Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-1	Production management	Galvanizing workshop	
2nd category		Industry	Sector / Product
Process control		Metalworking	Electroplating

Subject

Use of weekly and daily production schedule sheets

■ Diagnosis:

The company receives many orders in a relatively short delivery schedule to make it difficult to establish a reliable production schedule. Instead, a supervisor in charge of work acceptance/shipment checks the production status in each shift and gives oral instructions to workers.

If a work instruction is delayed, the work starts late. The order of work is determined by each worker, not necessarily in the order of delivery. The work status needs to be checked with each worker. Clearly, systematic production schedule control should be promoted using a production schedule sheet.

■ Guidance:

1) Sample forms of daily and weekly production schedule sheets were prepared and provided.
2) Then, production schedule planning and management manuals were prepared to promote understanding, and a training workshop was held at the galvanizing shop using the manuals.
3) The daily production schedule sheet was used and revised to reflect problems identified in actual use and was completed in a form that facilitates use of field workers.

■ Response of the enterprise (as confirmed during the follow-up activity):

During the follow-up diagnosis, the weekly and daily production schedule sheets were prepared, but they were not used because nobody understood how to use them for production schedule control. Follow-up guidance and consultation was provided to the corporate manager and persons in charge of production schedule management. As a result, the daily production schedule sheet was put into use. Now, the person in charge fills out the schedule sheet with planned production, based on which workers receives instruction. Workers are not accustomed to record production data in the sheet and the manager still gives guidance on the shop floor.

■ Other relevant points (issues to be solved and problems remained):

1) It is important to show original forms of production schedule sheets and related manuals to workers and identify problems through actual use in an attempt to perfect them by reflecting the field conditions and the needs of workers.
2) As proper production schedule control can be made only if workers record accurate production data, it is important to provide guidance for workers on a continuous basis.
3) Companies that introduced the weekly and daily production schedule sheets at the same time have experienced some confusion among field managers and supervisors. It is therefore recommended to introduce the daily production schedule sheet first, and after it is well adopted, to start the use of the weekly production schedule sheet.
4) It is also proposed, once production schedule control using the daily and weekly schedule sheets is established in the galvanizing shop, to deploy it to other departments for company-wide production schedule management.

1 Case A

Description of Problems

Production scheduling and Progress control are not made.

Diagnosis and Recommendation

- Suggestions for Production scheduling and Progress control (Refer Attachment A)
- Practical guidance for Production scheduling and Progress control to the Supervisor in charge of Receiving & Delivery of Goods jobs

Attachment A

How to make the Daily Production Schedule?

(Example: in the case of barrel plating)

1. Pick up the jobs which need Zn plating from the daily report printed out from the computer. (By the supervisor)

2. Classify the job for each Zn plating tank. (By the supervisor)
   - Barrel plating tank
   - Large-sized tank
   - Main tank

3. Fill in customer name and product name on the Daily Production Schedule sheet according to **the priority of delivery**. (By the supervisor)

4. Fill in the required plating quantity **on the shift** in the column of Planned Quantity. (By the supervisor)

5. Calculate required hours by dividing the required plating quantity by productive capacity per hour. (By the supervisor)
   - Productive capacity of Zn plating tank:

Barrel capacity:	Approximate 35 Kg/barrel
Tact time (Pitch time):	Approximate 12 minutes
Number of plated barrel per hour:	Approx. 5 barrel/hour (60 ÷12)
Production capacity per hour:	Approx. 175 Kg/hour

   - **Example 1**

     Required plating quantity: 450 Kg
     Required barrel number: 13 barrel (450 ÷ 35 = 12.86 ⇒ 13)
     Required hour: 156 minutes (13 × 12) ⇒ 2.6 hours

   - **Example 2**

     Required plating quantity: 50 Kg
     Required barrel number: 2 barrel (50 ÷ 35 = 1.43 ⇒ 2)
     Required hour: 24 minutes (2 × 12) ⇒ 0.4 hours

· **Example 3**

Required plating quantity: 20 Kg

Required barrel number: 1 barrel (20 ÷ 35 = 0.57 ⇒ 1)

Required hour: 12 minutes (1 × 12) ⇒ 0.2 hours

6. Fill in the calculated required hour in the column of Planned Working Time with bar. [Bar chart] (By the supervisor)

· Remarks: To consider set up time in the beginning of each shift.
Actual plating work is not done in the set up time.
Set up time is estimated at 30 minutes in the attached sample sheet.

7. Hand over the planed Daily Production Schedule sheet to the foreman of Zn plating shop on the shift before working shift. (By the supervisor)

8. Hand over the sheet to the operator of barrel plating tank. (By the foreman)

9. Fill in actual worked time in the column of Actual of Working Time with bar. (By the operator)

10. Gather the sheet filled in actual worked time through the foreman. (By the supervisor)

11. Check whether the jobs were done as scheduled or not on the sheet. If not, the reason of failure should be inquired of the foreman and the operator. (By the supervisor)

12. Add the left over jobs in the first place of following shift, if some jobs were left. (By the supervisor)

13. The above process should be repeated on every shift scheduling.

Daily Production Schedule (Day Shift)

Type of Plating	Zinc	Working Date		Scheduled on	
Name of Plating Tank	Barrel	Working Shift	Day	Scheduled by	

Name of Customer	Name of Product	Qty (Kg)		Working Time – Day Shift 7	8	9	10	11	12	13	14	15	16		
		Planned													
		Actual													
		Planned													
		Actual													
A	O	Planned	450												
		Actual													
B	Q	Planned	50	Set up time											
		Actual													
C	R	Planned	20												
		Actual													
D	S	Planned	900												
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													
		Planned													
		Actual													

Attachment A-1

Daily Production Schedule (Night Shift)

Type of Plating	Zinc			Working Date			Scheduled on	
Name of Plating Tank	Barrel			Working Shift	Night		Scheduled by	

Name of Customer	Name of Product	Qty (Kg)		Working Time — Night Shift												
				18	19	20	21	22	23	24	1	2	3	4	5	6
		Planned														
		Actual														
		Planned														
		Actual														
E	M	Planned	450	Set up time												
		Actual														
F	N	Planned	200													
		Actual														
G	P	Planned	150													
		Actual														
H	T	Planned	100													
		Actual														
I	U	Planned	280													
		Actual														
J	V	Planned	45													
		Actual														
K	W	Planned	300													
		Actual														
L	Y	Planned	350													
		Actual														
		Planned														
		Actual														
		Planned														
		Actual														
		Planned														
		Actual														
		Planned														
		Actual														

Attachment A-2

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category
MW-2	Production management
2nd category	
Process control	

Division / Process	
Galvanizing workshop	
Industry	Sector / Product
Metalworking	Electroplating

Subject

Production schedule control using a job ticket

■ Diagnosis:

Work pieces sent from customers are kept in a variety of containers, including cloth bags, cardboard boxes, metallic boxes, and net cages, many of which do not have indication of the company or product name. It is therefore difficult to identify work pieces in the process. Clearly, each container should be accompanied by a tag that indicates the customer name, the product name, quantity, the date received, and the scheduled date of shipment. The tag should be filled out when the work piece is received and should be attached to the work piece for quick and accurate identification.

■ Guidance:

1) To attach a label showing the scheduled date of shipment (day of week) to the job ticket for ease of production schedule control;
2) To place the job ticket to a designated board when the work piece is in the electroplating process;
3) To put the job ticket to a designated box when the electroplating work is completed; and
4) To collect each job ticket for the completed work piece for input to a computer.

This way, the job ticket can be effectively used for identification of work pieces, together with proper delivery and production schedule control.

■ Response of the enterprise (as confirmed during the follow-up activity):

At the time of the follow-up diagnosis, the job ticket has been introduced and a label showing the scheduled date of shipment has been attached to allow identification of work pieces and delivery schedule control. The system was further upgraded under guidance provided during the detailed diagnosis and is now used for production schedule control.

■ Other relevant points (issues to be solved and problems remained):

Originally, the job ticket was proposed to facilitate identification of work pieces. As it is continuously used, however, its application expands to delivery and production schedule control purposes. This is a good example of one innovation stimulating another.

1 Case A

Description of Problems

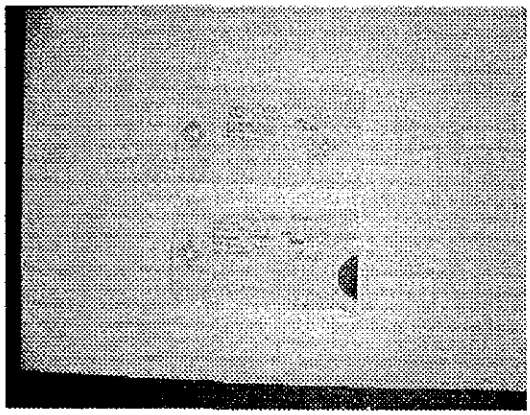
"Job Ticket" was not introduced.

Diagnosis and Recommendation

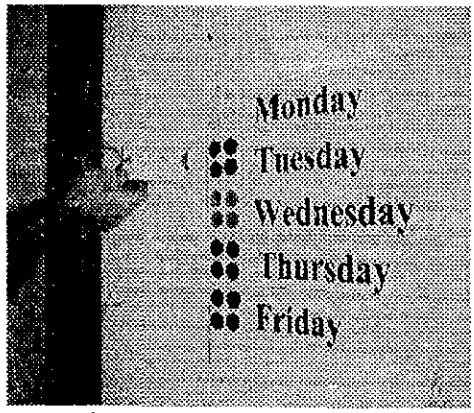
Practical guidance for how to use the "Job Ticket" was given (Refer Photograph).

Photograph the Progress Control System used the Job Ticket

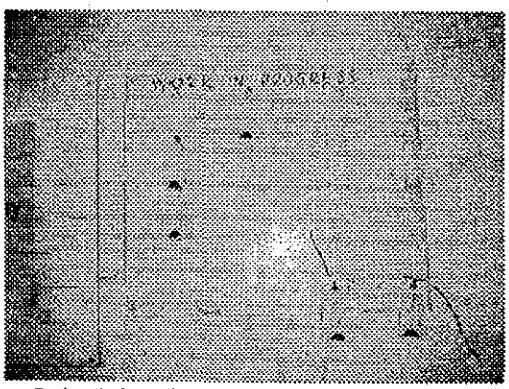
The prepared Job Ticket by the company



Job Tickets



The colour of seal shows the delivery day of the week



Job ticket is placed on a board next to the tank while job is in process

Required information such as customer name, product name, received date, required date, etc. are shown on the ticket

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-3	Production management	Galvanizing workshop	
2nd category		Industry	Sector / Product
Process control		Metalworking	Electroplating

Subject

Establishment of productivity management indices

■ Diagnosis:

The company consists of a variety of electroplating processes (e.g., galvanizing, nickel, chromium-nickel, and gold). However, it does not have departmental data on sales, production costs, and profits and grasp only total figures. It is therefore difficult to identify which department makes profits and which department has difficulty. Obviously, it is imperative to establish management indices for different departments, which will help proper control of each department.

■ Guidance:

1) The galvanizing shop consists of three lines and management indices should be determined for each line.
2) To establish three indices – production (kg)/man-hour, value (Rand)/weight (kg), and profits (Rand)/man-hour – for productivity management.

■ Response of the enterprise (as confirmed during the follow-up activity):

The indices were calculated from latest data (2001) and plotted in graphs, based on which each line was analyzed to identify problems.

■ Other relevant points (issues to be solved and problems remained):

To find a problem, it is important to collect detailed data on the process by segmentizing it as small as possible. Once the problem is identified, it is easier to develop a solution for improvement. The management expresses interest in the above advice and intends to apply it to other shops.

