glass : °C, °C, °C Port End °C, °C, °C O Flue °C, °C O Flue °C, °C O Flue °C, °C O Flue °C, °C O Air Preheat °C, °C, °C Bridge Wall °C R. T. or °C, °C, °C Working Chamber °C, °C, °C		Elec	trode : Ca	pacity		kW,	Nor.	kWl	h/h
OM. T. Crown Arch°C,max.°COM. T. GlassGlass :°C,Bottom :M. T. Bottom </td <td></td> <td></td> <td><i>и</i> П Тор</td> <td></td> <td>Side</td> <td>🗌 Bott</td> <td>om, Total</td> <td><u> </u></td> <td>CS</td>			<i>и</i> П Тор		Side	🗌 Bott	om, Total	<u> </u>	CS
OM. T. Crown Arch°C,max.°COM. T. GlassGlass :°C,Bottom :M. T. Bottom </td <td></td> <td></td> <td></td> <td></td> <td></td> <td>· · ·</td> <td></td> <td></td> <td></td>						· · ·			
OM. T. GlassGlass :°C,Bottom :M. T. BottomPort End°C,°C,°COFlue°C,°C,°COAir Preheat°C,°C,°CBridge Wall°C,°C°CR. T. or°C,°CWorking Chamber°C,°C,OForehearth°C,°C,°C°C,°C,	• •	5. Temp	erature	۰.	· ·				•
M. T. BottomPort End°C,°COFlue°C,°COAir Preheat°C,°CBridge Wall°C°CR. T. or°C,°CWorking Chamber°C,°COForehearth°C,°C,°C,°C,°C°C,°C,°C		0	M. T. Crown Arch			°C,	max.	· · · · · · · · · · · · · · · · · · ·	°C
Port End°C,°C,°COFlue°C,°COAir Preheat°C,°C,OAir Preheat°C,°CBridge Wall°C°CR. T. or°C,°CWorking Chamber°C,°C,OForehearth°C,°C,		0	M. T. Glass	Glass	:	°C,	Botto	m :	
OFlue°C,°COAir Preheat°C,°C,°CBridge Wall°C°C°CR. T. or°C,°CWorking Chamber°C,°COForehearth°C,°C,			M. T. Bottom		· · ·	· · · ·			
O Air Preheat °C, °C, °C Bridge Wall °C °C R. T. or °C, °C Working Chamber °C, °C O Forehearth °C, °C,			Port End		°C,		°C,		°C
Bridge Wall °C R. T. or °C, °C Working Chamber O Forehearth °C, °C		0	Flue		···	°C,		°C	
R. T. or °C, °C Working Chamber O Forehearth °C, °C, °C		0	Air Preheat		°C,				<u>°C</u>
Working ChamberOForehearth°C,°C,							°C		······
O Forehearth °C, °C, °C					· .	°C,		°C	
Gob <u>°C, °C, °C</u>		0	· . · · · · · · · · · · · · · · · · · ·			· .			
		• .	Gob		°C,		°C,		O
			·						
		· · ·							<u></u>
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🗌 Regenerato	or 🗌 Recu	perate	e 🗌 Was	te heat Boiler
-				
Regenerator : (W :	x (L		mm) × N	lo. PCS
Volume of Checker :	m ³	,	Height :	mm
Type of Checker :	🗌 Pigeon H	nole	0. B. W.	Cruciform
Checker Brick Size : (W :	x (L	:	mm) × (<u>T: mm)</u>
Type of Recuperate	Convect	ion	🗌 Radiatio	
Waste heat Boiler : Capacit	yt/	<u>h ,</u>	Pressure	kg/cm ²
7. Cooling Air, Heating Gas	and pupplier			
Sheet cooling Air : (Nm ³ /h)	×	<u> (</u> .	PCS)
Wall cooling Air : (Nm ³ /h)	×	(PCS)
F. H. Heating Burner (Nm ³ /h)	×	(PCS)
Bubblier : (
	<u>Nm³/h)</u>	<u>×</u>		PCS)
	<u>Nm[°]/h)</u>	×	(PCS)
	<u>Nm[~]/h)</u>	×		PCS)
8. Cooling Water	<u>Nm°/h)</u>	 :	(PCS)
	<u>Nm[~]/h)</u> t/h)	× X	(PCS) PCS)
8. Cooling Water		;	((PCS) PCS)
8. Cooling Water Batch charger : (t/h)	×	((((PCS) PCS) PCS)
8, Cooling Water Batch charger : (Reversal Damper : (t/h) t/h)	× ×	((((PCS) PCS) PCS) PCS)
8. Cooling Water Batch charger : (Reversal Damper : (Burner cooler : (t/h) t/h) t/h)	× × ×	(((((PCS) PCS) PCS) PCS) PCS)
8. Cooling Water Batch charger : (Reversal Damper : (Burner cooler : (Electrode holder : (t/h) t/h) t/h) t/h)	× × × ×	((((((PCS) PCS) PCS) PCS) PCS) PCS)
8. Cooling Water <u>Batch charger : (</u> <u>Reversal Damper : (</u> <u>Burner cooler : (</u> <u>Electrode holder : (</u> <u>Tuck cooler : (</u>	t/h) t/h) t/h) t/h) t/h)	× × × ×	((((((((PCS) PCS) PCS) PCS) PCS) PCS) PCS)
8. Cooling Water <u>Batch charger : (</u> <u>Reversal Damper : (</u> <u>Burner cooler : (</u> <u>Electrode holder : (</u> <u>Tuck cooler : (</u> <u>Throat cover cooler (</u>	t/h) t/h) t/h) t/h) t/h) t/h)	× × × × × ×	(((((((((((((PCS) PCS) PCS) PCS) PCS) PCS) PCS) PCS)
8. Cooling Water Batch charger : (Reversal Damper : (Burner cooler : (Electrode holder : (Tuck cooler : (Throat cover cooler (Stirrer : (t/h) t/h) t/h) t/h) t/h) t/h) t/h)	× × × × × × ×	(((((((((((((((((((PCS) PCS) PCS) PCS) PCS) PCS) PCS)
8. Cooling Water Batch charger : (Reversal Damper : (Burner cooler : (Electrode holder : (Tuck cooler : (Throat cover cooler (Stirrer : (Sheet cooler, Floatei (t/h) t/h) t/h) t/h) t/h) t/h) t/h) t/h)	× × × × × × × × ×		PCS) PCS) PCS) PCS) PCS) PCS) PCS) PCS)
8. Cooling Water Batch charger : (Reversal Damper : (Burner cooler : (Electrode holder : (Tuck cooler : (Throat cover cooler (Stirrer : (Sheet cooler, Floatei (t/h) t/h) t/h) t/h) t/h) t/h) t/h) t/h)	× × × × × × × × ×		PCS) PCS) PCS) PCS) PCS) PCS) PCS) PCS)

·····			Outer Surface Area (m ²)	Surface Temp (°C)	Unit Heat Loss (kcal/m²h)	Heat Loss (kcal/h)	Remark
	M.	<u>.</u> T.				,	
Bottom	Thr	oat					
Block	R.T.,W	or.Ch.			·····		
[Ca	nal				<u> </u>	
	Foreh	nearth					
	M.T.	Upper			******		
	· · · · · · · · · · · · · · · · · · ·	Under					
Side	Throat						
Block	R.T.,Wor.Ch.						
	Canal						
ſ	Fore	nearth					
	М	.T.					
Crown	Th	roat				<u> </u> [
Arch &	R.T.W	lor.Ch.					
Cover	Ca	inal					
ļ		nearth					
	Back Wal						· · · · · · · · · · · · · · · · · · ·
	М	.T.				ļ	
Breast	Throat						****
Wall	R.T.,Wor.Ch.			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			*****
1	Canal						
	Forel	nearth		· · · · ·			
	Breast Wa	all				ļł	
Wing	Fron	t Wall					
Wall	F.H	.End			<u> </u>	<u> </u>	
	A	rch				<u> </u>	
Port	Side						
	Bot	tom					
	Cr	own				<u> </u>	
Regene-	Side	Upper	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
	Wall	Middle	ļ]			
-rator		Lawer				ļ	
	End	Wall					
	ſ	ttom					
	Total						

Check List for Glass Works (10)

		A : Installed / Introduced B : Under Construction C : Under Planning		
Process		ltems	Application	Year of Application
law material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	1	Conversion of fuel		
	2	Introduction of electric booster		
	3	Introduction of oxygen burner or oxygen enriched burner		
Fuel	1	Increase in furnace scale		
	2	Improvement of furnace structure		
	3	Insulation of furnace crown, side wall and bottom		
	4	side wall and bottom Improvement of sealing of opening parts		
-	5	Improvement of cooling loss		
	6	Improvement of Recuperator		
	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m ²)		
[2	Increase in productivity (Yield rate up)		
	3	Improvement of excess air ratio		
Forming	1	Improvement of forming machine		
Annealing	1	Improvement of annealing lehr		:
Others	1	Installation of waste heat boiler etc.		
Management	1	Enrichment of instrumentation		
	2	Introduction of computer control system		
	3	Promotion of campaign for TQC, TPM and so on		

Check List for Glass Works (11)

and the second second

• •

	1996	Product (t)	Fuel (Nm ³)	Elec. (kWh)	Molton glass(t)	Cullet (t)	Room Temp. A.V.(°C)
	Jan,						
	Feb,						
	Mar.						
	Apr.						
	May.						
	Jun.						
	Jul.						
	Aug.			 			·
	Sep.		<u></u>				
	Oct.						
	Nov.						
	Dec.	<u> </u>					
	Total						
	2. Furnace Furnace Life :					months	
0	Area of Melter :		(W :	mm)	×	L	: mm)
	Depth of Melter :			mm			:
	Port :	Width	mm,	Pitch	<u></u>	No	. PCs.
ò	Partition :		D.C.,	🗌 Nec	k, 🛛 Th	roat, 🔲 S	Skimmer
	Area of Refiner, W	orking cham	ber :		(W :	mm) × (L :	mm)
	Depth of Refiner, \	Vorking cha	mber :			mm	
	Canal, Forehearth	+		PCs			

Check List for Glass Works (12)

		Check	List for Glass	: Works (1	3)		- <u></u>
	3. Combu	stion					
				ŋ			
0	Burner Pro		kg/o				
	Atomizer :		ne, 🗌 Air,	🔲 Steam,		Nm ³ /h	
	Purging Ai	r or steam :		<u></u>	<u></u>	Nm ³ /h	
	Position o	f Burner :	🗌 Тор, 🔲 🤅	Side, 🔲 (Jnder,	Through	
	Distributio	n Ratio :	1P %,2P	%,3P	%,4P	%,	
	02 % in Ex	(haust Gas :	1 <u>P %,2P</u>	%,3P	%,4P	%,	
		<u></u>	Under Chimney	/	%		
0	Oxygen B	urner: No.	PCs,		Nm ³ /	h	
	④ Electr	ode Heating				andra 1997 - Santa Santa 1997 - Santa Santa 1997 - Santa Santa	
						1.14/1 /)	· .
			acity		Nor.	kWh/h	
			p 🗌 Side	🗆 Bottom ,	Total	PCs	
	5. Tempe	erature	•				· .
	0	M. T. Crown Arch		°C,	max.	°C	:
	0	M. T. Glass M. T. Bottom	Glass :	°C,	Botto	om :	
		Port End	°C,		°C,	ා	
	0	Flue	· · · · · · · · · · · · · · · · · · ·	°C,	·····	°C	
	0	Air Preheat	°C,	· · · · · · · · · · · · · · · · · · ·	<u>°C;</u>	<u>℃</u>	
		Bridge Wall R. T. or		°C,	<u> </u>	°C	· ·
		Working Chamber	-	1 g	- V - P	n an an ann an an an an an an an an an a	
	0	Forehearth	°C,		°C,	°C	
	· · · · ·	Gob	°℃,		°C,	℃	
				•			
			· · ·				
	-						

🗌 Regenerato	or 🗌 Recu	nerat	or 🗂 Wa	ste heat Boiler
		ipoi ac		
Regenerator : (W :	mm) × (L		mm) × M	lo. PCs
Volume of Checker :	m	3	Height :	mm
Type of Checker :	🗌 Pigeon	hole	🗆 O. B. W	Cruciform
Checker Brick Size : (W :	mm) × (L		_mm) × (T: mm)
Type of Recuperator	Convect	ion	🗆 Radiatio	n 🗌 Ceramic
Waste heat Boiler : Capacit	v t/	'n,	Pressure	kg/cm ²
	<u>Nm³/h)</u>	×	(PCs)
7. Cooling Air, Heating Gas a	and Bubblier			
Sheet cooling Air : (Nm³/h)	x	(PCs)
Wall cooling Air : (Nm ³ /h)	×	(PCs)
F. H. Heating Burner(Nm ³ /h)	X	(PCs)
Bubblier : (Nm ³ /h)	×	(PCs)
8. Cooling Water				
Batch charger : (t/h)	×	(PCs)
	t/h)	X	(PCs)
Reversal Damper : (
Reversal Damper: (Burner cooler: (t/h)	×	(PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(t/h)	x	(PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(Tuck cooler :(t/h) t/h)	× ×	((PCs) PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(Tuck cooler :(Throat cover cooler(t/h) t/h) t/h)	× × ×	(((PCs) PCs) PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(Tuck cooler :(Throat cover cooler(Stirrer :(t/h) t/h) t/h) t/h)	× × × ×	(PCs) PCs) PCs) PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(Tuck cooler :(Throat cover cooler(Stirrer :(Sheetcooler, Floater(t/h) t/h) t/h) t/h) t/h)	× × × × ×	(PCs) PCs) PCs) PCs) PCs)
Reversal Damper :(Burner cooler :(Electrode holder :(Tuck cooler :(Throat cover cooler(Stirrer :(t/h) t/h) t/h) t/h)	× × × ×	(PCs) PCs) PCs) PCs)

Check List for Glass Works (14)

			Outer Area	⊖ Surface (m²)	Surface Temp (°C)	Unit Heat Loss (kcal/m ² h)	Heat Loss (kcal/h)	Remark
	М	.T.			1111.000			
Bottom	Thi	roat			}			
Block	R.T.,W	lor.Ch.						
	Ca Forel	inal nearth			• •	· · · · · · · · · · · · · · · · · · ·		
	M.T.	Upper						}
		Under						
Side		roat						
Block	R.T.,V	Vor.Ch.						ļ
	Ċa	anal						
	Fore	hearth						
	N	I.T.	ļ					
Crown	Th	roat	ļ					
Arch &	R.T.,V	Vor.Ch.	<u> </u>			· · · · · · · · · · · · · · · · · · ·		
Cover	C	anal]			
	1	hearth						
	Back Wa						1	
	T	И.Т.						
Breast		nroat						
Wall	1	Wor.Ch.						
		anal						
	1	hearth						
	Breast W							· · · · · · · · · · · · · · · · · · ·
Wing	1	nt Wall						
Wall		H.End						••••••••••••••••••••••••••••••••••
Wall	1						e d'ann	
Port	Arch				•••{••••••••••••••••••••••••••••••••••			
	Side Bottom			•••••••	,			
	· · · · · · · · · · · · · · · · · · ·	rown						· · · · · · · · · · · · · · · · · · ·
	Side	Upper						
Regene	- Wall	Middle		·····		•••		
-rator		Lawer				`		
	En B	d Wall						

Check List for Glass Works (15)

		A : Installed / Introduced B : Under Construction C : Under Planning		
Process		ltems	Application	Year of Application
Raw material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	. 1	Conversion of fuel		
Ì	2	Introduction of electric booster		
	3	Introduction of oxygen burner or oxygen enriched burner		
Fuel	1	Increase in furnace scale		
	2	Improvement of furnace structure		
	3	Insulation of furnace crown, side wall and bottom	· · · · · · · · · · · · · · · · · · ·	
	4	Improvement of sealing of opening parts		
	5	Improvement of cooling loss (water cooler, air cooling)		
	6	Improvement of Recuperator		***
	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m ²)	<u>.</u>	
	2	Increase in productivity (Yield rate up)		
	3	Improvement of excess air ratio		()
Forming	1	Improvement of forming machine	·	
Annealing	1	Improvement of annealing lehr		
Others	1	Installation of waste heat boiler etc.		
Management	1.	Enrichment of instrumentation		
	2	Introduction of computer control system		· ·
	3	Promotion of campaign for TQC, TPM and so on		

Check List for Glass Works (16)

 Production and 1996 	Product	Fuel	Elec.	Molton	Cullet	Room Temp.
	(t)	(Nm ³)	(kWh)	glass(t)	(t)	A.V.(°C)
Jan.					- /	
Feb.	- · · · · · · · · · · · · · · · · · · ·					
Mar.						
Apr.			· · · · ·	·		· · · ·
May.						
Jun.						
Jul.					• •	
Aug.				· · · · ·		
Sep.						
Oct.		<u></u>		····		
<u>Nov.</u>						
Dec.	<u> </u>		<u> </u>		<u> </u>	
Total				-		i
		<u> </u>	<u> </u>	1	I	.]
2. Furnace			· · · ·			
Furnace Life :					months	
		(W :	mm)	×	(1	: mm)
Area of Melter :		(44 .		~~~~		
Depth of Melter :	···· ·································		mm	· · · · ·		
Port :	Width	mm,	Pitch	mm,	No.	PCs.
Partition :		🗆 D.C.,	🛛 Neck,	🗌 Thro	at, 🗌 S	kimmer
Area of Refiner, W	orking chan	nber :	(W: m	um) × (L :	mm)
Depth of Refiner, V	Norking cha	mber :	· · · ·		mm	
Canal, Forehearth			PCs			· · · · · ·
Janai, I Vieneartii	. 1995		1 00			

