

## 12.4 Outline of the Plants

### 12.4.1 The Organization and Personnel of the Plant

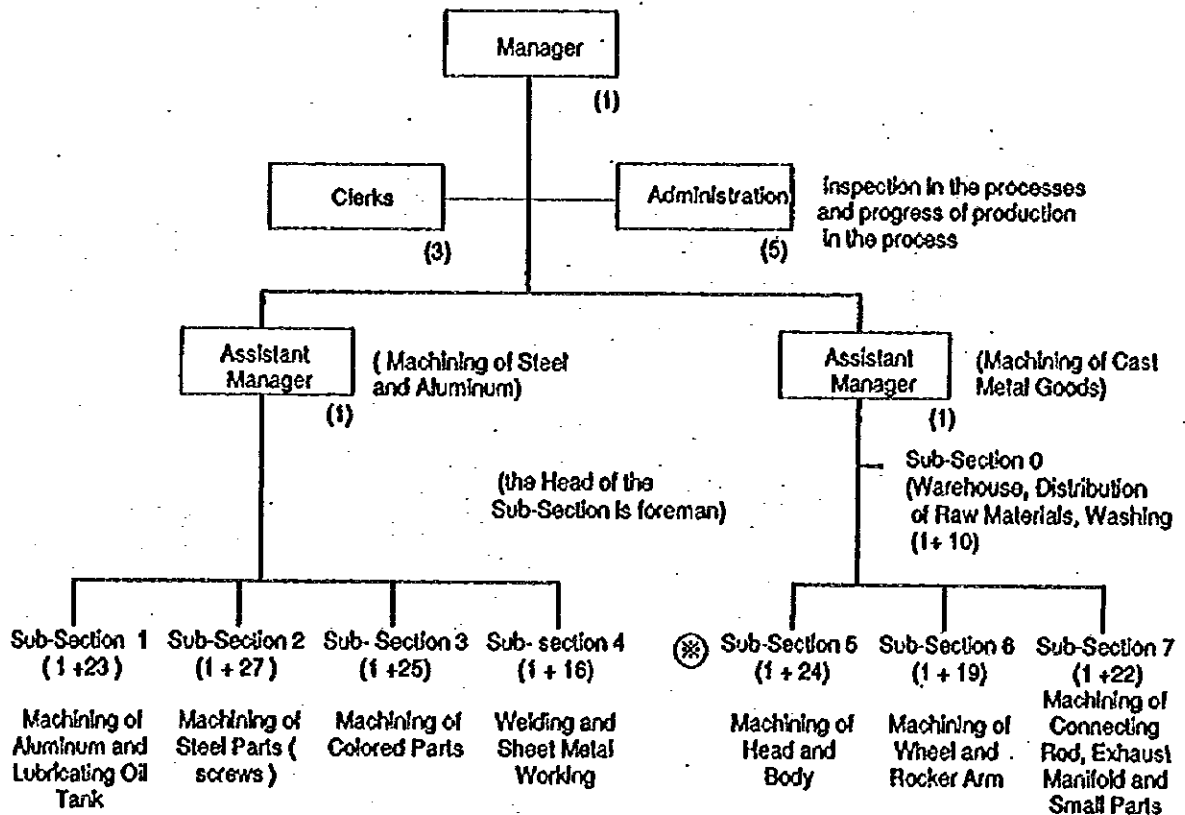
Following figures (Fig. 12-4-1 through Fig.12-4-5) show Mielec Engines Co.'s organization, indicating line and staff functions and the number of employees allocated.

Some problems are observed because of inflexibility of organizations which are broken down specifically to smaller operation units.

#### (A) The organization and Personnel of the Manufacturing Section, Production Department (Machining of Parts and Operation of Machinery) (S-378)

Fig. 12-4-1

(total number of the personnel : 185)

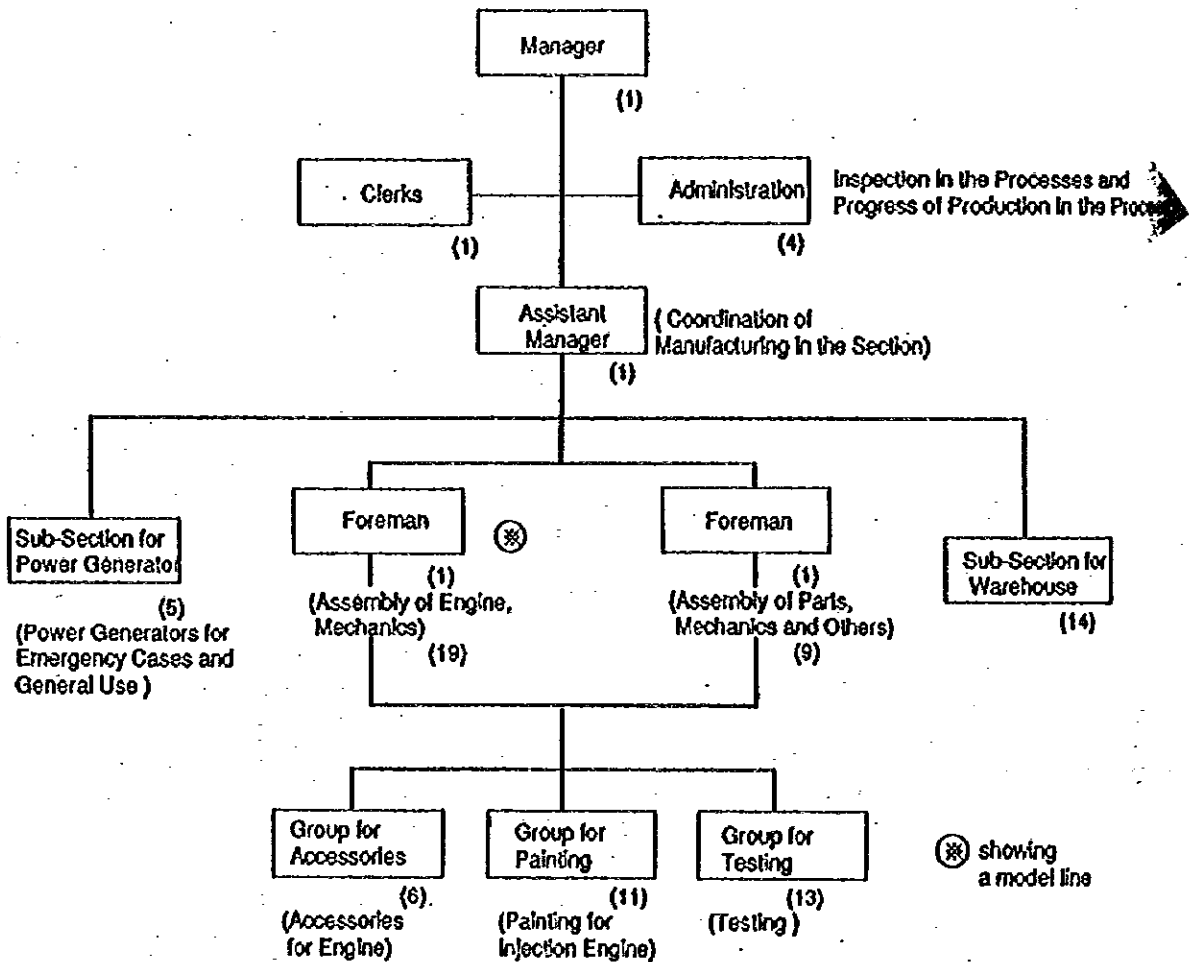


⊛ showing a model line

(B) The Organization, and Personnel of the Manufacturing Section, Production Department  
(Assembly and Operation) (S-680)

Fig. 12-4-2

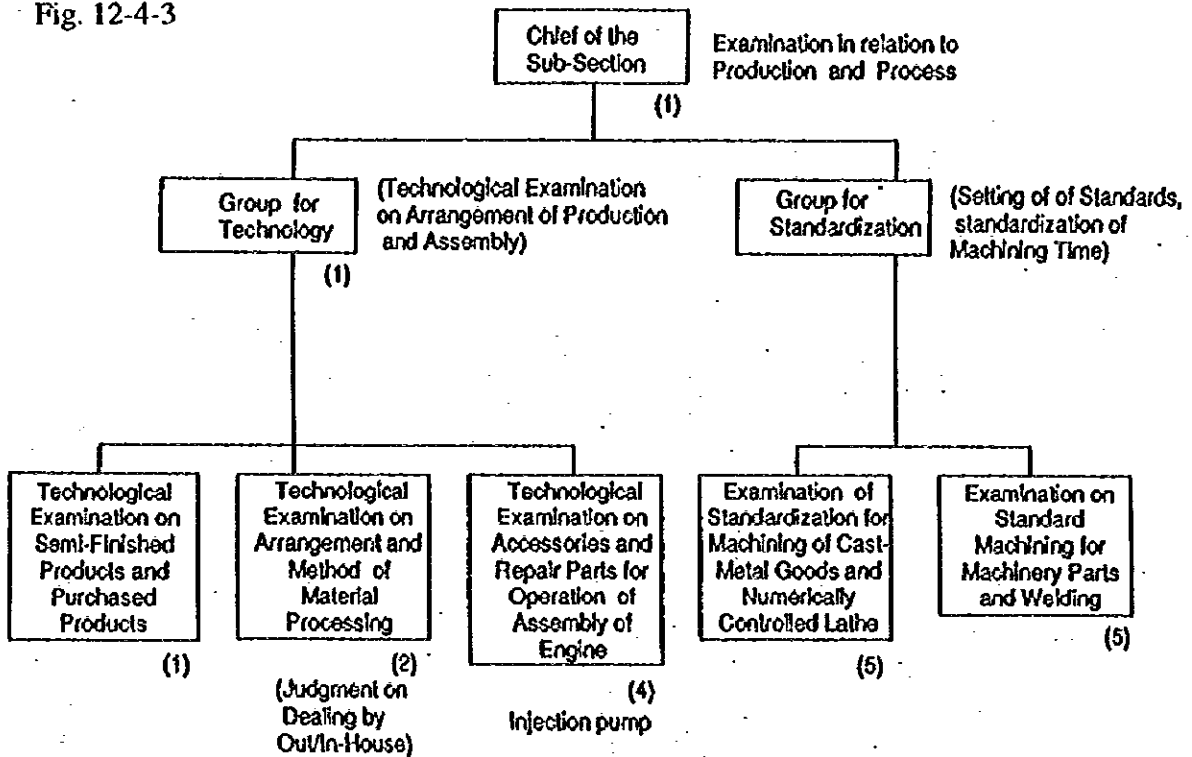
(total number of the personnel : 86)



(C) The Organization and Personnel of the Sub-Section for Production Technology, Production Department (PPT-822)

(total number of the personnel : 19)

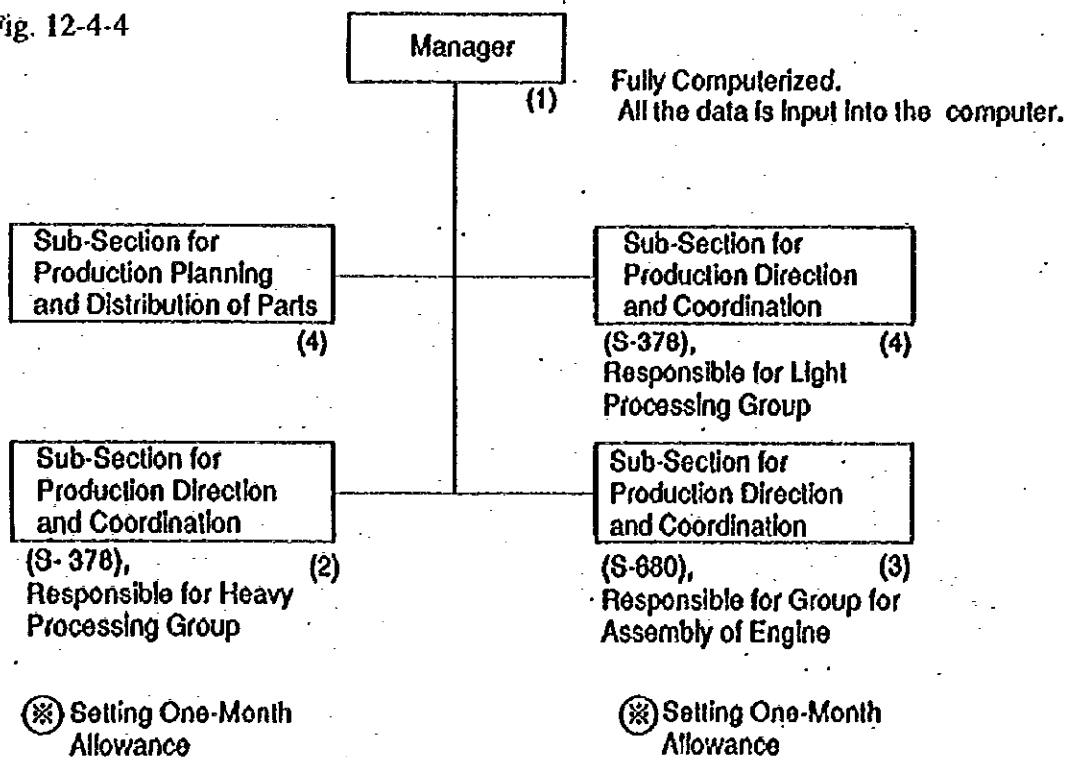
Fig. 12-4-3



(D) The Organization and Personnel of Production Planning Section (PKP-812)