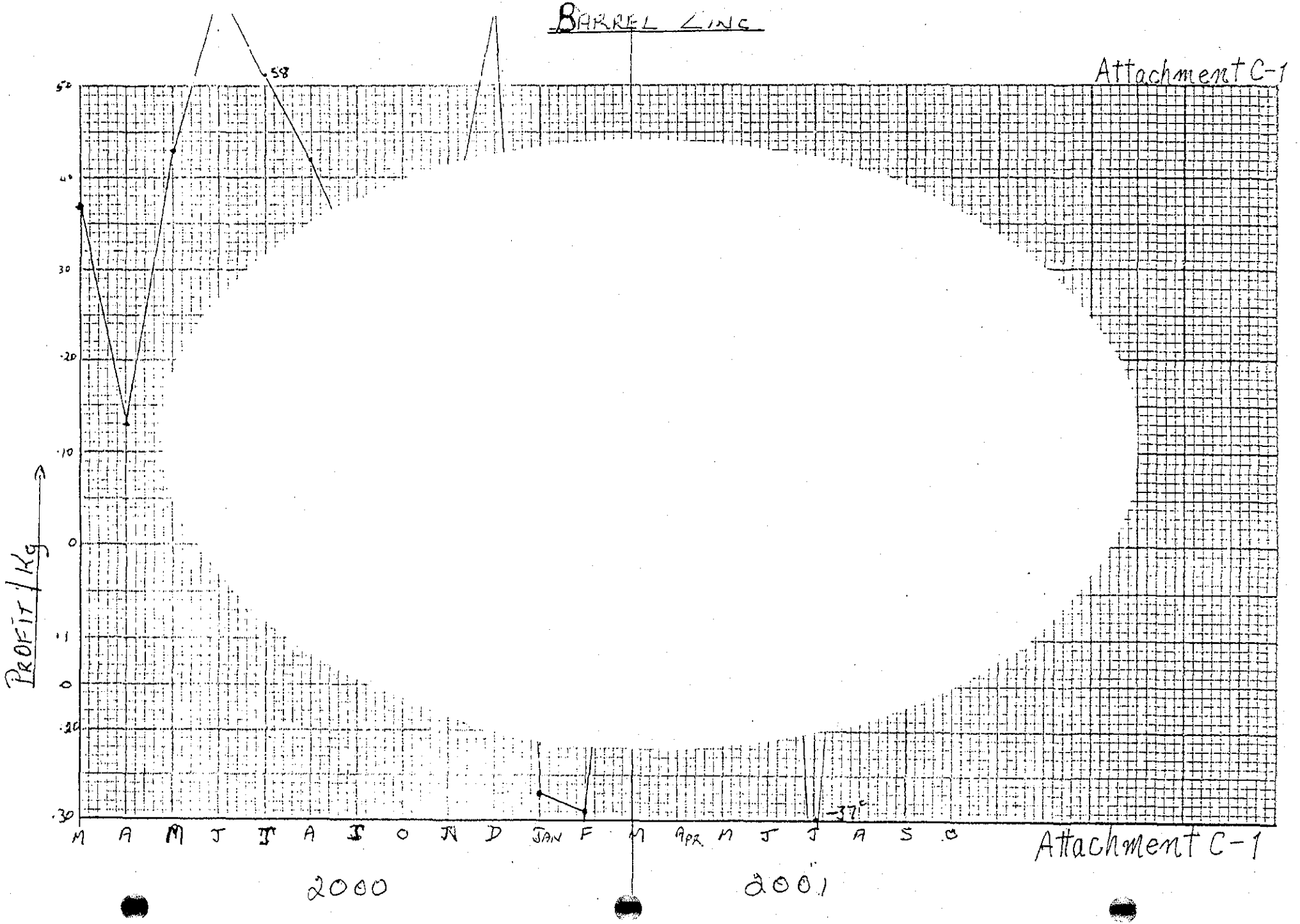
1 Case A

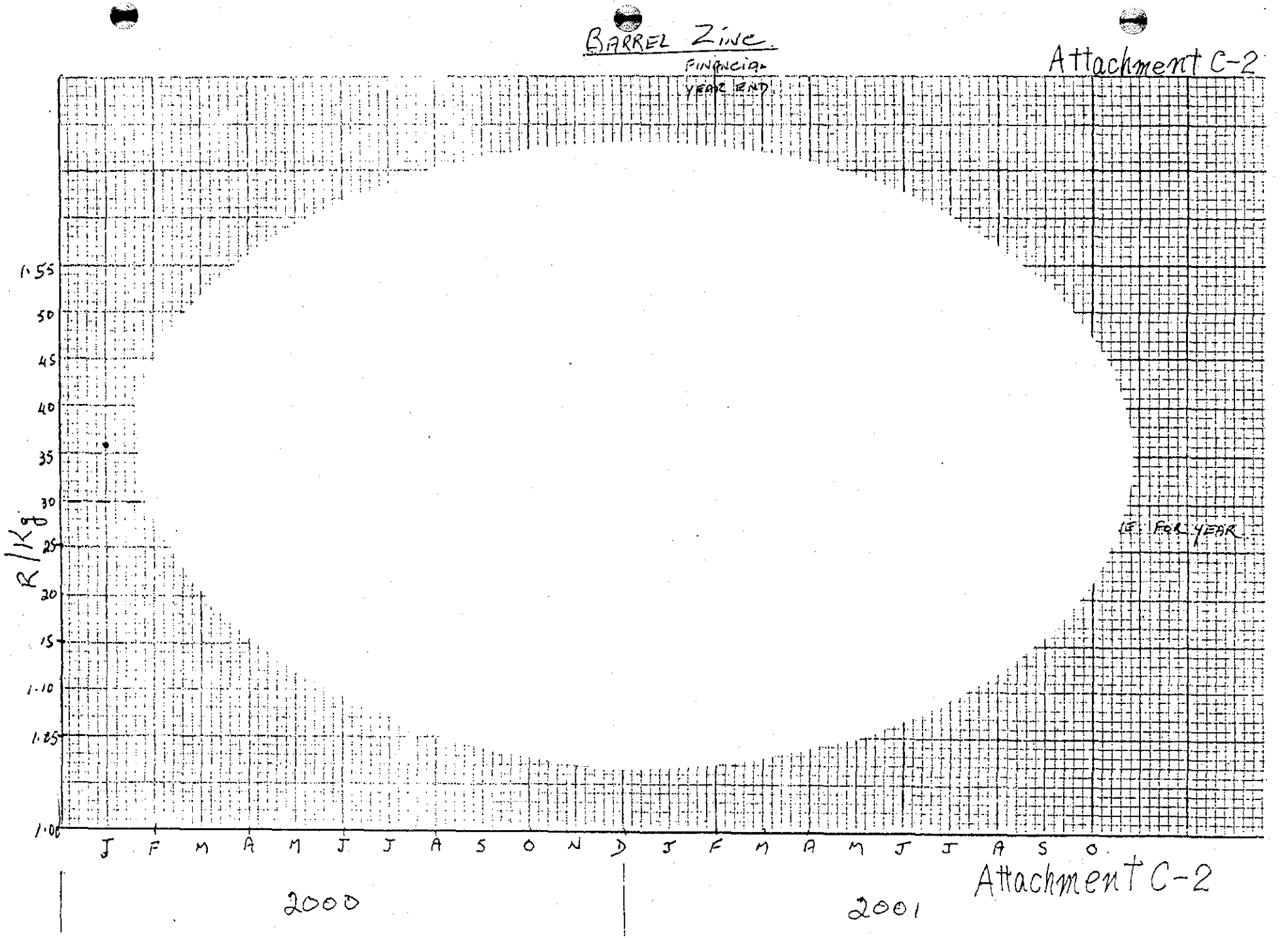
Description of Problems

Productivity indexes by division are not set.

Diagnosis and Recommendation

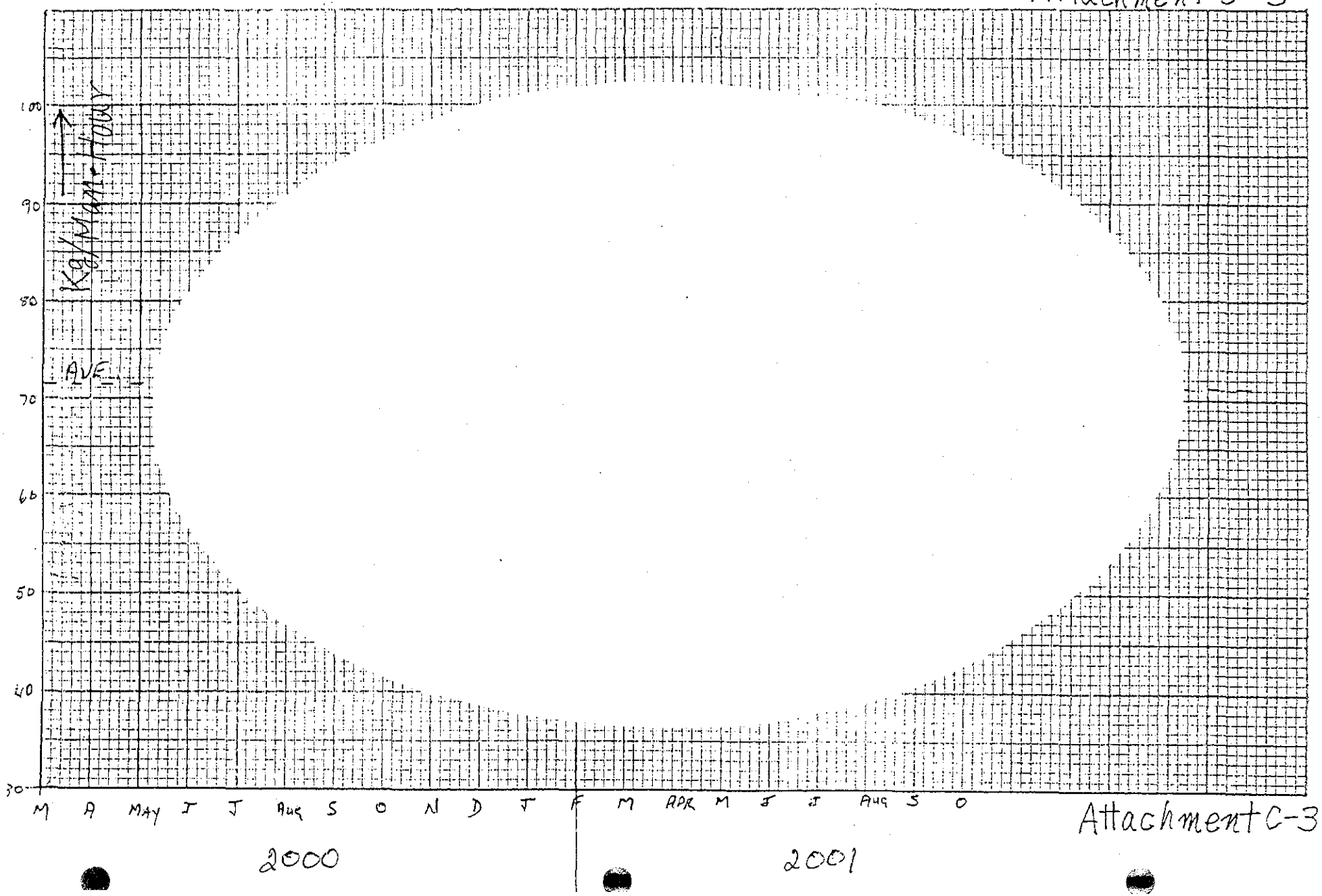
Introduction and guidance on how to use the productivity index as a management tool (*Refer Attachment C-1 to C-9*)


BARREL LINE
Attachment C-1
58
50
40
30
20
10
0
-1
0
-10
-30
PROFIT / KG
-37°
M A M J J A S O N D JAN F M APR M J J A S O
2000
2001
Attachment C-1


BARREL ZINC
FINANCIAL YEAR END
Attachment C-2
1.55
50
45
40
35
30
25
20
15
1.10
1.05
1.00
R/Kg
LE FOR YEAR
J F M A M J J A S O N D J F M A M J J A S O
2000
2001
Attachment C-2