4

	3. Co	ombustior	1						
0	Burne	er Pressu	re ;		kg	/cm ²			
	Atom	izer :		🗆 None,	🗆 Air,	🗌 Steam	n,	Nm	³ /h
	Purgi	ng Air or	steam :					Nm	³ /h
	Positi	on of Bu	mer :		ор, 🔲 :	Side, 🔲	Under,	🔲 Thro	ough
		bution Ra		1P	%,2P	%,3P	%,4P	%,	
		in Exhaus		1P	%,2P	%,3P	%,4P	%,	
				Un	der Chimn	ev	%		· · · · ·
C		en Burnei	r: No.		PC		Nm ³	/h	
			+						
	(4) E	lectrode	neating						
	Ŭ	Electrode	:	Capacit		k₩,	Nor.		kWh/h
	Ŭ		:	Capacit] Top	y □ Side	kW,			kWh/h PCs
	E	Electrode	:						
	E	Electrode // emperatur	:] Тор				1	
	{5. Te	Electrode // emperatur	: C	1 Top		🗌 Botto	om, Tota	1	PCs
	{5. Te	Electrode // emperatur	: Te T. Crown /	1 Top	<u>□ Side</u>	☐ Botto ℃, ℃,	om , Tota max.	1	PCs ℃
	{5. Te	emperatur) M. ⁻ M. ⁻ M. ⁻	: re Γ. Crown Α Γ. Glass	1 Top	☐ Side	☐ Botto ℃, ℃,	om , Tota max.	1 om :	PCs
	5. Te	Electrode // emperatur D M. ⁻ M. ⁻ M. ⁻ Por D Flue	: re T. Crown A T. Glass T. Bottom t End	1 Top	□ Side	□ Botto ℃, ℃, ℃,	om , Tota max. Bott °C,	om : °C	PCs ℃ ℃
	5. Te	Electrode // emperatur) M.) M.) M. Por) Flue) Air	: re T. Crown A T. Glass T. Bottom t End t End e Preheat	1 Top	<u>□ Side</u>	□ Botto ℃, ℃, ℃,	om , Tota max. Bott °C,	1 om :	PCs ℃
	5. Te	emperatur) M) M) M) M Por) Flue) Air Bric	: re T. Crown / T. Glass T. Bottom t End t End Preheat ge Wall	1 Top	□ Side	<u>ි Botto</u> ී , ී , ී ,	om , Tota max. Bott °C,	I om : °C	PCs ℃ ℃
	5. Te	emperatur) M.) M.) M.) M.) Flue) Flue) Air Brid R. 1	: Te T. Crown A T. Glass T. Bottom t End Preheat dge Wall T. or	l Top	□ Side	□ Botto ℃, ℃, ℃,	om , Tota max. Bott °C,	om : °C	PCs ℃ ℃
	5. Te	Electrode // emperatur D M. ⁻ M. ⁻ M. ⁻ M. ⁻ Por D Flue D Air Brid R. 1 Wor	: re T. Crown / T. Glass T. Bottom t End t End Preheat ge Wall	l Top	□ Side	<u>ి Botto</u> ి రా. ి రా. లి రా. రా.	om , Tota max. Bott °C,	I om : °C	PCs ℃ ℃

.

V-9-4-23

	enerator	Recupe	rator	🗌 Was	te heat Boiler
Regenerator :	(W :	mm) × (L	<u>.</u>	mm) ×	No. PCs
Volume of Checker	:	m	3,	Height :	mm
Type of Checker :		🛛 Pigeon hol	e	<u>о. в. </u> .	Cruciform
<u>Checker Brick Size</u>	:(W :	mm) × (L	:	mm) ×	(T: mm)
Type of Recuperato	1(Convection	<u>n</u>	🗌 Radiatio	n 🔲 Ceramic
Waste heat Boiler :	Capac	ity t/	<u>h</u> ,	Pressure	kg/cm ²
7. Cooling Air, Hea Sheet cooling Air :	ting Gas (and Bubblier Nm ³ /h)	· ×	(PCs)
Wall cooling Air :	(Nm ³ /h)	×	(PCs)
F. H. Heating Burne	 r (Nm ³ /h)	×	· · · · · · · · · · · · · · · · · · ·	PCs)
Bubblier :	·(Nm ³ /h)	×	(PCs)
8. Cooling Water					
Batch charger :	(t/h)	X	(PCs)
Reversal Damper :	(t/h)	×	(PCs)
Burner cooler :	(t/h)	×	(PCs)
Electrode holder :	(t/h)	×	(PCs)
Tuck cooler :	(t/h)	×	(PCs)
TUCK COULET .	er (t/h)	X	(PCs)
Throat cover coole		t/h)	×	(PCs)
	. (and the second	
Throat cover coole	(er (t/h)	×	(PCs)

Check List for Glass Works (19)

				Surface Temp (°C)		Heat Loss (kcal/h)	Remark
	M	I.T.		·····			
Bottom	Th	roat					
Block	R.T.,V	vor.Ch.		•••••••••••••••••••••••••••••			
		anal					******
		hearth					
	М.Т.	Upper Under					
Side	ть						
Block	****************	roat	 				
DIOCK		Vor.Ch.	 	,			
		anal					
	······································	hearth	· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·	-	
0		l.T.	, , ,			•	
Crown Arch &		roat					
		Vor.Ch.	·	*******			
Cover	C:						
	·····	hearth "		· · · · · · · · · · · · · · · · · · ·			
	Back Wa		1				·····
D	********	I.T.	·				
Breast		roat	 				
Wall		Vor.Ch.					
	C(
		hearth		·····	· · · ·		
	Breast W	· · · · · · · · · · · · · · · · · · ·		<u>.</u>			
Wing		t Wall				.]	
Wall		I.End				1	
n .		rch	1		······		
Port		ide 	1				
		ttom			1		
		own	· · · · · ·	<u> </u>	· · · · · · · · · · · · · · · · · · ·		
0	Side	Upper					
Regene~	Wall	Middle					•••••••
-rator		Lawer		· · · · · · · · · · · · · · · · · · ·	<u> </u>		
		l Wall ttom					
	Total					+	

Check List for Glass Works (20)

0	A B	gy Conservation Technology : Installed / Introduced : Under Construction : Under Planning		
Process		ltems	Application	Year of Application
Raw material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	1	Conversion of fuel		
	2	Introduction of electric booster		
	3	Introduction of oxygen burner or oxygen enriched burner		"
Fuel	1	Increase in furnace scale		
	2	Improvement of furnace structure		
· · · · ·	3	Insulation of furnace crown, side wall and bottom		
	4	Improvement of sealing of opening parts Improvement of cooling loss		
-	6	(water cooler, air cooling) Improvement of Recuperator		
	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m^2)	· · · · · · · · · · · · · · · · ·	
	2	Increase in productivity (Yield rate up)		
	3	Improvement of excess air ratio		
Forming	1	Improvement of forming machine		· · · · · · · · · · · · · · · · · · ·
Annealing	. 1	Improvement of annealing lehr		
Others	1	Installation of waste heat boiler etc.		
Management	1	Enrichment of instrumentation		
	2	Introduction of computer control system		
	3	Promotion of campaign for TQC, TPM and so on		
	ł <u></u>			
		V-9-4-26		

1996	Product (t)	Fuel (Nm ³)	Elec. (kŴh)	Morton glass(t)	Cullet (t)	Room Temp. A.V.(°C)
Jan.						
Feb.						
Mar.						
Apr.						
May.						
Jun.					·	
Jul.					···· ····	
Aug.					<u></u>	· · · · · · · · · · · · · · · · · · ·
Sep.			 			
Oct.	· ·					
Nov.		-	· · · ·			
Dec.						
Total						
			· ·	}	• • •	
2. Furnace Furnace Life :					months	
		<u></u>	· · · · · ·			· · · · · · · · · · · · · · · · · · ·
O Area of Melter		<u>(W :</u>)	X	(L: mm)
O Depth of Melte	r:		mm			
<u>Port :</u>	Width	mm,	Pitch	mm,	<u> </u>	lo. PCS.
O Partition :			□ Necl	<u>k, 🛛 Thr</u>	oat, 🗌	Skimmer
Area of Refine	. Working cham	ber ·			mm)×(L	: mm)
	er, Working char					
Canal, Forehea	rth: No.		PCS			
· · ·						

Check List for Glass Works (22)

	3. Combu	istion						
0	<u>Burner Pr</u>	essure :	kg/	cm ²				
	Atomizer	: <u> </u>	one, 🗌 Air,	🔲 Steam,		Nm ³ /ł	۱	
	Purging A	ir or steam :			<u></u>	Nm ³ /ł	<u>1</u>	
	Position o	of Burner :	🗌 Тор, 🗌	Side, 🗌	Under,	🖸 Thro	ugh	
	Distributio	on Ratio :	<u>1P %,2P</u>	%,3P	%,4P	%,		
	O_2 % in Ex	khaust Gas :	1P %,2P	%,3P	%,4P	%,	·	
		11	Under Chimney	<u>y</u>	%	······		<u> </u>
0	Oxygen B	urner: No.	PCS	<u>.</u>	Nm ³ /ł	<u>ז</u>		
								-
	④ Electr	rode Heating	,					
			•		M	134	L /L	
			pacity	kW,	Nor.		<u>h/h</u>	
	·····		b 🗌 Side	Bottor	n, Total	F	PCS	
							:	
	5. Tempe	erature				· .		
	0	M. T. Crown Arch		°C,	max.		°C	
	0	M. T. Crown Arch M. T. Glass	Glass :	°C, °C,	max. Botto	m :	°C	
		·····	Glass :			m :	°C	
		M. T. Glass	Glass : °C,			m : 1997 - 199	<u>ා</u> ර	
		M. T. Glass M. T. Bottom			Botto	m : 2010		
	0	M. T. Glass M. T. Bottom Port End		°C,	Botto °C, °C,			
	0	M. T. Glass M. T. Bottom Port End Flue	<u>°C,</u>	°C,	Botto °C,	°C	<u>°C</u>	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or	°C,	°C,	Botto °C, °C,		°C	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber	ింద. సార్లు	°C,	Botto °C, °C, °C	°C	ి ాం	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	ింద. సార్లు సార్లు సార్లు	°C,	Botto °C, °C, °C	°C	ා ි ා ි	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber	ింద. సార్లు	°C,	Botto °C, °C, °C	°C	ి ాం	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	ింద. సార్లు సార్లు సార్లు	°C,	Botto °C, °C, °C	°C	ා ි ා ි	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	ింద. సార్లు సార్లు సార్లు	°C,	Botto °C, °C, °C	°C	ා ි ා ි	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	ింద. సార్లు సార్లు సార్లు	°C,	Botto °C, °C, °C	°C	ා ි ා ි	
	0	M. T. Glass M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	ింద. సార్లు సార్లు సార్లు	°C,	Botto °C, °C, °C	°C	ා ි ා ි	

V-9-4-28

Check List for Glass Works (24)

🛛 Regenerat	or 👘 🗖 Rec	uperat	te 🗋 Wa	ste heat Boiler
Regenerator : (W :	mm) × (1	<u>_:</u>	mm) ×	No. PCS
Volume of Checker :	n	າ ³ ,	Height :	mm
Type of Checker :	🗌 Pigeon	hole	🔲 О. В. М	I. 🗌 Cruciform
Checker Brick Size :(W :	x (l	_:	mm) ×	<u>(T: mm)</u>
Type of Recuperate	Convec	tion	🗆 Radiati	on 🗌 Ceramic
Waste heat Boiler : Capacit	y t	/h,	Pressure	kg/cm ²
7. Cooling Air, Heating Gas	and Bubblier			
Sheet cooling Air : (Nm ³ /h)	×	(PCS)
Wall cooling Air : (Nm ³ /h)	×	. (PCS)
F. H. Heating Burner(Nm ³ /h)	×	(PCS)
Bubblier : (Nm³/h)	x	(PCS)
8. Cooling Water			· .	
Batch charger : (t/h)	×	(PCS)
Reversal Damper : (t/h)	×	(PCS)
Burner cooler : (t/h)	X	(PCS)
Electrode holder : (t/h)	×	(PCS)
Tuck cooler : (t/h)	×	(PCS)
Throat cover cooler (t/h)	×	(PCS)
Stirrer: (t/h)	×	(PCS)
Sheet cooler, Floater (t/h)	×	(PCS)
Other coolers : (t/h)	×	(PCS)

			Outer Surface	Surface	Unit Heat Loss	Heat Loss	Remark
r			Area (m²)	Temp (⁰C)	(kcal/m²h)	(kcal/h)	
	<u>M</u> .	Τ.	 		*****]	
3ottom 🛛	Thr	oat					
Block	R.T.,W	or.Ch.	}	1 	*****		
ļ.	Ca	nal	ç				
	Foreh	earth	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	·	<u> </u>	
	M.T.	Upper	,				
		Under			· · ·	<u>.</u>	
Side	Thr	oat			*******		
Block	R.T.,W	lor.Ch.	<u></u>		,		
	Ca	nal					*** ; • • • • • • • • • • • • • • • • •
· · [Foreł	nearth					· · · · ·
	M	.T.					
Crown	Th	roat					
Arch &	R.T.W	/or.Ch.					
Cover		anal					
	••••••	hearth					
	Back Wa		1				:
		I.T.		1			
Breast		roat					
Wall		Vor.Ch.					
		anal					
		hearth		******			
	Breast W		-				
Wing		nt Wall					····
Wall		l.End					
IT all		rch					
Port		Side		••••		*******	{······
For		ittom				***************************************	
		rown					· · · · · · · · · · · ·
	Side	Upper					
Regene-	Wall	Middle					
-rator		Lawer					
		d Wall					•
		ottom					1

Check List for Glass Works (25)

ł

		A : Installed / Introduced B : Under Construction C : Under Planning		
Process		ltems	Application	Year of Application
Raw material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	1.	Conversion of fuel		
	2	Introduction of electric booster		
	3	Introduction of oxygen burner or oxygen enriched burner		
Fuel	1	Increase in furnace scale		
	2	Improvement of furnace structure		
	3	Insulation of furnace crown, side wall and bottom		
	4	Improvement of sealing of opening parts		
	5	Improvement of cooling loss (water cooler, air cooling)		
	6	Improvement of Recuperator		
	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m ²)		
	2	Increase in productivity (Yield rate up)		
· · · · · · · · · · · · · · · · · · ·	3	Improvement of excess air ratio		
Forming	1	Improvement of forming machine		
Annealing	1	Improvement of annealing lehr		
Others	1	Installation of waste heat boiler etc.	, ,,, ,, , ,	
Management	1	Enrichment of instrumentation		
	2	Introduction of computer control system	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	3	Promotion of campaign for TQC, TPM and so on		

Check List for Glass Works (26)

	1996	Product (t)	Fuel (Nm ³)	Elec. (kWh)	Morton glass(t)	Cullet (t)	Room Temp. A.V.(℃)
	Jan.						
	Feb.			······	1997 - E.S.		· · ·
	Mar.						
-	Apr.						
-	May.						
_	Jun.						· · · · · · · · · · · · · · · · · · ·
	Jul.						
	Aug.						
	Sep.						· · · · · · · · · · · · · · · · · · ·
-	Oct.						
	Nov.					<u></u>	
=	Dec.		· · · · · · · · · · · · · · · · · · ·		1		
	Total						
	2. Furnace						
	·		·	• • • • •			ана
1	Furnace Life :		· · · · · ·		y tu s v tu s	months	· · · · · · · · · · · · · · · · · · ·
0 4	Area of Melter :		(W :	mm)	X .		_: mm)
0 1	Depth of Melter :			mm	· · · ·	· · ·	
_	Port :	Width	mm,	Pitch	mm,	N	o. PCS.
0]	Partition :	·	DC,	□ Necl	k, 🛛 Thi	roat, 🔲	Skimmer
<u>.</u>	Area of Refiner, W	orking cham	ber :		(W :	mm) × (L	: mm)
	Depth of Refiner, V	Working cha	mber :	e Solar de Carlo Alexandre			
_	Canal, Forehearth			PCS	• •		
-					·		· · ·

