9.2 Chemical Industry

9.2.1 Chemical Industry (Blachownia, Poch)

(1) Ethylbenzene

a. Purpose of measurement

The purpose is to grasp the status of energy use in the ethylbenzene manufacturing process.

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

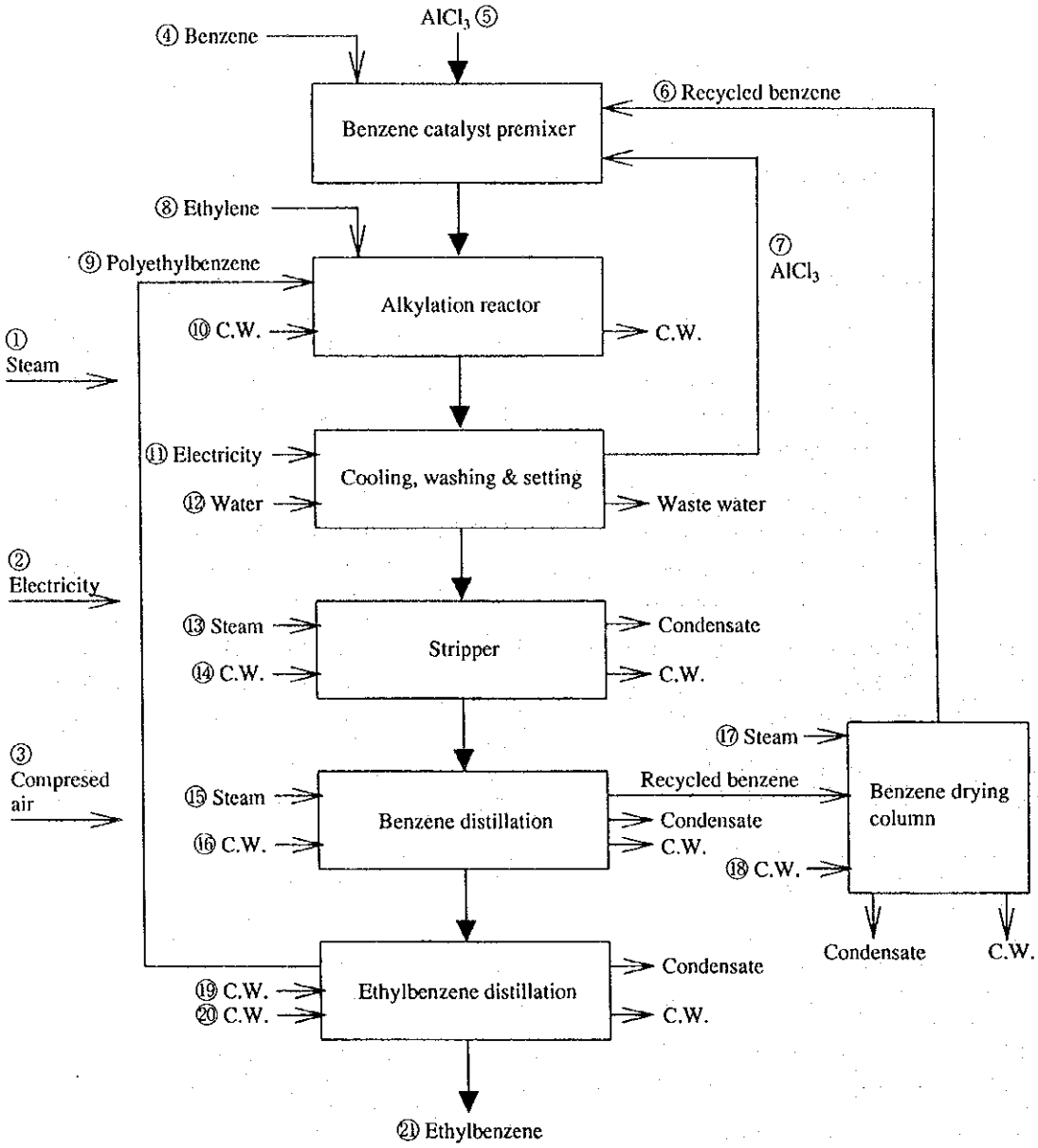
	Measurement items	Measurement time	Measuring equipment	Data processing
Total	① Total steam flow rate	24 h	Meter for operation	Memo
	② Total power consumption	24 h	Clamp meter	to FDD
	③ Total compressed air consumption	24 h	Meter for operation	Memo
Benzene catalyst premixer	④ Amount of charged benzene	24 h	Operation record	Memo
	⑤ Amount of charged $AlCl_3$	24 h	Operation record	Memo
	⑥ Benzene consumption	24 h	Operation record	Memo
	⑦ Amount of recycled $AlCl_3$	24 h	Operation record	Memo
Alkylation reactor	⑧ Amount of charged ethylene	24 h	Operation record	Memo
	⑨ Polyethylbenzene amount	24 h	Operation record	Memo
	⑩ Cooling water amount	24 h	Meter for operation	Memo
Cooling, washing & setting	⑪ Power consumption	24 h	Clamp meter	to FDD
	⑫ Water amount	24 h	Ultrasonic flowmeter	to Recorder
Stripper	⑬ Steam flow rate	24 h	Meter for operation	Memo
	⑭ Cooling water amount	24 h	Meter for operation	Memo
Benzene Distillation	⑮ Steam flow rate	24 h	Meter for operation	Memo
	⑯ Cooling water amount	24 h	Meter for operation	Memo
Benzen drying colmn	⑰ Steam flow rate	24 h	Meter for operation	Memo
	⑱ Cooling water amount	24 h	Meter for operation	Memo
Ethylbenzene distillation	⑲ Steam flow rate	24 h	Meter for operation	Memo
	⑳ Cooling water amount	24 h	Meter for operation	Memo
	㉑ Product output	24 h	Operation record	Memo

Note) The surface temperature should be measured, as required, by using a surface thermometer, radiation thermometer, etc. in order to grasp the heat insulation status of each equipment.

c. Measuring points

Figure 9.2.1 shows the measuring points for ethylbenzene.

Figure 9.2.1 Measuring Points of Ethylbenzen Process



(2) Benzene

a. Purpose of measurement

The purpose is to grasp the status of energy use in the benzene manufacturing process.

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

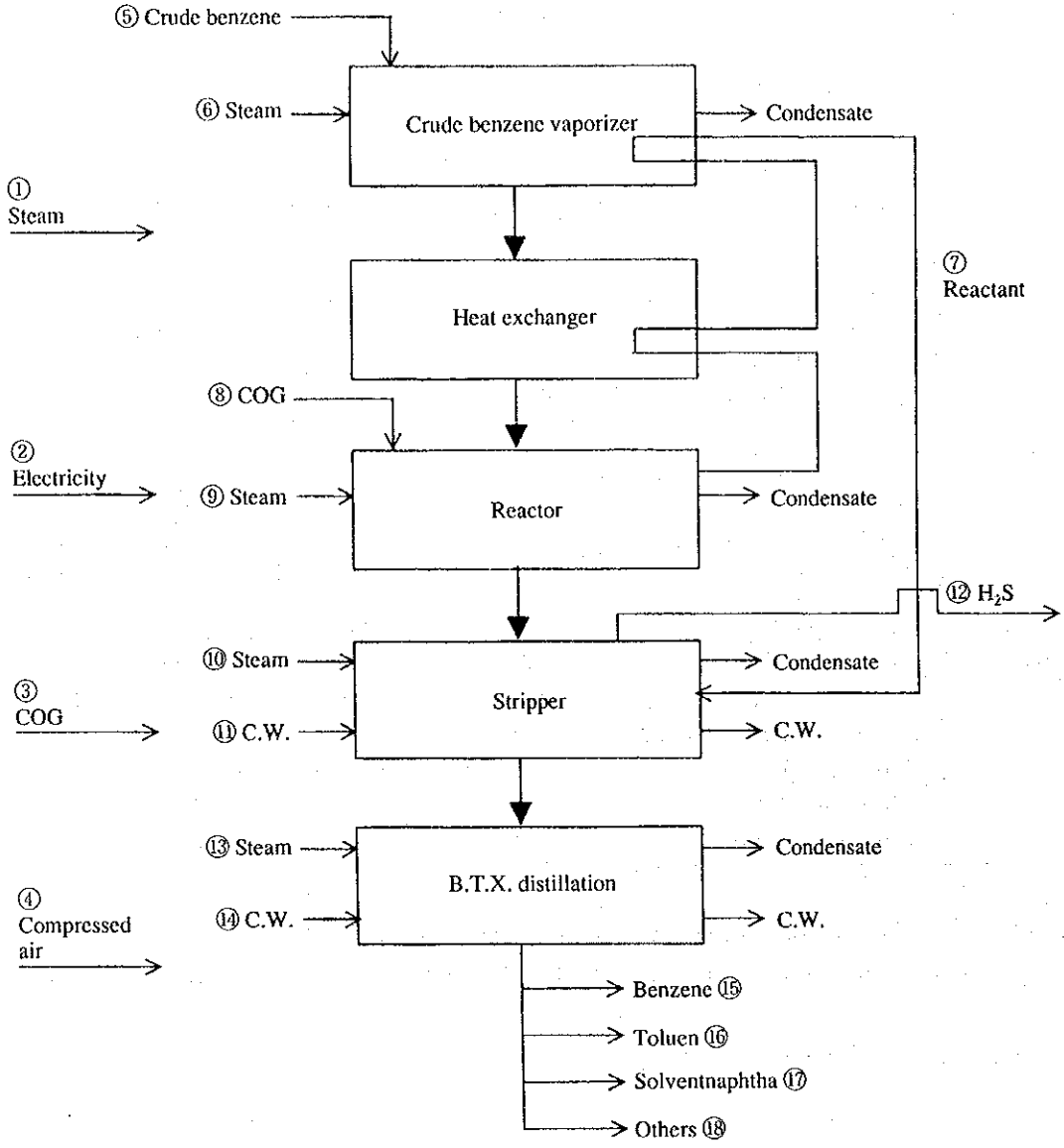
	Measurement items	Measurement time	Measuring equipments	Data processing
Total	① Total steam flow rate	24 h	Meter for operation	Memo
	② Total power consumption	24 h	Clamp meter	to FDD
	③ Total COG amount	24 h	Meter for operation	Memo
	④ Total amount of compressed air	24 h	Meter for operation	Memo
Crude benzene vaporizer	⑤ Crude benzene	24 h	Operation record	Memo
	⑥ Steam flow rate	24 h	Meter for operation	Memo
	⑦ Amount of reactant	24 h	Operation record	Memo
Reactor	⑧ COG flow rate	24 h	Operation record	Memo
	⑨ Steam flow rate	24 h	Meter for operation	Memo
Stripper	⑩ Steam flow rate	24 h	Meter for operation	Memo
	⑪ Cooling water amount	24 h	Meter for operation	Memo
	⑫ H_2S amount	24 h	Operation record	Memo
B.T.X. distilation	⑬ Steam flow rate	24 h	Meter for operation	Memo
	⑭ Cooling water amount	24 h	Meter for operation	Memo
	⑮ Product output (Benzene)	24 h	Operation record	Memo
	⑯ Product output (Toluene)	24 h	Operation record	Memo
	⑰ Product output (Sloventnaphtha)	24 h	Operation record	Memo
	⑱ Product output (Others)	24 h	Operation record	Memo

Note) The surface temperature should be measured, as required, by using a surface thermometer, radiation thermometer, etc. in order to grasp the heat insulation status of each equipment.

c. Measuring points

Figure 9.2.2 shows the measuring points for benzene.

Figure 9.2.2 Measuring Points of Benzene Process



(3) Tar

a. Purpose of measurement

The purpose of measurement is to grasp the status of energy use in the tar manufacturing process.