BARREL ZINC

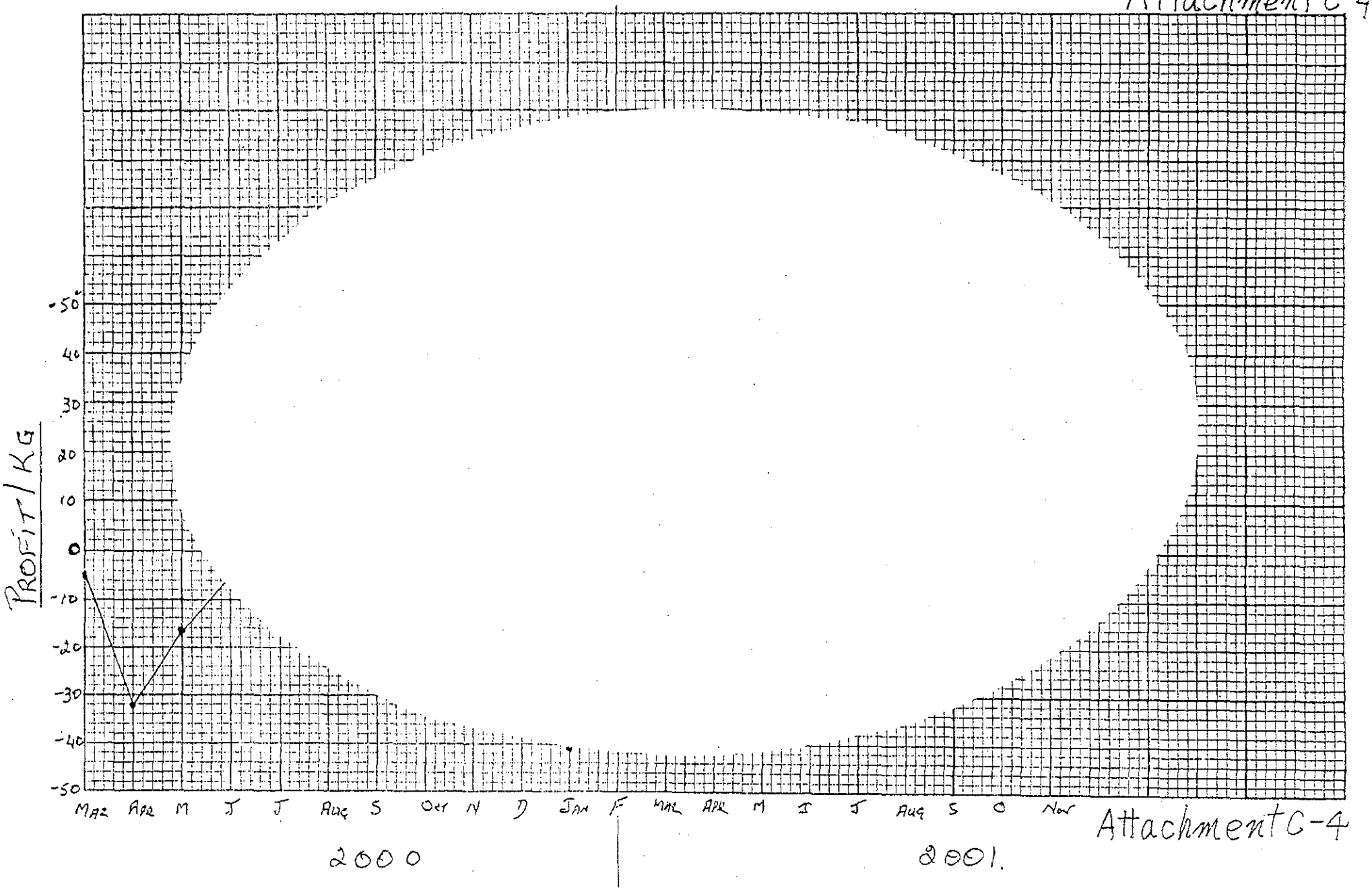
Attachment C-3



Attachment C-3

MAIN ZINC

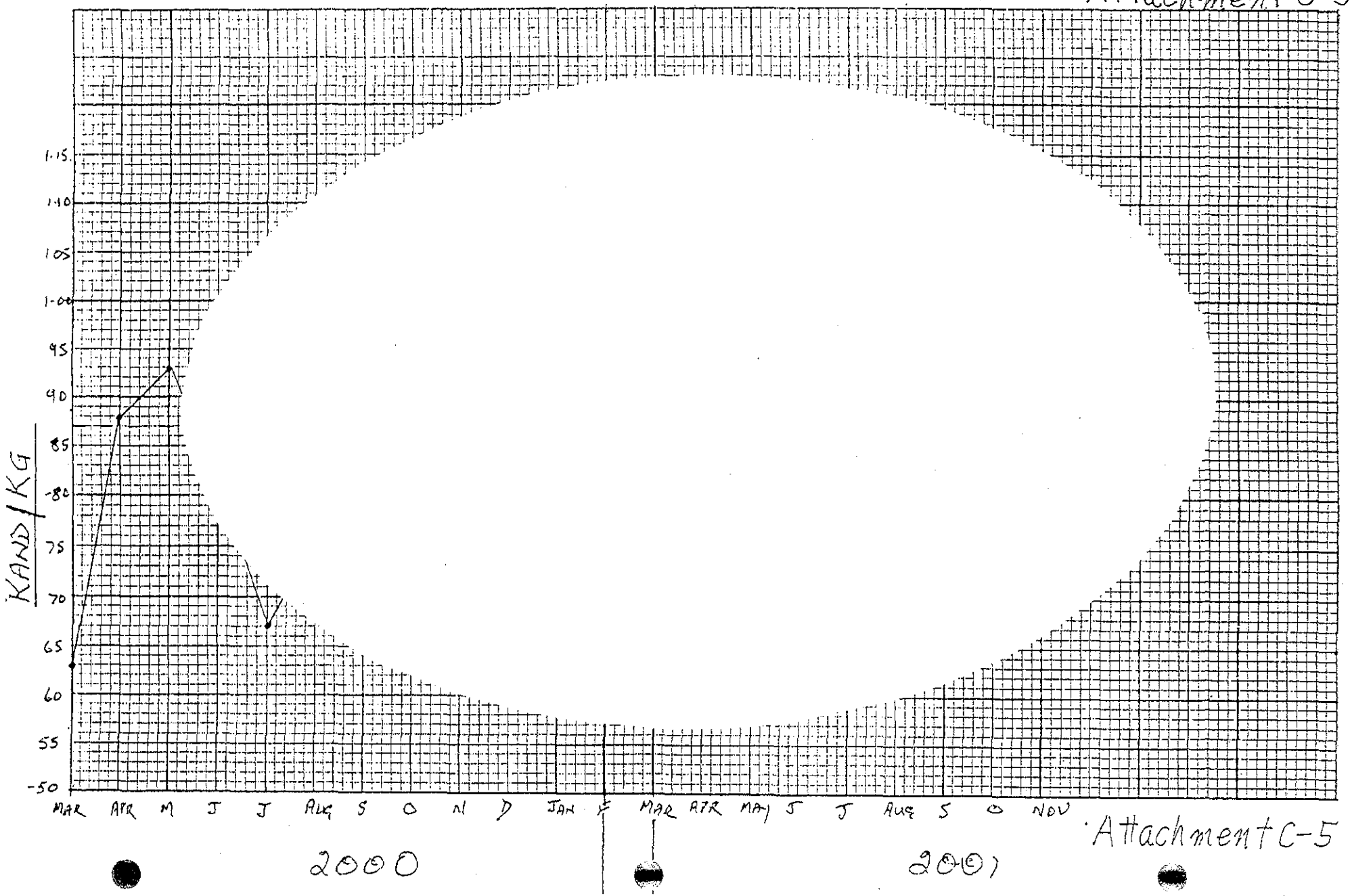
Attachment C-4



Attachment C-4

MAIN ZINC

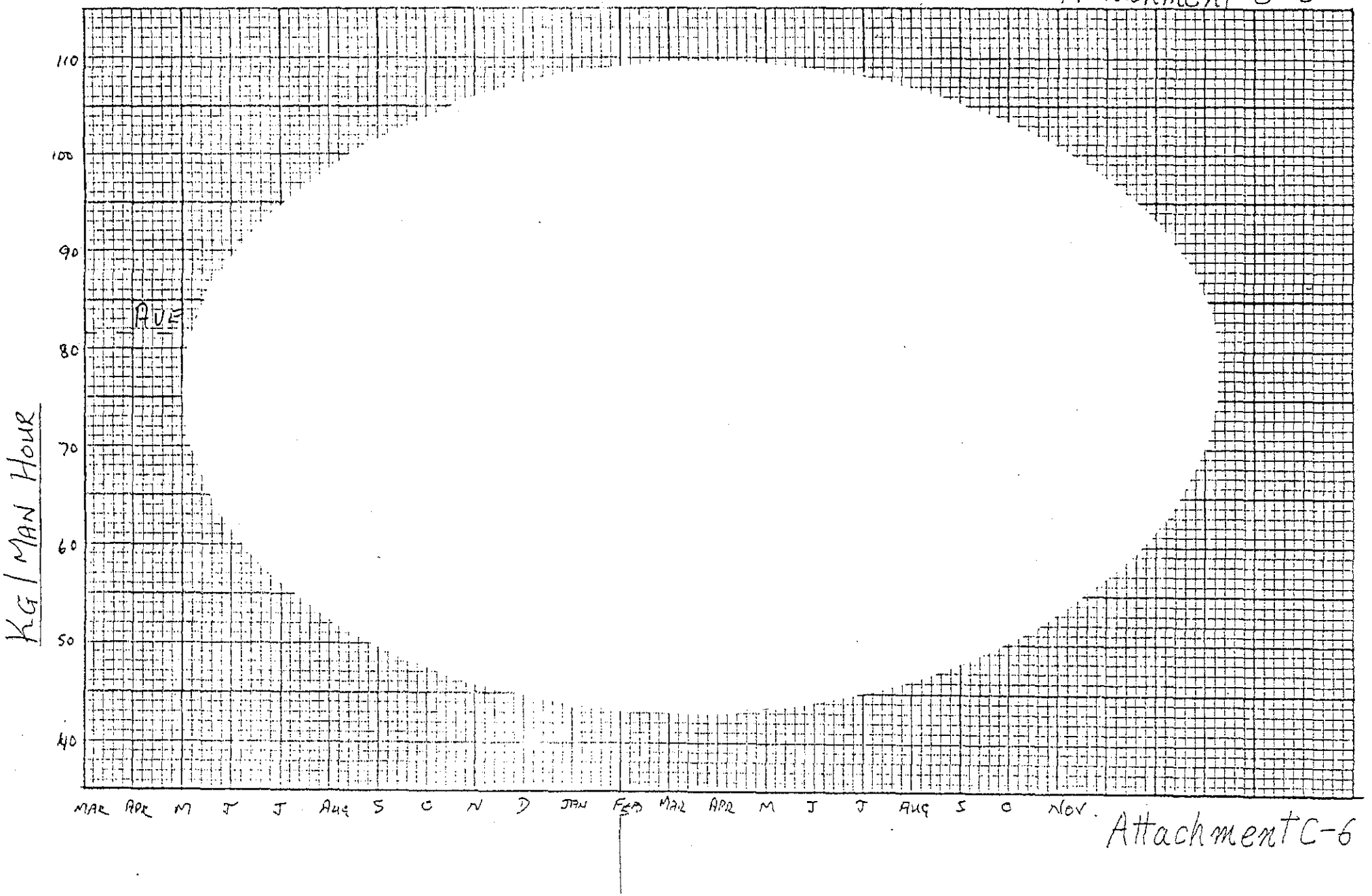
Attachment C-5



Attachment C-5

MAIN LINE

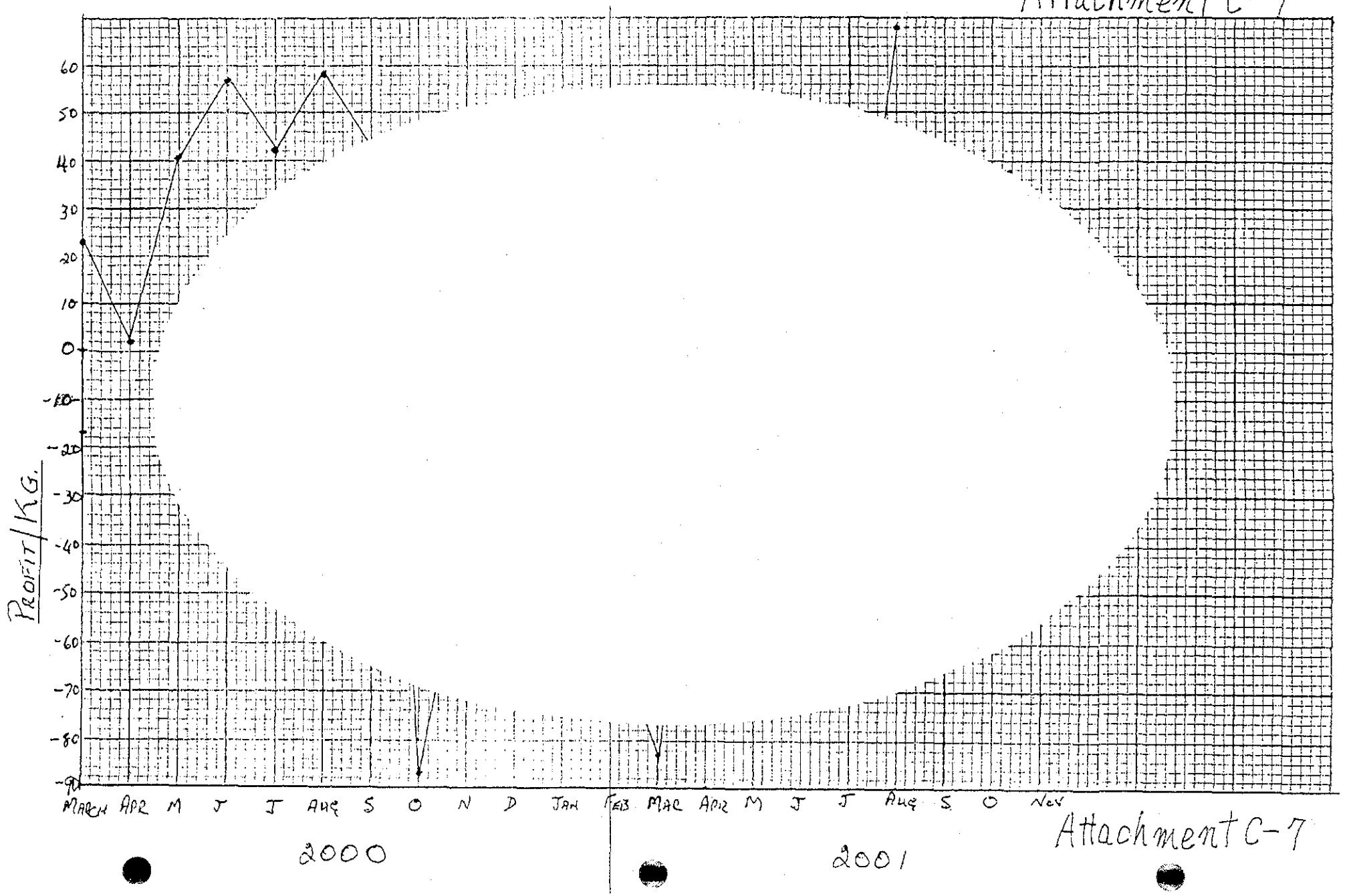
Attachment C-6



Attachment C-6

LARGE LINC

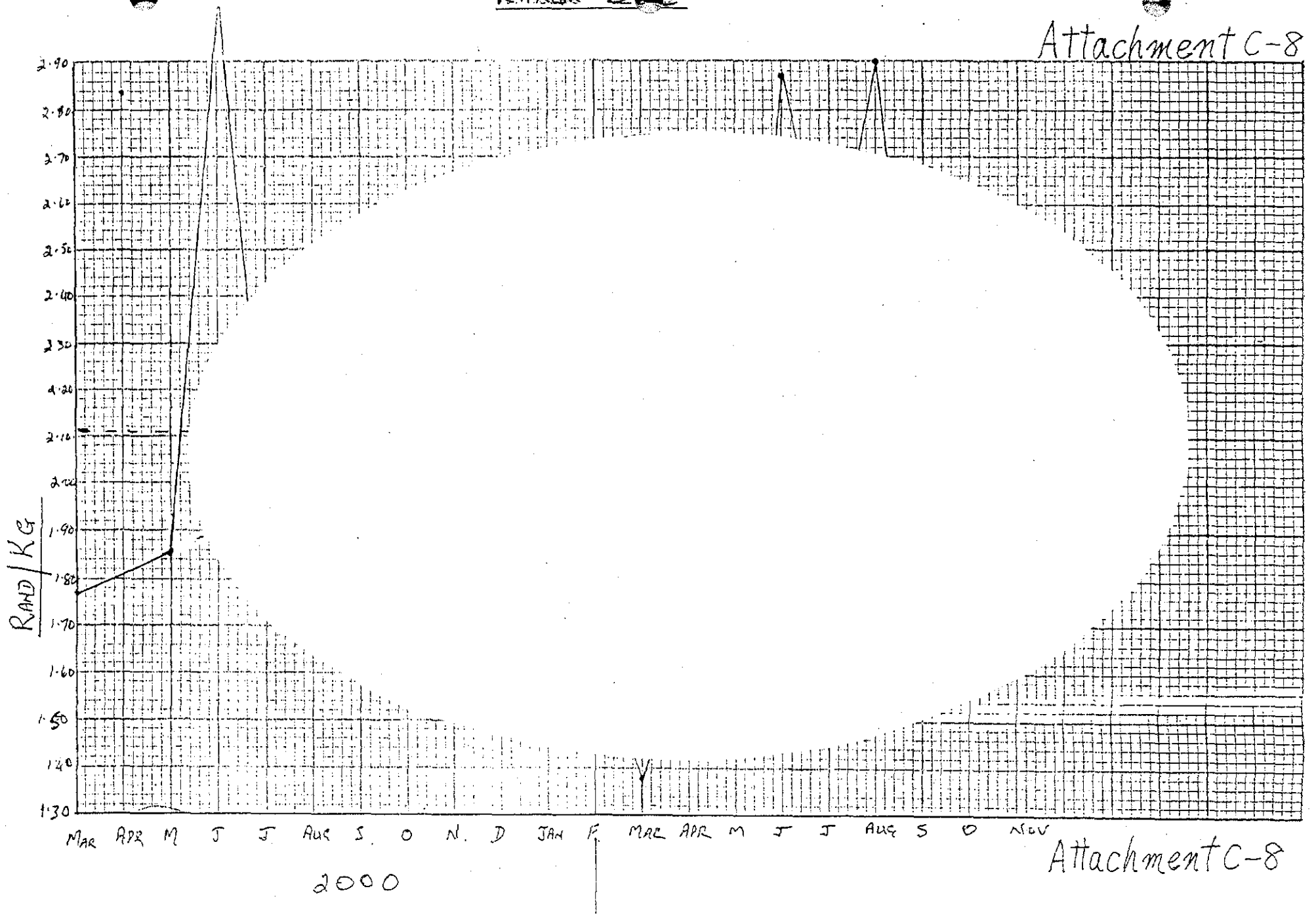
Attachment C-7



Attachment C-7

LARGE ZOOM

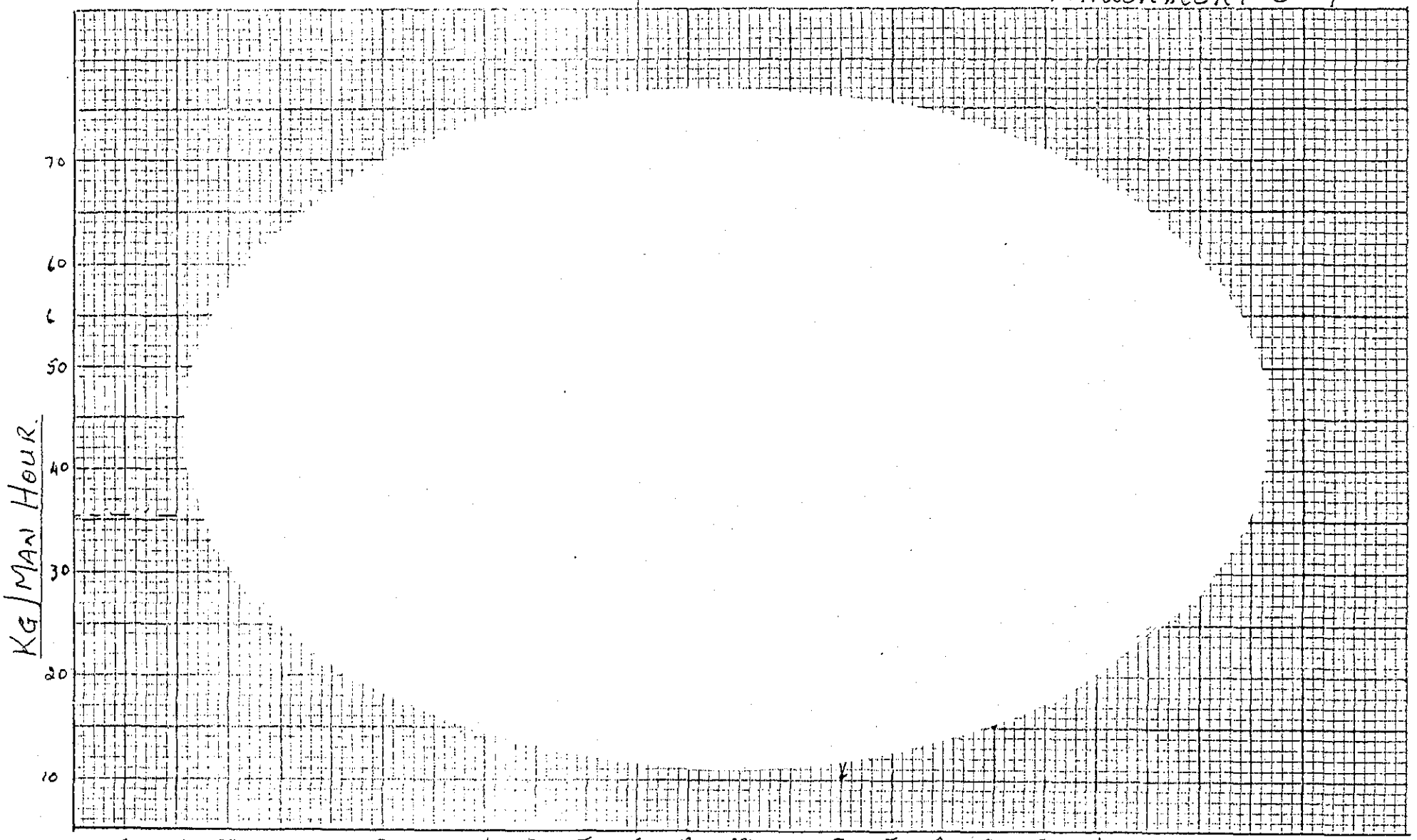
Attachment C-8



Attachment C-8

LARGE ZINC.