Check List for Glass Works (27)

	oustion					
Burner F	ressure :	kg/	′cm²		7- <u></u>	
Atomizer	·: 🗆 No	one, 🗌 Air, 📋 Steam,		Nm ³ /h		
Purging /	Air or steam :				Nm ³ /ł	<u>ı </u>
Position	of Burner :	🛛 Тор, 🗌	Side,	🗋 Under,	🛛 Thro	ugh
Distribut	ion Ratio :	1P %,2P	%,3P	% , 4P	%,	
0 ₂ % in E	xhaust Gas :	1P %,2P	%,3P	%,4P	%,	
<u> </u>		Under Chimne	У	%		·
Oxygen I	Burner: No.	PCS	s,	Nm³/h		
	rode Heating	pacity	kW,	Nor.	kW	h/h
	// 🗌 Тор	🗆 Side	D Bott	om, Total	P	PCS.
0	M. T. Crown Arch		°C,	max.	<u>;</u>	°C
0			00	D	. *	
	M. T. Glass M. T. Bottom	Glass :	°C,	Botton	n :	
•	M. T. Bottom		°C,	· ·	n :	°C
0		Glass : °C,	°C, °C,	Botton ℃,	n : °C	°
	M. T. Bottom Port End			· ·		<u>ා</u> ර
0	M. T. Bottom Port End Flue	<u>°C,</u>		°C,		
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or	<u>°C,</u>		°C,		
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber	°C,	°C,	<u>ී</u> ද, ීද, ීද	°C	<u>°C</u>
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	<u>ී</u> ද, ී ද, ී ද,	°C,	°C, °C, °C	°C	
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber	°C,	°C,	<u>ී</u> ද, ීද, ීද	°C	ා ද ව ි
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	<u>ී</u> ද, ී ද, ී ද,	°C,	°C, °C, °C	°C	ා ද ව ි
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	<u>ී</u> ද, ී ද, ී ද,	°C,	°C, °C, °C	°C	ා ද ව ි
0	M. T. Bottom Port End Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	<u>ී</u> ද, ී ද, ී ද,	°C,	°C, °C, °C	°C	ා ද ව ි

6 Heat Recovery				
🗌 Regen	erator 🗌 Recupe	erate 🔲	Waste heat Boiler	
			· .	
Regenerator : (W	: x (L :	mm)	× No. PCS	
Volume of Checker :	m ³ ,	Height	: mm	
Type of Checker :	🗌 Pigeon hol	e 🗌 O. I	3. W. 🗌 Cruciform	
Checker Brick Size : (W	: × (L :	mm) ×	(T: mm)	
Type of Recuperate	Convection	n 🗌 Rac		
Waste heat Boiler : Ca	pacityt/h ,	, Pressu	ire kg/cm ²	
7. Cooling Air, Heating Sheet cooling Air : (Nm ³ /h)	× (PCS)	
Wall cooling Air : (Nm ³ /h)	× (PCS)	
<u>F. H. Heating Burner(</u>		<u>× (</u>	PCS)	
Bubblier: (Nm ³ /h)	<u>× (</u>	PCS)	
· · · · · · · ·				-
8. Cooling Water				
8. Cooling Water Batch charger : (t/h)	× (PCS)	
	t/h) t/h)	× (× (PCS) PCS)	
Batch charger : (
Batch charger : (Reversal Damper : ((<u>t/h)</u> (<u>t/h)</u> (<u>t/h</u>)	× (PCS) PCS) PCS)	
Batch charger : (Reversal Damper : (Burner cooler : ((<u>t/h)</u> (<u>t/h)</u> (<u>t/h)</u> (<u>t/h)</u>	× (× (× (× (PCS) PCS) PCS) PCS)	
Batch charger : (Reversal Damper : (Burner cooler : (Electrode holder : ((<u>t/h)</u> (<u>t/h)</u> (<u>t/h)</u> (<u>t/h)</u>	× (× (× (× (× (PCS) PCS) PCS) PCS) PCS)	
Batch charger : () Reversal Damper : () Burner cooler : () Electrode holder : () Tuck cooler : ()	(t/h) (t/h) (t/h) (t/h) (t/h) (t/h)	× (× (× (× (PCS) PCS) PCS) PCS) PCS) PCS)	
Batch charger :()Reversal Damper :()Burner cooler :()Electrode holder :()Tuck cooler :()Throat cover cooler()Stirrer :()Sheet cooler, Floate	$\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$	× (× (× (× (× (× (× (× (× (PCS) PCS) PCS) PCS) PCS) PCS) PCS)	· · · · · · · · · · · · · · · · · · ·
Batch charger :()Reversal Damper :()Burner cooler :()Electrode holder :()Tuck cooler :()Throat cover cooler()Stirrer :()	(t/h) (t/h) (t/h) (t/h) (t/h) (t/h)	× (× (× (× (× (× (PCS) PCS) PCS) PCS) PCS) PCS)	
Batch charger :()Reversal Damper :()Burner cooler :()Electrode holder :()Tuck cooler :()Throat cover cooler()Stirrer :()Sheet cooler, Floate	$\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$ $\frac{t/h}{(t/h)}$	× (× (× (× (× (× (× (× (× (PCS) PCS) PCS) PCS) PCS) PCS) PCS)	

			Outer Surface Area (m ²)	Surface Temp (°C)	Unit Heat Loss (kcal/m ² h)	Heat Loss (kcal/h)	Remark
	М	.T					
Bottom	Th	roat					
Block	R.T.,Wor.Ch.		[
ĺ	Canal						
Î	Forehearth						
	М.Т.	Upper Under					
Side	ТЫ						
Block	Throat R.T.,Wor.Ch.] 			·····	
		nal	1			h	
			, 				
		nearth T					,
		.T.					
Crown		roat	{ 				
Arch &	R.T.,Wor.Ch.		 				
Cover	Canal		 		····		
		hearth	· · · ·				
r	Back Wa				· · · · · · · · · · · · · · · · · · ·		
		I.T.					
Breast		roat					
Wall	R.T.,Wor.Ch.		1		,		
	Canal						•••••••••••••••••••••••••••••••••••••••
		hearth			:	· · · · · · · · · · · · · · · · · · ·	
	Breast W						
Wing	**********	t Wall					,
Wall	F.H	l.End					
Port	Arch						
	Side						•••••••
	Bottom			<u> </u>		ļ	
	Crown						
	Side	Upper					
Regene-	Wall	Middle					
-rator		Lawer		:		1	
		l Wall ttom					

Check List for Glass Works (30)

	🕦 Ener	gy Conservation Technology		
		A : Installed / Introduced - B : Under Construction C : Under Planning		
Process		ltems	Application	Year of Application
Raw material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	1	Conversion of fuel		
	2	Introduction of electric booster		
	3	Introduction of oxygen burner or oxygen enriched burner		
Fuel	1	Increase in furnace scale		· · · · ·
	2	Improvement of furnace structure		
	3	Insulation of furnace crown, side wall and bottom		
	4	Improvement of sealing of opening parts		
	5	Improvement of cooling loss (water cooler, air cooling)		
	6	Improvement of Recuperator		
	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m ²)		
	2	Increase in productivity (Yield rate up)		
	3	Improvement of excess air ratio		
Forming	1	Improvement of forming machine		
Annealing	1	Improvement of annealing lehr		
Others	1	Installation of waste heat boiler etc.		2 5
Management	1	Enrichment of instrumentation		
	2	Introduction of computer control system		
	3	Promotion of campaign for TQC, TPM and so on		

Check List for Glass Works (31)

1996	Product (t)	Fuel (Nm ³)	Elec. (kWh)	Morton glass(t)	Cullet (t)	Room Temp. A.V.(°C)
Jan.						
Feb.						
Mar.						
Apr.						
May.						
Jun.						:
Jul.						
Aug.						
Sep.						
Oct.						
Nov.	N.1		·			
Dec]		
Total						
	- <u>I</u> I	·	I	<u> </u>		
2. Furnace						
 1 •e						
Furnace Life :					months	<u> </u>
Area of Melter :		(W :	mm)	×	<u>(L</u>	: mm)
Depth of Melter :			mm			<u> </u>
Port :	Width	mm,	Pitch	mm,	No.	PCS.
Partition :		DC,	🖸 Neck	<u>, 🛛 Thr</u> o	pat, 🔲 S	kimmer
Area of Refiner, Wo	rking chaml	ber :		(W :	mm) × (L :	mm)
Depth of Refiner, W	orking chan	nber :				
· · · ·	No.		PCS			

Check List for Glass Works (32)

7

	3. Combu	istion					
0	Burner Pr	essure :	kg/c	2 m ²	,		
	Atomizer	: 🗌 No	ne, 🛛 Air,	🔲 Steam,		Nm ³ /h	
	Purging A	ir or steam :	· · · · · ·			Nm ³ /h	_,
	Position o	of Burner :	🗌 Тор, 🛛	Side, 🗌	Under,	🛛 Through	
	Distributio	on Ratio :	1P %,2P	%,3P	%,4P	%,	<u></u>
	0 ₂ % in E>	khaust Gas :	1P %,2P	%,3P	%,4P	%,	
			Under Chimney	<u>,</u>	%		
0	Oxygen B	lurner: No.	PCS,	L	Nm ³ /h		
	(4) Electr	rode Heating					
	Elect	trode : Cap	acity	kW,	Nor.	kWh/h	
		и 🗆 Тор	🔲 Side	🗌 Botton	n, Total	PCS	
	5. Tempe	ſ	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	°C
	0	M. T. Crown Arch		°C,	max.		<u> </u>
	0	M. T. Glass	Glass :	°C,	Botton	n:	· ·
		M. T. Bottom Port End	°C,				°C
					°C		
	\circ			°C	°C,	ം സ	
	0	Flue		°C,		°C	
	0 0	Flue Air Preheat	°C,	°C,	°C, °C, °C	<u>°C</u>	°C
		Flue Air Preheat Bridge Wall			°C,	°C	
		Flue Air Preheat Bridge Wall R. T. or		°C,	°C,		
		Flue Air Preheat Bridge Wall			°C,		
	, ,	Flue Air Preheat Bridge Wall R. T. or Working Chamber	°C,		°C, °C		°C
	, ,	Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	°C,		°C, °C		°C
	, ,	Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	°C,		°C, °C		°C
	, ,	Flue Air Preheat Bridge Wall R. T. or Working Chamber Forehearth	°C,		°C, °C		°C

•

Check List for Glass Works (34)

6 Heat Recovery

Regenerator

🛛 Recuperate

🖸 Waste heat Boiler

Regenerator : (W :	× (L :	<u> </u>	PCS
Volume of Checker :	m ³ ,	Height :	mm
Type of Checker :	🗋 Pigeon hole	🖸 O. B. W.	Cruciform
Checker Brick Size :(W :	mm) × (L:	mm) × (T :	mm)
Type of Recuperate	Convection	Radiation	🗌 Ceramic
Waste heat Boiler : Capacity	/t/h,	Pressure	kg/cm²

7. Cooling Air, Heating Gas and Bubblier

Sheet cooling Air : (Nm³/h)	×	(PCS)	
Wall cooling Air : (Nm ³ /h)	×	(PCS)	
F. H. Heating Burner (Nm ³ /h)	×	(PCS)	· · ·
Bubblier : (Nm³/h)	×	(PCS)	

8. Cooling Water

Batch charger :	(t/h)	×	(PCS)	
Reversal Damper :	(t/h)	×	(PCS)	
Burner cooler :	(t/h)	×	(PCS)	
Electrode holder :	(t/h)	×	(PCS)	
Tuck cooler :	(t/h)	×	(PCS)	
Throat cover cooler	(t/h)	×	(PCS)	
Stirrer :	(t/h)	×	(PCS)	
Sheet cooler, Floater	(t/h)	X	(PCS)	
Other coolers :	(t/h)	×	· (PCS)	

M.T. Image: state				Outer Surface Area (m ²)	Surface Temp (°C)	Unit Heat Loss (kcal/m ² h)	Heat Loss (kcal/h)	Remark
Block R.T.Wor.Ch.		М	. T .					
$ \begin{array}{ $	Bottom	Th	roat				<u> </u>	
Forehearth Image: state s	Block	R.T.,W	lor.Ch.					
M.T. Upper Side Throat Block R.T.Wor.Ch. Canal				 				*****
Side Throat Image: Side state			Upper					
Block R.T.Wor.Ch.						· · · · · · · · · · · · · · · · · · ·		
Canal Image:						· · · · · · · · · · · · · · · · · · ·		
$\begin{array}{ c c c c c } \hline M.T. & & & & & & & & & & & & & & & & & & $		Ca	anal					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $						·		
Arch & R.T.,Wor.Ch.	Crown							
Cover Canal Image: Canal for the arth Image: Canal for the arth <th< td=""><td></td><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></th<>								
Back Wall M.T. Breast M.T. Breast Throat Wall R.T.Wor.Ch. Canal Canal Forehearth Image: Constraint of the second of t		rn Throat & R.T.,Wor.Ch. er Canal						
M.T. M.T. Breast Throat Wall R.T., Wor.Ch. Canal		Fore	hearth					
Breast Throat Image: Character of the second s		Back Wa	<u>II</u>					
Wall R.TWor.Ch. Canal Canal Forehearth Seast Wall Breast Wall Side Side Wall F.H.End Side Port Side Side Bottom Side Side Bottom Side Side Lawer Lawer Side	D		***********************					
Canal Canal Forehearth Image: Construction of the second								
Forehearth Image: Crown mark Image: Cr	Wall	1						
Breast Wall Image: Side state		[ar 1
Wall F.H.End Arch								· · · · · · · · · · · · · · · · · · ·
Arch Port Side Bottom	Wing	From	nt Wall					
Port Side Bottom Image: Side Crown Image: Side Side Upper Regene- Wall Middle Lawer	Wall							1
Bottom Crown Side Upper Regene- Wall Middle rator	Port					······································		
Crown Side Upper Regene- Wall Middle -rator Lawer								
Regene- Wall Middle -rator Lawer				e				
-rator Lawer		1	1					
	-	- Wall	{					
Bottom			d Wall					

Check List for Glass Works (35)

		A : Installed / Introduced B : Under Construction C : Under Planning		
Process	· •••• ••• •••	items	Application	Year of Application
Raw material	1	Improvement of raw material's character		
	2	Recirculating use of city cullet		
Utilities	1	Conversion of fuel		
	2	Introduction of electric booster	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
4 	3	Introduction of oxygen burner or oxygen enriched burner	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Fuel	1	Increase in furnace scale		
	2	Improvement of furnace structure		
• 	3	Insulation of furnace crown, side wall and bottom		***
. 4	4	Improvement of sealing of opening	1	
•	5	parts Improvement of cooling loss (water cooler, air cooling)		••••
	6	Improvement of Recuperator		· · ·
•	7	Improvement of checker height or shape in regenerator		
Operation	1	Increase in melting load (t/m ²)		
·	2	Increase in productivity (Yield rate up)		
• •	3	Improvement of excess air ratio		
Forming	1	Improvement of forming machine		
Annealing	1	Improvement of annealing lehr		
Others	1	Installation of waste heat boiler		
Management	1	Enrichment of instrumentation		
	2	Introduction of computer control system		
	3	Promotion of campaign for TQC, TPM and so on		***

Check List for Glass Works (36)

9.4.2 Silica Block (Silikaty)

(1) Autoclave

a. Purpose of measurement

The purpose is to grasp the current operation status in order to perform the heat balance of the autoclave.

b. Measurement item, measurement time, measuring equipment, and data processing

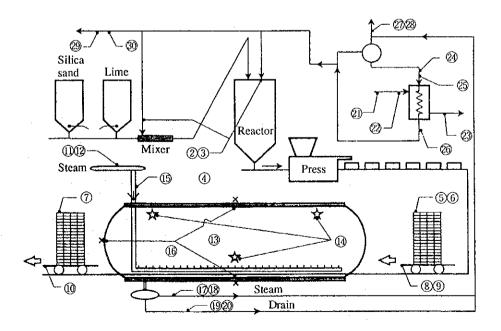
·	Measurement items	Measurement time	Measuring equipment	Data processing
Material	① Silica sand/lime mixing ratio	_	Operation record	Memo
Raw glass	② Content of water added (%)		Operation record	Memo
plate	③ Temperature of water added	24 h	Thermocouple	to Recorder
Product	(4) Ambient temperature	24 h	Thermocouple	to Recorder
	(5) Temperature of raw glass plate immediately before being carried in ACV	spot	Radiation thermometer	Memo
	 6 Amount of raw glass plate carried in ACV 	24 h	Operation record	Memo
	⑦ Product temperature immediately after being carried out of ACV	spot	Radiation thermometer	Memo
Charging car	Weight and material of the charging car	-		Мето
	④ Charging car temperature	spot	Surface thermometer	Memo
	immediately before being carried in ACV			
	① Charging car temperature immediately after being carried out of ACV	spot	Surface thermometer	Memo
Steam	① Temperature and pressure of steam for ACV	24 h	Meters for operation	Memo
	③ Steam consumption for ACV	24 h	Operation record	Memo
Autoclave	① ACV time schedule	1 cycle	Operation record	Memo
(ACV)	ACV temperature/pressure	l cycle	Meters for operation	Memo
	(B) ACV steam flow rate	1 cycle	Meters for operation	Memo
	① ACV surface temperature	1 cycle	Thermocouple	to Recorder
	① Amount of steam emitted from ACV	1 cycle	Meters for operation	Memo
	(B) Temperature of steam discharged from ACV	1 cycle	Thermocouple	to Recorde
	(1) Amount of condensate discharged from ACV	1 cycle	Meters for operation	Memo
	20 Temperature of condensate discharged from ACV	spot	Thermocouple	to Recorde

	Measurement items	Measurement time	Measuring equipment	Data processing
Heat	② Boiler pure water flow rate	24 h	Ultrasonic flowmeter	to Recorder
exchanger	2 Pure water temperature at heat exchanger inlet	24 h	Thermocouple	to Recorder
	② Pure water temperature at heat exchanger outlet	24 h	Thermocouple	to Recorder
	2 Temperature of recovered hot water at heat exchanger inlet	24 h	Thermocouple	to Recorder
	29 Temperature of recovered hot water at heat exchanger outlet	24 h	Thermocouple	to Recorder
	Plow rate of recovered hot water	24 h	Ultrasonic flowmeter	to Recorder
Discharge	② Amount of steam discharged	24 h	Meters for operation	Memo
	② Temperature of steam discharged	24 h	Thermocouple	to Recorder
	29 Amount of condensate discharged	24 h	Meters for operation	Memo
	③ Temperature of condensate discharged	24 h	Thermocouple	to Recorder

c. Measuring points

Figure 9.4.3 shows the measuring points of the autoclave.