(total number of the personnel : 14)

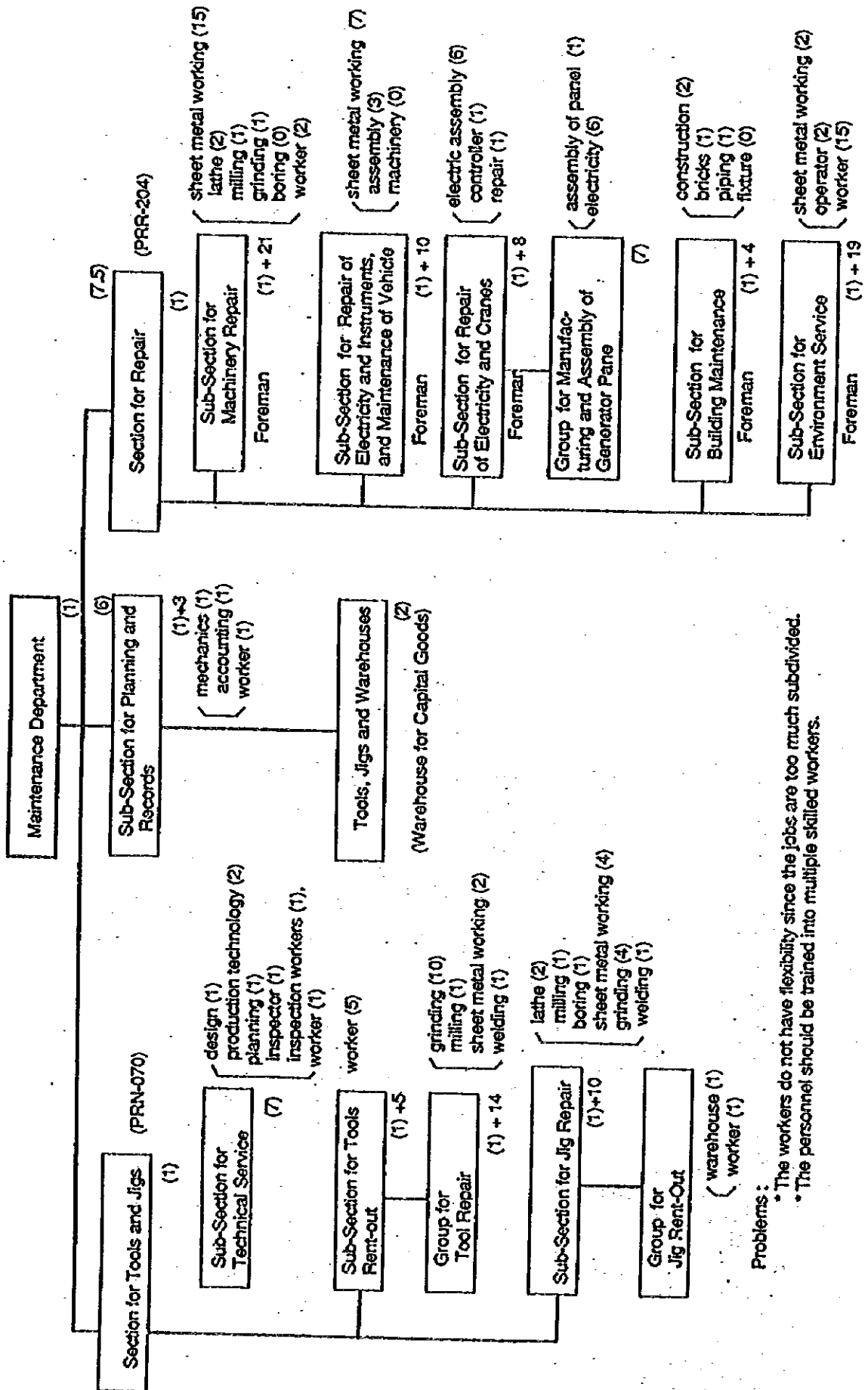
Fig. 12-4-4



(E) The Organization and Personnel of the Maintenance Department

(total number of the personnel : 124)

Fig. 12-4-5



Problems :  
 \* The workers do not have flexibility since the jobs are too much subdivided.  
 \* The personnel should be trained into multiple skilled workers.

## 12.4.2 Plant Layout and Main Equipment

The company is located in the WSK "PZL-MIELEC" area of the northeast part of the city of Mielec. Fig. 12-4-6 gives an overall map of the city, and Fig. 12-4-7 shows the company's location in the WSK "PZL-MIELEC" area.

The company is divided into 3 main blocks.

- (1) Main engine parts machining plant: 5,832 m<sup>2</sup>  
Parts machining plant and engine assembly plant: 5,184 m<sup>2</sup>  
General parts machining plant: 1,360 m<sup>2</sup> (not including office departments)  
Tools plant, tools warehouse, etc.: 2,592 m<sup>2</sup>  
A general presentation is given in Fig. 12-4-8, Fig. 12-4-9.
- (2) Engine testing cells: 3,315 m<sup>2</sup> (including generator assembly but not office departments)  
A general presentation is given in Fig. 12-4-10.
- (3) 2 buildings for sheet metal, welding, parts' warehouse, ambulance assembly, etc.: 4,860 m<sup>2</sup> (not including the office)  
The company was established a long time ago, and its buildings are long because of an equipment layout for an annual production volume of 12,000 engines. That equipment layout is therefore not very efficient considering the present scale of production.  
The situation that the company finds itself in, however, is inability to do anything drastic about equipment improvement, changes in layout and other rationalization because of lack of funds (as explained to me in talks with the director in charge of production and the production technology section chief).
- (4) Table 12-4-1 gives the findings of a survey of the main machining equipment belonging to the machinery plant, the equipment plant and the tool plant. A lot of that equipment is twenty, even thirty, years old and therefore presents problems in terms of productivity, equipment trouble, etc. However, improvement across the board cannot be expected considering the situation that the company now finds itself in, and therefore my proposals should be considered possible rational improvements in conjunction with future restructuring plans.

Fig. 12-4-6 Location of WSK "PZL—MIELEC" in Mielec Town

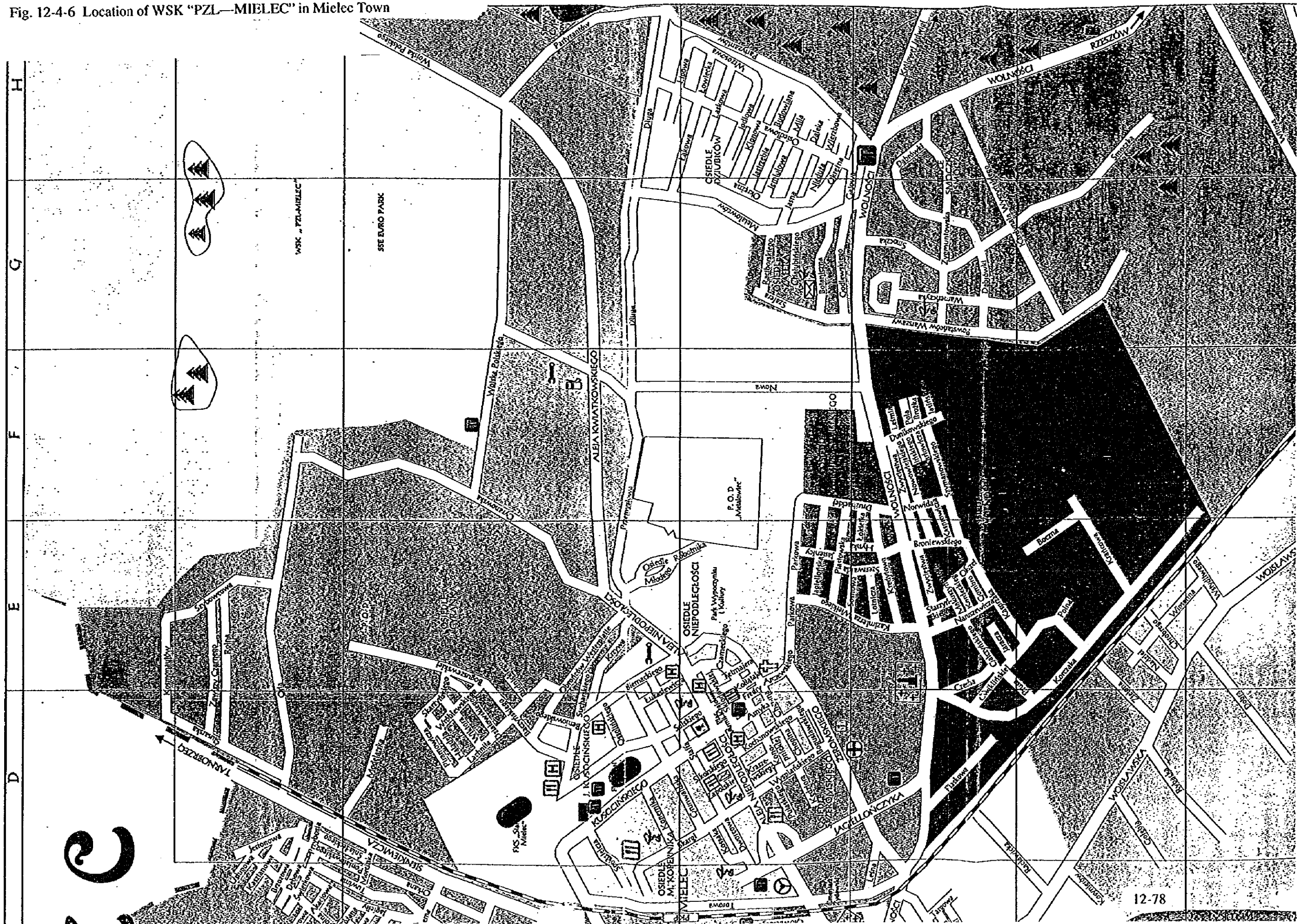


Fig. 12-4-7 WSK "PZL—MIBLEC" Area Layout Plan

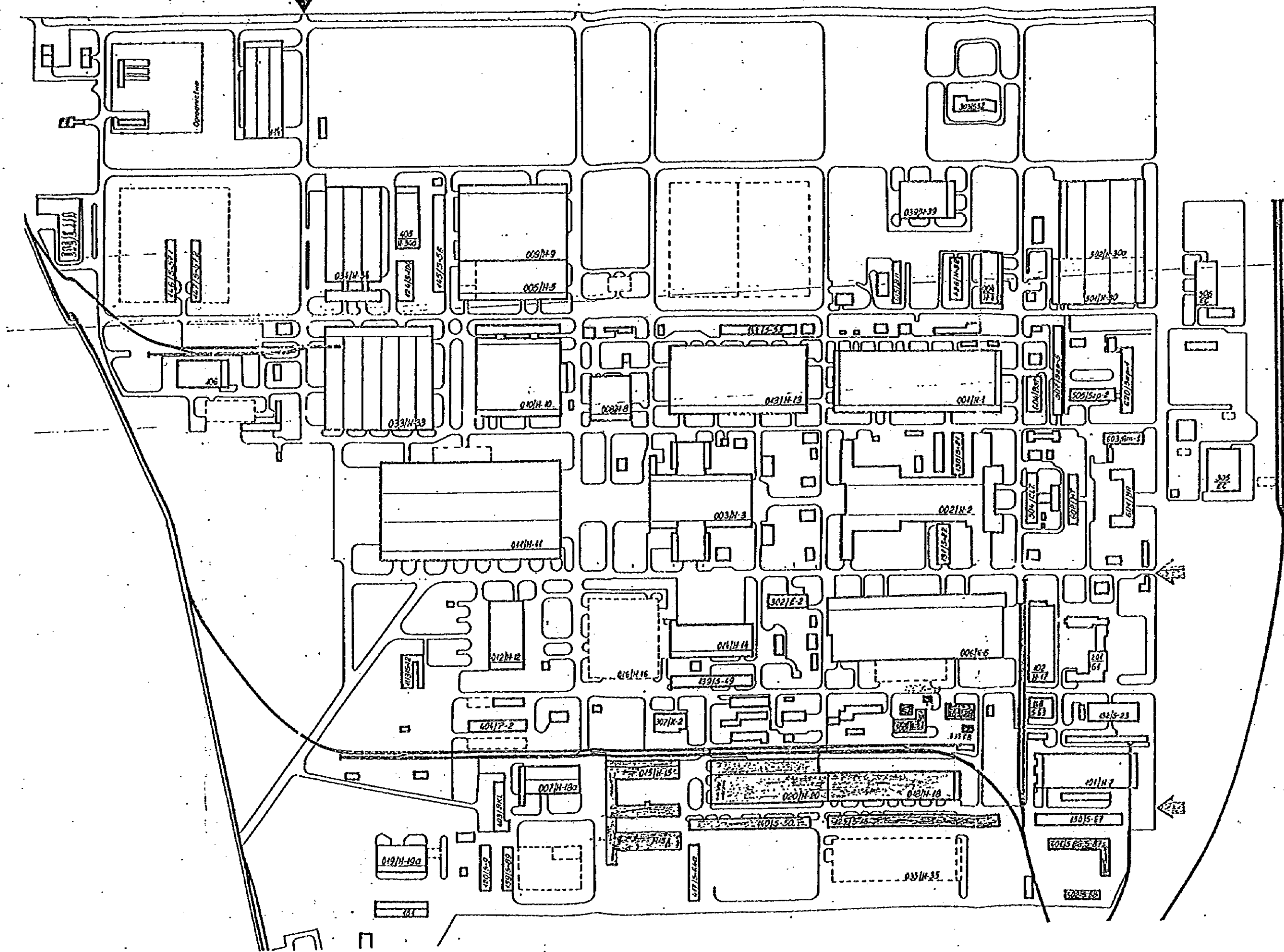


Fig. 12-4-8 Engine main parts machining Lay-out (S378)

