

## 2 Report on Extension Service to Industries (PT. Aneka Banusakti) - Part 2 -

20th September, 2001

SIDCAST JICA/MIDC

Eizo MAEDA & Ryozo HASHIDA

1. Date : 13th September, 2001(Tuesday) 9:00~15:10  
 2. Industry Name : PT. Aneka Banusakti  
 3. Participants : JICA: Mr. Hashida & Mr. Maeda  
                   : MIDC: Mr. Furqon & Mr. Agus from  
                   : Aneka Banusakti: Mr. Kurnia(Director), Mr. Ir. Dikdik Gunantra (QA Manager),  
                   & Mr. Gatot Sulisutyawan W (Engineering Dept.) from  
 4. Subject of Visit : Cooperation for Casting Quality Improvement

### — General Information —

#### 1. Present Production and Reject Situation

##### 1.1. Production

- a) Production Capacity: 300 Ton/Month.
- b) Production weight was 100 Ton/Month on our previous visit on 23rd April, '01, however, it increased to 150 Ton/Month on our last visit on 26th August, '01.
- c) Aneka has 3 kinds of production process, i.e. the centrifugal casting process for automotive cylinder liners, BLOMATIC (B&P) moulding line for automobile small parts, and Jolt Squeeze moulding machine for big brake drums.
- d) This time the 1.5 Ton high frequency furnace (that is the only facility for Aneka's melting) is out of order because of the electrical trouble, and Aneka has already lost one week. Aneka is afraid if the local specialist fails to fix the furnace. The next melting operation will be delayed until arrival of the original part (SCR) from the maker in USA, and another one week will be estimated, Mr. Dikdik explained.

##### 1.2. Products

Aneka's casting products listed below are mainly for the after-markets;

- a) Cylinder Liners for the automobile and motor cycle,
- b) Brake Drums for the automobiles and trucks.
- c) Liner Brakes for the automobile and motor cycle.

But not only for it, now they are going to deliver to RIKEN in Indonesia.

##### 1.3. Reject Ratio

The reject ratio of the centrifugal casting line was about 8% totally through foundry and machining this August, showing decreasing tendency this year. Furthermore, the reject ratio of others such as BLOMATIC (B&P) moulding line and Jolt Squeeze moulding machine was 15.5% totally this August.

#### 2. Other Equipment.

- a) Melting: 1.5T high frequency furnace.
- b) Chemical Laboratory: Spectrometer HILGER/POLYVAC200, 28 elements.
- c) Sand Laboratory: Sand test equipment are established.
- d) Lathes and honing machines for final machining.

### — DISCUSSIONS —

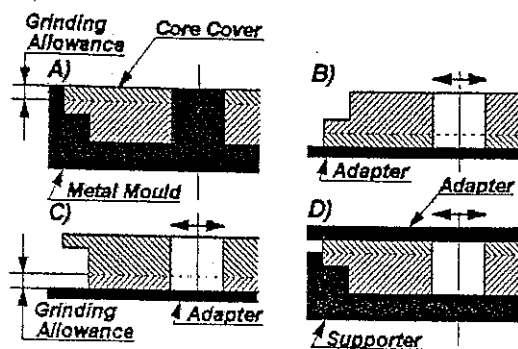
#### 1. Regarding Last Report

Our report regarding our last visit has already arrived there 2 days before, and distributed to the concerned personnel.

##### 1.1. Regarding the report, Q & A was performed for Aneka's confirmation first of all.

- 1) Regarding Paragraph 2.1.2.B), Aneka proposed to modify the procedure how to make flatness of the core cover surface as shown in Fig. 1 below, and JICA experts agreed such idea.





A) The core cover is made from resin-coated sand that is blown into the metal mould. On that time, the outside surface of the cover is located to the blowing side

B) In order to keep the flat surface, such surface is ground by hand, putting the surface toward the adapter. However, the flatness is not enough for keeping the right angle to the longitudinal direction of the core.

C) On our last visit, JICA recommended to grind the inside surface of the core cover instead of the outer surface, then the flatness of the outside surface can be kept better than previously.

D) The both edges of the cylinder liner casting are used as the reference surfaces for setting the casting to the machine for finishing the cylinder liner casting. Because of such reason, Aneka proposed to grind the outer surface of the core cover as same as the previous way, but on the support for improvement of the flatness better.

Fig. 1 – Flatness Improvement of Core Cover

2) Regarding Paragraph 2.1.2.E), JICA experts accepted Aneka's proposal that the chamfering on the edge corner of the core bottom would be carried out by hand.

3) The last recommendation for the core preparation has not yet been implemented because of many core storage and trouble on melting equipment.

4) The sulfur content standard, which is 0.04 % maximum in Aneka, should be changed into 0.04~0.06% for prevention from chill defects, recommended by JICA side.

5) Aneka promised to implement these recommendations step by step, because there were so many core storages.

## 1.2. Talking about Sonic Test

Many factors such as the graphite type and size, the eutectic cell size, the construction of micro structures such as ferrite, pearlite and others, and micro porosity by high P content affect on the sonic property, that is, these factors that affect on the mechanical properties such as hardness, modulus of elasticity etc. Furthermore, the sonic property also has many factors such as the frequency distribution, the damping capacity, and the sonic velocity. So it might be difficult to agree to the application of the sonic test by neither instrument nor feeling.

## 2. Problem on 2 and 4 Cycle Cylinder Liners and Liner Brakes Produced in BLOMATIC Moulding Line

### 2.1. Present Reject Condition (Table 1)

a) Cross Joint - The top defective deviation, Cross Joint that is detected on the cylinder liners comes from the mechanical problem, but not from the physical and the chemical problem. So it is possible to be destructed by Aneka. As the flask-less moulds are applied on BLOMATIC moulding line, the application of the dowel system is recommended on mould assembling for prevention from the cross joint deviation.

Table 1 - Reject Ratio Analysis of Cylinder Liners and Liner Brakes.

	Quantity of Casting	PR	M	CJ	GH	BM	BCR	SLI	SKG	LL	Total
		Sand Erosion	Miss Run	Cross Joint	Gas Hole	Broken Mould	Leakage	Slag Inclusion	Shrinkage	Others	
Cylinder Liner	1088	25	10	45	10	9	9	2	6	2	118
	881	40	21	64	0	8	5	0	11	6	155
Total	1949	65	31	109	10	17	14	2	17	8	273
	%	3.3	1.6	5.6	0.5	0.9	0.7	0.10	0.9	0.4	14.0
Liner Brake	1081	156	8	-	-	85	6	8	5	63	331
	%	14.4	0.7	-	-	7.9	0.6	0.7	0.5	5.8	30.6

b) Sand Erosion - Sand erosion shall be discussed later (See Photo 1 & 2)

c) Miss Run - The pouring temperature, 1400~1320 °C is regulated in Aneka Standard without records. The minimum pouring temperature should be 1350 °C (target minimum 1380°C), but it should be taken care of not to overheat before tapping, JICA side recommended.

## 2.2 Liner Brakes

1) These liner brake castings are the orders from RIKEN Indonesia. Aneka wants to reduce the defects detected on the liner brake castings. See such defect condition shown in Photo 4, 5 & 6. Aneka classifies these defects to the sand erosion, but according to our observation, the phenomenon is simple, and comes from the broken mould before pouring. These defects are the same kinds of defects detected on the cylinder liner castings that are mentioned in Paragraph 2.1.b) above. Then Aneka's mixed green sand characteristics, sand preparation process and moulding process have to be checked.

2) Characteristic of Prepared Green Sand (Table 2, 3 & 4)

Table 2 – Mixed Green Sand Characteristics for BLOMATIC

No	Items	Unit	Aneka Standard	Actual Range
1	Moisture Content	%	3.8~4.0	4.0~5.1
2	Permeability		130~180	90~126
3	Green Compression Strength	KN/m <sup>2</sup>	90~130	103~122
4	Shear Strength		30~45	31~38
5	GFN		---	68
6	Mold Hardness		80~90	75
7	Compactability		35~45	Not Tested
8	Active Clay	%	6~7	Not Tested

Table 3 – Green Sand Mixing Ratio

Material	Addition
New Sand	10%
Bentonite	1~1.5%
Sea Coal	0.6~0.8%
Dextrin	0.5~0.7%

Table 4 – Sand Grain Size

Sieve Size, mesh	Line Sand	New Sand
30	6.8	
40	29.16	
50	35.36	
70	17.63	
100	7.09	
140	2.36	
200	1.18	
270	0.41	
PAN	0	
GFN		

### 2-3. Sand Preparation System (See Fig. 2 attached)

The sand preparation system equipment is lined up almost perfectly. However, it is difficult to evaluate whether all equipment is awarded and maintained for the perfect function or not. For example, the Simpson type rollers are not clean. In addition, the sand mixture after passing through the existing aerator couldn't be observed.

Table 4 - Outline of Sand Preparation System

No	Function	Type of Device	Note
1	Separation of Castings from Sand	Shake out	
2	Cooling of Castings	Drum type	
3	Separation of Magnetic Materials from Sand	Cross type magnetic conveyor (Photo 7 & 8)	Good condition. No Magnetic pulley.
4	Disintegration and Removal of Sand Blocks	Breaker screen with $\phi$ 10 mm holes (Photo 9)	
5	Sand Cooling (Photo 10)	Fluidized sand bed	
6	Dust Collector for Fluidized Sand Bed	Bug filter type	Discharged dust is fine and it may be mainly carbon material (Photo 11 & 12)
7	Separation of Coarse Particles	5x5 screen	
8	Sand storage	Hopper	
9	Sand mixing	Simpson type with the automatic feeders and controlled system	No sand test apparatus beside the mixer. Bad condition of rollers (Photo 13 & 14)
10	Disintegration of agglomerated sand	Rotated pin type on belt conveyor sand flow	
11	Sand storage for moulding machine	Overhead sand hopper	

## 2-4 Evaluation of Sand Preparation System and Mixed Sand Characteristics

Anyway our observation of the condition of the moulds in BLOMATIC line and the sand test data given by sand laboratory led us to the following conclusions;

- a) Some of the most important properties such as compactability and active clay are not tested.
- b) Moisture control did not seem to be carried out by the mixer operator.
- c) The harmful iron oxide and clay ball were not observed on the mould surface. These mould surfaces were uniform and shown no existence of sand balls or the sand agglomeration.
- d) The dust discharged from the dust collector for sand cooler was fine, where probably to be the high carbon material content, and such situation is the evidence that the dust collector shows the better control with the adequate suction strength.