Attachment C-9



Attachment C-9.

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-4	Production management	Galvanizing workshop	
2nd category		Industry	Sector / Product
Transportation management		Metalworking	Electroplating

Subject

Layout improvement

■ Diagnosis:

Work pieces are received and shipped at the same entrance, and plated products are kept in the same location as work pieces to be processed. Furthermore, they are not arranged according to size. As a result, smooth movement of work pieces is hindered and it takes time to find a required work piece. Articles that do not seem to be used or are not frequently used are placed in the central part of the factory building to effectively reduce work space. Also, jigging (to attach work pieces to jigs for electroplating in the main tank) is carried out in the same area to further disturb with movement of goods.

The shop layout should be modified to improve the situation, and 5S activities should be introduced to ensure proper housekeeping including systematic storage and cleaning.

■ Guidance:

1) To separate the receiving point and the shipping point so as to create a single direction of each movement;
2) To separate storage for completed products and that for received work pieces;
3) To relocate jogging operation for main tank plating to a location near the main tank;
4) To separate storage for large work pieces and that for small ones to facilitate search;
5) To install racks to store small work pieces;
6) To attach an ID card to each container for ease of identification;
7) To identify and dispose articles that are not used in order to expand work space; and
8) To assort the chemical warehouse.

■ Response of the enterprise (as confirmed during the follow-up activity):

The above recommendations have been mostly implemented. As a result, movement of goods and work efficiency have much improved. During the detailed diagnosis), 5S activities were further promoted. (See attached sketch)

■ Other relevant points (issues to be solved and problems remained):

1) To reduce wasteful motion of workers, efforts should start from better housekeeping on the shop floor.
2) Then, the shop layout should be modified to ensure smooth movement of different goods within the shortest possible distance and in a single direction, as designed on the basis of analysis of an actual flow of materials and products.
3) The next step is to clean the shop floor before completion of work in each shift (10 minutes to be reserved for the purpose).
4) It is important to put 5S activities into everyday practice under participation of all workers.

1 Case A

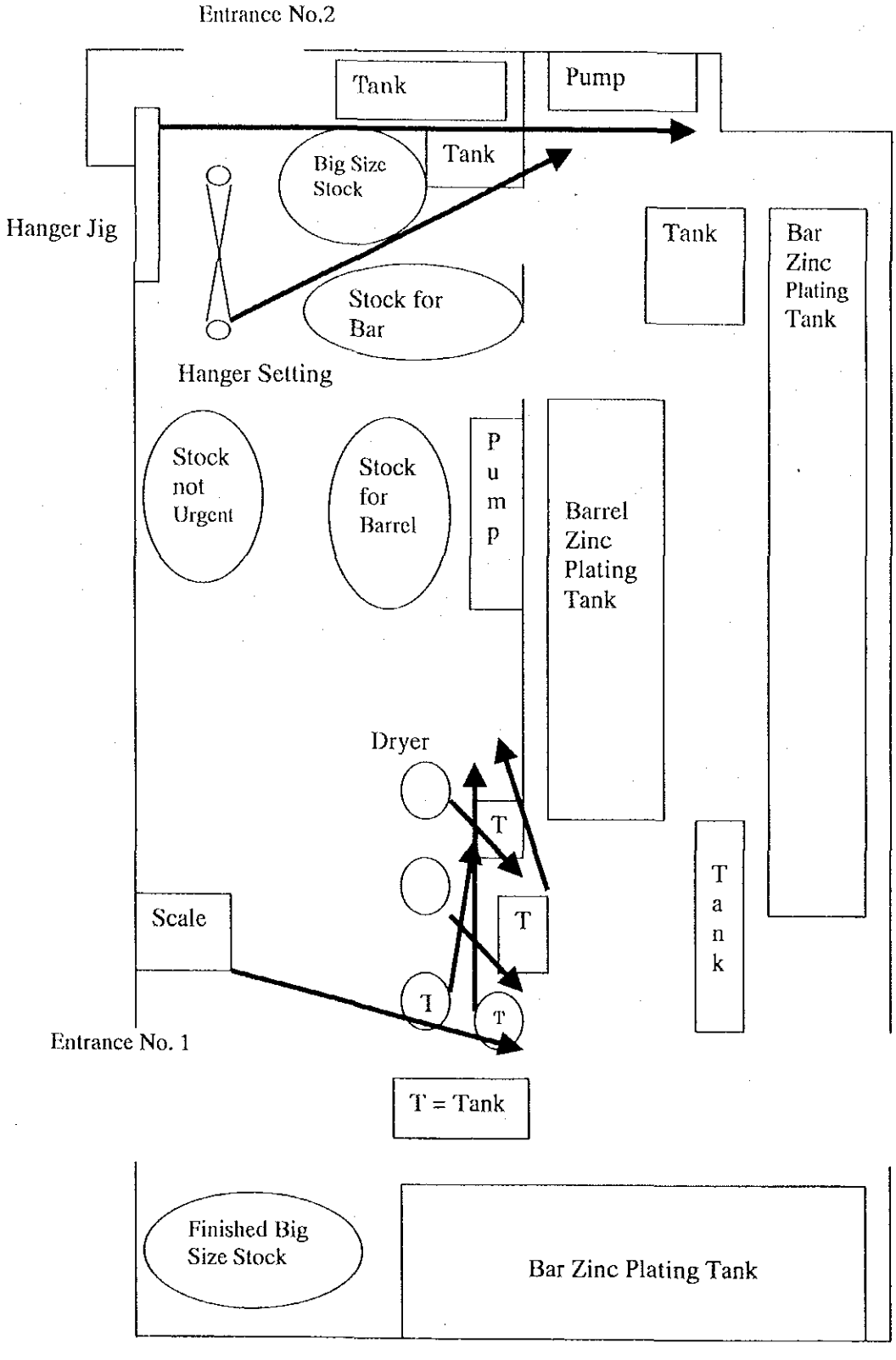
Description of Problem

The layout in the workshop was not efficient (Refer Sketch No.1).

Diagnosis and Recommendation

Practical guidance for layout was given.

Sketch No.1 the Present Layout of Zinc Plating Shop



Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category
MW-5	Production management
2nd category	
5S	

Division / Process	
Galvanizing workshop	
Industry	Sector / Product
Metalworking	Electroplating

Subject

Introduction of 5S activities

■ Diagnosis:

Work pieces are received and shipped at the same entrance, and plated products are kept in the same location as work pieces to be processed. Furthermore, they are not arranged according to size. As a result, smooth movement of work pieces is hindered and it takes time to find a required work piece. Articles that do not seem to be used or are not frequently used are placed in the central part of the factory building to effectively reduce work space. Also, jigging (to attach work pieces to jigs for electroplating in the main tank) is carried out in the same area to further disturb with movement of goods.

The shop layout should be modified to improve the situation, and 5S activities should be introduced to ensure proper housekeeping including systematic storage and cleaning.

■ Guidance:

1) To separate the receiving point and the shipping point so as to create a single direction of each movement;
2) To separate storage for completed products and that for received work pieces;
3) To relocate jogging operation for main tank plating to a location near the main tank;
4) To separate storage for large work pieces and that for small ones to facilitate search;
5) To install racks to store small work pieces;
6) To attach an ID card to each container for ease of identification;
7) To identify and dispose articles that are not used in order to expand work space; and
8) To assort the chemical warehouse.

■ Response of the enterprise (as confirmed during the follow-up activity):

The above recommendations have been mostly implemented. As a result, movement of goods and work efficiency have much improved. During the detailed diagnosis), 5S activities were further promoted. (See attached photographs)

■ Other relevant points (issues to be solved and problems remained):

1) To reduce wasteful motion of workers, efforts should start from better housekeeping on the shop floor.
2) Then, the shop layout should be modified to ensure smooth movement of different goods within the shortest possible distance and in a single direction, as designed on the basis of analysis of an actual flow of materials and products.
3) The next step is to clean the shop floor before completion of work in each shift (10 minutes to be reserved for the purpose).
4) It is important to put 5S activities into everyday practice under participation of all workers.

1 Case A

Description of Problem

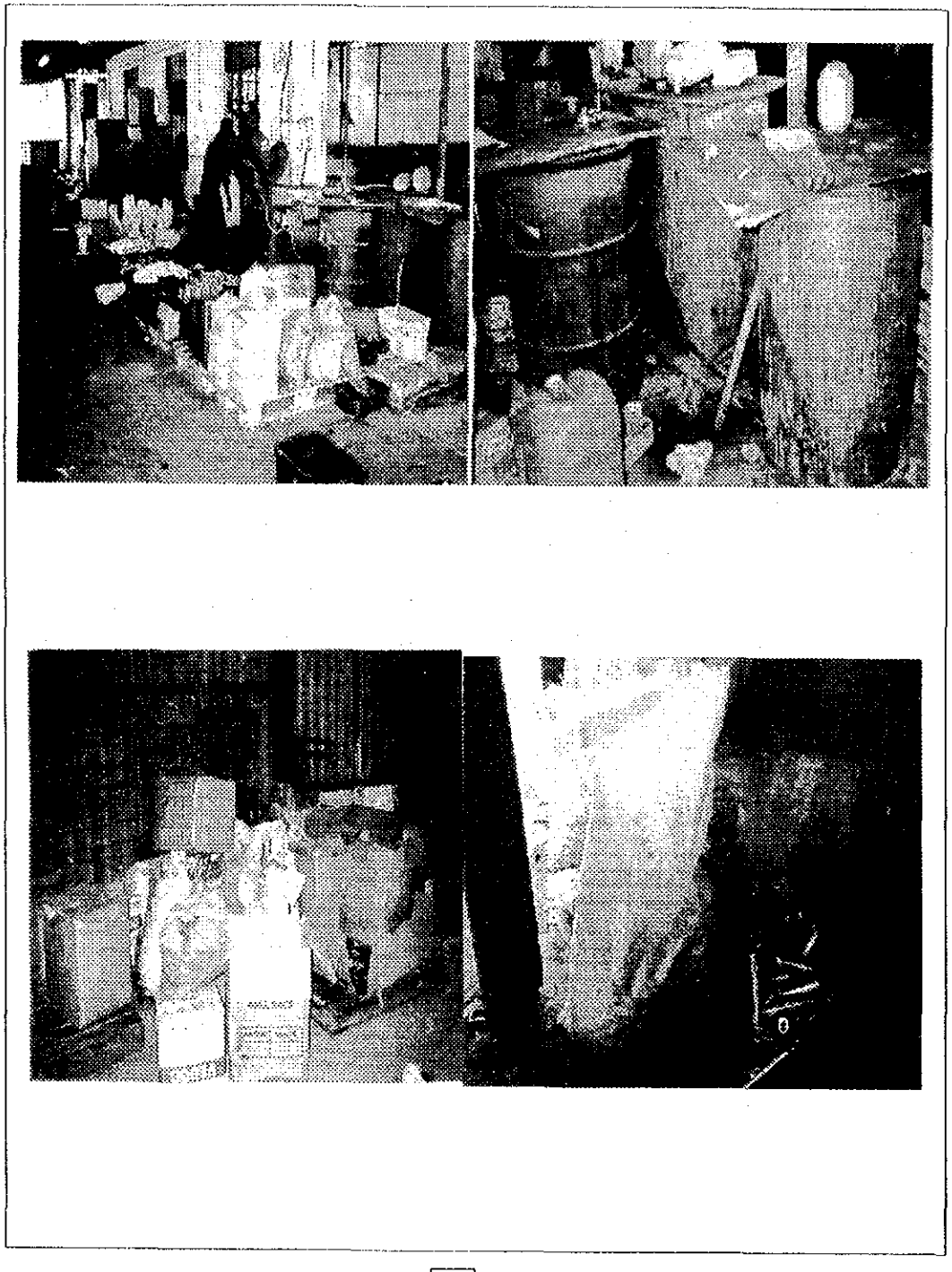
5S was not carried out well.

Diagnosis and Recommendation

Practical guidance for carrying out 5S was given (Refer Photograph 1 to 3).