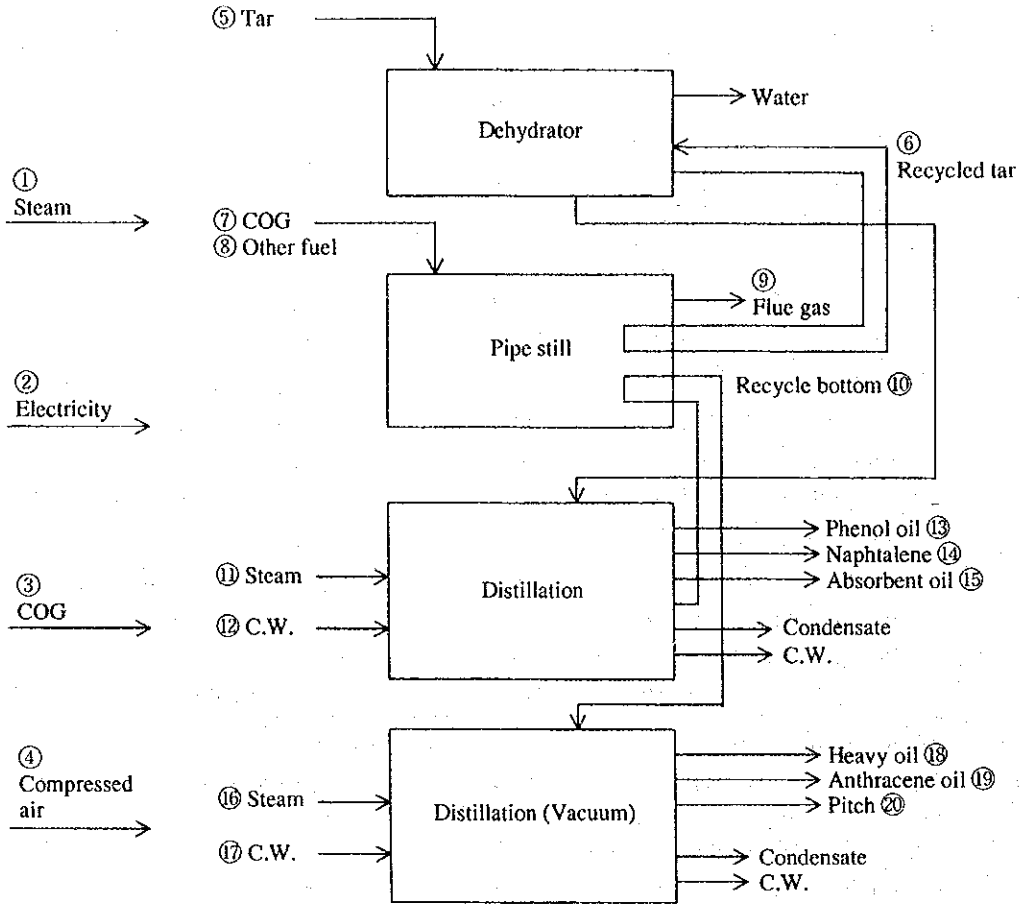
b. Measurement items, measurement time, measuring equipment, and data processing

	Measurement items	Measurement time	Measuring equipment	Data processing
Total	① Total steam flow rate	24 h	Meter for operation	Memo
	② Total power consumption	24 h	Clamp meter	to FDD
	③ Total amount of COG	24 h	Operation record	Memo
	④ Total amount of compressed air	24 h	Meter for operation	Memo
Dehydrator	⑤ Total amount of tar	24 h	Operation record	Memo
	⑥ Amount of recycled tar	24 h	Operation record	Memo
Pipe still	⑦ COG flow rate	24 h	Meter for operation	Memo
	⑧ Amount of other fuels	24 h	Operation record	Memo
	⑨ Amount of flue gas	24 h	Meter for operation	Memo
	⑩ Amount of recycled bottom	24 h	Operation record	Memo
Distillation	⑪ Steam flow rate	24 h	Meter for operation	Memo
	⑫ Cooling water	24 h	Meter for operation	Memo
	⑬ Product output (Phenol)	24 h	Operation record	Memo
	⑭ Product output (Naphthalene)	24 h	Operation record	Memo
	⑮ Product output (Absorbent)	24 h	Operation record	Memo
Distillation (Vacuum)	⑯ Steam flow rate	24 h	Meter for operation	Memo
	⑰ Cooling water amount	24 h	Meter for operation	Memo
	⑱ Product output (Heavy oil)	24 h	Operation record	Memo
	⑲ Product output (Anthracene)	24 h	Operation record	Memo
	⑳ Product output (Pitch)	24 h	Operation record	Memo

c. Measuring points

Figure 9.2.3 shows the measuring points for the tar process.

Figure 9.2.3 Measuring Points of Tar Process



(3) Energy utilization facilities

Equipment name	Targeted equipment or location	Measurement time
Electricity management	Power receiving facilities	24 h
Fan/blower	Boiler exhaust fan	24 h
Electric motor	Boiler feedwater	24 h
Air compressor	Major equipment	24 h
Pump	Cooling water pump	24 h
Transformer	Major equipment	24 h
Lighting	Various locations in the factory	spot
Boiler	Boiler room	24 h
Steam pipe	Various locations in the factory	spot

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

9.2.2 Dyestuff (Boruta)

(1) Dyestuff

a. Purpose of measurement

The purpose of measurement is to grasp the status of energy use in the dye manufacturing process.

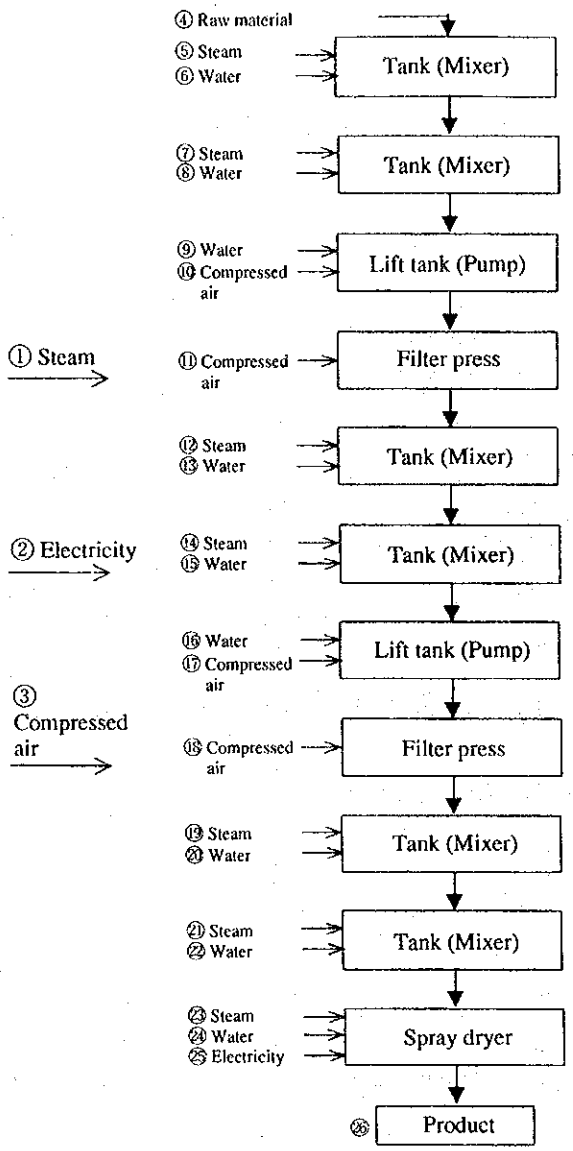
b. Measurement items, measurement time, measuring equipment, and data processing

	Measurement items	Measurement time	Measuring equipment	Data processing
Total	① Total steam flow rate	24 h	Meter for operation	
	② Total power consumption	24 h	Meter for operation	
	③ Total amount of compressed air	24 h	Meter for operation	
Raw material	④ Raw materials (Amount and composition)	–	Operation record	
Tank	⑤ Steam flow rate	24 h	Meter for operation	
	⑥ Water amount	24 h	Meter for operation	
Tank	⑦ Steam flow rate	24 h	Meter for operation	
	⑧ Water amount	24 h	Meter for operation	
Pump	⑨ Water amount	24 h	Meter for operation	
	⑩ Compressed air (Amount and pressure)	24 h	Meter for operation	
Filter press	⑪ Compressed air (Amount and pressure)	24 h	Meter for operation	
Tank	⑫ Steam flow rate	24 h	Meter for operation	
	⑬ Water amount	24 h	Meter for operation	
Tank	⑭ Steam flow rate	24 h	Meter for operation	
	⑮ Water amount	24 h	Meter for operation	
Pump	⑯ Water amount	24 h	Meter for operation	
	⑰ Compressed air (Amount and pressure)	24 h	Meter for operation	
Filter press	⑱ Compressed air (Amount and pressure)	24 h	Meter for operation	
Tank	⑲ Steam flow rate	24 h	Meter for operation	
	⑳ Water amount	24 h	Meter for operation	
Tank	㉑ Steam flow rate	24 h	Meter for operation	
	㉒ Water amount	24 h	Meter for operation	
Spray dryer	㉓ Steam flow rate	24 h	Meter for operation	
	㉔ Water amount	24 h	Ultrasonic flowmeter	
	㉕ Power consumption	24 h	Clamp meter	
Product	㉖ Product output	24 h	Operation record	

c. Measuring points

Figure 9.2.4 shows the measuring points for the dyeing process.

Figure 9.2.4 Measuring Points of Dyeing Process



(3) Energy utilization facilities

Equipment name	Targeted equipment or location	Measurement time
Electricity management	Power receiving facilities	24 h
	NH3 refrigerator	24 h
	Dyeing shop	24 h
Fan/blower	Blower for dryer	24 h
Electric motor	Major equipment	24 h
Air compressor	NH3 compressor	24 h
Pump	Major equipment	24 h
Transformer	Major equipment	24 h
Lighting	Various locations in the factory	spot
Boiler	–	–
Steam pipe	Various locations in the factory	spot

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

Check list for BORUTA S.A.

No.	Item		Unit					
1	Production			1993	1994	1995	1996	1997
1.1	Direct dye		ton/y					
1.2	Acid dye		ton/y					
1.3	Reaction dye		ton/y					
1.4	Others		ton/y					
	Total		ton/y					
2	Energy consumption			1993	1994	1995	1996	1997
2.1	Steam		GJ/y					
2.2	Electricity		MWh/y					
2.3	Ice		ton/y					
2.4	Compressed air		Nm3/y					
2.5	Water		m3/y					
2.6	Others							
3	Energy price			1997	1998			
3.1	Steam		PLN/t					
3.2	Electricity		PLN/kWh					
3.3	Ice		PLN/t					
3.4	Compressed air		PLN/Nm3					
3.5	Water		PLN/m3					
3.6	Others							