## 2.5. Observation and Evaluation of BLOMATIC Moulding Demonstration

Because of trouble in melting equipment, BLOMATIC moulding line was not operated. However, the moulding line was demonstrated with the sand system together for our observation.

### a) Basic Action of BLOMATIC Moulding Machine.

Both of cope and drag flasks (Photo 15) are set horizontally on the both side of the match plate individually. Sand is blown into the cope flask from the topside, and into the drag flask from the side, and then the squeezing is carried out from both of the bottom and the top (Photo 16 & 17). And finally the cope and the drag are striped from the pattern plate.

After both flasks are removed, the cope is set on the drag without turnover. That is, the mould surface of the cope has no chance to be exposed and checked by the operator whether the condition is acceptable or not, even though the main pattern is set on and drawn from the cope.

### b) Condition of Pattern and Mould.

We found the broken cope mould corner that was corresponding to the edge position of the cope pattern, where the sand adhesion was observed (Photo 18). It is not clear the reason why such sand adhesion occurs on these pattern edges. We could guess that one of the reasons is the fact that the sand mixing condition for this demonstrative operation was considered not to be the best because the temporary operator operated that time. However, considering the system was operated automatically, such condition was able to occur.

c) Compressed air blowing is applied to the pattern cleaning, but any lubricant like polishing was not applied to smooth pattern strip.

## 2-5. Recommended Method for Improvement of Sand Erosion (Broken Mould)

### 1) Pattern and Flask

- a) Apply ZIPSLIP for the smooth pattern strip, as a trial,
- b) Polish the pattern surface with the same direction as strip direction by finer sand paper than No. 800.
- c) Check parallelism of the cope and the drag on setting condition to the moulding machine.

### 2) Sand

- a) Control the moisture content at the sand mixer site by the operator in charge
- b) Check and manage Compactability.
- c) Na treated Ca bentonite should be applied by the ratio of 1/3~1/4 for improvement of the green sand strength.
- d) Try coconuts oil 1% to improve the smoothness of stripping and the mould surface stability.
- e) Try to confirm which is better, dextrin or starch.

3) Develop method how to check the mould condition, and also the pattern condition after its being drawn.

- a) For example, application of millers

4) Develop method how to get the good compacted condition for the cope with the topside blow.

- a) For example, improvement of the blowing mouth shape and positions.



Photo 1, 2 & 3 - Sand Erosion Defects detected on Cylinder Liner Castings



Photo 1



Photo 2



Photo 3

Photo 4, 5 & 6 - Aneka wants to reduce the defects detected on the Liner Brake Castings

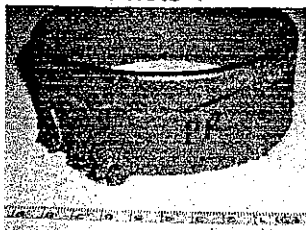


Photo 4

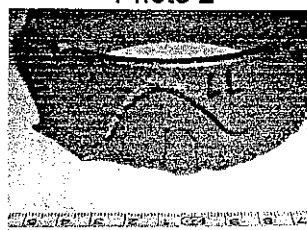


Photo 5

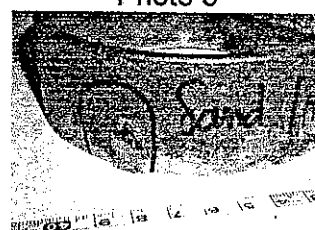
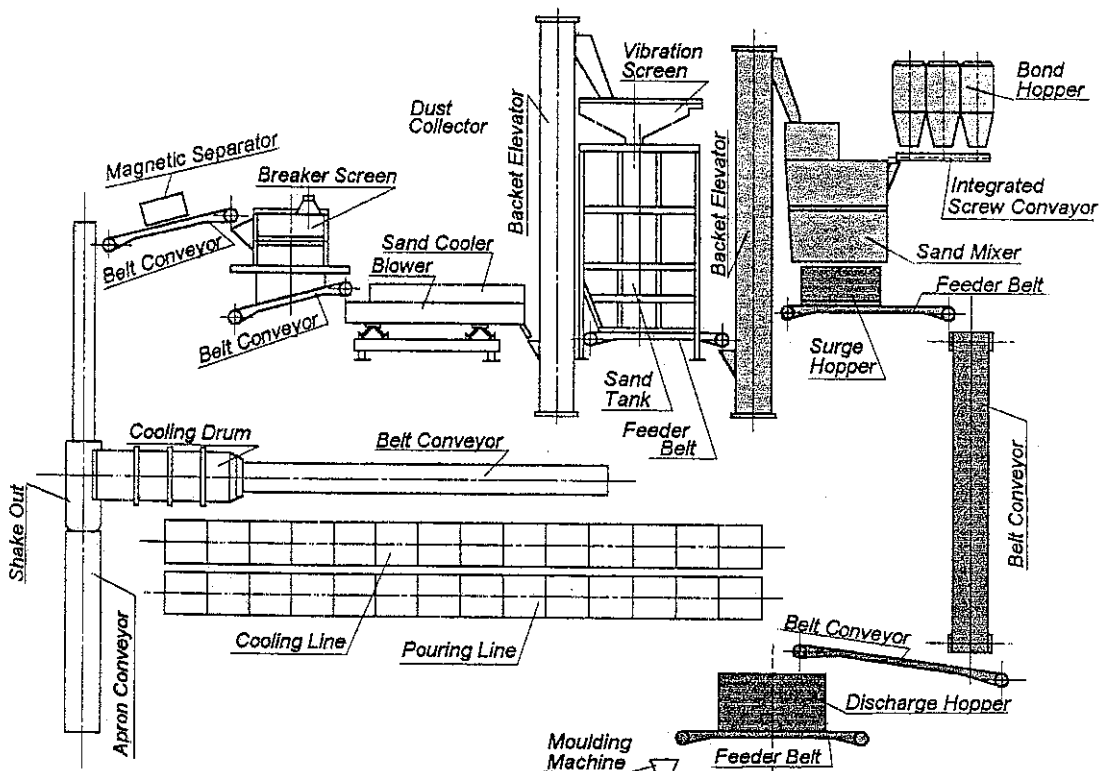


Photo 6



System Sand Preparation Flow

Figure 2

Photo 7 & 8 - Magnetic Separator established on the System Flow. Cross type magnetic conveyor. Good condition. No Magnetic pulley



Photo 7

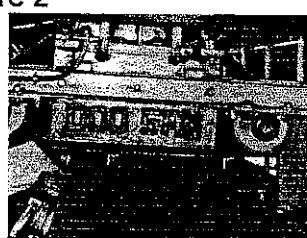


Photo 8

Photo 9 - Breaker screen with  $\phi$  10 mm holes for disintegration and Removal of Sand Blocks



Photo 9

Photo 10 - Sand Cooling with the fluidized sand bed.



Photo 10



Photo 11 & 12 - Dust Collector for Fluidized Sand Bed established Discharged dust is fine and it may be mainly carbon material

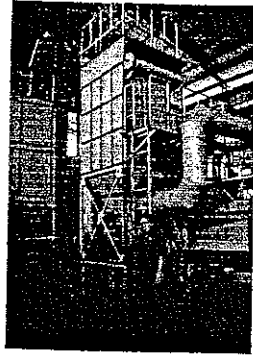


Photo 11

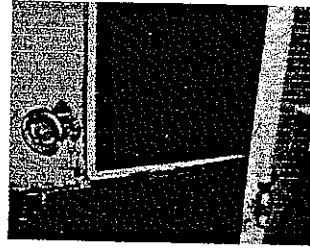


Photo 12

Photo 13 & 14 - Simpson Type Sand Mixer with the automatic feeders and controlled system Bad condition of rollers

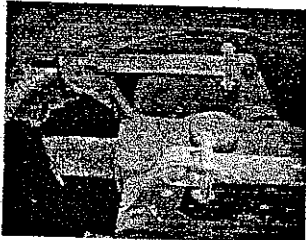


Photo 13

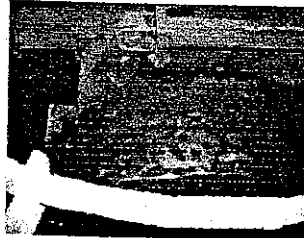


Photo 14

Photo 15 - On BLO-MATIC Moulding Machine, both of cope and drag flasks are set horizontally on the both side of the match plate individually.

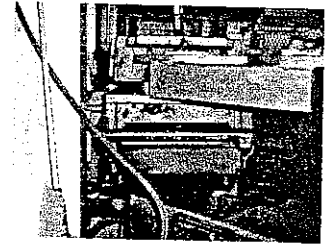


Photo 15

Photo 16 - Sand is blown into the cope flask from the topside



Photo 16

Photo 17- Sand is blown into the drag flask from the side.

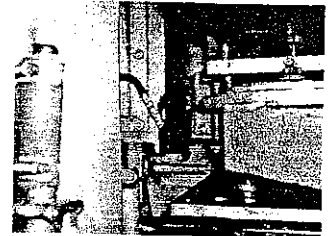


Photo 17

Photo 18- The broken cope mould corner that was corresponding to the edge position of the cope pattern.

