QUALITY CONTROL IN MIDLAND INDUSTRY

by

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A thesis

submitted to the University of Aston in Birmingham

for the degree of Master of Philosophy

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to my beloved late father

DECLARATION

This dissertation is submitted to the University of Aston in Birmingham in support of my application for admission to the degree of Master of Philosophy. It contains an account of my own work performed at the Depertment of Production Engineering of the University of Aston in the period July 1972 to October 1973 under the general supervision of Mr. J. D. Morrison. No part of it has been used previously in a degree thesis submitted to this or any other University. The work described in this thesis is the result of my own independent research except that the work in Chapter 2 on the literature survey is a review of and a commentary on the current state of quality control achievement in various countries all over the world.

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SUMMARY

The aim of this project is to study the practical techniques and theoretical treatments of quality control in the Midland industries. It involves a survey and analysis of the methods of achieving and maintaining quality and reliability in the products of Midlands' manufacturing companies. The effectiveness of various techniques of quality control is also assessed.

To achieve these objectives, various industries were ~~randomly~~ selected and were classified into groups of homogeneous product. The survey was divided into three phases and consisted of a discussion with the top management, a tour of the plant and the completion of a questionaire.

A brief literature survey of quality control achievement in various countries all over the world was carried out. This provides a possibility of comparing with the data obtained from the industrial visits.

The data obtained during the survey was ~~found to be satisfactory.~~ confirmed by personal contact. The analysis of these data provides a clear view of the actual situation of quality control in the Midland industries. They will provide a useful reference for all industries in the Midlands with regards to quality improvement.

One of the most striking problems in quality control is the quality of the bought out component. It is thus necessary for the supplier to ensure that the incoming components conform to the specification required. The establishment of a National

Quality Mark is suggested. The transformation of Statistical Quality Control to the more effective Total Quality Control System is essential. The implementation of new advanced technology such as computer control system and system engineering techniques are also recommended.

On the whole, quality control has been well performed and great achievements have been obtained in the Midland industries. Further development of quality control activity will certainly lead into another new era in the history of industrial development in the Midland industries.

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CONTENTS

CHAPTER 1 INTRODUCTION

The work mentioned in this thesis is related to the author's background as working and teaching in the field of Quality Control in the industry and the Institute of Technology.

It is after the second World War that the Quality Control came to be stressed in the industry. The contribution of Quality Control to the industry and the education in any part of the world is very important. "Quality Control " is the key word for the present international competitive market. In order to improve our standard of living, we need greater and greater productivity. Quality Control is thus an aid to production and finally to aim at a minimum cost of manufacture by the application of various control methods in Quality. Though Quality Control is a revolutionary philosophy used by the management, however, as human being become more and more developed, there is a need of Quality Control. Therefore, it should be promoted by all people. Since quality of product is growing rapidly, consumer is becoming sensitive of quality and is always seeking for the best return of the money they paid.

Therefore, the consciousness of product quality is manifested in people by the increasing attention paid to the subject of Quality Control in manufacturing industry, resulting in more educated response to quality criteria by consumers.

In a developed or a developing country, the social and economic structure of society needs an interchange of goods and services in order to aim at an organized state of affairs. When these goods and services are exchanged, they require a common

language and criteria for judging, that is standard-quality of these two factors, in order to judge the value of these two factors and also to confirm the methods by which the two factors can be put to optimum use.

Quality Control is an important means of aiming at scientific, technological and economic progress in all fields of human activities. The formulation and maintenance of Quality Control for industrial purpose is essential for a successful industrialization. Quality Control is an effective means of ensuring the standard of industrial products, as it determines the standard requirements for the whole range of industrial activities from raw material, through semi-finished components to the finished products. Quality control facilitates the internal commerce and also promotes the external trade.

The development of industrializing countries all over the world and the keenness of international competing market have shown that these countries must have high quality of the industrial products if they want to maintain their home markets as well as to hold the export market. Quality Control of product is essential for a successful export promotion since quality of products is a first impression to make or mar the external market. Therefore, Quality Control is an effective tool for which the countries can develop their national economies, achieve economic independence and also hold a respectful position in the international market and also to step up the economic progress and raise the living standard.

In the present days, due to the rapid technological and scientific changes all over the world, we emphasize the tremendous

importance of industry, commerce and engineering. Therefore, Quality Control is important in successfully achieving all these factors.

Therefore, the development of national economy, the increase of competitive high standard of products and the expansion of international export market, are all greatly dependent upon the successful operation of Quality Control.