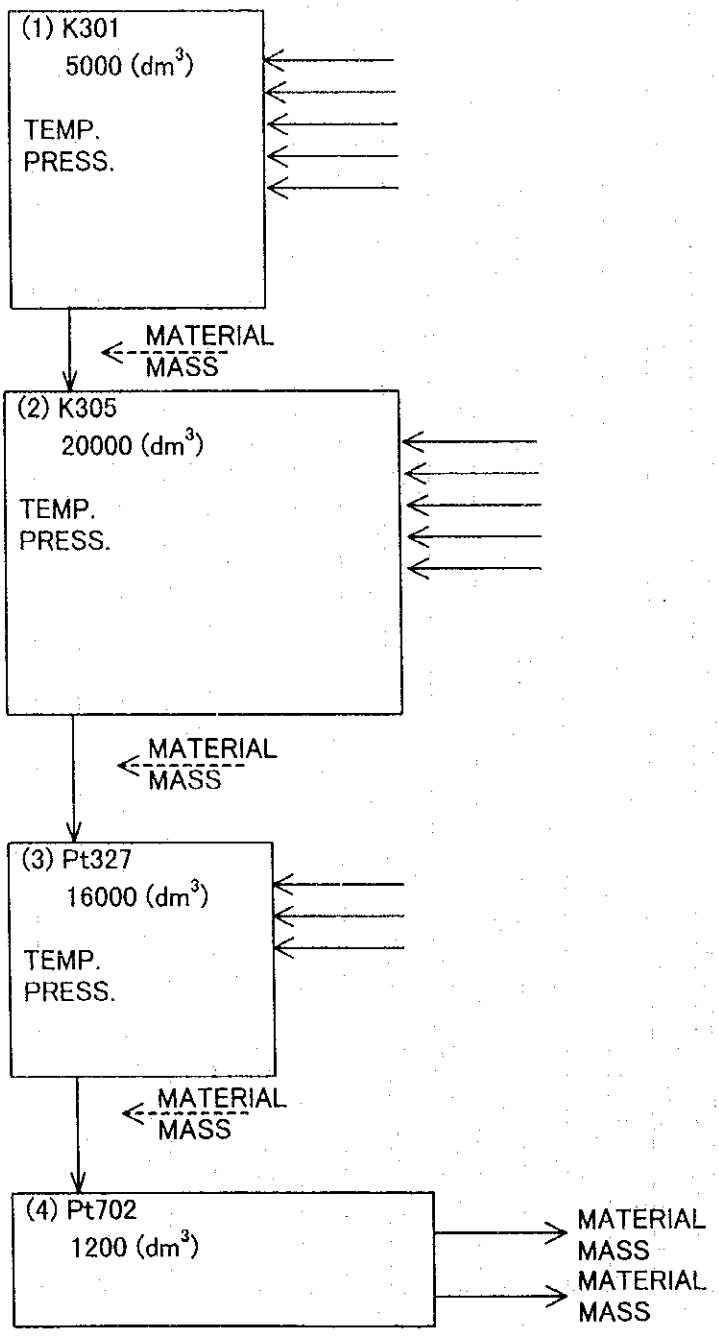
4	Specifications of Unit Process : Capacity, Operation condition, Stucture drawings, Sectional drawings							
4.1	Reactor							
4.2	Lift tank (Pump)							
4.3	Spray dryer and							
	process control system							
4.4	Filter press							
5	Space heating in Building							
5.1	Calculation sheet of							
	Space heating load							
6	Process flow diagram							

MATERIAL BALANCE SHEET 1/3

PRODUCT NAME	COLOR INDEX No.	FORMULA

1st. STEP :

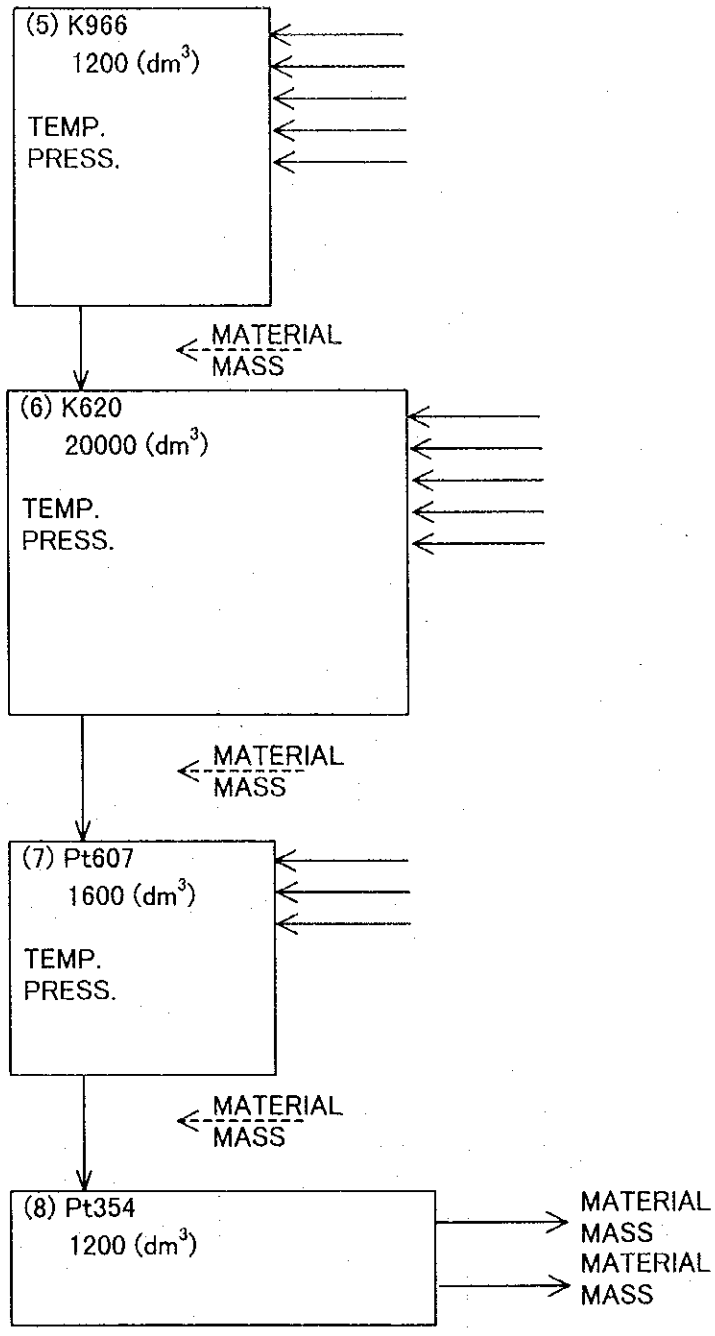
REACT.(Hr)	REHEATING CONDITION (MATERIAL-MASS, TEMP.,PRESS.,STEAM, etc.)	MAN-HOUR



2nd. STEP :

2/3

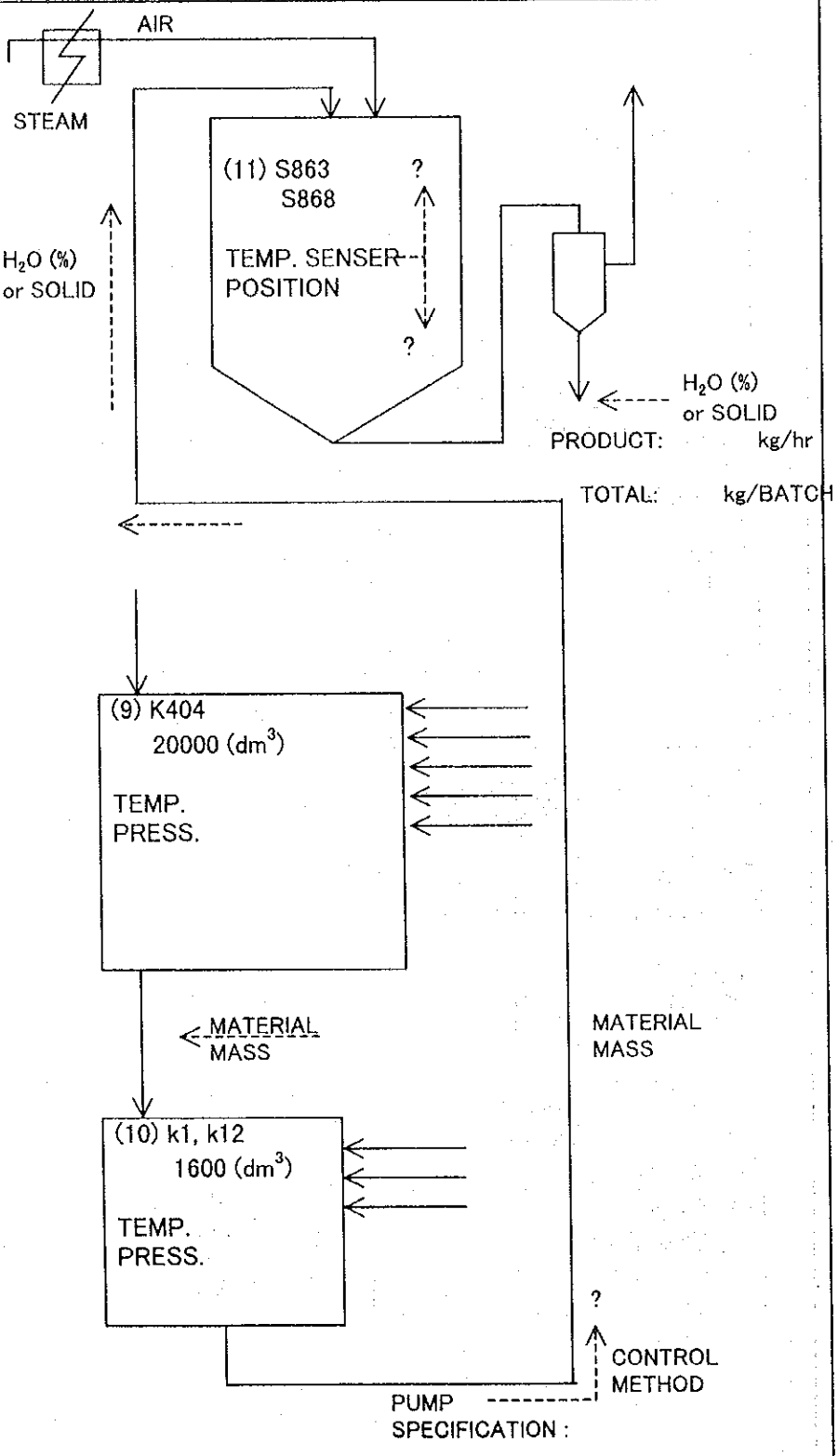
REACT.(Hr)	REHEATING CONDITION (MATERIAL-MASS, TEMP.,PRESS.,STEAM, etc.)	MAN-HOUR



3rd. STEP :

3/3

REACT.(Hr)	REHEATING CONDITION (MATERIAL-MASS, TEMP.,PRESS.,STEAM, etc.)	MAN-HOUR



9.3 Machine Manufacturing Industry

9.3.1 Tractor and Truck (Ursus and Star)

(1) Cupola

a. Purpose of measurement

The purpose of measurement is to survey the current operating status in order to perform heat balancing of the cupola.

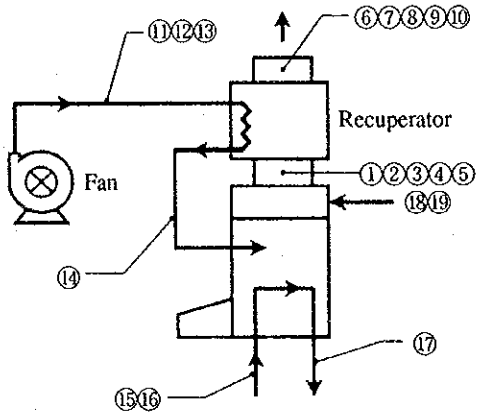
b. Measurement items, measurement time, measuring equipment, and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Exhaust gas temperature before heat recovery	24 h	Thermocouple	to Recorder
② Exhaust gas pressure before heat recovery	24 h	Low pressure indicator	to Recorder
③ Exhaust gas O_2 % before heat recovery	24 h	O_2 meter	to Recorder
④ Exhaust gas CO % before heat recovery	24 h	CO, CO_2 meter	to Recorder
⑤ Exhaust gas CO_2 % before heat recovery	24 h	CO, CO_2 meter	to Recorder
⑥ Exhaust gas temperature after heat recovery	24 h	Thermocouple	to Recorder
⑦ Exhaust gas pressure after heat recovery	24 h	Low pressure indicator	to Recorder
⑧ Exhaust gas O_2 % after heat recovery	24 h	O_2 meter	to Recorder
⑨ Exhaust gas CO % after heat recovery	24 h	CO, CO_2 meter	to Recorder
⑩ Exhaust gas CO_2 % after heat recovery	24 h	CO, CO_2 meter	to Recorder
⑪ Hot blast temperature before heat recovery	24 h	Thermocouple	to Recorder
⑫ Hot blast pressure before heat recovery	24 h	Low pressure indicator	to Recorder
⑬ Hot blast humidity % before heat recovery	24 h	Thermo-hygrometer	Memo
⑭ Hot blast temperature after heat recovery	24 h	Thermocouple	to Recorder
⑮ Primary side cooling water temperature	24 h	Thermocouple	to Recorder
⑯ Primary side cooling water amount	24 h	Ultrasonic flowmeter	to Recorder
⑰ Secondary side cooling water temperature	24 h	Thermocouple	to Recorder
⑱ Charged coke amount	24 h	Operation record	Memo
⑲ Charged pig iron amount	24 h	Operation record	Memo

c. Measuring points

Figure 9.3.1 shows the measuring points of cupola.