Photograph No. 1: the State of 5S in the Zinc Plating Shop

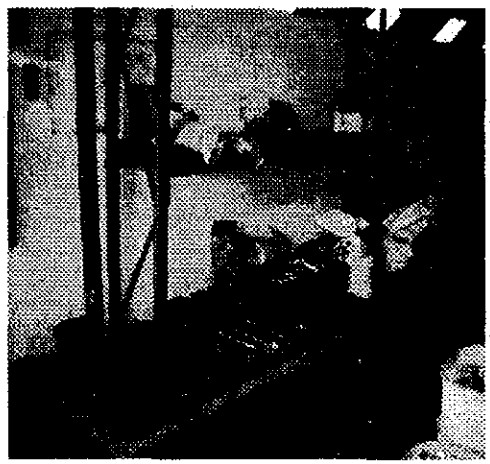
The Previous State of 5S in the Zinc Plating Shop



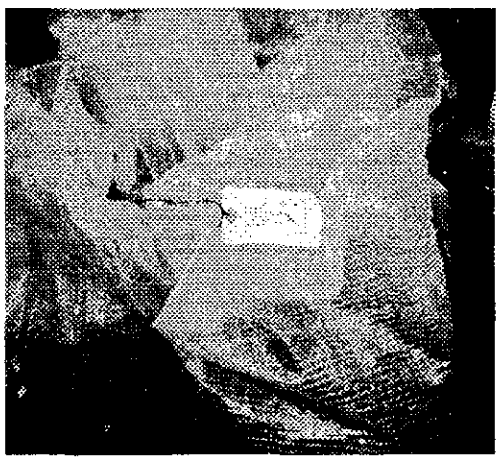
The Present State of 5S in the Zinc Plating Shop

The drums used on a less frequent Were moved to another place

Road and Goods storage areas were clearly separated by yellow line



A shelf were installed beside of the Wall for small size goods



A job thicket is attaché on every package for easy identification

Photograph No. 2: the Improved Housekeeping

Incoming Goods storage areas

Alphabet A B C D are indicated on the floor

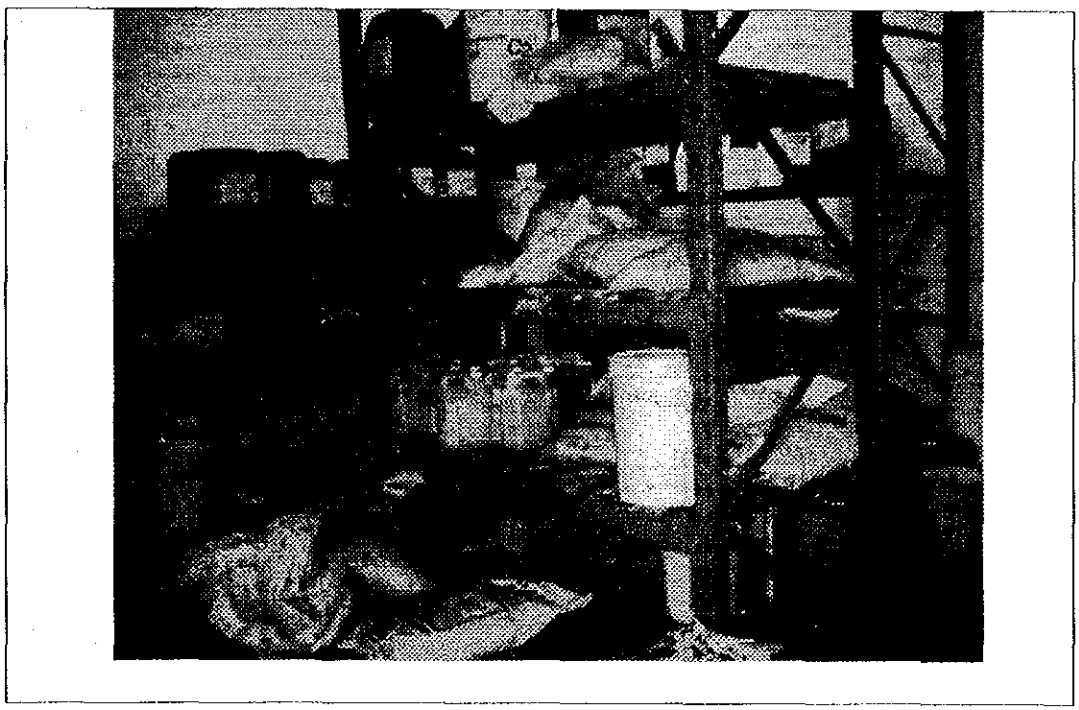
Outgoing Goods storage areas

Number 1 2 3 4 are indicated on the floor

Photograph No. 3: the State of 5S in the Chemical Store

The Previous State of 5S in the Chemical Store

The Present State of 5S in the Chemical Store



Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-6	Production management	Galvanizing workshop	
2nd category		Industry	Sector / Product
Work management		Metalworking	Electroplating

Subject

Improvement of the jogging method

■ Diagnosis:

A work piece is attached to a plating hanger one by one, using steel wire. It takes considerable time to attach and detach work pieces. Work efficiency should be improved by providing a specially designed jig to allow quick attaching and detaching of a work piece.

■ Guidance:

1) To design and make "S" shaped or "C" shaped jigs according to the shape of each work piece.
2) At present, the manager designs a jig for a new product, which is made by the maintenance shop and is furnished to the plating shop. However, quantity is not sufficient and steel wire continues to be used for jigging. Foremen in the plating shop complaint that the maintenance shop does not make jigs despite their request. It was advised to establish an internal rule for making of special jigs to assure availability according to the needs.

■ Response of the enterprise (as confirmed during the follow-up activity):

During the follow-up survey, steel wire was still used for many jigging operations. During the detailed diagnosis, special jigs were increased and the rule was established. (See attached photographs)

■ Other relevant points (issues to be solved and problems remained):

It is important to make a special jig for work pieces that are received in specific quantities, which helps improve work efficiency. As field workers tend to insist on the traditional work method, improvement measures should be planned and executed on the basis of detailed analysis of current problems.

1 Case A

Description of Problems

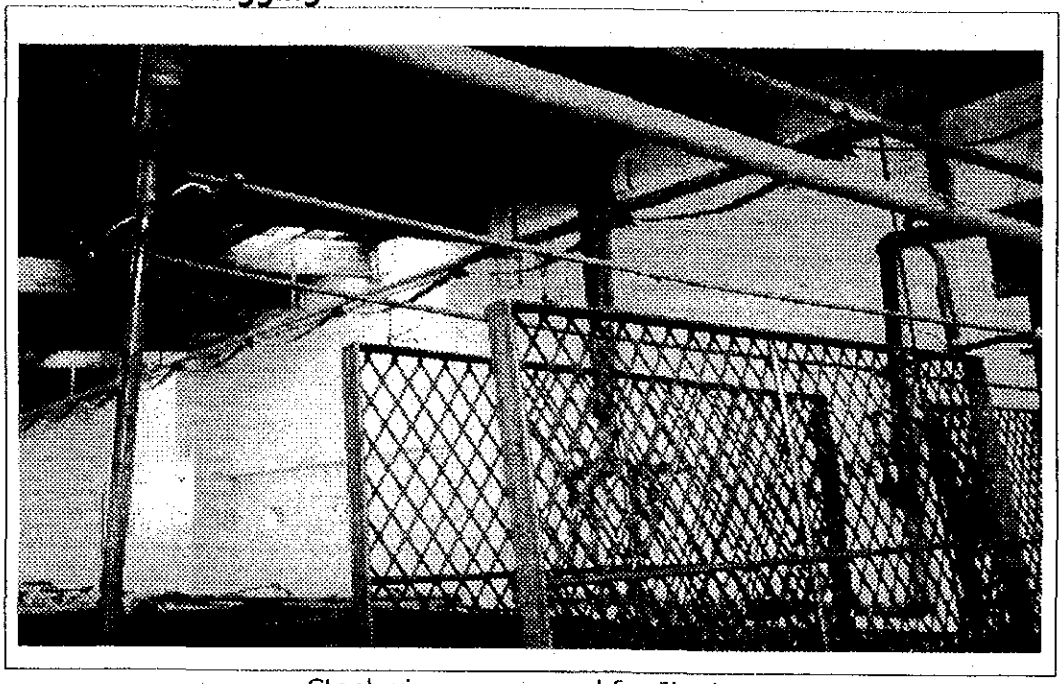
Some un-plated products are hanged on the hanger with wire. This method is unproductive.

Diagnosis and Recommendation

Products which can be hanged with a hook should not be hanged with wire at all. By using hooks productivity will increase. The hooks should be stored in an easily accessible manner at a designated place.

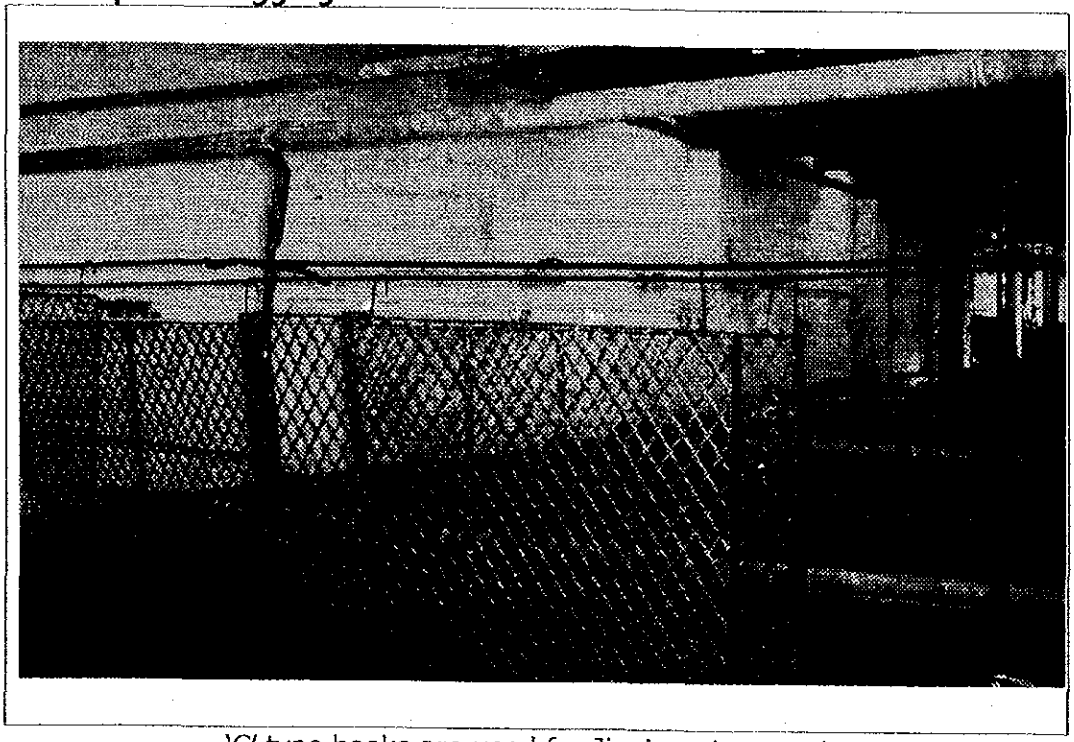
Photograph: Improvement of the Jigging Method

The Previous Jigging



Steel wires were used for Jigging

The Improved Jigging



'C' type hooks are used for Jigging at present

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-7	Production management	Brass die-casting workshop	
2nd category		Industry	Sector / Product
Quality control		Metalworking	Die-casting

Subject

Reduction of percentage defective

■ Diagnosis:

When the study team visited the company for preliminary diagnosis, the manager did not have detailed defect data because he believed that defective castings could be reused by molting. While he estimated the percentage defective at around 10%, the study team observed that 33 out of 120 castings were rejected (27.5%) and returned to a retaining furnace. Given the high percentage observed during the brief visit, an actual percentage defective would be much higher than the estimate.

While defective products are reusable, they incur additional costs, including the electricity charge for melting, labor and consumable costs for melting and casting, and thus reduction of the percentage defective is a critical factor for the company's management.

■ Guidance:

1) To collect and record defect data by full-time staff in order to understand the situation accurately;
2) To analyze data and identify major defect phenomena;
3) To identify a cause for each phenomenon and devise corrective measures;
4) To learn about the use of QC techniques for data analysis, identification of cause, and the development of corrective measures (taught in the form of lecture and practical training);
5) To count the number of defects found in final inspection by type (phenomenon); and
6) To prepare boundary samples for appearance inspection to prevent variation of judgment results among inspectors.

■ Response of the enterprise (as confirmed during the follow-up activity):

The above recommendations were mostly implemented at the time of the following survey. During the detailed diagnosis, an implementation plan for defect control measures was established using QC techniques. The company plans to implement an action plan on its own.

■ Other relevant points (issues to be solved and problems remained):

Critical for proper factory management is a continuous cycle of problem identification, planning of corrective measures, execution, and evaluation of results. The company is now expected to execute its action plan to reduce the percentage defective in an effective manner.

1 Case A

Description of Problems

There were many defects produced in casting.

Diagnosis and Recommendation

- Install easy counter meters and collect the rejected quantity. The cause of the number of variations in the reject quantity for every shot must be analyzed (See Attachment A).

- It is necessary to collect rejected quantities from every inspection process at each shift, and to analyse the causes of the rejects. The countermeasures to the reject should be token on the basis of causes analysis (See Attachment B).

- Improving the registration of classification of castings (See Attachment C).

- How to analyze and classify the data of defective castings (See Attachment D).

- Suggestions for how to decrease the defective castings (See Attachment E).

Attachment A Inspection Record on Die Casting Process

Name of Product						Inspector					
Machine No.						Checker					
Die No.			Numbers of Cavity			Cause of rejects					
Date	Shift	Numbers of Shot	Numbers of Cast	Numbers of Rejects	Rejective Rate (%)	Misrun	Cold shut	Off dimension	Inclusion	Others	
Weekly Total											

Attachment B-1 Inspection Record on Dimensional Inspection with Gauge

Name of Product							Inspector				
							Checker				
Date	Shift	Numbers of Inspection	Numbers of Rejects	Rejective Rate (%)	Cause of rejects						
					Off dimensio	Cold shut	Inclusion	Others			
Weekly Total											

Attachment B-2 Inspection Record on Visual Inspection

Name of Product							Inspector				
							Checker				
Date	Shift	Numbers of Inspection	Numbers of Rejects	Rejective Rate (%)	Cause of rejects						
					Craking	Cold shut	Inclusion	Others			
Weekly Total											

CATEGORY OF SHOT CASTINGS

Total Cast Quantity [12 pieces × The number of shot]					
Rejected Castings			Castings used other purpose		Good Castings
Caused by the mistake of operator (A)	Caused by the mistake of operator and/or the poor maintenance of die (A/B)	Caused by the poor maintenance of die (B)	Worming up shot of Die (C)	Samples for inspection (D)	
Should be counted as Reject			Should be counted as Others		Should be counted as Good Castings

Rejected Castings

(A)
- *Die Lube (Excess die lube)
- *Small Slug (Lack pouring metal)
- *Dropped in tray
- *Porosity (Lack pouring metal/Excess piston lube/Molten metal)

(A/B)
- *Stuck on the die (Lack die lube/Heat check/Temp. of die and molten metal)
- *Slug stuck on the tip of piston (Lack of lube/Heat check/Temp. of molten metal)
- *Fell off (Lack die cleaning/Heat check/Temp. of die)
- *Distortion = Bent Casting (Lack die cleaning/Heat check/Temp. of die)
- *Surface finish = Rough surface (Lack die cleaning)
- *Cracked

(B)
- *Problem of dimension
- *Heat check

Castings used other purpose

(C)
- *Worming up shot of Die (Uniformity of temperature of die)

(D)
- *Samples for cutting test (Porosity)
- *Samples for dimensional test (Accuracy)

Attachment C

Attachment D

29.10.2001

Questionnaire

1. What means the numerical value written down in the "Cmu Shots" column?

2. Does "S/lube" mean Sleeve lube?

3. What thing is Beep?

   Although two kinds of marks are registered in the column of "Beep", are their meanings different?

4. Reject codes
   4-1. What defect is "Die lube"?

   4-2. What defect is "Fell off"?

   4-3. What defect is "Surface finish"?

   4-4. What defect is "Distortion"?

      4-4-1. Why do you think "Excess die lube" is done?

      4-4-2. How is "timing of spray" decided?

         - have you any standard?
         - Is it left to judgment of a worker?

      4-4-3. How is the length of spray time (volume of lube) decided?

         - have you any standard?
         - Is it left to judgment of a worker?

   4-5. What defect is "Bent castings"?

5. Why does Core finish happen?

6. Although Cavity occurring defect in the same die is changed, why do you think it changes?

How to decrease the defective outputs/phenomena?

1. Have an accurate grasp and keep records of the defective outputs/phenomena together with the conditions of occurrences

What should be recorded?

1-1. Conditions of occurrences

1) Number of rejected outputs, description on defective phenomena, and rates of rejection.
2) Position on the die, where the defect occurred.
3) Distribution of defects among the working time (change in defect occurrence in relationship with the time elapsed since start of the work).

1-2. Working conditions

Be sure to record all the abnormal phenomena and troubles you found, such as:

1) Actions and working methods taken by the operator, when the defect occurred.
2) Condition of the die, and operational condition of casting machine, etc.
3) Condition of holding furnace, and the state of molten metal, lubricant,etc.