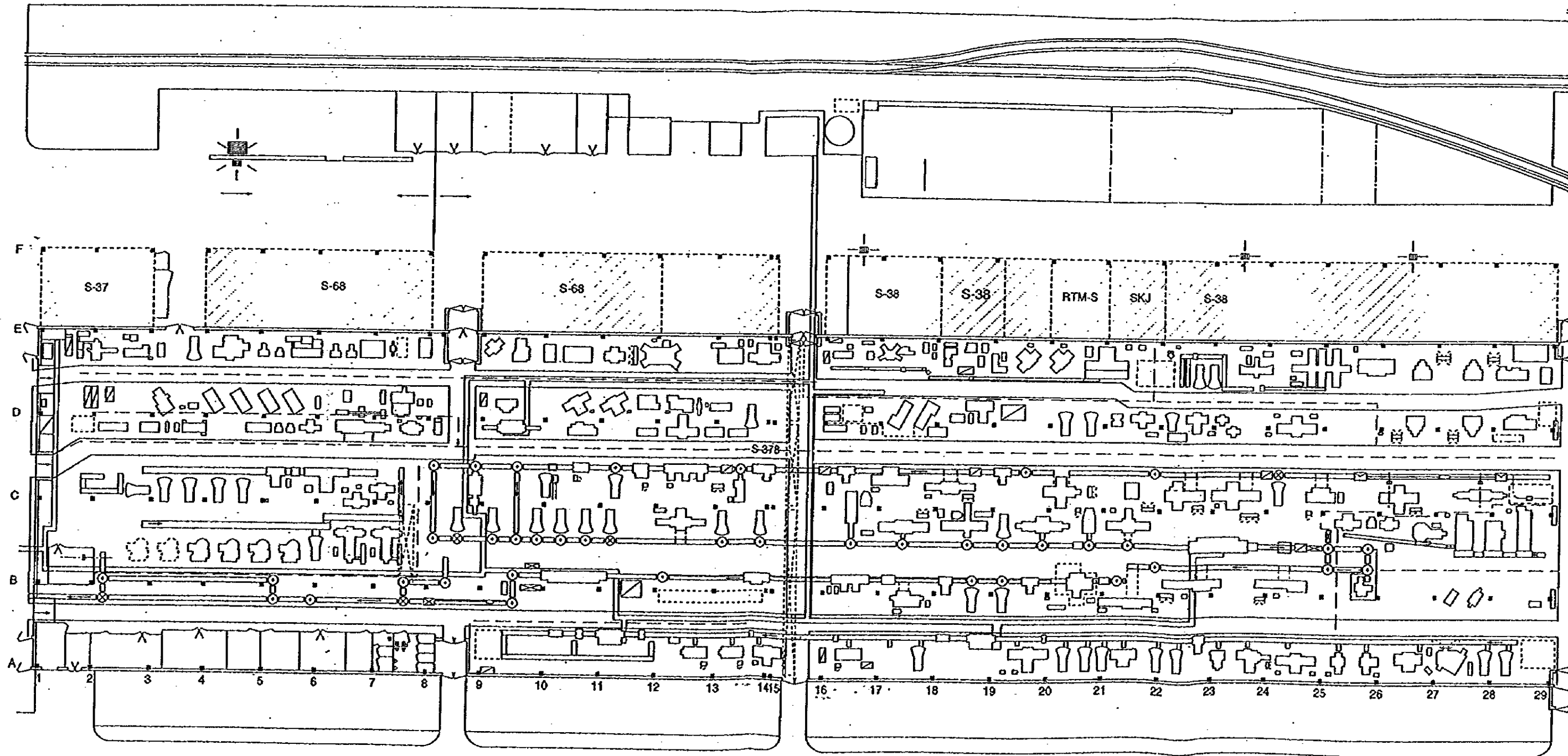




Fig. 12-4-9 Engine assembly Lay-out (S608)

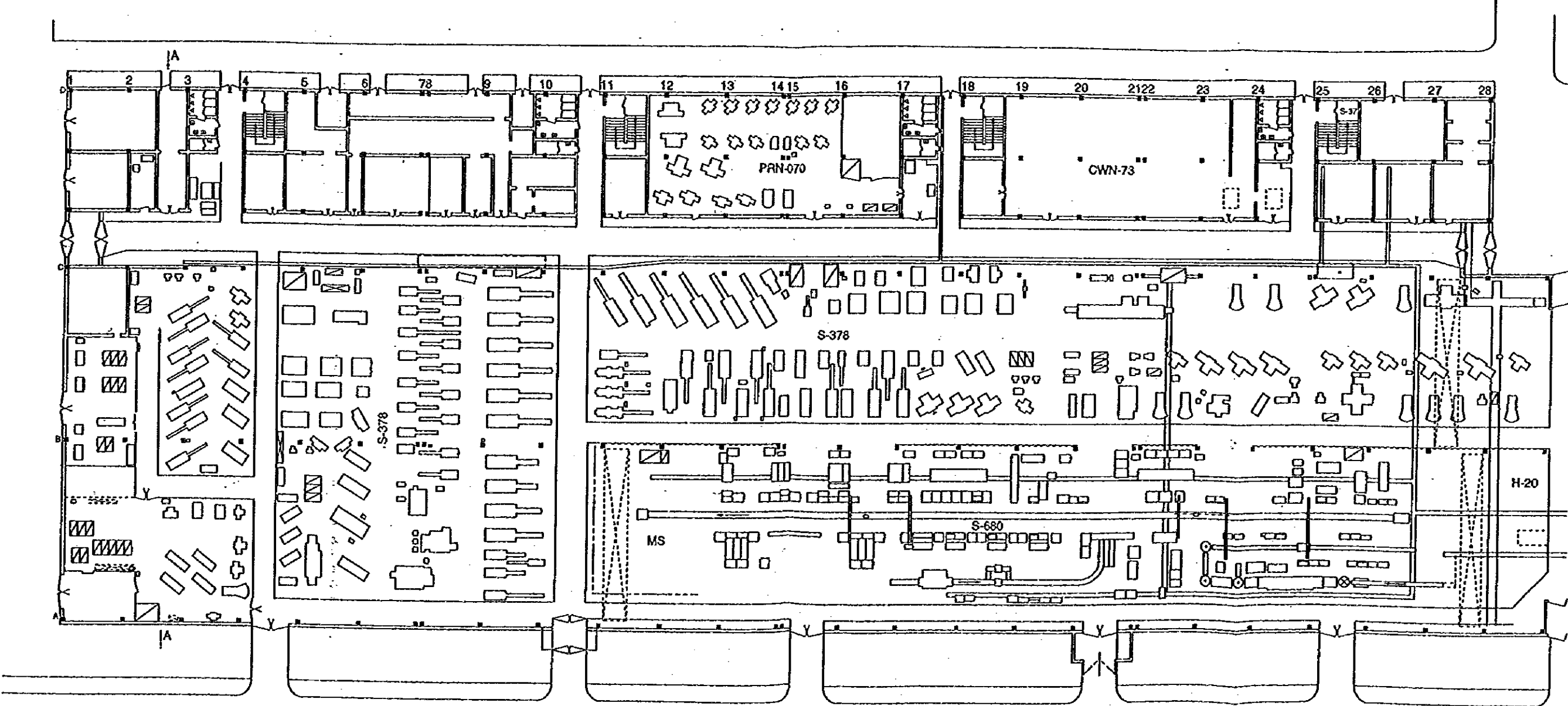


Fig. 12-4-10 Engine test cells Lay-out

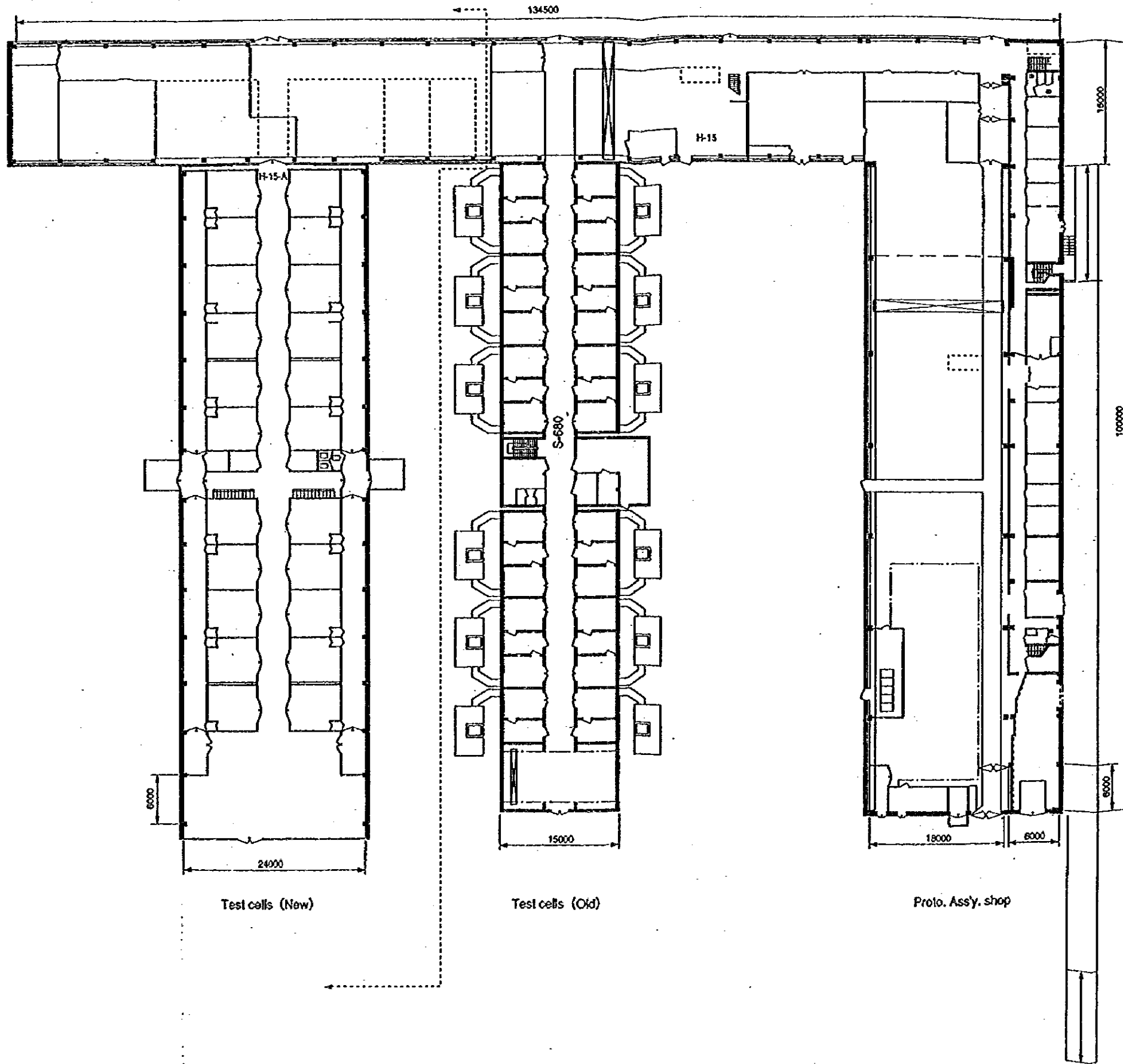




Table 12-4-1 Table Classifying Mielec's Main Machining Equipment by Year of Purchase

Machinery plant Name of machining line	N of machines	'60 '-63	'64 '-66	'67 '-69	'70 '-72	'73 '-75	'76 '-78	'79 '-81	'82 '-84	'85 '-87	'88 '-89	'91 '-93	'94 '-96
Cyl.Block	45			39	1	2			2	2	2		
Cyl.Head	24			18			3			3			
Con.Rod	19			7			6	4	1	1			
Fly Wheel	111	1		6		1	3						
Fly Wheel Housing	18			11		1	1	3		2			
Oil Pan	41		2	12	1	5	12	4		2	2		
Brg.Op	7			5			2						
Cam Plate	6			6									
Stud	6			1			4					1	
Small nonferrous parts	26			14	2	1	3	1		4			
Small ferrous machined parts	69	2	7	22	5	8	15	5	1	3			
Automatic machining equipment	66	3	9	17	13	2	11	4		7			
Welding line	16	1	1	6	1		3			2	2		
Others	16		2	9	1	1	1	1	1				
<b>Totals</b>	<b>373</b>	<b>4</b>	<b>21</b>	<b>173</b>	<b>24</b>	<b>21</b>	<b>64</b>	<b>22</b>	<b>5</b>	<b>27</b>	<b>5</b>	<b>0</b>	<b>1</b>
Total main equipment of tools section	34		6	7	1	6	3	3	2	2	5	0	0
Total main equipment of repair section	18	3	0	5	1	2	0	0	0	1	3	0	3
<b>Grand total</b>	<b>425</b>	<b>7</b>	<b>27</b>	<b>185</b>	<b>26</b>	<b>29</b>	<b>69</b>	<b>25</b>	<b>7</b>	<b>30</b>	<b>14</b>	<b>0</b>	<b>4</b>

- Notes: 1. Judging from this table, there has not been implementation of any major investment plans other those of the intensive investment undertaken thirty years ago and twenty years ago.
2. Nor has there been planned equipment modernization and replacement on account of wear and tear. That being the case, future investment planning must be rational equipment planning bearing EURO-3 in mind and in which attention is given to both modernization and replacement.
3. The figures for the quantities of equipment do not include devices for assembly and other purposes, related machinery and other small-scale equipment

### 12.4.3 Production and Working System

The M.E. assembles diesel engines (SW-680 and SWT-11) and deliver them to bus companies mainly. The monthly output is approximately 102 to 105 pieces. The ratio of these two types are about 35 % for SW-680 and 65 % for SWT-11. The production system is production on order and continuous production. The working system in the plant is one shift, i.e. working time from 7:00 to 15:00 and working day from Monday to Friday and every other Saturdays. The standard duration for engines up to delivery is two weeks. Besides, rush-through 3-day delivery is provided on user's request, i.e. one day each for machining and assembly, for performance test and for painting. Of course, it is conditioned with cash-on-delivery and extra charge.