Figure 9.3.1 Measuring Points of Cupola



(2) Reheating furnace

a. Purpose of measurement

The purpose of measurement is to survey the current operating status in order to perform heat balancing of the heating furnace.

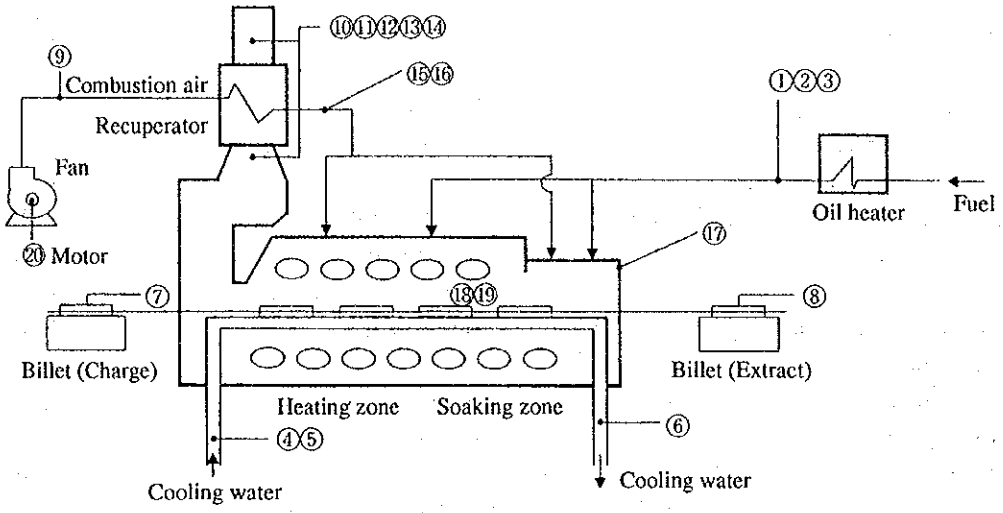
b. Measurement items, measurement time, measuring equipment, and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Fuel consumption	24 h	Ultrasonic flowmeter	to Recorder
② Fuel pressure	24 h	Pressure gauge	to Recorder
③ Fuel temperature	24 h	Thermocouple	to Recorder
④ Cooling water flow rate	24 h	Ultrasonic flowmeter	to Recorder
⑤ Cooling water inlet temperature	24 h	Thermocouple	to Recorder
⑥ Cooling water outlet temperature	24 h	Thermocouple	to Recorder
⑦ Billet charging temperature	24 h	Radiation thermometer	to Recorder
⑧ Billet extracting temperature	24 h	Radiation thermometer	to Recorder
⑨ Combustion air temperature at recuperator inlet	24 h	Thermocouple	to Recorder
⑩ Exhaust gas temperature	24 h	Thermocouple	to Recorder
⑪ Exhaust gas pressure	24 h	Low pressure indicator	to Recorder
⑫ Exhaust gas O_2	24 h	O_2 meter	to Recorder
⑬ Exhaust gas CO_2	24 h	CO, CO_2 meter	to Recorder
⑭ Exhaust gas CO	24 h	CO, CO_2 meter	to Recorder
⑮ Combustion air pressure at recuperator outlet	24 h	Low pressure indicator	to Recorder
⑯ Combustion air temperature at recuperator outlet	24 h	Thermocouple	to Recorder
⑰ Reheating furnace surface temperature	24 h	Surface thermometer	to Recorder
⑱ Furnace internal temperature	24 h	Radiation thermometer	to Recorder
⑲ Furnace internal pressure	24 h	Low pressure indicator	to Recorder
⑳ Power consumption for combustion air	24 h	Clamp meter	to Recorder

c. Measuring points

Figure 9.3.2 shows the measuring points of the heating furnace.

Figure 9.3.2 Measuring Points of Reheating Furnace



(3) Processes and lines

a. Purpose of measurement

The purpose of measurement is to grasp the energy intensity per product for each line. The current state of energy consumption of typical equipment for each process and line should be surveyed.

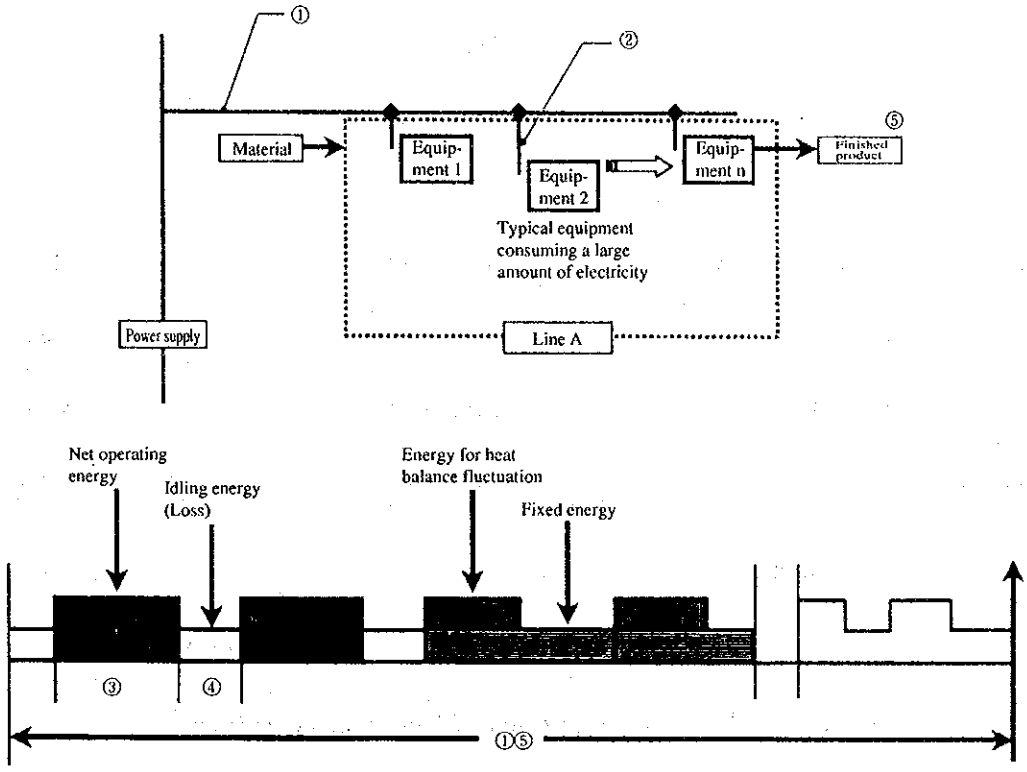
b. Measurement items, measurement time, measuring equipment, and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Power consumption (For the entire line)	24 h	Clamp meter	to FDD
② Power consumption (For typical equipment)	24 h	Clamp meter	to FDD
③ Power consumption for the net fabrication cycle per piece of targeted work	24 h	Clamp meter	to FDD
④ Power consumption for the waiting period from the completion of one process to the starting of the next process	24 h	Clamp meter	to FDD
⑤ Daily production volume	–	Operation record	Memo

c. Measuring points

Figure 9.3.3 shows the measuring points of each line power consumption and typical equipment.

Figure 9.3.3 Measuring Points of Electricity



(4) Heating (Various locations of the factory)

a. Purpose of measurement

The purpose is to grasp the amount of energy loss in space heating at various areas of the factory.

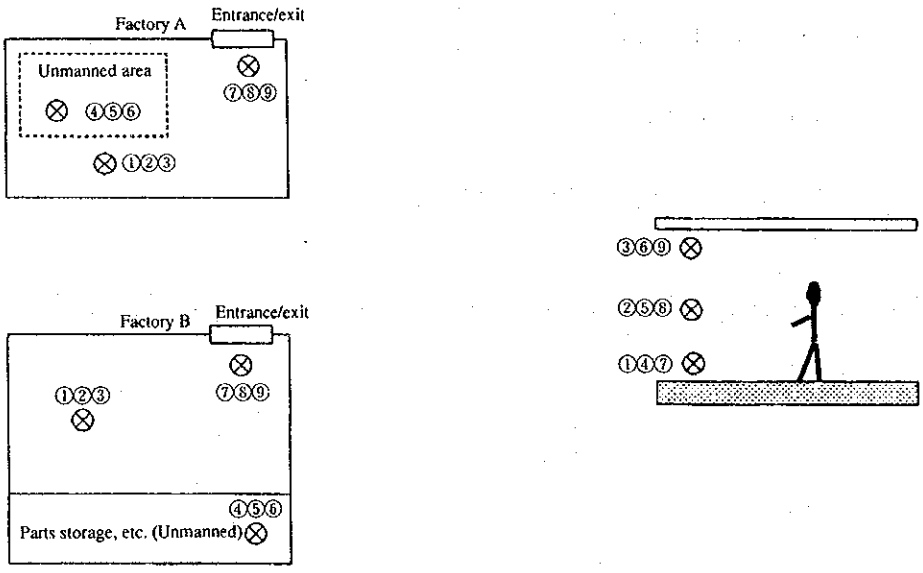
b. Measurement items, measurement time, measuring equipment and data processing

Measurement items	Measurement time	Measuring equipment	Data processing
① Floor temperature of manned work areas	spot	Thermometer	Memo
② Temperature at human height in manned work areas	spot	Thermometer	Memo
③ Temperature near the ceiling of manned work areas	spot	Thermometer	Memo
④ Floor temperature of unmanned work areas	spot	Thermometer	Memo
⑤ Temperature at human height in unmanned work areas	spot	Thermometer	Memo
⑥ Temperature near the ceiling of unmanned work areas	spot	Thermometer	Memo
⑦ Floor temperature at factory entrance/exit	spot	Thermometer	Memo
⑧ Temperature at human height at factory entrance/exit	spot	Thermometer	Memo
⑨ Temperature near the ceiling at factory entrance/exit	spot	Thermometer	Memo
⑩ Outdoor temperature	spot	Thermometer	Memo

c. Measuring points

Figure 9.3.4 shows the measuring points for assessing energy loss in heating.

Figure 9.3.4 Measuring Points of Room Temperature



(5) Energy utilization facilities

Equipment name	Targeted equipment or location	Measurement time
Electricity management	Processes and lines	24 h
Air compressor	For processing	24 h
Fan/blower	For heating	24 h
Pump	Cooling tower system	24 h
Lighting	Various locations of the factory	spot
Boiler	Boiler room	24 h
Steam piping	Various locations of the factory	spot

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

Check List for Process of Tractor Production

Date

Surveyor

1. General information

(1) Factory name

Company name: ZPC "URSUS"

(2) Adress Factory: 02-495 Warsaw

Head Office :

(3) Numbers of Employees

6864

(4) Main Products and production capacity

Name of Unit	Production Capacity	Start-up year
(a) Tractors type "C"		
(b) Heavy tractors type "U"		
(c) Tractors type "MP"		
(d)		
(e)		

(5) Production of Main Product and Future Production Plan

Products	1992	1993	1994	1995	1996	1997 (Plan)	2000 (Plan)
(a) Tractors type "C"							
(b) Heavy tractors type "U"							
(c) Tractors type "MP"							
(d)							
(e)							

(6) History of the plant

(Foundation and expansion the plant , rebuild , new production system share in the Industry , History of production etc.)

