FINAL REPORT FOR THE STUDY ON THE RENOVATION OF THE FOUR INDUSTRIAL PROJECTS IN THE UNION OF BURMA

(Volume III)

Annex 1

DETAILS OF FACTORY FACILITIES AND OPERATION DIAGNOSIS

April 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

Tokyo, Japan

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Chapter 1

ELECTRIC PRODUCTS MANUFACTURING FACILITY

Chapter 1 ELECTRIC PRODUCTS MANUFACTURING FACILITY

1-1 Lighting Fixture Shops

Production of lighting fixtures takes place in the following two HIs:

Factory	Use	Item Produced	Annual Production (pcs)	No. of Shops
No.1 HI Rangoon	For FL40 use	FA42751GL(double light fixture)	1,000	4 shops
		HIC-LF-F41(single light fixture)	38,000	
		FA41420GL(single lamp street lighting)	2,000	
	For ML use	Various Mercury Lamps	4,000	
No.3 HI Sinde	For FL20 use	FA21260(single lamp)	33,000	1 shop

Notes: FL = Fluorescent lamp
ML = Mercury lamp

Analysis of the evaluation and problem points of the present factories, together with improvement plans are treated as follows:

The production line of lighting fixtures for FL20W managed by No.3 HI is noted in Section 1-1-1, the production line of lighting fixtures for FL40W use of No.1 HI is noted at Section 1-1-2, and finally a general summary covering all of the production lines is presented in Section 1-1-3.

1-1-1 Lighting Fixtures for FL20W, No.3 HI

(1) Outline of production processes

1) Working equipment and layout

Production processes are divided into pressing, coating, assembly, and ballast making, and the layout is very good. The factory is spacious and well lit (Refer to Fig.AI-1-1-1).

2) Organization and personnel

Organization of the lighting fixture line is as follows:

- Shop Manager (1)
  - Sub Manager (2)
    - Assembly Foreman (1)
      - Ballast (17)
      - Starter (13)
      - Finish (9)
    - Progress
      - Store (3)
      - Engineer Staff(4) (in charge of material supplies)
    - Component Prod.
      - Press (15)
      - Coating (7)

Total personnel: 72

Further, four members of the Inspection section are dispatched each being in charge of ballast, pressing, coating, and finished fixture inspection respectively. "Progress" is taken to refer to the section responsible for progress control and materials control.

3) Raw materials and their supply

Parts are divided into domestically produced (LP) and imported (IP) and are as shown in the table below. However, all raw materials for iron plates, and chemical materials (resin for socket use, painting materials, etc.) are imported.

	LP No. of Items	IP No. of Items	Main Parts
Fixture Body	10	9	Name Plate, Capacitor, Glow Lamp, Bush, Washer, Cover, Screw, Spring Washer.
Ballast	37	6	Nut, Screw Nut, Rivet, Name Plate.
Step Down Transformer	16		
Socket	6	2	Rivet, Eyelet
Total	69	17	86

The share of domestic production of the component parts calculated on a point ratio is 80.2%. According to the HIC materials and components are brought in without causing any adverse effect on production.

4) Equipment capacity and production performance

The production performance of No.3 HI for lighting fixtures (FA21260GM, FL20W single lamp use) are as follows:

Production Performance for FA21260GM

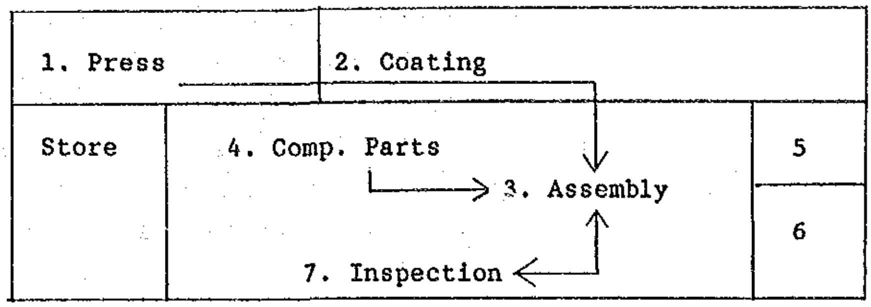
Prod. Period	No. Prod.
81/4-82/3	32,350
82/4-83/3	22,650
83/4-84/3	40,000
84/4-85/3	39,000
85/4-86/3	33,600
86/4-87/3	33,005

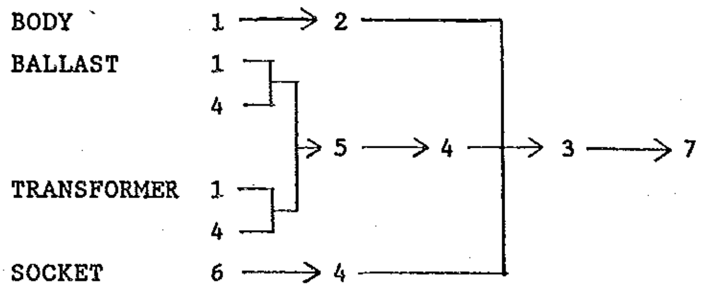
Regarding equipment capacity, there are 27 Presses (incl. large and small types; refer to document No.3), the coating equipment is of the large type capable of handling the 40 watt size. The factory is large and equipment capacity quite sufficient. The annual capacity of HIC is officially published as 48,000/y, but according to the above table the average annual production performance is 33,400 items and 2,800 items monthly.

(2) Analysis of production processes

1. Analysis of production process
   The outline analysis of operational processes is as shown in Fig.AI-1-1-2.

2. Flow chart diagram of production processes; the line of production processes is as follows:





Notes 5: packing pitch for Ballast and Transformer
6: forming of Socket

3) Problems concerning production methods and process chains

The coating device is too large in comparison to the present scale of production. Because of this several days production are stocked up and are coated together and operating rates are poor. There is also excess capacity of the press equipment and production is intermittent. As a result there are many production processes with a large number of parts in progress.

4) Problems and improvement of production methods and division of labor system

No problems at present.

5) Problems and improvement of equipment layout and material handling

As aforementioned, the equipment capacity was built with a considerable productive output in view, and the equipment layout was well made. With the present low productive level since machinery is spaced out inside the shop this leads to long conveyance distances between processes and considerable loss is involved. Moreover as mentioned above, the coating and press processes both carry out intermittent production and this leads to stocking of a large amount of parts in progress which is undesirable.

6) Problems and improvement of working machinery

a) Machinery

At present, a total of 53 machines are installed. Of these, the rotator of the winding machine needs replacement. Other minor problems include the breakage of switch buttons, decline in revolutions of the hoist pulley, inadequacies in all lighting systems due to lack of spare reflector lamps for drying purposes.

Further, repairs for even minor breakdowns are not done in the shop but are sent to the planning dept. As a result, although repairs are satisfactorily performed they tend to be delayed.

b) Dies

At present there are 84 sets of dies. Of these 28 sets are used and are classified separately. However, as there are spare dies for each kind available at present no impediment to production has been reported. As to the used dies the shop concerned requests the planning department to take care of repair or new purchasing. Some of the specimen sockets, etc. which were pressed showed slight problems of burring. However, these products are now manufactured to satisfactory standard.

c) Auxiliary equipment

No problem at present.

7) Problems and improvement of operating rates and line balancing

1. Over the two days, we conducted our trial inspection the total work force working at full production produced 1,500 products, more than half of the average production for one month (av. 2,800 per month). This seems adequate proof of sufficient productive capacity.

2. Although sufficient productive capacity exists due to low quantity of production and below capacity production, reduction in the operating rates and worsening of line balancing has developed.

3. As an example of line balancing problems, finished products are stored in piles without packaging because packing materials were not delivered.

8) Problems and improvement of reception of raw materials and components.

The present policy is that production takes place once raw materials and components have been received. The concept of ensuring the supply of materials and components on the basis of the productivity plan itself has not yet been established.

9) Problems and improvement of product dispatches

With the present system it is necessary to stock the finished products in the shop until personnel from the warehouse pick them up. It is necessary to set up a system whereby products are stored immediately on completion.

(3) Analysis of products quality

1) Investigation of occurrence of inferior goods

For quality control, the inspector on dispatch from the Inspection Dept. is responsible for disassembly and re-assembly or replacement of products adjudged to be inferior, to ensure production of superior products.

However, no record of inferior products is kept and they are not eliminated because of inferior quality. Furthermore, there is no record kept of reasons for the occurrence of inferior products. Among the total finished product the following are estimates of the percentage of inferior products which have been recycled:

ballast	5% approx.
finished products	2% approx.

Reasons for the occurrence of inferior products are too much backlash in ballast winding M/C and unstableness in soldering work of contact.

2) Problems and improvement of quality control standards and inspection methods

1. On a shop level, there seems to be little interest in establishing a sense of quality control and inspection standards, and these are left to the inspection staff responsible.

2. No records are kept of the voltage or amperage measured during inspection. With the present system of checking a product is judged as normal and it is passed if the meter needle moves once a lamp is attached and an electric current passed.

   Testing as to whether the watt and ampere are within the specified ranges at time of inspection must be checked and an evaluation made.

3. The following problems in particular are seen in connection with the inspection system as carried out by the inspectors:

   Inspection devices are deteriorated and despite imperfections in the meter's operation, wiring and terminals, the inspection devices supplemented with temporary rewiring are currently used.

   Voltage resistance inspecting devices are not employed.

Instead of standard test lamps general use lamps are used during testing.

Without reference to voltage and amperage tolerance ranges quality control checks are conducted on the basis that movement of the meter is sufficient for a positive result.

Quality control inspection of the ballast and step-down transformer takes place up to three times and no particular problems are evident.

As the inspection method for lamps is not based on the relevant law on inspection of electric products and industrial standards of the countries giving technical cooperation, so there is reason for doubt as to the stability of the finished product.

(4) Maintenance of equipment and buildings

1) Maintenance system

Equipment capacity considerably exceeds present production performance. No sign of production trouble due to equipment was currently found.

Should the need for repairs arise the concerned shop notifies the Planning Dept. and repairs take place with some tendency to delay. However, there are 28 sets of dies which are classified as Used Dies. At present, there are spares available for all of these. However, the problem of supplements can be expected to arise in the near future.

2) Problems and improvement of maintenance.

In the present inspection the following equipment, etc. was found to require maintenance repairs, and it is expected that the Planning Dept. has sufficient expertise to perform these repairs:

1.	Winding Machine of the Ballast	1 set
2.	Inspection Table of Finished Fixture	1 set
3.	Used Dies	28 sets

(5) Design of Manufactured Products

A single lamp 230 volt 20W (watt) fluorescent lighting fixture requires a ballast and step-down transformer. With present processing it is necessary to attach these two elements. Consequently, in order to improve the efficiency of the mounting operation integrating the two elements for mounting needs to be considered. On the Burmese side a wish has been expressed for use of these as one integral unit. However, the technical co-operating country has not carried out this integration. Even if this were to be done it would involve an overall change in processes, and would be too early at the present stage of excess productive capacity.

Besides improving the electrical stability of the lighting fixture, the shape and coloring of the reflector, for instance, needs considering to ensure that it matches with Burmese conditions and tastes. For example at present only fixtures with attached reflector are sold but sufficient potential demand for directly attachable devices without reflector is expected on the domestic market.

1-1-2 Lighting Fixtures for FL40W, No.1 HI

Many of the problems are the same as those for No.3 HI. The following is an account of the particular conditions of No.1 HI.

(1) Outline of production processes

1) Working equipment and layout

Layout of machine and equipment is shown on Fig.AI-1-1-1. The special lines for the lighting fixtures in the various shops are often not determined.

2) Organization and personnel

Lighting fixtures production at No.1 is divided among the shops as shown in table AI-1-1-1 and since this is carried out along with production of other items there is no specific organization for lighting fixtures.

3) Raw materials and their supply

Conditions here are almost the same as for No.3 HI(Sinde). However, the following two differences were noted. The step-down transformer is not necessary at No.1 HI for the production of lighting fixtures for 40 watt use. Secondly, although Sinde's cold rolled steel plates are noted as a local product, the cold rolled steel plates of No.1 HI are imported. (However, that used by No.3 HI is actually imported).

4) Equipment capacity and production performance

Production performance for No.1 HI is as follows:

Production Performance

	FA2751GL	FA41420GL	HIC-LF-F41	Total
83/4-84/3	1,200	1,500	45,630	47,980
85/4-86/3	1,000	3,000	40,950	44,950
86/4-87/3	875	2,000	36,920	39,795
Annual Av.	1,144	2,338	38,172	41,654

Note : This does not include the performance for the mercury lamp.

As pressing and coating equipment is also shared in use for production of other products estimations for pressing and coating of the lighting fixtures alone cannot be given.

Also estimations for equipment capacity excluding pressing and coating cannot be made either since manual operations are frequently involved and parallel production takes place.

According to HIC documentation equipment capacity for the entire HIC is some 88,800 of which 40,000 are produced at No.1 HI and 48,000 at No.3 HI.

(2) Analysis of production processes

1) Analysis chart outlining production processes

Analysis of processes is shown on Fig.AI-1-1-2 and operational processes are the same as in No.3 HI.

2) Flow chart

As has already been noted in Table AI-1-1-1, since the various production processes take place in different shops conveyance between shops of products in progress is needed.

3) Problems concerning operational methods and process chains

Since the present equipment capacity is excessive in the present circumstances to the production schedule production is intermittent and a large number of parts in progress results.

4) Problems and improvement of equipment layout and material handling

Since the press shop is particularly distant from the other shops efficiency of material handling is poor.

5) Problems and improvements of working equipment

The appropriate time for changing of the dies in the Press Shop has not been determined and dies are used as they are even though this has a detrimental effect on product quality. It is necessary to replace the iron core blanking dies used for production of the GZ40122MB-1 stabilizers. Since the dies of the various sockets have been in continuous use since 1972 they show considerable wear (refer to Table AI-1-1-2).

(3) Analysis of products quality

As has already been noted the deterioration of the dies is severe and a reduction in the quality of the production parts involved with the dies is evident. In the case of the sockets types there is a lot of burring but the section affected has been diligently taken up by the repair section and the socket quality has been brought back up to a level equal with that of the pressed parts of the bakelite mold section.

(4) Problems and improvement of maintenance

In the present inspection the following equipment, etc. were found to require maintenance repairs:

1. Dies; the iron core blanking Dies for use with the GZ40122 B-1 ballast.

2. The Inspection table for finished fixtures

Further, two EL coating devices (a static electric coating device) are installed in the present shop. Of these one is broken. There is one Lighting Fixture coating device, in good working order. However, in order to perform coating of other accessories, the shop needs to have two working machines as originally.

(5) Design of manufactured products

HIC itself modified the form of its main product, the HIC-LF-F41 Reflector and also changed the product item number. Other modifications need considering which would ensure that it matches with Burmese conditions and tastes. For example considerable potential demand for a directly attachable 40W devices without reflector is anticipated on the Burmese market.

1-1-3 Other Problems of the Production Equipment for Lighting Fixtures in the No.1 HI and No.3 HI

(1) Future production schedule

The following table shows the production schedule for the HIC fluorescent lamp and fluorescent lamp lighting fixtures:

Production Schedule for Lighting Fixtures

	1988/89 (present)	1990/91	1992/93	1994/95	1996/97
(a)fluorescent lamp	480,000	900,000	1,200,000	1,600,000	2,000,000
(b)fluorescent lamp fixture	73,000	80,000	90,000	90,000	90,000
(b)/(a) x 100	15.21%	8.88%	7.50%	5.62%	4.50%

Note: The production schedule shows the total for both No.1 and No.3 HIs.

The above chart, based on the long term plan of HIC, shows that the production output ratio (b)/(a) of the lamp and fixture decreases year by year. Sufficient measures to ensure an increased production of the fixture to correspond to the increased production schedule for the lamp must be considered otherwise a situation of deficiency of the lamp on the market will arise.

(2) Integration of the production equipment of No.1 HI and No.3 HI

Both No.1 HI and No.3 HI have an excess of equipment capacity and inevitably intermittent production is carried out and this has detrimental results.

A transfer of No.1 HI's present production facilities for integration at No.3 HI would make possible centralization and rationalization of output facilities. Given the present shop space of No.3 HI it would be possible to arrange the transfer of (excepting 40W ML specialized machinery) presses, dies, winding machines, measuring instruments, testing apparatus, etc. The existing coating equipment of No.3 HI has sufficient capacity to handle the entire requirements. However, the following problems would be faced:

1. A loss due to the return conveyance time for dispatch of blank materials and completed parts to Sinde and Rangoon would occur.

2. Simply removing the lighting fixture production line equipment from each shop of No.1 HI would only result in a reduction of total efficiency since the gap which would result would require filling, perhaps by the output of some similar electrical appliance.

3. As much of the same equipment is used for ML and FL production it would not be possible to continue only the ML line at No.1 HI. However, if the mercury lamp equipment were to be transferred at the same time to the No.3 HI factory modification of the layout of part of shop No.3 HI would be necessary.

   As indicated above it is proposed that the two factories No.1 HI and No.3 HI continue their current production system for manufacture of lighting fixtures and also set up a schedule for increased production of the fixture to meet the increased production schedule for the lamp, in order to meet market demand. Therefore, the present situation of equipment and machinery is considered to have sufficient excess capacity to meet future production.

Table AI-1-1-1 PROCESSES FOR LIGHTING FIXTURES PRODUCTION

Process for Lighting Fixtures	Shop	Other Parts/products Produced in the Shop
Press (Body, Reflector and Core of Ballast)	Press Shop No.1	Press parts for rice cooker, hot plate, etc. Press parts for vehicles.
Socket	Bakelite Molding Shop	Electric accessories for wiring.
Coating and Ballast Ass'y	Coating Shop	Coating of rice cooker, hot plate, etc.
Assembly	Electric Home Appliances Plant	Assembly of rice cooker, hot plate, iron, etc.

Table AI-1-1-2 LIST OF DIES FOR PRODUCTION OF SOCKETS OF LIGHTING FIXTURES, NO.1 HI

Sr. No.	Model	Nomenclature	Received in the Year										Total
			Up to 1969	1970	1971	1972	1975	1977	1979	1980	1983	1987	
1.	L.226	Socket Body				1							1
		Lamp Pin Holder				1							1
2.	L.227	Socket Body				2							2
		Lamp Pin Holder				2							2
		Front Cover				2							2
3.	L.231	Socket Body				2							2
		Lamp Pin Holder				1							1
		Front Cover				1							1
4.	G.41	Socket Cover				1							1

Figure AI-1-1-1 MACHINE LAYOUT OF LIGHTING FIXTURE SHOP

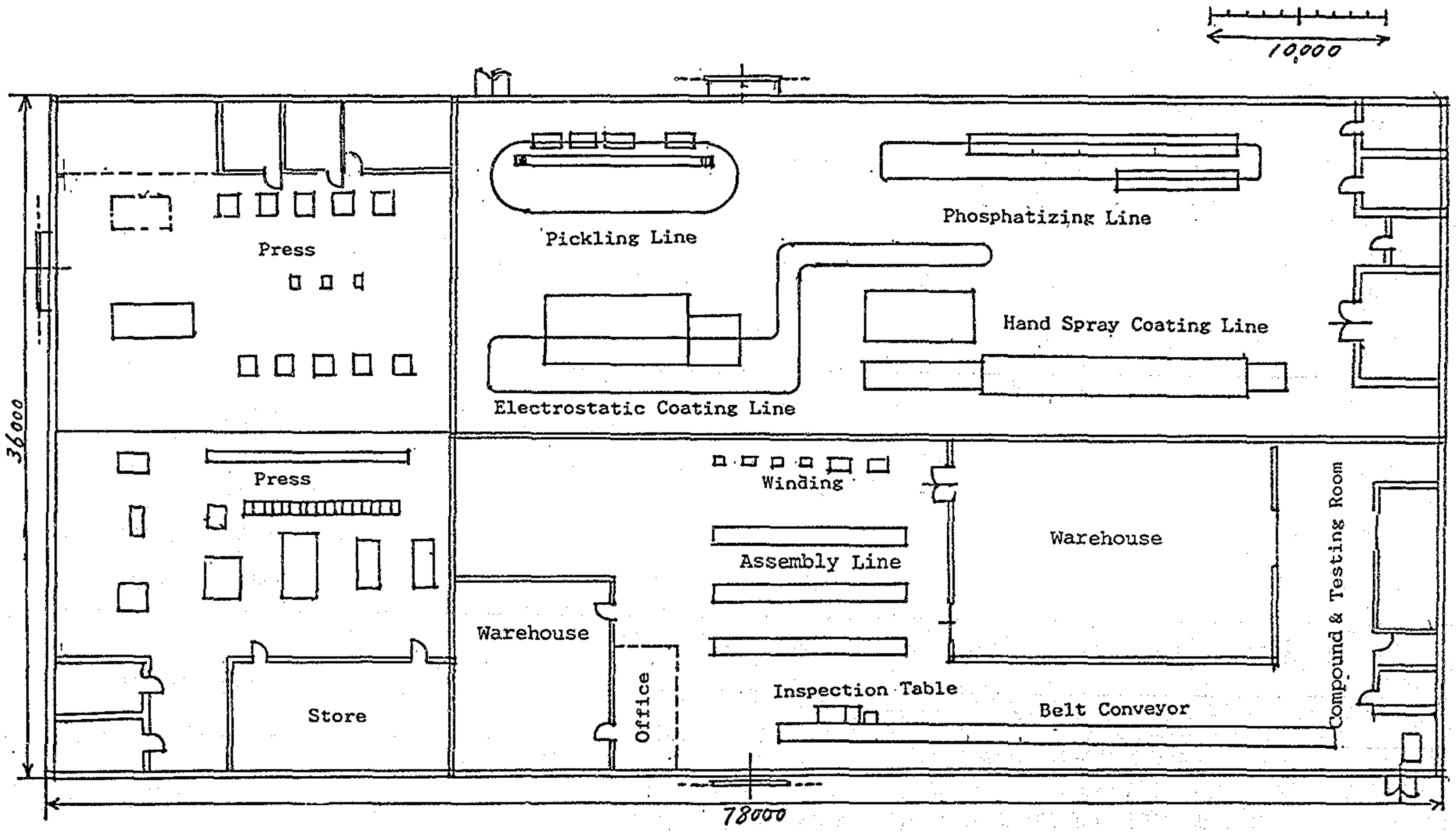
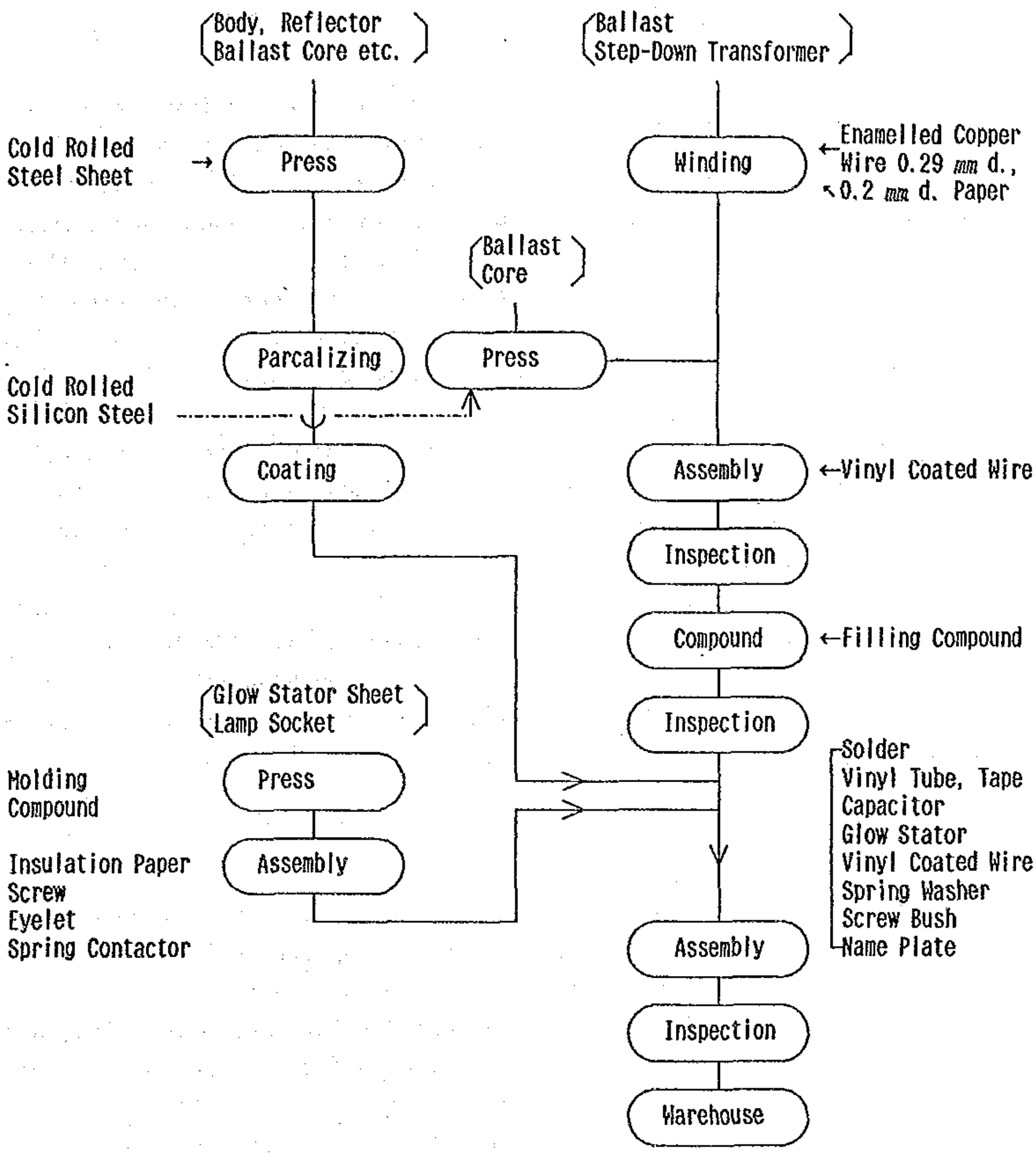