Figure 9.4.3	Measuring	Points o	of Autoclave
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(2) Energy utilization facilities

Equipment name	Targeted equipment or location	Measurement time
Electricity control	Power receiving facilities	24 h
Fan/blower	For boiler	24 h
Air compressor	Mixer, press	24 h
Electric motor	Mixer	24 h
Transformer	Major equipment	24 h
Lighting	Various locations of the factory	spot
Pump	For boiler feedwater	24 h
Boiler	Boiler room	24 h
Steam pipe	Various locations of the factory	spot

For the measurement method and the measuring points, see "ENERGY UTILIZATION FACILITIES".

General Item						
General Rom						
① Production	(Annual data)				(tonne d	or PCS)
	Design Capa.	1992	1993	1994	1995	1996
						·

Check List for Silica Block Works (1)

② Operation Hours (Annual data)

 Design Hours	1992	1993	1994	1995	1996
· · · · · · · · · · · · · · · · · · ·					

③ Utility Consumption (Annual data)

	Design Quant.	1992	1993	1994	1995	1996
Coal (t)						
Others Fuel						
Electric Power (kWh)						
Steam for Actoclave (t)						
Water for Boiler (t)						
Water for Others (t)						

	Coal		Electric	
Sp. gr.				
C (%)				
Н (%)				
S (%)				
Hh (Kcal/kg)			· · · · · · · · · · · · · · · · · · ·	
HI (Kcal/kg)				
Price (ZI)	<u> </u>			
5. Ratio of Energy cost Pro Fuel	oduct cost (Exis %,	ting) Electricity	%	
	%,		%	
Fuel	%,		%	
Fuel	%,		%	
Fuel ⑥ Quality of Products (Ex	%,		%	
Fuel ⑥ Quality of Products (Ex	%,		%	
Fuel ⑥ Quality of Products (Ex	%,		%	
Fuel ⑥ Quality of Products (Ex NO (%) O ₂ (%)	%,		%	
Fuel (6) Quality of Products (Ex 10 (%) O ₂ (%) ensity (kg/m ³)	%, isting)		%	
Fuel (6) Quality of Products (Ex 10 (%) O ₂ (%) ensity (kg/m ³) pecific (kcal/kg°C)	%, isting)		%	
Fuel (6) Quality of Products (Ex (10) (%) O ₂ (%) ensity (kg/m ³) pecific (kcal/kg°C) peat conductivity (kcal/mh°C)	%, isting)		%	

Check List for Silica Block Works (2)

.....

	Check List for Silica Blog	ok Works (3)	,
Specification of Raw	materials		
(1) Chemical Composit	tion and grain size Distribut	ion	
Silica sand			·····
Lime			
	<u> </u>		
② Mixing Rate			
· · · · · · · · · · · · · · · · · · ·			
Silica sand	%	%	%
			0/

Silica sand	%	%	%
Lime	%	%	%
· · · · · · · · · · · · · · · · · · ·	%	%	%
Water	%	%	%

3

Monthly Data of Production and Utility Consumption

1996		Product	coal	elec.	water
	(t or PCS.)	(t)	(kWh)	(t)
Jan.				ļ	
Feb.					
Mar.					
Apr.					
May.					
Jun.					
Jul.					
Aug.					
Sep.					
Oct.					
Nov.					
Dec.					

Name		Туре	Rated	Capacity	Motor	No.	Actual
			Quant.	Press.	(kW)	(PCS)	_load (%)
 	ļ		-				
 				+			
 							:
 	• •	************************************			<u></u>		·
						<u> </u>	······
 	<u>}</u>						
 	· ·					1	
 					· · · · · · · · · · · · · · · · · · ·	 .	
 					ļ <u> </u>		
		· · · ·			· · · · · · · · · · · · · · · · · · ·		

Check List for Silica Block Works (4)

Δ	· Installer	I / Introduced		
		Construction		
	: Under P			
-				
Process		ltems	Application	Year of Appreciati
Rawmaterials	1	Improvement of rawmat- erial's character		
	2	Improvement of mixing	•••••	********
		rate and water content		
Forming		Improvement of press form-		
		ing method		
Fuel and Boiler	1	Improvement of coal's		
		character for boiler		
	2	Exchange of boiler's		
1.1		type or capacity		
	3	Improvement of boiler for		
		energy conservation		
	4	Improvement of operation		
	5	Improvement of application		
		control of boiler		
Autoclave	1	Exchange of size of auto-		
		clave		
	2	Improvement of autoclave		
		(insulation and so on)		<u> </u>
	3	Improvement of filling rate		
		into the auto clave		
	4	Improvement of operation		
	5	pressure and temperature		
	J	Improvement of time circle (from carry in to carryout)		
	6	Improvement of rotation		
		schedule of autoclaves		
	7	Improvement of recovery me-		
		thod of waste steam and drain		
Product	1	Improvement of productivity		1
· ·		(vield rate up)		
	2	Improvement of quality of		
		product		
Management	1	Enrichment of instrum-		
		entation		
	2	Introduction of computer		
		control system		
	3	Promotion of campaign for		

Check List for Silica Block Works (5)

l

Check List / Building Brick				
Autoclave	Date:			
Factory / Company:				
Weitten ber				
Written by:				
General Information:				
No. of autoclaves installed				
Steam come from:		•		
Concept of autoclave system (diag	ram, handwritten)			
		•		
		-:		
Specification (designed):				
Туре				
Manufactured by				
Installed at		-		
Body size				
Diameter, cylindrical length				
Heat insulation		<u> </u> .		
Material / thickness		<u> </u>		
Operating condition				
Charged material		·		
Tons/charge		·		
Specific heat		·		
Water content				
Charging temperature	A	• •		
Discharging temperature				
Charging car	and the second			
Material / weight				
	V-9-4-50			
	¥-7-7-7-00	.:		

Time cycle chart

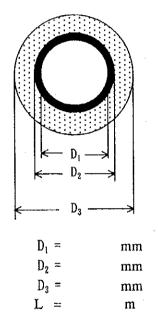
charging / steaming / discharging / waiting

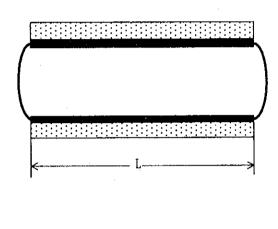
Condensate recovery

Annual Working Condition:

Yearly working days or hours Daily running hours

Dimension and Material

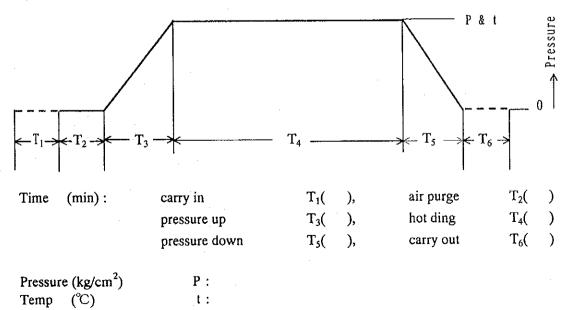




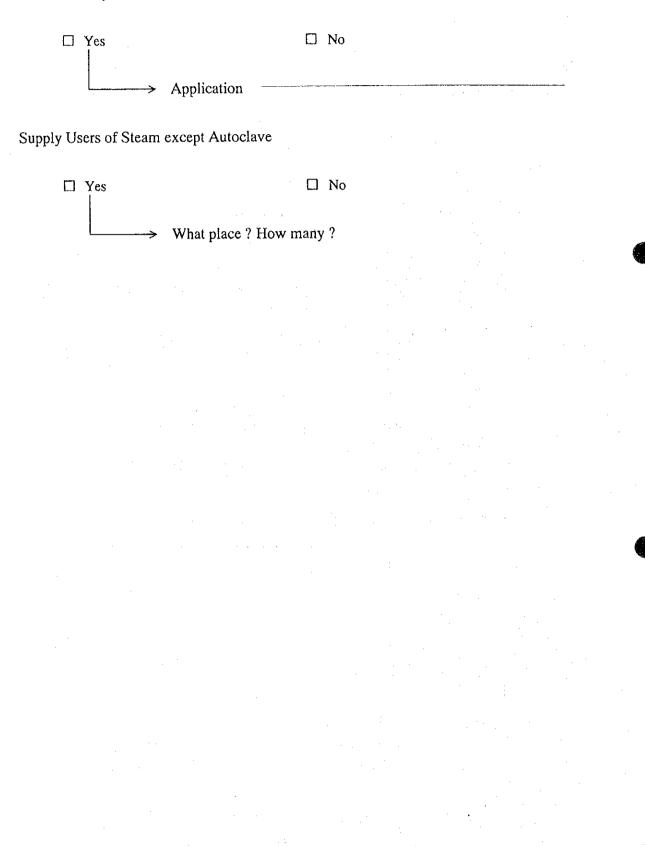
Material of Body :

Material of Heat Insulator :

Operation Time circle and Pressure and Temperature



Heat Recovery of Exhaust Steam and Drain



9.5 Food Industry

9.5.1 Olvit (Vegetable oil)

- (1) Deodorizer
 - a. Purpose of measurement

The purpose is to grasp the heat utilization state in a deodorizer.

b. Measurement items, measurement time, measuring instruments, and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Steam pressure of steam ejector	24 h	Meter for operation	Memo
2 Vacuum	24 h	Meter for operation	Memo
③ Deodorizer upper stage temperature	24 h	Meter for operation	Memo
Deodorizer middle stage temperature	24 h	Meter for operation	Memo
5 Deodorizer lower stage temperature	0.1 h × 4 times	Meter for operation	Memo
(6) Deodorizer wall temperature	0.1 h × 4 times	Thermocouple	to Recorder

c. Measuring points

The measuring points are shown in Figure 9.5.1.

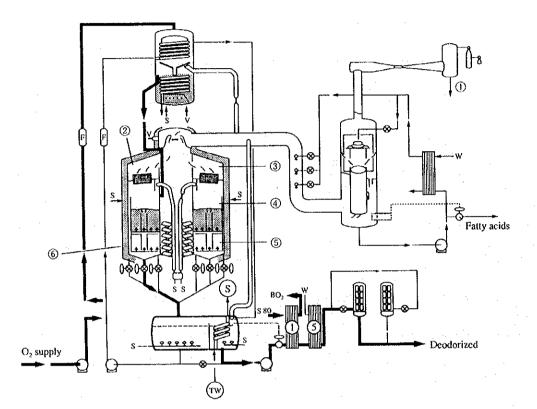


Figure 9.5.1 Measuring Points of Deodorizer

(2) Hydrogenation Tank

a. Purpose of measurement

The purpose is to grasp the heat utilization state in a hydrogenation tank.

b. Measurement items, measurement time, measuring equipment and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Raw oil temperature	24 h	Thermocouple	to Recorder
② Internal temperature at blowing hydrogen	24 h	Thermocouple	to Recorder
③ Internal pressure on completion of hydrogen blowing	24 h	Thermocouple	to Recorder
④ Pressure of the hydrogenation tank	24 h	Meter for operation	Memo
(5) Hydrogenation tank wall temperature	0.1 h × 4 times	Thermocouple	to Recorder
(6) Room temperature	$0.1 \text{ h} \times 4 \text{ times}$	Thermocouple	to Recorder
⑦ Steam pressure	24 h	Pressure transmitter	to Recorder

c. Measuring points

Figure 9.5.2 shows the measuring points of a hydrogenation reactor.

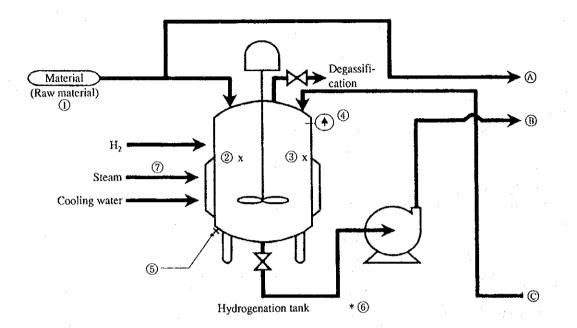


Figure 9.5.2 Measuring Points of a Hydrogenation Reactor

(3) Energy Utilization Facilities

Equipment	Tatgeted equipment or location	Measurement Time
Electricity management	Power receiving station	24 h
	Electrolytic cell	24 h
	Deodorization of oil	spot
	Agitator for refining	spot
	Mixer of margarine	spot
	Vacuum for refining	spot
Fan/blower	Cooling fan for margarine	spot
Electric motor	NH ₃ refrigerator	· · · · · · · · · · · · · · · · · · ·
Air compressor	NH ₃ compressor	24 h
	H ₂ compressor	spot
Pump	Cooling water pump	24 h
Transformer	Electrolytic cell	24 h
Lighting	Each process	spot
Boiler	Boiler room	24 h
Steam pipe	Various locations in the factory	spot

For the measurement method, measuring points, etc., see "10. ENERGY UTILIZATION FACILITEIS".

Check List for Vegetable Oil (1)

Date	
Surveyor	

Factory Name

No.	Process Equipment	[t er	D	<u></u>	Data		Note	2
1		Name						
ł		Moisture				%		
		Oil Content			1. C	%		
		OII CONTENT						
2	Degumming	Centrifuge	Гуре					
4	Degumming		Number					
			Flow			1/min		
			Гепр			C	÷	
			Flow			l/min		
						ای ای		
			Temp			Torr		
			Press					
			Temp					
			Press			kg/cm ²		
			Flow			kg/h		
			Diameter			מח		
		Aftercooler		_		D ²		
			Temp	In		C		
				Out		C		
		Oil Moisture		Out	2	%		:
		Dealing with	Gum		•			
3	Neutralization	Centrifuge	Type					
		· ·	Number					
		Feed	Flow			∶l/min]	·	
			Temp.			C		
			Flow			l/min		· .
			Flow	ļ		l/min		
			Press			Torr		
	1		Temp.			C		
		Room	Temp.			C		
			1 Capt					
4	Bleaching	Auxiliaries				%		
ľ	DICUCATAG	Bleach Tank	Тупе					
i i		Dicuch lank	Press			Torr		
			Temp.	1		C		
		filter	Type			Ŭ		
i i			Number					
			Flow			l/min		
1		Filteraid	1.10#			ton/day		
ĺ		rilleraiu		1		ton/ day		
5	Designation	Boastian	Time			min		····
0	Dewaxing	Reaction				۳۱ C		
		Dilton	Temp	1		C	1	
		Filter	Туре					
			Number	1		1/=:=		÷ .
1			Flow			l/min		
		Refrigerator	Type	1				
1		1	Number				1	
1			Capacity			kW		
			Flow	1_		l/min	1 · ·	
	1		Temp	In		C	1	
				Out		C L	ł	
1	1	Process Flow	wchart					
1		l		. 1		C	1	

Check List for Vegetable Oil (2)

No.	Process Equipment	ltem	Data	Note
6		Type Name		ŧĸĸĹĸŴſŎĸĊĹĸĸĸĔĸĸĹĸŴĊĸĸĸĸĸĸĸĸĸĸĹĊŎĸĸĊĸĸĸŢŎŎĸĸĊĸĸĸŢŎŢŎĸĊĹĸĸŔĸĸŢĸĸĸ
		Reciever Tank	1	
		Capacity	No. 1 m ³	
		oupuot()	No. 2 m ³	
			No. 3 m ³	
		Υ		
		Temp.	No. 1 °C	
			No. 2 °C	
			No. 3 °C	
		Mixing Tank		
		Capacity	No. I m ³	
			No. 2 m ³	
		Temp.	No. 1 °C	
		remp.	No. 2 °C	
		Out door Tomp	τ. 2 C	
~	Deside at the test	Out door Temp.		
7		Yacuum	Torr	
		Motor	k₩	
		Ejector St. Press	kg/cm²	
		Flow	kg/h	
		Diameter	תח	
		Barometric Condenser		
		Tray No	· · · · · · · · · · · · · · · · · · ·	
		Capacity	+	
		Temp.	ຕູ່ ເ	
		Steam	kg/cm ²	
		Steam	kg/h	
		Stay Time	min.	····
		Heater		
		Heat Transfer Area	n ^z	
		Flow	l/min	
		Temp.	C	
		Temp.	Ĉ	
		Steam Pressure	kg/cm ²	
		Steam Flow	kg/h	
		Waste Heat Recovery	K6/ II	
			spiral m ³	
		Heat Exchanger	spiral m ⁴	
			plate m ³	
		Room Temp.	C	
		Water Temp.	<u>ະ</u>	
8	Others	Running Cost		
	l	Steam	Z1/t	
		Electric Power	Zl/kWh	
	1	Filter	Ĉ	
		Yield		
		0il		
		Groats		
			в ³	
		Storage Tank		
		Product Quality		
	н	Water Content		
		Color		
		Acidity	1	
		Phospholipid		
9	Total	Refined Oil	kl	
	Consumption		Zl or \$	
		Electricity	kl	
	(1000)		Zl or \$	
		Fuel	kl	
	1	1, nc l		
		Wator	Zl or \$	
		Water	kl 71 om 4	
	1	1 · · · ·	Z1 or \$	1

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0.	Process	Item	Data	Note
	Equipment		1	
10	Hydrogenation			
	Bleached Oil	Capacity	kW	
	Feed Pump	Flow Rate	L/min	
		Temperature	<u> </u>	
	Preheater	Temperature	C	
	Reactor	Capacity	m ³	
		Temperature) °C	
		Time	h/batch	
	0i1	Capacity	kW	
	Circulating			
	Pump			
	Bleaching-Tank	Capacity	m ³	
		Temperature	°C	
		Time	h/batch	
	Hydrogenation	Capacity	k₩	
	Transfer Pump	Flow Rate	m ³ /min	·
	Vacuum Pump	Capacity	k¥	
		Pressure	mm/Hg	
	Hydrogenation	Production	kL/day	
	0il		kL/month	
	1	· · ·	kL/year	
	1	Temperature	°C	· .