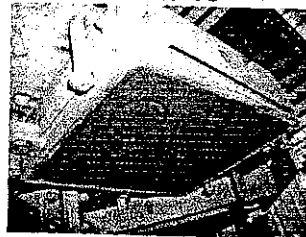


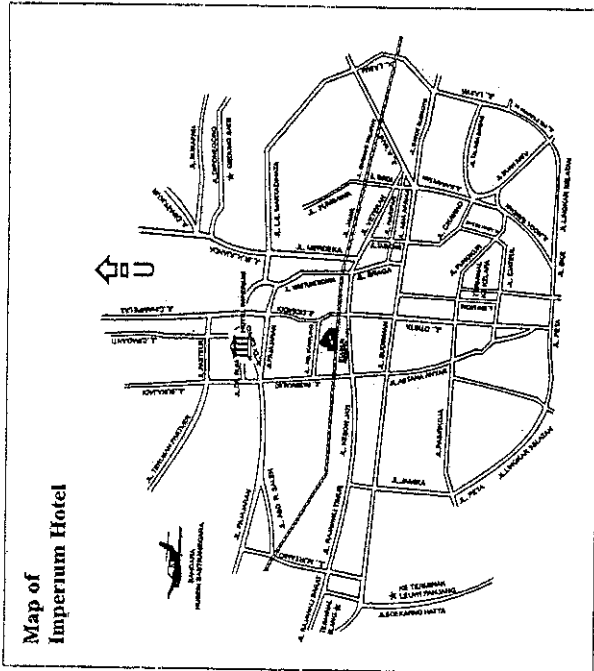
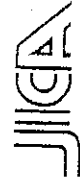
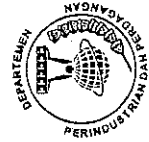
Photo 18

**SEMINAR ON  
IRON CASTING TECHNOLOGY**

**Hotel International Imperium**  
Bandung, March 22, 2001



Cooperation between :  
Institute for Research and Development of  
Metal and Machinery Industries (IRDMMI/MIDC)  
Japan International Cooperation Agency (JICA)



Nama Hotel	Tipe Kamar	Harga (Rp.)
International Catelya Guest House Telp. 022 - 4235306	Standard A	65.000
	Standard B	55.000
	Standard C	45.000
Topas Galena Hotel Telp. 022 - 6035637	Superior	235.000
	Deluxe	275.000
	Suite	600.000
Chrysanta Hotel Telp. 022 - 4237733	Standard Elegant	93.500
	Special	110.000
	Non AC	77.000
Grant Aquia Hotel Telp. 022 - 2037859	Standard	242.000
	Suite	423.000
Nylian Hotel Telp. 022 - 6040705	Ekonomi	98.000
	Standard	109.000

..... 2001

To :  
Secretariat of the Seminar on Iron Casting Technology  
IRDMMI (MIDC)- JICA  
Jl. Sangkurang 12  
Bandung 40135  
Attn: - Mr. Hadi Nugroho  
- Ms. Williany

**Registration Card**

Name 1 .....  
2 .....  
3 .....

Position .....

Organization .....

PostalAddress .....

Phone : .....  
Fax : .....

plan to attend the Seminar on Iron Casting Technology

SM

AB

## SEMINAR ON IRON CASTING TECHNOLOGY

### INTRODUCTION

- Foundry Industry has a strategic role in national industrial structure of a nation, including Indonesia, especially in supporting component and metal manufacturing industries.
- "The Project on Supporting Industries Development for Casting Technology" is the project jointly implemented by Institute for Research and Development of Metal and Machinery Industries (IRDMMI / MIDC) and Japan International Cooperation Agency (JICA) under the scheme of Japanese Technical cooperation to the Republic of Indonesia. The Project has commenced since April 1999 for five years based at IRDMMI/MIDC in Bandung. The Project aimed at developing small and medium scale industries to be able to provide domestic assembly industries with casting products to meet their quality level through improving technical services of IRDMMI / MIDC by dispatch of Japanese experts for technology transfer and other means.

### OBJECTIVE OF THE SEMINAR

The seminar is one of the important means to achieve the goal of the Project by providing useful information on iron casting technology to the small and medium scale industries. The IRDMMI and JICA could become accelerator of technology mastery for the small and medium scale foundry industries to improve their capabilities.

### THEME

Quality Improvement of Casting Product

### DATE & VENUE

The seminar will be held :

On : March 22, 2001

At : Hotel International IMPERIUM  
Ruang Arga Puspa  
Jl. Dr. Rum No. 30-32 / Dr. Cipto  
Bandung 40171

### TENTATIVE AGENDA

- 08.30 - 09.15 Registration
- 09.15 - 10.00 Opening Ceremony
- 10.00 - 10.15 Coffee Break
- 10.15 - 11.05 Session 1
- 11.05 - 11.55 Session 2
- 11.55 - 13.00 Lunch
- 13.00 - 13.45 Session 3
- 13.45 - 14.25 Session 4
- 14.25 - 14.40 Coffee Break
- 14.40 - 15.20 Session 5
- 15.20 - 16.00 Session 6
- 16.00 - 16.30 Summary & Closing Ceremony

### SELECTED PAPERS

- Countermeasure of Casting Defects due to Gating Design and Moulds  
(by Mr. Masatake ICHIKI, Hitachi Metals Ltd., Japan)
- Foundry Floor Test of Cast Iron for Quality Assurance  
(by Mr. Noboru YAMANAKA, Kawaguchi Foundry Association, Japan)
- FCD Maternal Development  
(by Mr. Bustanul / Universitas Indonesia)
- Riskless Casting for FCD Materials  
(by IRDMMI/MIDC)
- Current Demand of Automotive Component  
(by Gabungan Industri Alat-alat Mobil & Motor GLAMM)
- Foundry Management  
(by PT. Pakari Riken)

### REGISTRATION

Registration for participation is recommended for all participants. Please complete the enclosed registration form and return it to the secretariate by no later than 10<sup>th</sup> March 2001.

### SECRETARIAT OF THE SEMINAR

Institute for Research and Development of Metal and Machinery Industries (IRDMMI/MIDC)

Jl. Sangkuripang 12, Bandung 40135

Phone : (022) 2503171, 2503172, 2504107

Fax : (022) 2503172/2503978

Contact Persons : - Mr. Hadi Nugroho,

- Ms. Williamy Aminuddin.



**ANNEX 19: JICA Budget Allocation**  
**MIDC/JICA Project on Supporting Industries Development for Casting Technology in Indonesia**

as of the end of September, 2001  
 (Unit: Japanese Yen)

Japanese Fiscal Year	1998		1999		2000		2001		Total	
	Allocation	Actual	Allocation	Actual	Allocation	Actual	Allocation	Actual(-Sep.)	Allocation	Actual(-Sep.)
<b>1 JICA Local Budget</b>										
(1) Ordinary			23,119,000	25,665,655	4,111,000	5,118,744	2,886,000	1,260,639	30,116,000	32,045,038
(2) Extraordinary Electric Power Extension			5,119,000	5,119,000	3,461,000	4,459,000	2,886,000	1,260,639	11,466,000	10,838,639
(3) Extraordinary Machinery Installation			18,000,000	18,282,655	-	-	-	-	18,000,000	18,282,655
(4) Technical Exchange			-	2,264,000	-	-	-	-	-	2,264,000
			-	-	650,000	659,744	-	-	650,000	659,744
<b>2 Machinery &amp; Equipment</b>										
(1) Procured in Japan	176,000,000	194,696,250	92,600,000	69,010,832	14,000,000	17,802,720	3,550,000	51,398	286,150,000	281,561,200
(2) Procured Locally in Indonesia	176,000,000	194,696,250	24,250,000	12,267,500	1,000,000	6,958,770	900,000	51,398	202,150,000	213,973,918
	-	-	68,350,000	56,743,332	13,000,000	10,843,950	2,650,000	0	84,000,000	67,587,282

<Note> 1. "Allocation" means amount of budget allocated when each annual plan was approved.

## Draft Project Design Matrix (PDM)

Dec 15, 1998

## Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumptions
(Overall Goal) Small and medium scale foundry industries will be able to provide domestic assembly industries with casting products to meet their quality level	1 Increase of production delivered to assembly industries 2 Improvement of quality of products 3 Improvement of productivity and efficiency	1,2,3 Survey reports on foundry industries, questionnaires to and interviews with related industries	a There is no drastic change in the politic and economic situation in Indonesia b Supporting industries development policy will continue to be stable c Demand for Indonesian casting products will continue to be stable.
(Project Purpose) Technical services for small and medium scale foundry industries extended by MIDC will be improved	1 Level of satisfaction of present and former service beneficiaries 2 Level of satisfaction of industries 3 Number of newly improved services and targeted group	1,2 Questionnaires to and interviews with related industries 3 MIDC records	a Indonesian foundry industries will utilize the technology obtained from MIDC b Linkage between assembly and supporting industries will be established.
(Outputs of the Project) 0 Project operation unit will be enhanced 1 Machinery and equipment will be provided, installed, operated and maintained properly 2 Technical capability of the counterpart personnel (hereinafter referred to as "C/P") will be upgraded 3 Trial prototyping services will be implemented systematically 4 Technical dissemination services will be implemented systematically 5 Information services will be implemented systematically	0 Number and capability of staff, budget, established management system 1 Contents and conditions of machinery and equipment, route to get spare parts and situation to secure spare parts 2 Assessment by the Japanese experts, number of achieved Target Products for Technology Transfer 3 Number of implemented trial prototyping services 4 Number of implemented technical dissemination services, number of clients 5 Number of implemented information services, number of beneficiaries, number of participants	0 Organization chart, personnel record, accounting record and administration record 1 Machinery and equipment list, operation and maintenance record 2,3,4,5 MIDC records	a Trained C/P will remain at MIDC
(Activities) 0-1 Allocate necessary personnel 0-2 Make plans of activities 0-3 Make budget plan and execute properly. 0-4 Establish and operate management system 1-1 Make facility refurbishment plan and implement as planned. 1-2 Provide and install machinery and equipment 1-3 Operate and maintain the machinery and equipment properly 2-1 Make Technical Cooperation Program. 2-2 Implement technology transfer to the C/P 2-3 Monitor and evaluate the technology transfer to the C/P 3-1 Make plan of trial prototyping services 3-2 Implement the trial prototyping services 3-3 Monitor and evaluate the trial prototyping services 4-1 Make plan of technical dissemination services 4-2 Implement the technical dissemination services 4-3 Monitor and evaluate the technical dissemination services 5-1 Make plan of information services. 5-2 Collect and compile technical information and material 5-3 Provide industries with technical information and material 5-4 Monitor and evaluate the information services.	Inputs		C/P will remain at MIDC
	Indonesian side	Japanese side	(Preconditions) a Utilities of the Project site will be stably provided b Foundry industries will be cooperative to the Project
	1 Renovation, provision and maintenance of building and facilities 2 Allocation of C/P and administrative personnel 2-1 C/P a Administrative C/P b. Technical C/P 2-2 Supporting staff a Technical staff b Administrative staff c Any other personnel for smooth implementation of the Project 3 Provision and maintenance of machinery and equipment 4 Budgetary allocation of local cost necessary for implementation of the Project	1 Dispatch of Japanese experts 1-1 Long-term experts a Chief advisor b Coordinator c. Experts on casting 1-2 Short-term experts in the specific fields of technology may be dispatched, if necessary 2 Indonesian C/P training in Japan - A certain number of C/P per fiscal year 3 Provision of machinery and equipment 4 Budgetary allocation for supporting local cost	