The parts for assembling engines are all purchased. There are two types two cases for the parts, ① that the M.E. buys raw materials and machine them into parts by itself for use after testing and ② that it purchases machined parts for use after acceptance inspection. :

- ① The typical parts which are purchased as raw materials, machined and undergone inspection by the M.E. include : Cylinder block and head, connecting rod, flywheel and cover, valve and arm, cap for crank shaft, oil pan, oil tank, front plate, exhaust pipe, bolts, etc..
- ② The typical parts purchased as machined and used after acceptance inspection include : crank shaft, cam shaft,, piston, linner, hydraulic pipe, injection pump, supper charger, starter, etc..

Production plants also process assembly of engines, machining of spare parts engines for maintenance (for service shops) and machining of parts for sales (machining contract), etc..

These products are to be delivered to : regular clients (engines) such as JELCZ (bus), AUTOSAN (bus), and STLOWA WOLA (loader) on the basis of orders and production planning, they make up approximately 80 %, and to five construction companies (BUMAR, LEGMET, etc.) on the basis of orders and production planning as well, they make up approximately 20 % and include those for farm machineries.

The clients for spare parts for engine maintenance are users themselves, spare parts supply centers and construction maintenance centers, etc.. The parts processed under the machining contracts are to be delivered to affiliated companies, etc..

The sales branch (RH-860) makes annual plans for these productions and notice them to the divisions concerned. In terms of engines, especially, it makes annual production plan (for example, it made up the planning for 1997 on 8/E of this year, and it expects production of totally 1.350 pieces, i.e.

1,100 pieces, the production achievement for 1996, plus forecasted figure of increment in production, 20 %) and notice it to foundries and branches in the M.E. concerned to set it as a base of production and parts supply.

#### 12.4.4 Production Management

The actual state and problems of production in the M.E. are sorted out according to the branches concerned with production planning as following. :

##### (I) Manufacturing Plants :

- Monthly, 102 to 105 engines are assembled in the plants. The target figure for daily assembly is 8 pieces. In spite of the number, 200 pieces of cylinder head and 50 pieces of cylinder block were assembled in this August, although the situation might have been because of summer vacation. As a result of this excess production, the works in the processes are very much noticeable between the processes.
- Approximately 30 engines are assembled in the assembly line on its total length. We found uncompleted works at the place for those of finished. Stockout of parts partially contributed to this situation.
- On the other hand, machines are fully operated at the machining line for small parts. This is understandable, as for connecting rod, since the line has produced them nearly 500 pieces.
- Why does the M.E. want to secure such large amount of the works in the processes ? When I asked it to the members of improvement circles, They answered that to complete machining of cylinder block required 50 processes, the machining took 7 hours, and since following five problem would occur in the process, they had to provide these works in order to take measures for the difficulties and to secure production. :
  - (a) They often have machinery breakdown (5 to 10 %) and they have to suspend manufacturing unexpectedly.
  - (b) Materials for cylinder blocks often arrive behind the schedule.
  - (c) Tools (cutting tools, drills) sometime break in processing and have to be changed.
  - (d) Blowholes can be found in the cylinder blocks machined up to just before the completion. In this case, the parts can not be used. The fraction defective rate for that is about 10 to 30 %.

- (e) Since the capacity of machineries (44 machines) are not same and well balanced, it causes waiting time between the processes.
- Operators properly clean up area around machines, but they do not practice oiling, routine maintenance and minor repairs for the machines.
  - Not all of the operators can replace tools and jigs. In case of machineries with complicated mechanism, only skilled workers can do it.
  - The workers in the line are saying that they need to process cylinder blocks twice number of engines assembled in a day since machining of the parts takes much time. However, after we measured the time for machining of cylinder block, we found that it did not take as twice as that for engine. The personnel responsible for production technology did not conduct time study or examination for improvement.
  - Each branch functions separately. They do not make efforts to cooperate or organize systems between the divisions to improve production of engines. There is no personnel who, or section which points out it.
  - Roller conveyers are used for goods transportation between processes. The rollers rotate very heavily so that operators have to push forward cylinder blocks on the table. This makes workers fatigue as well as causing loss in time.
  - Workers leave defectives between processes. This situation causes to spend too much time for measures to be taken on. I wonder who gives the instruction and which section is responsible for handling of defectives.
  - The workers on the site work very serious and have high skill. A worker operates 4 to 5 machines. However, inspection is done on the line at the M.E.. It may be a problem for smooth progress of the processing. When I pointed out matters to be settled, the workers readily accepted them without objecting.

## (2) Maintenance Department

The personnel responsible for maintenance are very much experienced and highly skilled. However, since they have practiced breakdown maintenance (BM), there are following problems, :

- There are so many breakdown cases in machineries (5 to 10 % ?). Thus, the works in the processes are noticeable.

- Operators start to check up the situation and make contact with maintenance branch to ask repair after occurrence of the troubles.
- In case of breakdown, if they do not have spare parts, they have to resume production by making arrangement to purchase or by machining materials in the M.E. to manufacture the parts to be replaced. Until they manage to get the parts, the manufacturing has to be suspended for quite a long time. (N.B. : From Sept. 6 to 12, machining was suspended for 22 hours and 40 min. due to breakdown of 2 machines.)
- The M.E. does not have scaffolds for exclusive use to repair machines. Mechanics have to climb up on the top of machines and to repair in unstable and dangerous state.
- In assembly lines, cuttings are brought by the same conveyer with machined works. The cuttings fallen into the space of rotators and sliding cause troubles in rotating of rollers.
- Since records of breakdown or repair/maintenance are not provided for each machine, workers can not grasp the nature of troubles properly.
- I understand that the net working rate in the M.E. is low. However, many of the machineries were installed 20 to 25 years ago. Some of them should be revised their precision.
- Machines require regular maintenance as long as they are operated. I am not sure who is responsible for that in the M.E.. As a result, they were just left over without being taken any proper keeping.
- In order to implement productive maintenance, four functions, i.e. repair, inspection planning, maintenance techniques and coordination, are required. However, the M.E. only has one function which is repair.
- The number of the personnel for the Maintenance Department counts for 16.8 % for the total of the M.E.. This figure can not be considered as insufficient. The improvement and maintenance can be offered with the personnel of that number. However, because functions are segmented in the M.E., there may be some difficulties to pool the workers to organize and utilize them as those of multi-skilled.

### (3) Production Planning Department

- RH-860 already prepared annual production plan for 1997 at the end of this August, expecting 20 % of increased production in addition to this year's achievement. And it has noticed the figure to foundries and branches in the M.E. concerned. However, it



does not seem to be a figure, undergone sufficient discussion and examination in the M.E..

- As for the monthly production plan, PKP-812 gives direction to production plants one week before the end of coming month. In addition, it also delivers direction of output for 3 days in the month. If the production site observes this way, the excess works in the processes should not come upon. However, we found current state as following, :

"The Works of Cylinder Block and Cylinder Head in the Processes" (as of Sept. 3, 1996)

1) Cylinder Head :

- assembly plant for engines :  
place for raw materials (from the previous process): 200 pieces
- before washing : 20 pieces      stud attached : 6 pieces
- valve attached : 30 pieces      raw materials : 7 pieces
- Machining Plant :  
at the entrance side of the line , in and before boring : 6 +48 = 74 pieces
- in and before machining : 160 pieces

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- total number of the cylinder head in the processes : 497 pieces

2) Cylinder Block :

- assembly plant for engines (at entrance side of the line) :  
without cylinder liner built-in : 7 Pieces  
cylinder liner built-in : 5 pieces
- under being transported or assembled on the line for engines : 31 pieces
- before being transported to assembly plant, placed on the assembly line for cylinder block : 22 pieces
- before being machined on the process by multi-spindle drilling machine : 3 pieces
- before being tapped on the process by multi-spindle drilling machine : 6 pieces
- before washing or boring process : 29 pieces
- left over between the processes (right type) : 25 +27 = 52 pieces (tapped) total number of cylinder blocks in the processes : 155 pieces

3) other parts :

connecting rods (small parts machining shop) : 497 pieces

- A person in charge of production adjustment is assigned to PKP-812. However, he/she does not seem to take measures to reduce delay between processes. I will reconsider on this point when we will organize circle activities in the M.E..

#### 12.4.5 Quality Control

- (1) Company-Wide Quality Assurance System ME's tasks and policies regarding quality as described to us by its president as basic company policy are set forth in Chapter 12.5 of this report in connection with the study on the state of promotion of acquisition of ISO-9001 certification, and from what it told us it is clear that they are aiming for a quality assurance system that meets that standard.

A quality control group has been set up under the direct guidance of the president, and they are making a considerable efforts, but it would appear that they are presently about 7 months behind their planned progress.

When we confirmed the state of implementation of standardization with the production technology division, we were told that they had succeeded in bringing document and other control standards in line with ISO-9001, such standardization having been checked by those concerned with involvement of specialized groups.

However, from the viewpoint of whether or not operation is functioning properly in terms of operational quality assurance, it would seem that there are still many problems to be resolved as is clear from the following examples:

- 1) ISO-9001 related preparations have not yet been made in the development division, which raises doubt as to how deeply the policy of the company president has taken root.
- 2) Standard time schedules are posted at the plant, but so far they are not being used at all, the excuse given being that they are putting emphasis on quality rather than on raising productivity.
- 3) On the other hand, such standard times are being used to assess plant cost price, which means that data not based on the actual situation is being used.
- 4) One can say that in day-to-day work the plant work standards and documents are being sufficiently used. Unfortunately, however, there seems to be absence of the idea of using such data for future improvement of productivity, dealing with nonconformities, cost reduction and the like.
- 5) A quality assurance division directly under the president got started last year. We got the impression it is implementing auditing and inspection in a serious and sure manner. However, when a quality problem arises, the main action taken is adjustment decision by the post that is responsible, i.e. they are not yet really getting down to the task of determining the reasons for the quality trouble and establishing measures to cope with it.

Furthermore, since they told us that measures to cope with nonconformities concerning orders placed outside the company are not their responsibility, it would seem to be necessary to improve the functioning of a section in charge of company-wide quality assurance.

**(2) Work Related to Quality Control**

The state of carrying out of work related to quality control on the production lines is on the whole as follows.

1) Inspection by the manufacturing sections themselves is being carried out faithfully in accordance with the work standards. In the assembly sections there is an inspection sheet attached to each engine which each worker stamps with his seal after completing his work and which is also stamped with the seal of an inspector after his check following completion of final confirmation. Furthermore, personnel belonging to the quality assurance division oversee the state of implementation of such control.

2) On the cylinder block machining line the workers make careful visual checks after each process in view of the fact that there are many casting nonconformities, and when a defect is discovered, the piece is immediately removed from the line. That happens quite often, but they continue the work even if a whole pile of defective pieces accumulates during the process. Particularly regarding cavity defects, the probability of discovery at the time of hydraulic testing near the final process is high, and hence many problems such as the quantity of lost work in the different processes, increased volume of machining, etc.

What is done about the defects is that the manufacturer's personnel are called in to do hole filling work, followed by remachining. The rule followed is that if it is then OK, the matter is left at that, and if it is NG, repair work is repeated, followed by remachining once more, after which the piece is scrapped if it is again NG.

It really gives you a vague feeling of apprehension if you think about the quality problem there. For reference, a photo of a cylinder block bore part with cavities is given in Fig. 12-4-11.

3) The tools section is in charge of control of tools and measuring equipment, the method followed being that the workers take the tools to the tool control section to replace them on the basis of the replacement standards set by the production technology division. The system is being faithfully implemented, and there would not appear to be any problems in terms of the actual work.

Measuring equipment is handled in the same way, but each worker keeps his own personal issue record and controls replacement time at his own personal responsibility. We checked up on some measuring equipment and found that the system was being properly implemented, probably because of the fact that habits formed under strict controls in the years of Communist rule still remain with them.

4) The "first in, first out" rule concerning important parts is being strictly followed. Take the example of cylinder block castings. Because of possible problems concerning deformation in machining or during use, a storage facility has been installed for ageing them for 1.5 months after they come in. We checked work in process at the plant to see

what the actual situation was and found that 6-month-old castings were moving on the lines without any particular problems. They said that if they have to be taken them out of stock early because of low inventories, that is done on the basis of instructions by the production technology section, and that rule appears to be strictly followed.