Figure AI-1-1-2 OPERATION PROCESS CHART OF LIGHTING FIXTURE MANUFACTURE, NO.3 HI



1-2 Fluorescent Lamps (FL) and Incandescent Lamps (IL) Plant

(1) Outline of production processes

1) Working equipment and its layout

The fluorescent and incandescent lamps are produced on integrated production lines together with the mercury lamps (ML) in the Lamp Manufacturing Plant of the No.1 HI. There are four lines located in the center of the building, the two lines for the incandescent lamps, and one line each for the fluorescent and mercury lamps. Around the main building are located the areas for materials parts, the pre-treatment processing and testing room, the materials parts store, the spare parts store, the packaging area, motor room and the office.

At present, this plant is well planned as a lamp manufacturing shop. However, serious consideration of layout is necessary to ensure that the production efficiency is not impaired in the event of a future expansion of production. The ceiling is high and slated with good lighting. The building is well suited to the needs of highly precise working equipment which produces high temperatures. The layout of the equipment is as shown in Fig.AI-1-2-1. The storehouse for finished products is a two story building with material parts kept on the first and spare parts on the second floor.

2) Organization and personnel

In contrast with other shops there is a section for quality control and maintenance here. As production processing control is very important, involving operations such as the daily sampling measurements for the fluorescent and incandescent lamp production, and feedback of data to production sections, a quality control section has been set up. Further as the quality of the equipment differs considerably from that of other shops it is necessary to ensure provision of specialist spare parts, adjustment technology and a vacuum pump so that a Maintenance Section was set up (refer to Fig. AI-1-2-2).

The Quality Control Section possesses the testing and measuring devices necessary to inspection of the production processing control. For maintenance, as the number of operational metallurgical tools is limited sufficient operations are impossible and requests for supplements to the Planning Department are frequent. As to personnel formation, the Plant Manager, Quality Control Chief and Maintenance Chief have all three received on site training in Japan and the other personnel of managerial class have a good record of staying on with the company. Total personnel is 112, and present personnel organization as follows:

managerial posts	:	9
skilled labor	:	56
semiskilled labor	:	41
unskilled labor	:	6

It is necessary to consider the expansion of maintenance functions, equipment, and technicians.

3) Raw materials, parts and their supply performance

Because of the particular nature of the technology for lamp production all of the raw material parts are imported.

We can summarize the data for the number of representative items of raw material and component part categories needed according to the lamp types, as follows:

	RM	CP	Total
FL40	17	8	25
IL230V 60W	25	8	32

Propane gas was imported in the past but for the last 10 years or so changeover to local production has taken place. Except in the case of the IL the RM and CP for finished product use are all imported. At present the Ceramic Corporation has a mass production system of production. However there are problems in use as the reject rate is around 40 to 50%.

Changeover to local production of the glass tube for fluorescent lamp use has not been carried out.

With regard to the other chemical components, changeover to domestic production is supposed difficult for the present because of the large number of specialist lamp making components involved. The packaging sack and case for the incandescent lamp are domestically produced. The appearance of the case is very poor, and there is danger of damage to the lamp during export handling. The printing on the sack is good, but due to paper quality an automatic wrapping machine cannot be used and wrapping is performed manually.

4) Equipment capacity and production performance

a) The annual figures for both the production performance from 1978 to 1987 and the long term production schedule according to data provided by HIC is shown in Fig.AI-1-2-3. This shows that though the production output for incandescent lamps was about 3 million per year. This has decreased recently due to the rate of use of local bulbs and difficulty of obtaining these. Annual performance for the fluorescent lamp averages 400,000 to 450,000 and this level has been reached in the recent period of 1987/1988 also.

b) Data of HIC indicate that the equipment capacity for the incandescent lamp is 2,400,000 annually but this seems insufficient for the two lines and yet is too much for one line. The maximum production output to date was 3,600,000 units. This proves that if the delivery and rate of use of the bulbs is smooth and imported parts delivered to schedule an annual production of 3,600,000 per annum is possible. With the future production system of 6 million annual output it is possible to set up one more line. But of course it is essential that the required amount of material parts and spare parts be imported, that maintenance be carried out and that stoppages in operating due to equipment problems be eliminated.

According to the data of HIC, the equipment capacity for fluorescent lamps is 400,000 units annually and this accords with the present performance (refer to Figure-1-2-1). However, the long term schedule is for an annual 2 million units in 1996 which would require an increase of 4 lines to result in a total of 5 lines. The one line planned for increase cannot meet the required capacity. In this regard, the present 4,000 units per day and 10 operating days per month results in the annual performance of 40,000 to 45,000 units per month. So it is reasoned that if operating is increased to the full month (20 days/month operation) 80,000 units could be produced (or 960,000 units annually), so that with two lines it would be possible to have an annual production of 2 million. This is possible in terms of line speed but the realization of this production level depends on the delivery of imported material parts and spare parts according to the production schedule,and it will be necessary to adopt a system of full operating for both the existing and new lines.

c) Production items

There are five different items in the 230 V incandescent lamp range: 25, 40, 60, 75, and the 100W, but there is no production record for the 75W, and the production performance for the 25W is very small. Thus the volume ratio for the remaining main items of the 40, 60 and 100W is 1 : 4 : 5 respectively.

The two items of the fluorescent lamp range are the 20W and 40W having a production performance ratio of 42 : 58.

d) Reject rates

The state of the reject rate, according to the following calculation method, is as shown in Table AI-1-2-2 and Fig.AI-1-2-4.

reject rate (%) = (1 - A/B) X 100

where, A = finished superior lamp output, and
B = input volume of parts to line

Summing this up, the reject rate of the fluorescent lamp when the tube used is imported is 14.3%. Further, for the incandescent lamp when an imported bulb is used the reject rate is 10 to 15%. When the local bulb is used on the other hand the reject rate of the incandescent lamp is 40 to 50%.

The local bulb is extremely poor and has a reject rate of 10 to 15%. The lamp making process has some 30% reject rate. So, 30% of the imported parts become reject since of these only the cap can be re-used through manual operations.

e) Product items by line

As a rule, for the incandescent lamp A line handles 60 mm d items (60W, 100W), B Line 55 mm d (40W, 25W), and for the fluorescent lamp every two months the line alternates production of the 20W and 40W.

(2) Production processes

1) Table outlining the analysis of production processes

The analysis of production processes is as shown in Fig.AI-1-2-5.

2) Flow chart

The flow chart is as shown in Fig.AI-1-2-6. At present there is no problem, but when expansion of equipment is carried out in the future it will be necessary to re-consider the flow of production.

3) Problems and improvement of the operational procedures and process chains of the main finished products and parts

a) As the packaging of the FL bulb (imported) is sometimes delivered torn and soiled on arrival at the shop it is soaked in the water vat and placed in a vat of weak acid before going to the first process stage of cleaning, and this involves wasteful manual operations. This problem is due to the placing of parts outdoors at the mercy of rain for long periods instead of in the No.1 HI Store room (Warehouse) (refer to Fig.AI-1-2-7). Even if a thorough cleansing of the dirt and mud is achieved, glass quality is impaired and this increases the chance of damage during the sintering process. Serious consideration of the maintenance system is therefore required.

b) The completed incandescent lamp bulb is packed in the sack by hand because of the paper quality of the locally made packaging, previously mentioned.

c) There was neither a large number of intermediate products lying about, as is the case in a number of other shops, nor was there any problem as to imbalances between the capacities of the process chains.

4) Problems and improvements of operational procedures and division of labor

a) We can roughly divide questions relating to operations for the fluorescent and incandescent lamps into four main areas; preparatory making up of materials, lamp production lines, lamp lighting testing, and packaging operations.

1. Preparatory making up of materials

The materials are made up by specialist operators using specialized equipment, and operations involve producing reactions to a prescribed time schedule. At present there is no problem concerning the equipment.

2. Lamp production lines

The processing for the fluorescent lamp is integrated from the tube cleaning to aging.

Also, for the incandescent lamp production lines are integrated for processes from the frost treatment to lighting. Once line operations begin on this integrated line parts processing is continued at an even equal speed. Operators carry out the line input, conveyance, supervision, adjustment, and process line extending systematically and in step with this speed. A large number of the operators are experienced and skilled, and they almost never cause any breakdowns. One problem is that the breakdown of a machine at the center of the line causes a total stoppage and operations can not be resumed until repairs are completed. It is not possible to stop only the broken machine and stockpile the intermediate parts in progress. So, unless a 100% operating level is maintained through assurance of preventative maintenance and a sufficient stock of spare parts, a reduction of efficiency and product quality results.

Besides machine breakdowns, the exhaustion of material parts supplies, and the rest breaks between operations lead to a large reduction in efficiency and productivity, and are a cause for unreliability of product quality. On this point the present shop differs somewhat from others. As already mentioned in (1) 4) b) the equipment capacity has been set at a low level in anticipation of the above factors. However, this is a major element in future production increases. The essential point is that once production has been started it must continue until the specified time (for completion).

3. Lighting testing and packaging

These are manual operations without index guidelines, but the operators seem to be quite skilled.

4. Manual operations

As already stated in (1) 3), for the packaging for the incandescent lamp it is not possible to use an automatic packaging machine in the case of local packaging material. Further, as stated in (2) 3) a) cleaning operations for the fluorescent lamp tubes left out in the rain involve troublesome manual operations. This results in unnecessarily wasteful manual operations. Also, involved manual operations are required to enable the re-use of the caps of the domestically produced incandescent lamps which are found to be rejects either when inspected after the frost process (delustering) or as finished products. These are problems which can not be resolved by measures taken within the shop alone and need to be handled by the concerned staff.

5) Problems and improvements of equipment layout and material handling

The layout is straightforward and well planned and there is no problem in material handling.

When the fluorescent lamp line is expanded by one set the moving of the mercury lamp line somewhere else to enable this expansion could be considered.

When the incandescent lamp line is expanded by one set, this should be located at the central passage route, and it is necessary to consider moving the present incandescent lamp lines A and B a little further north or south.

6) Problems and improvements of the working equipment

Most of the equipment has been in operation for more than 20 years and deterioration is general. Two improvement measures are possible either replacement or through an overhaul with sufficient provision for necessary spare parts. However, it is necessary to make a specialist evaluation of the possible operating period if an overhaul using spare parts is carried out.

Machine list is as shown in Tables AI-1-2-3(1) to (6), and breakdown conditions are recorded at the time of inspection as shown in the list, Table AI-1-2-4.

Classification of equipment according to the degree of machine trouble is as follows:

1. Lack of spare parts, which has an adverse effect on yield (reject rate) and quality, but operations are somehow continued and the entire line equipment is concerned.

2. Spare parts not available, and production continues without that particular process function. In particular, the with the breakdown of measuring or adjustment devices operations are continued on intuition or by the operator's sense. This has an adverse effect on quality and the operating efficacy.

3. Equipment which no longer functions, and which is out of operation. Fortunately, production can somehow be achieved without this equipment, and so these are left insufficiently repaired. Further, considerable problems in product quality result.

4. At present there is no particular trouble, but in the event of some breakdown HIC is unable to find substitute equipment from another shop. As examples of equipment which has stopped production are the high vacuum pump, mercury diffusion pump, vacuum gauge, and the exhaust center bulb. It is therefore highly advisable to have

spare parts for these devices available.

Even after drawing up a list of spare parts, making the request for estimates, and receiving estimate prices from Japan the dispatch of orders takes place some 2 to 3 years later.

7) Problems and improvements of operating rates and line balancing

The equipment capacity of the lines, as mentioned in (1) 4) b), is esteemed by HIC to be 2,400,000 annually for the incandescent lamp, and 400,000 annually for the fluorescent lamp, but this is actually very low considering line speed and operating time given that there were no stoppages.

The causes of line stoppages and reduced operating rates are as follows:

1. Imported parts and materials out of stock

2. Occurrence of machine troubles because of a lack of spare hands on hand and insufficiency of preventative maintenance for equipment. As production is line production the occurrence of machine trouble in one area results in the stoppage of the entire equipment.

3. Occurrence of inoperative machine heads due to a shortage of spare parts on hand. For example, a machine with 48 heads can produce 48 lamps at one rotation. However, 2 inoperative heads will result in a 4% reduction of the operating rate.

   Therefore, provision of materials and parts in line with the production schedule is, of course, necessary. The most essential precondition is a continuing preventative maintenance system to ensure the normal operating of the lines through a sufficient supply of spare equipment parts.

   As to line balancing no problem has been observed.

8) Problems and improvements of raw materials and parts received.

Problems include the already mentioned soiling of imported fluorescent lamp tubes stored outside, and the quality and volume of local incandescent lamp tubes received. At the time of inspection, material parts and chemical compounds particularly sensitive to high temperatures and humidity were stored in orderly fashion in a low temperature room. However, it is necessary to seriously reconsider this storage system.

As mentioned in 1) 4) d) the domestically produced incandescent lamp has a reject rate of 40-50%, so that only half become lamps and this results in great waste of productive output, operating efficiency, product quality and some 30% of the imported material parts (refer to Table AI-1-2-2). Exhibition of the rejects is done on a shop level (Fig.AI-1-2-8). It would seem that contacts exist with bulb manufacturers but the reject rate has not been improved. Besides the question of quality, in 1987 only 700,000 units were delivered (some 50,000 per month). The reason for this extremely small delivery quantity was a shortage of fuel and spare parts on the bulb manufacturers side. So if rejects and deformed bulbs were to be returned this would lead to an even further reduction in lamp production.

A sample of domestically produced fluorescent bulbs were obtained and tested but proved to be completely reject. At present a re-evaluation should be made once the quality of the bulbs has been stabilized.

9) Problems and improvements of dispatch of finished products

As there is a shortage both of incandescent and fluorescent lamps, superior finished products for these are conveyed out of the shop and no problem exists.

(3) Analysis of product quality

1) Occurrence of rejects

a) Defective processing

For both the fluorescent and incandescent lamp processing a system of process management, through measurements on a sampling basis at specified times and appropriate action, has been implemented. We checked the data sheets for these and found that operations were carried out to specified norms. Only data sheets have been made up and management does not extend to the drawing of a control chart. However, production of a large number of rejects unnoticed or line stoppages due to the occurrence of some serious problem of product quality in mid processing stages do not occur. As already stated in (2) 6) 1. and 2. operations are continued in despite of breakdowns of equipment important to product quality or shortage of spare parts and this requires urgent attention and rectification.

Further, the rejects mentioned in (1) 4) d) often result from damage of the lamp or the condition or handling of equipment. Reject lamps in terms of quality which occur during the last process account for some 1-2%. However, the problem of the quality of domestically produced incandescent lamp bulbs is very serious.

b) Rejects of the completed lamps

At the final processing stage a lighting check of all units is carried out and then these are dispatched. Sampling inspection for initial performance and life tests are carried out separately. The galvanometer used as the device for testing has been broken for 2 or 3 years and so tests cannot be carried out.

c) Quality as a lamp (both the fluorescent and incandescent lamps)

External appearance: There are a large number which would not look acceptable. In particular the indications are poor and require improvement, as follows:

Dimensions: No particular problem.

Brightness: Because of breakdown of the measuring device measurements are not carried out. This is a serious problem.

Life span: Data from the life span tests indicates quite good performance.

Emphasis is given to the idea that a lamp which shines a long time is a good lamp, and it would seem that questions of brightness and external appearance are not regarded as having great importance.

Further, glass cracks in the domestically produced incandescent lamp have been known to develop during use, and it is feared that this may result in an increase in early problem points. It is also feared that lamps may have a short life span once marketed because of over brightness since they are not tested for brightness.

2) Improvement of product quality

As the quality of the bulb is a very large influence on the quality of the lamp, an early improvement in the quality of the incandescent lamp bulbs domestically produced in particular is urgently required. In order to increase the general level of quality it is necessary to resolve machine problems and to ensure the proper working of all line equipment through provision of spare parts.

3) Problems and improvements of quality standards and testing methods

There is no problem with the quality standards as such, but it is necessary to ensure the production of lamps which meet these standards.

As the galvanometer is broken it would be advisable to replace this with a digital type automatic testing device when the general modernization of measuring devices is undertaken. At the same time general re-consideration of other measuring devices should be made. Together with this it is necessary to provide for standard devices to ensure the lamp's particular brightness and vacuum level.

(4) Maintenance of the equipment and buildings

1) Problems and improvements of maintenance system

There is a maintenance section in the shop. This section possesses only one boring machine, one grinder and one vice as tooling machinery, and it is not possible to carry out delicate operations with this limited equipment. In contrast to other shops there are lines with special processes, and it is necessary to obtain the other simple metallurgical tools and machine tools, such as a lathe and miller, needed for the manufacture of and fixing of simple spare parts. There is sufficient space available for equipment. There is no problem with the buildings as such.

2) Repair performance

The main operations of a maintenance type currently carried out are the care of the vacuum pump and the fixture of imported spare parts to machinery. It would seem that even minor spare parts involve a request for manufacture to the machine shop. It is necessary to evaluate ways by which simple machine tooling can be done in the shop.

The equipment presently requiring maintenance is listed in Table AI-1-2-4.

3) Other points

The question of chemical treatment of waste liquids is completely ignored and waste water is eliminated by drains. It is necessary to consider the treatment of pollution in No.1 HI.

(5) Designing of finished products

The following improvements of current products are desirable:

Remodeling of the one current 38 mm diameter production line to that for a 28 mm diameter model would be advisable. Both the 38 mm and 28 mm diameter tubes meet the IEC and JIS standards but since the world tendency is to the 28 mm diameter tube and the ratio of production output is increasing.

Since the life span of the fluorescent lamp is long an early changeover to the 28 mm diameter tube is advantageous for the future. Since the fixture and socket are designed to allow interchangeability of both the 28 and 38 mm diameter tubes there will be no problems in use caused by the change in diameter specification.

It is not necessary to make any design modifications other than those for the change in diameter specification.

As the incandescent lamp is to IEC standard for the time being no design modifications are required. Further, since the voltage of the HIC lamps are 230 volts they do not correspond to the JIS (JIS is only for 100 volt use).

Diversification of the FL and IL product models should be considered after an increase in productivity has resulted in a sufficient supply of lamps to the market.

As a means of reaching and maintaining a level of product quality equal or superior to that of the advanced industrial countries the products are to be regularly sent to the designing countries and it is necessary to promptly establish a system for mutual confirmation as to whether or not the products currently produced are produced according to the initial product design.