**ANNEX 21: SUMMARIZED RESULTS OF PDM INDICATORS (Draft as of the mid-term of the Project) (1/3)**

JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

Jan. 24, 2002 (Ver.3)

Narrative Summary of the Project	Verifiable Indicators	Results	Remarks
<p><b>(( Overall Goal ))</b> Small and medium scale foundry industries will be able to provide domestic assembly industries with casting products to meet their quality level.</p>	<p>1. Increase of production delivered to assembly industries</p> <p>2. Improvement of quality of products</p> <p>3. Improvement of productivity and efficiency</p>	<ul style="list-style-type: none"> <li>- Annual production of automobile, the largest user of casting products, increased from 58,079 in 1998 to 123,244 in 1999 and 345,416 in 2000.</li> <li>- Annual casting production in Indonesia is estimated at 150,000t in 1996.</li> <li>- Annual average casting production of surveyed 15 companies in 2000 is 110t. (Referential data: to be handled carefully)</li> <li>- Defect ratio in surveyed 15 companies in 2000 is 14.8% (Internal 11.8%, Customer 3.0%). (Referential data: to be handled carefully)</li> <li>- Labor Productivity Index (used in the Project: Monthly Production (t) / Number of Technical Personnel (person)) in 15 surveyed companies in 2000 is 1.56 (t / person). (Referential data: to be handled carefully)</li> <li>- Energy Efficiency Index (used in the Project: Monthly Production (t) / Monthly Induction Furnace Electric Power Consumption (kwh)) in 15 surveyed companies in 2000 is 1,180 (kwh / t). (Referential data: to be handled carefully)</li> </ul>	
<p><b>(( Project Purpose ))</b> Technical services for small and medium scale foundry industries extended by MIDC will be improved.</p>	<p>1. Level of satisfaction of present and former service beneficiaries</p> <p>2. Level of satisfaction of industries</p> <p>3. Number of newly improved services and targeted group</p>	<ul style="list-style-type: none"> <li>- Average satisfaction ratio of the participants for the latest Seminar in 2001 is 4.19 out of 5.00.</li> <li>- Average satisfaction ratio of the participants for the latest Training Course in 2001 is 4.23 out of 5.00.</li> <li>- Expectation for the Project technical services in 2001                             <ul style="list-style-type: none"> <li>➢ Information Service (Seminar etc.) (72%), Extension Service (Site Visit &amp; Consultation) (57%), Training Course in MIDC (53%), Prototyping Service (29%)</li> </ul> </li> <li>- Four (4) major services, thus, Extension Service (Technical Consultation in Industry), Training Service (Training Course for SME in MIDC), Information Service (Seminar etc.) and Trial Prototyping Service have been newly improved.</li> <li>- Ten (10) foundry companies are designated as target companies or targeted group.</li> </ul>	
<p><b>(( Outputs of the Project ))</b> 0. Project operation unit will be enhanced.</p>	<p>0. Number and capacity of staff, budget, established management system</p>	<ul style="list-style-type: none"> <li>- 203 persons are allocated as MIDC staff and 38 members of staff are allocated as MIDC C/P.</li> <li>- MIDC budget allocation was nominally improved.                             <ul style="list-style-type: none"> <li>➢ MIDC Total: Rp.4,762 million('01), Rp.3,081 million('00), 55% up</li> <li>➢ MIDC Project Budget: Rp.1,062 million('01), Rp.577 million('00), 84% up</li> </ul> </li> </ul>	<p>Refer to: Annex 6 Annex 7</p>

JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

**ANNEX 21: SUMMARIZED RESULTS OF PDM INDICATORS (Draft as of the mid-term of the Project) (2/3)**

JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

Jan. 24, 2002 (Ver.3)

Narrative Summary of the Project	Verifiable Indicators	Results	Remarks
<p>1. Machinery and equipment will be provided, installed, operated and maintained properly.</p>	<p>1. Contents and conditions of machinery and equipment, route to get spare parts and situation to secure spare parts</p>	<ul style="list-style-type: none"> <li>➢ MIDC Counter Budget for JICA Project: Rp.473 million('02 proposed), Rp.387 million('01), Rp.325 million('00), 22% up &amp; 19% up respectively</li> <li>- Established management system: Public Relations (Project Leaflet, Project Video), Linkages (with Industries, associations, academies, institutions etc.), Organization (Joint Coordinating Committee), Meetings (Regular Meeting, Technical Meeting, Review Meeting, Morning Meeting etc.), Need Survey (Report, Questionnaire etc.), Communication (Networking, Client List etc.) etc.</li> <li>- Machinery and Equipment provided by JICA and installed in MIDC: Total 67 items (24 items procured in Japan and 43 items procured locally in Indonesia), which are worth ¥281,561,200 (or Rp. 21,659 million).</li> <li>- The machinery and equipment mentioned above are basically kept in good conditions in MIDC.</li> <li>- The routes to get 84 kinds of parts, materials etc. have been identified available in local shop.</li> <li>- For the two most valuable, important and crucial equipment, that is, Double Squeeze Moulding System and <math>\alpha/\beta</math> Organic Sand Moulding System, 108 kinds of spare parts have been already secured (provided) by JICA and more than 50 kinds of spare parts are to be secured in FY2001.</li> </ul>	<p>Refer to: Annex 15</p>
<p>2. Technical capability of the counterpart personnel (hereinafter referred to as "C/P") will be upgraded.</p>	<p>2. Assessment by the Japanese experts, number of achieved Target Castings for Technology Transfer</p>	<ul style="list-style-type: none"> <li>- Assessment (0-to-4 Scale) shows the progress of the average level from the 1<sup>st</sup> year to 2<sup>nd</sup> and 3<sup>rd</sup> year as follows [1<sup>st</sup> year -&gt; 2<sup>nd</sup> year -&gt; 3<sup>rd</sup> year]:                             <ul style="list-style-type: none"> <li>➢ Overall [0.66 -&gt; 1.26 -&gt; 2.22]</li> <li>➢ (1) Casting Plan [0.6 -&gt; 0.8 -&gt; 1.6]</li> <li>➢ (2) Pattern Making [1.0 -&gt; 2.0 -&gt; 2.7]</li> <li>➢ (3) Moulding [0.9 -&gt; 1.1 -&gt; 2.2]</li> <li>➢ (4) Melting [0.3 -&gt; 1.6 -&gt; 2.9]</li> <li>➢ (5) Examination and Quality Control [0.5 -&gt; 0.8 -&gt; 1.7]</li> </ul> </li> <li>- Total 28 Target Castings have been achieved for Technology Transfer, which has already compared favorably with the number (15) planned at the beginning of the Project.</li> </ul>	<p>Refer to: Annex 26</p> <p>Annex 27</p>
<p>3. Trial prototyping services will be implemented systematically.</p>	<p>3. Number of implemented trial prototyping services</p>	<ul style="list-style-type: none"> <li>- One hundred twenty-five (125) trial prototypical products have been made and implemented as trial prototyping services.                             <ul style="list-style-type: none"> <li>➢ 18 Automotive Components</li> <li>➢ 9 Agricultural Machinery Components</li> <li>➢ 7 Electrical Components</li> <li>➢ 26 Textile Machinery Components</li> <li>➢ 20 Castings for Jig &amp; Fixture for Automotive Assembling (Export)</li> <li>➢ 7 Industrial Machinery Components for Multifarious Industries</li> <li>➢ 38 Others</li> </ul> </li> </ul>	<p>Refer to: Annex 30 Annex 31</p>

**ANNEX 21: SUMMARIZED RESULTS OF PDM INDICATORS (Draft as of the mid-term of the Project) (3/3)**  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

Jan. 24, 2002 (Ver.3)

Narrative Summary of the Project	Verifiable Indicators	Results	Remarks
4. Technical dissemination services will be implemented systematically.	4. Number of implemented technical dissemination services, number of clients	(1) Extension Services - Fifty (50) foundries/companies have been visited by the Project totally 96 times mainly for the purpose of Extension Services (technical consultation). - Among them ten (10) foundries/companies have been designated as the Target Companies (main clients) (2 in Bandung, 3 in Surabaya / East Java, 3 in Ceper / Yogyakarta, 1 in JABOTABEK and 1 in Sukabumi) (2) Training Courses - Four (4) Training Courses have been carried out for small and medium scale foundry industries (except for short courses less than one week) and totally 108 trainees have been benefited by the Project. - Three (3) Training Courses have been carried out for large-scale companies such as Toyota and University on a charged basis (except for short courses less than one week) and totally six (6) trainees have been benefited by the Project.	Refer to: Annex 18
5. Information services will be implemented systematically.	5. Number of implemented information services, number of beneficiaries, number of participants	- Two (2) Seminars on Iron Casting Technology and One (1) Opening Ceremony with Commemorative Seminar have been carried out so far. - Totally 510 participants have attended these seminars.	Refer to: Annex 18