Check List for Vegetable Oil (3)

Process	Item	Unit	Design	Actual
Bleaching	Productivity	t/hour		
	Filter	L/min		
	Working time	hour/day		
	Bleach tank Press	Torr		
Deodorizing	Vacuum	Torr		
	Flow	L/min		
	Temperature in	deg.		
	Temperature out	deg.		
	Steam pressure	kg/cm ²		
	Steam flow	kg/cm ²		
	Productivity	t/day		
Hydrogenazation	Bleached oil Productivity	/ t/day		
	Flow rate	L/min		
	Vacuum pump Capacity	kW		
	Pressure	mm/Hg		
Plant total	Electricity consumption	kWh/t		
	Fuel consumption	Mcal/t		
	H ₂ consumption	Nm ³ /t		
	Cooling water consumption	m ³ /t		

Check List for Vegetable Oil (5)

12. Production and Energy Consumption

	Unit	1992	1993	1994	1995	1996
Production						
Steam						
Electricity				· · · · · · · · · · · · · · · · · · ·		
Water						

13. Energy consumption in 1995-1996

	Unit	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	May
Steam												
Electricity								· · ·				

14. Production

	Unit	1992	1993	1994	1995	1996
Raw oil						
Refined oil						
Hydrogenated oil						
Others						
Total						

15. Production in 1995-1996

	Unit	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	May
Raw oil												
Refined oil												
Hydrogenated oil						L]					
Others												ļ
Total							·		[<u> </u>	

16. Production in 1995-1996 (%)

	Unit	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	May
Raw oil	%	100	100	100	100	100	100	100	100	100	100	100
Refined oil	%											ļ
Hydrogenated oil	%										ļ	
Others	%											
Total	%								·	<u> </u>		

Check List for Vegetable Oil (6)

17. Energy consumption in 1996

I' THINES CONSTRUCTION IN TAKE										
	Production	Ę	Electricity	Electricity Natural gas	lio	Compressed Hydrogen	Hydrogen	Coal	Steam	Recycle
						air				water
Unit	Name	ton	10^3 kWh	$10^3 \mathrm{Nm}^3$	Ĵ	$10^3 \mathrm{Nm}^3$	$10^3 \mathrm{Nm}^3$	ton	ton	10^{3}m^{3}
Bleaching of raw oil										
Deodorizing						-				
Others						-				
Total consumption										
Hydrogenation										
Packing					-					
Water										
Recycling										
Waste water										
	Production	ų	Electricity	Natural gas	lio	Compressed Hydrogen	Hydrogen	Coal	Steam	Recycle

	Production	Electricity	lectricity Natural gas	Oil	Compressed	Hydrogen	Coal	Steam	Recycle
			•		air				water
Unit	ton	10^3 kWh	10 ³ kWh 10 ³ Nm ³	L	10^3Nm^3 10^3Nm^3	$10^3 \mathrm{Nm}^3$	ton	ton	10^3m^3
Generated				-					
Purchased									
Process									
Others								-	
Total									
Max. demand									

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Check List for Vegetable Oil (7)

Process	Item	Application	Year of application
Bleaching	1. Control of steam pressure		
	2. Insulation of tank		
	3. Vacuum system	· · · ·	
Deodorizing	1. Control of steam pressure	· · · ·	
	2. Heat recovery		
	3. Vacuum control		
	4. New deodorizing system		
Hydrogenation	1. Insulation of tank		
	2. Hydrogen generator		
	3. Recycle system of H_2		
	4. Heat recovery		
Packing	1. Heat recovery		
	2. Recovery of cooling water	·	
Cooling system	1. Temperature control		
·	2. Recycle of water		
Boiler	1. Check of dowsum boiler		
•	2. Pressure control		
	3. Heat recovery		

31. Energy Conservation Method	31.	Energy	Conservation	Metho	1
--------------------------------	-----	--------	--------------	-------	---

(A): Operating/Installed

(B): Not perfect but operating/Under construction

(C): Not operating/Under planning

9.5.2 Meat Processing Factory (Lubmeat, Koscian)

- (1) Meat processing
 - a. Purpose of measurement

The purpose is to grasp the status of heat use in the manufacturing processes.

b. Measurement item, measurement time, measuring equipment, and data processing

	Mea	surement items	Measurement time	Measuring equipment	Data processing
Dissection room	(1)	Temperature of hot water washing tank	0.1 h	Glass thermometer	Memo
	2	Room temperature	$0.1 h \times 4 times$	Glass thermometer	Memo
Raw material	3	Product temperature	0.1 h	Surface thermometer	Memo
treatment room	4	Room temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo
Heat treatment	(5)	Automatic smoking/decating room temperature	24 h	Thermocouple	to Recorder
room	6	Steam pressure	24 h	Pressure gauge	to Recorder
Meat canning	1	Sterilizing temperature	24 h	Thermocouple	to Recorder
	8	Steam pressure	24 h	Pressure gauge	to Recorder
Refrigerator	9	Refrigerator inside temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo
(Freezer)	0	Outdoor temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo

c. Measuring points

Figure 9.5.3 shows the measuring points for the meat manufacturing processes.

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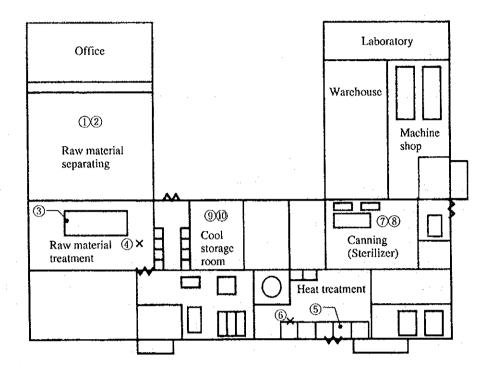


Figure 9.5.3 Measuring Points of Meat Process

(2) Energy utilization facilities

Equipment name	Targeted equipment or location	on Measurement time	
Electricity control	Power receiving facilities	24 h	
Fan/blower	Major equipment	spot	
Electric motor	For NH ₃ refrigerator	spot	
Air compressor	NH ₃ compressor	24 h	
Pump	Cooling water pump	24 h	
Transformer	Major equipment	24 h	
Lighting	Various locations of the factory	spot	
Boiler	Boiler room	24 h	
Steam pipe	Various locations of the factory	spot	

For the measurement method and the measuring points, see "ENERGY UTILIZATION FACILITIES".

Check List for Meat (1)

Factory name

No.	Process		Item		Note
1	Raw chicken	Handling			
2	Washing style	Container	Room temp.	deg.	
			Water temp.	deg.	
3	Chiller	Auto		t/year	
		Manual		t/year	
4	Treatment	Bath	Size	m ³	
			Temp.	deg.	
			pH		
5	Washing		Temp.	deg.	·
6	Cooling	Spin chiller	Temp.	deg.	
7	Take to pieces	Capacity		t/day	
8	Packing .	Capacity		t/day	
9	Freezing	Refrigerator	Temp.	deg.	
		Capacity		kW	
10	Waste	Waste water		m ³ /year	
		BOD		m ³ /year	
11	Total	Steam		t/t-product	н. Пология Полого (1996)
	consumption (1996)	Electricity		kWh/t-product	

2 Chicken	Name												
	Yield						%						
	Room temp.						deg.						
	Feed flow						t/mo:	nth					
	Monthly ener	gy co	nsum	ption	ı (19 9	5-199	96)						
								Nov.	Dec.	Jan.	Feb.	Mar.	May
	Steam										ļ		
	Electricity												
	Production an	nd en	ergy	consu	mptic	on (t/y	vear)		r		T		1
		unit	19	992	19	93	19	94	19	95	19	996	ļ
	Production												l .
	Steam				<u> </u>								
	Electricity				L		<u> </u>				<u> </u>		1
	Waste water	[
					_								_

No,	Process		Item		Note
13	Canning meat	Raw handling	<u>z</u>		
		Name			
		Capacity		t/day	
		Room temp.		deg.	· · · · · · · · · · · · · · · · · · ·
14	Defrost	Capacity		deg.hour	
15	Heating	Bath	Size	m ³	
			Temp.	deg.	
		Capacity		t/hour	
16	Meat slicer	Feed flow		kg/min	:
17	Neoder	Bath	Size	m ³	
			Temp.	deg.	
			Batch	kg/min	
18	Packing	Capacity		t/day	
19	Sterilization	Capacity		t/batch	
		Temp.		deg.	
		Time		/day	
20	Total	Steam		t/t-product	
ļ	consumption	Electricity		kWh/t-product	
	(1996)			· · · · · · · · · · · · · · · · · · ·	

Check List for Meat (2)

21 Prepared Name food and Slicer type number instant food Feed flow kg/min Feed temp. deg. Room temp. deg. Packing type Capacity packs/hour Monthly production in 1996 (t/year) 22 Preparator June Jul. Aug Sep. Oct. Nov Dec. Jan. Feb. Mar May food Production Production (t/year) 1992 1993 1994 1995 1996 Production 23 Instant food Monthly production in 1996 (t/year) June Jul. Aug Sep. Oct. Nov. Dec. Jan. Feb. Mar May Production Production (t/year) 1992 1993 1994 1995 1996 Production Monthly energy consumption (1995-1996) 24 Total unit Jun. Jul. Aug Sep. Oct. Nov. Dec. Jan. Feb. Mar May consumption (1996) Steam Electricity Production and energy consumption (t/year) 1994 1995 1996 unit 1992 1993 Steam Electricity

Check List for Meat (3)

Check	Líst	for	Meat	(4)
-------	------	-----	------	-----

No.	Process		Item		Note
25	Sliced ham	Capacity		t/day	
}				t/month	
				t/ycar	
26	Pressed ham	Capacity		t/day	
1				t/month	
				t/year	·
27	Sausage	Capacity		t/day	
				t/month	
				t/year	
28	Chopper	Туре			
		Capacity		t/day	
			· · · · · · · · · · · · · · · · · · ·	kW i	· · · · · · · · · · · · · · · · · · ·
	Cutter	Туре			
		Capacity		t/day	
				kW	
	Injector	Feed temp.		deg.	
		Capacity	· · · · · · · · · · · · · · · · · · ·	kW/h	
	Boiling house	Dry base	Temp.	deg.	
		Wet base	Temp.	deg.	
		Capacity	Size	kg/house	
	Vacuum packer	Vacuum		mm/H_20	
		Capacity		packs/h	
		Power		kW	

Check List for Meat (5)

29. Design and operation information	29.	Design	and	operation	information	
--------------------------------------	-----	--------	-----	-----------	-------------	--

Process	Item	Unit	Design	Actual
Raw chicken	Handling	t/day		
		t/hour		
Chiller	Capacity	R.T.		
	Temperature	deg.		
	Electricity	kW		
Canning meat	Handling	t/day		
		t/hour		
	Sterization	t/batch		
Preparated food	Productivity	t/hour		
		t/day		
	·	t/month		
Instant food	Productivity	t/day		
		t/year		
Ham	Productivity	t/day		
				1
Sausage	Productivity	t/day		

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Check List for Meat (6)

30. Energy Consumption in 1996

Process	Production	Electricity	Coal	Steam	Water
Unit	ton	10^3 kWh	ton	ton	10^3m^3
Raw chicken					
Canning meat			· · ·		
Prepared food		······································			
Instant food					
Ham					
Sausage	_				

Process	Production	Electricity	Coal	Steam	Water
Unit		10 ³ kWh	ton	ton	10^3m^3
Generated					
Purchased			· · · · · ·		
Process					,
Others					
Total					1
Max. demand					

Check List for Meat (7)

Process	Item	Application	Year of application
Broiler	1. Speed control		
	2. Room temperature control system		
· · ·	3. Water control		
	4. Cooling system (Refrigerator)		
Ham, sausage, bacc	on 1. Steam control		
	2. Speed control		
	3. Vacuum control		
	4. Demand control		
	5. Chiller system		
	6. Others		
Canned food meat	1. Insulation		
	2. Steam pressure control		
•	3. Time control		
	4 .Heat control		
··· .	5. Cooling water control		
	6. Room temperature control		
	7. Boiler control system		
Others	1. Utility control		

31. Energy Conservation Method

(A): Operating/Installed
(B): Not perfect but operating/Under construction
(C): Not operating/Under planning

9.5.3 Milk Products (Obrzanska, Mlecz)

- (1) Milk
 - a. Purpose of measurement

The purpose is to grasp the usage status of heat and electricity in the manufacturing processes.

........................

b. Measurement item, measurement time, measuring equipment, and data processing

	Measurement items	Measurement time	Measuring equipment	Data processing
Tank lorry	① Outdoor temperature	$0.1 \text{ h} \times 2 \text{ times}$	Glass thermometer	Memo
Silo tank	② Raw milk cooling temperature	$0.1 \text{ h} \times 4 \text{ times}$	Meters for operation	Memo
	③ Holding temperature	24 h	Operation record	Memo
	④ Chilled water temperature	24 h	Thermocouple	to Recorder
Sterilizer	5 Sterilizer temperature	$0.1 \text{ h} \times 4 \text{ times}$	Surface thermometer	Memo
	6 Holding tank temperature	$0.1 \text{ h} \times 4 \text{ times}$	Surface thermometer	Memo
	⑦ Steam temperature	$0.1 \text{ h} \times 4 \text{ times}$	Meters for operation	Memo
Surge tank	8 Product temperature	24 h	Operation record	Memo
-	④ Outdoor temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo
	① Tank side wall temperature	$0.1 \text{ h} \times 4 \text{ times}$	Surface thermometer	Memo
	① Chilled water temperature	24 h	Thermocouple	to Recorder
Paper	Power consumption	24 h	Clamp meter	to FDD
container				
filling				
machine			·	
Refrigerator	③ Well water temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo
-	Indoor/outdoor temperature	$0.1 \text{ h} \times 4 \text{ times}$	Glass thermometer	Memo

c. Measuring points

Figure 9.5.4 shows the measuring points for the milk product manufacturing processes.

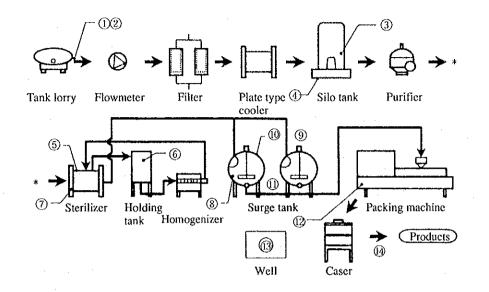


Figure 9.5.4 Measuring Points of Milk Process

(2) Powder milk

a. Purpose of measurement

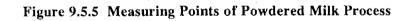
The purpose is to grasp the status of heat use in the manufacturing processes.