- 5) In terms of actual work, inspection is being carried out properly, with records being kept on it, but in the absence of quality control thinking all they do is eliminate pieces as defects when nonconformities occur instead of seeking the causes, devising measures to counter them and taking action to prevent reoccurrence.

As a result, the same nonconformities are repeated over and over, which would appear to constitute a heavy burden on the company. They really need to be trained in statistical analysis and judgment for the sake of vitalization. We are sure that some day the efforts of the improvement team this time will bear fruit. We should not be in a hurry about achievement of results in that respect, but rather should quietly keep an eye on how the situation develops. For reference, the text of the report on the study at the casting company is given as (4).

### (3) Policy Control

According to its president, ME does have policies, but presently policy cannot be seen embodied in specific concrete form.

For example, the president says that the inventory control goal is 2 weeks, but we are told that actually there is still more than one month. When we checked with the line chiefs, they were aware of the president's goal, but we got no concrete answers when we asked what is being done about failure to achieve that goal. The only answers we got were reasons why it cannot be attained, such as poor delivery situation regarding outside orders and need to take safety measures in view of the high incidence of defects.

Since the president himself does not know how to go about embodying policy in concrete form, it would appear that nothing can be done about failure to follow policy.

It would seem to be necessary in that respect to provide easily understandable instruction regarding such matters as policy breakdown methods. For reference, the points of proceeding with policy control that are being implemented at Isuzu Motors are given below:

**Policy = Task + Goal (figures) + Measures**

- 1) As tasks are selected themes concerning overcoming of the present situation required of the section.
  - Achievement of important tasks is promoted by the section itself.
- 2) Setting of policy starts with consideration of what was done wrong in the previous period.
  - Setting by free exchange of opinion vertically and horizontally.
- 3) Tasks are not enough for policy.
  - Measures must be formulated as ways of achieving the goals.
  - Items and standards of control of measures must be clearly indicated.
- 4) There must be periodical evaluation of implementation of policy.
  - Corrective steps must be taken in case of failure to meet the control standards.
- 5) The way the work is organized must be changed on the basis of policy control.
- 6) Superiors must check on the progress that subordinates are making with the tasks and give them guidance and encouragement on them.

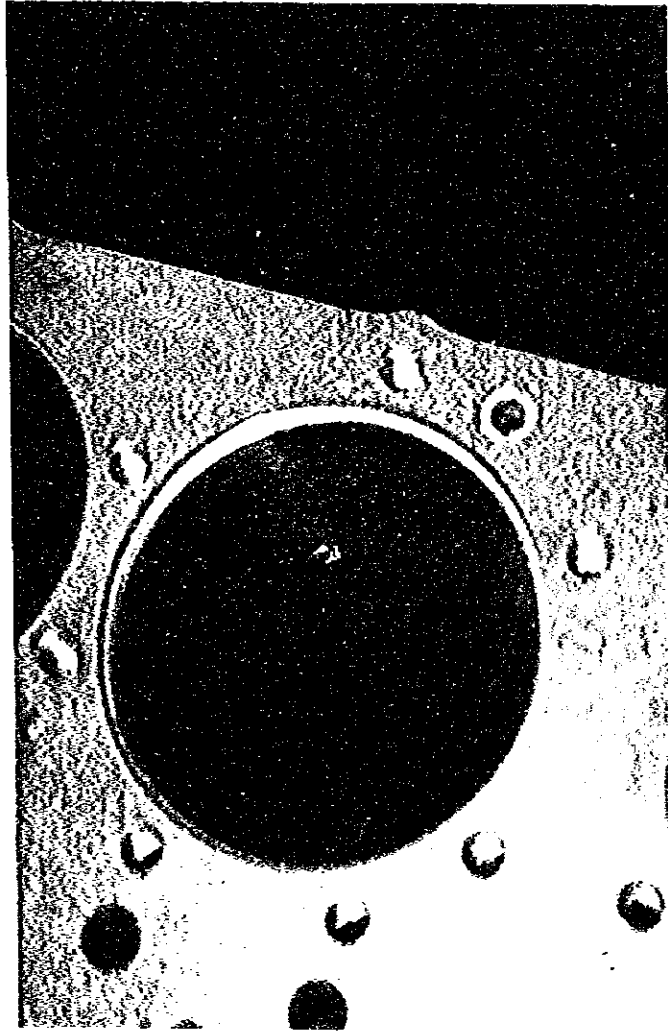


Fig. 12-4-11 A Blow Hole Defect on the Cylinder Bore

#### (4) Problem of Casting Defects

In the survey of the casting company the biggest problem that was noted in all of the departments was the high rate of defects in casted parts.

In our survey we placed particular emphasis on the cylinder body and the cylinder head as main engine parts.

- 1) Date of survey: September 2, 1996  
Place: WSK-RZESZOW casting company (Rzeszow)  
Survey team: Tashiro, Higuchi, Miyakawa  
Counterpart: Mr. Dzik, director

#### 2) Outline of company

It is a company consisting of three divisions, each with a self-supporting accounting system:

- Division producing airplane, helicopter and other engines and transmissions.
- Division producing vibration isolators, turbo, etc. for use by both ships and motor vehicles.
- Casting and forging division, including company-wise plant maintenance and power division

The company has qualified for ISO 9001, for which it applied in June 1995

The casting plant, headed by Mr. Dzik, makes steel and aluminum castings, dies, etc. and does precision casting.

#### 3) Relationship With The Company

- The relationship between the two companies started in the sixties. Rzeszow supplied most of the necessary parts for the SW series, and The Company was the client for 60% of its castings and most of its forgings.
- Presently most of its production is for export to such countries as Italy, Switzerland, the Netherlands, Germany and the U.S. Recently it has started to have relations with the Japanese company Kawasaki Heavy Industries.
- Although The Company's share of its production was 60% in the "golden age," it has now declined to 12%.
- 4-5 years ago it stopped the casting plant and laid off the employees for half a year, paying the salaries of only the specialists.
- This year it might just barely recover the production level of 1989.
- The casting division is not at all dependent on The Company.
- In case of nonconformities, they are strict about QC, with summons to appear even for minor painting errors.

**A DIFFICULT COMPANY TO DEAL WITH:** They do not consider The Company an important client.

- Meetings are not held regularly, only when problems arise.
- They get in touch frequently concerning modernization and other new developments.

#### 4) Casting Technology

- The induction heating furnaces and core sand of its melting furnaces are all produced locally.
- It is adjusting its furnace internal insulation, core adhesives, etc. to its Western European clients and working for QC improvement. That has had results, and it now very happily exports 30% of its production as finished products.
- Since its Western European clients are increasing, its imports of casting materials from Western Europe are also gradually increasing.

#### 5) Connections with universities and research institutes

- Carried out with support from KBN.
- Contracts with the Krakow Casting Technology Research Institute, Krakow Institute of Technology.
- The company has held an international symposium at which the discussion centered on casting QC and the report on which I have received.

#### 6) Problems That The Company Has

- Four years ago it launched a cost reduction campaign, reducing its personnel strength from 800 to 500 and raising its product quality by 80%. Downward trend in export sales as result of strict foreign exchange policy.
- The Company should put more effort into market development. Cooperation possible regarding price reduction.
- Product profit rate should be analyzed quarterly for the sake of cutting the price of, or refusing to purchase, poor products.
- Four years ago it decided on standards ignoring profit, accepting orders with a goal of 7,000-7,500 tons in spite of a probable deficit. It operated in the red for two years.
- It has even made an analysis of its global competitiveness, and its sales outlets have increased, attaining 7,500 tons/year in 1994.
- It has stopped purchasing trucks with SW680 engines from the Company because of their unpopularity due to insufficient horsepower for long-distance operation, mountain uphill stretches, expressways, etc.
- Since competitors have raised their level as regards horsepower, it would be a good idea to talk with Rzeszow concerning countermeasures. Rzeszow is enthusiastic about discussion of modernization plans, but the problem is where the money is to come from.

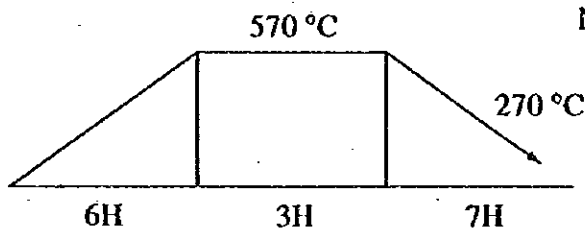


## 7) Findings of Plant Survey

### Survey of Cylinder Body Line

- The casting materials have lots of burrs (low precision because of superannuated molds and poor maintenance)
- Casting weight of 339 kg
- Too rough removal of sand from body, and too much dust in the plant (poor environment)
- Good annealing work standards.

The significance of the 1.5-month seasoning and the machining conditions are explained in the survey report on the situation at Isuzu Motors.



Note: If the actual conditions are such, distortion ought to have been eliminated. That would suggest that it is necessary to study the significance of seasoning for 1.5 months.

- As for reduction of 7 mm finishing allowance, it can be considered in accordance with the values that they are capable of.
  - The problem of sand remaining on the body can be resolved by using sand of better quality, but that would increase cost. The matter is still open to discussion.
  - The flow appears to be in lots of 30, but that makes for too big an inventory. When I asked Mr. Tashiro about the setup for receiving orders, he told me that they are making arrangements now for change along with modernization starting in October.
- 8) The Company's Appraisal of the Casting Company (mainly as regards cylinder blocks)
- In the case of cylinder blocks, in particular, precision is poor, and there are lots of cavities.
  - In view, however, of the fact that The Company does not have casting technology and the fact that the casting company is in a strong position, The Company has to accept what it says, and even its claims are not always entertained.
  - Acceptance inspection consists mainly of inspection of outer appearance as regards hardness, machining reference plane, roughness, etc.
  - In principle, defective parts are supposed to be returned to them, but in actual practice they come to make minor repairs and adjustments, and only if the part is still found to be defect after that procedure has been repeated twice, is it actually rejected. When there is little time, The Company does the repairing itself, invoicing them for it. Up to 1986 The Company received a 7% payment as a penalty, but that no longer applies.

- Because of the large machining allowance (7 mm according to the drawing of the unworked material) and considerable deformation The Company has added a building for keeping an inventory equivalent to the quantity used in one and a half months for the sake of seasoning.
- The purchase prices are 1,100-1,200 zloty for cylinder blocks and 120 zloty for cylinder heads. That is higher than elsewhere for casted parts. Also, there is generally a discount of about 10%, but they do not accept that because of their special position. Furthermore, it sometimes takes several days of negotiations in order to reach agreement on prices.
- The Company has tried to get other casting companies to accept its orders instead of them, but none have responded because of the small quantities.

#### 9) Problems Considered From the Viewpoint of Understanding the Present Situation

- Rzeszow Casting is a large company that now exports to Western European countries and appears to be making the most of its strength. Now that the Company's share of its work has fallen to 12%, versus 60% in the past, it has assumed a very strong attitude of ignoring customers, and that is to be regretted.
- The survey mission this time had planned beforehand to implement improvement work at the casting company as a measure for coping with casting defects, but considering the arrogant attitude of that company's officials and other circumstances that came to light in the survey, we decided to cancel those plans since it seemed to us that otherwise we might make trouble for the Company.
- As already mentioned above, there are many problems on the production lines of the casting company. It would seem that thirty years without any design changes and also without change in molds as well as impossibility of wooden mold correction due to decrease in quantity are the cause of such a high frequency of burrs. (We were not allowed to take any notes or photographs, our cameras being taken from us when we entered and returned to us when we left the company.)
- The situation regarding occurrence of defects on the company's machining lines as determined by us in checking the actual situation is 15-30% defects, which is extremely high, and one can consider the loss to be even greater if one considers the remedy of reworking also to be loss. But, unfortunately, although the Company keeps regular records, they do not do any statistical analysis work, which prevents them from being able to immediately cope with the situation.
- The first domestic survey was carried out with respect to Isuzu Motors and others and is reported on elsewhere.
- One has to conclude the Company's tragedy consists in the fact that it does not have a casting company under its control. After all, casting plants are very important indeed, as indicated by the saying "Those who control castings control engines." At the risk of exaggeration, success or failure of casting could have a major influence on the success or failure of the restructuring. It will therefore be necessary to rethink imports and producers with which outside orders are placed.

(5) Report on Findings of Isuzu Motors Study

In view of the The Company's difficulties with casting defects as ascertained at the time of the first study, it was decided to make a visit to Isuzu Motors' Kawasaki plant for the purpose of finding out mainly how the relationship between casting and machining is being handled in Japan. As a result, at the time of the second study we held a meeting with the director in charge of production and the department and section chiefs concerned to explain the findings and accomplish technology transfer in that respect.

The director in charge of production later told us tha the explanations give at that meeting had been of great help to them. Copies of the materials used that the meeting were distributed to all participants in the Polish translation.

The following table indicates The Company's actual conditions and the differences with Isuzu Motors.