Foundation:

History of expantion

Share of products in Poland

(6) Outline of Production Processes(Process Flow Sheet)

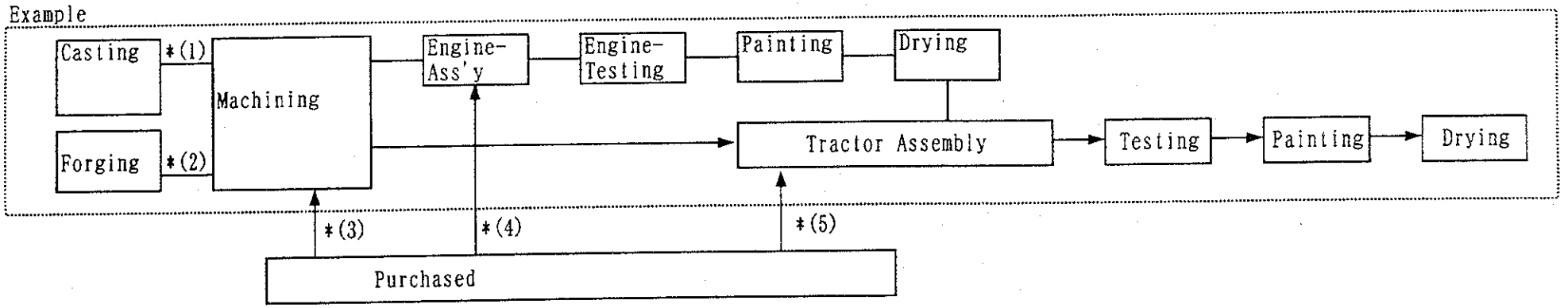
Next page

(7) Factory and Plant Layout

Please separately prepare.

6. Out-line of production process

Example



NO	Name of product/parts	Example
*(1)		Cylinder-block , Ccylinder-head Counter weight
*(2)		Crank-shaft Connecting-rod
*(3)		Bracket
*(4)		Fuel-pump, Starter
*(5)		Tire/wheel

2. Transition of Energy Consumption

(1) Unit Price of Energy (1995-1996)

Energy	Heat value		Unit price	
	Heat value	Unit	1995	1996
Coal		kcal/t	/t	/t
Fuel Oil		kcal/kl	/kl	/kl
Gas Oil		kcal/kl	/kl	/kl
Kerosene		kcal/kl	/kl	/kl
LPG		kcal/kg	/kg	/kg
Natural Gas		kcal/m3	/m3	/m3
Electricity				
In-house		kcal/kWh	/kWh	/kWh
Purchased		kcal/kWh	/kWh	/kWh
Demand			/kW	/kW

(2) Tend of Energy Consumption

Energy	Unit	1992	1993	1994	1995	1996	1997 (Plan)
Coal	(t)						
Fuel Oil	(kl)						
Gas Oil	(kl)						
Kerosene	(kl)						
LPG	(kg)						
Natural Gas	(m3)						
Electricity							
Total	(mWh)						
In-house	(mWh)						
Purchased	(mWh)						
Demand	(kW)						

(3) Energy consumption for each plant/process in 1996 (or 1995)

(another sheet --page. 5--)

2.(3) Energy consumption for each plant/process in 1996(or 1995)

Process	Production		Electricity	Coal	Fuel oil	Gas oil	Kerosene	LPG	Natural gas
	Product	Unit	▪ kWh	ton	kl	kl	kl	kg	▪ Nm3
Energy supply									
(1)Air compresser									
(2)Boiler									
(3)generator									
(4)Others									
(Sub-total)									
Casting									
(1)Melting									
(2)Others									
(Sub-total)									
Forging									
Machining(include parts shop)									
Assembly									
Paint & Drying									
Others(office,...)									
Consumption total									
(1)In-house									
(2)Purchased									

(4) Tend of Energy intensity by process

(Energy supply , Casting , Forging , Machining , Assembly , others)

(4)-1. Energy supply station /shop

			1994	1995	1996
Product (*1)	Steam ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

(4)-2.Casting

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

(4)-3. Forging

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

(4)-4.Machining

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (▪ kcal)					
Energy intensity (*2 / *1) (▪ kcal/ton)					

(4)-5. Assembly

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (▪ kcal)					
Energy intensity (*2 / *1) (▪ kcal/ton)					

(4)-6. ( )

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (▪ kcal)					
Energy intensity (*2 / *1) (▪ kcal/ton)					

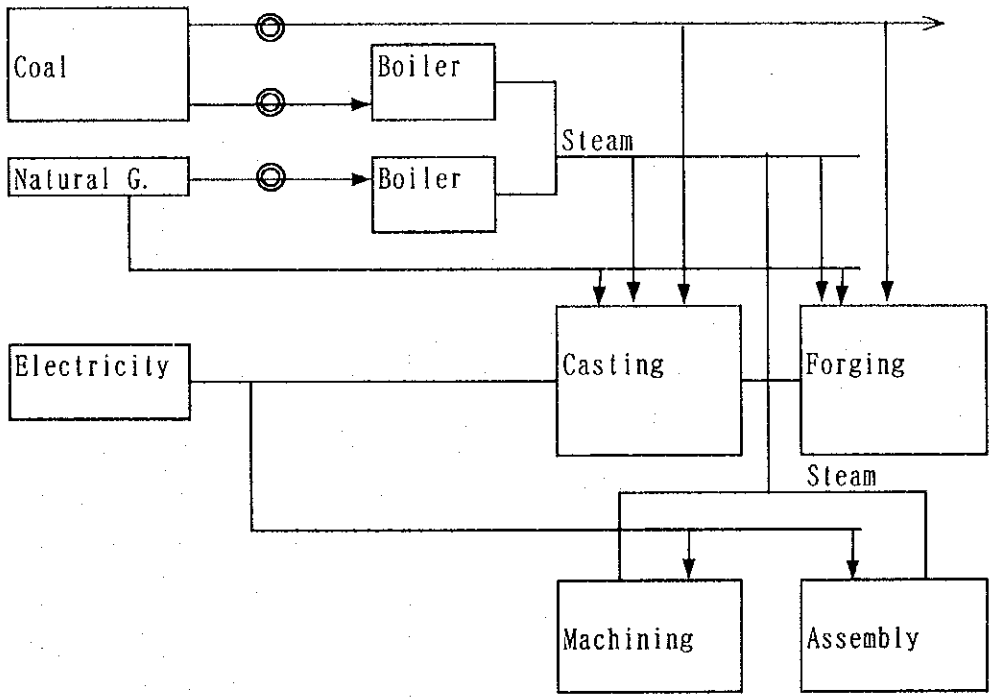
(5) Rate of energy cost for production cost in whole plant

$$\frac{\text{Energy cost}}{\text{Production cost}} = \frac{\qquad}{\qquad} = \boxed{\quad}\%$$

(6) How much is the target rate of energy cost vs Production cost? : [ ] %

(7) Energy supply flow diagram showing flow meter location like a following example

Example of energy supply fow diagram



(8) Major equipment for Compressed Air consumption

No	Name of process/line	Name of equipment	Purpose to use	Pressure	Max consumption (m3/min)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

(9) Major equipment for Steam consumption

No	Name of process/line	Name of equipment	Purpose to use	Pressure	Max consumption (ton/h)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

(10) Average temperature for the Office and plant

Season	Setting Temperature (Area)
	(Area:)
	(Area:)
	(Area:)
	(Area:)
	(Area:)
	(Area:)

3. Production system

3-1. Casting (Melt and Mold)

(1) Main specification of Casting process (Major equipment for energy consumptio

Equipment	Specification		
Cupola (1) (set)	Type		
	Built year		
	Capacity		ton/hour
	Ratio of cokes(ｺｰｸｽ比)		%
	Cokes intensity(ｺｰｸｽ原単位)		kg/ton
	Maximum inside dia. of the melting zone (溶解帯最大炉内径)		mm
	Melting Temperature (溶湯温度)		℃
	Temp. of hot ventilation		℃
	AmOunt of hot ventilation		Nm3/min
Cupola (2) (set)	Type		
	Built year		
	Capacity		ton/hour
	Ratio of cokes(ｺｰｸｽ比)		%
	Cokes intensity(ｺｰｸｽ原単位)		kg/ton
	Maximum inside dia. of the melting zone (溶解帯最大炉内径)		mm
	Melting Temperature (溶湯温度)		℃
	Temp. of hot ventilation		℃
	AmOunt of hot ventilation		Nm3/min
Heat insulation furnace (1)	Type		
	Built year		
	Kind of energy		
	Frequency		Hz
	Capacity		
	Temperature(Target of furnace temp.)		℃
Heat insulation furnace (2)	Type		
	Built year		
	Kind of energy		
	Frequency		Hz
	Capacity		
	Temperature(Target of furnace temp.)		℃

Main specification of Casting process

Equipment	Specification	
Molding machine (1)	Type	
	Built year	
	Kind of energy	
	Rated output of driving motor	KW
Molding machine (2)	Type	
	Built year	
	Kind of energy	
	Rated output of driving motor	KW
Core oven (1)	Type	
	Built year	
	Temperature	
	Kind of energy	
Core oven (2)	Type	
	Built year	
	Temperature	
	Kind of energy	
Shot blast (1)	Type	
	Capacity	
	Built year	
	Rated output of motor	
	Rated output of dust collector	
Shot blast (2)	Type	
	Capacity	
	Built year	
	Rated output of motor	
	Rated output of dust collector	

Main specification of Casting process

Equipment	Specification	
Annealing Furnace (1)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Annealing Furnace (2)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Drying furnace (1)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Drying furnace (2)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Another		

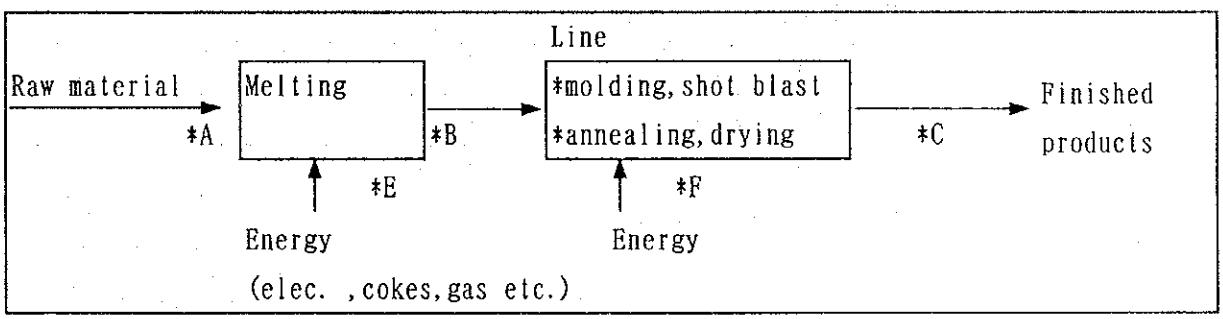
(2) Design and operational information(Typical equipment)

Process	Item	Design	Actual
Cupola (1)	Productivity	t/hour	t/hour
	Ratio of cokes	%	%
	Cokes intensity	kg/ton	kg/ton
	Form of operation	h/day (h/month)	h/day (h/month)
	Molten volume	ton/year	ton/year
Cupola (2)	Productivity	t/hour	t/hour
	Ratio of cokes	%	%
	Cokes intensity	kg/ton	kg/ton
	Form of operation	h/day (h/month)	h/day (h/month)
	Molten volume		
Heat insulation furnace (1)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Form of operation	h/day (h/month)	h/day (h/month)
Heat insulation furnace (2)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Form of operation	h/day (h/month)	h/day (h/month)
Molding machine	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton (kWh/t)	Mcal/ton (kWh/t)
	Form of operation	h/day (h/month)	h/day (h/month)
Core oven	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)

Design and operational information(Typical equipment)

Process	Item	Design	Actual
Shot blast	Productivity	t/hour	t/hour
	Energy consumption	Mcal/ton (kWh/t)	Mcal/ton (kWh/t)
	Form of operation	h/day (h/month)	h/day (h/month)
Annealing furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)
Drying furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)