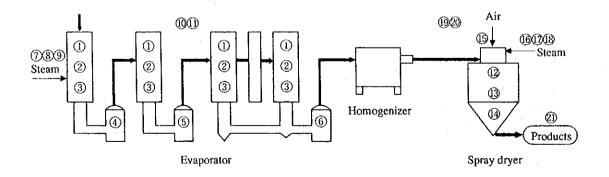
b. Measurement item, measurement time, measuring equipment, and data processing

	Measurement items	Measurement time	Measuring equipment	Data processing
Evaporator	① Evaporator surface temperature	spot	Radiation thermometer	Memo
• .	(2) Evaporator surface temperature	spot	Radiation thermometer	Memo
	③ Evaporator surface temperature	spot	Radiation thermometer	Memo
	④ Condensed fluid temperature	spot	Meters for operation	Memo
	(5) Condensed fluid temperature	spot	Meters for operation	Memo
	6 Condensed fluid temperature	spot	Meters for operation	Memo
	⑦ Steam pressure	l charge	Pressure gauge	to Recorder
	(8) Steam temperature	spot	Meters for operation	Memo
	(9) Steam flow rate	l charge	Vortex flowmeter	to Recorder
	(1) Evaporator room temperature	spot	Glass thermometer	Memo
	① Outdoor temperature/humidity	spot	Thermo-hygrometer	Memo
Dryer	① Dryer surface temperature	spot	Radiation thermometer	Memo
	① Dryer surface temperature	spot	Radiation thermometer	Memo
	Dryer surface temperature	spot	Radiation thermometer	Memo
	(1) Hot blast volume	spot	Hot-wire anemometer	Memo
	① Steam pressure	1 charge	Pressure gauge	to Recorder
	① Steam temperature	spot	Meters for operation	Memo
	③ Steam flow rate	1 charge	Vortex flowmeter	to Recorder
	① Dryer chamber inside temperature	spot	Glass thermometer	Memo
	Ø Outdoor temperature/humidity	spot	Thermo-hygrometer	Memo
Product	② Product temperature	spot	Meters for operation	Memo

c. Measuring points

Figure 9.5.5 shows the measuring points for the powder milk manufacturing processes.





(3) Energy utilization facilities

Equipment name	Targeted equipment or location	Measurement time	
Electricity control	Power receiving facilities	24 h	
Fan/blower	Major equipment	24 h	
Electric motor	For NH ₃ refrigerator	24 h	
Air compressor	NH, compressor	24 h	
Pump	For city water	24 h	
Transformer	Major equipment	24 h	
Lighting	Various locations of the factory	24 h	
Boiler	Boiler room	24 h	
Steam pipe	Various locations of the factory	24 h	

For the measurement method and the measuring points, see "ENERGY UTILIZATION FACILITIES".

Check List for Dairy (1)

Factory name

.

No.	Process			Ite	m							No	ote		
1	Receiving	Raw milk						kL/ye	ar					÷.,	
			Temp				. 1	deg.							
		Silo	-						1						
		Tank number													
			Size					kL							
		Flow meter						kL/da	у						
2	Clarification	Clarifier						deg.				-			
		Centrifuge						rpm.						· .	
		_						kW 🐇						· .	:
3	Pasteurization	UHT						deg.							
		Holding tank						kL							
		-						deg.						- 	
		time			· · .			min.							
		Homogenizer						kW							
		press						kg/cn	n2(G))					
4	Storage		Ter	np.				deg.		-			•		
		•	Capa	acity				kL							
5	Packing		Capa	acity				packs	s/h						
								kL/da	•						
								kL/m							
								kL/y	ear					·	
6	Production &	Monthly energ				<u>995-1</u>	.996)						T	<u>r</u> -	7
	energy		unit	Jun.	Jul.	Aug.	Sep.	Öct.	Nov.	Dec.	Jan.	Feb.	Mar.	May	4
	consumption	Steam		L	· .	ļ				ļ		ļ	ļ	ļ	4
		Electricity		<u> </u>	l								<u> </u>		
		Production an	d energ							T				า	
			unit	19	992	19	93	. 19	994	19	995	19	996.		
		Production		_		ļ		ļ				 		-	
ļ		Steam		ļ		<u> </u>		<u> </u>					·	ł	
		Electricity	_	 		 		<u> </u>				<u> </u>		-	
		Water										1			

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Check	List	for	Dairy	(2)
-------	------	-----	-------	-----

No.	Process			Item	. <u> </u>			Note	·····-
8	Cream	Plate type heater				m2			
		Heating surface	Temj	o.		deg.			
		Centrifuge				kW			
		0				rpm.			
		Pasteurizer	Tem	Э.		dcg.			
			HTS			sec.			
		Homogenizer		1		kW			
		riontogenizer							
		D 4			41 a -	kg/cm2(G)			
		Production and		· · · · · · · · · · · · · · · · · · ·		T 1004 T	1005	1006	
			unit	1992	1993	1994	1995.	1996	
		Production		-					
		Steam				<u> </u>			
		Electricity				ļ			
		Water				<u> </u>]	
					<u> </u>				
9	"Symidal"	Mixing tank	Tem	р.		deg.			
	yogurt	Homogenizer				kW			
		- ·	press	5		kg/cm2(G)			
		Packing	Capa			kL/day			
	· · ·	Ŭ	Pow	-		kW			
		Fermenter	Tem			deg.			
		Room		г [.] .		hour			
		Production and	i Léner	gy consum	ntion				
			unit	1992	1993	1994	1995	1996	
		Production							
		Steam			L			{	
				<u> </u>		+	<u></u>		
		Electricity Water				· · · · · ·			
	1	[TT aLCI	L	l	L			L	
10	Dry milk	Packing		[t/day		·,	
		Pasteuriger ten	ıp			deg			
		HTST		1		sec.			
		Dryer Temp				deg.			
		Steam Press				kg/cm ²			
		Dryer Capacity	e .			t/h			
		Evaporator Ca	pacity			t/day			
		Vacuum				No.1			
	· · ·					No.2			
	· · · ·		•			No.3			
	.	Temp				No.1			
		. · · ·				No.2			
						No.3	- <u></u>		
		Production and				1004	1005	1004	
		Dundunti	unit	1992	1993	1994	1995	1996	
		Production	<u> </u>		<u> </u>				
		Steam Electricity	 					<u> </u>	
		Water	+	<u> </u>		- <u>-</u>		┨	
			1	1	l	· · I		L	

11 Butter		Aging tank Metal charn Butter machine Packing	Powe	Г). r r r	ption 1993	deg. deg. sec. deg. hour kW kW kW kg/day kW	1995	1996	
12 Cheese		Aging tank Metal charn Butter machine Packing Production and Production Steam Electricity	HTST Temp Powe Powe Powe Powe	F o. r r r <u>r</u> <u>y consum</u>		sec. deg. hour kW kW kW kg/day kW		1996	
12 Cheese		Aging tank Metal charn Butter machine Packing Production and Production Steam Electricity	Temp Powe Powe Powe). r r r gy consum		deg. hour kW kW kW kg/day kW		1996	
12 Cheese		Metal charn Butter machine Packing Production and Production Steam Electricity	Powe Powe Powe Powe	r r r gy consum		hour kW kW kW kg/day kW		1996	
12 Cheese		Metal charn Butter machine Packing Production and Production Steam Electricity	Powe Powe Powe Powe	r r r gy consum		kW kW kW kg/day kW		1996	· · · · · · · · · · · · · · · · · · ·
12 Cheese		Metal charn Butter machine Packing Production and Production Steam Electricity	Powe Powe Powe	r r gy consum		kW kW kg/day kW		1996	
12 Cheese		Butter machine Packing Production and Production Steam Electricity	Powe Powe	r r zy consum		kW kg/day kW		1996	· · · · · · · · · · · · · · · · · · ·
12 Cheese		Packing Production and Production Steam Electricity	Powe	r 3y consum		kg/day kW		1996	· · · · · · · · · · · · · · · · · · ·
12 Cheese		Production and Production Steam Electricity	lenerg	gy consum		kW		1996	
12 Cheese		Production and Production Steam Electricity	lenerg	gy consum		kW		1996	
12 Cheese		Production Steam Electricity	I . I			1994		1996	
12 Cheese		Production Steam Electricity	I . I			1994		1996	
12 Cheese		Steam Electricity			· · · · · · · · · · · · · · · · · · ·				· . :
12 Cheese		Electricity		· · · · · · · · · · · · · · · · · · ·					
12 Cheese									
12 Cheese								1	
12 Cheese									· '
12 Cheese					· · · · · · · ·	· · · ·			
		Packing	•			t/day			
		Pasteurizer	Temp	э.		deg.	· · · ·		
			HTS	Т	· · · ·	sec.			
		Mechanical							
	·	cheese bat	Powe	er		kW			-
		(mixer)	Tem	p.		deg.			
		Mold press	Powe	er		kW			
		Fermentation	Tem	p.		deg.	and the second se		
			Stay			days			
		Production and	lenerg	gy consum	ption			-	•
			unit	1992	1993	1994	1995	1996	÷ .
		Production							
		Steam							
		Electricity	1						
		LEJECHIGHTY	1	1	1				

Check List for Dairy (3)

Check List for Dairy (4)

Process	Item	Unit	Design	Actual
Receiving	Raw milk	kL/day		
Clarification	Centrifuge	kL/day		
		kL/hour		
Pastcurization	UHT	deg/min		
	Max. Temp.	deg		
	Time	min		
	Productivity	t/day		
		t/hour		
Packing	Capacity	t/day		
		t/hour		
Storage	Тетр.	deg.		
	Capacity	kL		
Chiller	Handling	deg.		
	Capacity	R.T.	·	
Cream	Handling	kL/day		
Yogurt	Handling	kL/day		
Butter	Handling	kL/day		· · ·
Cheese	Handling	kL/day		

13. Design and operation information

Check List for Dairy (5)

Rcycle water Rcycle water $10^{3}m^{3}$ $10^{3} m^{3}$ Steam Steam ton ton Compressed air Compressed air $10^3 \mathrm{Nm}^3$ $10^3 \mathrm{Nm}^3$ Natural gas Natural gas $10^3 \mathrm{Nm}^3$ $10^3 \mathrm{Nm}^3$ 0il offo Ц ۲ Electricity Electricity 10^3 kWh 10^3 kWh Production Production 14. Energy Consumption in 1996 (Evaporator) Yogule line (THU) (Packing) (Packing) (Packing) Max. demand Cheese line Waste water Consumed energy Butter line Generated energy Cream line Process Process Purchased Generated Unit Unit Milk line Process Others Total

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Check List for Dairy (6)

Process	Item	Application	Year of application
Raw milk	1. Stock system control of temperature		
	2. Recovery of cooling water		
	3. Chiller		
Clarification	1. Room temperature control system		
	2. Insulation		
Pasteurization	1. UHT system		
	2. Heat recovery		
	3. Recycle water		
	4. Cooling tower		
Chiller	1. Temperature control		
	2. Measure and control system		
	3. Other control		·
Evaporator	1. Steam effect		
	2. Vacuum control		
Flow speed control	1. Process		
	2. Packing		
	3. Others		

15. Energy Conservation Method

(A): Operating/Installed

(B): Not perfect but operating/Under construction

(C): Not operating/Under planning

10. ENERGY UTILIZATION FACILITIES

10. ENERGY UTILIZATION FACILITIES

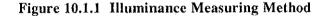
10.1 Lighting

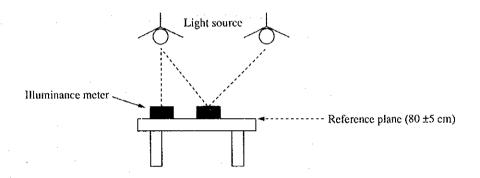
10.1.1 Purpose of Measurement

The purpose is to grasp whether or not illumination is provided in a manner that matches the illuminance standard for the type of work and the location.

10.1.2 Measurement Method (See Figure 10.1.1)

Measurement items : Illuminance on the reference working plane Measuring instrument: Portable illuminance meter





10.1.3 Method of Diagnosis

If the level of illuminance measured exceeds the illuminance standard, energy conservation measures such as reducing the number of lamps should be taken. For reference, the JIS (Japanese Industrial Standard) illuminance standard for factories and that for offices are shown in Table 10.1.1 and Table 10.1.2, respectively.

10.1.4 Energy Conservation Measures

Energy conservation measures to be taken for lighting include the following. (For details, see "IV Guidelines".)

(1) Reduction of the length of lighting time

Turn off lights when they are not needed, etc.

(2) Securing the appropriate level of illuminance

Obtain the illuminance levels that conform to the illuminance standard.

(3) Localized illumination

Concentrate lighting on locations where it is actually needed.

(4) Adoption of high-efficiency lamps and lighting apparatus (luminaires)

Replace the existing lighting with high-pressure sodium lamps and high-efficiency luminaires.

(5) Improvement of utilization factor

Give careful consideration to the luminous intensity distribution of luminaires and their installation positions.

(6) Improvement of maintenance frequency

Perform periodical cleaning and replacement of lamps.

(7) Utilization of natural light

Introduce ways to utilize daylight.

V-10-1-2

lluminance lx	Category of Work	Location
3,000 -	Manufacture of precision machinery, electro- nic devices, and highly detailed close visual work at printing factories • Assembly (a), • Inspection (a), • Testing (a) • Screening (a), • Design, • Drawing	Instrument panels and control panels in control rooms and other such areas
1,500 — 1,000 —	Close visual work such as screening and inspection at textile factories, composing and proofreading at printing factories, and analysis at chemical plants • Assembly (b), • Inspection (b), • Testing (b) • Screening (b)	Designing rooms, Drawing rooms
750 — 500 —	Regular visual work at general manufacturing processes • Assembly (c), • Inspection (c), • Testing (c) • Screening (c), • Wrapping (a), • Clerical work inside warehouses	Control rooms
300 200	Less detailed visual work • Limited types of work • Wrapping (b), Packing (b), (c)	Electric rooms Air conditioning machine rooms
150 — 100 —	Light visual work • Limited types of work • Wrapping (b), • Packing (b), (c)	Entrance/exit, Hallways, Passages Warehouses where work is conducted Stairways, Powder rooms, Lavatories
75 — 50 —	• Works such as loading, unloading and moving packages	Indoor emergency stairways, Warehouses, Indoor power facilities
30 20		Outdoor (passages, plant security facilities etc.)
10		

Table 10.1.1 Illuminance Standard for Factories (JIS Z 9110)

Note: (a): indicates situations requiring fine details, weak contrasts, and high precision.

(b): indicates work that falls in a category somewhere between (a) and (c).

(c): indicates less detailed work aided by stronger contrasts.

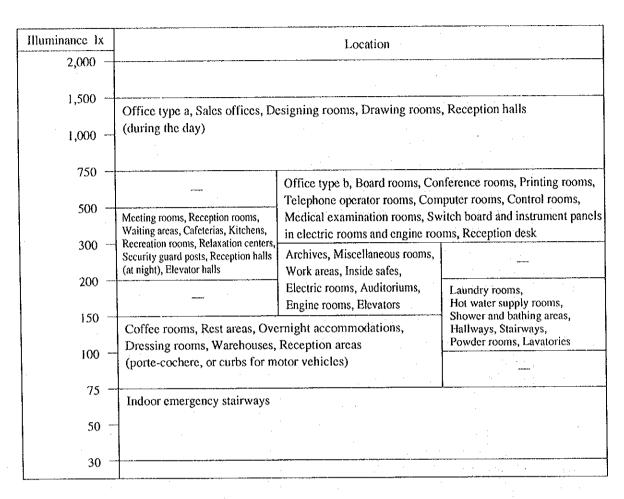


Table 10.1.2 Illuminance Standard for Offices (JIS Z 9110)

Note: For offices, "a" is desirable if visually intensive tasks are performed, or if it feels darker indoors than outdoors due to the effect of daylight.

Lighting Fitting

	Date	
	Surveyor	
. Lighting system	□ General □ General and Local	<u> </u>
2. Method of Turning on and off	🗋 Automatic 🗆 Manual 📑 Both automatic and mar	nual
③ Circuit Separation (In case of General Lighting)	 One switch per Room Several switches per Room One switch per Room (Turn, Line by Line from Window s 	ide)
Wind of Lamp	incandescent Lamp 🗍 fluorescent Lamp (Daylight) Fluorescent Lamp (White) 🗍 Energy Conservation type F.L Fluorescent mercury Lamp Good-Color High Pressure Sodium Lamp Metal halide Lamp. (High efficiency type)	
5. Cleaning Frequency of Lighting Fitting	s Time/year	
3. Utilization of Daylight	done () no ()	
	Measurement Record for Lighting Fitting	
	(Time at AM or PM . Date	
Place		
Illminance		
Distribution System Kind of Lamp		
Wall Color		

. . .

10.2 Air Compressor

10.2.1 Purpose of Measurement

The purpose is to understand the actual load operation status (air flow rate, pressure, temperature, electricity consumption, etc.) against the compressor design capacity

10.2.2 Method of Measurement (See Figure 10.2.1)

Measurement time: On a basis of 24 h, day or month (depending on the load condition)

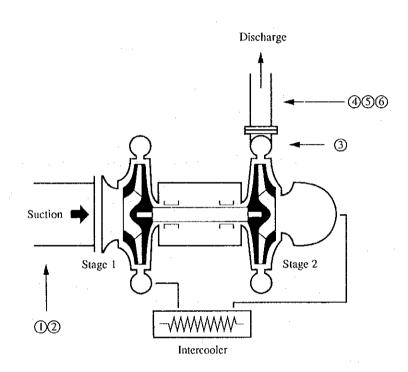


Figure 10.2.1 Air Compressor Measuring Points

	Items to be Measured	Measuring Equipment	
1	Air temperature at a flow rate measuring point	Thermometer	\rightarrow Value converted on a basis of standard state
2	Static pressure at compressor inlet	Pressure gauge	\rightarrow Suction pressure
3	Static pressure at compressor outlet	Pressure gauge	→ Discharge pressure
(1)	Static pressure at an air flow rate measuring point	Pressure gauge	
(5)	Dynamic pressure at an air flow rate measuring point	Orifice	\rightarrow Air flow rate
6	Outlet cross-sectional area		
1	Voltage	Clamp meter	
8	Current	Clamp meter	
9	Electric power	Clamp meter	

Table 10.2.1 Items to be Measured for Air Compressor and Measuring Equipment

*When measurement on site is not available, use the reading on the local indicator.