Table AI-1-2-1 PRODUCTION RECORD OF FL LAMPS IN 1987

(Unit: pcs)

		FL20	FL40	Total
1987	January	-	25,760	25,760
	February	-	36,600	36,600
	March	33,840	-	33,840
	April	32,280	-	32,280
	May	-	51,160	51,160
	June	-	30,080	30,080
	July	40,000	-	40,000
	August	30,000	-	30,000
	September	10,020	24,760	34,780
	October	-	54,000	54,000
	November	10,020	32,960	42,980
	December	26,100	42,280	68,380
	Total	182,260	297,600	479,860
1988	January	600	51,280	51,880

Table AI-1-2-2 REJECT RATE OF BULB FOR IL/FL

For	Imported Bulb		Local Bulb	
IL	Total Rejected*1	n.a. (10-15%)	Total Received Total Rejected 1) Rejected at Unpacking Process 2) Rejected after Frosting of which: Broken Cracked	140,300 pcs 18,587 pcs (13.2%)*2 1,623 pcs (1.15%) 16,964 pcs (12.09%) 11,042 pcs 5,922 pcs
FL	Line Input Total Rejected 1) Line Reject 2) Reject at Inspection	5,219 pcs n.a. (14.3%)*3 643 pcs (12.3%) n.a. (2.0%)	Not Applicable	

Notes: *1 Excluding broken bulb in the unpacking process.
*2 Reject rate on Dec. 28, 1987.
*3 Reject rate on Feb. 10, 1988.
n.a. = not available

Table AI-1-2-3(1) LIST OF EQUIPMENT IN TROUBLE
- INCANDESCENT LAMP PLANT -

No.	Description of Machine	Description of Trouble
A, B 1	Frosting Machine	- Backlash in rotation meter. Lack of spare parts.
A, B 2	Drying Conveyor	- Thermometer is missing.
A, B 4	Flare Inspection Table	- Lack of spare parts for flare stem and carrier, burner mal-functioning, mal-alignment of the entire system.
A, B 5	Flare Machine	
A, B 6	Steming Machine	
A, B 8	Mount Mill	- Failure in inserter.
A, B 9	Sealing Machine	- Bulb holder failed.
A, B 10	Exhausting Machine	- Questionable diameter matching of exhaust tube and rubber hose.
A, B 11	Marking Apparatus	- Less faulty than FL.
A, B 12	Cement Filler	- Cement extruder.
A, B 13	Basing Machine	- Flashing device is missing.
A, B 16	Basing M/C Control Panel	- Flashing does not work.

Notes: A: 1st Line
B: 2nd Line

Table A1-1-2-3(2) LIST OF EQUIPMENT IN TROUBLE
- FLUORESCENT LAMP PLANT -

No.	Description of Machine	Description of Trouble
F, G 6	Dryer	- Lack of bulb holder.
F, G 7	Washing Machine	- Lack of bulb holder.
F, G 8	Flare Machine	- Foot tube mis-aligned, inspection table glass broken.
F, G 9	Steming Machine	- Troubles on lead wire feader, burner, stem holder, stem mover, stem carrier and the entire alignment.
F, G 13	Cement Filler	- Failures in shaft and jig.
F, G 14	Sintering Unit	- Thermocolour is used in place of thermometer.
F, G 16	Sealing Machine	
F, G 17	Exhusting Machine	- Heater is cut frequently, pumps spares needed, voltage control on distributor does not work, leakage test detector is missing.
F, G 18	Basing Machine	- Burner condition is poor.
F, G 23	Pumps for Exhausting M/C	- No spare is available.
F, G 24	Control Panel for Exhausting	- Voltage control for heater on distributor does not work.

Notes: F: 1st Line
G: 2nd Line

Table AI-1-2-3(3) LIST OF EQUIPMENT IN TROUBLE
- MERCURY LAMP PLANT -

	No.	Description of Machine	Description of Trouble
H	1	Washing Apparatus	- Air regulator valve does not work.
H	2	Drier	
H	3	Coating Apparatus	
H	4	Ball Mill	
H	5	Baking Machine	
H	6	Marking Apparatus	
H	7	Wipper	
H	8	Sealing Machine	
H	9	Annealer	
H	10	Mount Chuter	
H	11	Exhausting Machine	
H	12	Soldering Apparatus	
H	13	Bashing Machine	
H	16	Flare Inspecting Table	
H	17	Stem Lead Bender	
H	18	Stem Etching Tub	
H	19	Stem Drying Box	
H	20	Mount Working Table	
H	21	Seating Press	
H	22	Ignition Voltage Messure	
H	23	Reducing Furnace	
H	24	Parts Charging Box	
H	25	Packing Table	
H	26	Luminous	
H	27	Life Test Rack	
H	28	Voltage Regulater	
H	29	Filling Gas Pressure Messure	
H	30	Torsion Tester	
H	31	Hight Gauge	
H	41	Flare Machine	
H	42	Steming Machine	
H	43	Mount Machine	

Table Al-1-2-3(4) LIST OF EQUIPMENT IN TROUBLE
- PRIMOVER ROOM -

	No.	Description of Machine	Description of Trouble
L	1	Life Test Controller	-Time switch failure
M	1	Electric Grinding Machine	
M	2	Working Table	
M	3	Electric Drill Machine	
M	4	Vacuum Test Machine	
P	1	Air Cooling Unit	-Out of service due to failure
P	2	Blower	
P	3	Blower	
P	4	Vacuum Pump	
P	5	Vacuum Pump	
P	6	Air Compressor	
P	8	Control Pannel	
P	9	Air Receiver	
O	1	Oxygen Supply Device	
O	2	Oxygen Receiver	

Table AI-1-2-3(5) LIST OF EQUIPMENT IN TROUBLE
- QUALITY CONTROL -

	No.	Description of Machine	Description of Trouble
Q	1	Sphere	
Q	2	Measuring Table for IL & FL	-Galvamometer failure
Q	4	Stabilizer	
Q	5	IL Gas Pressure Measurement	
Q	6	IL Gas Pressure Measurement	
Q	7	Emitter Grop Test	
Q	8	V-GS Tester	
Q	9	FL Gas Pressure Measurement	
Q	10	Torque Test Tester	

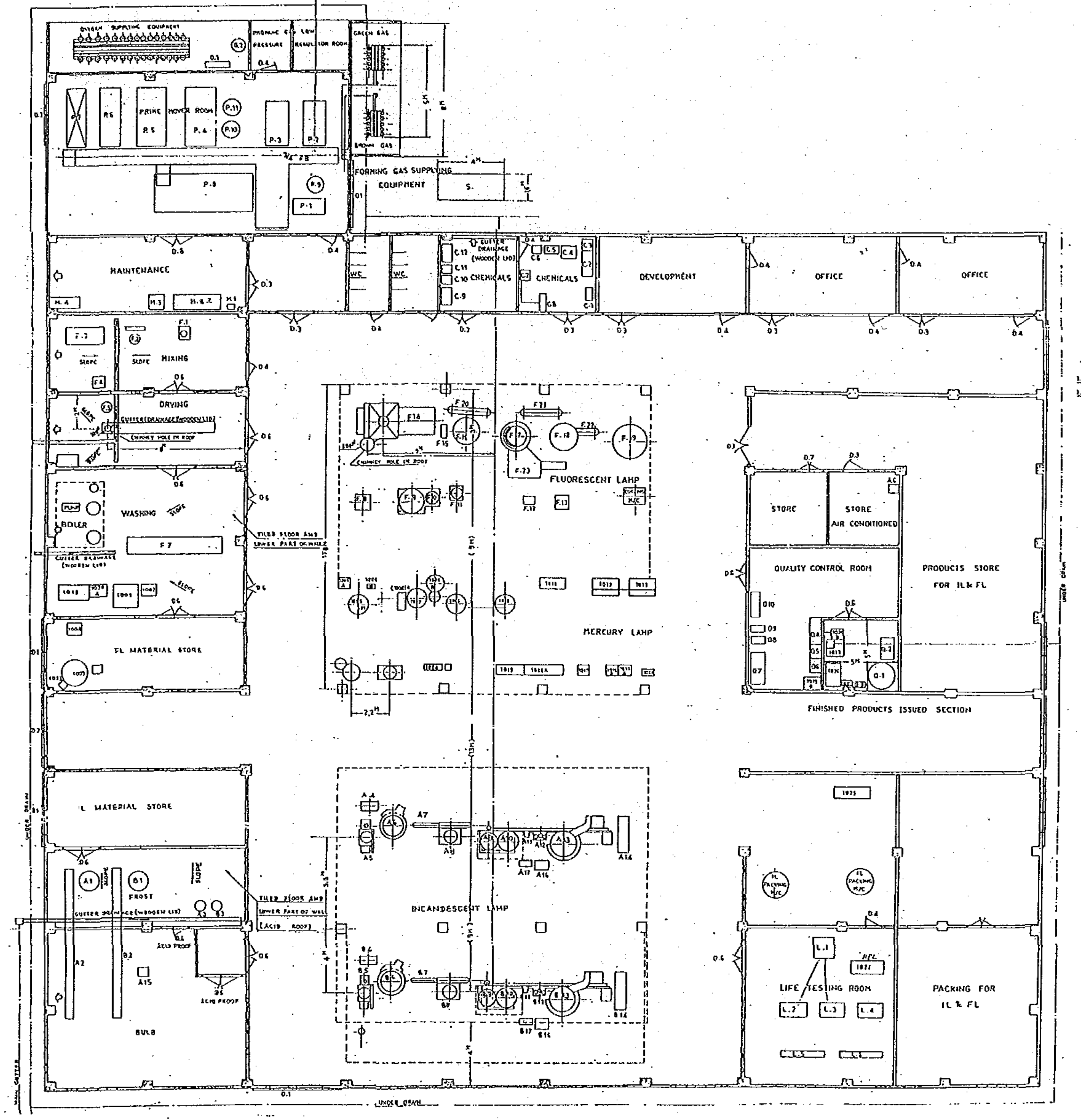
Table AI-1-2-3(6) LIST OF EQUIPMENT IN TROUBLE
- CHEMICAL ROOM -

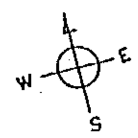
	No.	Description of Machine	Description of Trouble
C	1	Shaker	
C	2	Getter Spraying	
C	3	Coil Inspection Table	
C	4	Shaker	
C	5	Shaker	
C	6	Heater Box	
C	7	Water Purification Apparatus	-Deteriorated to be renewed
C	8	Distiller Apparatus for Mercury	-2 sets out of 4 are wrong
C	9	Cappine Cement Mixer (Big)	
C	10	Cappine Cement Mixer (Small)	
C	11	Cappine Cement Mixer (Small)	
C	12	Cappine Cement Mixer (Big)	

Table AI-1-2-4 LIST OF EQUIPMENT DETERIORATED OR OUT OF SERVICE

No.	Machine or Equipment	Present Condition	Action Required
A16	Flashing Frame	- Flashing system is missing.	To be replaced.
B16	Flashing Frame	- Flashing system is missing.	To be replaced.
C7	Water Purification Apparatus	- Deterioration.	To be replaced.
C8	Distiller Apparatus Mercury	- 2 sets of 4 sets deteriorated.	To be replaced.
Q2	Measuring Table	- Galvanometer is out of service.	To be replaced.
L1	Life Test Control Box	- On-off for FL does not function (failure of time-switch).	To be replaced.
P1	Air Cooling Unit	- Out of service due to failure.	To be repaired or replaced.
P7	Air Compressor	- Being used for another service.	To be procured.
1001	Washing Apparatus for ML Bulb	- Air regulating valve in failure.	To be replaced.
F12	Exhaust Control Box FL	- Voltage regulation on distributor does not work.	To be repaired or replaced.
F17	Exhaust Machine	- Leakage test detector is missing.	To be replaced.
F15	Marking Unit for FL Sealing	- Operation is poor.	To be replaced.

Figure AI-1-2-1(1) LAYOUT OF LAMP MANUFACTURING PLANT, NO.1 HI





PRIMOVER ROOM

SR No	NOMENCLATURE	REMARK
H-1	ELECTRIC GRINDING MACHINE	
H-2	WORKING TABLE	
H-3	ELECTRIC DRILL MACHINE	
H-4	VACUUM TEST MACHINE	
P-1	AIR COOLING UNIT	
P-2	BLOWER	
P-3	BLOWER	
P-4	VACUUM PUMP	
P-5	VACUUM PUMP	
P-6	AIR COMPRESSOR	
P-8	CONTROL PANNEL	
P-9	AIR RECEIVER	
O-1	OXYGEN SUPPLY DEVICE	
O-2	OXYGEN RECEIVER	

Figure AI-1-2-1(2) LAYOUT OF LAMP MANUFACTURING PLANT, NO.1 HI

IL GROUP (1)

Sr.No	NOMENCLATURE	REMARK
A-1	FROSTING MACHINE	
A-2	BULB DRYING CONVEYOR	
A-3	FROSTING STOCK LIQUID TANK	
A-4	FLARE INSPECTION TABLE	
A-5	FLARE MACHINE	
A-6	STEM MACHINE	
A-7	STEM CONVEYOR	
A-8	MOUNTING MACHINE	
A-9	SEALING MACHINE	
A-10	EXHAUST MACHINE	
A-11	MARKING UNIT	
A-12	CAP FILLER MACHINE	
A-13	CAPPING MACHINE	
A-14	BURNING FRAME	
A-16	FLASHING FRAME	
A-17	FILLING GAS UNIT	

IL GROUP (2)

Sr.No	NOMENCLATURE	REMARK
B-1	FROSTING MACHINE	
B-2	BULB DRYING CONVEYOR	
B-3	FROSTING STOCK LIQUID TANK	
B-4	FLARE INSPECTION TABLE	
B-5	FLARE MACHINE	
B-6	STEM MACHINE	
B-7	STEM CONVEYOR	
B-8	MOUNTING MACHINE	
B-9	SEALING MACHINE	
B-10	EXHAUST MACHINE	
B-11	MARKING UNIT	
B-12	CAP FILLER MACHINE	
B-13	CAPPING MACHINE	
B-14	BURNING MACHINE	
B-16	FLASHING FRAME	
B-17	FILLING GAS UNIT	

FL LINE

Sr.No	NOMENCLATURE	REMARK
F-1	NITROCELLULOSE MIXER	
F-2	SOLUTION MIXER	
F-3	BALL MILL	
F-4	COATING VESSEL PREPARATION.	
F-5	COATING MACHINE	
F-6	GLASS TUBE POWDER DRYING CONVEYOR	
F-7	CLEAR BULB WASHING MACHINE.	
F-8	FLARE MACHINE.	
F-9	STEM MACHINE.	
F-10	ANNEALING MACHINE.	
F-11	MOUNT MACHINE.	
F-12		
F-13	CAP FILLER MACHINE.	
F-14	SINTERING MACHINE.	
F-15	WIPPING MACHINE	
F-16	SEALING MACHINE	
F-17	EXHAUST MACHINE.	
F-18	CAPPING MACHINE.	
F-19	AGING MACHINE.	
F-20	SEALING CONVEYOR	
F-21	EXHAUST CONVEYOR.	
F-22	CAPPING CONVEYOR.	
F-23	EXHAUST PUMPS.	

QUALITY CONTROL

SR. No	NOMENCLATURE	REMARK
Q.1	SPHERE	
Q.2	MEASURING TABLE FOR IL & FL	
Q.3	STABILIZER	
Q.5	IL GAS PRESSURE MEASUREMENT	
Q.6	IL GAS PRESSURE MEASUREMENT	
Q.7	EMITTER DROP. TEST	
Q.8	V-GS TESTER	
Q.9	FL GAS PRESSURE MEASUREMENT	
Q.10	TORQUE TEST TESTER	
Q.I		

H.P.L

S.No	NOMENCLATURE	REMARK
1001	BULB WASHING UNIT	
1002	BULB DRYING INSTALLATION	
1003	BULB COATING & DRYING MACHINE	
1004	SWITCH BOX	
1005	ROTARY SINTERING FURNACE	
1006A	SINGLE WIPPING UNIT	
1006B	HAND MARKING UNIT	
1007	SEALING MACHINE	
1008A	MOUNT CHUTE	
1008B	SEALING ANNEALER	
1009	PUMPING MACHINE	
1010	CAPPING MACHINE	
1011	SOLDERING UNIT	
1012	AGING MACHINE (HP - 125W)	
1013	AGING MACHINE (HF - 150 & 400W)	
1014	FLARE INSPECTION TABLE	
1015	SPOT WELDER	
1016A	STEM BENDING APPARATUS	
1016B	SHEETING PRESS	
1017	REDUCTION FURNACE	
1018	STEM ETCHING APPRATUS	
1019A	IGNITION TEST APPARATUS	
1019B	GAS PRESSURE MEASUREMENT	
1020A	STEM HEATER BOX	
1020B	METERS	
1022	MEASURING TABLE	
1023	MEASURING BOX	
1021	LIFE TEST FRAME	

CHEMICAL ROOM

SR. No	NOMENCLATURE	REMARK
C1	SHAKER	
C2	GETTER SPRAYING	
C3	COIL INSPECTION TABLE	
C4	SHAKER	
C5	SHAKER	
C6	HEATER BOX	
C7	WATER PURIFICATION APPARATUS	
C8	DISTILLER APPARATUS FOR MERCURY	
C9	CAPPING CEMENT. MIXER (BIG)	
C10	" " " (SMALL)	
C11	" " " (")	
C12	" " " (BIG)	

Figure AI-1-2-2 ORGANIZATION OF IL/FL MANUFACTURING PLANT

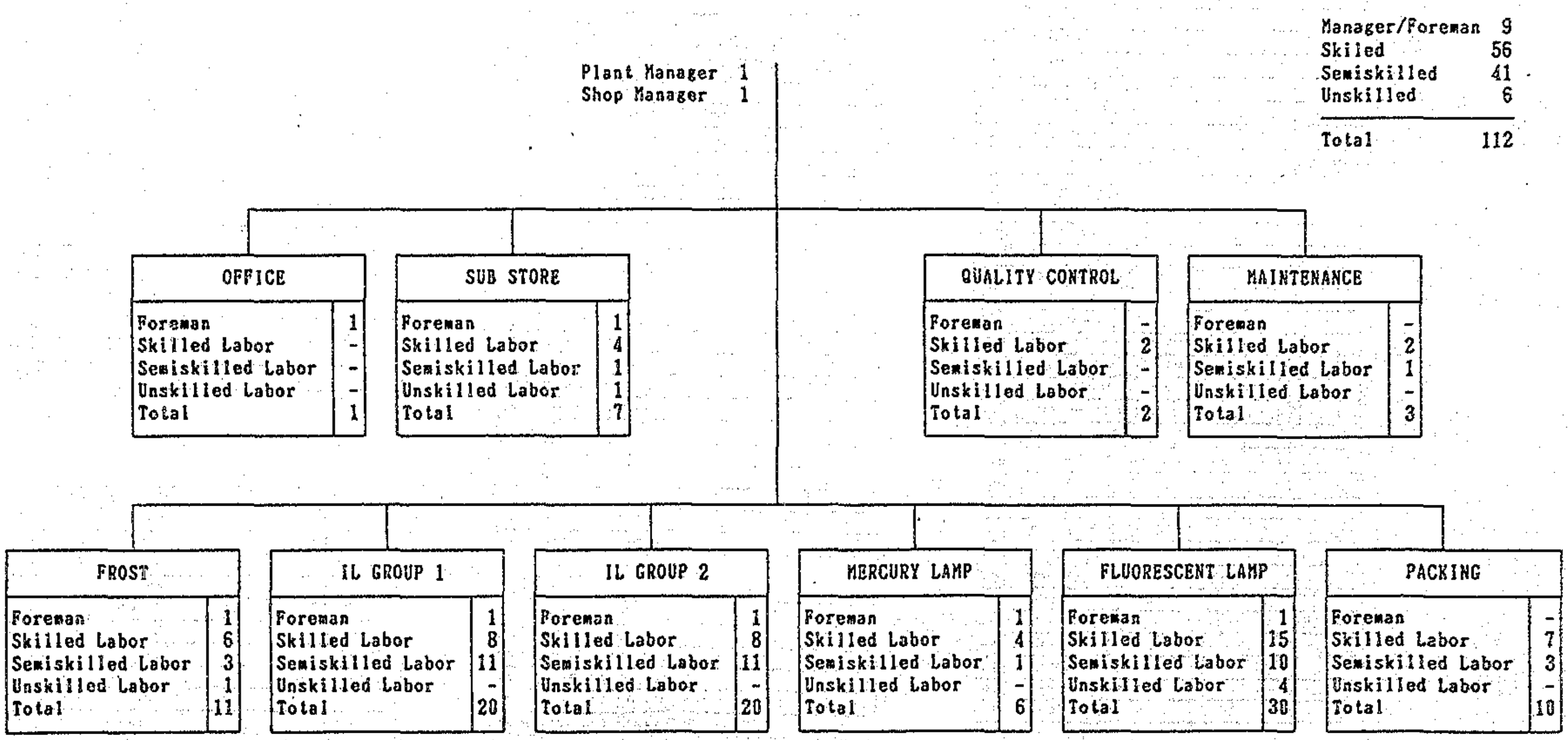


Figure AI-1-2-3(1)   ACTUAL AND PLANNED PRODUCTION OF ELECTRIC BULBS (1)