The techniques for Quality Control management and administration are simple but powerful. These have been widely used in industries all over the world to improve the product quality and to reduce the costs. However, the effectiveness of these tools is dependent upon the understanding of the production and inspection personnels, the engineers and the management.

It is recognised that the manufacture of goods of the required quality as far as the customer is concerned, depends fundamentally on the degree of conformance of the manufactured item to the design as delineated by drawings, specifications or other standards of supply. Therefore, Quality Control is to meet the quality standard or specification, to maintain and improve the level uniformity and the reliability of the quality. Thus this modern Quality Control is not a collection of inspection techniques, but a complete management system in which such things as market research, design, production, inspection, sales and shipping and field feedback are intergral components. Therefore to achieve these aims, it concerns the circle of business process, i.e. research, development, design, production and conveyance, transportation, installation work, regulation and preservation, in order to aim at a reduced prime cost and to assure the time of delivery. The people connected in the circle of business process should be

constantly regulated and kept in good contact.

At present, in either developed or developing industrialization countries, we see the elementary stage of the transformation from the traditional industrial inspection activity into an effective Quality Control system. However, still a small number of manufacturers through out the world operate the formal Quality Control objectives.

We also observe in some advanced industrialized countries how and why the original idea of statistical Quality Control has been transformed to the new idea of total Quality Control. Moveover, the characteristics of these two different ideas of Quality Control, especially the notion and the systems of information, have attached to each of them.

When we refer back to the original state of Shewhart Principles of statistical quality control, a large emphasis was placed on the implication of the applications of statistical methods to Quality Control. The applicability of statistical approaches to industrial engineering production were implemented based on the approximate admissibility of introducing probability theory into the actual production circumstances by which to interpret fluctuation of product qualities during production. This probability theory implemented to the production include the Normal, Binomial and Poisson distributions; sampling theory; curve fitting; regression and correlation; analysis of variance, etc. It may be true enough to say that without statistical methods, no systematic and scientific approaches to quality control would have been introduced.

From the accumulation of experience in various industries throughout the world, we realise that the implications of this new advanced powerful technique of total quality control has caused

remarkable results. The impact of total quality control on the philosophy and operation of modern management has already been recognized as one of the major new areas of the modern management.

There are three main trends contributing to the major significance of total quality control. Firstly, the modern market places have changed from the price competition alone to the equally intensive competition in product quality; secondly is to aim at the production as well as the cost reductions, and lastly is the quality costs.

The concept of Total Quality Control covers all the stages of manufacturing from the purchasing of the materials and machine to the selling of the finished products. To obtain the effectiveness of Total Quality Control in better product quality and lower quality cost, it must be applied equally to all the stages of manufacturing from the raw material to the consumer where the finished products are sold. As a result, it achieves better utilisation of resources at all stages of processing and ensures the steady flow of a larger volume of products of acceptable quality. It must be appreciated by the whole organization from the top management to the shopfloor worker. Therefore, it involves all the personnels associated with purchasing, designing, processing, inspection and selling in respect of quality consciousness.

Essentially, the new concepts of Total Quality Control include policy of the company, adequate specification of requirement, proving manufacturing data and design, planning to maintain quality, purchasing, vendor rating, planning for consistant production, supervision, process control, quality audit, production permits and concessions, packaging and despatch, after sales service, control of quality and reliability costs, reporting and

interpreting the figures, cost of Quality Control, analysing customer complaints, quality evaluation and integration of the Quality Control team, etc.

Quality Control in most industries in the world is creating new and greater demands. People search for tighter control checks and assurance on the products. They want more information and want it faster. They require the information degested and coordinated better, and thus they demand better records on this important work. Today the control computer system which is a powerful equipment and techniques are available for product Quality Control. In some of the advanced industrialized countries, computer has widely been used for Quality Control purposes. We realize in some industries, the purpose of the computer system has been used in reducing the indirect-job workers, in improving the accuracy of obtained Quality Control reports, in saving time, and in increasing the quality and density in Quality Control information. And then it was aimed to achieve and enlarge the application in order to increase various information. Thus, it also assists operators and engineers in relieving them from trouble~~some~~ in checking and judging from a large amount of data. The quality check in individual device has been able to be performed without any kind of mistakes with computerization.