Efficiency is calculated using the following shaft power formula.

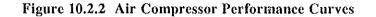
$$L = \frac{(a+1)K}{K-1} \cdot \frac{P_s Q_s}{6120} \cdot \left\{ \left(\frac{P_d}{P_s}\right)^{\frac{K-1}{K(a+1)}} - 1 \right\} \cdot \frac{1}{\eta_c \eta_t}$$

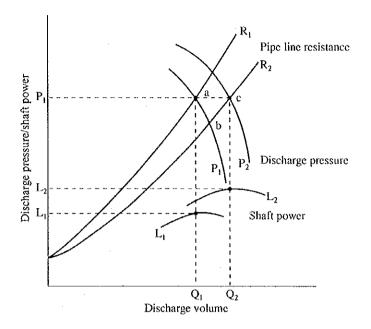
- L : Required power [kW]
- P_s : Absolute pressure of intake air [kg/m².abs]
- P_d : Absolute pressure of discharged air [kg/m².abs]
- Q_s: Volume of air per unit of time converted on a basis of intake state [m³/min]
- a : Number of intercoolers
- K: Adiabatic index of air
- η_c : Total adiabatic efficiency of compressor
- η_i : Transmission efficiency

10.2.3 Method of Diagnosis

Using the measurement and calculation results, the discharge quantity, discharge pressure, and shaft power are plotted on the performance curve. The extent to which the discharge quantity and discharge pressure can be reduced for energy saving is reviewed based on this actual load. (Reduction of required power)

An example of a performance curve is shown in Fig. 10.2.2.





10.2.4 Energy Conservation Measures

Energy conservation measures to be taken for air compressors include the following. (For details, see "IV. Guidelines")

(1) Reduction of discharge pressure

Discharge pressure should be supplied at the minimum level required.

(2) Maintenance of piping

Measures such as leakage prevention, and periodic draining, etc. should be implemented.

(3) Optimization of pressure setting

Settings for minimum pressure, maximum pressure, and yield pressure, etc. required by the line should be optimized.

(4) Reduction of intake resistance

Periodic cleaning of filters and other such apparatus should be carried out.

(5) Reduction of intake temperature

Fresh air should be taken in.

(6) Control of the number of machines to be used

Operation should be controlled on a multiple machine basis.

(7) Introduction of small capacity compressors

Machines exclusively used for light load operations during holidays, etc. should be installed.

Measurement Record for Motor Driven Machine (Compressor)

Date	
Surveyor	

		Nam	e of Sho	p			Loca	No.		
No.	Time	Rating	ting Actual			Inlet		Pressure	Remark	
			Voltage	Current	k₩ Power	Тетр ℃	Outlet	End Use		
		k₩	Y	A	Power	C	kg/cm ²	kg/cm ²	<u>(On - Off Time)</u>	
							· ·			

Date -Surveyor

Name of Shop							Locat	No.		
No.	Time	Rating		Actual		Inlet	Pressure		Remark	
		KW	Voltage V	Current	kW Power	Тетр ℃	Outlet kg/cm ²	End Use kg∕cm²	(On - Off Time)	
 		+								

Date Surveyor

Name of Shop							Locat	No.		
No.	Time	me Rating	Rating Actual			Inlet	Pressure		Remark	
		KW	Voltage V	Current A	kW Power	Temp ℃	Outlet kg/cm ²	End Use kg/cm ²	(On - Off Time)	
		[
									· .	

Leakage volume _____L/H

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10.3 Motor

10.3.1 Purpose of Measurement

The purpose is to grasp the present operating situation as compared with the motor rated capacity.

10.3.2 Method of Measurement (See Figure 10.3.1)

Measurement time: On a basis of 24 h, day, or month (depending on the load condition)

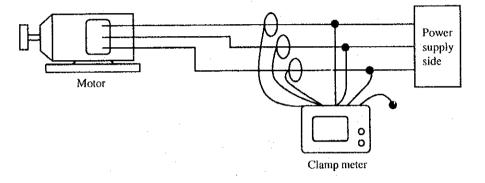


Figure 10.3.1 Motor Measuring Points

Table 10.3.1 Measurement Items for Motors and Measuring Equipment

Items to be Measured	Measuring Equipment			
① Electricity (Current)	Clamp meter			
② Voltage	Clamp meter			
③ Power factor	Clamp meter			

*If no voltage terminal connection is available, the electric current may be measured instead.

10.3.3 Method of Diagnosis

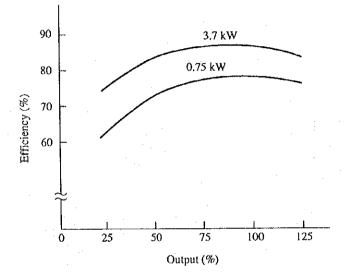
The efficiency of a motor should be most preferable at the load factor of 70 % to 100 % of the rated capacity. (See Figure 10.3.2)

The present load factor is obtained based on the measurement results.

When the result shows a load factor of 70% or less, some appropriate measure, such as replacement of motors, should be considered.

Load factor = $\frac{\text{Actual load (kW)}}{\text{Rated output (kW)}} \times 100 [\%]$

Figure 10.3.2 Efficiency - Load Factor Curves (An example of induction motor)



10.3.4 Energy Conservation Measures

Energy conservation measures to be taken for motors include the following: (For details, see "IV Guidelines".)

(1) Replacement of motors

Motors that match the load, high-efficiency motors, etc. should be used.

(2) Control of power supply voltage

The power supply voltage should be carefully managed when using 3-phase induction motors and other such motors that are susceptible to voltage fluctuations.

(3) Prevention of idle rotation and reduction of starting loss

Motors should be stopped when not in use, and direct-on-line starting should be adopted.

(4) Rotational speed control

The number of poles, the power source frequency, etc. should be changed.

Check List for Motor Driven Machine (1) (30 motors of higher rank of output)

Date	
Surveyor	

Na	me of Shop	Location	No.
		Number of similar Equipment	<u> </u>
	Kind of motor	() AC () Induction	() Wound Rotor
			() Squirrel Cage
			() Others
		() Synchronous	, ,
		() DC () Series	
3	Rating of Motor	Out put kW	Voltage V
	-	CurrentA	Frequency <u>Hz</u>
		RPM грш.	Num. of Pole
4	Starting method	() Full Voltage	() Star-delta (Y - △)
		() Rotor-resistance	() Others
5	Coupling Apparatus		()Gear ()Others
		Meterial () Nat	
		() Syn	ntheticNum
	· · · · · · · · · · · · · · · · · · ·		
_	Load	() Pump () Blower	() Compressor () Others
_	Kind and Density	() Air () Water	() Others
7	Kind and Density of Fulid	() Air () Water () Density (or Specific Gravit	() Others y)
7	Kind and Density of Fulid Flow Control	 Air Air Density (or Specific Gravit Automatic Valve 	() Others y) () Speed Control
7	Kind and Density of Fulid Flow Control Method	() Air () Water () Density (or Specific Gravit () Automatic () Valve () manual () Damper	 () Others y) () Speed Control () Others
7	Kind and Density of Fulid Flow Control	 Air Density (or Specific Gravit Automatic Valve manual Damper Motor Pole Change 	 () Others y) () Speed Control () Others e () Voltage
7 ⑧	Kind and Density of Fulid Flow Control Method Speed Control	 Air Density (or Specific Gravit Automatic Valve manual Damper Motor Pole Change Mechanical Frequency 	 () Others y) () Speed Control () Others e () Voltage () Others
7 ⑧	Kind and Density of Fulid Flow Control Method Speed Control Automatic Turn-off	 Air Density (or Specific Gravit Dutomatic Automatic Valve manual Damper Motor Pole Change Mechanical Frequency 	 () Others y) () Speed Control () Others e () Voltage () Others
7 ⑧ 10	Kind and Density of Fulid Flow Control Method Speed Control Automatic Turn-off (when off load)	 () Air () Water () Density (or Specific Gravit () Automatic () Valve () manual () Damper () Motor () Pole Change () Mechanical () Frequency () Yes () No 	 () Others y) () Speed Control () Others e () Voltage () Others
7 ⑧ 10	Kind and Density of Fulid Flow Control Method Speed Control Automatic Turn-off (when off load) Lubrication	<pre>() Air () Water () Density (or Specific Gravit () Automatic () Valve () manual () Damper () Motor () Pole Change () Mechanical () Frequency () Yes () No time/year</pre>	 () Others y) () Speed Control () Others e () Voltage () Others
7 ③ 10 11 12	Kind and Density of Fulid Flow Control Method Speed Control Automatic Turn-off (when off load)	 () Air () Water () Density (or Specific Gravit () Automatic () Valve () manual () Damper () Motor () Pole Change () Mechanical () Frequency () Yes () No time/year time/month 	 () Others y) () Speed Control () Others e () Voltage () Others

Check List for Motor Driven Machine (2)

Daf	e		Factory				Surveyo	<u>r</u>			(Blower	. Pump)
Nai	e of Sho		Location			· · · · · · · · · · · · · · · · · · ·	······	Pati	ng of Mc	No.		Pole
No.	Name of	Machine			·	Flow	Drocourd	Pipe	Univo Volvo	Velocity	Esti-	Effici-
	-	Actual		Dowon	Temp. of	niow m ³ /min	Pressure	dia	Position	of	mated	ency
11	Time	Volt	Current	Power	Fluid	Rated	-	ura	1021110	Fluid	load	0,
					riuiu	Actual				11010	1000	
	ļ	77		kW	Ψ	Max. Min.	kg. co ^z	(ID)		m/s		%
		γ	<u>A</u>	VU		Max. MIII.	NR. CO	(11)/				
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				······································								
			I		<u> </u>		<u> </u>		<u>L</u>	i		ر را در را در
(N) -	the second		Location	<u> </u>	· · · · · · · · · · · · · · · · · · ·				-,	No.		
Nat	ne of Sho	op Nachina	LOCALION	<u> </u>				Rati	ng of Mo		kW,	Pole
<u>NO.</u>	Name of	Actual	Domor	·····	Temp.	Flow	Pressure		Valve	Velocity		Effici-
			ruwei	Power	of	m ³ /min	ricosuru	dia	Position	of	mated	ency
	Time	Volt	Current	rower	Fluid	Rated	- `	ų iu		Fluid	load	
			· · ·		riulu	Actual				I LULA	1044	
		V	A	k₩	τ	Max. Min.	kg. cm ²	(ID)		m/s		%
		Ŷ	<u>A</u>	КЛ		Μάλ. Μ111.	NE.CM	(10/		/ <u> </u>	····	
							- <u> </u>	·				
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Mai	no of Ch	07	Location	n 7.					•	iNo.	1.1.1	5. S.
Na	ne of Sh		Location	<u>n</u>		<u> </u>		Rat		No. ator	kW.	Pole
Na No.	me of Sh Name of	Machine		<u>n</u>	Temp	Flow	Pressure		ng oi M	otor.		Pole Effici-
Na No.	Name of	Machine Actual	Power		Temp.	Flow	Pressure	Pipe	ng of M Valve	otor Velocity	Esti-	Effici-
Na No	ne of Sh Name of Time	Machine			lof	m ³ /min	Pressure		ng oi M	velocity Velocity of	Esti- mated	
Na No.	Name of	Machine Actual	Power			m ³ /min Rated	Pressure	Pipe	ng of M Valve	otor Velocity	Esti-	Effici-
Na No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid	Esti- mated	Effici- ency
Nai No.	Name of	Machine Actual	Power		lof	m ³ /min Rated	Pressure kg.cm ^z	Pipe	ng of M Valve	velocity Velocity of	Esti- mated	Effici-
Nai No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid	Esti- mated load	Effici- ency
Nai No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
Nai No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
Nai No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
Na No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
Na No.	Name of	Machine Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time	Machine Actual Volt V	Power Current A	Power	of Fluid	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time	Machine Actual Volt V	Power Current A Blower	Power kW	of Fluid C	n ³ /min Rated Actual		Pipe dia	ng of M Valve	velocity Velocity of Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time	Machine Actual Volt V	Power Current A Blower	Power kW Q · PT	of Fluid	n ³ /min Rated Actual	kg. cm ²	Pipe dia (ID)	ing of M Valve Position	otor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time	Machine Actual Volt V v d Power of F P =	Power Current A Blower <u>A ·</u> 612	Power kW Q · PT 0 · η	of Fluid C (kW)	n ³ /min Rated Actual	kg. cm²	Pipe dia (ID)	v of Fluid	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require	Machine Actual Volt V V A Power of F P = : Total Pre	Power Current A Blower <u>A ·</u> 612 ssure (mm	Power k₩ Q · PT 0 · η Aq or kg/m ²	of Fluid C (kW)	n ³ /min Rated Actual	Adequate	Pipe dia (ID) Velocity	of Fluid	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require	Machine Actual Volt V v d Power of F P =	Power Current A Blower 612 ssure (mm. (1.1 - 1	Power k₩ <u>Q · PT</u> 0 · η Aq or kg/m ² .3)	of Fluid C (kW)	n ³ /min Rated Actual	Adequate	Pipe dia (ID) Velocity Velocity (m/sec)	of Fluid (kg/cm ²)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require	Machine Actual Volt V V d Power of H P = : Total Pre : Allowance	Power Current A Blower <u>A·</u> 612 ssure (mm (1.1 - 1 y of blow	Power k₩ <u>Q · PT</u> 0 · η Aq or kg/m ² .3)	of Fluid C (kW)	n ³ /min Rated Actual	Adequate	Pipe dia (ID) Velocity	of Fluid	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q	Machine Actual Volt V V d Power of F P = : Total Pre : Allowance : Efficienc : Flow (m ⁵ /m	Power Current A Blower <u>A·</u> 612 ssure (mm (1.1 - 1 y of blow in)	Power k₩ <u>Q · PT</u> 0 · η Aq or kg/m ² .3)	of Fluid C (kW)	n ³ /min Rated Actual	Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec)	of Fluid (kg/cm ²)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q	Machine Actual Volt V V d Power of F P = : Total Pre : Allowance : Efficienc : Flow (m ⁵ /m	Power Current A Blower <u>A·</u> 612 ssure (mm (1.1 - 1 y of blow in)	Power k₩ <u>Q · PT</u> 0 · η Aq or kg/m ² .3)	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec)	of Fluid (kg/cm ²)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q	Machine Actual Volt V V d Power of H P = : Total Pre : Allowance : Efficienc : Flow (m ³ /m	Power Current A Blower <u>A</u> 612 ssure (mm (1.1 - 1 y of blow in) Pump	Power <u>k</u> ₩ <u>Q · PT</u> 0 · η Aq or kg/w ² . 3) ver (0.72	of Fluid C (kW)	n ³ /min Rated Actual	Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec)	of Fluid (kg/cm ²)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q	Machine Actual Volt V V A Power of H P = : Total Pre : Allowance : Efficienc : Flow (m ³ /m ed Power of H P =	Power Current A Blower $\frac{A \cdot 612}{612}$ ssure (mm. (1.1 - 1) y of blow in) Pump $\frac{A \cdot 7}{6.1}$	Power kW Q · PT 0 · η Aq or kg/m ² .3) ver (0.72 \cdot Q · H 2 · η	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15	of Fluic vof Fluic Pressure (kg/cm ²) 1 - 2	tor Yelocity Fluid <u>m/s</u>	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q	Machine Actual Volt V V A Power of H P = : Total Pre : Allowance : Efficienc : Flow (m ³ /m ed Power of H P =	Power Current A Blower $\frac{A \cdot 612}{612}$ ssure (mm. (1.1 - 1) y of blow in) Pump $\frac{A \cdot 7}{6.1}$	Power kW Q · PT 0 · η Aq or kg/m ² .3) ver (0.72 \cdot Q · H 2 · η	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15	of Fluid vof Fluid vof Fluid vof Fluid vof Fluid vof Fluid vof Fluid	tor Yelocity Fluid <u>m/s</u>	Esti- mated load	Effici- ency
No.	Name of Time Time Require PT A n Q Q C) Require A	Machine Actual Volt V V A Power of F P = Total Pre Allowance Efficienc Flow (m ³ /m ed Power of F P = Allowance	Power Current A A Blower <u>A</u> 612 ssure (mm (1.1 - 1 y of blow in) Pump <u>A · 7</u> 6.1 c. 1 - 1 (1.1 - 1 (1.1 - 1) (1.1	Power kW Q · PT 0 · η Aq or kg/m ² .3) ver (0.72 \cdot Q · H 2 · η	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air Adequate	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15	of Fluid vof Fluid v	tor Yelocity Fluid <u>m/s</u>	Esti- mated load	Effici- ency
No.	Name of Time Time PT A η Q) Require A γ	Machine Actual Volt V V d Power of F P = : Total Pre : Allowance : Efficienc : Flow (m ³ /m ed Power of f P = : Allowance : Density (Power Current A Blower 612 ssure (mm. (1.1 - 1 y of blow in) Pump A · ? 6.1 (1.05 - (kg/1)	Power kW Q · PT 0 · η Aq or kg/m ² .3) ver (0.72 \cdot Q · H 2 · η	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15 e Velocity (m/sec)	of Flui vof Flui vof Flui vof Flui vof Flui vof Flui vof Flui v Pressur (kg/cm ⁷)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time PT A η Q) Require A γ Q	Machine Actual Volt V V A A A A A A A A A A A A A A A A A	Power Current A Blower 612 ssure (mm. (1.1 - 1 y of blow in) Pump A · ? 6.1 c (1.05 - (kg/1)) min)	Power <u>kw</u> <u>Q · PT</u> $0 \cdot \eta$ Aq or kg/w ² .3) rer (0.72 <u>· Q · H</u> $2 \cdot \eta$ 1.2)	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15	of Flui vof Flui vof Flui vof Flui vof Flui vof Flui vof Flui v Pressur (kg/cm ⁷)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency
No.	Name of Time Time PT A η Q) Require A γ	Machine Actual Volt V V d Power of F P = : Total Pre : Allowance : Efficienc : Flow (m ³ /m ed Power of f P = : Allowance : Density (Power Current A Blower 612 ssure (mm. (1.1 - 1 y of blow in) Pump A · ? 6.1 c (1.05 - (kg/1)) min)	Power <u>kw</u> <u>Q · PT</u> $0 \cdot \eta$ Aq or kg/w ² .3) rer (0.72 <u>· Q · H</u> $2 \cdot \eta$ 1.2)	(k₩) - 0.78)	n ³ /min Rated Actual	Adequate Adequate Adequate Velocity Air Adequate Adequate Velocity	Pipe dia (ID) Velocity Velocity (m/sec) 8 - 15 e Velocity (m/sec)	of Flui vof Flui vof Flui vof Flui vof Flui vof Flui vof Flui v Pressur (kg/cm ⁷)	tor Velocity Fluid m/s	Esti- mated load	Effici- ency

