9.2 化学

9.2.1 化学 (Blachownia, Poch)

(1) エチルベンゼン

a. 測定目的

エチルベンゼンの製造過程におけるエネルギー使用状況を把握する。

b. 測定項目、測定時間、計測器、データ処理

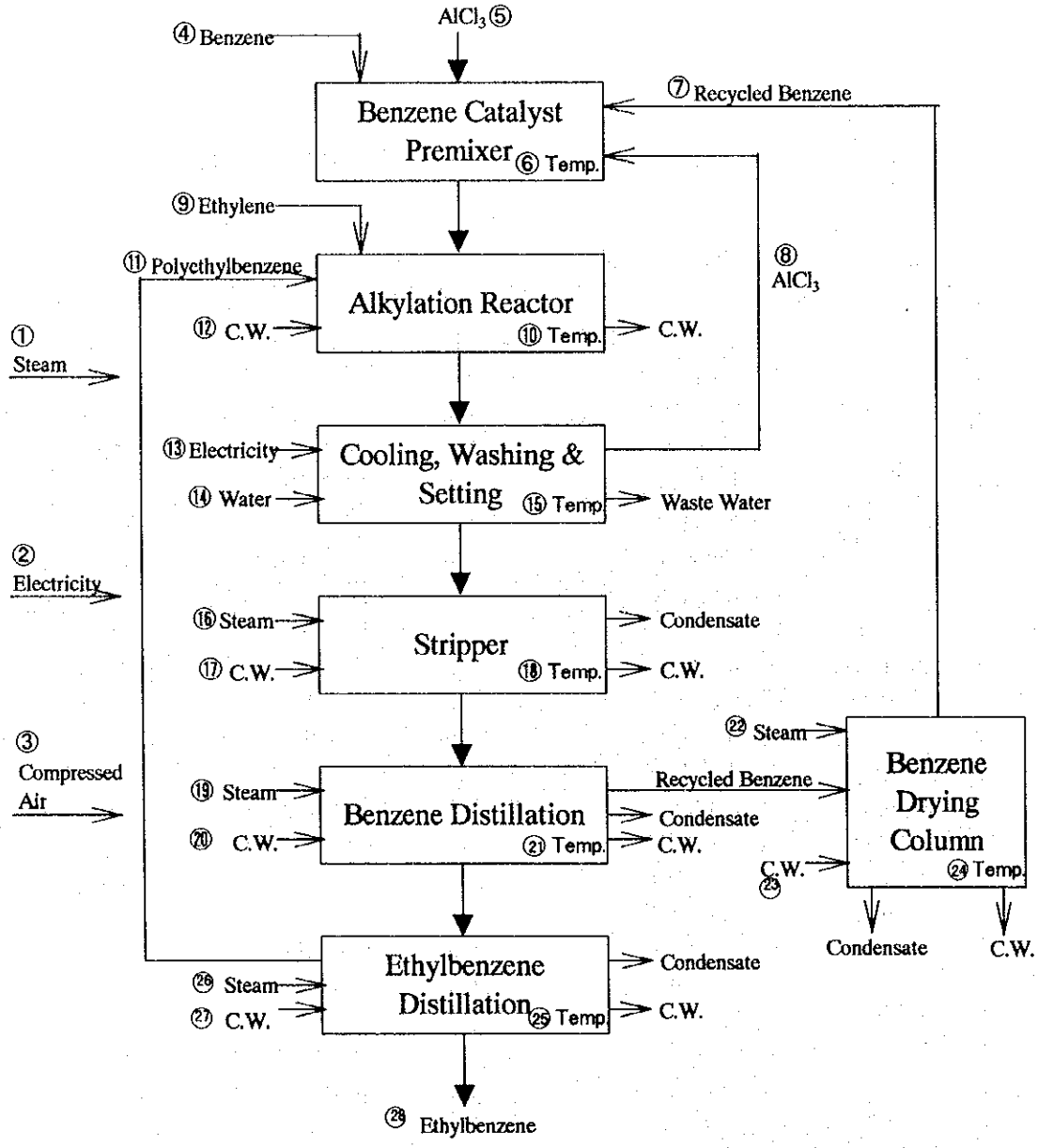
測 定 項 目		測定時間	計測器	データ処理
Total	① Total 蒸気流量	24h	操業用メータ	Memo
	② Total 電力量	24h	クランプメータ	to FDD
	③ Total 圧縮空気量	24h	操業用メータ	Memo
Benzene Catalyst Premixer	④ 投入 Benzene 量	24h	操業記録	Memo
	⑤ 投入 $AlCl_3$ 量	24h	操業記録	Memo
	⑥ 反応温度	24h	操業用メータ	Memo
	⑦ Benzene 量	24h	操業記録	Memo
	⑧ Recycled $AlCl_3$ 量	24h	操業記録	Memo
Alkylation Reactor	⑨ 投入 Ethylene 量	24h	操業記録	Memo
	⑩ 反応温度	24h	操業用メータ	Memo
	⑪ Polyethylbenzene 量	24h	操業記録	Memo
	⑫ 冷却水量	24h	操業用メータ	Memo
Cooling, Washing & Setting	⑬ 電力量	24h	クランプメータ	to FDD
	⑭ 水量	24h	超音波流量計	to Recorder
	⑮ 反応温度	24h	操業用メータ	Memo
Stripper	⑯ 蒸気流量	24h	操業用メータ	Memo
	⑰ 冷却水量	24h	操業用メータ	Memo
	⑱ 反応温度	24h	操業用ﾒｰﾀ	Memo
Benzene Distillation	⑲ 蒸気流量	24h	操業用メータ	Memo
	⑳ 冷却水量	24h	操業用メータ	Memo
	㉑ 反応温度	24h	操業用メータ	Memo
Benzene Drying Column	㉒ 蒸気流量	24h	操業用メータ	Memo
	㉓ 冷却水量	24h	操業用メータ	Memo
	㉔ 反応温度	24h	操業用メータ	Memo
Ethylbenzene Distillation	㉕ 反応温度	24h	操業用メータ	Memo
	㉖ 蒸気流量	24h	操業用メータ	Memo
	㉗ 冷却水量	24h	操業用メータ	Memo
	㉘ 製品量	24h	操業記録	Memo

note) 各設備の断熱状況を把握するため表面の温度を表面温度計、放射温度計等で適時測定する。

c. 測定点

エチルベンゼンの測定点を Figure 9.2.1 に示す。

Figure 9.2.1 Measuring Points of Ethylbenzene Process



(2) ベンゼン

a. 測定目的

ベンゼンの製造過程におけるエネルギー使用状況を把握する。

b. 測定項目、測定時間、計測器、データ処理

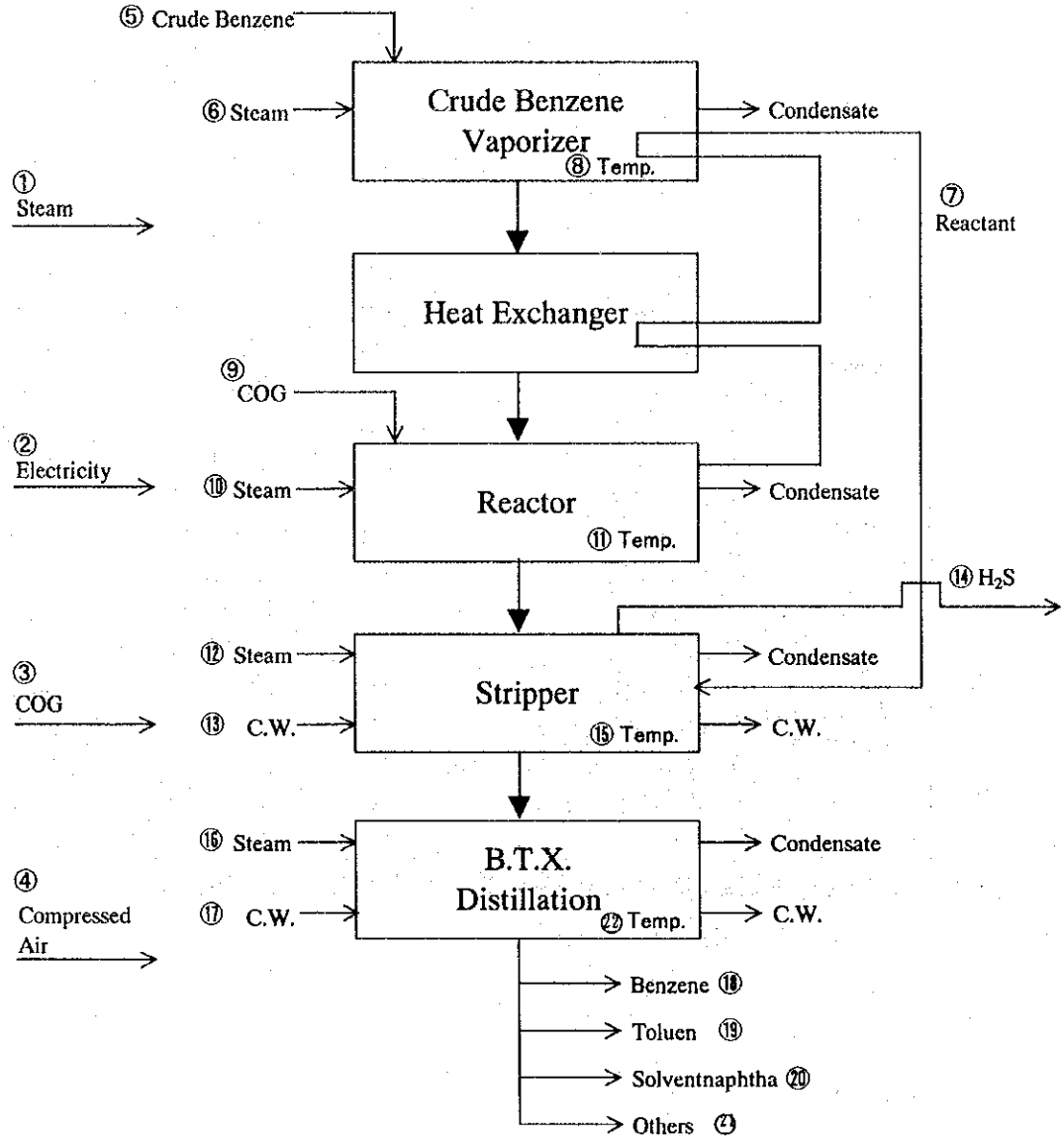
測 定 項 目		測定時間	計測器	データ処理
Total	① Total 蒸気流量	24h	操業用メータ	Memo
	② Total 電力量	24h	クランプメータ	to FDD
	③ Total COG 量	24h	操業用メータ	Memo
	④ Total 圧縮空気量	24h	操業用メータ	Memo
Crude Benzene Vaporizer	⑤ 粗 Benzene	24h	操業記録	Memo
	⑥ 蒸気流量	24h	操業用メータ	Memo
	⑦ 反応物量	24h	操業記録	Memo
	⑧ 反応温度	24h	操業用メータ	Memo
Reactor	⑨ COG 流量	24h	操業記録	Memo
	⑩ 蒸気流量	24h	操業用メータ	Memo
	⑪ 反応温度	24h	操業用メータ	Memo
Stripper	⑫ 蒸気流量	24h	操業用メータ	Memo
	⑬ 冷却水量	24h	操業用メータ	Memo
	⑭ H_2S 量	24h	操業記録	Memo
	⑮ 反応温度	24h	操業用メータ	Memo
B.T.X. Distillation	⑯ 蒸気流量	24h	操業用メータ	Memo
	⑰ 冷却水量	24h	操業用メータ	Memo
	⑱ 製品量(Benzene)	24h	操業記録	Memo
	⑲ 製品量(Toluene)	24h	操業記録	Memo
	⑳ 製品量(Solventnaphtha)	24h	操業記録	Memo
	㉑ 製品量(Others)	24h	操業記録	Memo
	㉒ 反応温度	24h	操業用メータ	Memo