Today the control computer systems are used in many kinds of applications, not only for controlling processes in such industries as steel, paper, aluminium, petroleum, chemical and power generation (conventional and nuclear), but also for production scheduling, inventory control, warehousing, sales forecasting, environmental control, production control and, more recently, for the field of Quality Control

Therefore, the application of computer system to quality control is a means of obtaining better control, lower cost, better failure analysis data, higher reliability and utilimately, wider product acceptance by people. Thus, the application of Quality Control with computerization has been widely adopted by the present industry.

System Engineering[1] is defined as that branch of engineering specifically concerned with the application of scientific knowledge to the design and creation of groups of interacting human and/or machine elements, directed by information, which operate on and/or direct material, information, energy, and/or human to achieve a common specific purpose or objective.

System Engineering is divided into six major areas :

(1) Systems analysis.

(2) Systems programming.

(3) Systems design.

(4) Systems equipment manufacture.

(5) Systems installation and check-out.

(6) Systems service.

Today, many industries increase the close interrelationships between these six areas of system engineering and the work of quality control engineering. Product quality is, of course, one important area where the overall, total systems approach is of major significance. In attempting to improve the quality of the products and at the same time to reduce the costs of this quality, one must lead in the solution of those system problems which exist in the quality areas of the business. Therefore, some industries are concentrated at the system engineering activity in order to achieve in developing and applying the principles and concepts of

system engineering as they bear upon the field of Quality Control.

The accumulation of experience from the industries has shown that system engineering approach in the case of guidance control units substantially improves the product quality and significantly reduces the quality costs.

In Great Britain, a survey of the present situation and development of Quality Control techniques have been carried out by Dr. B. W. Jenney[2] in 1971. The results of this survey presented a clear view of the actual situation of quality control in Great Britain and showed to all industries the possibilities of quality improvement by knowing their position with respect to the rest of industries.

In Great Britain[3], during the Quality and Reliability Year 1966/67, and since, many firms have achieved substantial economics, while at the same time increased the competitiveness of their products. This has been done by focussing the interest of their own employees and of the employees of the large numbers of firms who support them, on the overall purpose of the enterprise. It is believed that this involvement of the total available work force is essential for the achievement of satisfactory product. Three key words borne in mind by successful managements are Responsibility, Involvement, and Integration.

A typical way in which the importance of defined responsibility has been recognized and implemented in Great Britain is the popular theme "Right First Time"[4]. This implies that in the efficiently managed enterprise, every job will be done correctly from the outset, with no effort wasted on unproductive work. In turn it has led to a realisation that blaming the poor "workmanship" for quality troubles can lead to highly misleading conclusions.

It is now well-established that operator error accounts for between less than 5% and about 25% of the total spoilt work. This figure depends upon the extent to which the process is pre-determined by planning and tooling, or is controlled by the operator himself. The remainder, say 85% of the total, is due to causes which are the responsibility of the management, at every level from foreman to the top.

These causes include poor communications, illegible or unclear drawing, design requirements, inadequate training, inadequate facilities, unsatisfactory working. All of these contribute greatly towards the inability to get the job "right first time."

In Great Britain, the formation of Local Quality and Reliability Groups provided the opportunity to involve senior management. The extent to which this was achieved is shown by the published results of the Quality and Reliability Year[5]. More than 8000 firms representing 40% of the nation's work force in the manufacturing and process industries, participated. Striking economics were effected, and improvements in reliability achieved, even in those firms which are normally considered to be highly efficient. The Service/Industry Conference on the Reliability of Service Equipment, held in London, February 1968, was over-subscribed by 100%. 35% of the industrial attendees were senior executives and 21% of them were company board members.

Another important development has been the growing realisation of the dependence of a primary contractor upon his hundreds of supplying companies. During Quality and Reliability Year, leading firms held conference with their suppliers. This has led to a realisation that the suppliers' responsibilities must be clearly defined, and to be effective, these responsibilities must be laid

down in the contract agreed by the two parties. For the contract to be legally bound, specifications of the performance and of the desired quality must be expressed in measurable terms.

Quality and Reliability Year gave the impetus to a movement which is persisting. By methods adapted to their individual circumstances, firms made arrangements to allow employees to see some thing of the customers' problems. Aircraft engine firms arranged for employees to have flights in aircraft powered by their own products and to visit airforce stations, airports and maintenance depots. Motor vehicle accessory manufacturers arranged visits to car makers, and cultivated the thought that the worker at the next station in the production line was also a customer of the induvidual operative.

Some industry personal pride was developed by giving all employees a clearer idea of their own role in the organization.