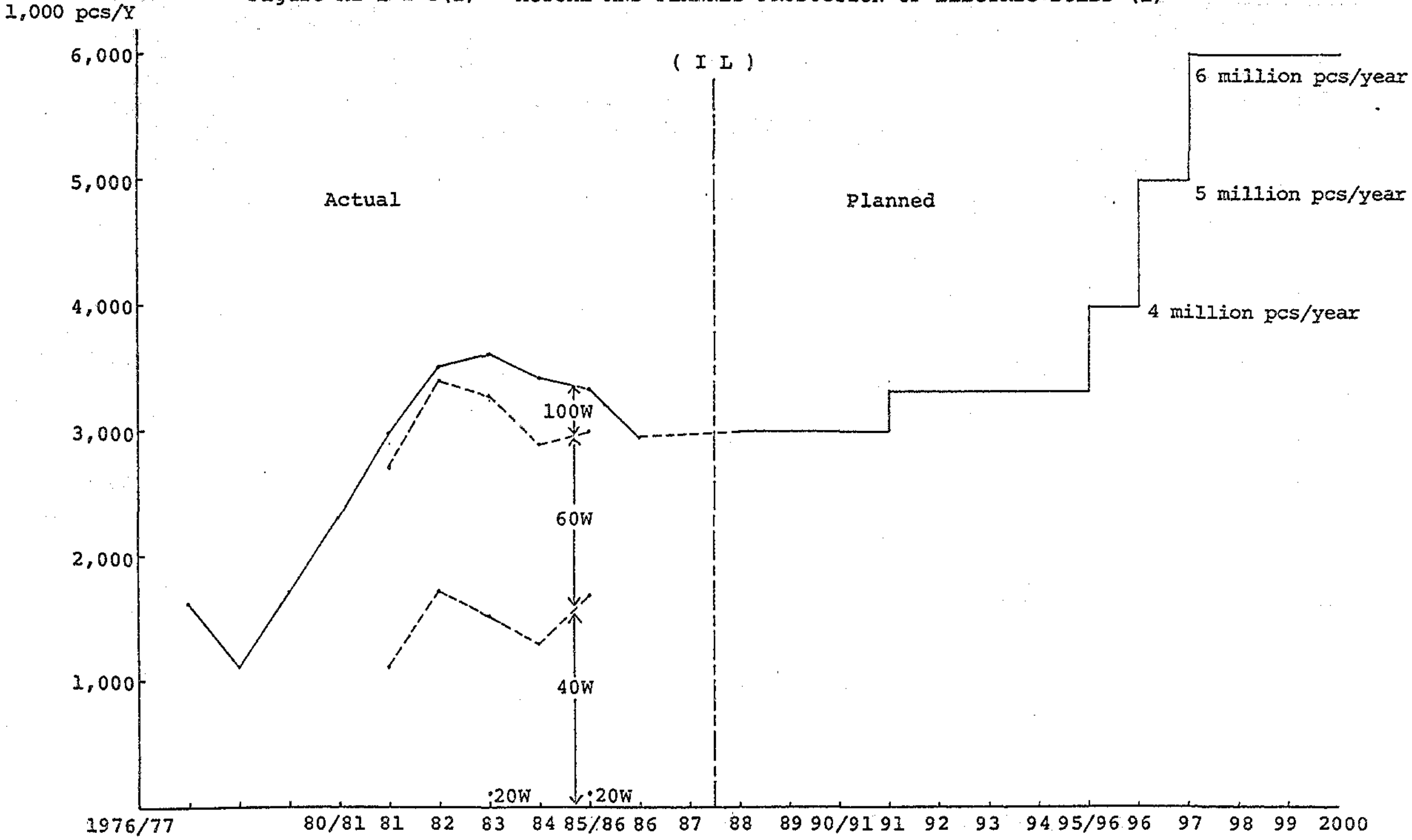


Figure AI-1-2-3(2) ACTUAL AND PLANNED PRODUCTION OF ELECTRIC BULBS (2)

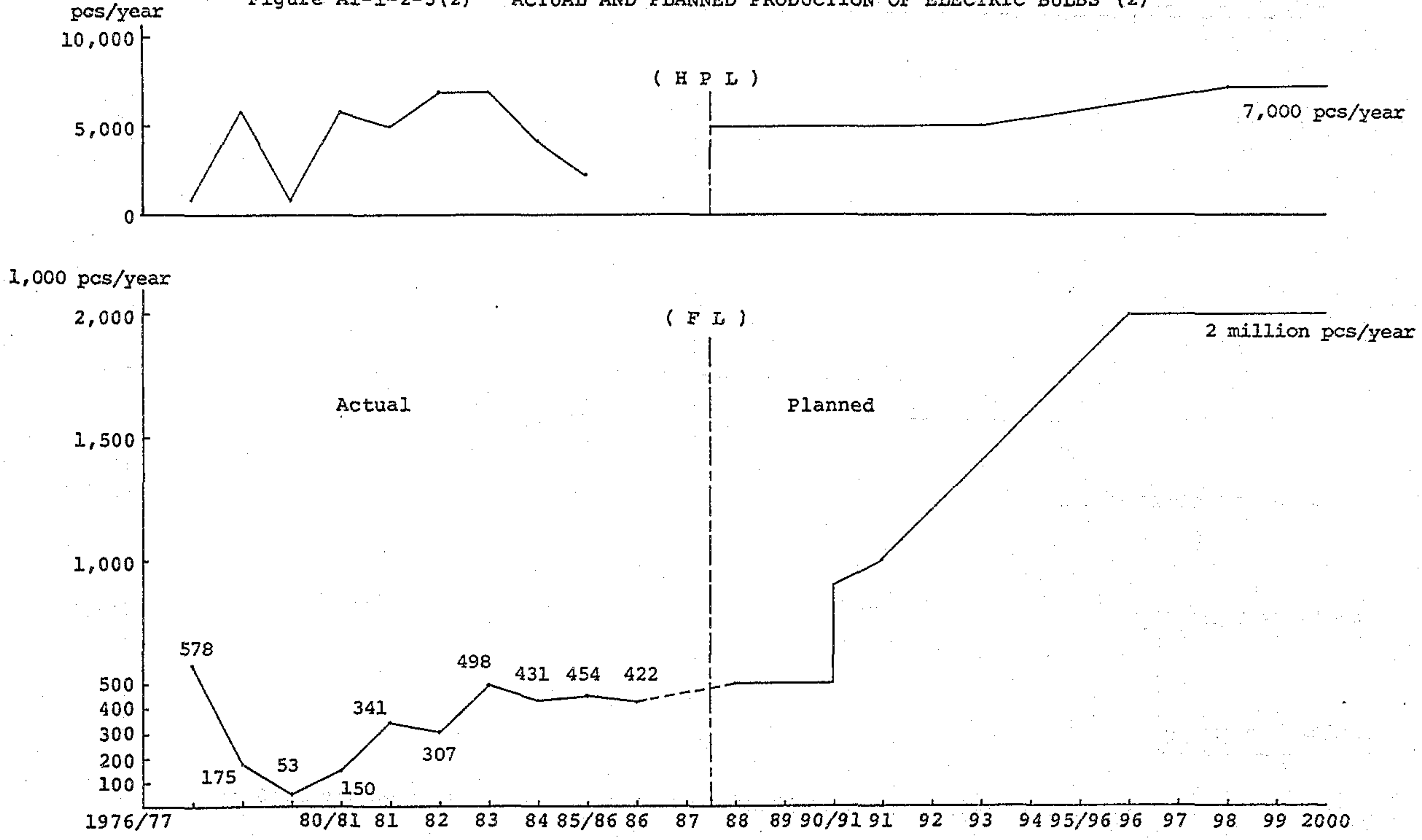


Figure AI-1-2-4 REJECTED PARTS AT LAMP MAKING LINE

Total Rejected Parts Received 18,587 pcs (13.2%) (A)

Line Input 7,877 pcs

- Sealing Process Reject 1,091 pcs (13.85%)
  - Sealing Hole
  - Bulb Broken
  - Lamp Damage
- Exhaust Process Reject 574 pcs (7.29%)
  - Lamp Damage
  - Leakage
- Capping Process Reject 94 pcs (1.19%)
- Burning Process Reject 653 pcs (8.29%)
  - Leakage
  - Filament Touch

Finished Lamp 5,465 pcs (Output) (69.37%)

Total Line Reject 2,412 pcs (30.6%) (B)

Total Reject (A)+(B) 43.8%

Notes: Total rejected rate in December 1987: 40-50%
Total rejected rate of imported bulb: 10-15%

Figure AI-1-2-5(1) MANUFACTURING FLOW CHART OF INCANDESCENT LAMP

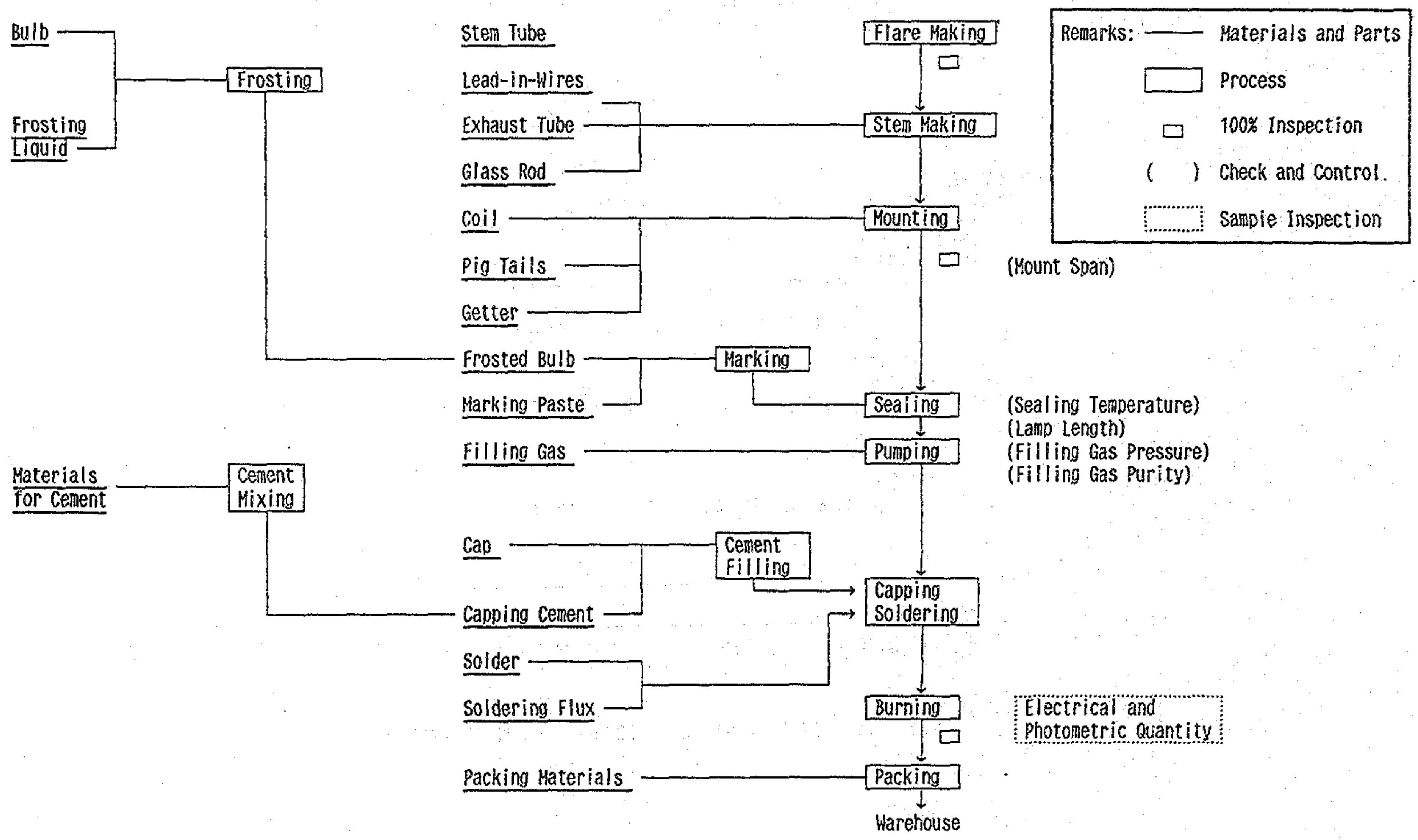


Figure AI-1-2-5(2)   MANUFACTURING FLOW CHART OF FLUORESCENT LAMP

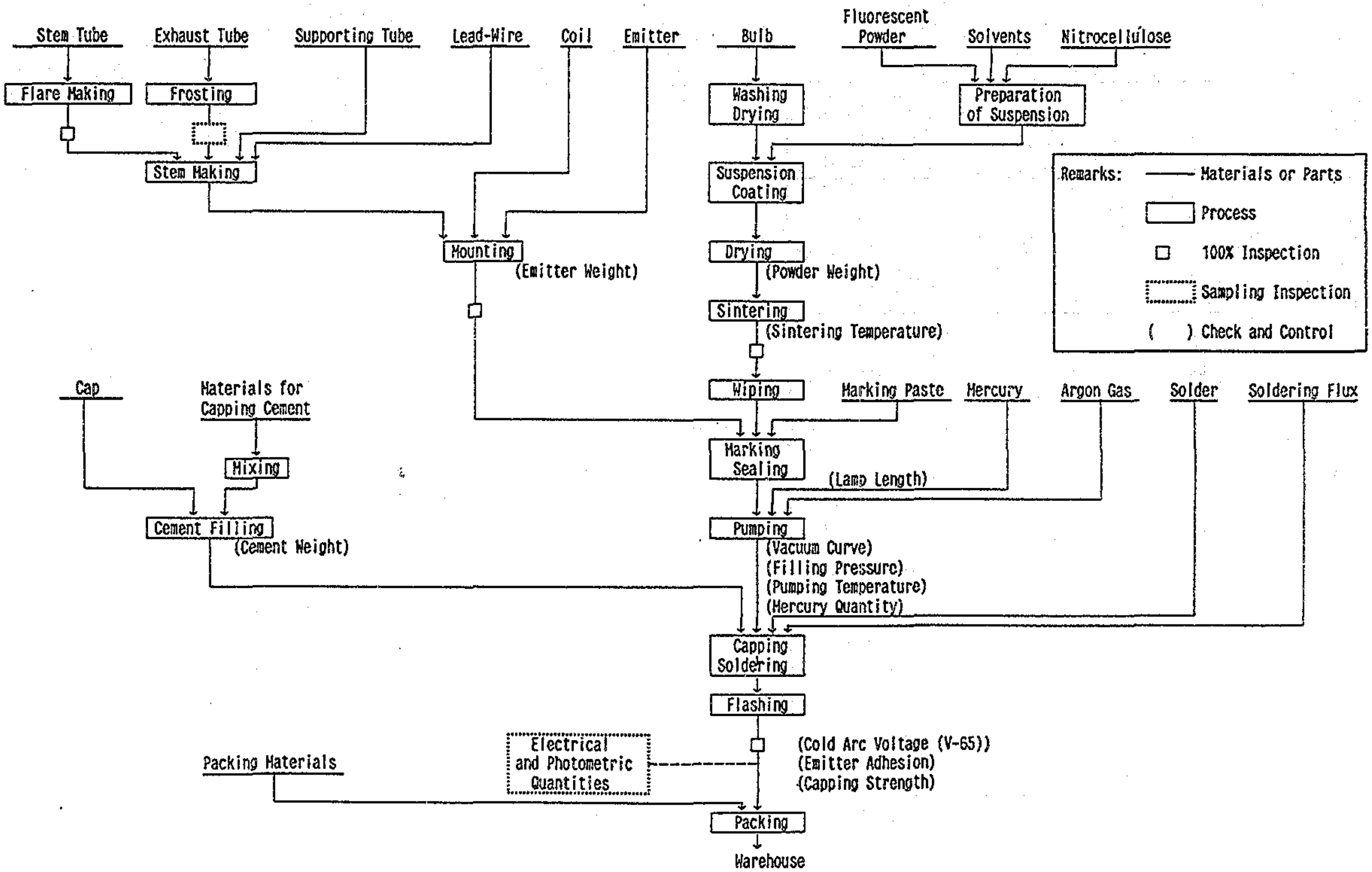


Figure AI-1-2-6 OUTLINE WORK FLOW CHART

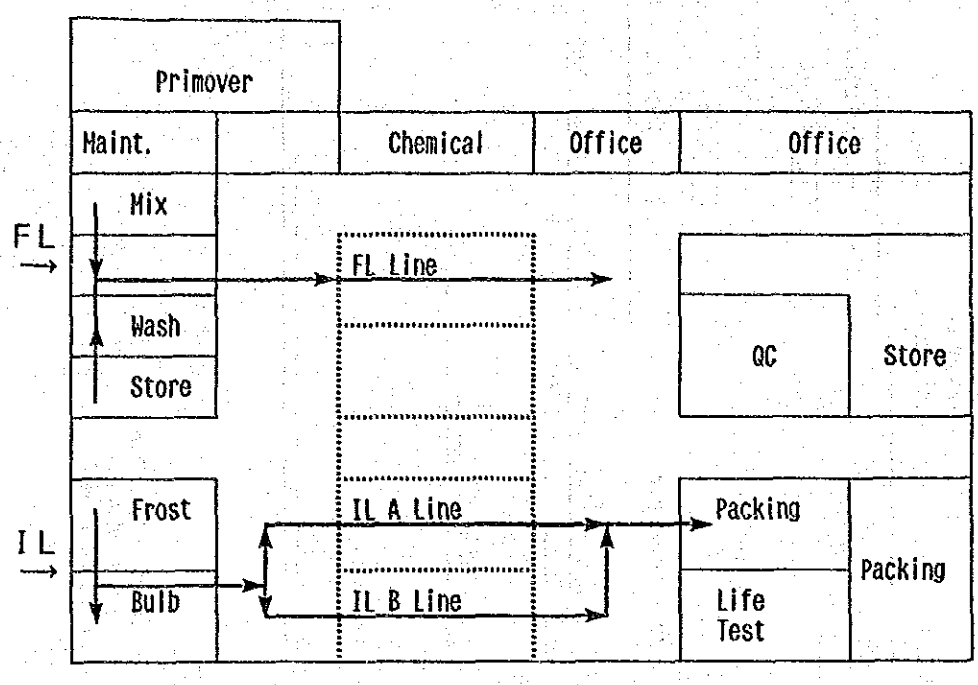
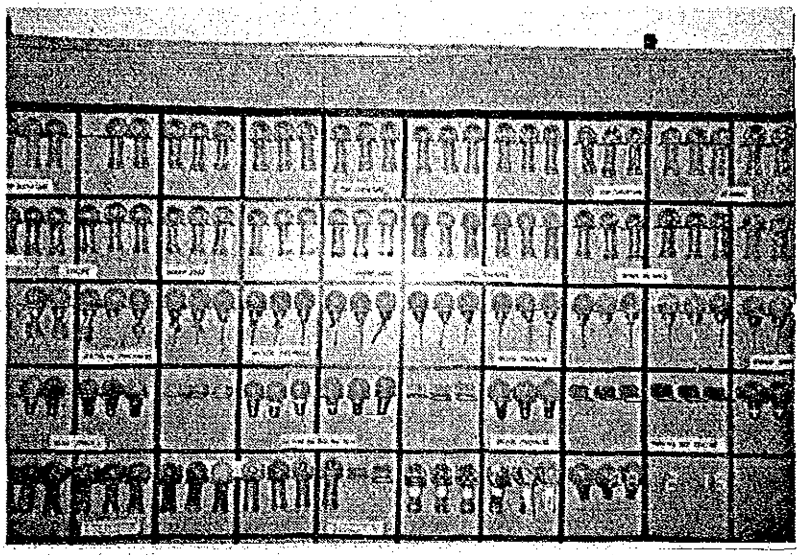


Figure AI-1-2-7 DEMONSTRATION OF ACTUAL REJECTS OF LOCAL IL BULB



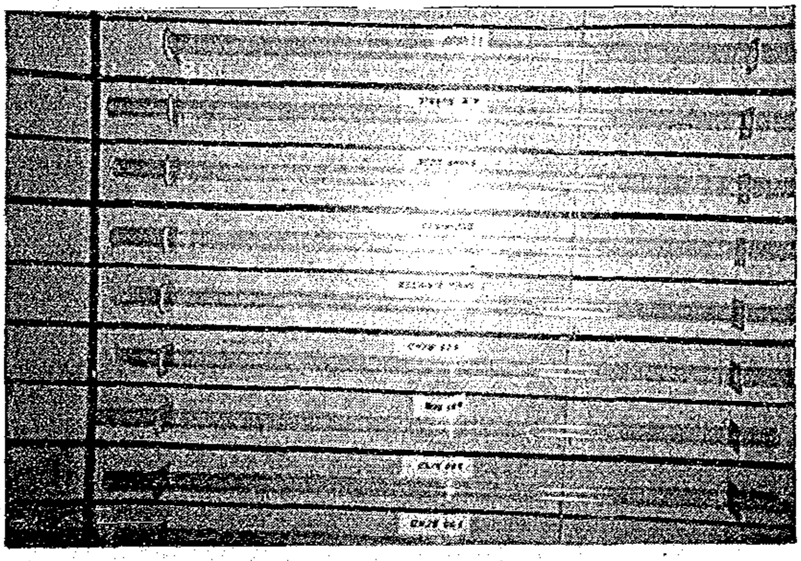
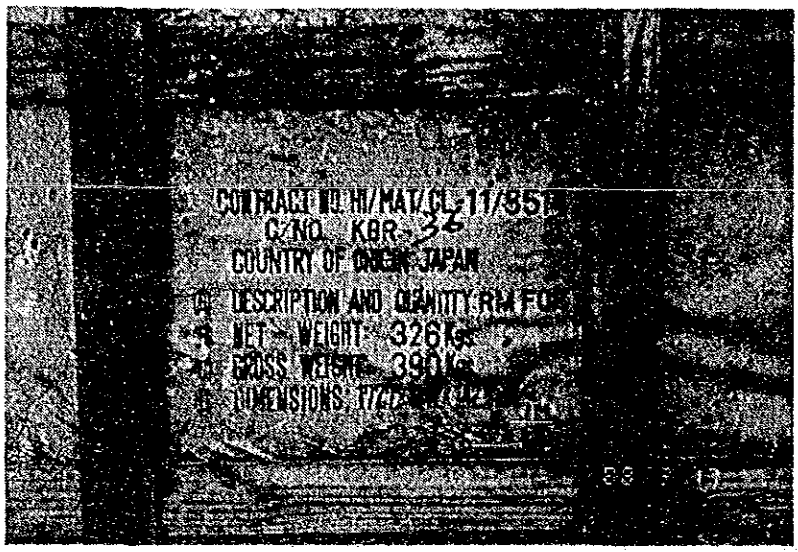
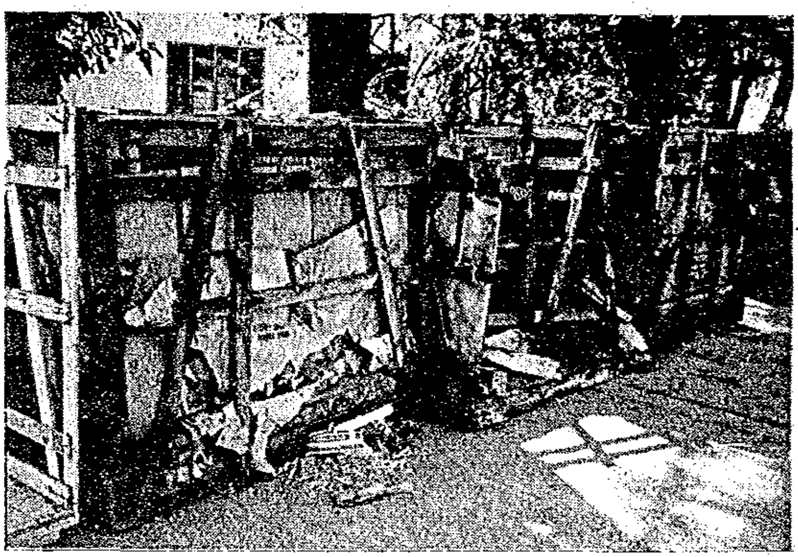


Figure AI-1-2-8 DEMONSTRATION OF SPOILED AND DAMAGED IMPORTED FL TUBE DUE TO POOR STORAGE AT WAREHOUSE





1-3 Dry Battery Plant

1-3-1 Outline of Production Processes

(1) Layout of working equipment

The layout of working equipment is indicated on Fig.AI-1-3-1.