note) 各設備の断熱状況を把握するため表面の温度を表面温度計、放射温度計等で適時測定する。

c. 測定点

ベンゼンの測定点を Figure 9.2.2 に示す。

Figure 9.2.2 Measuring Points of Benzene Process



(3) タール

a. 測定目的

タールの製造過程におけるエネルギー使用状況を把握する。

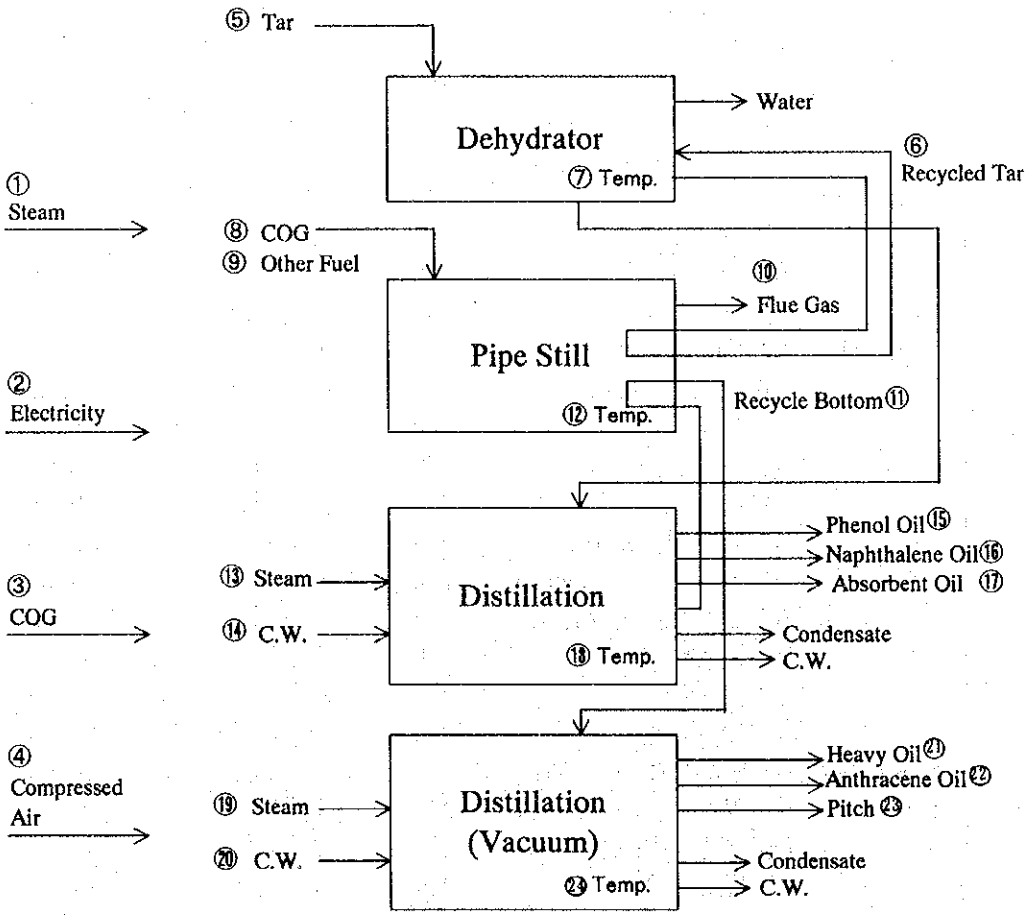
b. 測定項目、測定時間、計測器、データ処理

測 定 項 目		測定時間	計測器	データ処理
Total	① Total 蒸気流量	24h	操業用メータ	Memo
	② Total 電力量	24h	クランプメータ	to FDD
	③ Total COG 量	24h	操業記録	Memo
	④ Total 圧縮空気量	24h	操業用メータ	Memo
Dehydrator	⑤ Total Tar 量	24h	操業記録	Memo
	⑥ Recycled Tar 量	24h	操業記録	Memo
	⑦ 反応温度	24h	操業用メータ	Memo
Pipe Still	⑧ COG 流量	24h	操業用メータ	Memo
	⑨ Other Fuel 量	24h	操業記録	Memo
	⑩ Flue Gas 量	24h	操業用メータ	Memo
	⑪ Recycle Bottom 量	24h	操業記録	Memo
	⑫ 反応温度	24h	操業用メータ	Memo
Distillation	⑬ 蒸気流量	24h	操業用メータ	Memo
	⑭ 冷却水	24h	操業用メータ	Memo
	⑮ 製品量(Phenol)	24h	操業記録	Memo
	⑯ 製品量(Naphthalene)	24h	操業記録	Memo
	⑰ 製品量(Absorbent)	24h	操業記録	Memo
	⑱ 反応温度	24h	操業用メータ	Memo
Distillation (Vacuum)	⑲ 蒸気流量	24h	操業用メータ	Memo
	⑳ 冷却水量	24h	操業用メータ	Memo
	㉑ 製品量(Heavy Oil)	24h	操業記録	Memo
	㉒ 製品量(Anthracene)	24h	操業記録	Memo
	㉓ 製品量(Pitch)	24h	操業記録	Memo
	㉔ 反応温度	24h	操業用メータ	Memo

c. 測定点

タールの測定点を Figure 9.2.3 に示す。

Figure 9.2.3　Measuring Points of Tar Process



(3)　エネルギー利用

設 備 名	対　　象	測定時間
電力管理	受電設備	24h
ファン・ブロワ	ボイラ排気ファン	24h
電動機	ボイラ給水	24h
エアコンプレッサ	主要設備	24h
ポンプ	冷却水ポンプ	24h
変圧器	主要設備	24h
照明	工場各地	spot
ボイラ	Boiler Room	24h
蒸気配管	工場各地	spot

測定方法、測定点については「10. エネルギー利用」参照。

9.2.2 染料 (BORUTA)