2. Make analysis of the defective outputs/phenomena

What should be analyzed?

2-1. Frequency by type of defects

Categorize the defects, and count the number of defects by category based on the date recorded. Visualize the results using the following tools:

1) Total up the data in a table.
2) Express the data in a graph.
3) Make a **Pareto chart.**

2-2. Relationship between the working conditions and the occurrence of defects

Study correlation between the working condition as the possible cause, and the occurrence of defects as the effect, using the following methods:

1) **Stratification**

Stratify the data to identify the correlation between the following:

- Dies used vs. frequency of rejection

  Can you find out any differences in the frequency of rejection among dies of

No. 30, 33, 34 and 36?

- Operators vs. frequency of rejection

  Can you find out any differences in the frequency of rejection among Operators A, B, and C?

- Shifts vs. frequency of rejection

  Can you find out any differences in frequency of rejection between night shift and day shift.

- Working time zone vs. frequency of rejection

  Can you find out any difference in frequency of rejection among the starting 30 shots, shots in the middle of working time zone, and the last 30 shots.

3. Study the cause of defects

3-1. Study the working conditions

Study the difference in the working conditions, if the difference was identified in frequency of rejection among the working conditions, as the results of the data stratification.

3-2. **Cause and Effect Diagram (Fish bone)**

Study the cause of major defective outputs/phenomena using Cause and Effect Diagram (Fish bone).

4. Take action to prevent the defective outputs/phenomena

4-1. Action on the basis of the stratification result

Test operation adapting the working conditions, which was identified as that of less defects on the basis of the stratification study.

4-2. Action on the basis of the study results using Cause and Effect Diagram

Examine the factors technically, which were identified as the possible causes of the defective outputs/phenomena through the analysis of Cause and Effect Diagram. On the basis of results, test operations varying the major influencing factors of working conditions thus identified.

5. Evaluate the actions taken, and standardize the measures

5-1. If the result was satisfactory:

If the defects decrease to a satisfactory level, prepare a working standard

incorporating the working conditions tested.

5-2. If the results are not satisfactory:

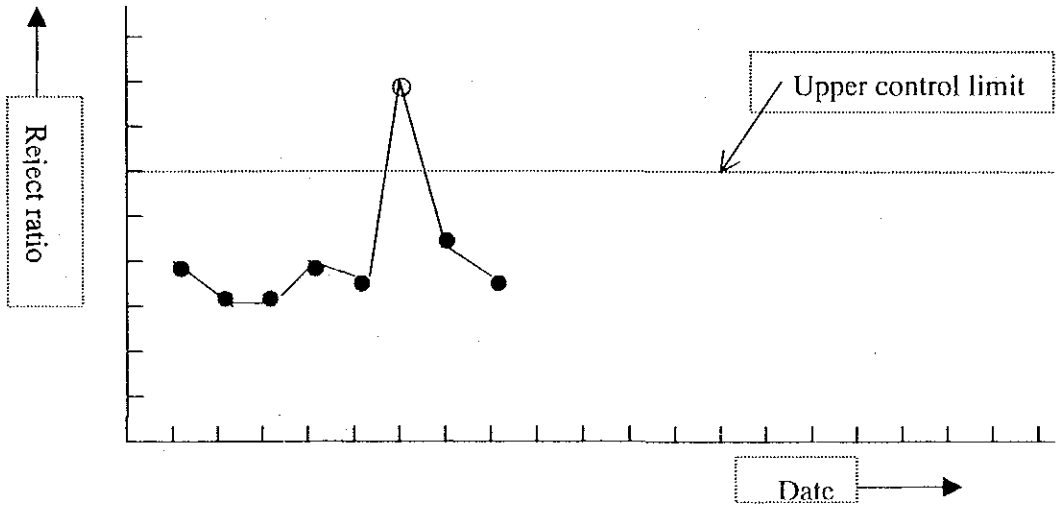
Repeat the tests varying the factors of working conditions, while studying the possible causes of the defects. When the defects decrease to a satisfactory level, prepare a working standard incorporating the working conditions thus obtained.

5-3. Device preventive measures

Besides preparation of the working standard, it is also important to define clearly about the control items, control methods, and responsible supervisors of them, making the QC process flow chart.

6. Process control by means of p chart or reject ratio graph

Control the manufacturing process by daily reject ratio.



When a reject ratio goes over the upper control limit, the manufacturing process should be considered abnormal.

Be sure to analyze the defective outputs/phenomena, after that, make correct countermeasures on the process.

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-8	Production management	Brass die-casting workshop	
2nd category		Industry	Sector / Product
Quality control		Metalworking	Die-casting

Subject

Promotion of quality control using the QC flow sheet

■ Diagnosis:

The company plans to manufacture aluminum die cast, automotive parts and make prototypes. For automotive parts, the ability to secure and assure quality is most important. This should come from quality assurance activities in all production steps. The QC flow sheet is an effective tool to support systematic quality control and it is desirable to establish a quality control system using the QC flow sheet and its related quality control techniques.

■ Guidance:

Field guidance and training is provided in the following areas:
1) Preparation of a production flow sheet for die castings; and
2) Preparation of a QC flow sheet for castings constituting engine parts.

■ Response of the enterprise (as confirmed during the follow-up activity):

During the follow-up survey, the QC flow sheet was not used and a further recommendation was made.

■ Other relevant points (issues to be solved and problems remained):

As the quality control system using the QC flow sheet is considered to be a success factor for production of automotive parts that is planned by the company, it is strongly recommended to introduce the QC flow sheet as the first step.

1 Case A

Description of Problems

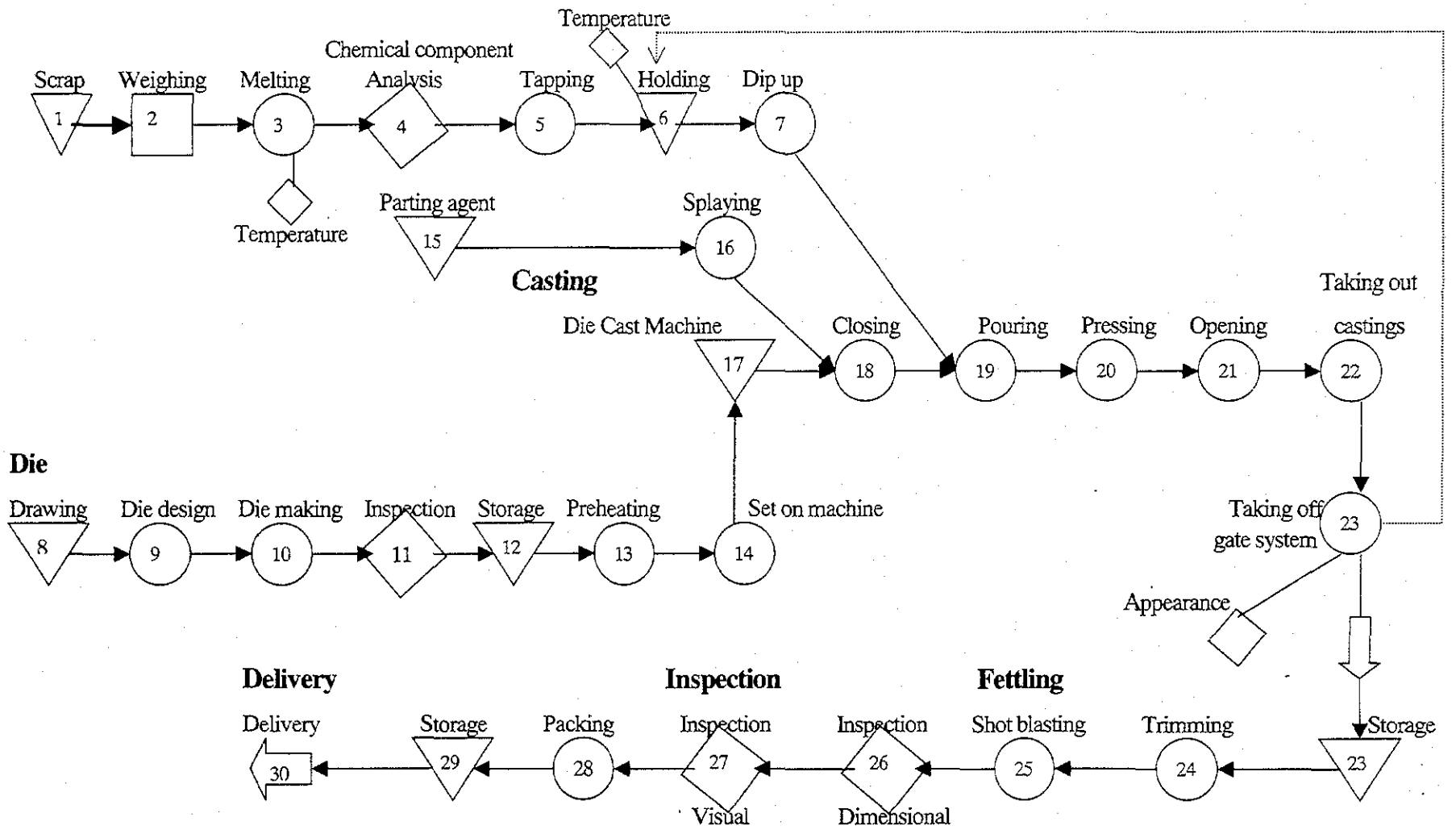
Quality Control based on QC flow sheets was not carried out.

Diagnosis and Recommendation

- It is necessary to make a QC flow sheet and to promote the systematic quality control (Refer Attached Page 1).

- Practical guidance on how to categorize the defective castings (Pareto chart), how to analyze the causes of defects (Cause and Effect Diagram), and how to make the countermeasures for the defects (Refer Attached Page 2 - 8).

Observed Manufacturing Flow Chart



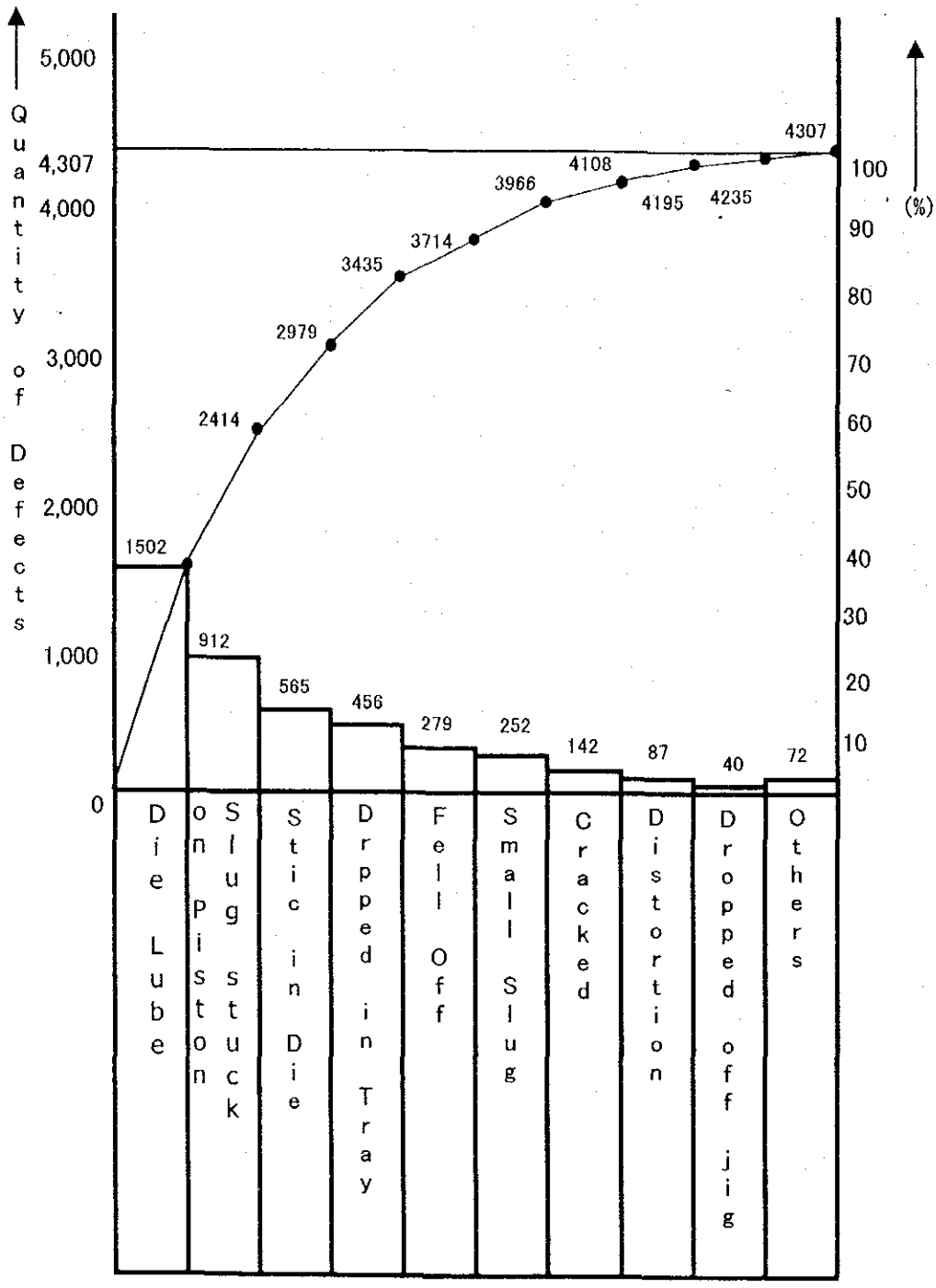
DATA FOR MAKING THE PARETO CHART OF DEFECTS IN CASTING PROCESS

Die No.	Casting Date	Batch No.	Die Lube	Stick in Die	Fell Off	Cracked	Distortion	Dropped in Tray	Slug stuck on Piston	Small Slug	Drapped off jig -	Others e.g. set up surf. Fin	Total	Total Casting	Reject Ratio (%)
34	13.09.'01	R1347	270	77	103	89	2	60	48	24	0	3	676	6,600	10.2
34	170.9.'01	R1380	482	112	30	7	11	120	120	72	1	0	955	6,600	14.5
Sub-total			752	189	133	96	13	180	168	96	1	3	1,631	13,200	12.4
36	19.09.'01	R1384	96	10	25	0	65	36	228	60	22	2	544	6,600	8.2
36	4.10.'01	R1404	59	78	21	46	2	48	144	0	3	19	420	6,600	6.4
36	9.10.'01	R1409	239	147	68	0	1	108	312	12	5	7	899	6,600	13.6
36	11.10.'01	R1413	356	141	32	0	6	84	60	84	9	41	813	6,600	12.3
Sub-total			750	376	146	46	74	276	744	156	39	69	2,676	26,400	10.1
Totat of 34 + 36			1,502	565	279	142	87	456	912	252	40	72	4,307	39,600	10.9
Order of quantity			①	③	⑤	⑦	⑧	④	②	⑥	⑨	⑩			