Thus, the value of this involvement provides great improvements in morale of employees.

Industrial management requires the cooperation of the efforts of the groups comprising the organization. Therefore the enterprise as a whole can present a united force to compete with other firms. And this requires action to integrate the activities of the individuals and departments in the firm, and also the Vendor firms which supply and support the raw material to the main enterprise.

Therefore to achieve this integration of activity, the planned and systematic pattern of all action is required in British industries.

At the same time, the author has a pleasure in introducing in Chapter 2 briefly the current state of Quality Control that exist in some of the developed and developing countries in the world.

It will provide us a clear picture of how Quality Control is existing in the present world of international competitive market.

England is one of the advanced industrialized countries. We also understand that the Midland area is highly industrialized with both heavy and light industries. It is therefore a great interest to perform this project "Quality Control in Midland Industry".

After this survey, we believe that the summary of the data obtained from the various industries will provide us a clear view of the actual situation of Quality Control that exists in the Midland industries. It will also provide the author an opportunity to learn the practical techniques and theoretical treatments of Quality Control in the Midland industries. This project involves a survey and analysis of the methods of achieving and maintaining quality and reliability in the products of Midland's manufacturing companies. It also includes a study of the practical technique and theoretical treatment of these various techniques with a view to assess their effectiveness.

CHAPTER 2 LITERATURE SURVEY

Introduction

In order to understand the present and future development of Quality Control in the developed and developing countries, the author has undertaken the preparation of this literature survey to study the effect of Quality Control in relation to the people and the culture of the world. It will provide us a clear view to establish principles and to analyse and compare what has been accomplished in the sector of Quality Control.

Every industry-conscious nation has now made substantial efforts in introducing and extending the methods and several developing nations have made appreciable advances.

Quality Control ~~have~~ had vital relationships with methods of modern management, of industrial engineering of statistical quality control and the design of experiments. Therefore a country must find ways to develop a body of practitioners knowledgeable in these and other different phases of professional quality control practice.

In the present survey, thirteen countries have been chosen. The order in which they appeared in the following is based on their geographical location, i.e. America, Australia, Asia, Europe and Africa.

U.S.A.

A young American physicist Dr. Walter A. Shewhat who laid the foundations of Quality Control single-handed and yet in a practically complete form.The American manufacturers of Western Electric Company which has the largest volume of telephone equipments in the world discovered in the early twenties that a great proportion of their products was rejected at the stage of inspection because of poor quality.Dr. Shewhat of the Engineering Department in the Western Electric Company (renamed as the Bell Laboratories in 1925) was requested to carry out research to reduce the large proportion of rejections.As a consequence of his investigations, a report was produced in the same year in which the technique of Statistical Quality Control was introduced in a sufficiently well developed form for practical use.A book titled " Economic Control in Quality of Manufactured product " was published in 1931 which resulted in the advancement of Statistical Quality Control in American industry and world prosperity through Quality Control.

A spectacular advance of Quality Control in American industry began at the onset of the second world war.It came about as a result of the urgent needs to expand the defence production in about 1940. Statistical Quality Control was used on an increasing scale after the war for non-military production in American industry to improve quality and lower the cost of productions.The widespread use of Statistical Quality Control enabled American industry to substain war production and later lead to rapid industrial progress.In 1943, over 8000 people were trained in Statistical Quality Control in higher educational institutions and several thousand more in their

own factories.Altogether around fifteen to sixteen thousand people were trained in order that Statistical Quality Control could be set off in America.

In America,the significant contributions are from people who gather together for the exchange and dissemination of information concerning this new technology.This was the basis for the formation of the American Society for Quality Control in 1946. It was the dedication by a handful of individuals to the proposition that important economic benefits could result from the application of the existing technology.The influence of the society in the intervening 26 years is best acknowledged through its memberships.The majority of the total of over 20,000 individuals have more than a passing interest in the technology.

The vast procurement activity of the American Government and the need for controlled quality of products,especially defence materials,resulted in substantial Government leadership in the application and the expansion of the technique.Responses to their efforts in the past twenty years from industries in the Defence and Aerospace fields is a direct testimony to their influence and effectiveness.

The present position of the American industry is a result of the following factors.Firstly,the vision and courage of the management people to commit available resources to a given problem; secondly,the stimulation brought about by world actions;thirdly, the dedication of people to a new technology;and finally,the very nature of the developing technology which literally exploded in the past twenty years.