(1) 染料

a. 測定目的

染料の製造過程におけるエネルギー使用状況を把握する。

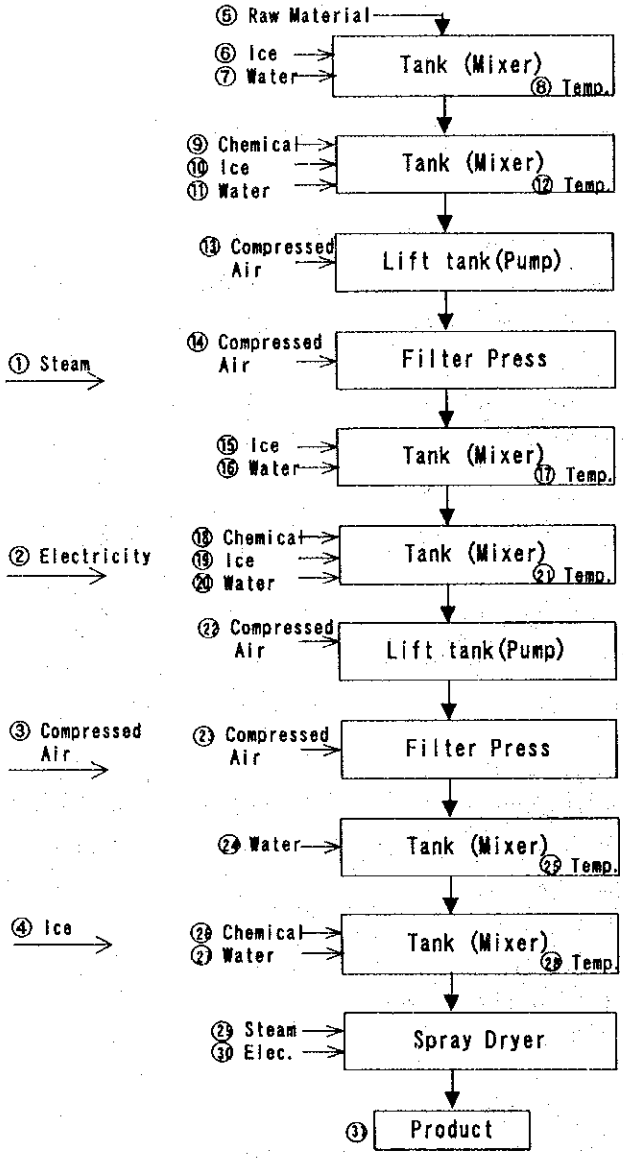
b. 測定項目、測定時間、計測器、データ処理

測 定 項 目		測定時間	計測器	データ処理
Total	① Total 蒸気流量	24h	操業用メータ	Memo
	② Total 電力量	24h	操業用メータ	Memo
	③ Total 圧縮空気量	24h	操業用メータ	Memo
	④ 氷量	24h	操業記録	Memo
Raw Material	⑤ 原料（量、成分）	-	操業記録	Memo
Tank	⑥ 氷量	24h	操業用メータ	Memo
	⑦ 水量	24h	操業用メータ	Memo
	⑧ 反応温度	24h	操業用メータ	Memo
Tank	⑨ 薬品（量、成分）	24h	操業記録	Memo
	⑩ 氷量	24h	操業用メータ	Memo
	⑪ 水量	24h	操業用メータ	Memo
	⑫ 反応温度	24h	操業用メータ	Memo
Pump	⑬ 圧縮空気（量、圧力）	24h	操業用メータ	Memo
Filter Press	⑭ 圧縮空気（量、圧力）	24h	操業用メータ	Memo
Tank	⑮ 氷量	24h	操業用メータ	Memo
	⑯ 水量	24h	操業用メータ	Memo
	⑰ 反応温度	24h	操業用メータ	Memo
Tank	⑱ 薬品（量、成分）	24h	操業記録	Memo
	⑲ 氷量	24h	操業用メータ	Memo
	⑳ 水量	24h	操業用メータ	Memo
	㉑ 反応温度	24h	操業用メータ	Memo
Pump	㉒ 圧縮空気（量、圧力）	24h	操業用メータ	Memo
Filter Press	㉓ 圧縮空気（量、圧力）	24h	操業用メータ	Memo
Tank	㉔ 水量	24h	操業用メータ	Memo
	㉕ 反応温度	24h	操業用メータ	Memo
Tank	㉖ 薬品（量、成分）	24h	操業用メータ	Memo
	㉗ 水量	24h	操業用メータ	Memo
	㉘ 反応温度	24h	操業用メータ	Memo
Spray Dryer	㉙ 蒸気流量	24h	操業用メータ	Memo
	㉚ 電力量	24h	クランプメータ	to FDD
Product	㉛ 製品量	24h	操業記録	Memo

c. 測定点

染料の測定点を Figure 9.2.4 に示す。

Figure 9.2.4 Measuring Points of Dying Process



(2) エネルギー利用

設 備 名	対 象	測定時間
電力管理	受電設備 NH_3冷凍機 Dyeing shop	24h 24h 24h
ファン・ブロワ	Dryer 用ブロワ	24h
電動機	主要設備	24h
エアコンプレッサ	NH_3コンプレッサ	24h
ポンプ	主要設備	24h
変圧器	主要設備	24h

照明	工場各地	spot
ボイラ	—	—
蒸気配管	工場各地	spot

測定方法、測定点については「10. エネルギー利用」参照。

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		m^3N/y					
2.5	Water		m^3/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/m^3N					
3.5	Water		PLN/m^3					
3.6	Others							

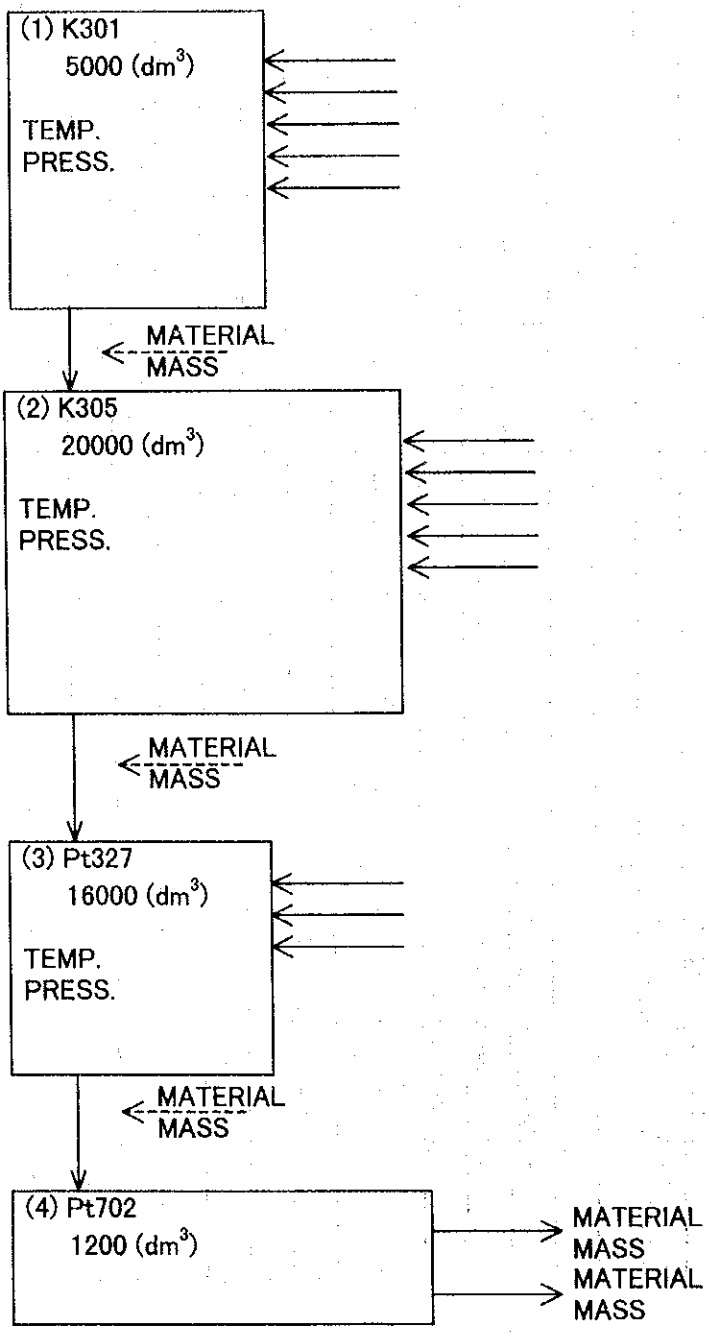
4	Specifications of Unit Process : Capacity, Operation condition, Stucture drawings, Sectional drawings							
4.1	Reactor							
4.2	Lift tank (Pump)							
4.3	Spray dryer and							
	process control system							
4.4	Filter press							
5	Space heating in Building							
5.1	Calculation sheet of	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

MATERIAL BALANCE SHEET 1/3

PRODUCT NAME	COLOR INDEX No.	FORMULA

1st. STEP :

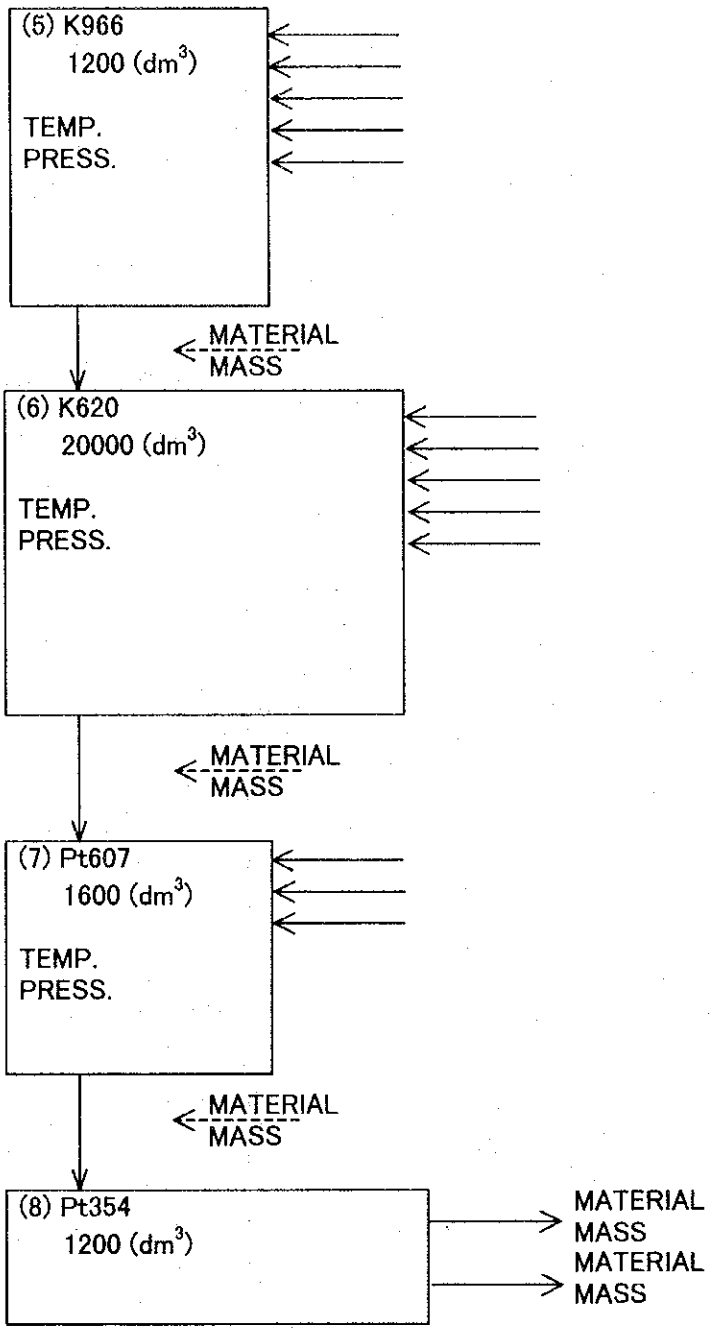
REACT.(Hr)	REHEATING CONDITION (MATERIAL-MASS, TEMP.,PRESS.,STEAM, etc.)	MAN-HOUR