## Tentative Schedule of Implementation (TSI) (Draft)

Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

as of December 31 2001

Calendar year	1997				1998				1999				2000				2001				2002				2003				2004
Fiscal Year	1997				1998				1999				2000				2001				2002				2003				
	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Term of Technical Cooperation																													
JAPANESE SIDE																													
1 Dispatch of mission																													
1-1 Preliminary study	-																												
1-2 Supplementary study		-	-																										
1-3 Implementation study																													
1-4 Management Consultation																													
1-5 Advisory																													
1-6 Evaluation																													
2 Dispatch of Experts																													
2-1 Long-term experts																													
2-1-1 Chief advisor																													
2-1-2 Coordinator & SME Development																													
2-1-3 Casting Technology Management																													
2-1-4 Pattern Making																													
2-1-5 Moulding																													
2-2 Short-term experts																													
(Short-term experts on specific fields will be dispatched if necessary)																													
3 Training of C/P in Japan																													
(Certain number of C/P will be accepted annually)																													
4 Provision of machinery and equipment																													
INDONESIAN SIDE																													
1 Building and facilities																													
1-1 Renovation																													
1-2 Maintenance																													
2 Allocation of C/P and administrative personnel																													
3 Provision and maintenance of machinery and equipment																													
4 Budgetary allocation of local cost necessary for implementation of the Project																													

Note:

- 1 This schedule is subject to change in accordance with the progress of the Project
- 2 The line of — means achievement before R/D in December 1998.
- 3 The line of - - means initial plan as of December 1998
- 4 The line of — means achievement after R/D until December 2001.
- 5 Titles of 2-1-2 and 2-1-3 were changed in April 2001 from "Coordinator" and "Casting Plan / Melting" respectively.
- 6 Mission "Management Consultation" and "Advisory" combined to form "1-5 Management Consultation" since FY 2000

# Annex 23 Plan of Operations (PO) (Draft)

Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

as of December 31, 2001

Calendar Year	1999				2000				2001				2002				2003				2004		
Project Year / Japanese Fiscal Year	98	1999			2000				2001				2002				2003						
	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I
Term of Technical Cooperation	Signing of R/D																						
0 Project operation unit will be enhanced																							
0-1 Allocate necessary personnel																							
0-2 Make plans of activities																							
0-3 Make budget plan and execute properly																							
0-4 Establish and operate management system																							
1 Machinery and equipment will be provided, installed, operated and maintained properly																							
1-1 Make facility refurbishment plan and implement as planned																							
1-2 Provide and install machinery and equipment																							
1-3 Operate and maintain the machinery and equipment properly																							
2 Technical capability of the counterpart personnel (hereinafter referred to as "C/P") will be upgraded.																							
2-1 Make Technical Cooperation Program																							
2-2 Implement technology transfer to the C/P																							
2-3 Monitor and evaluate the technology transfer to the C/P																							
3 Trial prototyping services will be implemented systematically																							
3-1 Make plan of trial prototyping services																							
3-2 Implement the trial prototyping services																							
3-3 Monitor and evaluate the trial prototyping services																							
4 Technical dissemination services will be implemented systematically																							
4-1 Make plan of technical dissemination services																							
4-2 Implement the technical dissemination services																							
4-3 Monitor and evaluate the technical dissemination services																							
5 Information services will be implemented systematically																							
5-1 Make plan of information services																							
5-2 Collect and compile technical information and material																							
5-3 Provide industries with technical information and material																							
5-4 Monitor and evaluate the information services																							

Note:

- 1 This schedule is subject to change in accordance with the progress of the Project
- 2 The line of — means that the respective activities will be implemented during the corresponding term
- 3 The line of - - - means that the respective activities will be implemented during the corresponding term if necessary
- 4 The line of — means that the respective activities were implemented during the corresponding term

ANNEX 24 (1/6):

**Annual Plan of Operations (APO) (Revised Draft)**  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

**OUTPUT 0. Project operation unit will be enhanced.**

Calendar Year / Indonesian Fiscal Year Project Year / Japanese Fiscal Year	FY2001 Plan made in Sep., '00												FY2002 Plan (Draft) made in Nov., '01			Remarks										
	CY 2001						CY 2002						CY2003													
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6		7	8	9	10	11	12	1	2	3	Responsible person in Project(*)
Term of Technical Cooperation																										
0. Project operation unit will be enhanced.																										
0-1 Allocate necessary personnel.																										
0-1-1 Make personnel allocation plans.																										
0-1-2 Allocate personnel as planned.																										
0-2 Make plans of activities.																										
0-2-1 Make and revise plans of activities.																										
0-2-2 Make plans of activities for the next year.																										
0-3 Make budget plan and execute properly.																										
0-3-1 Make and revise budget plan.																										
0-3-2 Execute budget plan properly.																										
0-4 Establish and operate management system.																										
0-4-1 Establish management system.																										
0-4-2 Operate management system.																										

as of Nov., '01

(\*)

<Indonesian Side>	<Japanese Side>
PD :Project Director	CA :Chief Advisor
VPD :Vice Project Director	PC :Project Coordinator
PM :Project Manager	LE :Long-term Expert
C/P :Coordinator Project	SE :Short-term Expert
(to be supported by Co.Coordinator Project)	
C/P :Indonesian C/P	

--- Plan  
 — Actual



Annual Plan of Operations (APO) (Revised Draft)  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

OUTPUT 1. Machinery and equipment will be installed and maintained properly.

Calendar Year / Indonesian Fiscal Year Project Year / Japanese Fiscal Year	FY2001 Plan made in Sep. '00												FY2002 Plan (Draft) made in Nov. '01												Remarks
	CY 2001						CY 2002						CY 2003						Responsible person in Project(*)	Input(*)					
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9			10	11	12	1	
Term of Technical Cooperation																									
1. Machinery and equipment will be installed and maintained properly.																									
1-1 Make a facility refurbishment plan and implement as planned.																									
1-1-1 Make a facility refurbishment plan.																									
1-1-2 Implement as planned.																									
1-2 Provide and install necessary machinery and equipment.																									
1-2-1 Identify specifications of necessary machinery and equipment.																									
1-2-2 Implement tenders and select traders.																									
1-2-3 Procure and transport the machinery and equipment to the Project site.																									
1-2-4 Install the machinery and equipment.																									PC,LE,SE,CP,C/P PC,LE,SE,CP,C/P
1-3 Operate and maintain the machinery and equipment properly.																									
1-3-1 Make operation and maintenance plans of the machinery and equipment.																									CA,PM
1-3-2 Operate and maintain the machinery and equipment as planned.																									CA,PM PC,CP
Making of maintenance record of machinery and equipment																									PC,LE,SE,CP,C/P CA,PM

as of Nov., '01

(\*)

<Indonesian Side> PD :Project Director VPD :Vice Project Director PM :Project Manager CP :Coordinator Project (to be supported by Co.Coordinator Project) C/P :Indonesian C/P	<Japanese Side> CA :Chief Advisor PC :Project Coordinator LE :Long-term Expert SE :Short-term Expert
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— Plan  
 — Actual

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**Annual Plan of Operations (APO) (Revised Draft)**  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

**OUTPUT 2. Technical capability of the counterpart personnel will be upgraded.**

Calendar Year / Indonesian Fiscal Year Project Year / Japanese Fiscal Year	FY2001 Plan made in Sep., '00												FY2002 Plan (Draft) made in Nov., '01			Remarks									
	CY 2001						CY 2002						CY2003												
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6		7	8	9	10	11	12	1	2	3
Term of Technical Cooperation	Target																								
2. Technical capability of the counterpart personnel (hereinafter referred to as "C/P") will be upgraded.																									
2-1 Make technical cooperation program.																									
2-1-1 Evaluate the technical capability of the C/P.																									
2-1-2 Specify target castings to measure their technical level.																									
2-1-3 Prepare drawings of the target castings.																									
2-1-4 Make C/P training plans per technology transfer field.																									
2-2 Implement technology transfer to the C/P.																									
2-2-1 Prepare teaching materials.																									
2-2-2 Implement technology transfer as planned.																									
2-3 Monitor and evaluate the result of technology transfer to the C/P.																									
2-3-1 Monitor the result of technology transfer to the C/P.																									
2-3-2 Evaluate the result of technology transfer to the C/P.																									
																									PC,LE,SE,CP,C/P
																									CA,PM
																									PC,LE,SE,CP,C/P
																									CA,PM
																									PC,LE,SE,CP,C/P
																									CA,PM
																									PC,LE,SE,CP,C/P
																									CA,PM
																									PC,LE,SE,CP,C/P
																									CA,PM
																									PC,LE,SE,CP,C/P
																									CA,PM

(\*)

<Indonesian Side>	PD :Project Director	VPD :Vice Project Director	PM :Project Manager	CP :Coordinator Project (to be supported by Co.Coordinator Project)	C/P :Indonesian C/P
<Japanese Side>	CA :Chief Advisor	PC :Project Coordinator	LE :Long-term Expert	SE :Short-term Expert	

— Plan  
 - Actual

as of Nov., '01

ANNEX 24 (4/6):

Annual Plan of Operations (APO) (Revised Draft)  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

OUTPUT 3. Trial prototyping services will be implemented systematically.