Experience from the American industry has shown that well organised, systematic and technically based programs which integrate company quality effort and product conception through product placement in the hands of a customer who remains satisfied represent the practical, economical and effective way to achieve the quality results which are now essential to company-wide health and profitability.

Today, the application of the Total Quality Control[6] has been widely adopted by the American industry. It has ~~not~~ now received the same attention in countries such as Japan. Total Quality Control of American style are greatly emphasized on the following five major scopes :

(1) The Total Control of Quality - Products must be controlled starting from planning and design stage to a trouble-free product being placed in the hands of a customer who remained satisfied.

(2) The Technical Area of Quality Control - The industrial cycle influenced and created the customer satisfaction. There are four main identifications of technical area which put Quality Control to work.

(a) New Design Control

(b) Incoming Material Control

(c) Product Control

(d) Special Process Studies.

(3) The Quality System - This system enables the organization to function administratively and technically through the development and maintenance for the company. It includes two most important subsystems : (a) Preproduction Quality Evaluation and (b) Products and Quality Process Planning. It also includes Purchased Material Quality Planning and Control, Quality Information Feedback

,Quality Information Equipment,Quality Training,Orientation and Manpower Development,Post-production Quality Service, Management of the Quality Control Function and Special Quality Studies.

(4) The Technologies of Total Quality Control - The application of technologies will make the quality system real and effective.These technologies include :

(a) Quality Control Engineering

(b) Process Control Engineering

(c) Quality Information Equipment Engineering

(5) The Cost of Quality Control - To achieve a good Total Quality Control program is to attain better quality and lower costs.This Quality Cost includes the following three categories

(a) Failure Costs

(b) Appraisal Costs

(c) Prevention Costs

The sucessful application of Total Quality Control in American industry is one of the significant factor which lead America to become an industrial pioneer of today.

Recently,American industry adopted a new method of System Engineering [7] .This method was regarded as a revolution in Quality Control and Reliability.The Systems approach to Quality Control is one of the most important developments in the Quality field over the past decade.It is likely to become one of the foundations for modern Quality Control and Reliability because of its successful application in American industry.

System Engineering offers new opportunities to meet the

the demands of industry for much improved productivity and profitability and major equipment system for greater effectiveness.Furthermore,the application of Systems principles to Civic operations have already provided the answer to Governmental needs for a continually improving economy in American industry.

One of the large Electronics Company manufacturing complex electronic products have applied both System Engineering Program and Quality Control Engineering.Providing there is a thoroughly structured Total Quality System that fitted properly together all quality elements for the electronic product,one has an integrated operating structure which points to full customer satisfaction at low quality costs.An even more important measurement made of Systems effectiveness is that the Quality and Reliability of the product was much improved and customer satisfaction - in - use was excellent.This is only one of the examples of the results of the partnerships between System Engineering and Quality Engineering.

In conclusion,the application of System Engineering to American industry has made a major impact on Modern Quality Control.

Computer technique [8] has been widely employed by American industry.It has the excellent abilities of performing calculations such as Control Charts,Histograms,Analysis of Variance and Regression Analyses.It is also capable of providing graphical displays. Programs for these techniques are usually available in the form of Package Programs.

Applications of computers to Process Control have become established in the past seven years.The results are a great increase in productivity in American industry.Some of the applications

of computers to automation in American industry are :

(i) Automatic Transmission Testing.

(ii) Transmission Valve Body Testing.

(iii) Distribution Adjustment and Test.

(iv) Engine (hot) Testing.

(v) Carburetor Testing.

(vi) Axle Differential and Carrier Unit Assembly.

(vii) Foundry Melt Operations.

(viii) Glass Manufacturing.

(ix) Detail Part Machining (numerical Control).

(x) Rear Axle Testing.

(xi) Torque Convention Balancing.

(xii) Exhaust Emission Analysis.

Some of the operations involved in these applications are :

(i) Machining.

(ii) Assembly of parts.

(iii) Control of Process variables in continuous process.

(iv) Acceptance/rejection testing of functional, closed assemblies.

(v) Adjustment of such assemblies.

(vi) Balancing.

It is well known that in American industry,the application of computers has achieved great labor cost reduction;increased production due to the high speed of computers;improved failure detection resulting from the precision of computers;and major reduction in operator dependence which eliminates human errors.

Zero Defects [9] has been successful in sectors of American

industry. The concept of Zero Defects in American industry is to promote a constant conscious desire to do a job right the first time. To-day, Zero Defects is a standard for Management, a standard that Management can convey to the employees to help them to decide to "Do the job right at the first time".