2nd. STEP :

2/3

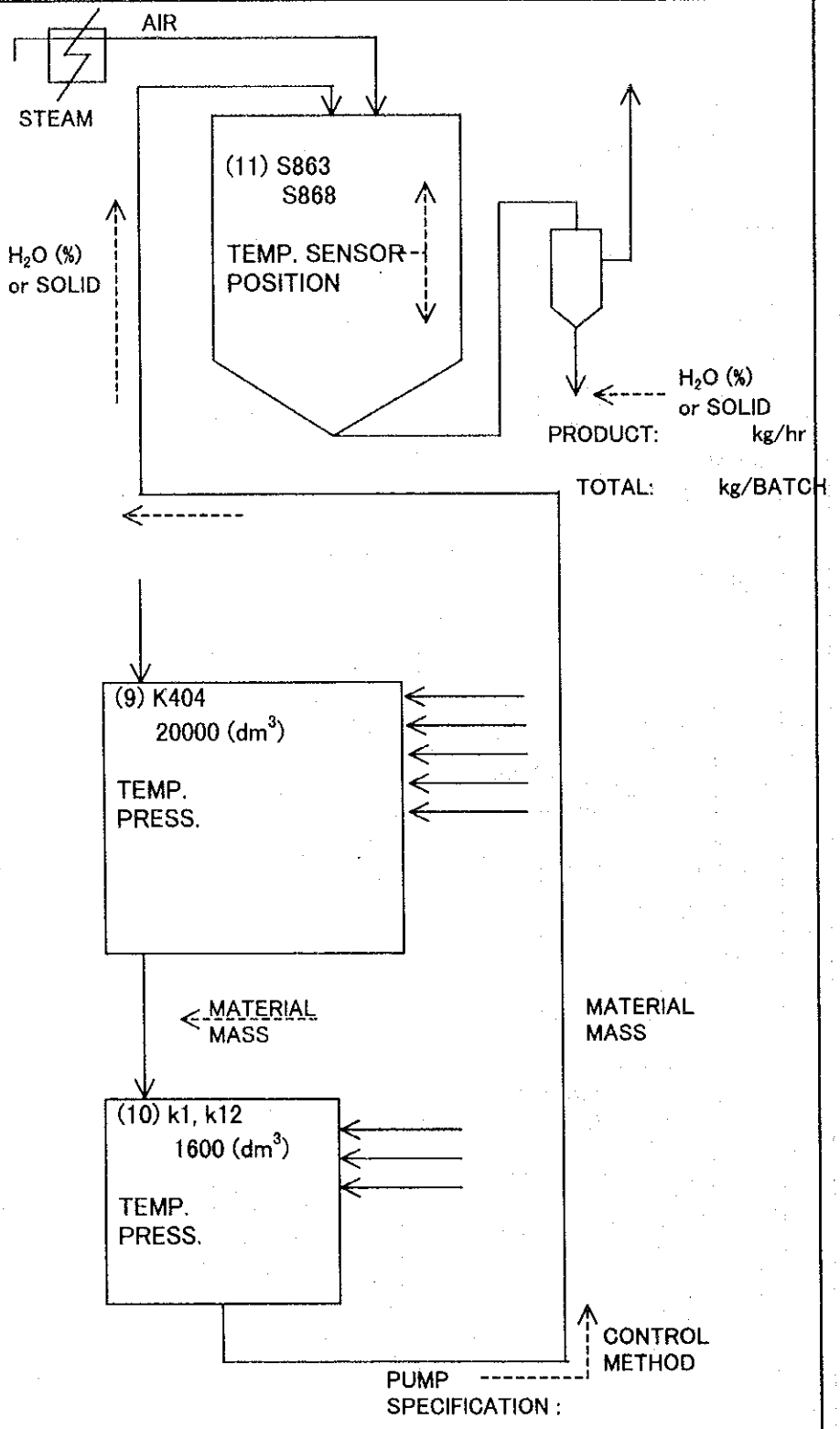
REACT.(Hr)	REHEATING CONDITION (MATERIAL-MASS, TEMP.,PRESS.,STEAM, etc.)	MAN-HOUR



3rd. STEP :

3/3

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



9.3 機械

9.3.1 トラクタ、トラック (URSUS, STAR)

(1) キュポラ

a. 測定目的

キュポラの熱精算実施のため現在の運転状況を把握する。

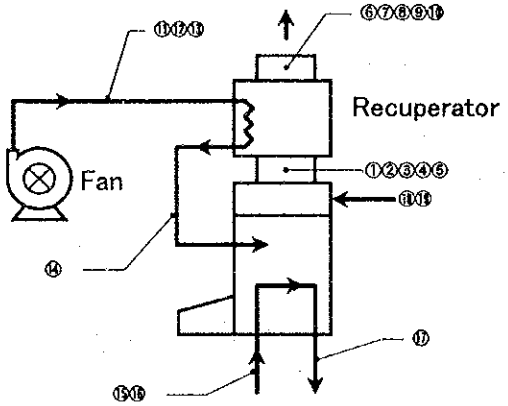
b. 測定項目、測定時間、計測器、データ処理

測 定 項 目	測定時間	計測器	データ処理
① 熱回収前排ガス温度	24h	熱電対	to Recorder
② 熱回収前排ガス圧力	24h	微差圧計	to Recorder
③ 熱回収前排ガス O_2%	24h	O_2メータ	to Recorder
④ 熱回収前排ガス CO%	24h	CO,CO_2メータ	to Recorder
⑤ 熱回収前排ガス CO_2%	24h	CO,CO_2メータ	to Recorder
⑥ 熱回収後排ガス温度	24h	熱電対	to Recorder
⑦ 熱回収後排ガス圧力	24h	微差圧計	to Recorder
⑧ 熱回収後排ガス O_2%	24h	O_2メータ	to Recorder
⑨ 熱回収後排ガス CO%	24h	CO,CO_2メータ	to Recorder
⑩ 熱回収後排ガス CO_2%	24h	CO,CO_2メータ	to Recorder
⑪ 熱回収前送風温度	24h	熱電対	to Recorder
⑫ 熱回収前送風圧力	24h	微差圧計	to Recorder
⑬ 熱回収前送風湿度%	24h	湿温度計	Memo
⑭ 熱回収後送風温度	24h	熱電対	to Recorder
⑮ 冷却水1次側温度	24h	熱電対	to Recorder
⑯ 冷却水1次側水量	24h	超音波流量計	to Recorder
⑰ 冷却水2次側温度	24h	熱電対	to Recorder
⑱ 投入コークス量	24h	操業記録	Memo
⑲ 投入銑鉄量	24h	操業記録	Memo