Calendar Year / Indonesian Fiscal Year	FY2001 Plan made in Sep.'00												FY2002 Plan (Draft) made in Nov.'01												Remarks
	CY 2001						CY 2002						CY 2003						Responsible person in Project(*)	Input(*)					
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9			10	11	12	1	
Term of Technical Cooperation																									
3. Trial prototyping services will be implemented systematically.																									
3-1 Make plan of trial prototyping services.																									
3-1-1 Analyze the result of needs survey on technical services of MIDC.																									
3-1-2 Make implementation plans of trial prototyping services.																									CA,PM
3-2 Implement the trial prototyping services.																									
3-2-1 Implement the trial prototyping services as planned.																									CA,PM
3-3 Monitor and evaluate the trial prototyping services.																									
3-3-1 Monitor the trial prototyping services.																									CA,PM
3-3-2 Evaluate the trial prototyping services.																									CA,PM

as of Nov., '01

(\*)

<Indonesian Side>	<Japanese Side>
PD :Project Director	CA :Chief Advisor
VPD :Deputy Project Director	PC :Project Coordinator
PM :Project Manager	LE :Long-term Expert
CP :Coordinator Project	SE :Short-term Expert
(to be supported by Co.Coordinator Project)	
C/P :Indonesian C/P	

— Plan  
 — Actual

Annual Plan of Operations (APO) (Revised Draft)

JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

OUTPUT 4. Technical dissemination services will be implemented systematically.

Calendar Year / Indonesian Fiscal Year Project Year / Japanese Fiscal Year	FY2001 Plan made in Sep., '00												FY2002 Plan (Draft) made in Nov., '01			Remarks										
	CY 2001						CY 2002						CY 2003													
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6		7	8	9	10	11	12	1	2	3	Responsible person in Project(*)
Term of Technical Cooperation																										
4. Technical dissemination services will be implemented systematically.																										
4-1 Make plan of technical dissemination services.																										
4-1-1 Analyze the result of needs survey on technical services of MIDC.																										
4-1-2 Make implementation plans of technical dissemination services.																										
4-2 Implement the technical dissemination services.																										
4-2-1 Implement extension services by visiting industries as the technical dissemination services as planned.																										
4-2-2 Implement training services in and out of MIDC as the technical dissemination services as planned.																										
4-3 Monitor and evaluate the technical dissemination services.																										
4-3-1 Monitor the technical dissemination services.																										
4-3-2 Evaluate the technical dissemination services.																										

as of Nov., '01

<Indonesian Side> PD :Project Director VPD :Deputy Project Director PM :Project Manager CP :Coordinator Project (to be supported by Co.Coordinator Project) C/P :Indonesian C/P	<Japanese Side> CA :Chief Advisor PC :Project Coordinator LE :Long-term Expert SE :Short-term Expert
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— Plan  
— Actual

ANNEX 24 (6/6):

**Annual Plan of Operations (APO) (Revised Draft)**  
**JICA/MIDC Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia**

**OUTPUT 5. Information services will be implemented systematically.**

Calendar Year / Indonesian Fiscal Year Project Year / Japanese Fiscal Year Term of Technical Cooperation	CY 2001				CY 2002				CY 2003				Responsible person in Project(*)	Input(※)	Remarks																																																																																																																																																																																																																																																																																																																																																																																							
	FY 2001				FY 2002 (Draft)																																																																																																																																																																																																																																																																																																																																																																																																	
	4	5	6	7	8	9	10	11	12	1	2	3				4	5	6	7	8	9	10	11	12	1	2	3																																																																																																																																																																																																																																																																																																																																																																											
5. Information services will be implemented systematically.  5-1 Make plan of information services. 5-1-1 Make implementation plans of information services.  5-2 Collect and compile technical information and material. 5-2-1 Collect technical information and material. 5-2-2 Compile technical information and material.  5-3 Provide industries with technical information and material. 5-3-1 Prepare for seminar on casting technology. 5-3-2 Hold seminar on casting technology. 5-3-3 Provide technical information and material by other means such as publications and open library.  5-4 Monitor and evaluate compiling of and providing with technical information and material. 5-4-1 Monitor and evaluate compiling of technical information and material. 5-4-2 Monitor and evaluate providing with technical information and material.																																																																																																																																																																																																																																																																																																																																																																																																						

as of Nov., '01

(\*)

<Indonesian Side> PD :Project Director VPD :Deputy Project Director PM :Project Manager CP :Coordinator Project (to be supported by Co.Coordinator Project) C/P :Indonesian C/P	<Japanese Side> CA :Chief Advisor PC :Project Coordinator LE :Long-term Expert SE :Short-term Expert
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--- Plan  
 = Actual

### Technical Cooperation Program (TCP)

Project on Supporting Industries Development for Casting Technology in the Republic of Indonesia

Progress as of Dec. 31, 01, Plan was revised on Dec. 31, 01

Calendar Year	1998				1999				2000				2001				2002				2003				
Fiscal Year	1998				1999				2000				2001				2002				2003				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I
Term of Technical Cooperation																									
(PO2-2) Implement technology transfer to the C/P																									
<b>1. Casting Plan</b>																									
1-1 Understanding of drawings including procedure																									
1-2 Pattern and mould plan																									
1-3 Riser and gating system plan																									
1-4 Utilization of Casting Flow and Solidification Simulation System																									
1-5 Casting specification																									
<b>2. Pattern Making</b>																									
2-1 Understanding of drawings including procedure																									
2-2 Pattern making design and full scale drawing																									
2-3 Operation and maintenance of machinery and equipment																									
2-4 Handling and maintenance of hand tools																									
2-5 Wooden pattern making																									
2-6 Inspection of pattern																									
2-7 Mending and storage of patterns																									
<b>3. Moulding</b>																									
<b>3-1 Sand preparation</b>																									
3-1-1 Selection and preparing of green mould sand																									
3-1-2 Selection and preparing of organic mould sand																									
3-1-3 Sand reclamation																									
3-1-4 Testing of sand and mould																									
<b>3-2 Moulding and core making</b>																									
3-2-1 Hand moulding with green mould sand																									
3-2-2 D/S Machine moulding with green mould sand																									
3-2-3 J/S Machine moulding with green mould sand																									
3-2-4 Moulding with organic mould sand																									
3-2-5 Core making (Hand & Blowing)																									
3-2-6 Coating																									
<b>4. Melting</b>																									
4-1 Selection and storage of materials																									
4-2 Mixing ratio calculation of charging																									
4-3 Materials charging and melting operation																									
4-4 Molten metal treatment																									
4-5 Foundry test for monitoring molten metal characteristics																									
4-6 Pouring practice																									
4-7 Lining maintenance of furnace/ladle, and ladle preheat																									
<b>5. Examination and Quality Control</b>																									
5-1 Selection and operation of finishing process																									
5-2 Chemical analysis																									
5-3 Mechanical test (Hardness)																									
5-4 Mechanical test (Tensile)																									
5-5 Metallurgical examination																									
5-6 Scribing and dimensional inspection																									
5-7 Surface defect inspection visually																									
5-8 Surface defect inspection (PT and MT)																									
5-9 Internal defect inspection (UT and RT film review)																									
5-10 Defects analysis and its countermeasure																									
5-11 Statistical quality control																									

Monitoring and Evaluation Sheet for TCP – Current Status and Plan  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

Revised on Dec. 31, 2001.