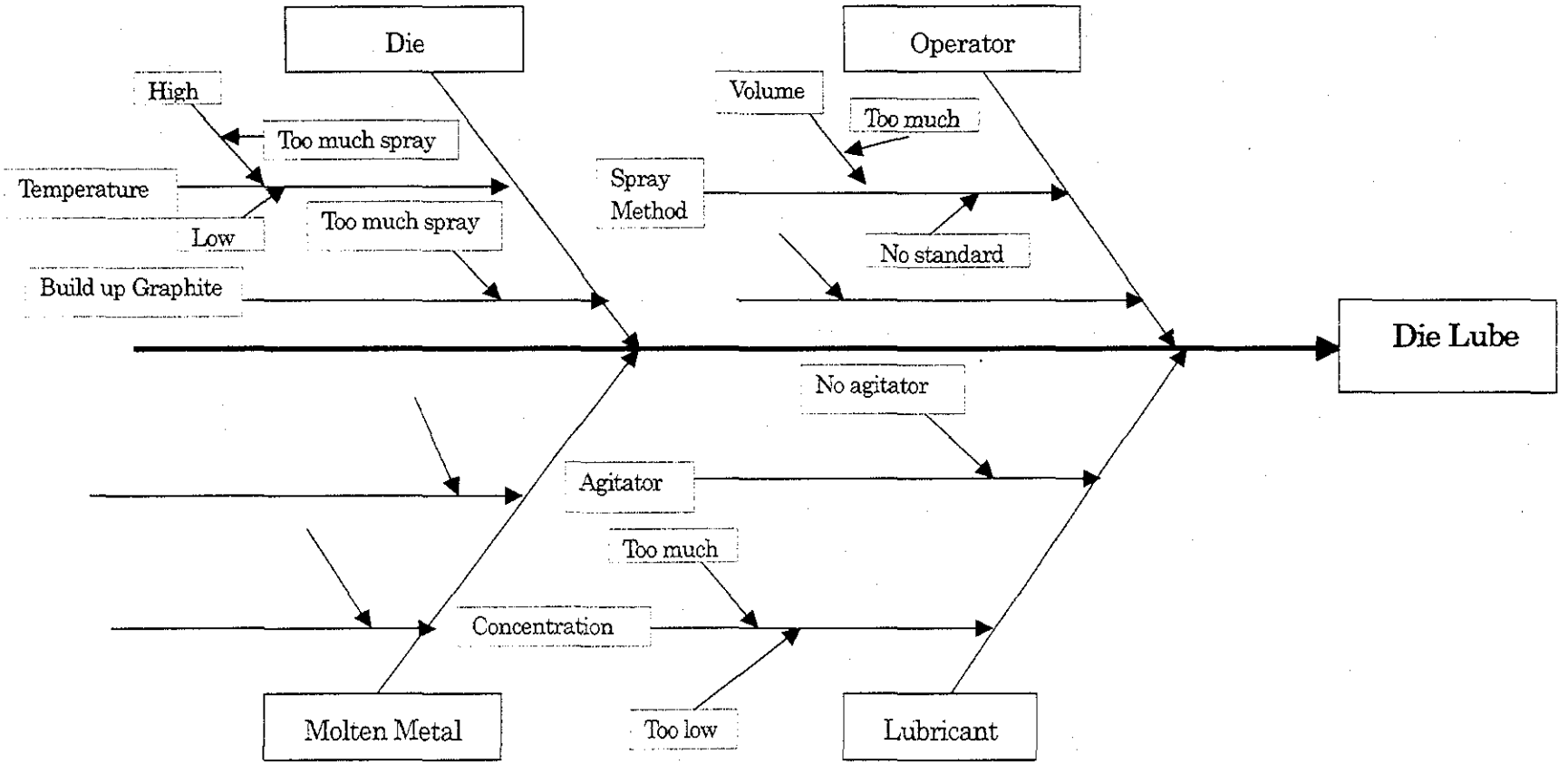
Order of quantity			①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩			
Die No.	Casting Date	Batch No.	Die Lube	Slug stuck on Piston	Stick in Die	Dropped in Tray	Fell Off	Small Slug	Cracked	Distortion	Dropped off jig	Others e.g. set up surf. Fin	Total	Total Casting	Reject Ratio (%)
34	13.09.'01	R1347	270	48	77	60	103	24	89	2	0	3	676	6,600	10.2
34	170.9.'01	R1380	482	120	112	120	30	72	7	11	1	0	955	6,600	14.5
Sub-total			752	168	189	180	133	96	96	13	1	3	1,631	13,200	12.4
36	19.09.'01	R1384	96	228	10	36	25	60	0	65	22	2	544	6,600	8.2
36	4.10.'01	R1404	59	144	78	48	21	0	46	2	3	19	420	6,600	6.4
36	9.10.'01	R1409	239	312	147	108	68	12	0	1	5	7	899	6,600	13.6
36	11.10.'01	R1413	356	60	141	84	32	84	0	6	9	41	813	6,600	12.3
Sub-total			750	744	376	276	146	156	46	74	39	69	2,676	26,400	10.1
Totat of 34 + 36			1,502	912	565	456	279	252	142	87	40	72	4,307	39,600	10.9
Accumulated total			1,502	2,414	2,979	3,435	3,714	3,966	4,108	4,195	4,235	4,307	4,307	39,600	10.9

Attached Page 2

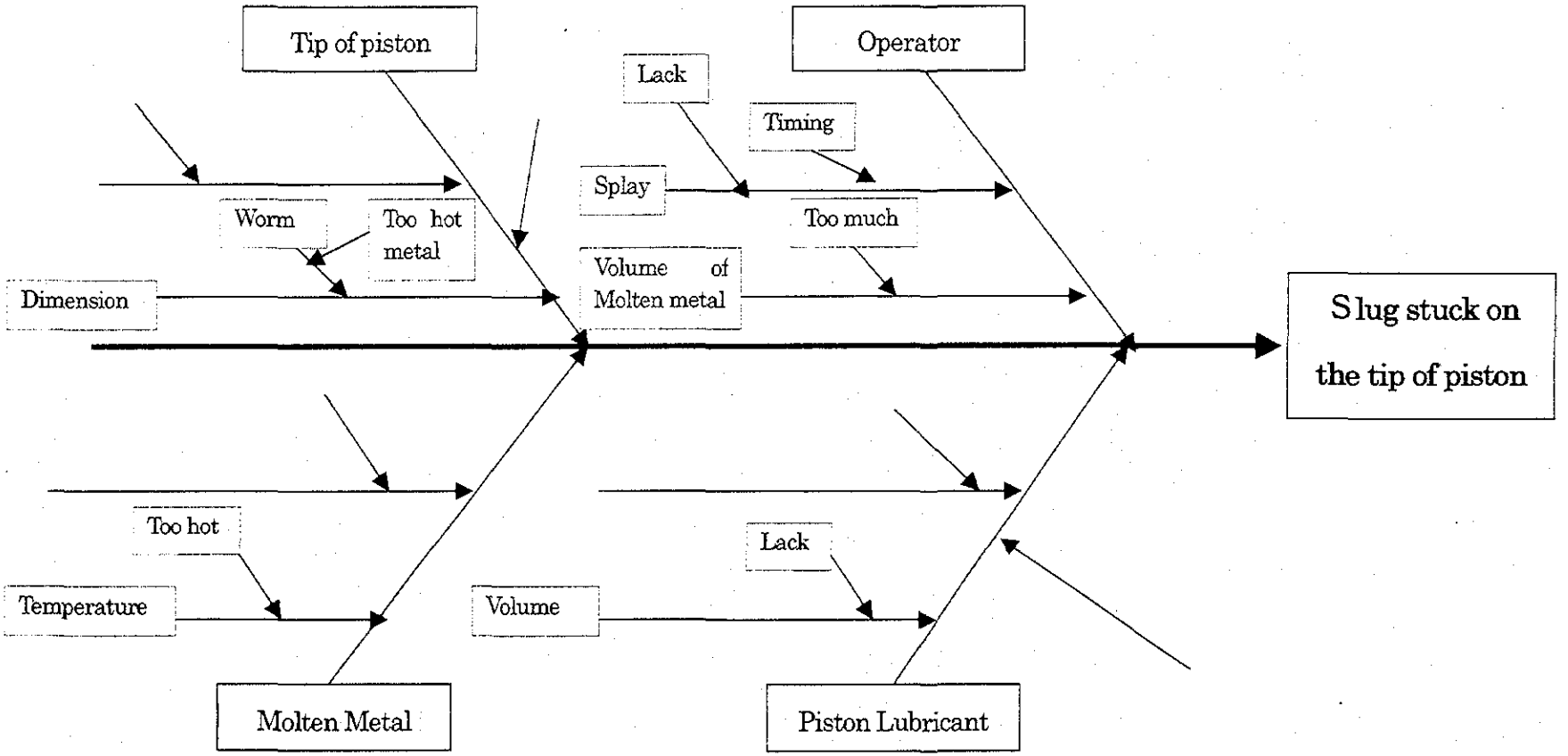
PARETO CHART OF DEFECTS
IN CASTING PROCESS



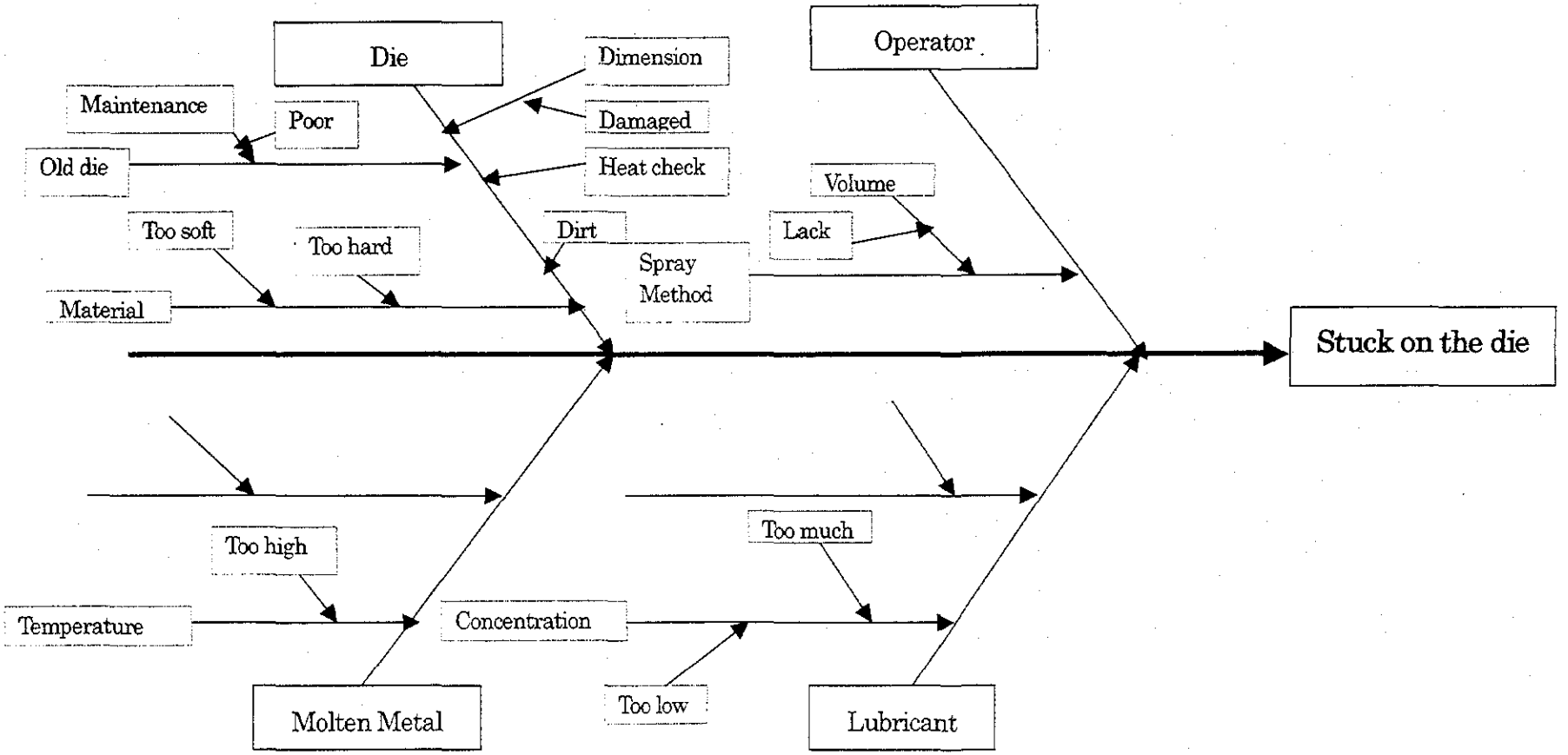
CAUSE AND EFFECT DIAGRAM (No. 1)



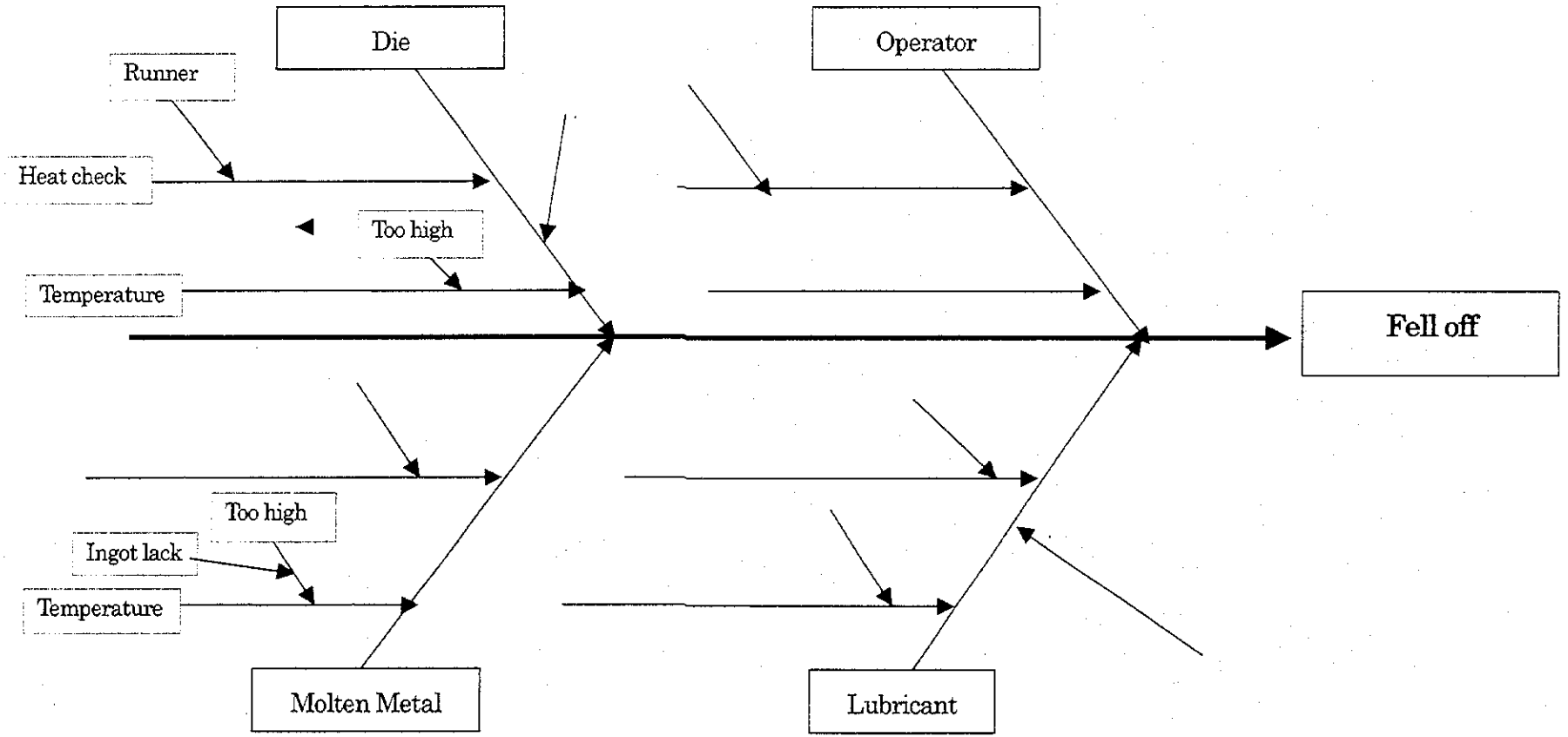
CAUSE AND EFFECT DIAGRAM (No. 3)