c. 測定点

キュポラの測定点を Figure 9.3.1 に示す。

Figure 9.3.1　Measuring Points of Cupola



(2)　加熱炉

a.　測定目的

加熱炉の熱精算実施のため現在の運転状況を把握する。

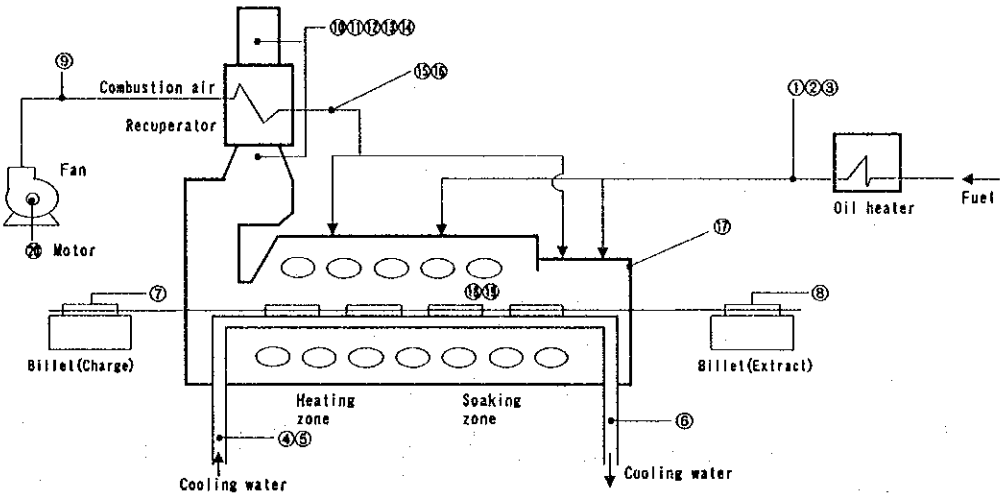
b.　測定項目、測定時間、計測器、データ処理

測 定 項 目	測定時間	計測器	データ処理
① 燃料消費量	24h	超音波流量計	to Recorder
② 燃料圧力	24h	圧力計	to Recorder
③ 燃料温度	24h	熱電対	to Recorder
④ 冷却水流量	24h	超音波流量計	to Recorder
⑤ 冷却水入口温度	24h	熱電対	to Recorder
⑥ 冷却水出口温度	24h	熱電対	to Recorder
⑦ ビレット投入温度	24h	放射温度計	to Recorder
⑧ ビレット取出温度	24h	放射温度計	to Recorder
⑨ Recuperator 入口燃焼空気温度	24h	熱電対	to Recorder
⑩ 排ガス温度	24h	熱電対	to Recorder
⑪ 排ガス圧力	24h	微差圧計	to Recorder
⑫ 排ガス O_2	24h	O_2 メータ	to Recorder
⑬ 排ガス CO_2	24h	CO, CO_2 メータ	to Recorder
⑭ 排ガス CO	24h	CO, CO_2 メータ	to Recorder
⑮ Recuperator 出口燃焼空気圧力	24h	微差圧計	to Recorder
⑯ Recuperator 出口燃焼空気温度	24h	熱電対	to Recorder
⑰ 加熱炉表面温度	24h	表面温度計	to Recorder
⑱ 炉内温度	24h	放射温度計	to Recorder
⑲ 炉内圧力	24h	微差圧計	to Recorder
⑳ 燃焼用空気ファン電力	24h	クランプメータ	to Recorder

(3) 測定点

加熱炉の測定点を Figure 9. 3.2 に示す。

Figure 9.3.2 Measuring Points of Reheating Furnace



(3) 各プロセス、各ライン

a. 測定目的

各ラインごとの製品原単位を把握する。

各プロセス、各ラインの代表設備のエネルギー消費状況を把握する。

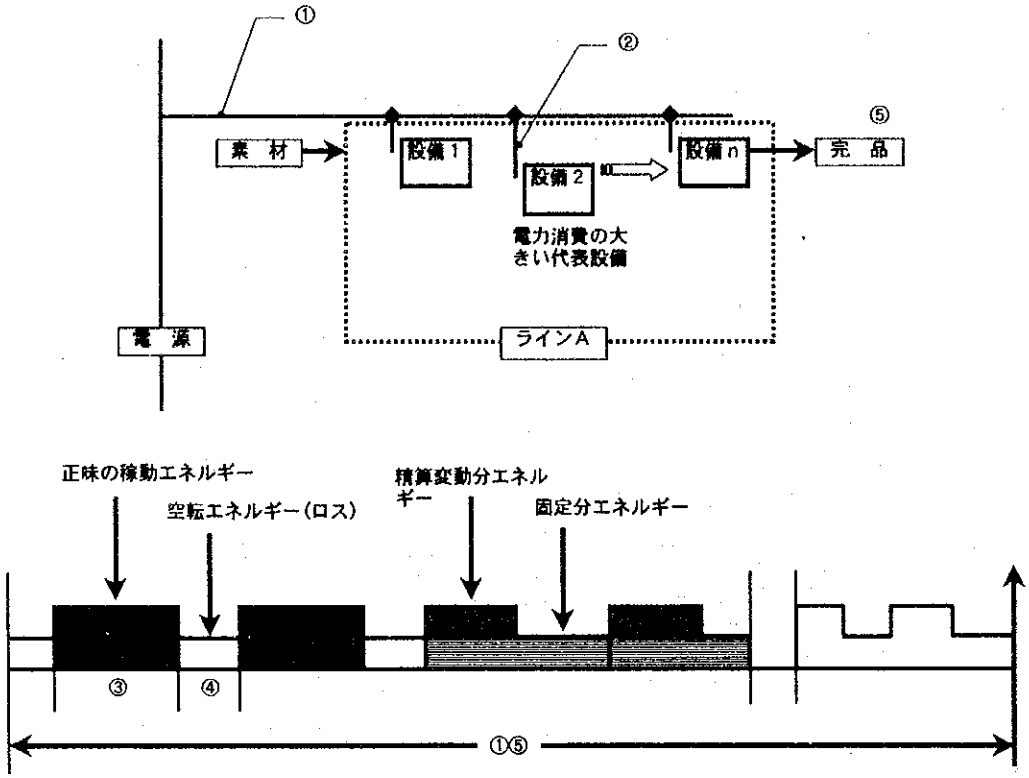
b. 測定項目、測定時間、計測器、データ処理

測 定 項 目	測定時間	計測器	データ処理
① 消費電力量 (ライン全体)	24h	クランプメータ	to FDD
② 消費電力量 (代表設備)	24h	クランプメータ	to FDD
③ 対象ワーク 1 ケ当りの正味加工サイクル消費電力	24h	クランプメータ	to FDD
④ 加工完了から次の加工開始までの待機電力	24h	クランプメータ	to FDD
⑤ 1 日の出来高	—	操業記録	Memo

c. 測定点

各ラインの消費電力量および代表設備の測定点を Figure 9. 3.3 に示す。

Figure 9.3.3　Measuring Points of Electricity



(4)　暖房（工場各地）

a.　測定目的

工場各地の暖房におけるエネルギー損失の把握。

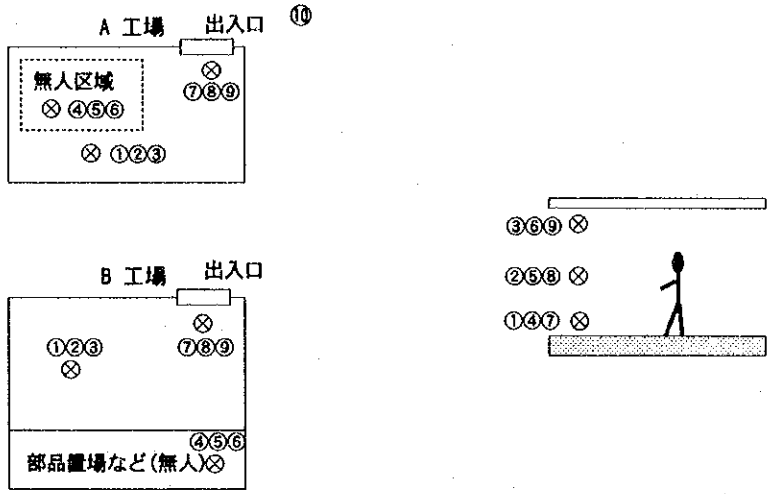
b.　測定項目、測定時間、計測器、データ処理

測 定 項 目	測定時間	計測器	データ処理
① 有人作業区域床上温度	spot	温度計	Memo
② 有人作業区域人の高さでの温度	spot	温度計	Memo
③ 有人作業区域天井付近温度	spot	温度計	Memo
④ 無人区域床上温度	spot	温度計	Memo
⑤ 無人区域人の高さでの温度	spot	温度計	Memo
⑥ 無人区域天井付近温度	spot	温度計	Memo
⑦ 工場出入口床上温度	spot	温度計	Memo
⑧ 工場出入口人の高さでの温度	spot	温度計	Memo
⑨ 工場出入口天井付近温度	spot	温度計	Memo
⑩ 外気温度	spot	温度計	Memo

c.　測定点

暖房におけるエネルギー損失のための測定点を Figure 9. 3.4 に示す。

Figure 9.3.4　Measuring Points of Room Temperature



(5)　エネルギー利用

設 備 名	対　　象	測定時間
電力管理	各プロセス、各ライン	24h
エアコンプレッサ	プロセス用	24h
ファン・ブロア	暖房用	24h
ポンプ	冷却塔系	24h
照明	工場各地	spot
ボイラ	Boiler Room	24h
蒸気配管	工場各地	Spot

測定方法、測定点等については「10.　エネルギー利用」参照。

Check List for Process of Tractor Production

Date

Surveyor

1. General information

(1) Factory name

Company name: ZPC "URSUS"

(2) Address Factory: 02-495 Warsaw

Head Office :

(3) Number 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 of the plant , rebuilding , new production system, share in Poland, History of production etc.)

Foundation:

History of expansion

Share of products in Poland

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

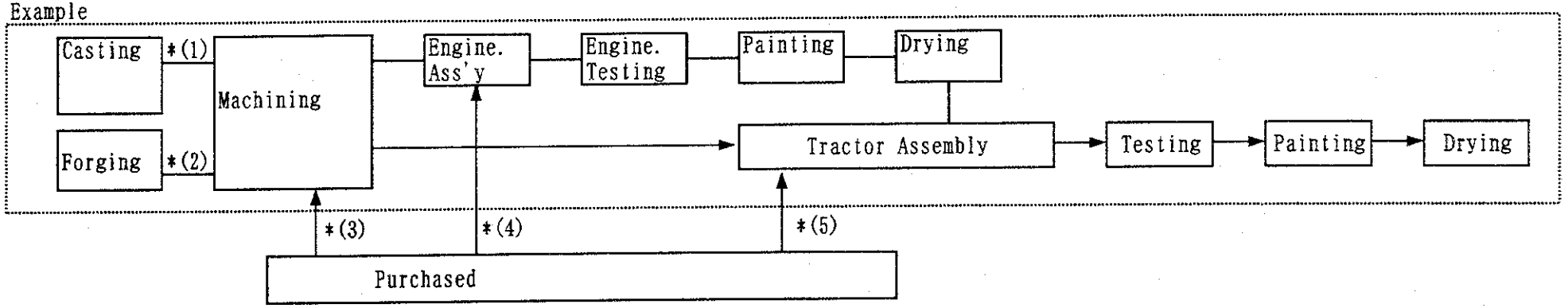
See next page

(8) Factory and Plant Layout

Please separately prepare.