Subject of TCP	Final Status Point	Annual Progress Status (Current/Target)					TT Implemented Methodology of TT	Input from Japanese Side	TT Plan from Now Methodology of TT	Input from Japanese Side	Comments by Japanese Experts	Final Products
		1st	2nd	3rd	4th	5th						
<b>1. Casting Plan</b>												
1-1 Understanding of drawings including procedure	4	0/(1)	1/(2)	2/(2)	3/(3)	/(4)	LEC/OJT	LE/SE	LE/SE/SP	•The average level of drawing understanding and casting designing was reached to the target because of 2 beginners' active practices. But more positive implementation is requested to C/P who had the basic facility before our project. •HICASS should be utilized more effectively. •Importance of casting specification has begun to be recognized.	Lecture Document (3+12) Work Record Format (1+1) Casting Design Dwg (15+46), Manufacturing Report (0+6)	
1-2 Pattern and mould plan	3	1/(1)	1/(2)	2/(2)	3/(3)	/(3)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
1-3 Riser and gating system plan	3	1/(1)	1/(2)	2/(2)	3/(3)	/(3)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
1-4 Utilization of casting flow & solidification simulation system	3	1/(1)	1/(1)	1/(2)	1/(2)	/(3)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
1-5 Casting specification	4	0/(0)	0/(1)	1/(2)	1/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
<b>2. Pattern Making</b>												
2-1 Understanding of drawings including procedure	4	1/(2)	2/(3)	3/(4)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP	•With strong leader ship of the leader through fine assistance by LE, three C/Ps who were lower than main other two persons were improved; accordingly the average level of this group was improved better. •Daily maintenance of equipment and tools were started, but still not enough. •Regarding utilization of hand tools as well as pattern inspection and storage, further efforts should be made.	Pattern Manf. Manual (1+1), Machine Mainten. Manual (2+7) Work Record Format (1+0) •Wood Machine Maintenance Record Format(1+1), Manufacturing Report (+1) •Training Course (1+2).	
2-2 Pattern making design and full scale drawing	4	1/(2)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
2-3 Operation and maintenance of machinery and equipment	4	1/(2)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
2-4 Handling and maintenance of hand tools	4	1/(1)	2/(2)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
2-5 Wooden pattern making	4	1/(2)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
2-6 Inspection of pattern	4	1/(1)	2/(2)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
2-7 Mending and storage of patterns	4	1/(2)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
<b>3. Moulding</b>												
3-1 Sand preparation												
3-1-1 Selection and preparing of green mould sand	4	1/(0)	1/(1)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP	•Eng. Gr. specified applicable sand on the moulding drawings. •Sand was prepared per the procedure shown on the board. •G/sand reclamation should be improved. Org/resin declination was checked with percolation tests. •G & Org/sand tests were carried out periodically with public protection. Mould hardness/strength were measured on D/S moulds.	•Work Record Format (3+0) Lecture Document (1+2) Sand Test Procedure (1+1), Sand/Resin Test Record Format (1+1), Sand Mixing Procedure (+3), •Characteristic Control Table Format (1+1), •Tool Drawing (2+3).	
3-1-2 Selection and preparing of organic mould sand	4	1/(0)	2/(2)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
3-1-3 Sand reclamation.	4	1/(0)	1/(1)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
3-1-4 Testing of sand and mould	4	1/(0)	1/(2)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
3-2 Moulding and core making												
3-2-1 Hand moulding with green mould sand	4	0/(0)	1/(1)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP	•Hand & machine moulding techniques were improved to the higher level than our target due to TT & OJT. But J/S process was seldom practiced because of poor flasks. •Coring and washing were practiced on large heavy wall castings ordered, but more practice will be requested. •Recent good leadership of the leader due to LE's advice repetition was influenced of better quality of moulds and castings.		
3-2-2 D/S machine moulding with green mould sand	4	1/(0)	1/(2)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
3-2-3 J/S machine moulding with green mould sand	4	1/(0)	1/(2)	1/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
3-2-4 Moulding with organic mould sand	4	1/(0)	1/(2)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
3-2-5 Core making (Hand and Blowing)	4	1/(1)	1/(2)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
3-2-6 Coaling	4	1/(1)	1/(2)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/CPTJ/ EQ	LE/SE/SP			
<b>4. Melting</b>												
4-1 Selection and storage of materials	4	1/(0)	1/(1)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-2 Mixing ratio calculation of charging materials	4	0/(0)	2/(3)	3/(4)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-3 Materials charging and melting operation	4	0/(0)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-4 Molten metal treatment	4	0/(0)	2/(3)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-5 Foundry test for monitoring molten metal characteristics	4	0/(0)	1/(1)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-6 Pouring practice	4	0/(0)	2/(2)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
4-7 Lining maintenance of furnace/ladle, and ladle preheat	4	1/(1)	1/(2)	3/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
<b>5. Examination and quality control</b>												
5-1 Selection and operation of suitable finishing process	4	1/(0)	1/(2)	3/(4)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-2 Chemical analysis	4	1/(1)	1/(2)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-3 Mechanical test (Hardness Test)	4	1/(1)	1/(2)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-4 Mechanical test (Tensile Test)	4	1/(1)	1/(2)	1/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-5 Metallurgical examination	4	1/(1)	1/(2)	2/(3)	/(4)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-6 Scribbling and dimensional inspection	4	0/(1)	1/(1)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-7 Surface defect inspection (VT)	3	0/(0)	1/(1)	2/(2)	/(3)	/(3)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-8 Surface defect inspection (PT & MT)	3	0/(0)	0/(1)	1/(2)	/(2)	/(3)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-9 Internal defect inspection (UT and RT film review)	3	0/(0)	0/(1)	1/(2)	/(2)	/(3)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-10 Defects analysis and its countermeasure	4	0/(0)	1/(1)	2/(2)	/(3)	/(4)	LEC/OJT	LE/SE/SP	LE/SE/SP			
5-11 Statistical quality control	3	0/(0)	1/(1)	1/(2)	/(2)	/(3)	LEC/OJT	LE/SE/SP	LE/SE/SP			

Note 1) Abbreviation  
 VT: Visual Test, RT: Radiographic Test, UT: Ultrasonic Test, SP: Self Practice, PT: Liquid Penetrant Test, TT: Technology Transfer, LE: Long-term Expert, SE: Short-term Expert, C/P: Counterparts, EQ: Equipment, MAT: Materials

Note 2) Status Point  
 0: not started, 1: not satisfied, 2: fair, 3: satisfied, 4: well satisfied

Level	Contents												
1. Accurate Dimension	1	Pulley FC, G/S, Hand	3	Pulley FC, G/S, J/S	5	Disc Brake FC, G/S, Hand	7	Gear FCD, G/S & $\alpha$ /R, Hand	9	Shoe & Brill FC, G/S, Hand	11	Motor Cover FC, G/S, Hand	13
	2	Gear FC, G/S, Hand	4	Gear FC, G/S, J/S	6	Fly Wheel FC, G/S, Hand	8	Bearing House FCD, G/S, Hand	10	Toggle FC, $\alpha$ /R, Hand	12	Rollers FC, $\alpha$ /R, Hand	14
2. Shape Perfection	1	$\phi$ 96 Impeller FC, G/S, D/S	3	Cir. Double Cam FCD, G/S, Hand	5	Jack Lever #4 FC & FCD, G/S, Hand & J/S	7	Cam 11/11 FCD, G/S, Hand	9		11		13
	2	$\phi$ 120 Impeller FC, G/S, D/S	4	Oval Double Cam FCD, G/S, Hand	6	Jack Lever #3 FCD, G/S, J/S & Hand	8	Top Lever FC, G/S, Hand	10		12		14
3. Sound Surface	1	Ingot Case FC, $\alpha$ /R, Hand	3	Pulley Hub A FC, G/S, D/S	5	Rear Case FC, $\alpha$ /R, Hand	7		9		11		13
	2	Pulley Hub B & C FC, G/S, D/S	4	Front Case FC, $\alpha$ /R, Hand	6		8		10		12		14
4. Internal Soundness	1	Bearing Case FCD, G/S, Hand	3	Cam 11/22 & 1/3 FCD, G/S, Hand	5		7		9		11		13
	2	Burner FC, G/S, Hand	4		6		8		10		12		14
5. Mechanical & Metallurgical Properties	1		3		5		7		9		11		13
	2		4		6		8		10		12		14





**Curriculum for Individual Target Casting Level**  
 JICA/MIDC Project on Supporting Industries Development for Casting Technology in Indonesia

(Revised on Dec. 31, 2001)

Target Casting Level	1	2	3	4	5	Common
	Accurate Dimension	Shape Perfection	Sound Surface	Internal Soundness	Mechanical & Metallurgical Properties	
<b>1. Casting Plan</b>						
1-1 Understanding of drawings including procedure	○					
1-2 Pattern and mould plan		○	○			
1-3 Riser and gating system plan			○	○		
1-4 Utilization of Casting Flow & Solidification Simulation System						○
1-5 Casting Specification						○
<b>2. Pattern Making</b>						
2-1 Understanding of drawings including procedure	○					
2-2 Pattern making design and full scale drawing		○				
2-3 Operation and maintenance of machinery and equipment		○				
2-4 Handling and maintenance of hand tools		○				
2-5 Wooden pattern making	○					
2-6 Inspection of pattern	○					
2-7 Mending and storage of patterns						○
<b>3. Moulding</b>						
<b>3-1 Sand preparation</b>						
3-1-1 Selection and preparing of green mould sand	○					
3-1-2 Selection and preparing of organic mould sand	○					
3-1-3 Sand reclamation						○
3-1-4 Testing of sand and mould						○
<b>3-2 Moulding and core making</b>						
3-2-1 Hand moulding with green mould sand	○	○	○	○		
3-2-2 D/S Machine moulding with green mould sand		○	○	○		
3-2-3 J/S Machine moulding with green mould sand		○	○	○		
3-2-4 Moulding with organic mould sand	○	○	○	○		
3-2-5 Core making (Hand and Blowing)		○	○	○		
3-2-6 Coating		○	○	○		
<b>4. Melting</b>						
4-1 Selection and storage of materials						○
4-2 Mixing ratio calculation of charging materials						○
4-3 Materials charging and melting operation			○	○		
4-4 Molten metal treatment			○	○		
4-5 Foundry test for monitoring molten metal characteristics			○	○		
4-6 Pouring practice			○			
4-7 Lining maintenance of furnace/ladle, and ladle preheat						○
<b>5. Examination and quality control</b>						
5-1 Selection and operation of finishing process						○
5-2 Chemical analysis					○	
5-3 Mechanical test (Hardness)					○	
5-4 Mechanical test (Tensile Test)					○	
5-5 Metallurgical examination					○	
5-6 Scribing and dimensional inspection	○					
5-7 Surface defect inspection (VT)		○				
5-8 Surface defect inspection (PT and MT)			○			
5-9 Internal defect inspection (UT and RT film review)				○		
5-10 Defects analysis and its counter measure						○
5-11 Statistical quality control					○	

## TENTATIVE LIST OF PROTOTYPICAL PRODUCTS (1/3)

MIDC/JICA Project on Supporting Industries Development for Casting Technology in Indonesia