1) Machining

Study item	The Company's problems	Situation at Isuzu
Machining allowance	An excessive 7-8 mm	$4 \pm 2$ mm for cylinder blocks in the 11-12 liter class, $3 \pm 2$ mm in the vicinity of the machining reference plane, 3 mm tolerance with respect to burrs
Method of cutting top and bottom surfaces	Machining in three processes: rough, intermediate and finishing	Normally 3-3.5 mm rough machining and 0.5 mm finishing machining, with slight additional finishing for special items; as far as possible, placement of finishing process(es) in the latter half
Occurrence of deformation and cracks	Storing for 1.5 months for seasoning in view of the high frequency of deformation	In case of multiple hole machining, bottom holes are opened early for elimination of residual stress; big influence of rough cutting of top and bottom surfaces and journal and bore parts; machining of tappet holes, etc. in early processes of the machining
Spot facing	Carried out in a number of processes	Carried out for important places

Study item	The Company's problems	Situation at Isuzu
Washer fastening and folding between bolts	Carried out	Carried out where necessary; adoption of angle method for bolt fastening elsewhere
Crankshaft H.T	High-frequency quenching	Nitriding
Camshaft H.T	Cementation: waterproofing plating	High-frequency quenching
Connecting rod precision	Selective fitting with piston	Center distance of $\pm 0.05$ mm; no selective fitting
FMS machining line	Production on very long line (presently producing 1,200 units/year with 12,000 units/year capacity) [example of Cylinder Block]	Capacity of 500 units/month of 6WA-1 cylinder blocks alone with 7 MC's, 7 NC's and 4 other machines (2 regular shifts operating 21 days/month); Investment: about 50 million yen (during the "bubble economy" period) in 7 MC's, including washing, conveyance and jigs; Presently 13 units/day; 45' C. Time and 75% target rate of operation on MC line, 1st and 2nd shift, each 1 person; 40' C. Time and 70% target rate of operation on NC line, 1st and 2nd shift, each 1 person; see Fig. 11-1-2 for layout

## 2) Casting

Study item	The Company's problems	Situation at Isuzu
Rate of defects	10-30% (machining)	0.7% for 1.7T-liter class cylinder blocks; 4% for 11-liter class (1.5% of(?) processing time) (from casting to completion of machining)
Nature of defects	Not much data available; all they say is "cavities"	Necessary to divide into different categories: blowholes, sand marks, drawholes, slag holes, etc.
Causes of defects	Too many cavities	Insufficient drying of core; necessary to check for possible clogging of core gas holes and die gas holes but also important to block gas holes when necessary; uniformity within sprue at time of pouring is important; 2% difference in defects between automatic pouring and manual pouring
Problem of deformation	Implementation of annealing and storage for 1.5 months for seasoning	No annealing, the point being uniform cooling; early removal of core for even cooling (attention to cracking), cannot be too early up to 500°C; gradual cooling after that is important. Adequate implementation of measurement of stress is necessary (with breaking).
Removal of sand	Good sand costs more, but it comes off easier (opinion of the casting company)	Vibration alone will not do the job, well-aimed tapping by tapping hammer also being important; the method adopted at Isuzu is removal of sand in water at 50,000 V by "decorer processing" and dry tapping.

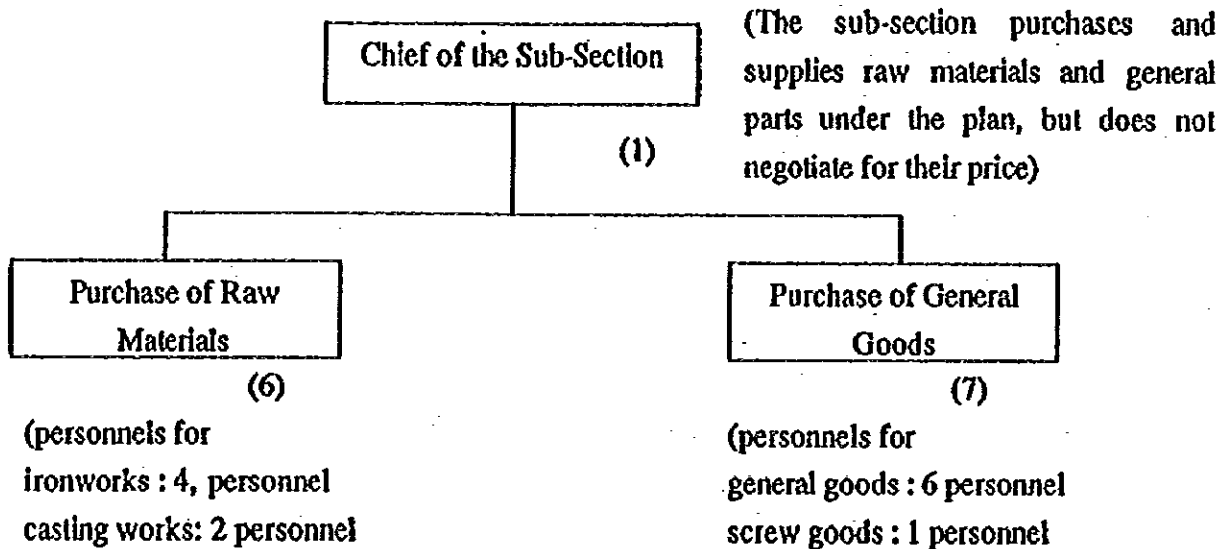
### 3) Assembly

Study item	The Company's problems	Situation at Isuzu
Situation concerning use of studs	Use of lots of studs	Only bolts used for fastening of cylinder head, but studs used for fastening of manifold
Ring gear	Bolts used for attachment	Shrink fitting (high-frequency) on assembly line side, no use of bolts
Washing of bridge metal for crankshaft	Washing with detergent oils and wiping off on assembly line before assembly	Assembly straight from the delivery packing (placed on shelf in unit quantity for 1 crankshaft), no washing or wiping
Washing of crankshaft	Careful washing by spraying with detergent oil from nozzle of hand-held hose	"Alkali spray" washing in automatic washing device together with connecting rods, etc.
Cylinder liner precision	Fitting by cooling (dry ice)	Loose fit; selective fitting with 20 micron or 10 micron clearance

## 12.4.6 Purchase

### (1) The Organization, Personnels and Duties of Purchase (Supply) Department :

Fig. 12-4-12 The Organization and Personnels of Sub-Section for the Supply (PKZ-814)  
(total number of the personnel : 14)

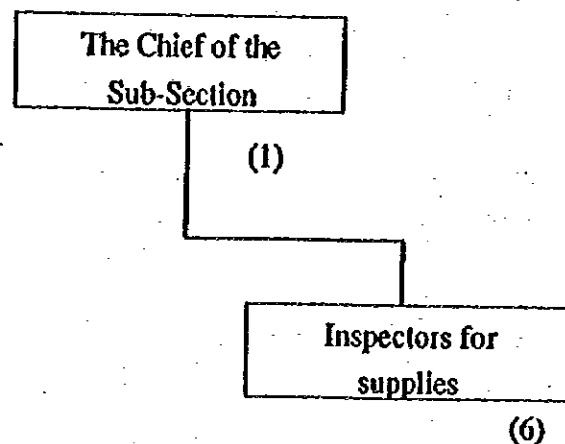


- The M.E. places orders for necessary goods to 48 major companies exclusively. Although these companies are located in the areas of 60 to 500 km from the M.E., the personnel responsible for purchase often visit them, however they do not make negotiations on prices at all (FE-890 is in charge of that). They are handling only designated goods and amounts. The 48 companies have been in a relationship as counterparts since the
- As for the flow of procedure on purchase, RH-860 receives orders from users, provides purchasing plan and list (name of the goods, amount, price) and notice the parts which should be purchased in coming 3 months to PKZ-814. PKZ-814 prepares order sheets and places orders based on them. Arrived goods are received by warehouse (PKM-816). PKD-818 is in charge of acceptance inspection. In case of purchase of expendable supplies from companies other than those 48 companies, PKZ-814 negotiates for the prices.
- Complaint handling is to be done after the production branch notice troubles to PKD-818 directly and SJ-900 irons out it. However, there has been no precedent instance of complaint to the 48 companies.
- The M.E. requires stock of materials for 1 week production for engines as the minimum amount of inventories.

- It also has implemented some ideas to reduce costs. The goods are transported by trucking. Important parts, i.e. cylinder block, etc. are received in one lump sum for one month production.
- The personnel responsible for purchase are afraid that they may fail to keep good relationship with the 48 companies since the M.E., recently, came to reduce the amount of money for the orders for the companies as reduction in output of engines.
- The goals of the sub-section and indication for the degree of satisfaction can be explained as if it can make delivery on the deadline, that will be considered as 50 % of contentment and otherwise it provides for not to occur troubles.

(2) The Organization , Personnel and Duties of the Inspection Branch (PKD-818)

Fig. 12-4-13 The Organization and Personnels of Sub-Section for Inspection  
(total number of the personnel for the sub-section : 7)



(acceptance inspection for purchased parts, workers with experience of 25 to 27 years)

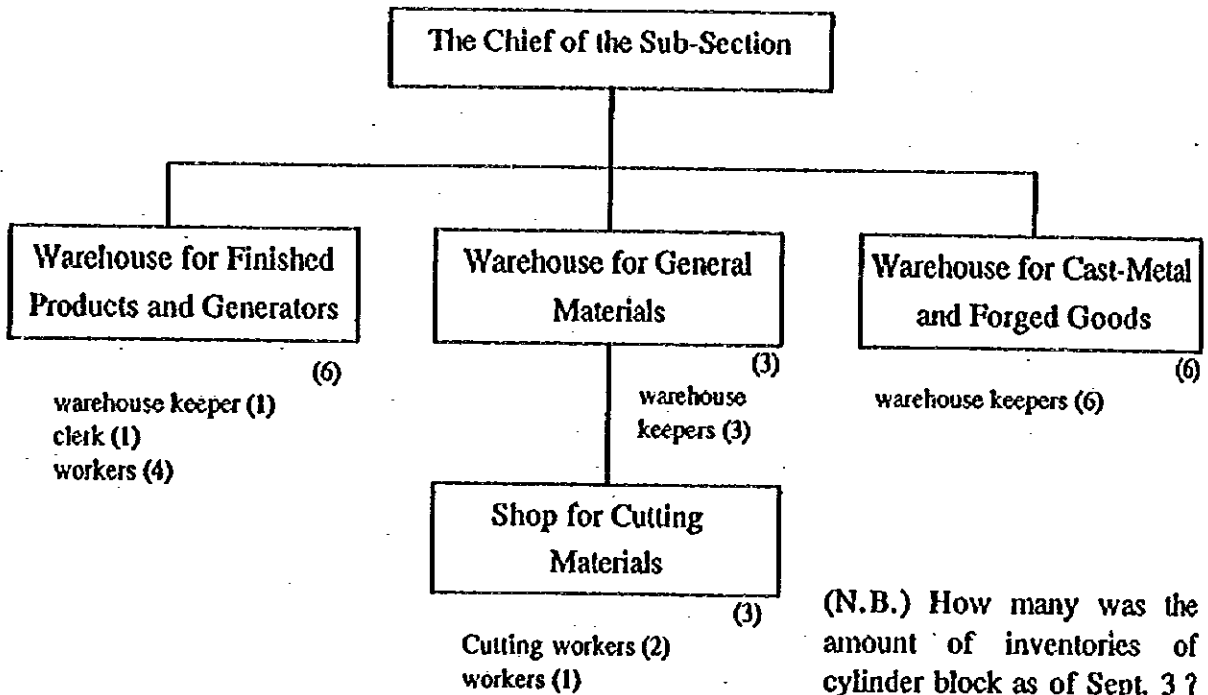
- Because the M.E. provided less number of personnel for this section, compared with the amount of the parts accepted, before introduction of ISO 9000, it checked only documents without having actual tests for the parts, and conducted tests only when it received complaints from the production site. However, since it has introduced ISO 9000 and the standard requires sampling test, right now, it practices the test properly. However, the system has started only 2 months before, thus it is not necessarily working well.



- In case of important part, cylinder block, it designated the points that should be checked and has practiced checking them. For example, the check-up items include hardness, basic worked surface, degree of roughness, damages or scratches on the surface by viewing, etc..
- Assuming 10 parts arrived, and 2 of them were found defective, they are returned to the manufacturer as a principle. They will be brought to the foundry manufactured to be judged how they should be handled, whether they should be repaired by the M.E. or by the foundry. Anyway, they will be examined with intention of utilizing them as much as possible, because the foundries are good counterparts with 30 years history. In case of stockout, the parts are accepted according to the judgment of the chief of the section, and examined the defectives thoroughly, repairing them with the manufacturer.
- The M.E. imposed penalty (7 % of contract money) until 1986. The penalty was imposed on the manufacturers.
- The Sub-Section for Production Technology prepares test specifications. In case of important parts, the Research and Development Department makes decision for them. The military had set the specifications before. However, in case of ships, the LLoyd's sets them and the M.E. followed this case.
- Of course, injection pumps are categorized in important parts. For the parts, the M.E. handles the complaints, but it has not compiled statistics data on defectives.
- This inspections may result better to be done by the Design, Service and Inspection Department. I think it would be helpful if the test is shared by the manufacturers with negotiation with them. I consider that the sampling inspection for the small parts is appropriate.

(C) The Organization, Personnel and Duties of the Sub-Section for Raw Materials and Warehouse (PKM-816) :

Fig. 12-4-14 The Organization and Personnel of the Raw Materials and Warehouse  
(total number of the sub-section : 19)



- The 100 to 150 pieces of cylinder block arrive monthly. They arrive 4 to 5 times in a month by trucking. They are transported by consolidated service of blocks, heads and wheels, etc..
- In terms of unloading at the warehouse, light parts are done by warehouse keepers while heavy goods should be done by contracted experts due to the regulation of Polish Safe Management Law.
- Since cylinder block requires seasoning treatment, the M.B. has expanded the warehouse recently. The arrived parts are to be left for 1.5 months according to the date of arrival. The M.B. applies push-up method for the use of the parts.