The processes arranged are as follows:

1. Tamping to sealing process for UM-1H (Old line)
2. Tamping to sealing process for UM-1H (New line)
3. Tamping to sealing process for UM-2H
4. Tamping to sealing process for UM-3P
5. Finishing process for UM-1H (Old line)
6. Finishing process for UM-1H (New line)
7. Finishing process for UM-2H
8. Finishing process for UM-3P
9. Inner jacket making process
10. Outer jacket making process
11. Mixing and electrolyte process
12. Py-sealing injection process
13. Zinc pellet making process
14. Component parts making process
15. Zinc can making process
16. Plastic container making process

Note: The plastic container (16.) is a product for use with agricultural machinery.

The UM-1H old line has been in operation since 1967, and the new line since 1973. The old line is generally deteriorated and the question of replacement has been raised several times.

(2) Organization and personnel arrangement

The organization of the dry battery plant is shown on Fig.AI-1-3-2.

The three Plant Managers are each in charge of administration of one of the following groups:

In charge of Group A:

Py-sealing Injection
Container (for agricultural use)
Zinc Pellet and Zinc Can
Component Press
Office

In charge of Group B:

Mixing and electrolyte
Outer Jacket
Inner Jacket
Raw Material Store
Sub-store and Spare Parts Store

In charge of Group C:

Individual Assembly Lines of UM-1H, UM-2H and UM-3P
Packing
Maintenance and Boiler

There is no organization table available but there are some 10 or so personnel here from the Inspection Dept. and 4 to 5 members of personnel in charge of the Service Shop.

(3) Supply of raw materials and parts

Of parts in use the carbon rod and cap are imported from Japan.

For the following items only materials are imported from Japan and these are then processed in Burma: bottom insulator, guide paper, red ring, top plate, zinc can, outer jacket, inner jacket, and py-sealing.

Changeover to local supply of all packaging materials and parts for the display box has been completed.

All raw materials such as magnesium dioxide, etc. are imported.

Dispatch of orders is generally done at the beginning of the fiscal year (April-May) taking into account remaining stock.

Deliveries usually take 2-3 months in the case of some lots payment is extended over several installments.

(4) Production performance

Table AI-1-3-1 shows performance for a recent five year period. UM-1 is the main line making up for 95% of total production.

It is supposed that the large reduction evident for the period Apr.'86 to Mar'87 was due to constraint on funding margins in order to assure a supply of raw materials together with the influence of fuel conditions.

The number of operating days for No.1 HI (cf. Table AI-1-3-2) by each line in 1987 were as follows:

Operating days for UM-1H Old line (Tamping to sealing)	133 DAYS
Operating days for UM-1H New line (Tamping to sealing)	151 DAYS
Operating days for UM-1H Old line (Finishing)	151 DAYS
Operating days for UM-1H New line (Finishing)	53 DAYS

The above results indicate that line operation takes place only 5-13 days per month.

1-3-2 Analysis of Production Processing

(1) Outline analysis of processing

This is shown in Fig.AI-1-3-3 and Table AI-1-3-3. The various titles for each section of the dry cell are indicated in Fig.AI-1-3-4.

(2) Problems of operational methods and process chains

Consideration of the following headings is necessary:

1) Zinc pellet process

1. Zinc melting: it is necessary to examine renewal of the burner which would accompany fuel conversion.

2. Casting (pouring into mold): reinforcement for operations to keep the metal mold in horizontal position.

3. Rolling operation: countermeasures against flapping of roller.

4. Pellet punching: supplement and anti-friction of metal mold.

5. Smearing of lubricant: relocation to outbuildings to prevent noise, pollution and soiling.

2) Zinc can process

Consideration of the following headings is necessary:

1. Impact extruding: It is necessary to examine the supplement of sufficient metal molds.

2. Trimming: It is necessary to examine the conversion from outer to inner edge trimming machines.

The new specifications would require the addition of production processes but as a result finished products of a finer quality could be expected.

3) Other components

Not only are the containers such as the outer jacket, py sealing, zinc can, etc., inappropriate, they also usually run the danger of deformation and soiling. Also with regard to other components the containers, arranging shelves, and conveyance means must be strengthened and improved, and a shift to more efficient and programmed material handling needs to be made.

(3) Problems of production methods and division of labor system

The py-sealing and zinc pellets have been supplied to No.2 HI by No.1 HI. As of last year it became possible for No.2 HI to manufacture its own zinc pellets, but py-sealing is still supplied from No.1 HI.

If the installation of M/C in No.2 HI for py-sealing use takes place hereafter provision of components by No.1 HI could completely be phased out.

(4) Problems of layout and conveyance

As can be seen from Fig.AI-1-3-5 and AI-1-3-6, the R/M and C/P pass in and out of the sub-store via the narrow factory route.

As the entrance side of the sub-store gate is at present closed to access, times for entry and exit are limited. A thorough overhaul of material handling, expansion of the factory entry and exit gate, and enlargement of routes need to be examined.

As a dry battery is a chemical product the factory floor surface is particularly liable to damage and soiling. The present factory has a sunken floor on the far side from the gate, and so it is difficult to keep machinery and equipment as installed in a horizontal position.

The factory floor surface needs to be restored to a horizontal surface. And those parts susceptible to damage by soiling must be coated.

(5) Problems of working equipment

Equipment out of order is as follows:

1. Component Making 15ton Press (DB-126-D.: Under repair.

2. Zinc pellet making 40ton Press (DB-132-C): To be excluded from equipment.

3. Zinc pellet making 40ton Press (DB-133-B): Under repair.

4. Pellet barrel mixer (DB-121) (DB-134) : Presently planned for relocation outside.

5. Zinc can making Horizontal Press (DB-116A) and (DB-116B): Numerous problems in the last 4-5 years. Normally one machine under repair.

6. Compressor station (DB-145) and (DB-146) : Under repair.

The production level of the working equipment at the dry battery plant is high, reaching 100% operating rates as far as material supplies permit. As repairs lag behind schedule fundamental countermeasures are required.

1-3-3 Analysis of Products Quality

(1) Occurrence of rejects

The reasons for the occurrence of rejects in the zinc can process are shown below. In particular Nos. 6 and 7 are by direct sensory check by operators without measuring devices.

1. short can (can so short there is no cutting allowance)
2. bent (can bent)
3. tin bottom (bottom of can very thin)
4. spiral (trimming at a slanted angle)
5. flash (can was split)
6. dirty can (can soiled)
7. dirty pellet (soiled pellet)

Machinery which is responsible for the occurrence of rejects on the assembly line are as follows:

tamping M/C
guide paper
bobbin inserting
visual inspection
curling M/C
py sealing
capping
red ring M/C

The headings and contents of inspections made by inspectors on loan from the Inspection Department are listed on Table AI-1-3-4.

(2) Analysis of relation with preceding processes

If each individual component of the dry cell is appropriately completed then a superior article can be finally assembled almost without relation to preceding processes.

However, there is a problem of the water constituent in the combined materials (mix). But if the mix is prepared according to the specifications laid down in the operating manual and supervision of environment and conditions takes place until the dry cell is assembled it should not be affected by conditions of temperature or humidity.

Discharge characteristics of dry cell are measured by Inspection Dept. personnel noted in 1-3-1(2) and the records are maintained. Tables 1-3-7(1) to (4) indicate the typical discharge curves of dry cells which are acceptable.

At present, however, when defective dry cells (characterized by extreme discharge) are identified there is no feedback to the Production Dept. with the present system so that a confirmation inspection of that particular lot cannot be carried out.

It is necessary to follow up with confirmation inspections based on feedback reports.

(3) Problems of quality control criteria and inspection method

It is necessary to confirm that the direct sensory inspections carried out by operators and the performance inspections carried out by inspectors are correctly undertaken. For this an observer inspection and comparison of data is required. At present, such a system is not employed. It is expected that arrangements for mutual confirmation by regular dispatch of finished products to the manufacturers will be implemented soon. In the long term implementation of product quality control methods on a par with those of the advanced industrial nations are necessary.

Table AI-1-3-1 PRODUCTION OF DRY BATTERIES IN THE LAST 5 YEARS

(Unit: pcs)

	UM-1H	%	UM-2H	%	UM-3H	%
82/4 - 83/3	20,923,286	97.1	180,528	0.8	438,073	2.0
83/4 - 84/3	20,403,692	96.2	539,328	2.5	265,800	1.3
84/4 - 85/3	18,177,316	96.1	205,752	1.1	530,700	2.8
85/4 - 86/3	19,120,865	97.3	176,160	0.9	344,424	1.8
86/4 - 87/3	13,436,290	94.4	285,198	2.0	510,216	3.6

Table AI-1-3-2 PRODUCTION AND REJECTION OF DRY BATTERY, UM-1H

Jan., to Dec., 1987 (Unit: pcs)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
UM-1H Old Line (Tamping to Sealing)													
Operated Days	8	10	10	13	15	11	14	9	12	10	14	7	133
Q'ty Produced	305,422	297,170	374,338	448,196	631,940	244,800	494,040	394,216	324,631		472,750	205,375	4,526,505
Q'ty Rejected	10,633	10,639	10,459	13,407	19,268	8,966	16,560	10,837	12,370	10,933	16,891	7,402	148,365
UM-1H New Line (Tamping to Sealing)													
Operated Days	12	9	7	13	6	18	17	16	14	13	9	17	151
Q'ty Produced	344,738	301,080	268,953	500,363	265,798	644,354	601,332	619,920	491,212	483,068	298,413	607,496	5,426,727
Q'ty Rejected	10,763	9,851	6,958	16,005	7,098	19,869	17,807	16,317	14,180	19,886	9,013	15,087	62,834
UM-1H Old Line (Finishing Line)													
Operated Days	12	10	16	8	15	9	15	14	17	9	12	14	151
Q'ty Produced	460,056	405,216	663,505	335,016	745,859	480,504	849,585	734,715	854,211	434,834	559,768	778,152	7,301,321
Q'ty Rejected	2,859	709	1,721	519	3,349	4,055	7,602	2,566	4,368	1,618			34,370
UM-1H New Line (Finishing Line)													
Operated Days	10	5	7	3	10	7	-	-	-	4	2	5	53
Q'ty Produced	221,920	164,256	245,039	128,424	461,533	325,080	-	-	-	171,486	67,464	46,752	1,831,954
Q'ty Rejected	1,496	668	1,306	446	5,712	2,873	-	-	-	758	417	588	14,254

Table Al-1-3-3 PROCESS CHART OF DRY BATTERY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1 Zinc Pellet	1	2,5				3									4																		
2 Zinc Can		1					2								3					4		4											
3 PY Sealing	1	2,6		3	4										5											7							
4 Red Ring	1	2,6	3					4							5												7						
5 Bottom Plate	1	2,6	3					4							5															7			
6 Top Plate	1	2,6	3					4					7		5																		
7 Guide Paper	1	2,6	3					4							5				7														
8 Bottom Insulator	1	2,6	3					4							5						7												
9 Inner Jacket	1	2									3		4	6	5														7				
10 Outer Jacket	1	2							3	4		5	6	8	7														9				
11 Carbon Rod	1	2																3															
12 Natural Manganese Dioxide	1	2															3	4															
13 Acetylene Black	1	2															3	4															
14 Ammonium Chloride	1	2														3				4													
15 Zinc Chloride	1	2														3				4													
16 Zinc Oxide	1	2														3	4																
17 Zinc Powder	1	2														3	4																
18 Corn Starch & as Starch	1	2														3				4													
19 Aqua Ammonia	1	2														3				4													
20 Mercuric Chloride	1	2														3				4													
21 Powder	1	2														3				4													
22 Wax	1	2																					3										
23 Paraffin	1	2																						3									
24 Blown Asphalt	1	2										3																					

Note: 1: Main Store 2: Sub Store 3: Press R/H Area 4: Material Pre-Heating
5: Injection Section 6: Zinc Pallet Section 7: Zinc Can Section 8: Punching Press Section
9: Sheet Metal Area 10: Slitting Section 11: Paper Pipe Making Section 12: Metal Jacket Making Section
13: Outer Jacket Assembly 14: Outer Jacket Stock Area 15: Inspection 16: Electrolyte & Paste Prep.
17: Mixing Process 18: Tamping Process 19: Guide Paper Sticking 20: Paste Pouring
21: Bottom Insulator Inserting 22: Bobbin Inserting 23: Cooking & Cooling 24: Wax Pouring
25: Paraffin Coating 26: PY Sealing Inserting 27: Red Ring Inserting 28: Capping
29: Outer Jacket Sheating 30: Bottom Plate Inserting 31: Final Inspection 32: Packing
33: Manufacture Store

Table AI-1-3-4 CHECKING POINTS OF INSPECTION DEPARTMENT - DRY BATTERY PLANT -

Process	Measurement				
	Item	No.	Sampling	Chart	Control Limits
Zinc Can	Height	5	4 times/day	L, S-R	5.25 + 0.3mm
Zinc Can	Wall Thickness	5	4 times/day	L, S-R	0.85 + 0.05mm
Zinc Can	Bottom Thickness	5	4 times/day	L, S-R	0.57 + 0.15mm
Inner Jacket	Rim Curled Height	5	4 times/day	L, S-R	59.4 + 0.2mm
Outer Jacket	Top Inner Diameter	5	4 times/day	L, S-R	26.7 + 0.2mm
Outer Jacket	Rim Curled Height	5	4 times/day	L, S-R	57.9 + 0.2mm
Tamping	Bobbin Diameter	5	4 times/day	L, S-R	25.9 + 0.5mm
Tamping	Bobbin Shoulder Height	5	4 times/day	L, S-R	40.0 + 0.5mm
Tamping	Bobbin Over-all Height	5	4 times/day	L, S-R	57.0 + 0.15mm
Tamping	Bobbin Weight	5	4 times/day	L, S-R	40.0gm
Sealing	Zinc Can Curled Rim Inner Diameter	5	4 times/day	L, S-R	28.0 + 0.15mm
Sealing	Carbon Rod Protruding Height	5	4 times/day	L, S-R	4.1 + 0.6mm
Sealing	PY Shoulder Height	5	4 times/day	L, S-R	54.0 + 0.2mm
Sealing	Over All Height	5	4 times/day	L, S-R	59.7 + 0.2mm
Cooking	Paste Weight	5	4 times/day	L, S-R	8.4gm
Cooking	Wax Weight	5	4 times/day	L, S-R	0.55gm
Finishing	Over-all Height	5	4 times/day	L, S-R	60.3 + 0.3mm
Finishing	Shoulder Height	5	4 times/day	L, S-R	56.0 + 0.15mm