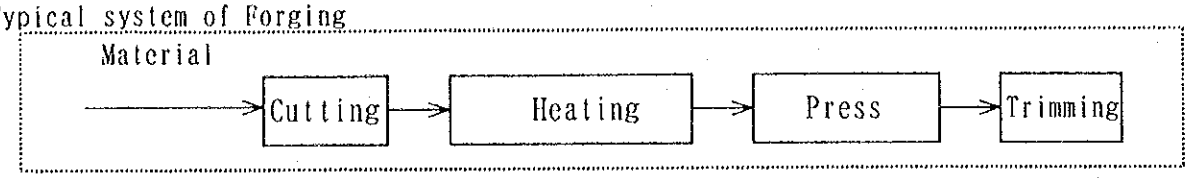
(3) Whole operation



1. A ratio of melting metal for charged raw materials: (*A/*B)= about %
2. A ratio of finished products for casting metal: (*B/*C)= about %
3. Energy consumption rate for melting metal: (*E/*A)= Mcal/ton
4. Energy consumption rate for all casting process: (*E+*F)/*C= Mcal/ton
5. Typical operation hours of casting process
   hours/day
   (hours/month)
6. Total products of casting per year
   ton/year

3-2. Forging

Typical system of Forging



(1) Main specification of Casting process (Major equipment for energy consumptio

Equipment		Specification	
Cutting machine Shearing machine (over 30 KW)	(1)	Type	
		Built year	
		Motor power	KW
	(2)	Type	
		Built year	
		Motor power	KW
	(3)	Type	
		Built year	
		Motor power	KW
Heating furnace	(1)	Type	
		Built year	
		Capacity	
		Kind of energy	
		Temperature	℃
	(2)	Type	
		Built year	
		Capacity	
		Kind of energy	
		Temperature	℃
Press / Air hammer	(1)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
	(2)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	

Equipment	Specification		
Press / Air hammer	(3)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
	(4)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
Trimming	(1)	Type	
		Built year	
		Motor power	KW
	(2)	Type	
		Built year	
		Motor power	KW
Another		Name of equipment	
		Type	
		Capacity	
		Built year	
		Motor power	

(2) Design and operational information Forging line(Typical equipment)

Process	Item	Design	Actual
Cutting machine Shearing machine (over 30 KW)	Form of operation	h/day (h/month)	h/day (h/month)
Heating furnace (1)	Productivity		
	Temperature		
	Kind of energy		
	Energy consumption		
	Form of operation	h/day (h/month)	h/day (h/month)

Design and operational information Forging line(Typical equipment)

Process	Item	Design	Actual
Heating furnace (2)	Productivity	t/hour	t/hour
	Temperature	℃	℃
	Kind of energy		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (1)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (2)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (3)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (4)	Productivity	ton/hour	ton/hour
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Trimming	Productivity	ton/hour	ton/hour
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)

(3) Whole operation

1. A ratio of finished products for forging materials: about % (output / input)

2. Energy consumption rate for all Forging process: about Mcal/ton

3. Typical operation hours of Forging process hours/day

(hours/month)

4. Total products of casting per year ton/year

3-3. Machining

(1) Main specification and operating formation of major Equipments for energy consumption at Machining process

Kind of Energy	NO	Main specification			Form of operation				
		Name of equipment	Specification		Item	Design		Actual	
Electricity (Except heat treatment equipment)	1		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	2		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	3		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	4		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	5		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	6		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
Fuel and gas	1	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	2	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	3	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	4	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	5	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	6	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%

Main specification and operating formation of major Equipments for energy consumption at Machining process

Kind of Energy	NO	Main specification			Form of operation				
		Name of equipment	Specification		Item	Design		Actual	
Electricity	1	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
	2	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
	3	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
Fuel or gas	1	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
	2	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
	3	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
Compressed Air	1	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m3/min	Rate of operation	about	%	about	%
	2	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m4/min	Rate of operation	about	%	about	%
	3	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m5/min	Rate of operation	about	%	about	%
	4	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m6/min	Rate of operation	about	%	about	%
	5	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m7/min	Rate of operation	about	%	about	%

3-3. Assembly

(1) Main specification and operating formation of major Equipments for energy consumption at assembly line

Kind of Energy	NO	Main specification			Form of operation		
		Name of equipment	Specification		Item	Design	Actual
Electricity	1	Assembly conveyor for	Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
	2	Assembly conveyor for	Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
	3		Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
	4		Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
	5		Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
	6		Motor power	KW	Form of operation	h/day	h/day
					Rate of operation	about %	about %
Fuel and gas	1	Washing machine	Pump motor power	KW	Form of operation	h/day	h/day
			Temp. of liquid	℃	Rate of operation	about %	about %
	2	Washing machine	Pump motor power	KW	Form of operation	h/day	h/day
			Temp. of liquid	℃	Rate of operation	about %	about %
Compressed Air	1	Air blow machine after washing	Pressure		Form of operation	h/day	h/day
			Max. consumption	m3/min	Rate of operation	about %	about %
	2	Air blow machine after washing	Pressure		Form of operation	h/day	h/day
			Max. consumption	m4/min	Rate of operation	about %	about %

Main specification and operating formation of major Equipments for energy consumption at assembly line

Kind of Energy	NO	Main specification			Form of operation		
		Name of equipment	Specification		Item	Design	Actual
Electricity	1	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
	2	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
	3	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
Compressed Air	1	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				
	2	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				
	3	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				

3-4. Painting and Drying

(1) Main specification and operating formation of major Equipments for energy consumption at Painting & Drying

Kind of Energy	NO	Main specification			Form of operation		
		Name of equipment	Specification		Item	Design	Actual
	1	Paint booth (1)			Typical product		
					Kind of paints		
					Painting time	min/unit	min/unit
					productivity	units/day	units/day
					Form of operation	h/day	h/day
	2	Paint booth (2)			Typical products		
					Kind of paints		
					Painting time	min/unit	min/unit
					productivity	units/day	units/day
					Form of operation	h/day	h/day
	1	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power (lump)		productivity	units/day	units/day
			Temp. of hot wind		Form of operation	h/day	h/day
	2	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power (lump)		productivity	units/day	units/day
			Temp. of hot wind		Form of operation	h/day	h/day

4. Energy Management

(1) Energy conservation strategy and target

(2) How do you follow about it ?

(3) Energy conservation promotion organization

(4) Activity of energy conservation committee

(5) The group that execute mainly energy conservation activity

(6) System of collect the idea for improvement and estimating system

(7) Investment for energy conservation in the past

Year	Contents of investment	Cost of investment	Expectation of effect	Results

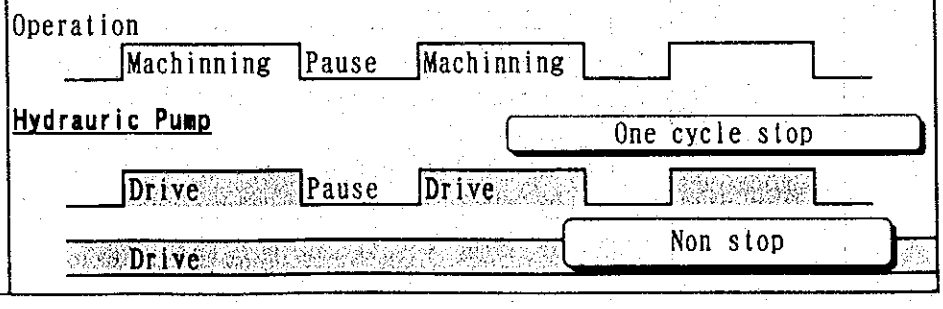
(8) Energy conservation activity

Please mark applicable ones.

Example: (A) =Operating/Installed
(B) =Not perfect but operating as a role /Under construction
(C) =Not operating/Under planning

Process	NO.	Items	Application	Year of application
Management system	1	Awareness of energy conservation to employee	( )	
	2	Education of correct operating method to employee	( )	
	3	Collecting system of idea for improvement and estimating system	( )	
Operation system	4	Operation in low electricity rate such as night and holiday	( )	
	5	Shift of operating time and working day in order to use energy efectively	( )	
	6	To turn off elctricity when no one is in the office	( )	
	7	To turn off the power of an equipment that is not used for hours	( )	
	8	Control the temperature for a heater	( )	
	9	Cleaning the electric appliances (Cycle = years)	( )	
	10	Light-on & light-off by actual bright (Outside lighting)	( )	
	11	To use a efficiency light	( )	
ユーティリテイ	12	Reduction of compreesed air pressure	( )	
	13	Pressure control of compressed air	( )	
	14	Pressure control of steam	( )	
	15	Recovery steam drain	( )	
	16	Control of power factor	( )	
	17	To reduce a pressure loss of pipe	( )	
	18	Local supply of compreessed air by booster	( )	
	19	Suitable supply by number control of small compreeser	( )	
	20	To stop the compresser in plant holiday	( )	
	21	To repair of broken windows and doors for avoiding heat loss	( )	
	22	To stop a few leak of compressed air even if it is no problem for production	( )	
	23	Enforce the insulation of steam pipe	( )	

Process	NO.	Items	Application	Year of application
Casting	24	Improvement of energy consumption rate of melting(ton)	( )	
	25	To reduce the failure in casting	( )	
	26	To reduce the idling time of machine	( )	
	27	To avoid cold air invasion in treatment furnace	( )	
	28	(Cupola)Pre-heating of blast by exhaust gas	( )	
	29	(Cupola)Long and continuous operation	( )	
	30	(Cupola)Oxygen enrichment in blast	( )	
	31	To control the r.p.m of dust collector	( )	
	32	Stop of dust collector during stop of production line	( )	
	33	Enforcement the insulation of furnace	( )	
	34	Concentrated control the accumulators of hydraulic system (to combine several accumulator)	( )	
	35	(Shot blast)Minimum time of shot blast	( )	
	36	(Shot blast)To control a suitable shot time by work	( )	
	37	To reduce the idling time of sand treatment equipment at a lunch break	( )	
	38	Recirculation of cooling water	( )	
	39	To control a suitable blow time for molding	( )	
	40	To reduce the idling time of grind motor for casting	( )	
Forging	41	To reduce the idling time of machine	( )	
	42	To reduce the allowance by improvement of material	( )	
	43	To avoid cold air invasion in heating furnace	( )	
	44	To avoid cold air invasion in heating furnace	( )	
	45	Simple arrangements toreduce preparation time at line changing	( )	
Machining	46	To reduce the idling time of machine	( )	
	47	To reduce the warm-up time	( )	
	48	Use the function of"one cycle stop"	( )	



Process	NO.	Items	Application	Year of application
(machining)	49	Simplify the machining process (no milling, drilling...)	( )	
	50	To reduce the amount of machining (To reduce the machining time)	( )	
	51	To reduce the failure of machining (To reduce the energy of remake)	( )	
	52	To combine several machining process with multiple equipment to reduce the number of equipment.	( )	
	53	Control the temperature of washing liquid	( )	
	54	Air blow after washing only during the product is there.	( )	
Assembly	55	To reduce the idling time of machine	( )	
	56	To reduce the warm-up time	( )	
	57	Use the function of"one cycle stop" (refer NO.49)	( )	
	58	To reduce the assembly process	( )	
	59	To reduce the assembly time(speed up)	( )	
	60	To reduce thefailure of machining	( )	
Painting and Drying	61	To avoid cold air invasion in drving furnace	( )	
	62	To use quick dry type paint	( )	
	63	To reduce a thickness of coating	( )	
Another	64	improvement the power factor of large sized motor	( )	
	65	Concentrated production (close the factory during no product)	( )	
	66	Improvement of quality(reduction of failure)	( )	
	67	Replacement of old pump with high efficiency	( )	

Check List for Process of Truck Production

Date _____

Surveyor _____

1. General information

(1) Factory name

Company name: Starachowice company "STAR"

(2) Adress Factory: _____

Head Office : _____

(3) Numbers of Employees

_____

(4) Main Products and production capacity

Name of Unit	Production Capacity	Start-up year
(a)		
(b)		
(c)		
(d)		
(e)		

(5) Production of Main Product and Future Production Plan

Products	1992	1993	1994	1995	1996	1997 (Plan)	2000 (Plan)
(a)							
(b)							
(c)							
(d)							
(e)							

(6) History of the plant

(Foundation and expansion the plant , rebuild , new production system share in the Industry , History of production etc.)