- The M.E. takes inventory once in a year. The warehouse keepers only put computer data in order. WSP-800 is responsible for actual check-up of amounts. As for the works in the processes which are kept by production branch, the personnel concerned take inventory twice a year.
- There are two warehouses for maintenance branch, one for tools and spare parts and the other for capital goods. Service Department also has its warehouse and the goods in it are kept by personnel in charge of each section separately with responsibility.
- Although caps were distributed to each branch, workers do not wear it.
- Standard volume of inventories is enough materials for 1 week production, however, some items are enough for 1 to 1.5 months production.

## 12.4.7 Control of Companies With Outside Orders Are Placed

The following is a summary of information concerning companies with which outside orders are placed that we received in meetings with divisions and sections heads of the different divisions concerned with plant operation.

### (1) Purchases

- 1) Presently purchases are made from 48 large domestic companies.
- 2) Small items for which there is no problem about quality are purchased on the market.
- 3) Purchase cost is a high 70% of production cost.
- 4) The prices and amounts of purchases are decided on by the finance and accounting division (FE-890) and not the sections that make the purchases. All the sections that make the purchases do is confirm the indicated parts and indicated purchase values and carry out the acceptance procedure.
- 5) Imported items are handled by the marketing division (RZ-850).
- 6) Designation of the companies from which the purchases are to be made is accomplished by the development or production technology division on the basis of decision on C/P at commencement of production and provision of drawings.
- 7) Purchase of standard parts from companies other than the above-mentioned 48 is left up to the procurement control section (cheap purchases).

### (2) System for Placement of Orders

- 1) The domestic sales division issues information on orders received, product lists, drawings and quantities per month.
- 2) Parts are divided into raw materials, processing, etc. for necessary order lists on the basis of 3-month plans and monthly plans.
- 3) The amounts are decided on the basis of estimates of contingency increases, etc. (to be on the safe side).
- 4) Drawings and inspection standards are sent separately by the issuing section at the time of placement of the orders.

- 5) In case of occurrence of nonconformities, information is collected on them and sent to the company with which the order was placed as preparation for replacement (on the basis only of instructions from above).
- 6) Concerning change of plants with which outside orders are placed: When they requested casting companies throughout Poland to present estimates for new parts orders from it in reaction to the high frequency of casting parts nonconformities, they did not received even one reply. The biggest problem is the small quantities involved.

### (3) Inspection System

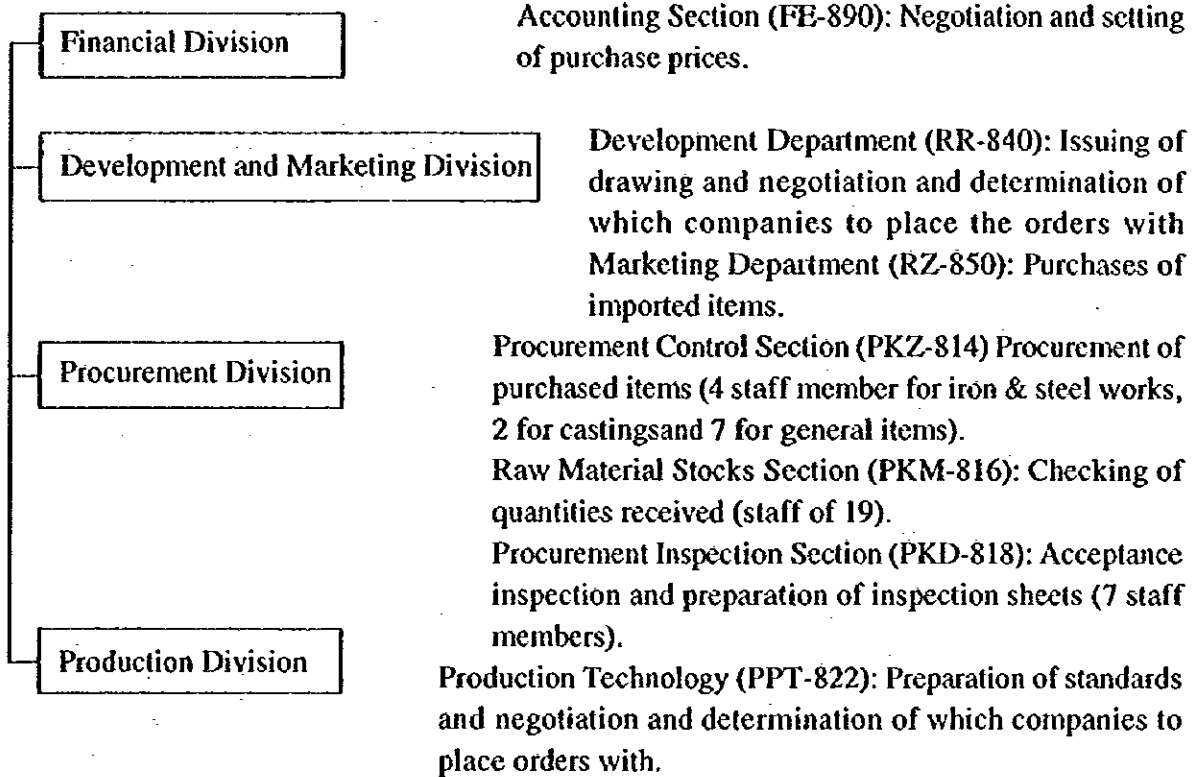
- 1) ISO-9001 just got started in June and is not functioning regularly.
- 2) In the case of general parts the people in charge of storerooms check the quantities, and the parts are then put in stock without any inspection.
- 3) In the case of important parts, the people in charge of storerooms check the quantities, and then the parts are inspected mainly as regards appearance (with addition of hardness, roughness, etc. in the case of cylinder bodies).
- 4) In principle, defective parts are sent back, but when inventories are low, the manufacturer sends people to identify which ones can be repaired, and the manufacturer is invoiced the cost of the repairs. Up until 1986 a 7% penalty was imposed on defective parts. They do not keep statistics on defect rates.  
Scheduled future inspection system:
  - Inspection by visiting personnel for parts that cannot be inspected in house.
  - Acceptance inspection of parts that can be inspected.
  - Inspections at the manufacturer in the case of small C/P and untrustworthy manufacturers.

### (4) Setting of Prices for Ordered Parts

- 1) Everything depends on negotiations.  
At total of 190,000 zloty was saved in the first quarter of this year, and the savings in the second quarter were 180,000 zloty, but those figures cannot be compared because of inflation. The prices of castings are higher than those of other parts. The usual discount is 3-5% and sometimes even as such as 10%, but Rzeszow Casting seems to be in a special position in that it does not give discounts.

**(5) Opinion Concerning Control of Companies With Which Orders Are Placed**

The system of control of such companies can be summarized as follows:



- 1) The work is divided among 4 divisions. Both division of responsibilities by type of work and a cooperative attitude between the different sections are important.
- 2) Most of the 48 domestic companies with which orders are placed have had relations with the company from the old days of production in large quantities and are easy to deal with. On the other hand, however, there is a now great deal of dissatisfaction on their part because of today's smaller quantities of production, and one gets the impression that the company should, but cannot, do something to improve the situation.
- 3) Please see sections 6.5.5 and 6.5.6 above concerning our surveys of a casting company, with which The Company is having trouble because of the high frequency of defects, and two injection pump manufacturers as representative producers.

## 12.5 State of Promotion of ISO-9001

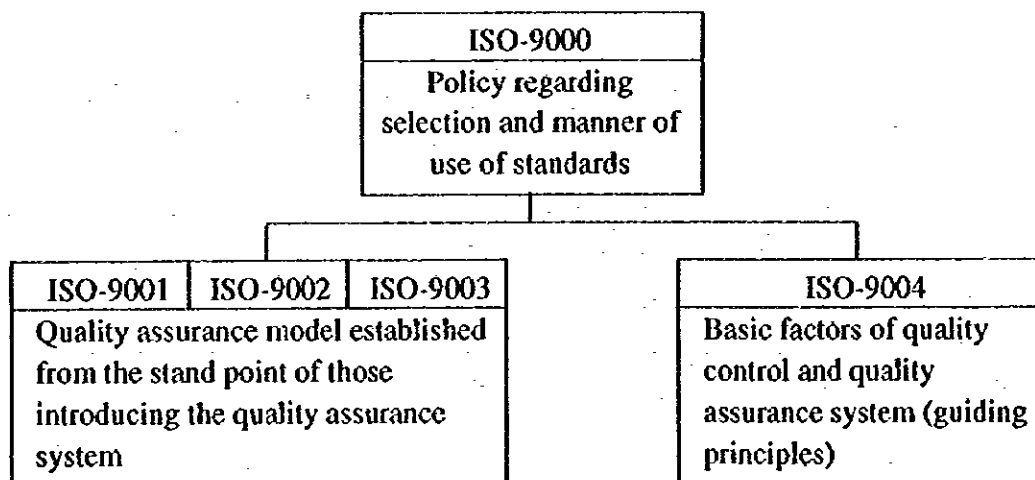
### 12.5.1 Summary Description of the Company's Promotion Plan

In 1995 the Company announced its tasks and policies regarding quality. That marked the beginning of activities for the purpose of establishing a quality assurance system meeting the standards of the ISO-9000 series. The aim of that, with sights set on ISO-9001 from the outstart, has been not only for the work of all of the company employees to meet the standards set in the drawings and manuals but also for them to become confident that by so doing, they are serving all the company's customers, for which the work is done (the "the customer comes first" idea). For that purpose training was carried out by specialized consultants of the company AQeL according to a defined schedule.

Control groups directly under the company president were formed and have begun to accomplish their functions. If the efforts are successful, the door will be open to integration of quality and productivity, and they are aware of the fact that development of the system is possible only with development of employees. Such efforts can be expected to continue in 1996.

### 12.5.2 Study Conditions

- (1) There are three types of acquisition of ISO-9000 certification, and the Company is aiming at ISO-9001, the one with the widest scope.



Scope of application

	Design	Purchases	Inspection	Storage and packing	Production	Services
ISO-9001	—————	—————	—————	—————	—————	—————
ISO-9002		—————	—————	—————	—————	—————
ISO-9003				—————	—————	

Table 12-5-1 Scope of Acquisition of ISO-9001

(2) The following is an account of the schedule of efforts for acquisition of ISO-9000 certifications and the present state of progress toward that end.

- May 1997                      Application for diagnosis and presentation of quality manual
- Later in 1997                Screening
- Still later in 1997        Certification

(3) **The Way of Accomplishing Quality Assurance Required by the ISO-9000 Series**

Essentially there is not much difference between it and Japanese quality assurance. The points of difference are as follows: 1) documentation of the way quality assurance is accomplished, 2) keeping of records of quality confirmation results and 3) introduction of internal quality inspection.

(4) The above differences are an important key to winning international trust because although Japanese products are of good quality, from the viewpoint of the U.S. and Europe the way such quality is accomplished is not very transparent and therefore hard to understand, and that makes for failure to win full confidence.

Thus, it is possible to clear the way of achieving quality assurance through documentation and keeping of records, and introduction of internal inspection can be said to be an effective means of maintaining and improving the way in which quality assurance is accomplished. Even after acquisition of ISO-9001 certification, follow-up screening by external entities continues to be implemented on a semipermanent basis twice a year, and whenever such follow-up screening is not passed, certification is canceled.

For that reason as well, i.e. in order to maintain acquisition of certification, it is important that there be day-to-day control activities, including implementation of internal quality inspection before follow-up screening in order to accomplishment improvement before nonconformities appear.

(5) **Present Problems**

1) At the time of our preliminary study in February 1996 application for diagnosis and presentation of quality manuals were earmarked for October 1996, but they are seven months behind schedule.

2) The Company has to prepare a total of 50 documents, but only 25 of them have been completed, which means a present (November 1996) achievement rate of 50%.