1. (7) 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/m^3N	/m^3N	/m^3N
Electricity				
In-house		kcal/kWh	/kWh	/kWh
Purchased		kcal/kWh	/kWh	/kWh
Demand			/kW	/kW

(2) Trend 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	(m^3N)						
Electricity							
Total	(mWh)						
In-house	(mWh)						
Purchased	(mWh)						
Demand	(kW)						

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

(another sheet -- page. V-9-3-10 --)

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	m^3N
Energy supply									
(1)Air compressor									
(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) Trend 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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (kcal)					
Energy intensity (*2 / *1) (kcal/ton)					

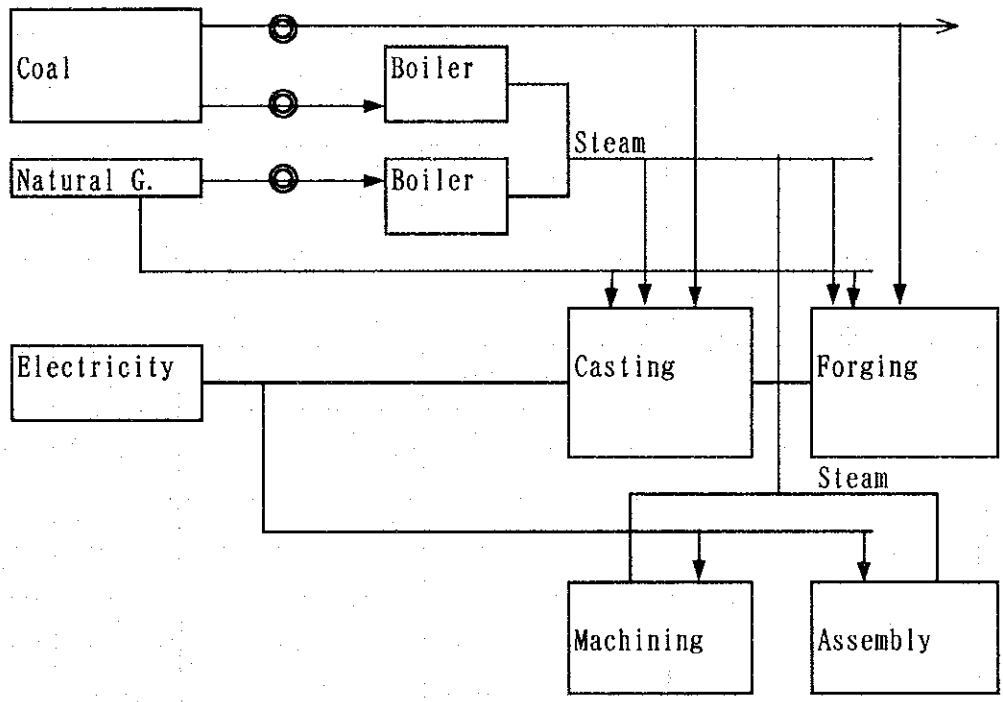
(5)Rate of energy cost for production cost in whole plant

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

(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 flow diagram



(8) Major equipment for Compressed Air consumption

No	Name of process/line	Name of equipment	Purpose to use	Pressure	Max. consumption (m^3N/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 consumption)

Equipment	Specification	
Cupola (1) (set)	Type	
	Built year	
	Capacity	ton/hour
	Coke rate(ｺｰｸｽ比)	%
	Coke 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 blast	℃
	Amount of hot blast	m^3N/min
Cupola (2) (set)	Type	
	Built year	
	Capacity	ton/hour
	Coke rate(ｺｰｸｽ比)	%
	Coke 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 blast	℃
	Amount of hot blast	m^3N/min
Forehearth (Receiver) furnace (1)	Type	
	Built year	
	Kind of energy	
	Frequency	Hz
	Capacity	
	Temperature(Target of furnace temp.)	℃
Forehearth (Receiver) 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 dust collector motor	
	Rated output of dust collector	
Shot blast (2)	Type	
	Capacity	
	Built year	
	Rated output of dust collector 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	
Others		

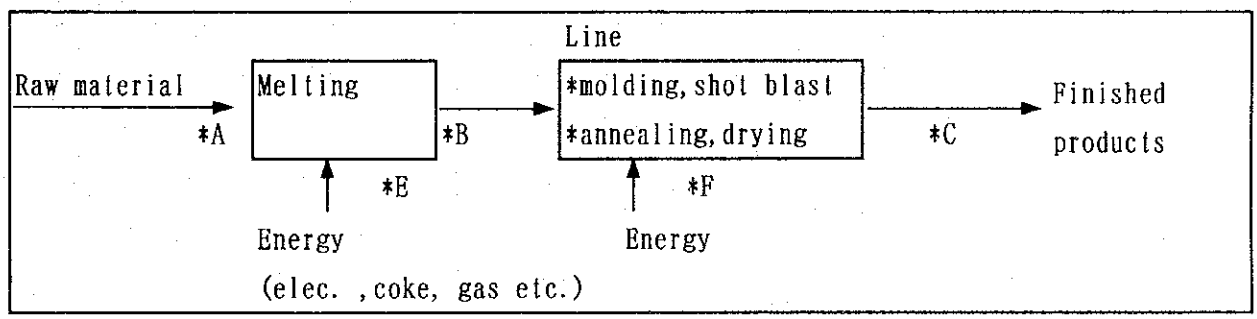
(2) Design and operational information(Typical equipment)

Process	Item	Design	Actual
Cupola (1)	Productivity	t/hour	t/hour
	Coke rate	%	%
	Coke intensity	kg/ton	kg/ton
	Operational conditions	h/day (h/month)	h/day (h/month)
	Molten iron volume	ton/year	ton/year
Cupola (2)	Productivity	t/hour	t/hour
	Coke rate	%	%
	Coke intensity	kg/ton	kg/ton
	Operational conditions	h/day (h/month)	h/day (h/month)
	Molten iron volume		
Forehearth (Receiver) furnace (1)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Operational conditions	h/day (h/month)	h/day (h/month)
Forehearth (Receiver) furnace (2)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Operational conditions	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)
	Operational conditions	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		
	Operational conditions	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)
	Operational conditions	h/day (h/month)	h/day (h/month)
	Motor capacity	kW	kW
Annealing furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Operational conditions	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		
	Operational conditions	h/day (h/month)	h/day (h/month)

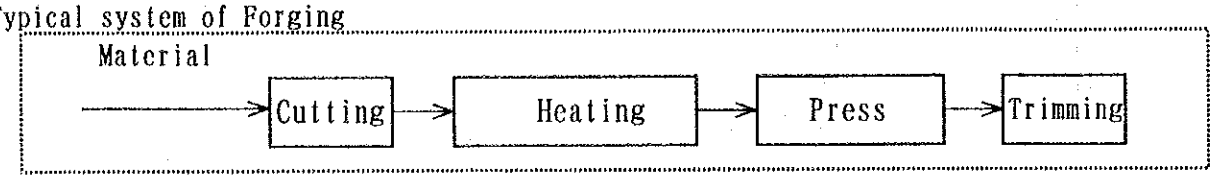
(3) Whole operation



1. Ratio of melting metal for charged raw materials: (*A/*B)= about %
2. 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
Others		Name of equipment	
		Type	
		Capacity	
		Built year	
		Motor power	

(2) Design and operational information on 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		
	Operational conditions	h/day (h/month)	h/day (h/month)

Design and operational information on Forging line(Typical equipment)

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

(3) Whole operation

1. 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 Equipment for energy consumption at Machining process

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

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

Kind of Energy	NO	Main specification			Operational results				
		Name of equipment	Specification		Item	Design		Actual	
Electricity	1	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
	2	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
	3	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
Fuel	1	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
	2	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
	3	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
Compressed Air	1	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	2	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	3	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	4	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	5	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%

3-4. Assembly

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

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

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

Kind of Energy	NO	Main specification			Operational results		
		Name of equipment	Specification		Item	Design	Actual
Electricity	1	Electric wrench (Electric screwdriver)	Motor power Max. torque	KW	Operational conditions	h/day	h/day
	2	Electric wrench (Electric screwdriver)	Motor power Max. torque	KW	Operational conditions	h/day	h/day
	3	Electric wrench (Electric screwdriver)	Motor power Max. torque	KW	Operational conditions	h/day	h/day
Compressed Air	1	Pneumatic wrench (Pneumatic screwdriver)	Pressure Max. torque		Operational conditions	h/day	h/day
	2	Pneumatic wrench (Pneumatic screwdriver)	Pressure Max. torque		Operational conditions	h/day	h/day
	3	Pneumatic wrench (Pneumatic screwdriver)	Pressure Max. torque		Operational conditions	h/day	h/day