Foundation:

History of expantion

Share of products in Poland

(6) Outline of Production Processes(Process Flow Sheet)

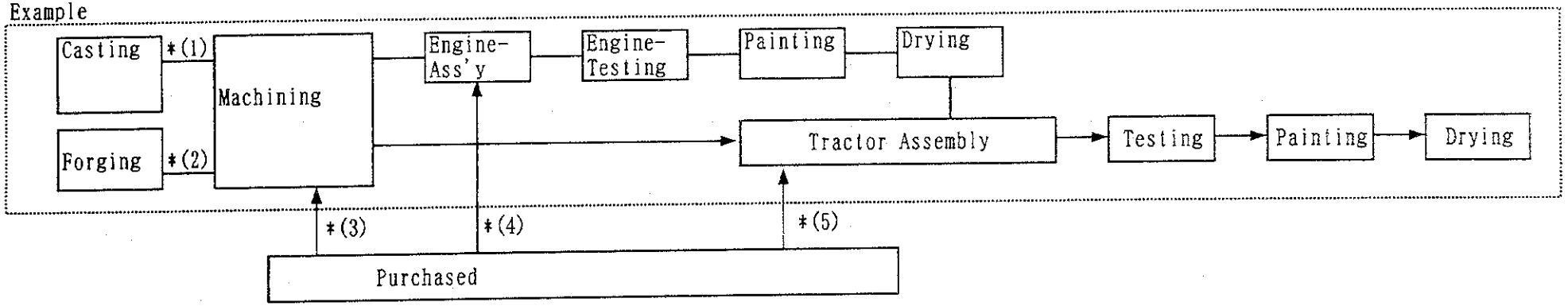
Next page

(7) Factory and Plant Layout

Please separately prepare.

6. Out-line of production process

Example



NO	Name of product/parts	Example
*(1)		Cylinder-block , Ccylinder-head Counter weight
*(2)		Crank-shaft Connecting-rod
*(3)		Bracket
*(4)		Fuel-pump, Starter
*(5)		Tire/wheel

2. Transition of Energy Consumption

(1) Unit Price of Energy (1995-1996)

Energy	Heat value		Unit price	
	Heat value	Unit	1995	1996
Coal		kcal/t	/t	/t
Fuel Oil		kcal/kl	/kl	/kl
Gas Oil		kcal/kl	/kl	/kl
Kerosene		kcal/kl	/kl	/kl
LPG		kcal/kg	/kg	/kg
Natural Gas		kcal/m3	/m3	/m3
Electricity				
In-house		kcal/kWh	/kWh	/kWh
Purchased		kcal/kWh	/kWh	/kWh
Demand			/kW	/kW

(2) Tend of Energy Consumption

Energy	Unit	1992	1993	1994	1995	1996	1997 (Plan)
Coal	(t)						
Fuel Oil	(kl)						
Gas Oil	(kl)						
Kerosene	(kl)						
LPG	(kg)						
Natural Gas	(m3)						
Electricity							
Total	(mWh)						
In-house	(mWh)						
Purchased	(mWh)						
Demand	(kW)						

(3) Energy consumption for each plant/process in 1996 (or 1995)

(another sheet --page. 5--)

2.(3) Energy consumption for each plant/process in 1996(or 1995)

Process	Production		Electricity	Coal	Fuel oil	Gas oil	Kerosene	LPG	Natural gas
	Product	Unit	▪ kWh	ton	kl	kl	kl	kg	▪ Nm3
Energy supply									
(1)Air compresser									
(2)Boiler									
(3)generator									
(4)Others									
(Sub-total)									
Casting									
(1)Melting									
(2)Others									
(Sub-total)									
Forging									
Machining(include parts shop)									
Assembly									
Paint & Drying									
Others(office,...)									
Consumption total									
(1)In-house									
(2)Purchased									

(4) Tend of Energy intensity by process

(Energy supply , Casting , Forging , Machining , Assembly , others)

(4)-1. Energy supply station /shop

			1994	1995	1996
Product (*1)	Steam	ton	ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (" kcal)					
Energy intensity (*2 / *1) (" kcal/ton)					

(4)-2. Casting

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (" kcal)					
Energy intensity (*2 / *1) (" kcal/ton)					

(4)-3. Forging

			1994	1995	1996
Product (*1)	ton		ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (" kcal)					
Energy intensity (*2 / *1) (" kcal/ton)					

(4)-4. Machining

			1994	1995	1996
Product (*1)		ton	ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

(4)-5. Assembly

			1994	1995	1996
Product (*1)		ton	ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

(4)-6. ( )

			1994	1995	1996
Product (*1)		ton	ton	ton	ton
Energy unit	Heat Value				
Coal (ton)		kcal/t	ton	ton	ton
Fuel oil (kl)		kcal/kl	kl	kl	kl
Gas oil (kl)		kcal/kl	kl	kl	kl
Kerosene (kl)		kcal/kl	kl	kl	kl
LPG (kg)		kcal/kg	kg	kg	kg
Natural. (m3)		kcal/m3	m3	m3	m3
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (* kcal)					
Energy intensity (*2 / *1) (* kcal/ton)					

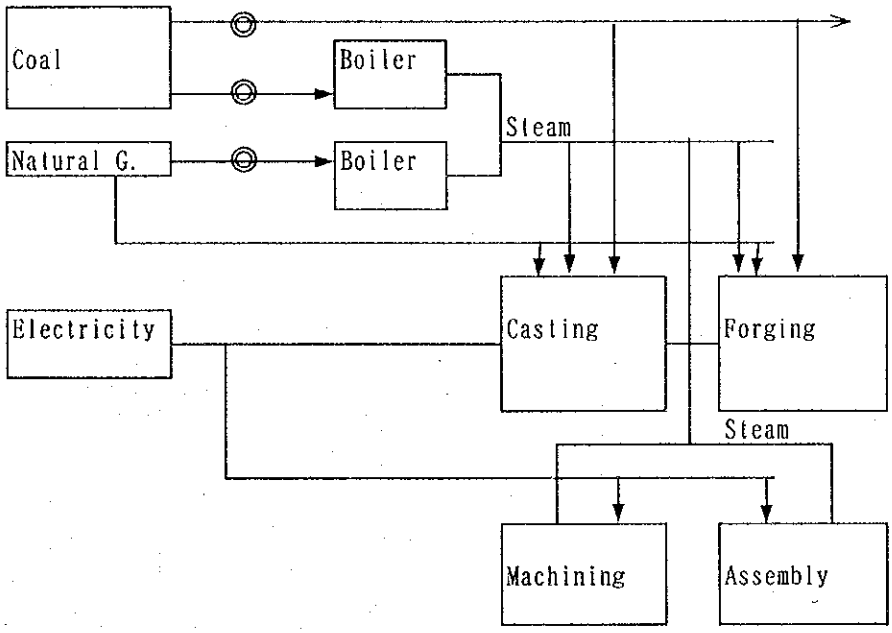
(5)Rate of energy cost for production cost in whole plant

$$\frac{\text{Energy cost}}{\text{Production cost}} = \frac{\qquad}{\qquad} = \boxed{\quad}\%$$

(6)How much is the target rate of energy cost vs Production cost? : ____%

(7) Energy supply flow diagram showing flow meter location like a following example

Example of energy supply fow diagram



(8) Major equipment for Compressed Air consumption

No	Name of process/line	Name of equipmen	Purpose to use	Pressure	Max consumption (m3/min)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

(9) Major equipment for Steam consumption

No	Name of process/line	Name of equipmen	Purpose to use	Pressure	Max consumption (ton/h)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

(10) Average temperature for the Office and plant

Season	Setting Temperature (Area)
	(Area:)
	(Area:)
	(Area:)
	(Area:)
	(Area:)
	(Area:)

3. Production system

3-1. Casting (Melt and Mold)

(1) Main specification of Casting process (Major equipment for energy consumption)

Equipment	Specification		
Cupola (1) (set)	Type		
	Built year		
	Capacity		ton/hour
	Ratio of cokes(ｺｰｸｽ比)		%
	Cokes intensity(ｺｰｸｽ原単位)		kg/ton
	Maximum inside dia. of the melting zone (溶解帯最大炉内径)		mm
	Melting Temperature (溶湯温度)		℃
	Temp. of hot ventilation		℃
	AmOunt of hot ventilation		Nm3/min
Cupola (2) (set)	Type		
	Built year		
	Capacity		ton/hour
	Ratio of cokes(ｺｰｸｽ比)		%
	Cokes intensity(ｺｰｸｽ原単位)		kg/ton
	Maximum inside dia. of the melting zone (溶解帯最大炉内径)		mm
	Melting Temperature (溶湯温度)		℃
	Temp. of hot ventilation		℃
	AmOunt of hot ventilation		Nm3/min
Heat insulation furnace (1)	Type		
	Built year		
	Kind of energy		
	Frequency		Hz
	Capacity		
	Temperature(Target of furnace temp.)		℃
Heat insulation furnace (2)	Type		
	Built year		
	Kind of energy		
	Frequency		Hz
	Capacity		
	Temperature(Target of furnace temp.)		℃

Main specification of Casting process

Equipment	Specification	
Molding machine (1)	Type	
	Built year	
	Kind of energy	
	Rated output of driving motor	KW
Molding machine (2)	Type	
	Built year	
	Kind of energy	
	Rated output of driving motor	KW
Core oven (1)	Type	
	Built year	
	Temperature	
	Kind of energy	
Core oven (2)	Type	
	Built year	
	Temperature	
	Kind of energy	
Shot blast (1)	Type	
	Capacity	
	Built year	
	Rated output of motor	
	Rated output of dust collector	
Shot blast (2)	Type	
	Capacity	
	Built year	
	Rated output of motor	
	Rated output of dust collector	

Main specification of Casting process

Equipment	Specification	
Annealing Furnace (1)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Annealing Furnace (2)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Drying furnace (1)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Drying furnace (2)	Type	
	Size	
	Built year	
	Temperature	
	Kind of energy	
Another		

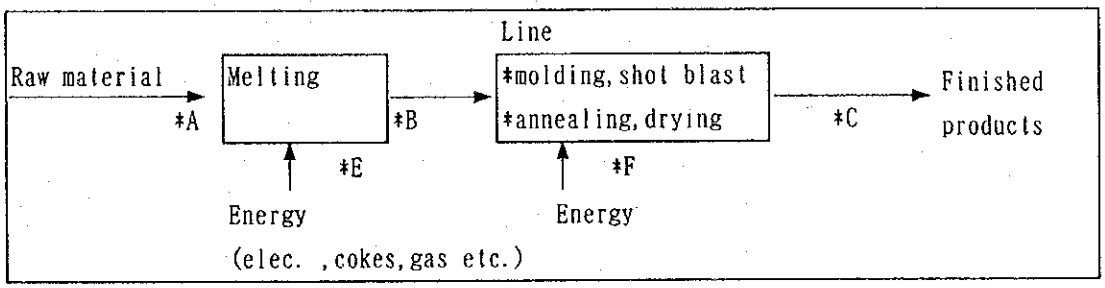
(2) Design and operational information(Typical equipment)

Process	Item	Design	Actual
Cupola (1)	Productivity	t/hour	t/hour
	Ratio of cokes	%	%
	Cokes intensity	kg/ton	kg/ton
	Form of operation	h/day (h/month)	h/day (h/month)
	Molten volume	ton/year	ton/year
Cupola (2)	Productivity	t/hour	t/hour
	Ratio of cokes	%	%
	Cokes intensity	kg/ton	kg/ton
	Form of operation	h/day (h/month)	h/day (h/month)
	Molten volume		
Heat insulation furnace (1)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Form of operation	h/day (h/month)	h/day (h/month)
Heat insulation furnace (2)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Form of operation	h/day (h/month)	h/day (h/month)
Molding machine	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton (kWh/t)	Mcal/ton (kWh/t)
	Form of operation	h/day (h/month)	h/day (h/month)
Core oven	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)

Design and operational information(Typical equipment)

Process	Item	Design	Actual
Shot blast	Productivity	t/hour	t/hour
	Energy consumption	Mcal/ton (kWh/t)	Mcal/ton (kWh/t)
	Form of operation	h/day (h/month)	h/day (h/month)
Annealing furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)
Drying furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Form of operation	h/day (h/month)	h/day (h/month)