No.	No.	No. *	Product Name	Material	Customer	Remarks
<b>Automotive Components</b>						
1	At-01	8	Brake Drum	FC	Ceper BPPT	
2	At-02	9	Fly Wheel	FC	Ceper BPPT	
3	At-03	31	φ 120 Impeller (for Car Radiator Pump)	FC	Silika Foundry Utama	
4	At-04	32	φ 96 Impeller (for Car Radiator Pump)	FC	Silika Foundry Utama	
5	At-05	54	Bracket #1	FCD	Indo Pattern Lestari	
6	At-06	55	Bracket #2	FCD	Indo Pattern Lestari	
7	At-07	56	Bracket #3	FCD	Indo Pattern Lestari	
8	At-08	57	Bracket #4	FCD	Indo Pattern Lestari	
9	At-09	58	Bracket #5	FCD	Indo Pattern Lestari	
10	At-10	59	Bracket #6	FCD	Indo Pattern Lestari	
11	At-11	60	Bracket #7	FCD	Indo Pattern Lestari	
12	At-12	70	Pulley Hub B	FC	CV. Akur	
13	At-13	71	Pulley Hub C	FC	CV. Akur	
14	At-14	72	Pulley Hub A	FC	CV. Akur	
15	At-15	76	Pulley 440 (for Ship)	FC	CV. Castar	
16	At-16	80	Sprocket 540 (for Ship)	FCD	CV. Castar	
17	At-17	81	Sprocket 356 (for Ship)	FCD	CV. Castar	
18	At-18	121	Rocker Arm	FC	UKNT	
<b>Agricultural Machinery Components</b>						
19	Ag-01	4	Bearing Case (for Marmer Cutter)	FCD	Trimuda Pratama	
20	Ag-02	27	Wheel Gear (for Sugar Mill)	FCD	Silika Foundry Utama	
21	Ag-03	34	Wheel Gear (for Sugar Mill)	FCD	Silika Foundry Utama	
22	Ag-04	53	Bearing House (for Wood Processing M)	FCD	Paparti Pertama Suka.	
23	Ag-05	75	Nozzle	FC	CV CasterFC	
24	Ag-06	77	Pulley (for Grass Cutting Machine)	FC	Dairy Project	
25	Ag-07	114	Upper Roller (for Pulp Machine)	FC	(MIDC)	
26	Ag-08	115	Medium Roller (for Pulp Machine)	FC	(MIDC)	
27	Ag-09	116	Lower Roller (for Pulp Machine)	FC	(MIDC)	
<b>Electrical Components</b>						
28	EI-01	63	Shoe	FC	Pita Kracak	
29	EI-02	64	Brill	FC	Pita Kracak	
30	EI-03	78	Impeller (for Power Plant)	FC	PRN	
31	EI-04	84	Motor Cover	FC	Polypin	
32	EI-05	86	Die for Suspension	FCD	CV. Castar	
33	EI-06	90	Die for Suspension Cover	FCD	Cipta Nusa Castech	
34	EI-07	103	Die for Suspension Cover	FCD	Cipta Nusa Castech	
<b>Textile Machinery Components</b>						
35	Tx-01	37	Jack Lever #1	FCD	Nata Teknik	
36	Tx-02	38	Jack Lever #2	FCD	Nata Teknik	
37	Tx-03	39	Incline Wheel Gear	FCD	A & W	
38	Tx-04	40	Sprocket Wheel Gear	FCD	A & W	
39	Tx-05	42	Circle Double Cam	FCD	Kurnia Teknik	
40	Tx-06	43	Oval Double Cam	FCD	Kurnia Teknik	
41	Tx-07	44	Open Lever Roller	FCD	Kurnia Teknik	
42	Tx-08	45	Cutter Holder	FCD	Kurnia Teknik	
43	Tx-09	46	Jack Lever #3	FC	Kurnia Teknik	
44	Tx-10	47	Jack Lever #4	FC	Kurnia Teknik	
45	Tx-11	48	Handle	FCD	Indokarya Bandung	

## TENTATIVE LIST OF PROTOTYPICAL PRODUCTS (2/3)

MIDC/JICA Project on Supporting Industries Development for Casting Technology in Indonesia

No.	No.	No.	Product Name	Material	Customer	Remarks
46	Tx-12	49	Flange	FCD	Indokarya Bandung	
47	Tx-13	50	Gear	FCD	Setia Teknik	
48	Tx-14	68	Toggle	FCD	Kurnia Teknik	
49	Tx-15	73	Cam 11/22	FCD	Aryono	
50	Tx-16	74	Cam 1/3	FCD	Aryono	
51	Tx-17	91	Cam 11/11	FCD	Aryono	
52	Tx-18	92	Die for Printing Holder	FCD	CV. Castar	
53	Tx-19	95	Stopper Pin	FC	Yogi Saptra	
54	Tx-20	105	Die for Adjustable Printer	FC	CV. Castar	
55	Tx-21	106	Part A for Adjustable Printer	FC	CV. Castar	
56	Tx-22	107	Part B for Adjustable Printer	FC	CV. Castar	
57	Tx-23	108	Part C for Adjustable Printer	FC	CV. Castar	
58	Tx-24	109	Part D for Adjustable Printer	FC	CV. Castar	
59	Tx-25	123	Top Lever	FC	Haryono	
60	Tx-26	124	Disc	FC	Gamma Epsilon	
<b>Industrial Machinery Components for Automotive Manufacturing</b>						
61	IA-01	79	Front Case #FC1-1	FC	Shinwa Engineering	
62	IA-02	82	Rear Gear Case #RC1-1	FC	Shinwa Engineering	
63	IA-03	83	Rear Case #RC1-2	FC	Shinwa Engineering	
64	IA-04	85	Rear Case #RC1-3	FC	Shinwa Engineering	
65	IA-05	88	Front Case #FC1-2	FC	Shinwa Engineering	
66	IA-06	89	Front Case #FC1-3	FC	Shinwa Engineering	
67	IA-07	94	Front Case #FC1-4	FC	Shinwa Engineering	
68	IA-08	96	Front Case #FC2-2	FC	Shinwa Engineering	
69	IA-09	97	Rear Gear Case #RC2-2	FC	Shinwa Engineering	
70	IA-10	101	Rear Case #RC2-1	FC	Shinwa Engineering	
71	IA-11	102	Rear Gear Case #RC2-5	FC	Shinwa Engineering	
72	IA-12	104	Front Case #FC2-1	FC	Shinwa Engineering	
73	IA-13	110	Front Case #FC2-3	FC	Shinwa Engineering	
74	IA-14	111	Rear Gear Case #RC2-4	FC	Shinwa Engineering	
75	IA-15	112	Front Gear Case #FC2-5	FC	Shinwa Engineering	
76	IA-16	113	Rear Case #RC2-3	FC	Shinwa Engineering	
77	IA-17	117	Rear Case #RC2-6	FC	Shinwa Engineering	
78	IA-18	118	Rear Case #RC2-7	FC	Shinwa Engineering	
79	IA-19	119	Rear Case #RC2-8	FC	Shinwa Engineering	
80	IA-20	120	Front Gear Case #FC2-4	FC	Shinwa Engineering	
<b>Industrial Machinery Components for Multivarious Industries</b>						
81	IM-01	51	Burner	FC	Indo Pattern Lestari	
82	IM-02	52	Blower Impeller (for Turbine Case)	FC	Lapan Jakarta	
83	IM-03	62	Flange	FCD	Indo Karuya	
84	IM-04	66	Ingot Case	FC	Huhtomag	
85	IM-05	87	Pallet Wheel	FC	Adly Kreasi	
86	IM-06	99	Pallet Wheel 80	FC	Adly Kreasi	
87	IM-07	100	Gas Manifold	FC	Pibdurohini	
<b>Others</b>						
88	O-01	1	End Core (Air Craft Model)	Al-Si Casting	BPPT	
89	O-02	2	Nose (Air Craft Model)	Al-Si Casting	BPPT	
90	O-03	3	Rear (Air Craft Model)	Al-Si Casting	BPPT	
91	O-04	5	Bearing House Unit, Cover #1	FCD	Bp.Adi	

## TENTATIVE LIST OF PROTOTYPICAL PRODUCTS (3/3)

MIDC/JICA Project on Supporting Industries Development for Casting Technology in Indonesia

No.	No.	No. *1	Product Name	Material	Customer	Remarks
92	O-05	6	Bearing House Unit, Cover #2	FCD	Bp.Adi	
93	O-06	7	Bearing House Unit, Ring	FCD	Bp.Adi	
94	O-07	10	Disc Refiner (Sugar Mill)	Ni- Hard IV	MIDC, Trial	
95	O-08	11	Weight (D/S Equipement)	FCD	MIDC Foundry	
96	O-09	12	Carriage (D/S Equipement)	FCD	MIDC Foundry	
97	O-10	13	Lower Flask (D/S Equipement)	FCD	MIDC Foundry	
98	O-11	14	Upper Flask (D/S Equipement)	FCD	MIDC Foundry	
99	O-12	15	Roller (D/S Equipement)	FCD	MIDC Foundry	
100	O-13	16	Imp. Vane (Hanger Shot Blast)	Ni- Hard IV	MIDC Foundry	
101	O-14	17	Stator (Hanger Shot Blast)	Ni- Hard IV	MIDC Foundry	
102	O-15	18	Rotor (Hanger Shot Blast)	Ni- Hard IV	MIDC Foundry	
103	O-16	19	Cover (Hanger Shot Blast)	Ni- Hard IV	MIDC Foundry	
104	O-17	20	Riner (Hanger Shot Blast)	Ni- Hard IV	MIDC Foundry	
105	O-18	21	Pulley	FC	SIDCAST, Target Step1	
106	O-19	22	Gear	FC	SIDCAST, Target Step1	
107	O-20	23	Pulley	FC	SIDCAST, Target Step1	
108	O-21	24	Gear	FC	SIDCAST, Target Step1	
109	O-22	25	Hammer Tip (Sugar Mill)	CL-15Cr	MIDC Welding	
110	O-23	26	Ingot Moulds	FC	SIDCAST, Target Step1	
111	O-24	28	Brake disc	FC	SIDCAST, Target Step1	
112	O-25	29	Fly Wheel	FC	Adly Kreasi	
113	O-26	30	Middle Cramp	FCD	MIDC Foundry	
114	O-27	33	Permanent Mould	FC	Silika Foundry Utama	
115	O-28	35	Al Nozzle (Al Smelting)	Meehanite	Balai Ind.,-Medan	
116	O-29	36	Weight for Moulds	FCD	MIDC Foundry	
117	O-30	41	Small Cramp	FCD	MIDC Foundry	
118	O-31	61	Support Base for Tilting Table	FCD	MIDC	
119	O-32	65	Round Table for Tilting Table	FCD	MIDC	
120	O-33	67	End Bracket	FC	MIDC	
121	O-34	69	Table for Chill Test	FC	MIDC	
122	O-35	93	Impeller	Bronze	IPTN	
123	O-36	98	Sampling Spoon	FCD	MIDC	
124	O-37	122	Impeller (Water Pump)	Bronze	MIDC(BPPT)	
125	O-38	125	Flask Holder	SC	MIDC	

\*1: Refer to the "List of Ordered Casting Products"