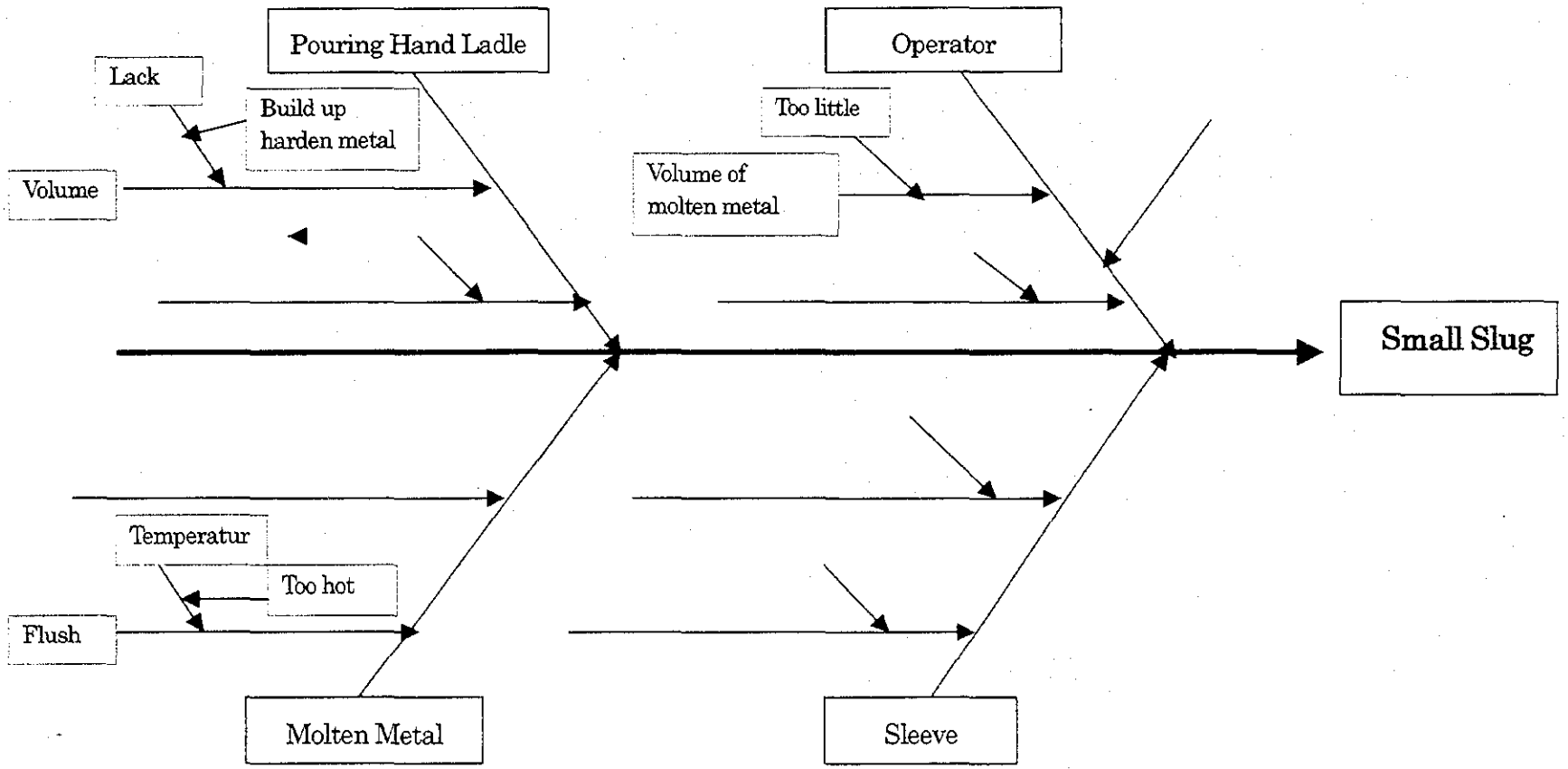
CAUSE AND EFFECT DIAGRAM (No. 5)



CAUSE AND EFFECT DIAGRAM (No. 7)



CAUSE AND EFFECT DIAGRAM (No. 8)



Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category
MW-9	Production management
2nd category	
Work management	

Division / Process	
Brass die-casting workshop	
Industry	Sector / Product
Metalworking	Die-casting

Subject

Establishment of standard work time for the casting process

■ *Diagnosis:*

The company wishes to establish standard work time for casting operations. There are roughly two approaches to this: to determine it from theoretical values and machine performance data; and to set it on the basis of actual data.

■ Guidance:

To conduct time study of the casting process ten times and to obtain the average data, except for anomalous time, and adopt it as standard work time.

■ Response of the enterprise (as confirmed during the follow-up activity):

Time study was performed as recommended and the present work time was estimated.

■ Other relevant points (issues to be solved and problems remained):

If efforts continue on the basis of the present work time data, the company will be able to determine the improvement results in terms of specific value. Notably, the casting cycle time varies greatly with the mold's conditions. It is desirable to maintain the molds in good condition for the benefit of quality improvement, productivity improvement, and the increase in machine's operating efficiency.

1 Case A

Description of Problems

A standard cycle time in the casting process was not set.

Diagnosis and Recommendation

A standard cycle time should be set based on data from the actual production at the workshop. The time should be measured for every work step at 10 times, and the average value is used as a new standard time (See attached Table).

Table: Cycle Time Analysis of Die Casting Process

Date of observation & measurement		Observed and measured product name	
Observed & measured by:		No. of used machine	No. of used die	Used times of die

No. of Work step	Details of work	Duration (second)										
		1	2	3	4	5	6	7	8	9	10	mean
1	Cleaning and Splaying of parting agent											
2	Closing of die											
3	Pouring of molten metal											
4	Press and solidification											
5	Opening of die											
6	Taking out castings											
A	Cycle time (1+2+3+4+5+6)											
B	Total idle time											
	Total Time (A+B)											

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category
MW-10	Production management
2nd category	
Work management	

Division / Process	
Brass die-casting workshop	
Industry	Sector / Product
Metalworking	Die-casting

Subject

Accurate estimation of die casting machines' operating rate

■ Diagnosis:

The operating rate of die casting machines is not accurately estimated. It is one of the essential indices for productivity improvement.

■ Guidance:

Field guidance is given to teach the method for estimating the operating rate.

■ *Response of the enterprise (as confirmed during the follow-up activity):*

The company counts and records the number of shots per hour and shift.

■ Other relevant points (issues to be solved and problems remained):

If efforts continue on the basis of the measured data, the company will be able to determine the improvement results in terms of specific value.
The casting cycle time varies greatly with the mold's conditions. It is desirable to maintain the molds in good condition for the benefit of quality improvement, productivity improvement, and the increase in machine's operating efficiency.

1 Case A

Description of Problems

There were no reliable data on actual working hours for the die-cast machines.

Diagnosis and Recommendation

The number of shots per hour and per shift should be counted and recorded.

1) It is necessary to collect the operating ratio for every shift.
   Real working hours: A= (the number of shots in 1 shift x standard cycle time)
   All working hours: B= (8 hours per 1 shift)
   Operating-ratio = A / B x 100
2) It is necessary to record the number of shots in every hour (See attached Table).

Table: Operation ratio Record on Die Casting Process

Date		Shift	Recorder		
Name of Product				Checker	
Machine No.		Die No.		Numbers of Cavity	

Time	Target Shots (A)	Actual Shots (B)	Operating Ratio (A/B × 100)	Remarks

Remarks; Target shots = 3600 seconds(1Hr) ÷ Standard cycle time

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-11	Production management	Brass die-casting workshop	
2nd category		Industry	Sector / Product
Work management		Metalworking	Die-casting

Subject

Improvement of the work environment in the casting shop

■ Diagnosis:

Smoke comes out of the die casting machine as molten metal is poured and fills the shop. Proper ventilation is required.

■ Guidance:

It is advised to provide a ventilation hood above the mold for the die casting machine and the pouring point where smoke is generated.

■ Response of the enterprise (as confirmed during the follow-up activity):

The ventilation hood has been installed above the mold but is small and does not suck smoke completely.

■ Other relevant points (issues to be solved and problems remained):

The ventilation hood should be expanded to the pouring point for better ventilation.

1 Case A

Description of Problems

The workshop was filled with smoke from the die-cast machines.

Diagnosis and Recommendation

A large ventilating hood should be installed with the die-cast machines.

Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-12	Production management	Brass die-casting workshop	
2nd category		Industry	Sector / Product
5S		Metalworking	Die-casting

Subject

Introduction of 5S practice

■ Diagnosis:

The shop floor is untidy and poorly cleaned. No poster or notice to encourage worker's morale is posted in the shop.

■ Guidance:

(1) To identify and dispose articles that are not used, and collect and assort those in use and store them orderly; and
(2) To plot key production targets and actual data (e.g., percentage defective, production volume and productivity) in a chart or graph, and post it in a visible location to raise awareness of workers.

■ Response of the enterprise (as confirmed during the follow-up activity):

None of the recommendations have been implemented and the manager does not have much interest.

■ Other relevant points (issues to be solved and problems remained):

It is important to motivate the manager to realize the need for 5S activities. He showed some interest in the results achieved by other companies that implemented our recommendations after the detailed diagnosis.
It is recommended to motivate him further by giving a field tour at companies in the "bench club," which conduct 5S and small group activities.

1 Case A

Description of Problems

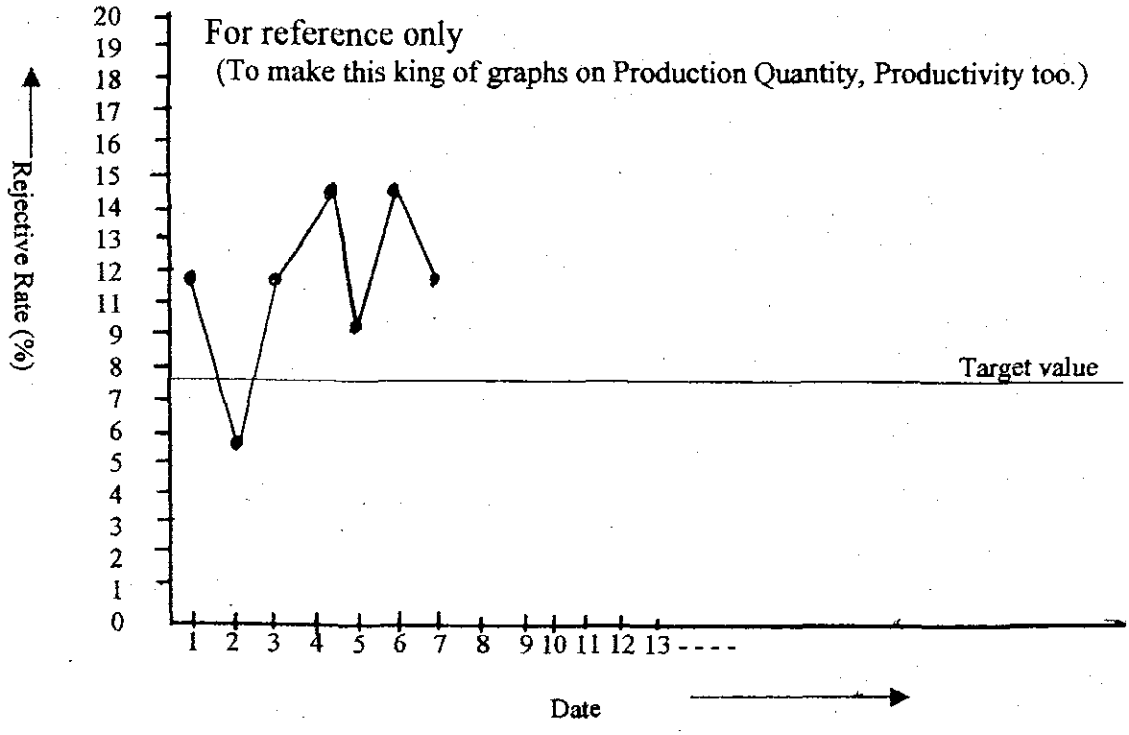
The workshop was not cleaned. There were no posters to raise the morale of workers.

Diagnosis and Recommendation

5S should be introduced with the initiative from management. It is necessary to put up the daily actual result of defective rate, production quantity, and productivity with the target value, on some graphs or sheets in the workshop (See attached Figure).

This will create transparency and improve employee's morale.

Figure Graph to Rejective Rate on Die Casting Process



Case Study Summary of Enterprise Diagnosis and Guidance

Case No.	1st category	Division / Process	
MW-13	Metalworking technology	Brass die-casting workshop	
2nd category		Industry	Sector / Product
Die-casting		Metalworking	Die-casting

Subject

Maintenance of dies

■ Diagnosis:

Approximately 60% of defects are attributable to poor maintenance of dies. To reduce defects, therefore, the highest priority should be given to better maintenance. The more the die is used (increase in the number of shots), the more head cracks occur in the die due to heat from the molten metal. A heat crack makes separation of the product from the die difficult, thus increasing the casting cycle time. The longer cycle time adversely affects the die's head balance and causes various defects.

■ Guidance:

It is recommended to determine a standard die repair cycle on the basis of the relationship between the number of shots and the percentage defective.

■ Response of the enterprise (as confirmed during the follow-up activity):

During the detailed diagnosis, the study team collected and analyzed defect data. It was revealed that the percentage defective for dies with 10,000 or less shots was 13%, those with 19,000 shots 28.8%, and 21,000 shots 31.8%. According to the manager, the die making shop does not have enough capacity to increase the repair frequency, and the problem will be addressed when the shop capacity is expanded in the future.

■ Other relevant points (issues to be solved and problems remained):

Proper maintenance of dies is critical for the die casting process. To reduce the percentage defective significantly, the repair frequency should be increased.

1 Case A

Description of Problems

PDC's biggest bottleneck area is the tool room. Over 60% of the rejects are die related. The data for the time to repair used dies is not understood quantitatively. Cycle time is different on a new die and a used die. In order to decide a reasonable timing on die repair, such data are necessary.

Diagnosis and Recommendation

Dies should be maintained and repaired appropriately. There are seven dies in use at present, which makes it possible to investigate how the cycle time differs on a new die and a used die.

It is necessary to investigate how the cycle time is different on a new die and a die used repeatedly, and to find the proper repairing timing from these data (See attached Figure).

Figure Investigation Records to Cycle time of Die Casting