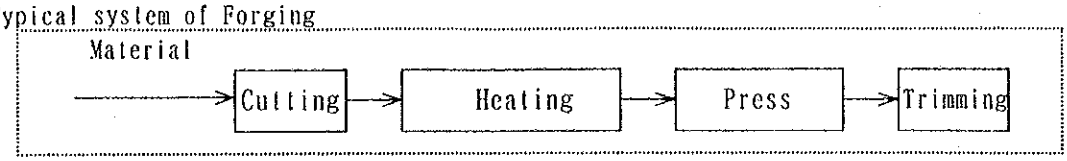
(3) Whole operation



1. A ratio of melting metal for charged raw materials: (*A/*B)= about %
2. A ratio of finished products for casting metal: (*B/*C)= about %
3. Energy consumption rate for melting metal: (*E/*A)= Mcal/ton
4. Energy consumption rate for all casting process: (*E+*F)/*C= Mcal/ton
5. Typical operation hours of casting process hours/day
(hours/month)
6. Total products of casting per year ton/year

3-2. Forging

Typical system of Forging



(1) Main specification of Casting process (Major equipment for energy consumption)

Equipment		Specification	
Cutting machine Shearing machine (over 30 KW)	(1)	Type	
		Built year	
		Motor power	KW
	(2)	Type	
		Built year	
		Motor power	KW
	(3)	Type	
		Built year	
		Motor power	KW
Heating furnace	(1)	Type	
		Built year	
		Capacity	
		Kind of energy	
		Temperature	℃
	(2)	Type	
		Built year	
		Capacity	
		Kind of energy	
		Temperature	℃
Press / Air hammer	(1)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
	(2)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	

Equipment	Specification		
Press / Air hammer	(3)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
	(4)	Type	
		Capacity	ton
		Built year	
		Motor power	KW
		Kind of energy	
Trimming	(1)	Type	
		Built year	
		Motor power	KW
	(2)	Type	
		Built year	
		Motor power	KW
Another		Name of equipment	
		Type	
		Capacity	
		Built year	
		Motor power	

(2) Design and operational information Forging line(Typical equipment)

Process	Item	Design	Actual
Cutting machine Shearing machine (over 30 KW)	Form of operation	h/day (h/month)	h/day (h/month)
Heating furnace (1)	Productivity		
	Temperature		
	Kind of energy		
	Energy consumption		
	Form of operation	h/day (h/month)	h/day (h/month)

Design and operational information Forging line(Typical equipment)

Process	Item	Design	Actual
Heating furnace (2)	Productivity	t/hour	t/hour
	Temperature	℃	℃
	Kind of energy		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (1)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (2)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (3)	Productivity		
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Press / Air hammer (4)	Productivity	ton/hour	ton/hour
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)
Trimming	Productivity	ton/hour	ton/hour
	Energy consumption	/ton	/ton
	Form of operation	h/day	h/day
		(h/month)	(h/month)

(3) Whole operation

1. A ratio of finished products for forging materials: about % (output / input)
2. Energy consumption rate for all Forging process: about Mcal/ton
3. Typical operation hours of Forging process hours/day (hours/month)
4. Total products of casting per year ton/year

3-3. Machining

(1) Main specification and operating formation of major Equipments for energy consumption at Machining process

Kind of Energy	NO	Main specification			Form of operation				
		Name of equipment	Specification		Item	Design		Actual	
Electricity (Except heat treatment equipment)	1		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	2		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	3		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	4		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	5		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	6		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
Fuel and gas	1	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	2	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	3	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	4	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	5	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	6	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%

Main specification and operating formation of major Equipments for energy consumption at Machining process

Kind of Energy	NO	Main specification			Form of operation				
		Name of equipment	Specification		Item	Design		Actual	
Electricity	1	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
	2	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
	3	Induction hardening machine	Ppower	KW	Form of operation		h/day		h/day
			Frequency	Hz	Rate of operation	about	%	about	%
Fuel or gas	1	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
	2	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
	3	Heating furnace	Kind of energy		Form of operation		h/day		h/day
			Temperature	℃	Rate of operation	about	%	about	%
Compressed Air	1	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m3/min	Rate of operation	about	%	about	%
	2	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m4/min	Rate of operation	about	%	about	%
	3	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m5/min	Rate of operation	about	%	about	%
	4	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m6/min	Rate of operation	about	%	about	%
	5	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m7/min	Rate of operation	about	%	about	%

3-3. Assembly

(1) Main specification and operating formation of major Equipments for energy consumption at assembly line

Kind of Energy	NO	Main specification			Form of operation				
		Name of equipment	Specification		Item	Design		Actual	
Electricity	1	Assembly conveyor for	Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	2	Assembly conveyor for	Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	3		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	4		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	5		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
	6		Motor power	KW	Form of operation		h/day		h/day
					Rate of operation	about	%	about	%
Fuel and gas	1	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
	2	Washing machine	Pump motor power	KW	Form of operation		h/day		h/day
			Temp. of liquid	℃	Rate of operation	about	%	about	%
Compressed Air	1	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m3/min	Rate of operation	about	%	about	%
	2	Air blow machine after washing	Pressure		Form of operation		h/day		h/day
			Max. consumption	m4/min	Rate of operation	about	%	about	%

Main specification and operating formation of major Equipments for energy consumption at assembly line

Kind of Energy	NO	Main specification			Form of operation		
		Name of equipment	Specification		Item	Design	Actual
Electricity	1	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
	2	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
	3	Electric nut runner (Electric driver)	Motor power	KW	Form of operation	h/day	h/day
			Max. torque				
Compressed Air	1	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				
	2	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				
	3	Air nut runner (Air driver)	Pressure		Form of operation	h/day	h/day
			Max. torque				

3-4. Painting and Drying

(1) Main specification and operating formation of major Equipments for energy consumption at Painting & Drying

Kind of Energy	NO	Main specification			Form of operation		
		Name of equipment	Specification		Item	Design	Actual
	1	Paint booth (1)			Typical product		
					Kind of paints		
					Painting time	min/unit	min/unit
					productivity	units/day	units/day
					Form of operation	h/day	h/day
	2	Paint booth (2)			Typical products		
					Kind of paints		
					Painting time	min/unit	min/unit
					productivity	units/day	units/day
					Form of operation	h/day	h/day
	1	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power (lump)		productivity	units/day	units/day
			Temp. of hot wind		Form of operation	h/day	h/day
	2	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power (lump)		productivity	units/day	units/day
			Temp. of hot wind		Form of operation	h/day	h/day

4. Energy Management

(1) Energy conservation strategy and target

(2) How do you follow about it ?

(3) Energy conservation promotion organization

(4) Activity of energy conservation committee

(5) The group that execute mainly energy conservation activity

(6) System of collect the idea for improvement and estimating system

(7) Investment for energy conservation in the past

Year	Contents of investment	Cost of investment	Expectation of effect	Results

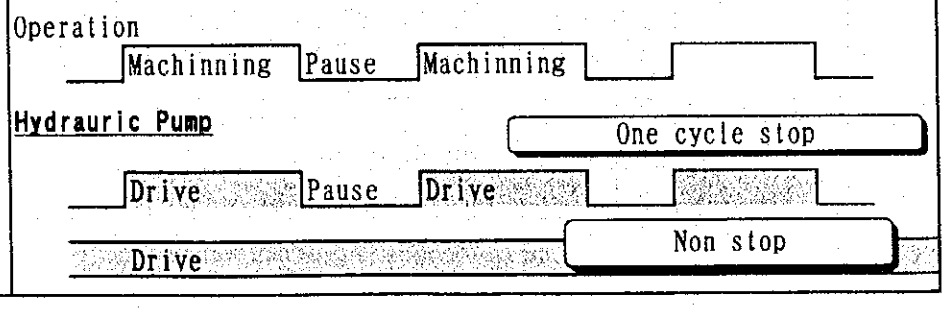
(8) Energy conservation activity

Please mark applicable ones.

Example: (A) =Operating/Installed
(B) =Not perfect but operating as a role /Under construction
(C) =Not operating/Under planning

Process	NO.	Items	Application	Year of application
Management system	1	Awareness of energy conservation to employee	( )	
	2	Education of correct operating method to employee	( )	
	3	Collecting system of idea for improvement and estimating system	( )	
Operation system	4	Operation in low electricity rate such as night and holiday	( )	
	5	Shift of operating time and working day in order to use energy efectively	( )	
	6	To turn off elctricity when no one is in the office	( )	
	7	To turn off the power of an equipment that is not used for hours	( )	
	8	Control the temperature for a heater	( )	
	9	Cleaning the electric appliances (Cycle = years)	( )	
	10	Light-on & light-off by actual bright (Outside lighting)	( )	
	11	To use a efficiency light	( )	
ﾕｰﾃｨﾘﾃｲ	12	Reduction of compreesed air pressure	( )	
	13	Pressure control of compressed air	( )	
	14	Pressure control of steam	( )	
	15	Recovery steam drain	( )	
	16	Control of power factor	( )	
	17	To reduce a pressure loss of pipe	( )	
	18	Local supply of compreessed air by booster	( )	
	19	Suitable supply by number control of small compreeser	( )	
	20	To stop the compresser in plant holiday	( )	
	21	To repair of broken windows and doors for avoiding heat loss	( )	
	22	To stop a few leak of compressed air even if it is no problem for production	( )	
	23	Enforce the insulation of steam pipe	( )	

Process	NO.	Items	Application	Year of application
Casting	24	Improvement of energy consumption rate of melting(ton)	( )	
	25	To reduce the failure in casting	( )	
	26	To reduce the idling time of machine	( )	
	27	To avoid cold air invasion in treatment furnace	( )	
	28	(Cupola)Pre-heating of blast by exhaust gas	( )	
	29	(Cupola)Long and continuous operation	( )	
	30	(Cupola)Oxygen enrichment in blast	( )	
	31	To control the r.p.m of dust collector	( )	
	32	Stop of dust collector during stop of production line	( )	
	33	Enforcement the insulation of furnace	( )	
	34	Concentrated control the accumulators of hydraulic system (to combine several accumulator)	( )	
	35	(Shot blast)Minimum time of shot blast	( )	
	36	(Shot blast)To control a suitable shot time by work	( )	
	37	To reduce the idling time of sand treatment equipment at a lunch break	( )	
	38	Recirculation of cooling water	( )	
	39	To control a suitable blow time for molding	( )	
	40	To reduce the idling time of grind motor for casting	( )	
Forging	41	To reduce the idling time of machine	( )	
	42	To reduce the allowance by improvement of material	( )	
	43	To avoid cold air invasion in heating furnace	( )	
	44	To avoid cold air invasion in heating furnace	( )	
	45	Simple arrangements toreduce preparation time at line changing	( )	
Machining	46	To reduce the idling time of machine	( )	
	47	To reduce the warm-up time	( )	
	48	Use the function of"one cycle stop"	( )	



Process	NO.	Items	Application	Year of application
(machining)	49	Simplify the machining process (no milling, drilling...)	( )	
	50	To reduce the amount of machining (To reduce the machining time)	( )	
	51	To reduce the failure of machining (To reduce the energy of remake)	( )	
	52	To combine several machining process with multiple equipment to reduce the number of equipment.	( )	
	53	Control the temperature of washing liquid	( )	
	54	Air blow after washing only during the product is there.	( )	
Assembly	55	To reduce the idling time of machine	( )	
	56	To reduce the warm-up time	( )	
	57	Use the function of"one cycle stop" (refer NO.49)	( )	
	58	To reduce the assembly process	( )	
	59	To reduce the assembly time(speed up)	( )	
	60	To reduce thefailure of machining	( )	
Painting and Drying	61	To avoid cold air invasion in drying furnace	( )	
	62	To use quick dry type paint	( )	
	63	To reduce a thickness of coating	( )	
Another	64	improvement the power factor of large sized motor	( )	
	65	Concentrated production (close the factory during no product)	( )	
	66	Improvement of quality(reduction of failure)	( )	
	67	Replacement of old pump with high efficiency	( )	