The state of progress of the different departments and sections as regards completion of documentation is as follows:



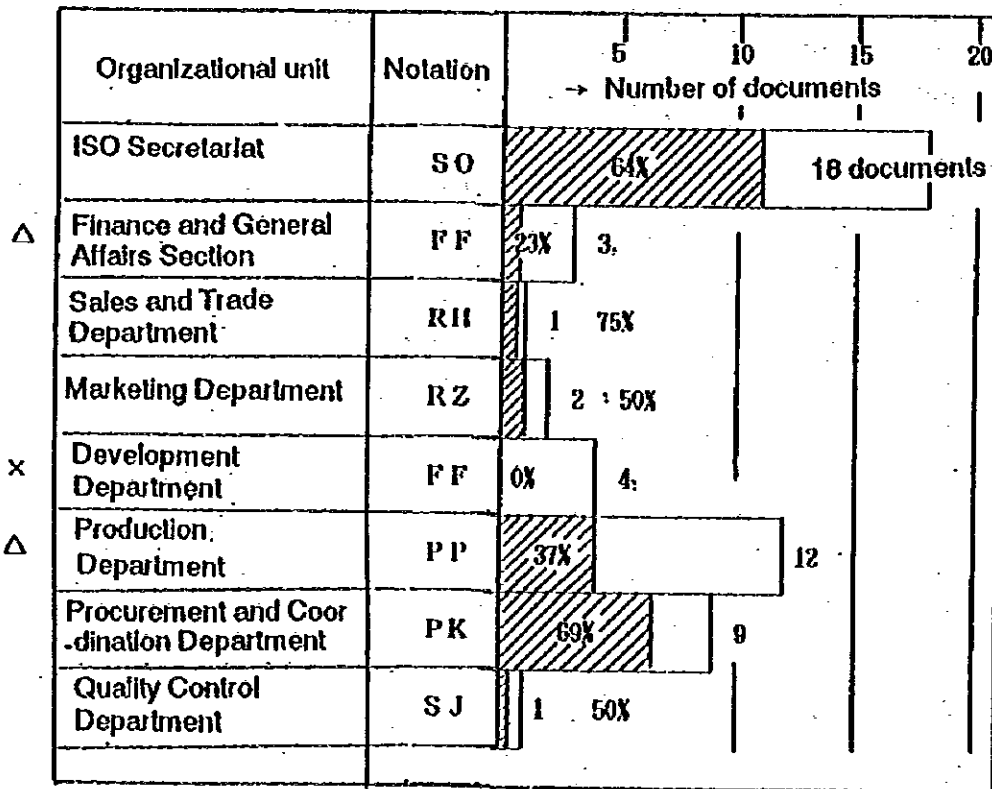


Table 12-5-2 State of Progress in Completion of ISO 9001 Documentation

- (3) The progress of the Company's ISO Secretariat and Procurement and Coordination Department in documentation for ISO 9000 is going as planned, but implementation of documentation, design review, etc. of design control, which falls under the Design and Development Department, is behind schedule.

We were told by people in the Company's ISO-9000 Promotion Secretariat that they are worried about the Development Department's tendency to place emphasis only on achieving results in terms of product quality and to regard the process of quality control as of little importance.

That is very similar to the situation in Japan at the time of introduction of TQC in the decade 1955-65, when development departments and sections attached little importance to the process of development.

Looking at the case of the Japanese company Isuzu Motors, its four plants in Japan and one plant in the U.S. have successively acquired ISO-9000 certification, but all of them were diagnosed under ISO-9002. Now, however, they have set their sights still higher and intend to start activities for acquisition of ISO-9001 certification, which includes development as well.

- 3) Some plant departments, too, are very good about using documents and keeping records, but they are still just putting things down on paper, hardly any of them having yet managed to make such efforts produce results in terms of quality improvement and work improvement.

### 12.5.3 Trend Regarding Putting Business Management on ISO Footing

The state standard of the International Standardization Organization (ISO) that sets the management guiding principles on the basis of which enterprises should make efforts regarding environmental measures (ISO 14001) took effect in September of this year. That follows the ISO 9000 series (quality assurance standards) of 1987, making acquisition of certification with respect to ISO standards a passport for international transactions and therefore a task that no international company can afford to neglect. And there is still more to come: work in the ISO on standardization of safety and hygiene and finances and accounting, too, is already under way. With the official taking of effect of ISO 14001, many companies have already decided to start activities toward acquisition of certification with respect to it as well, and some Japanese companies are even aiming at doing so with respect to their production plants by the end of 1998.

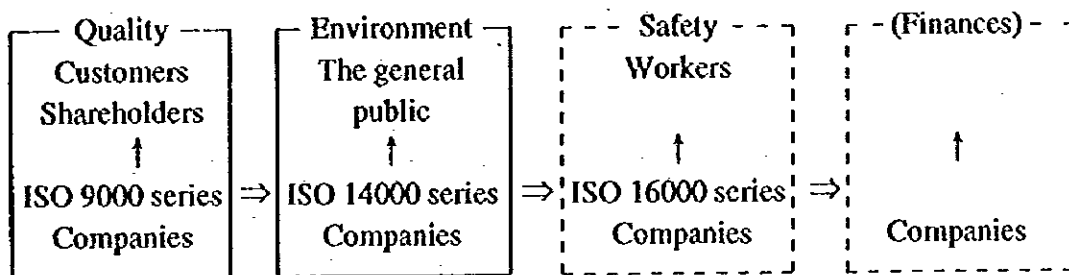


Table 12-5-3 Trend Regarding Putting Business Management on ISO Footing

### 5. GRAFICZNY SCHEMAT POSTĘPOWANIA.

#### 5.1. Struktura organizacyjna Systemu Zapewnienia Jakości.

Organization Chart of Quality Management

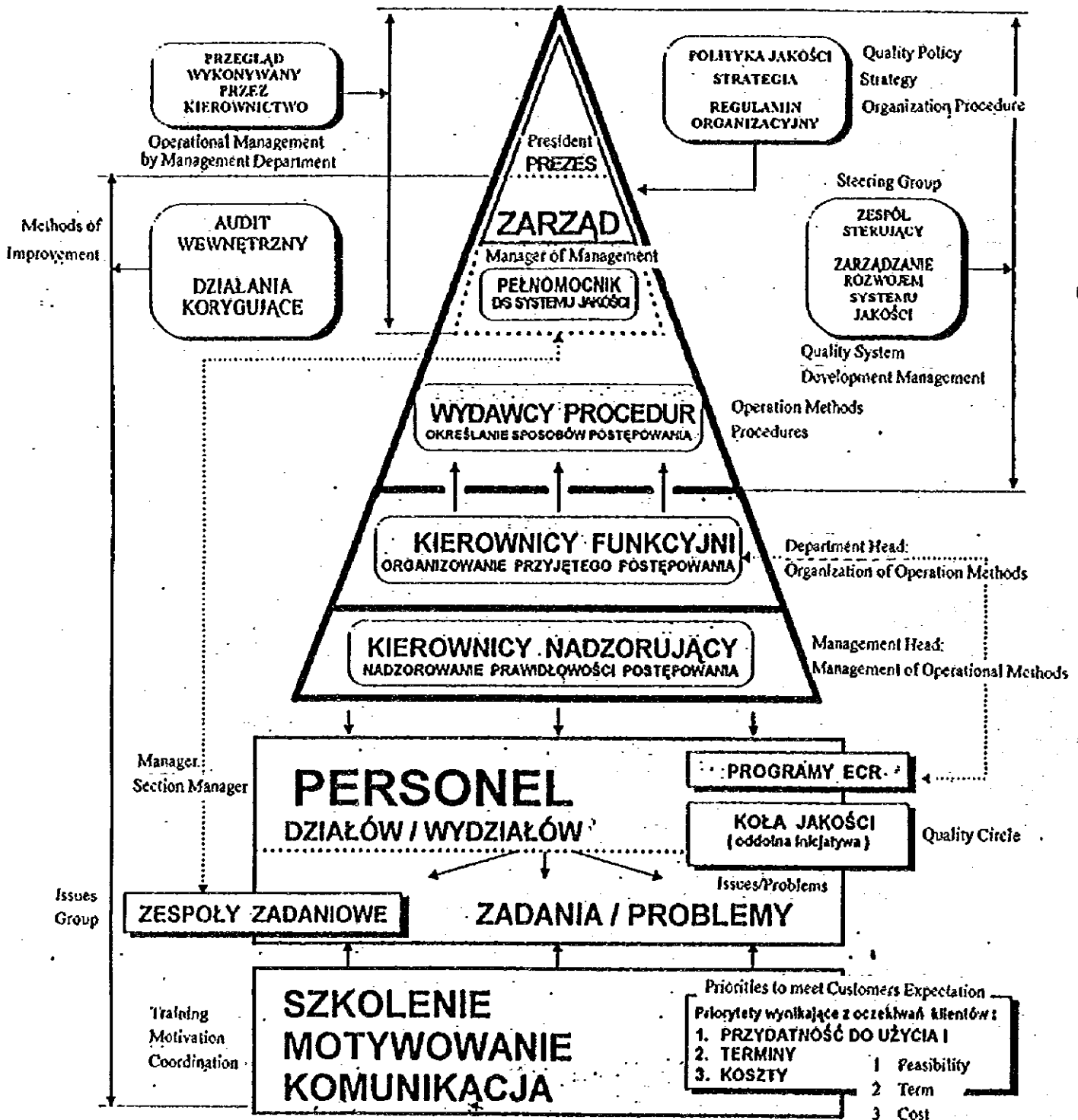
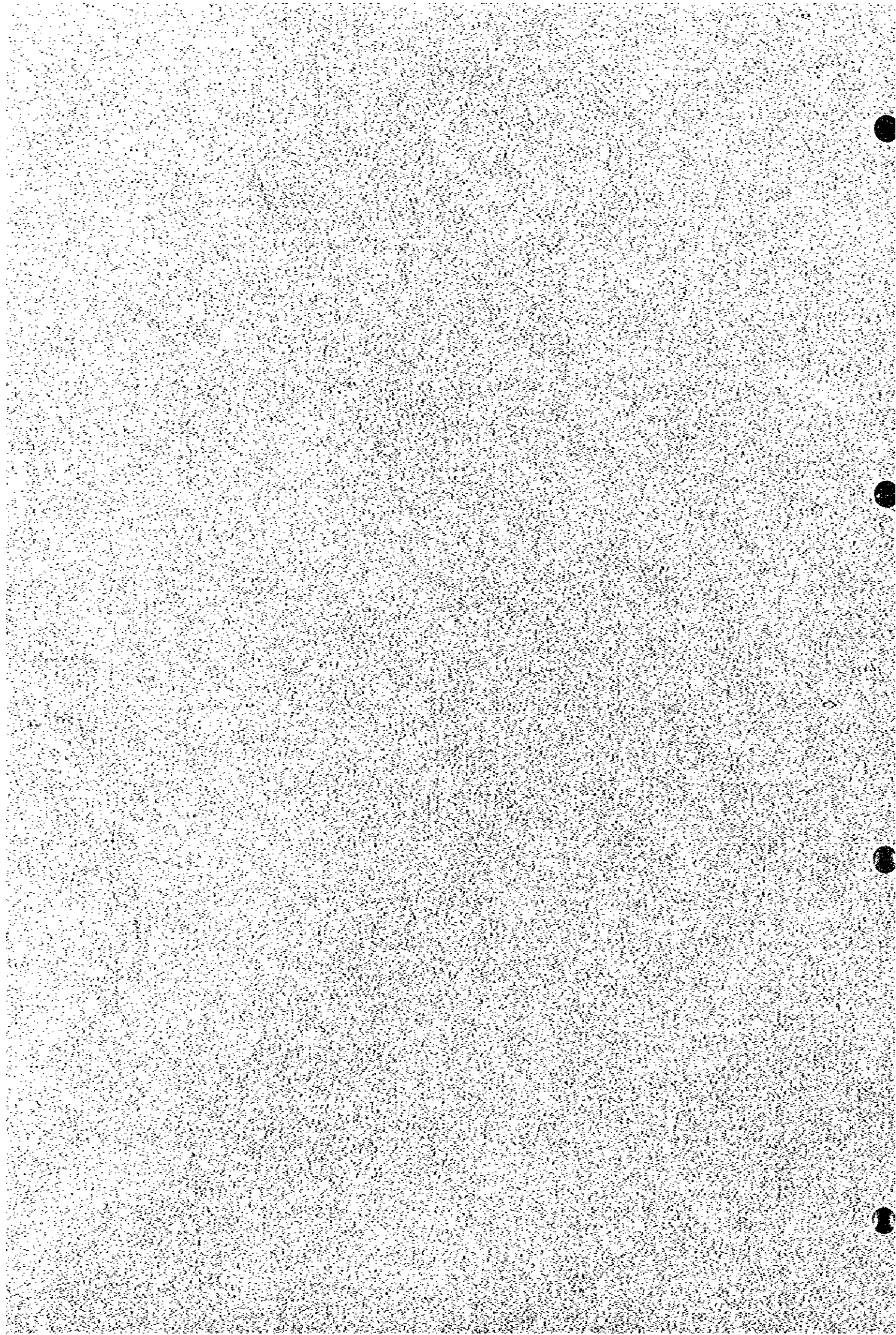


Fig. 12-5-4 ISO 9001 Quality Management System of Mielec Engine Co.

Source: Mielec Engines Co.

## 13 Conclusion



### **13 Conclusion**

The study team proposed mid- and long- term business strategies for PZL-Mielec Engines Co. The Company made a good start by two reasons. Firstly the Company's top management committed to formulate its own mid- and long-term plan. Secondly the successful results of improvement circle teams of the plant elevated the mind of the all employee involvement in the restructuring program.

Toward 2001, the remaining state-owned enterprises in Poland will be privatized. This will elevate productivity levels and technical sophistication of products, making competitive power in the market economy. The Company must however, overcome its difficulties by restructuring as other state-owned enterprises are currently doing.

As the results of the activities made this time, the restructuring plan will work correspondingly, but it is necessary to work up implementation plans and promptly construct a managerial and controlling structure and systems hereafter. The study team judges that Mielec Engines Co. can put this into practice by its own ability.

The major objective of the study is making recommendations with regard to the restructuring of the state-owned enterprises to the Polish government and the industry based on study team's experiences obtained during the restructuring program for PZL-Mielec Engines Co. The Ministry of Economy organized the corporate management seminar in order to attain this objective at the seminar which took place on March 3 1997, the study team presented the results of the model company's restructuring effort as a template for a wide range of other Polish enterprises. Exchange of opinions and comments among participants was constructive.

The study team has received requests from the Company and the government to follow-up on the success and progress of the restructuring hereafter.