3-5.Painting and Drying

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

Kind of Energy	NO	Main specification			Operational results		
		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
					Operational conditions	h/day	h/day
	2	Paint booth (2)			Typical products		
					Kind of paints		
					Painting time	min/unit	min/unit
					Productivity	units/day	units/day
					Operational conditions	h/day	h/day
	1	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power(lamp)		Productivity	units/day	units/day
			Temp. of hot wind		Operational conditions	h/day	h/day
	2	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power(lamp)		Productivity	units/day	units/day
			Temp. of hot wind		Operational conditions	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 estimation system

(7) Investment for energy conservation in the past

Year	Contents of investment	Cost of investment	Expectation of effect	Results

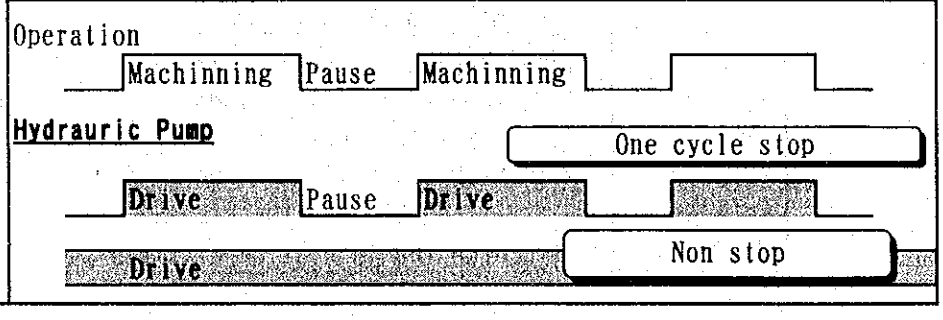
(8) Energy conservation activity

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 estimation 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 effectively	( )	
	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 of the electric appliances (Cycle = years)	( )	
	10	Light-on & light-off by actual brightness (Outside lighting)	( )	
	11	To use a efficiency light	( )	
Utilities	12	Reduction of compressed air pressure	( )	
	13	Pressure control of compressed air	( )	
	14	Pressure control of steam	( )	
	15	Recovery of steam drain	( )	
	16	Control of power factor	( )	
	17	To reduce the pressure loss of pipe	( )	
	18	Local supply of compressed air by booster	( )	
	19	Suitable supply by number control of small compressor	( )	
	20	To stop the compressor 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 into the heat treatment furnace	( )	
	28	(Cupola)Heating of blast by exhaust gas	( )	
	29	(Cupola)Long and continuous operation	( )	
	30	(Cupola)Oxygen enrichment in blast	( )	
	31	r.p.m. control of dust collector motor	( )	
	32	Stop of dust collector during stop of production line	( )	
	33	Enforcement of the furnace insulation	( )	
	34	Concentrated control of the accumulators of hydraulic system (to combine several accumulator)	( )	
	35	(Shot blast)Minimum time of shot blast	( )	
	36	(Shot blast)Suitable shot time control by work	( )	
	37	To reduce the idling time of sand treatment equipment during lunch break	( )	
	38	Recirculation of cooling water	( )	
	39	Suitable blow time control for molding	( )	
	40	To reduce the idling time of motor for casting	( )	
Forging	41	To reduce the idling time of machine	( )	
	42	To reduce the defective products by improvement of material	( )	
	43	To avoid cold air invasion into the heating furnace	( )	
	44	To avoid cold air invasion into the heating furnace	( )	
	45	Simple arrangement to reduce 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 replace several machining process with multifunctional 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 the failure of machining	( )	
Painting and Drying	61	To avoid cold air invasion into the drying furnace	( )	
	62	To use quick dry type paint	( )	
	63	To reduce the thickness of coating	( )	
Others	64	Improvement of the power factor of large sized motor	( )	
	65	Concentrated production (close the factory during no production)	( )	
	66	Improvement of quality(reduction of failure)	( )	
	67	Replacement of old pumps with high efficiency ones	( )	

Check List for Process of Truck Production

Date _____

Surveyor _____

1. General information

(1) Factory name

Company name: Starachowice company "STAR"

(2) Address Factory: _____

Head Office : _____

(3) Number 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 of the plant , rebuilding , new production system, share in Poland , History of production etc.)

Foundation:

History of expansion

Share of products in Poland

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

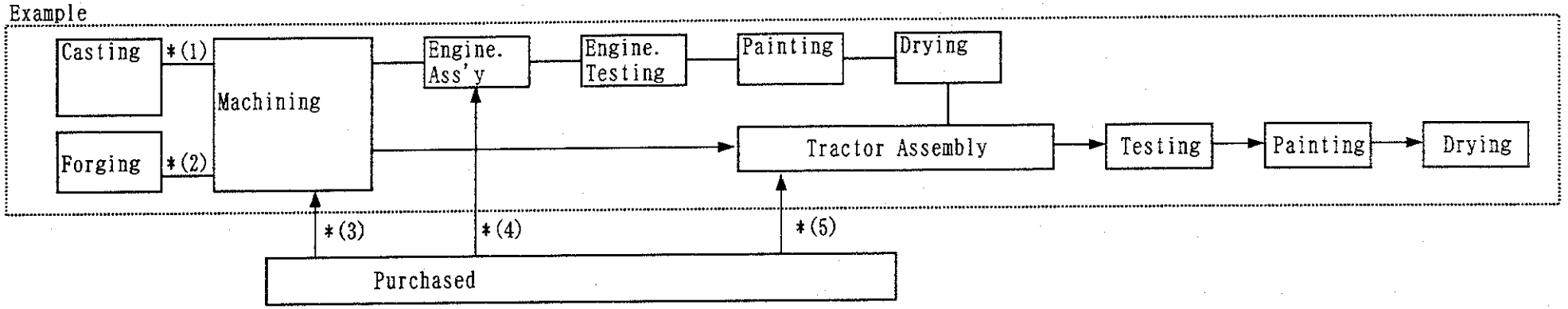
See next page

(8) Factory and Plant Layout

Please separately prepare.

1.(7) 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/m^3N	/m^3N	/m^3N
Electricity				
In-house		kcal/kWh	/kWh	/kWh
Purchased		kcal/kWh	/kWh	/kWh
Demand			/kW	/kW

(2) Trend 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	(m^3N)						
Electricity							
Total	(mWh)						
In-house	(mWh)						
Purchased	(mWh)						
Demand	(kW)						

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

(another sheet -- page. V-9-3-36 --)

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	m^3N
Energy supply									
(1)Air compressor									
(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) Trend 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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
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 G. (m^3N)		kcal/m^3N	m^3N	m^3N	m^3N
Elec. (mWh)		kcal/kWh	mWh	mWh	mWh
Total consumption(*2) (kcal)					
Energy intensity (*2 / *1) (kcal/ton)					

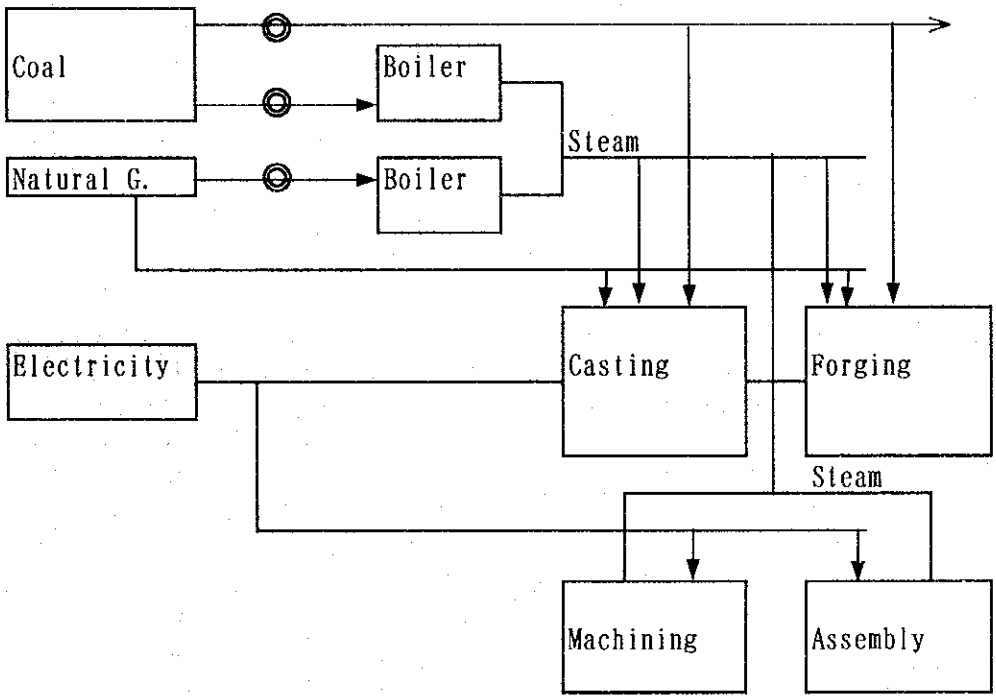
(5)Rate of energy cost for production cost in whole plant

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

(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 flow diagram



(8) Major equipment for Compressed Air consumption

No	Name of process/line	Name of equipment	Purpose to use	Pressure	Max. consumption (m^3N/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 consumption)

Equipment	Specification	
Cupola (1) (set)	Type	
	Built year	
	Capacity	ton/hour
	Coke rate(ｺｰｸｽ比)	%
	Coke 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 blast	℃
	Amount of hot blast	m^3N/min
Cupola (2) (set)	Type	
	Built year	
	Capacity	ton/hour
	Coke rate(ｺｰｸｽ比)	%
	Coke 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 blast	℃
	Amount of hot blast	m^3N/min
Forehearth (Receiver) furnace (1)	Type	
	Built year	
	Kind of energy	
	Frequency	Hz
	Capacity	
	Temperature(Target of furnace temp.)	℃
Forehearth (Receiver) 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 dust collector motor	
	Rated output of dust collector	
Shot blast (2)	Type	
	Capacity	
	Built year	
	Rated output of dust collector 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	
Others		