Figure AI-1-3-1 MACHINE LAYOUT FOR DRY-BATTERY PLANT, RANGOON

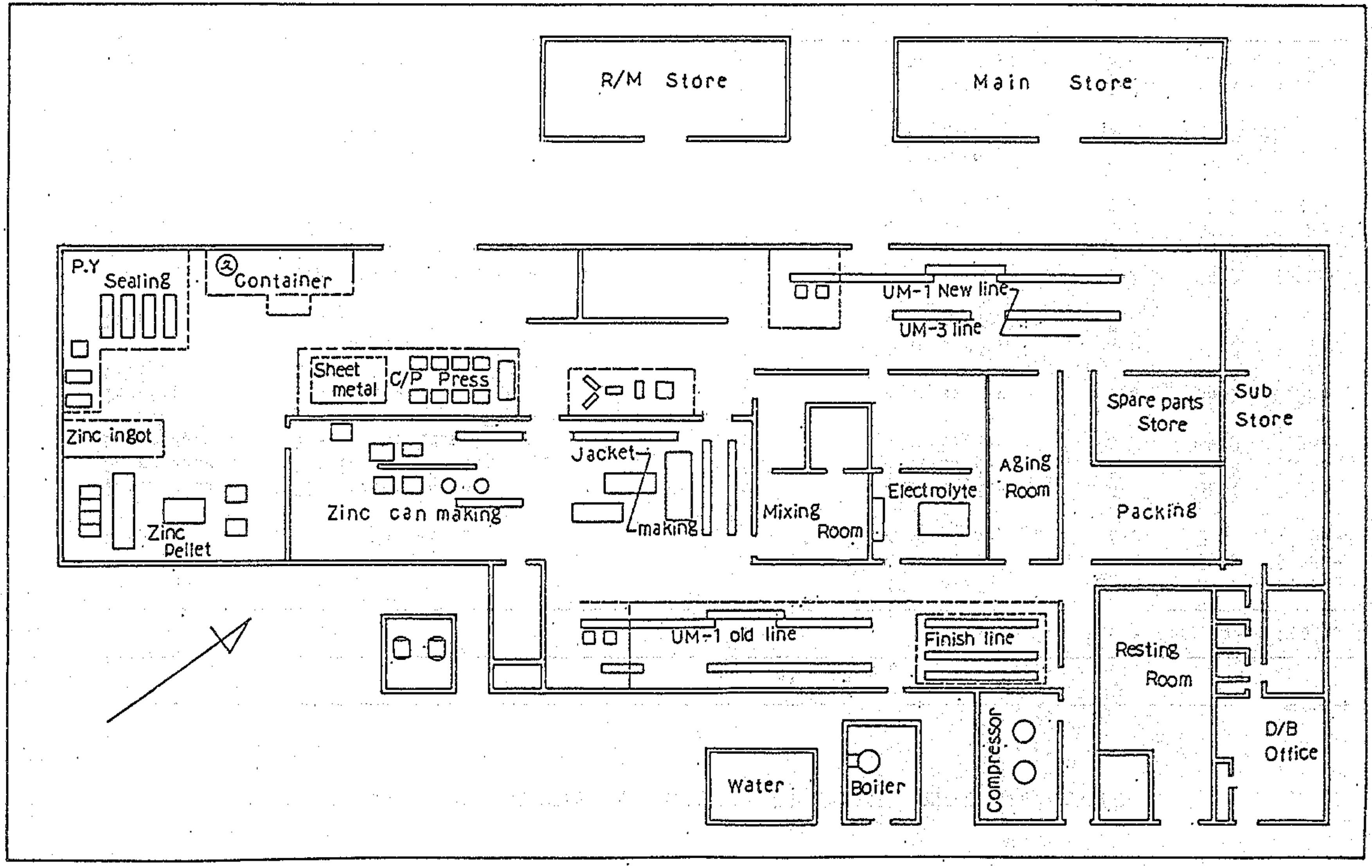


Figure AI-1-3-2 ORGANIZATION OF DRY BATTERY PLANT

OFFICE	
FOREMAN	–
SKILLED LABOUR	5
SEMI-SKILLED LABOUR	3
UN-SKILLED LABOUR	–
TOTAL	8

MATAINENCE & BOILER	
FOREMAN	–
SKILLED LABOUR	4
SEMI-SKILLED LABOUR	4
UN-SKILLED LABOUR	2
TOTAL	10

ZINC PELLET	
FOREMAN	–
SKILLED LABOUR	3
SEMI-SKILLED LABOUR	3
UN-SKILLED LABOUR	14
TOTAL	20

ZINC CAN	
FOREMAN	–
SKILLED LABOUR	9
SEMI-SKILLED LABOUR	2
UN-SKILLED LABOUR	3
TOTAL	14

PRESS	
FOREMAN	1
SKILLED LABOUR	5
SEMI-SKILLED LABOUR	7
UN-SKILLED LABOUR	9
TOTAL	22

P. Y. SEALING	
FOREMAN	1
SKILLED LABOUR	2
SEMI-SKILLED LABOUR	6
UN-SKILLED LABOUR	5
TOTAL	14

SUB STORE	
FOREMAN	–
SKILLED LABOUR	5
SEMI-SKILLED LABOUR	7
UN-SKILLED LABOUR	2
TOTAL	14

SPARE PARTS STOR	
FOREMAN	1
SKILLED LABOUR	2
SEMI-SKILLED LABOUR	1
UN-SKILLED LABOUR	1
TOTAL	5

JACKET	
FOREMAN	1
SKILLED LABOUR	22
SEMI-SKILLED LABOUR	10
UN-SKILLED LABOUR	7
TOTAL	40

MIXING & ELECTROLYIE	
FOREMAN	–
SKILLED LABOUR	3
SEMI-SKILLED LABOUR	5
UN-SKILLED LABOUR	1
TOTAL	9

UM-1H TAMPING TO SEALING	
FOREMAN	1
SKILLED LABOUR	17
SEMI-SKILLED LABOUR	15
UN-SKILLED LABOUR	28
TOTAL	61

UM-1H FINISHING	
FOREMAN	–
SKILLED LABOUR	16
SEMI-SKILLED LABOUR	5
UN-SKILLED LABOUR	5
TOTAL	26

UM-2,3. TAMPING~SEALING	
FOREMAN	–
SKILLED LABOUR	5
SEMI-SKILLED LABOUR	7
UN-SKILLED LABOUR	3
TOTAL	15

UM-2,3.FINISHING&PACKING	
FOREMAN	–
SKILLED LABOUR	5
SEMI-SKILLED LABOUR	12
UN-SKILLED LABOUR	8
TOTAL	25

Figure AI-1-3-3 PROCESS CHART FOR UM-1H ASSEMBLY LINE

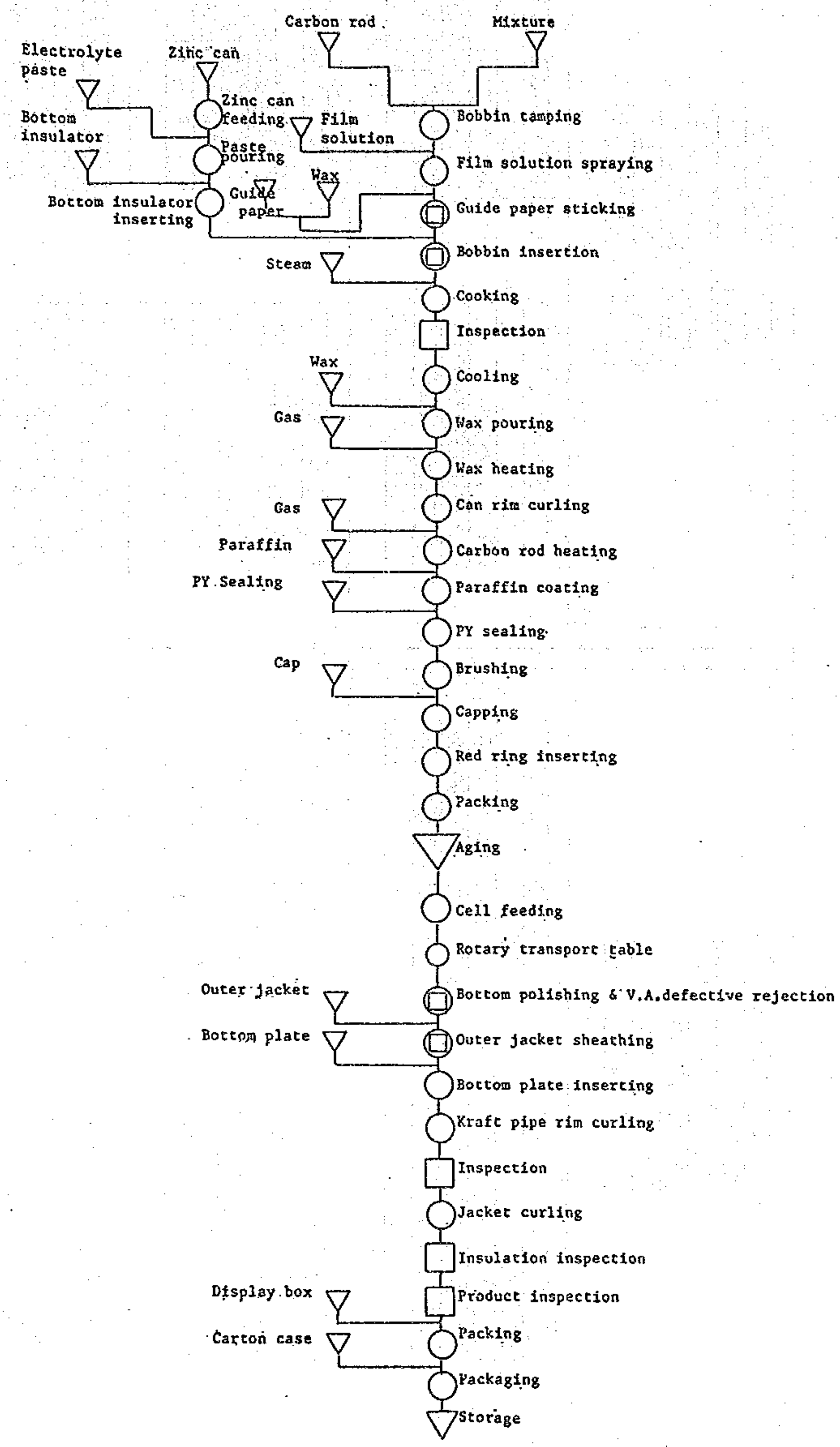
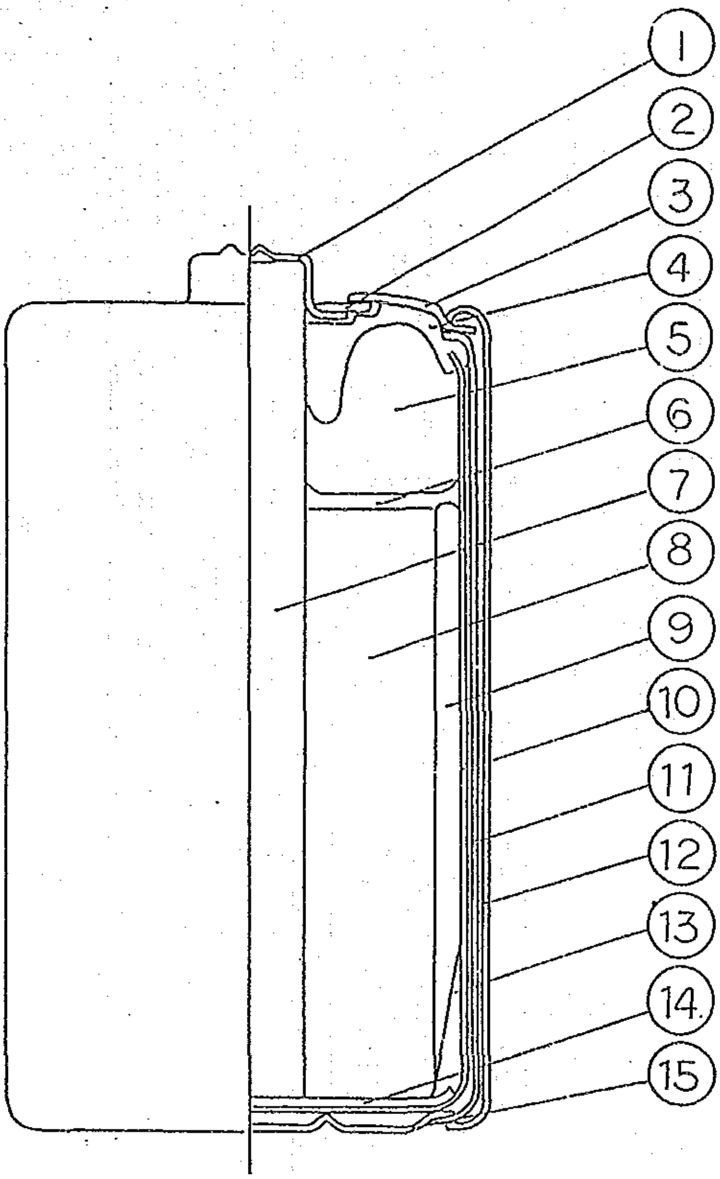


Figure AI-1-3-4 CONSTRUCTION OF UM-1 (R20) (PX-KRAFT SEALING TYPE)



1	Cap
2	Red Ring
3	Top Plate
4	PY Sealing
5	Air Space
6	Wax
7	Carbon Rod
8	Tamped Bobbin
9	Electrolyte
10	Zinc Can
11	Inner Jacket
12	Metal Jacket
13	Guide Paper
14	Bottom Insulator
15	Bottom Plate