Measurement Record for Motor Driven Machine (Compressor)

Date	
Surveyor	
<u>, , , , , , , , , , , , , , , , , , , </u>	

		Name	of Shop				Locat	No.		
No.	Time	Rating				Inlet	Pressure		Remark	
			Voltage	Current	k₩	Temp	Outlet	End Use kg/cm ²		
		k₩	V V	A	Power	°C	kg/cm ²	kg/cm ²	(On - Off Time)	
			, ,							
			· · · · ·			· · · · · · · · · · · · · · · · ·				
			<u> </u>							

Date Surveyor

Γ			Name	e of Shop				Locat	No. Remark	
h	о.	Time	Rating		Actual		Inlet			
		· .	KW	Voltage V	Current A	k\ Power	Temp ℃	Outlet kg/cm ²	End Use kg/cm ²	(On - Off Time)
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Date Surveyor

		Name	of Shop				Locati	No.		
lo.	Time	Rating KW	Actual			Inlet	P	ressure	Remark	
			Voltage V		k₩ Power	Тетр С	Outlet kg/cm ²	End Use kg/cm²	(On - Off Time)	
·		and the second								
					·					
					· ·					
Ť		·				•••••				
-†	· · ·									

Leakage volume

L/H

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Log Sheet of Operation of Motors (Others)

Dat	e	
Sur	veyor	

	Name o	f Shop	Location							No.	
No.	Process			Rated		Acti	ual		Rev.	Speed	Note
	Use	facturer (Year	Month. oper. hours	Power	Ytg.	g. Amp.	kW	p. f.	rpm	Control	
		Built)		<u>k₩</u>	V	<u>A</u>	<u> </u>	%			
						· · · · · · · · · · · · · · · · · · ·	 	· · ·			
								<u> </u>			

<u>Date</u> Surveyor

Name o	f Shop				Location				No	•
No.Process	Manu-	Month.	Rated		Actu			Rev.	Speed	Note
Use	facturer (Year Built)	oper. hours	Power kW	Ytg. V	Amp. A	k₩	p. f. %	rpm	Control	
	Duilty		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							· · ·
			· ·							
	· · · · · · · · · · · · · · · · · · ·									

Date Surveyor

No. Name of Shop Location Speed Actual Rev. Note No.Process Month. Rated Manup. f. Control k₩ rpm Vig. facturer oper. Power Amp. Use hours (Year Built) % k₩ Y A

10.4 Transformers

10.4.1 Purpose of Measurement

The purpose is to grasp the actual load condition against the design capacity of transformers.

10.4.2 Method of Measurement (Figure 10.4.1)

Measuring time: On a basis of 24 h, day, month (depending on the state of the load)

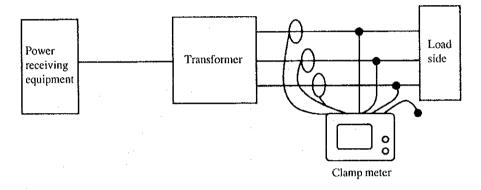


Figure 10.4.1 Measuring Points of a Transformer

Table 10.4.1 Items to be Measured for Transformer and Measuring Equipment

Measuring Equipment
Clamp meter
Clamp meter
Clamp meter

10.4.3 Method of Diagnosis

The efficiency of transformers reaches the maximum when the load loss and no-load loss are equal, with most of them at around 50 to 70 % load. (Figure 10.4.2)

The extent to which the efficiency can be raised should be studied based on the actual load measured, design performance, and tables of test results.

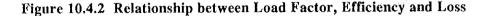
Because the load on the transformer does not remain constant throughout the day, operating methods that will improve efficiency on a day long basis should be considered.

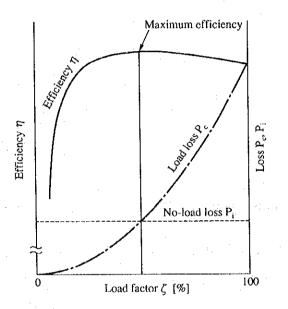
All day efficiency =
$$\frac{W_o}{W_o + 24 P_i + \sum p_c t} \times 100 [\%]$$

W_o: Cumulative output per day [Wh]

Pi : No-load loss [W]

Pc: Load loss (changes with fluctuations in load over time) [W]





10.4.4 Energy Conservation Measures

Energy conservation measures to be taken for transformers include the following: (For details, see "IV. Guidelines".)

(1) Stopping the transformers operating under light load

Electrical facilities which may be stopped during the nighttime and on holidays should be concentrated in one location.

(2) Control of the number of operating transformers

Switching the operation type to parallel operation or individual operation should be considered.

(3) Reviewing the capacity

Smaller capacity transformers should be adopted.

(4) Management of load group voltages

The voltage fluctuations and unbalanced voltage should be improved.

Check List for Transformer

Date Surveyor

Name of Shop	Location	No. of Bank	· · · · · · · · · · · · · · · · · · ·	No.
1 Type of Transformer	() Oil Immersed S	elf Cooling	() Dry typ	be
	() Forced coil Ai	r Cooling	() Others	
2 Number of Phase	() Three phase	() Single	phase	
3 3 Phase connection				
(for Single Phase Tr)	() <u>△</u> - Y () Y -	Δ () Δ - Δ	<u> () Y Y (</u>) V - V
4) Rated Output	kVA	Num. of Bank		
5 Rated Voltage	Primary	k٧	Secondary	V
Rated Current		Α		<u>A</u>
6 Rated Frequency	Hz	·····		
7 % impedance	% at		kVA base	
8 Manufacturer		· · · · · · · · · · · · · · · · · · ·	-	
9 Year built		· · ·		
10 Loss	Iron loss		k₩	
	Copper loss at full	load	kW	·

Measurement Record (1)

Time	Voltage	Corrent	Apparent	Power	Power	Oil	Wat	Hour Me	ter	Remark
1740	γ	A	Power kVA	k₩	factor %	Temp. ℃	Reading	Coeff't Factor	kWh	
						_				
		<u> </u>								
		·								·
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		<u> </u>								
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		1			1		1			
···			<u> </u>							
										-
		<u> </u>		<u> </u>	+					1
						<u> </u>				
				· ·					<u> </u>	

Measurement Record (2)

Date	
Surveyor	

ion of Board			Branch	·	Users	No.
Time	Yolt	Ampere	k₩	Cos φ	kVA	Remark
				ļ		
				· · · · · ·		
		<u> </u>				

Date

<u>Surveyor</u>

Locat	ion of Board			Branch		Users	No.	
No.	Time	Volt	Ampere	k₩	Cos φ	kVA	Remark	
	· ·							

Date

Surveyor

Locat	ion of Board			Branch	- r	Users	No.
<u>lo.</u>	Time	Volt	Атреге	k₩	Cos φ	kVA	Remark
		·					
			-				
	· · · · ·						

10.5 Fans and Blowers

10.5.1 Purpose of Measurement

The purpose is to grasp the actual load operation situations (flow rate, pressure, temperature, power consumption, etc.) as compared with the fan/blower design performance

10.5.2 Measurement Method (See Figure 10.5.1)

Figure 10.5.1 Fan and Blower Measuring Points

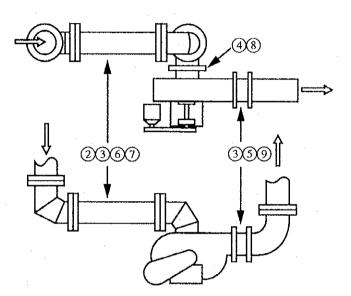


Table 10.5.1	Items to be	Measured for	Fans and	Blowers and	Measuring	Equipment
--------------	-------------	--------------	----------	-------------	-----------	-----------

	Items to be Measured	Measuring Equipment	
1	Dry bulb thermometer at fan outlet	Thermometer	
2	Suction dry bulb thermometer at an air flow rate measuring point	Thermometer	· · ·
3	Suction wet bulb thermometer at an air flow rate measuring point	Hygrometer	\rightarrow Specific weight
4	Static pressure at fan inlet	Pressure gauge	
5	Static pressure at fan outlet	Pressure gauge	\rightarrow Fan static pressure
6	Static pressure at an air flow rate measuring point	Pitot tube or anemomaster	
1	Dynamic pressure at an air flow rate measuring point	Pitot tube or anemomaster	→ Air flow
8	Suction port sectional area		
9	Discharge port sectional area		\rightarrow Value converted to specification state
10	Voltage	Clamp meter	
	Current	Clamp meter	$(\rightarrow \text{Efficiency})$
	Electric power	Clamp meter	\rightarrow Efficiency
(]	Damper opening (Inlet)	Visual check	Load
(14)	Damper opening (Outlet)	Visual check	Load

*When measurement on site is not available, use the reading on the local indicator.

Efficiency is obtained based on the following shaft power calculation formula.

$$L = \frac{L_{\rm T}}{\eta_{\rm F}} \, [\rm kW]$$

where

- $\eta_{ extsf{F}}$: Blower efficiency
- L_T : Air motive power [kW]

$$L_{T} = \frac{K}{K-1} \cdot \frac{P_{t1} \cdot Q}{6120} \left\{ \left(\frac{P_{t2}}{P_{t1}} \right)^{\frac{K-1}{K}} - 1 \right\} [kW]$$

where

P_{it}: Suction side absolute pressure [kg/m²·abs]

P₁₂: Discharge side absolute value [kg/m²·abs]

Q : Air flow [m³/min]

K : Specific heat ratio (1.4 for air)

When the pressure ratio is 1.03 or less, the following equation may be used.

$$L_{T} = \frac{QP_{T}}{6120} [kW]$$

where

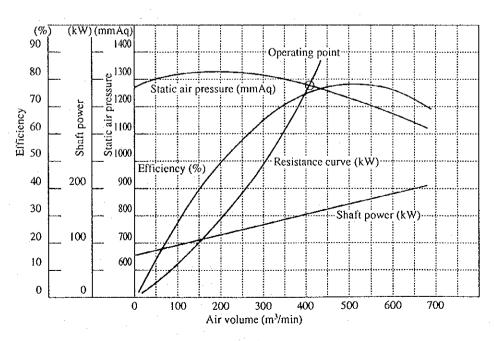
P_T: Total pressure of blower [mmAq]

10.5.3 Method of Diagnosis

Air flow, resistance curve and shaft power are plotted on performance curves based on the measured and calculated results. With these actual load curves for reference, the extent to which air flow volume and static pressure can be reduced should be considered. (e.g. controlling the rotational speed, cutting blower impellers, etc.)

Figure 10.5.2 shows examples of performance curves.







10.5.4 Energy Conservation Measures

Energy conservation measures to be taken for blowers include the following: (For details, see "IV. Guidelines".)

(1) Reduction of shaft power

Operating with optimum air flow volume, preventing air leakage, etc.

(2) Reduction of operating time

On/off operation, etc.

(3) Replacement of blowers

Replacing with a blower which matches the current load

(4) Modification of impellers

Modifying the outer diameter of impellers (Impeller cutting)

(5) Control of rotational speed

Rotational speed control for the load (VVVF)

(6) Control of the number of machines to be used

Managing the operation on a multiple machine basis

(7) Use of high-efficiency equipment

Adopting high-efficiency equipment for the blower body, power transmission devices and motors

	Julveyor
Name of Shop	Location No.
1 Name of Equipment	
©Kind of motor	() AC () Induction () Wound Rotor () Squirrel Cage () Others
	() Synchronous () DC () Series () Shunt () Compound
③Rating of Motor	Out put kW Voltage V Current A Frequency Hz RPM rpm. Num. of Pole
4 Starting method	() Full Voltage() Star-delta (Y - △)() Rotor-resistance() Others
5 Coupling Apparatus	Meterial () Natural Tension () SyntheticNum
6 Load	() Pump () Blower () Compressor () Others
7 Kind and Density of Fulid	() Air () Water () Others () Density (or Specific Gravity)
(8) Flow Control Method	() Automatic () Valve () Speed Control () manual () Damper () Others
(9) Speed Control	() Motor () Pole Change() Voltage () Mechanical() Frequency () Others
10 Automatic Turn-of	f () Yes () No
(when off load)	
11 Lubrication	time/year
12 Filter cleaning	
13 Flow Chart of flu	id

Check List for Motor Driven Machine (1) (30 motors of higher rank of output)

Date Surveyor

Check List for Motor Driven Machine (2)

Da	te		Factory			Surveyor					_(Blower, Pump)		
Name of Shop No.Name of Machine			Location Power Temp, Flow Pre					Rat Pipe				Pole Effici-	
	Time	Actual Volt	Power Current	Power	of Fluid	n ³ /min Rated Actual	Pressure	dia.	Position	of Fluid	mated load	ency	
		<u>v</u>	A	k₩	Ű	Max. Min.	kg.cm²	(ID)		m/s		%	

Nat	ne of Sho Name of)p Machine	Location				T	Rati	ing of Mo	No. tor		Pole
<u>No.</u>	Time	Actual Volt	Power Current	Power	Temp. of Fluid	m ³ /min Rated	Pressure	Pipe	Valve Position	Velocity	Esti- mated load	Effici- ency
		V	A	k₩	٣	Actual Max. Min.	kg. cm ²	(ID)		m/s		%
						· · · · · · · · · · · · · · · · · · ·						
									1			

Name of Shop Location			1.1		e en Angele e	No.		
No.Name of Machine				Rati	ng of Mo	tor	kW,	Pole
Actual Power	Temp.	Flow	Pressure	Pipe		Velocity		Effici-
Time Volt Current Power	of	m ³ /min	 	dia.	Position	of	mated	ency
	Fluid	Rated	1			Fluid	load	
		Actual	1 1		ł			
V A kW	Ϋ́	Max. Min.	kg.cm ⁷	(ID)	· .	m/s		%
						·		
	<u> </u>				1	1		
	1							
	1	-			<u> </u>			ļ
	1		·		<u> </u>			!

(1) Required Power of Blower $P = \frac{A \cdot Q \cdot PT}{6120 \cdot \eta} (kW)$ PT: Total Pressure (mmAq or kg/m ²) A : Allowance (1.1 - 1.3) η : Efficiency of blower (0.72 - 0.78) Q : Flow (m ³ /min)	Adequate Velocity of Fluid Adequate Velocity Pressure Velocity (m/sec) (kg/cm ²) Air 8 - 15 1 - 2
(2) Required Power of Pump $P = \frac{A \cdot \gamma \cdot Q \cdot H}{6.12 \cdot \eta} (kW)$ $A : Allowance (1.05 - 1.2)$ $\gamma : Density (kg/1)$ $Q : Flow (m3/min)$ $\eta : Efficiency of Pump$ $H : Head (m)$	Adequate Velocity of Fluid Adequate Velocity Pressure Velocity (m/sec) (kg/cm ²) Water 1.5 - 3.0 3.0 - 10