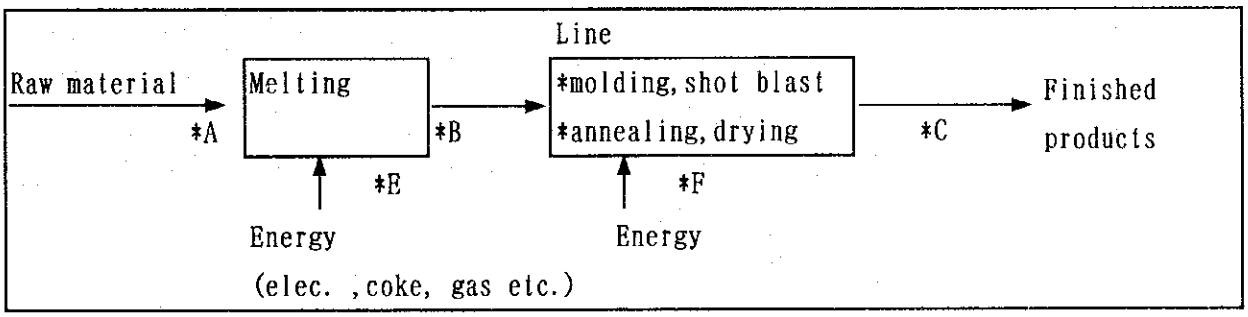
(2) Design and operational information(Typical equipment)

Process	Item	Design	Actual
Cupola (1)	Productivity	t/hour	t/hour
	Coke rate	%	%
	Coke intensity	kg/ton	kg/ton
	Operational conditions	h/day (h/month)	h/day (h/month)
	Molten iron volume	ton/year	ton/year
Cupola (2)	Productivity	t/hour	t/hour
	Coke rate	%	%
	Coke intensity	kg/ton	kg/ton
	Operational conditions	h/day (h/month)	h/day (h/month)
	Molten iron volume		
Forehearth (Receiver) furnace (1)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Operational conditions	h/day (h/month)	h/day (h/month)
Forehearth (Receiver) furnace (2)	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature	℃	℃
	Operational conditions	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)
	Operational conditions	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		
	Operational conditions	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)
	Operational conditions	h/day (h/month)	h/day (h/month)
	Motor capacity	kW	kW
Annealing furnace	Productivity	t/hour	t/hour
	Kind of energy		
	Energy consumption	Mcal/ton	Mcal/ton
	Temperature		
	Operational conditions	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		
	Operational conditions	h/day (h/month)	h/day (h/month)

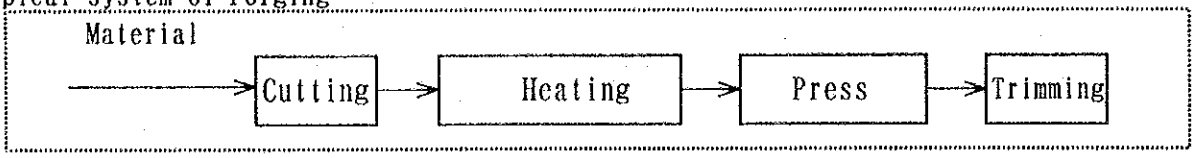
(3) Whole operation



1. Ratio of melting metal for charged raw materials: (*A/*B)= about %
2. 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
Others		Name of equipment	
		Type	
		Capacity	
		Built year	
		Motor power	

(2) Design and operational information on 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		
	Operational conditions	h/day (h/month)	h/day (h/month)

Design and operational information on Forging line(Typical equipment)

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

(3) Whole operation

1. 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 Equipment for energy consumption at Machining process

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

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

Kind of Energy	NO	Main specification			Operational results				
		Name of equipment	Specification		Item	Design		Actual	
Electricity	1	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
	2	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
	3	High-frequency induction hardening	Ppower	KW	Operational conditions		h/day		h/day
			Frequency	Hz	Operational rate	about	%	about	%
Fuel	1	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
	2	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
	3	Heat treatment furnace	Kind of energy		Operational conditions		h/day		h/day
			Temperature	℃	Operational rate	about	%	about	%
Compressed Air	1	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	2	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	3	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	4	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%
	5	Air blow machine after washing	Pressure		Operational conditions		h/day		h/day
			Max. consumption	m3/min	Operational rate	about	%	about	%

3-4. Assembly

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

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

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

Kind of Energy	NO	Main specification			Operational results		
		Name of equipment	Specification		Item	Design	Actual
Electricity	1	Electric wrench (Electric screwdriver)	Motor power	KW	Operational conditions	h/day	h/day
			Max. torque				
	2	Electric wrench (Electric screwdriver)	Motor power	KW	Operational conditions	h/day	h/day
			Max. torque				
	3	Electric wrench (Electric screwdriver)	Motor power	KW	Operational conditions	h/day	h/day
			Max. torque				
Compressed Air	1	Pneumatic wrench (Pneumatic screwdriver)	Pressure		Operational conditions	h/day	h/day
			Max. torque				
	2	Air nut runner (Pneumatic screwdriver)	Pressure		Operational conditions	h/day	h/day
			Max. torque				
	3	Air nut runner (Pneumatic screwdriver)	Pressure		Operational conditions	h/day	h/day
			Max. torque				

3-5.Painting and Drying

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

Kind of Energy	NO	Main specification			Operational results		
		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
					Operational conditions	h/day	h/day
	2	Paint booth (2)			Typical products		
					Kind of paints		
					Painting time	min/unit	min/unit
					Productivity	units/day	units/day
					Operational conditions	h/day	h/day
	1	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power(lamp)		Productivity	units/day	units/day
			Temp. of hot wind		Operational conditions	h/day	h/day
	2	Drying furnace	Type		Typical products		
			Kind of energy		Drying time/unit	min/unit	min/unit
			power(lamp)		Productivity	units/day	units/day
			Temp. of hot wind		Operational conditions	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 estimation system

(7) Investment for energy conservation in the past

Year	Contents of investment	Cost of investment	Expectation of effect	Results

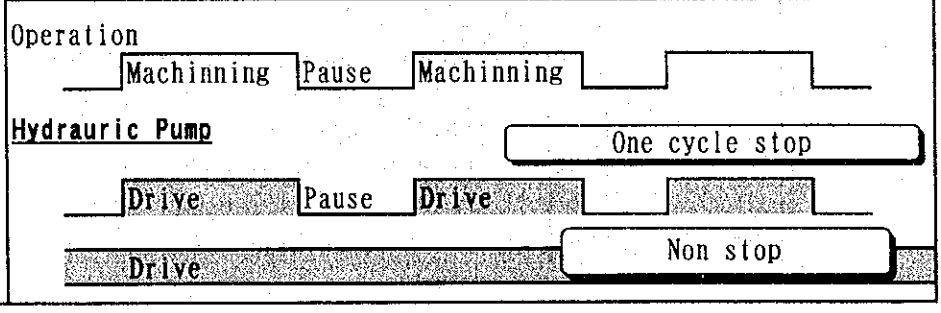
(8) Energy conservation activity

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 estimation 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 effectively	( )	
	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 of the electric appliances (Cycle = years)	( )	
	10	Light-on & light-off by actual brightness (Outside lighting)	( )	
	11	To use a efficiency light	( )	
Utilities	12	Reduction of compressed air pressure	( )	
	13	Pressure control of compressed air	( )	
	14	Pressure control of steam	( )	
	15	Recovery of steam drain	( )	
	16	Control of power factor	( )	
	17	To reduce the pressure loss of pipe	( )	
	18	Local supply of compressed air by booster	( )	
	19	Suitable supply by number control of small compressor	( )	
	20	To stop the compressor 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 into the heat treatment furnace	( )	
	28	(Cupola)Heating of blast by exhaust gas	( )	
	29	(Cupola)Long and continuous operation	( )	
	30	(Cupola)Oxygen enrichment in blast	( )	
	31	r.p.m. control of dust collector motor	( )	
	32	Stop of dust collector during stop of production line	( )	
	33	Enforcement of the furnace insulation	( )	
	34	Concentrated control of the accumulators of hydraulic system (to combine several accumulator)	( )	
	35	(Shot blast)Minimum time of shot blast	( )	
	36	(Shot blast)Suitable shot time control by work	( )	
	37	To reduce the idling time of sand treatment equipment during lunch break	( )	
	38	Recirculation of cooling water	( )	
	39	Suitable blow time control for molding	( )	
	40	To reduce the idling time of motor for casting	( )	
Forging	41	To reduce the idling time of machine	( )	
	42	To reduce the defective products by improvement of material	( )	
	43	To avoid cold air invasion into the heating furnace	( )	
	44	To avoid cold air invasion into the heating furnace	( )	
	45	Simple arrangement to reduce 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 replace several machining process with multifunctional 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 the failure of machining	( )	
Painting and Drying	61	To avoid cold air invasion into the drying furnace	( )	
	62	To use quick dry type paint	( )	
	63	To reduce the thickness of coating	( )	
Others	64	Improvement of the power factor of large sized motor	( )	
	65	Concentrated production (close the factory during no production)	( )	
	66	Improvement of quality(reduction of failure)	( )	
	67	Replacement of old pumps with high efficiency ones	( )	