Figure AI-1-3-5 FLOW CHART OF ZINC AND ZINC CAN

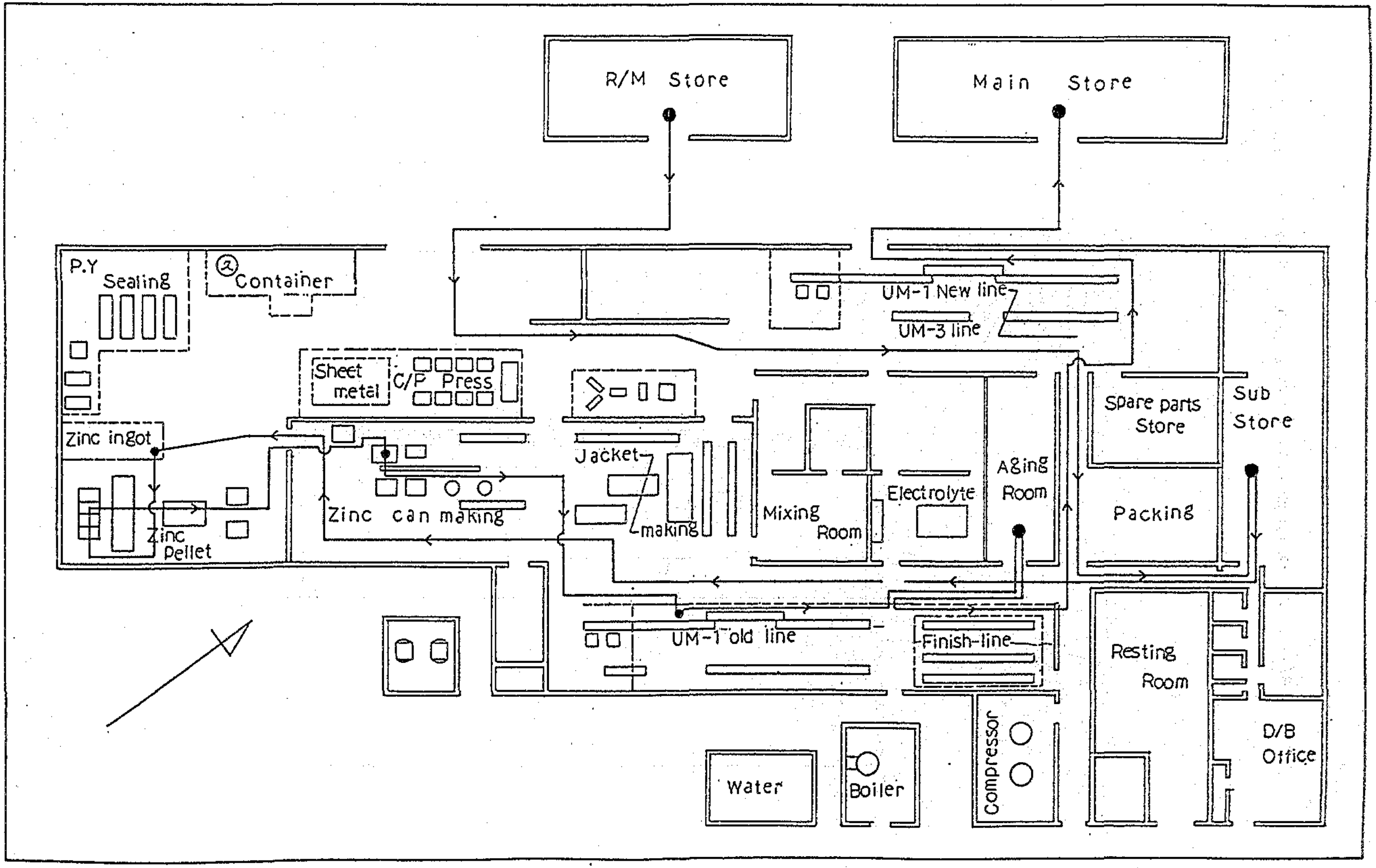


Figure AI-1-3-6 FLOW CHART OF STEEL SHEET/OUTER JACKET

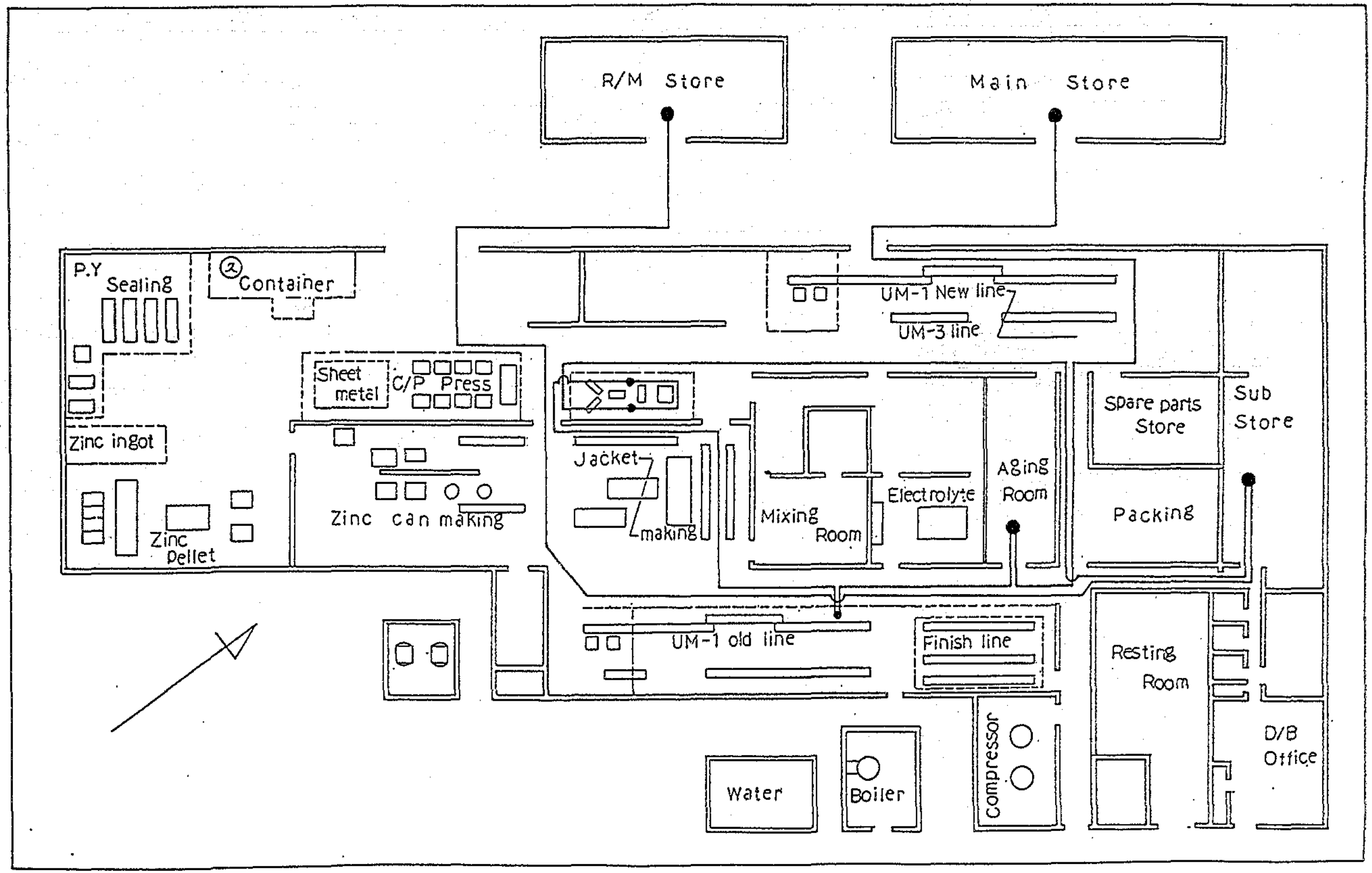


Figure AI-1-3-7(1) DISCHARGE CURVE FOR D/C BATTERY

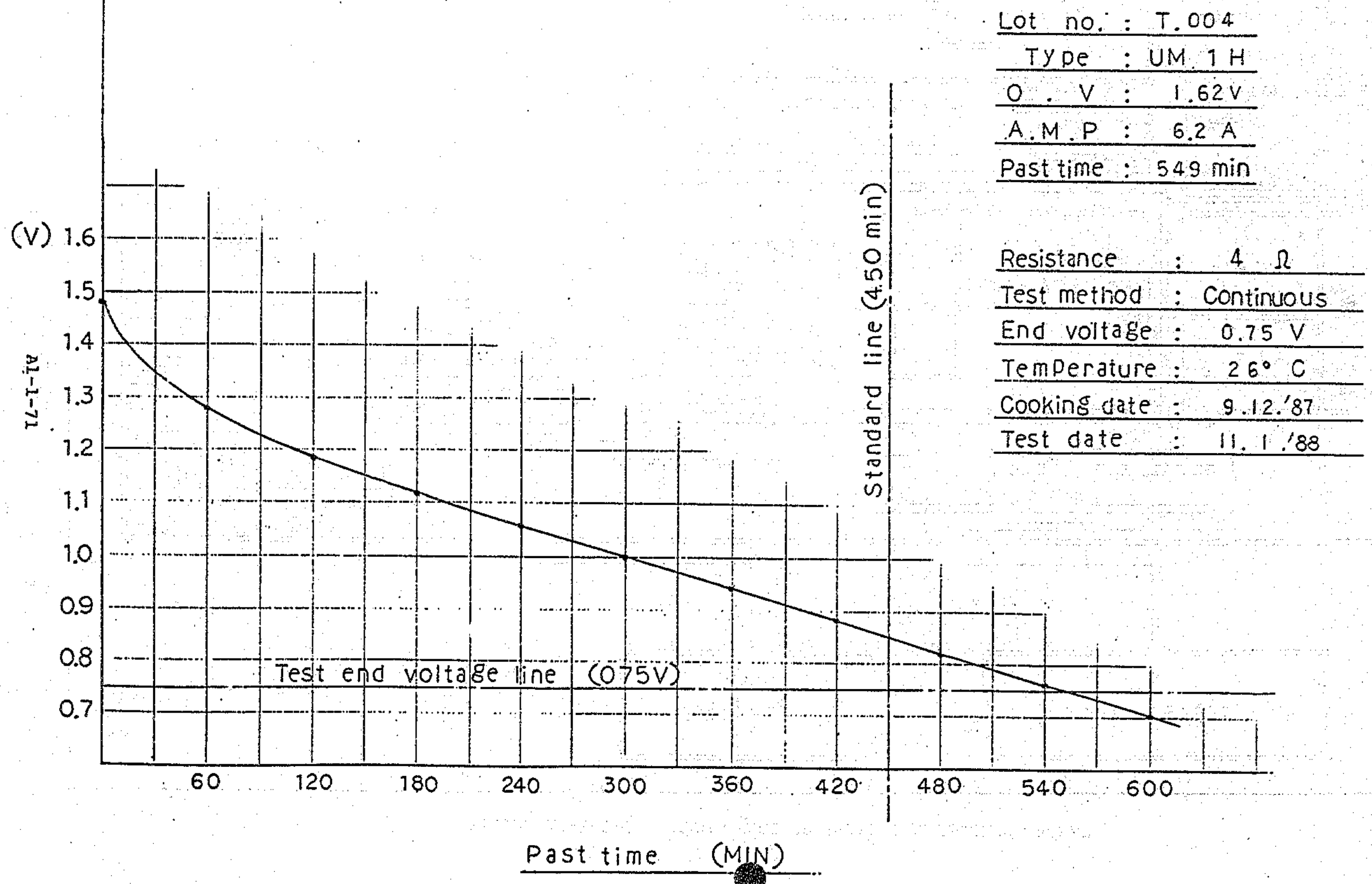


Figure AI-1-3-7(2) DISCHARGE CURVE FOR D/C BATTERY

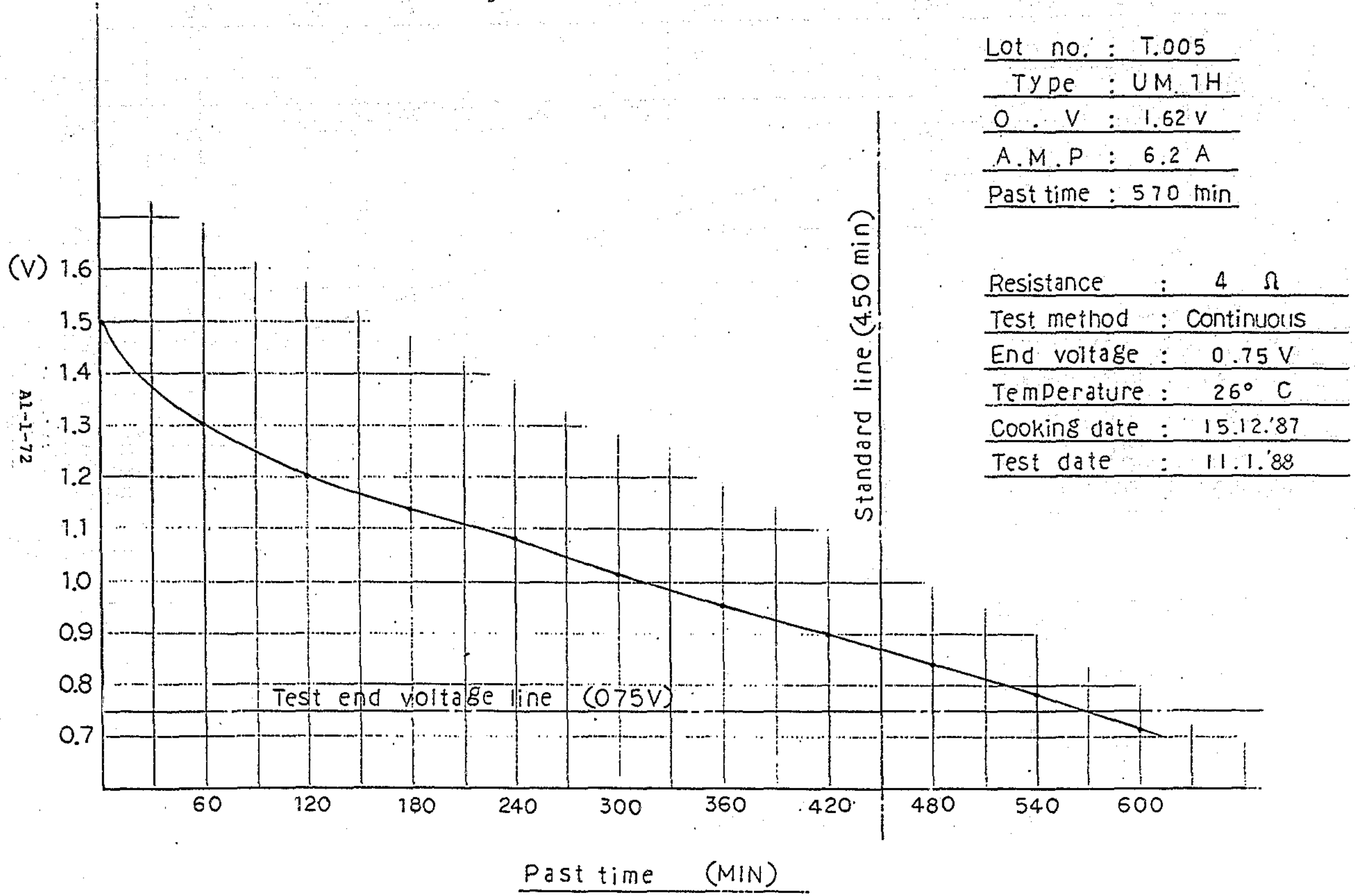


Figure AI-1-3-7(3) DISCHARGE CURVE FOR D/C BATTERY

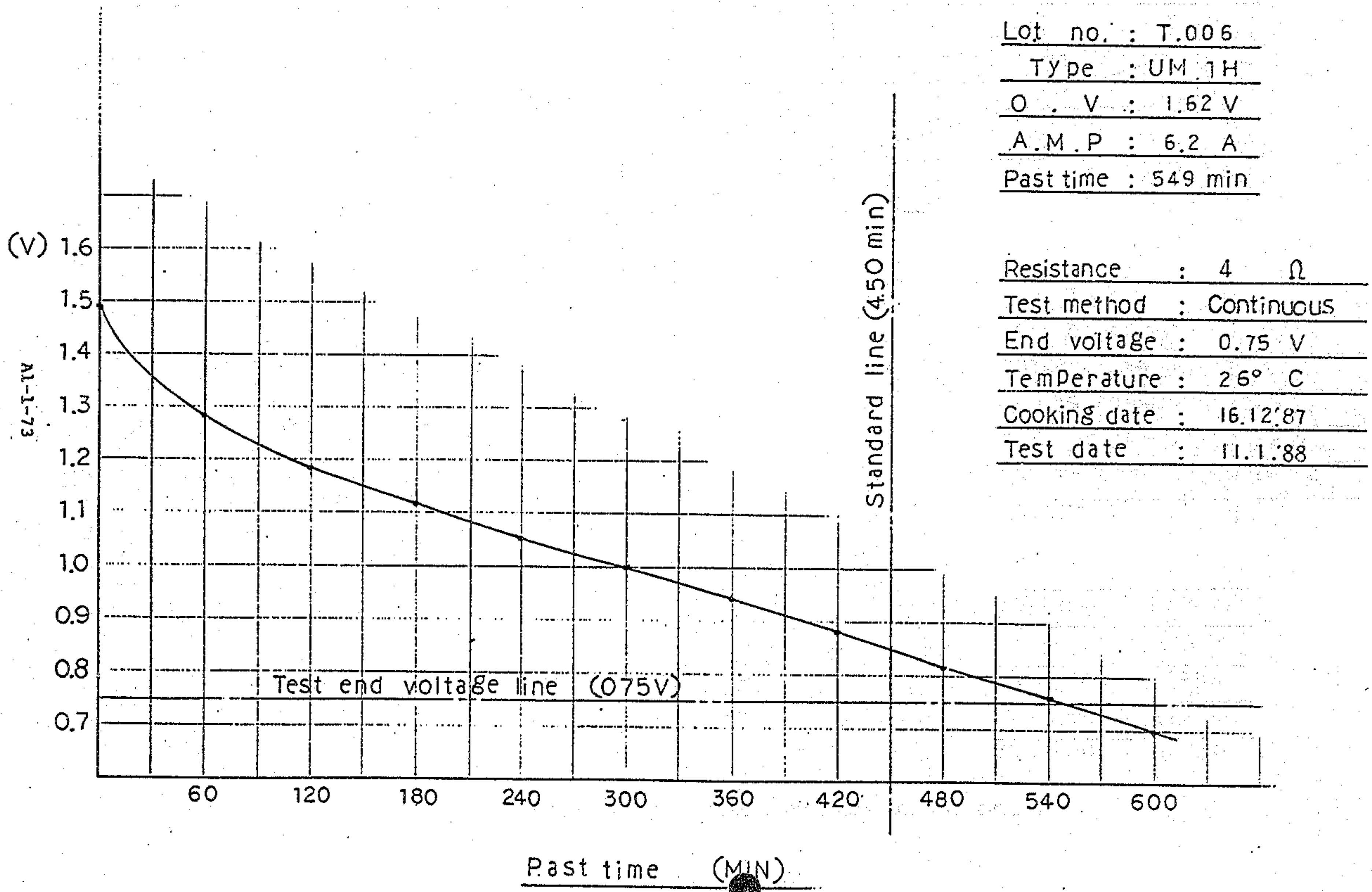


Figure AI-1-3-7(4) DISCHARGE TEST SHEET

PRODUCTION DATE	COOKING DATE	Sr. No.	O.V	A.M.P	C.V	E.V	Remark
24.12.87	9.12.87	1	1.60	6.2	1.48	0.75	T004
"	"	2	1.60	6.0	1.48		"
"	"	3	1.62	6.2	1.50		"
3.1.88	15.12.87	4	1.62	6.2	1.50		T005
"	"	5	1.62	6.2	1.50		"
"	"	6	1.60	5.8	1.48		"
"	16.12.87	7	1.62	6.2	1.48		T006
"	"	8	1.60	6.0	1.48		"
"	"	9	1.62	6.2	1.50		"

TYPE	UM1H
RESISTANCE	4 Ω
TEST METHOD	CONTINUOUS

DATE Measured	TIME Measured	Past Time	Temp	1	2	3	4	5	6	7	8	9	10
11. 1.88	7:00		26	1.48	1.48	1.50	1.50	1.50	1.48	1.48	1.48	1.50	
	8:00	60		1.28	1.28	1.30	1.30	1.30	1.28	1.28	1.28	1.30	
	9:00	120		1.18	1.18	1.20	1.20	1.20	1.18	1.18	1.18	1.20	
	10:00	180		1.12	1.12	1.14	1.14	1.14	1.12	1.12	1.12	1.14	
	11:00	240		1.06	1.06	1.08	1.08	1.08	1.06	1.06	1.06	1.08	
	12:00	300		1.00	1.00	1.02	1.02	1.02	1.00	1.00	1.00	1.02	
	1:00	360		0.94	0.94	0.96	0.96	0.96	0.94	0.94	0.94	0.96	
	2:00	420		0.88	0.88	0.90	0.90	0.90	0.88	0.88	0.88	0.90	
	3:00	480		0.82	0.82	0.84	0.84	0.84	0.82	0.82	0.82	0.84	
	4:00	540		0.76	0.76	0.78	0.78	0.78	0.76	0.76	0.76	0.78	
	5:00	600		0.70	0.70	0.72	0.72	0.72	0.71	0.70	0.70	0.72	

1-4 Watt-hour Meter (WHM) Shop

The watt-hour meter is extremely important for purposes of electricity rates transactions. In Burma electricity distribution is of the 230/400V 50 Hz three-phase AC four-wire type. At No.3 HI the single phase 230V 15A 50 Hz WHM TE1 model and the three-phase three-wire 400V 30A 50 Hz WHM TW1 model are produced.

The present evaluation is for the single phase WHM TE1 model watt-hour meter. Since demand for the TW model watt-hour meter is at present very low output is small and as parts and materials are almost used up future continued supply seems unlikely. Because the power distribution system is of a three-phase four-wire type the three-phase three-wire watt meter has the disadvantage of permitting electricity stealing. Hereafter, a three-phase four-wire WHM must be considered for Burma.

1-4-1 Outline of Production Processing

(1) Working equipment and layout

The WHM shop consists of a machine shop and assembly shop (refer to Fig.AI-1-4-1.

1) A press, automatic machine, welding machine, casting machine, and assembly machine for press machined parts are installed in the machine shop. As there is sufficient space between machines the conveyance of materials and the changing of metal patterns, etc. is easy. The work area is spacious.

2) The assembly shop consists of an assembly work area, a parts store, inspection room and packaging work area. In the a conveyer belt for exclusive use is found in the assembly line work area and the measuring devices area has plenty of room. As this shop is provided with air conditioning it offers a work environment rare in Burma which is suitable for manufacture of precision measuring devices.

3) Dies

These are ranged and stacked according to a single face on wooden racks and are easy to take out and replace.

(2) Organization and Personnel

1) Organization

The organizational structure is shown in Fig.AI-1-4-2. However, the inspector is dispatched from the Inspection Dept. and inspection of parts and finished WHM products is conducted in the WHM shop.

2) Personnel

There are 109 personnel in the WHM Shop altogether. The breakdown is as follows:

manager	1	sub-manager	1
foremen	5	skilled labor	14
semiskilled labor	55	unskilled labor	33

(3) Supply performance for materials and parts

1) Raw Materials

These are almost entirely imported.

2) Component parts

The number of items of raw materials and parts used in the production of the TE1 Model WHM are as shown in the table below:

Model	Raw Materials	Components	
		local	imported
TE1	53	75	51

Once a WHM shop manager sends a request form to the main store after receiving a production directive from Head Office raw materials and component parts are immediately conveyed to the WHM Shop.

(4) Equipment capacity and production performance

1) Equipment capacity

The production capacity of facilities in the WHM shop is for 50,000 TE1 WHMs per year and 5,000 Model WHMs per year. Production performance for March, 1987 was 4,046 sets of the Model WHMs. However, it is reported that production relies on a high overtime rate and involves considerable overworking.

2) Production performance

Fig.AI-1-4-3 shows the annual production performance from April, 1981 to March, 1987 and the long term output schedule for HIC.

Given the present facilities with supply of raw materials and components it seems possible to increase production by 20-30%. If future production reaches the 40,000 per annum level it will be necessary to consider the addition of an reject inspection bench and experiment bench. As of 1977 the raw materials and parts for the TW1 Model WHM were no longer imported. The total number imported up to 1976 was 10,000 sets. Up to October 1987 the total production output figure had reached the 10,000 mark.

1-4-2 Analysis of Production Processing

(1) Outline analysis of processing

The flow chart sent from Japan for stages from raw material to finished product is still being used. A flow chart appropriate for this particular factory has not been drawn up and the flow chart found in Fig.AI-1-4-4 was made especially for this present survey by No.3 HI.

(2) Flow chart

No flow chart has been drawn up. Parts machined in the WHM Shop are carried for a total lot check in the Inspection Room of the assembly shop before going on to the next process.

It is therefore necessary to reconsider the processes for machined parts in the WHM shop before considering a flow chart.

(3) Problems and improvement of manufacturing methods and process chains of main finished products and component parts

1. The steel plates used as a raw material in the WHM Shop are sometimes rusted and unusable when brought in because of the poor storage system in the main store. This requires measures to improve the storage system of the main store.

2. Tables are required which permit a view of the evolving situation of the monthly processing tables, together with the schedule and performance for this.

3. There are no operating standards, and no definite indication as to what operators are processing, how many items are produced, and whether quality is good or not. It is necessary to make provision for these operating standards and product quality standards.

4. There is not sufficient implementation in the WHM Shop for production control of processed parts. Introduction and employment of such management methodology as monthly processing tables and operating standards is necessary.

(4) Problems and improvement of the manufacturing methods and division of labor

Operations in the WHM shop can be divided into those of the machine shop which processes machine parts and the assembly room where dirt and dust is strictly kept out. Provided that raw materials are available the WHM shop is now in a position to be able to process almost all pieces. At present, these methods seem to be satisfactory.

Plating is needed for the surface handling of WHM parts. As this plating is requested from other shops intake to schedule is not possible and so it is difficult to draw up a monthly production schedule for the WHM shop without counter measures such as overtime, etc.

(5) Problems and improvement of equipment layout and material handling

It is considered that there is no problem to the layout and material handling of the WHM shop in either the machine shop or the assembly shop. Equipment to be added in view of future output increase is a pre-calibration bench.

(6) Problems and improvement of equipment and machinery

Machinery in the machine shop is kept clean and well cared for, however, it is necessary to clearly mark out pathways and work areas inside the factory.

As the WHM is a precision measuring device it is necessary to avoid any dirt or dust in the assembly shop. However, the work floor is of exposed concrete at present. Therefore it is urgent to coat with a covering layer of dust protecting paint or lay down some dust preventive vinyl flooring. As much manual work is involved it is necessary to increase the lighting.

1) Working equipment

Some 14 years have passed since the equipment was installed in 1973. It is considered necessary to undertake a complete overhaul. The following is a list of equipment which has stopped production because of breakdown:

1. Cannot be repaired even if spare parts available
   air compressor (HM-15 Model Meiji Air Compressor Mfg.)
   air compressor (L53 Model Tanabe Pneumatic Machinery Co.)
   element dryer (Nippon Kogei Kogyo Co.)
   Belton abrasive grinding machine (Fanow, West Germany)
   Compressor (F EO V Fern Bebicon)

2. Repair possible if spare parts available

resistance welding M/C	(Yr-120 National)
tapping and drilling M/C	(7B TT Tokushu Koki Seisakusho)
30 ton power press	(S 30 Osaka Kiko Co.)

2) Molds

There is no problem for the present with the molds. Repairs of simple molds can be done in the HIC Factory. However, it is not yet possible to make new molds. At present, the molds have only one face each for the use of parts processing. As it is expected that WHM production will not be possible if damage occurs to the molds it is necessary to make preparations for this eventuality for the important molds.

3) Measuring devices

All measuring devices are in working order. Supervision of machine processes and of measuring devices is important for the production of the WHM. As discrepancies in the measuring devices results in a loss of the manufactured WHMs reliability it is important to correct any discrepancies of the rotary standard WHM used for measurements and to adjust differences of assembled WHMs in particular. Calibration of the Rotary Standard WHM takes place every three months at the EPC (Electric Power Corporation) located in Rangoon. As the requested documents concerning this are not available the reliability of these calibration is difficult to ascertain. Other measuring devices are not corrected. A system for calibration of the measuring devices must be devised.

4) Others

Machinery for the moment is operative. But the machine parts are already worn. A list of spare parts requiring immediate replacement is found in Table AI-1-4-1.

(7) Problems and improvement of operating rates and line balancing

Productive capacity of equipment on lines is 50,000 per year for the TE1 Model WHM and 5,000 per year for the TW1 Model WHM. However, judging from the actual operating time the operating rate seems quite low. A schedule of 2,500 - 3,000 per month output is possible. For an output schedule of more than 3,000 per month poses the following problems:

Pre-calibration on the conveyer line requires too much time and the line balance of the conveyer is uneven. In order to balance the line installation of a calibration bench is necessary.

(8) Problems and improvement of reception of raw materials and parts

Rusty iron plates are sometimes sent to the WHM shop. The storage system of the main store needs consideration.

(9) Problems and improvement of finished product dispatch

Finished products are dispatched in the direction of the Head Office and no problems exist.

1-4-3 Analysis of Products Quality

(1) Occurrence of rejects

6-7 Inspectors are dispatched from the No.3 HI Inspection Dept. to the WHM shop. All parts processed in the WHM shop are inspected by the inspectors. The inspectors also undertake an external observation check and device discrepancy check of the assembled and adjusted products.

1) Defective processing

The defect rate for machined parts is approx. 5-7%. The reject rate is the same for each of the parts. The credibility of these results is questionable (Refer to Table AI-1-4-2).

2) Finished product rejects

There are no records of rejects. Assembled and adjusted products are checked by the inspectors. Products with device discrepancies are returned for re-adjustment to the adjuster again.

(2) Relation with preceding and following processes

Except for the surface handling of ore production processes take place in the WHM shop and so continuous production processing is possible. There are not many problems therefore.

(3) Problems and improvement of product quality standards and inspection methods

The Japanese JIS quality standards are employed, and efforts to follow these was evident. The construction of WHMs can be judged by eye. As the WHM calculates the electricity rates accuracy of measurements is important. The installation of correction equipment for the rotary standard and measurement devices needs consideration. For example, in advanced industrial countries an authorization validity period for WHMs is established and once this period has expired the WHM cannot be used in transactions. A WHM at the end of the authorized validity period can be re-used after repair and adjustment. It is necessary to adapt the quality standards and inspection methods to match with the needs of Burma taking the above points into account.

1-4-4 Maintenance of Equipment and Buildings

(1) Maintenance system

There is no maintenance system for equipment and buildings.

(2) Repair performance

There is a registrar of equipment repairs and details of the equipment are recorded in this (refer to table AI-1-4-3). A system of preventive checking is necessary for maintenance of equipment. As repairs at present are done by the repair shop this entails a considerable delay when a machine breaks down. The WHM shop does not see the time needed for repairs as a problem but it is necessary to reduce the frequency of breakdowns by employment of the above preventive maintenance system and urge Maintenance Dept. to reduce the time for maintenance repairs.

(3) Problems and improvement of maintenance

Same as (2) above.

1-4-5 Manufactured Product Design

The TE1 Model WHM which was designed in 1964 is no longer produced in Japan so there is a danger that problems with the supply of parts will develop in the future. The introduction of a more efficient and easily manufactured WHM together with the supply of a three-phase four-wire type WHM requires consideration.

Table AI-1-4-1 LIST OF EQUIPMENT SPARE PARTS REQUIRED (WHM SHOP)

Sr No.	M/C No.	Machine Name	Model	Maker Name	Spare Part	Qt'y	Remarks
1	P3-1	Dieing Machine	Pu-30	Aida Press Eng. Ltd.	Bearing NKS-7525	2 Sets	
					Bearing NTB-1730	2 Sets	
					Bearing 7025	2 Sets	
2	P1-3-1	Power Press	S-30	Osaka Kiko	Bearing	2 Sets	
3	P3-5	Winding m/c		Osaka Winding m/c Co. Ltd.	Magnetic Clutch	6 Nos.	
					Clutch Ball Bearing 6082	6 Nos.	
4	P1-7	Drilling & Tapping	7 BTT	Tokushu Koki	Clutch Plate	6 Nos.	
5	P4-19	Automatic Lathe		Fuji Seiki Co. Ltd.	Round Belt 7 mm diameter	20 Meter	
6	P1-6-3	Spot Welder m/c		Matsushita Elc. Co. Ltd.	Printed Circuit Card	1 Nos.	
					Spot Tip	10 Nos.	
7		Molding m/c	DAC-37	Mazda Ltd.	Thermostat 100 W 115/230 V (70-200C)	4 Nos.	
					Thermometer	4 Nos.	
					Pressure Gauge 350 kg/cm2	2 Nos.	
8	P0-3-5	Single Phase Watt Hour Meter Test Board	FS-5001	Keihin Denso KK	Alligator Clips	200 Nos.	
9	P4-4	Hobbing m/c	HAMAI-40	Hamai Co. Ltd.	Core Bar 1Z-311-002	4 Nos.	With Rolling Center
					Core Bar 1Z-312-002	4 Nos.	
					Core Bar 11C1-723-0	4 Nos.	
					Core Bar 1Z-313-006	4 Nos.	
					Core Bar 11C1-736-0	4 Nos.	
10	P4-16	Wire Straightening & Cutting	BABY-A	Takashima Sangyo	Reforming Die	24 Nos.	
11	P4-6	Bench Lathe	BABY-1-HM	Boley Ltd., W. Germany	Collect Chuck & Head Stock 32 as	1 Set	
					Collect Chuck & Head Stock 31 as	1 Set	
12	P4-21	Gear Checker		Toko Seiki Ltd.	Counter SP-15-1	4 Nos.	

Table AI-1-4-2(1) REJECT RATE OF WATT-HOUR METER, MODEL TE-1 (1)

Sr No.	Part No.	Name of Part	Production Good	Production Rej	Rej. %	Ass'y Q'ty Rej.	Rej. %
1	E-101	Base	26,000	1,800	7		
2	E-102	Terminal Box	26,000	1,800	7		
3	E-103	Hanger	26,000	1,800	7		
4	E-104	Main Frame Supporter	52,000	3,600	7		
5	E-105	Base Sealing Metal	52,000	3,600	7		
6	E-113	Test Terminal	26,000	1,800	7		
7	E-112A	Terminal A	78,000	5,400	7		
8	E-112C	Terminal C	2,600	1,800	7		
9	E-114	Terminal Plate	78,000	5,400	7		
10	E-114C	Terminal Plate C	26,000	1,800	7		
11	E-116	Test Link	26,000	1,800	7		
12	E-119	Terminal Block Set Metal	26,000	1,800	7		
13	E-121	Terminal Cover	26,000	1,800	7		
14	E-134	Bridge	26,000	1,800	7		
15	E-134	Terminal Washer	512,000	21,600	7		
16	E-212E	Magnet Yoke	26,000	1,800	7		
17	E-221	F.L Adjusting Magnetic Shunt	26,000	1,800	7		
18	E-22?	F.L Adjusting Screw Clamp	26,000	1,800	7		
19	E-231	Light Load Vane	26,000	1,800	7		
20	E-232	L Figured Metal	26,000	1,800	7		
21	E-235	Light Load Adjusting Set Metal	26,000	1,800	7		
22	E-301	Potential Core	884,000	44,982	5	16,218	2
23	E-302E	Lead Wire Terminal	26,000	1,323	5	477	2
24	E-302F	Insulating Paper for Lead Wire					
25	E-304	Potential Core Clamp Plate	26,000	1,323	5	477	2
26	E-308	Potential Coil Spacer	26,000	1,323	5	477	2
27	E-310	Phase Compensator	26,000	1,800	7		
28	E-312	2nd Class Temperature Compensator	26,000	1,800	7		
29	E-313	Temperature Compensation Yoke	26,000	1,800	7		
30	E-401	Current Core	624,000	31,752	5	11,448	2
31	E-403A	Current Coil Insulating Plate A	26,000	1,323	5	477	2
32	E-407	Yoke	26,000	1,323	5	477	2
33	E-441	Over Load Compensator A	26,000	1,800	7		
34	E-413	Over Load Compensator B	26,000	1,800	7		
35	E-413	Over Load Compensator Supporter	26,000	1,800	7		

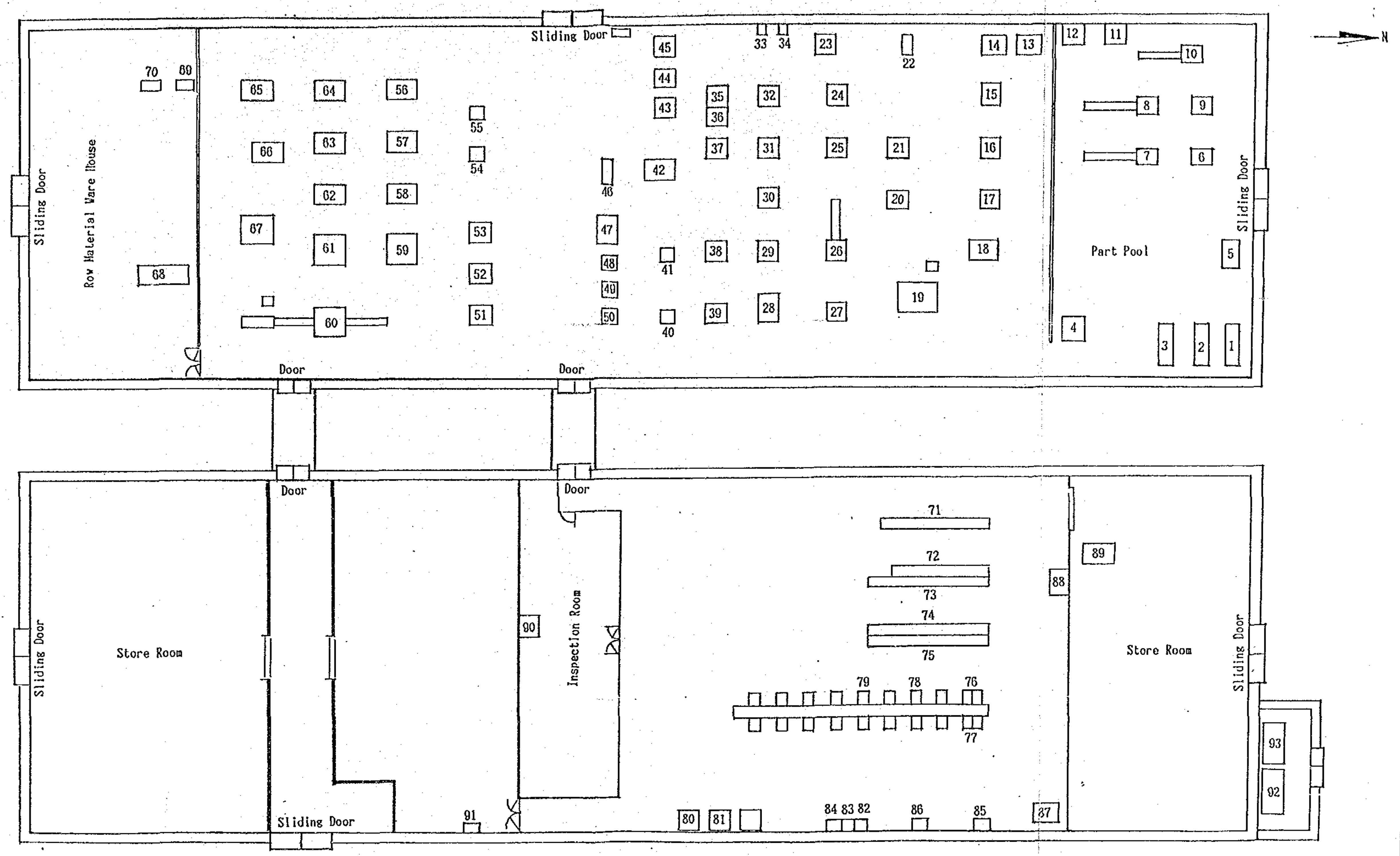
Table AI-1-4-2(2) REJECT RATE OF WATT-HOUR METER, MODEL TB-1 (2)

Sr No.	Part No.	Name of Part	Production Good	Production Rej	Rej. %	Ass'y Q'ty	Ass'y Rej.	Rej. %
36	E-611	Glass Cover Frame	26,000	1,800	7			
37	E-612	Glass Cover Sealing Metal	52,000	3,600	7			
38	E-649	Sealing Screw Washer	52,000	3,600	7			
39	E-745	Register Clamp Washer	26,000	1,800	7			
40	E-201E	Main Frame	26,000	1,800	7			
41	E-501	Disk	26,000	1,800	7			
42	E-502	Disk Spindle	26,000	1,800	7			
43	E-701	Register Frame	26,000	1,800	7			
44	E-702	Register Frame Stay	26,000	1,800	7			
45	E-721	Worm Wheel	26,000	1,800	7			
46	E-723	1 Spindle	26,000	1,800	7			
47	E-726	2 Gear	26,000	1,800	7			
48	E-732	3 Gear	26,000	1,800	7			
49	E-735	4 Gear	26,000	1,800	7			
50	E-731	2 Spindle	26,000	1,800	7			
51	E-743	Spindle Stopper	26,000	1,800	7			
52	E-746	Digit Spindle	52,000	1,800	3			
53	E-738	Gear Boss A	26,000	1,800	7			
54	E-739	Gear Boss B	26,000	1,800	7			
55	E-111	Terminal Block	26,000	1,800	7			

Table AI-1-4-3 RECORD OF DIE MAINTENANCE
- WATT-HOUR METER PLANT -

Date	Namenclature	Description of Repair	Die No.
Aug. 17, '84	Potential Core Die	Surface Grinding	D3.7-2
Oct. 16, '84	Potential Core Die	Surface Grinding	D3.1-4
Feb. 11, '85	Potential Core Die	Surface Grinding	D3.7-2
May 24, '85	Potential Core Die	Surface Grinding	D3.1-4
Dec. 3, '85	Potential Core Die	Surface Grinding	D3.7-2

Figure AI-1-4-1 MACHINE LAYOUT OF WATT HOUR METER SHOP



MACHINE LAYOUT PLAN OF WATT HOUR METER

Figure AI-1-4-2 WATT-HOUR METER SHOP ORGANIZATION

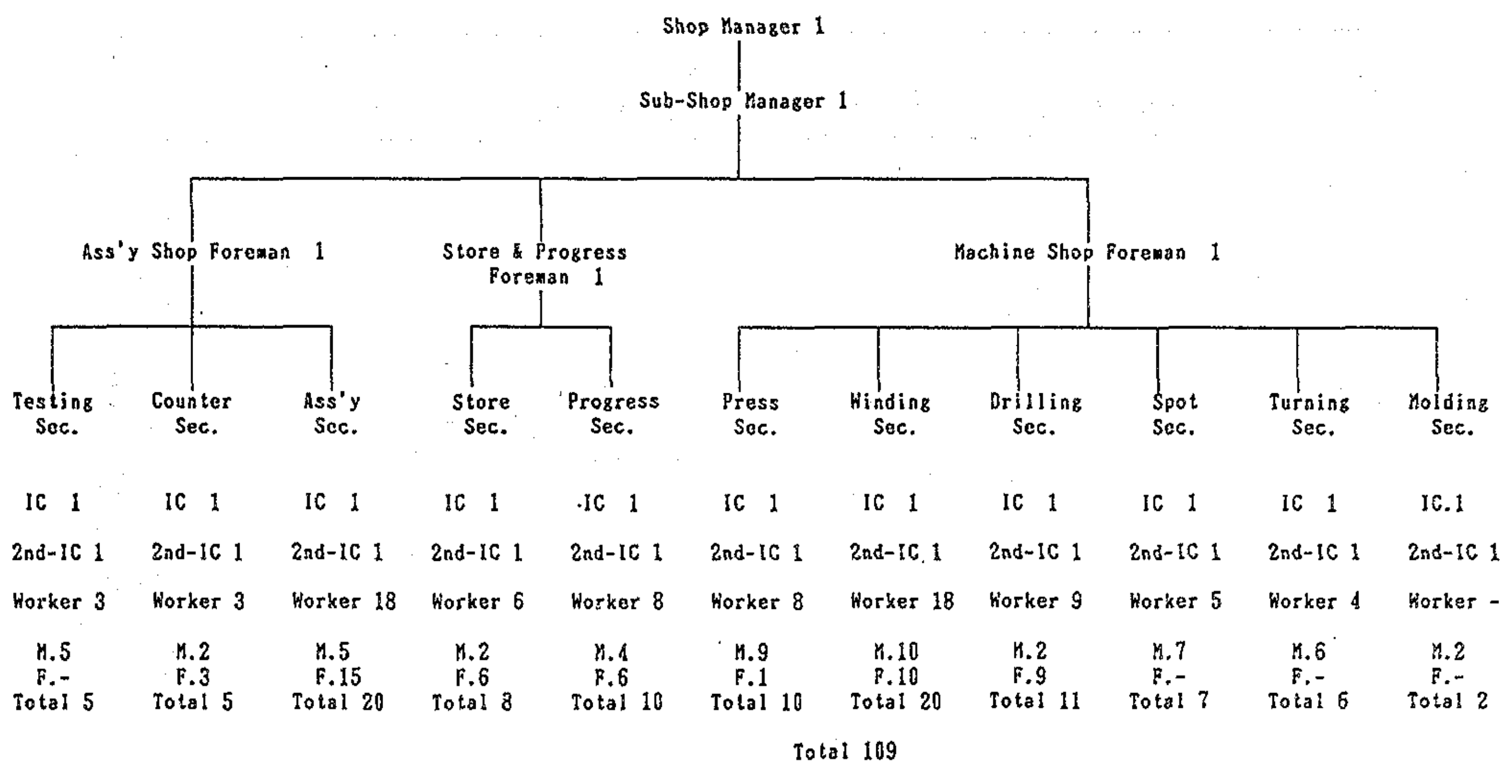


Figure AI-1-4-3   PRODUCTION RECORD AND FUTURE PLAN

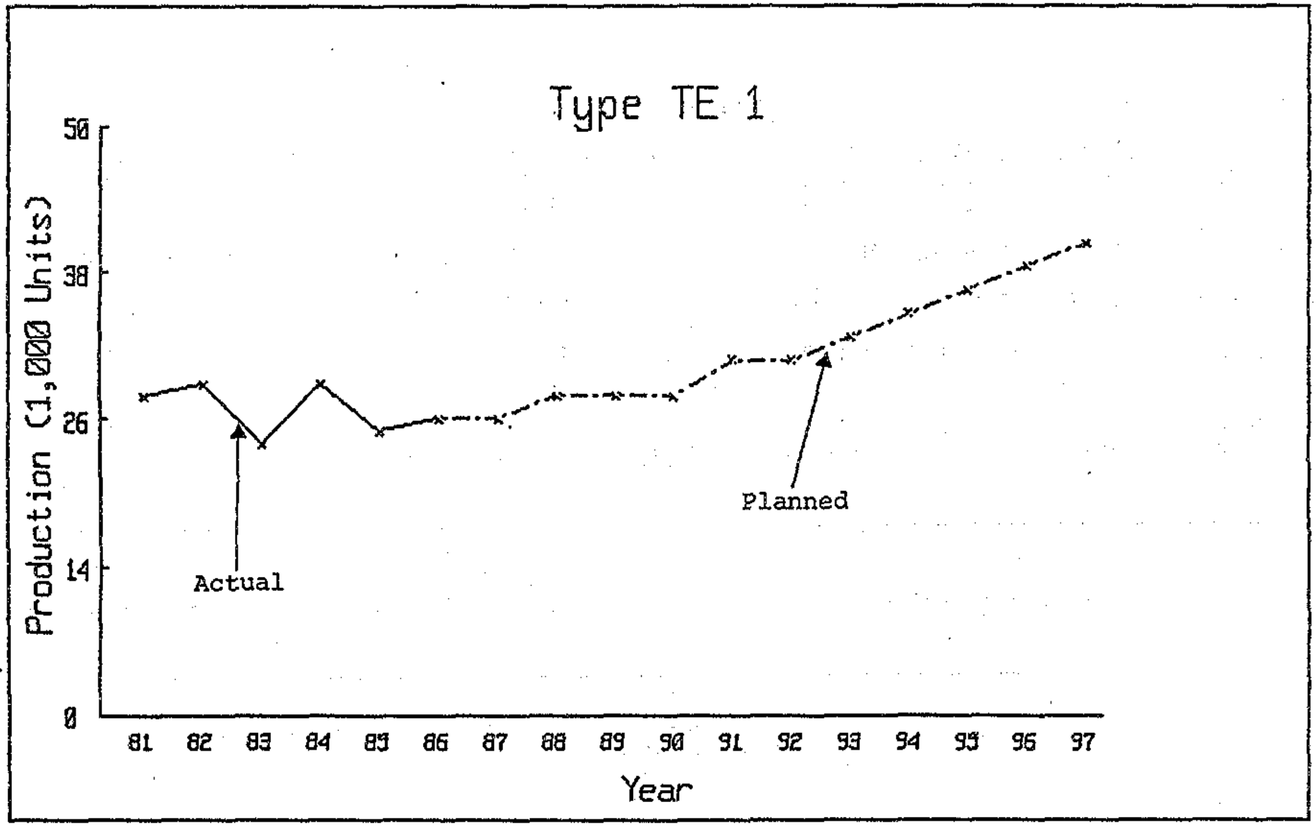
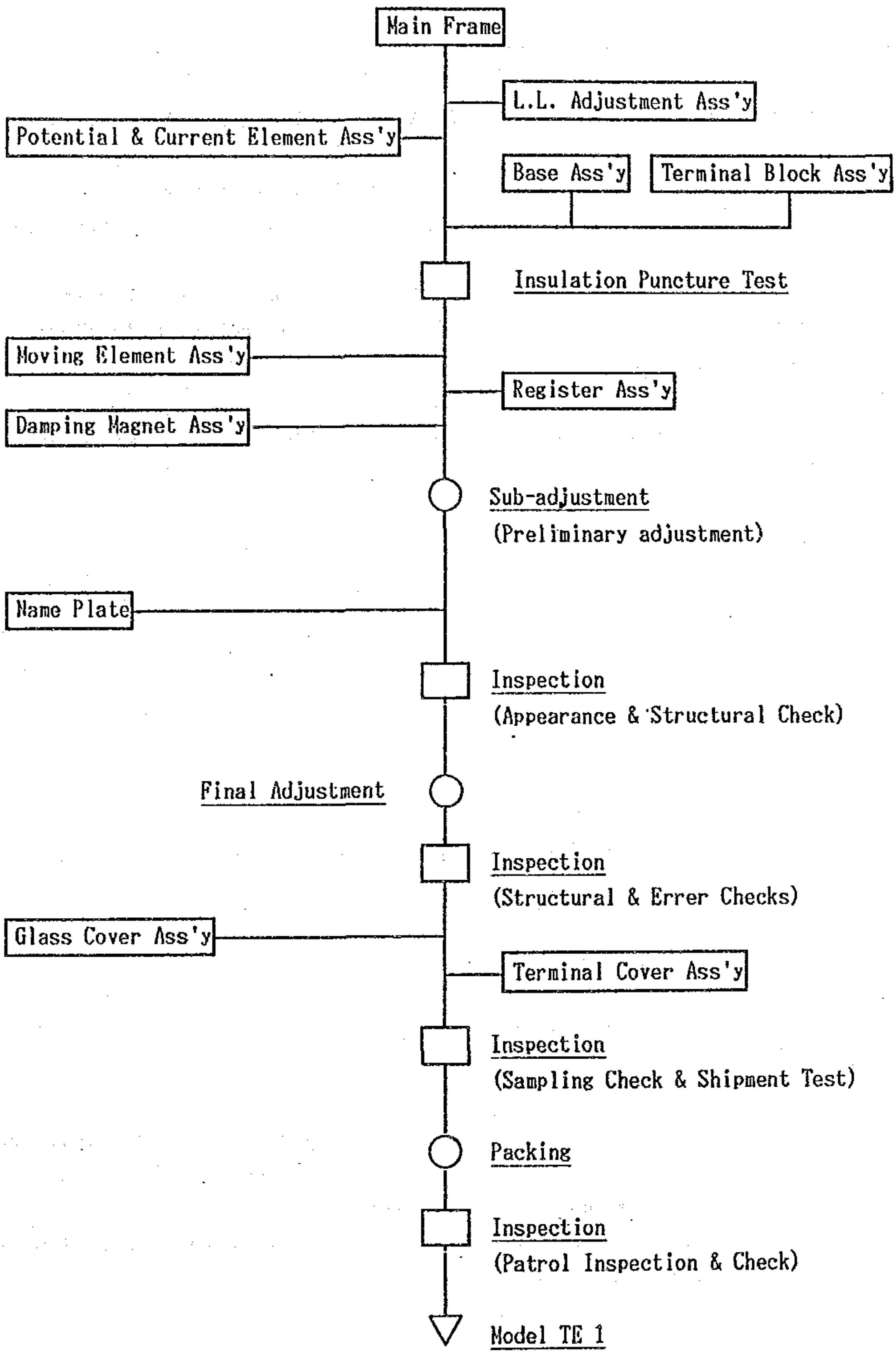


Figure AI-1-4-4 FLOW PROCESS CHART FOR WATT HOUR METER TE 1



1-5 Motor and Fan Shops

1-5-1 Outline of Production Processes

(1) Working equipment and its layout

The equipment and its layout is indicated in Fig.AI-1-5-1.

Each of the shops in No.3 HI is generally of sufficiently size and height and gave the impression of being a good industrial environment.

The main aim of the present factory is the production of parts for electric motors, electric fans and irons. There are assembly lines for the motor and fan lines.

The following manufacturing operations take place at the factory in question.

1) Press
2) Lathing
3) Milling
4) Drilling
5) Grinding
6) Painting
7) Winding
8) Die casting

The number of pieces of working machinery number more than 100 however many of these are not in working order.

(2) Organization personnel arrangement

Diagrams illustrating the outline of organization are found in Tables AI-1-5-1 to AI-1-5-3 and Fig.AI-1-5-2.

Judging from the personnel arrangement plan rough numbers of personnel for each shop can be estimated as follows: total personnel approx. 150, motor related personnel 65, fan related personnel 82, and generator related personnel 10. Other 10 members of the Inspection Dept. are dispatched to each shop.

There are differences and discrepancies between the various documents concerning personnel. This is perhaps because the work done proceeds on a process group basis and as a result it is difficult to distinguish production lines clearly.

(3) Supply performance of materials and parts

Tables AI-1-5-4 and AI-1-5-5 give an outline of details as to materials, parts and their supply performance for the 7.5kW model motor and 130YO fan.

Present conditions of supply and imported materials and parts are shown in Table AI-1-5-6 (however, this excludes the imported painting material containing solvent).

Various kinds of washers, screws, rivets, bolts, nuts and bushings are included in the parts imported. Since production started it would seem that there has not been an opportunity proved to proceed with the local supply of these.

Production output for both the motor and fan is low. Production output by separate items is even lower. The central parent company, decides the scheduled delivery dates on the basis of reports of parts inventory, and imported parts are ordered according to the schedule set. It is normal for the Japanese supplier to send a mixed cargo of all the items ordered at one dispatch.

(4) Production performance

Table AI-1-5-7 indicates production performance for a 3 year period for the motor, fan and electric iron base lines.

Motor and fan production is centered on the production of the main parts. Assembly of the main parts takes place once a sufficient quantity has been ensured.

The size of lots actually assembled is approx. 100-200 sets. These are assembled over 2-4 sessions annually. However, lots of 500 of the fan 130YO are produced every two months.

Demand for the electric iron base is strong and changes must be carefully followed.

1-5-2 Analysis of Production Processing

(1) Outline analysis of processing

Production processes dispatch for the main parts of the representative models (1.5 kW motor and 130YO fan) can be seen on Figs.AI-1-5-3 (1) and AI-1-5-3 (2).

The motor flow charts Figs.AI-1-5-4 (1) and AI-1-5-4 (2) for the 7.5 kW motor are attached for reference. While the flow of production of the main parts for the fan and motor both is considered important products are not manufactured until a certain quantity of output has been accumulated on the assembly line.

Before going to the assembly line the main parts are kept in the store after passing an complete inspection of all parts by the Inspection Dept.

In the assembly operations of the electric motor and electric fan as there is no special equipment available operations are carried out by tools.

(2) Process flow

Besides Figs. AI-1-5-3 and AI-1-5-4 the flow of operations for the frame of the 1.5 kW motor and the rotary element of the 130 volt fan are as shown in Figs.AI-1-5-5 (1) and AI-1-5-5 (2).

Transportation between processes takes place by hand truck. Specified containers and store racks are not used.

Present layout for the electric generator (for agricultural use), motor, and fan was based it seems on standards at at time when the scheduled production output was of considerable scale.

Consequently layout needs to be re-considered to bring it in line with the present low production output.

(3) Problems of production methods and process chains

Motor frames without any externally visible radiator wings were quite common. These were machined by press welding or pipe lathing and machining appears to be simple and easy. In order to increase productivity it is worth considering modifications in the pressing process method for frames in No.3 HI. However, as this plan would involve new investment, mean a decrease in demand for local materials and an increase for imported pipes or iron plates, it is not very attractive.

In order to meet the challenge of the all resin fans flooding the market HIC plans the switch over to a resin product which requires the introduction of an injection machine. Given the difficulty of operations with the present cast products, mostly made from aluminum die casts, it is clearly advisable to move in the direction of resin production. However in present circumstances it is necessary to go ahead with a plan having immediate efficacy at the same time as the introduction of equipment is carried out. Besides fans, there are a number of domestic appliances of the large resin type, and considering that their demand will grow it is necessary to make a prompt decision concerning these.

At present HIC is considering the changeover to a direct line type of production process for the fan guard of the spiral type. At present the operational processes for this are involved. The present operational methods take a great deal of time as can be seen from the Figs.AI-1-5-6(1) and AI-1-5-6(2), iron wires are cut to short lengths then welded to the required form. After changeover to a plastic model a consideration of the materials of guard is recommended.

(4) Problems of the production methods and division of labor system

As previously stated, the production of the main parts of the motor and fan depend on the foundry due to the division of labor system employed. At present, this system does not pose any problems.

(5) Problems of layout and transportation

The need for a re-consideration of the layout has already been noted and explained.

At 42 locations in the factory products in progress of the motor and fan are blocked though it is not clear whether this is because main parts, handled in a large number of machining processes, total more than 50 different machine types. These blockages are indicated on Figs.AI-1-5-7, and AI-1-5-8(1) to AI-1-5-8(3).

Management of process progress based on a policy of "finish operations on one lot then proceed to the next lot" is desirable.

(6) Problems and improvement of working equipment

Fig.AI-1-5-9 shows machinery at present not usable or requiring repair indicating 23 units of equipment are out of order. The maintenance requirements of 18 out of them are reported.

Table AI-1-5-8 is a list of the unusable machinery and representative examples are shown in Figs.AI-1-5-10 (1) to AI-1-5-10 (3).

According to HIC there are no hindrances to production conditions at present but addition of the equipment shown in Table AI-1-5-9 and comprehensive layout will be needed to cope with future expansion of output from the stance of productivity.

Changes in the equipment repair performance indicate that repairs of valves, connectors, fuses, control boxes, etc., i.e. those relating to electric and oil pressure are frequent. Lack of spare parts over a long period resulted it seems in transfer of parts of one machine to another for that period.

Of the 23 machines 18 were made in West Germany. As main parts of these have been employed for other uses renovation is expected to cause difficulties.