Education and Training Programme of Quality Control in American Industry[10-13] - Quality Control is regarded as one of the major subject in the curriculum in Economic and Engineering Course for the undergraduate study in American Universities. There also exists well extablished advanced degree courses. An established course of Master of Science Degree in Engineering with the major field designation of "Reliability and Quality Engineering" was introduced together with the "Advanced Statistical Quality Control" degrees granted by some Universities.

In America, the Department of Defence has played a significant role for training in Quality Control. The demand for specialized and skillful Quality Control personnel in the department of Defence stems from the type of supplies, armament and equipments needed by the military. And also the methods utilized in protecting the quality and reliability of material throughout the design, procurement, storage, maintenance and the use-phase of the life cycle of the military equipment have provided a strong impetus for the Department of Defence to establish Quality Control training and career development programme. Also for this purpose, a military specification (MIL - Q - 9858) entitled " Quality Control System Requirements"[14] and a Quality Control and Reliability Handbook was published for the broad

utilization throughout the Department of Defense.

The private enterprise of the American industry has provided the in-plant training course for employees within the company.

Since the very beginning of the American Society for Quality Control,local sections and specialized groups of the Society have conducted training courses in Statistical Quality Control.An annual National Technical Conference Transcctions which is conducted by the American Society for Quality Control is well known throughout the world.It has played a very important role in the promotion of Quality Control not only for their nation but also to contribute the best knowledge of Quality Control to the world.

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AUSTRALIA

The significance of the Total Quality Control as a management system and the application of modern Quality Control techniques have an increasing attention in Australia due to the rapid expansion of industrialisation. According to the official statistical records of 1967/1968, in the total of 62967 factories, 92% of these factories employed less than 50 workers, 278 factories employed over 500 workers and only 91 factories employed over 1000 workers.

In Australia, overseas capital has played a very important role in the development of her industry. Therefore they have had a significant influence on the attitude of Australian industrial management to Quality Control. It is only natural that their work are often based on the policies of their overseas principals and affiliates, and by the activities of National and international organisations operating in the field of Quality Control overseas.

The Australian Defence Production have a great influence on their Quality Control. The main impetus of the Australian industry to the Quality Control Movement has come from the Quality assurance activities of those Government organisations concerned with the procurement of military supplies. One of these organisations which influence the Quality Control generally in Australia is the "Army Inspection Service" formed in 1911 and continued until the present day, and it is the largest organisation in Australia engaged in the Quality Control field. An accept/reject

inspection organisation has operated since 1939 leaning fairly heavily to end product inspection on a 100% basis and engaging in certain incoming material and intermediate product inspection on a somewhat similar basis. There were only few factory in which the inspection departments carried out the inspection job for defence supplies. And the final product Quality depended totally on the screening operations of the Army Inspection Service. The techniques of Statistical Quality Control in Australian industry was a limited ability to comprehend the emerging requirements which were being vigorously introduced by the Ministry of Munitions and the production authorities of the various Government factories. It is believed that the Government instructional courses during 1944 on Statistical Methods of inspection and controlling quality and the application of such methods in the Government factories laid down the foundation of modern Quality Control in Australian Industry. The responsibilities of the manufacturers to control product quality at all stages of production was established since 1950. Therefore a policy which was aimed to make contractors develop effective Quality Control procedures was introduced by the Australian Military Force in 1960, and specification for the Army was promulgated in 1966 to lay down inspection requirements and conditions for industry which produce military defence component and so giving legal emphasis to the Quality Control policy of the Army. And this specification is the same as that of the U.S.A. MIL. Q 9858A, but it concentrates more on the inspection requirements rather than specifically demand a Total Quality Control system as in the U.S.A.

During the World War II, due to the commencement of the Australian Industry in the Aircraft production and that of the Wirraway Project, it was necessary for the Royal Australian

Air Force to formulate its quality assurance activities and inspection was carried out on outside service. Therefore the Aeronautical Inspection Directorate was formed. Originally the organisation adopted the procedures of the United Kingdom A.I.D., and this organisation at present is the branch known as the Quality Control branch, Department of Air, and performed the so called approved Firms System. This scheme functions as a system and with uniform procedures permits the system to operate freely between contractors and sub-contractors. As with the Army and Navy procedures, there is continuous monitoring and surveillance of Quality Control and Product verification appropriate to the projects involved. Quality assurance activities in the Royal Australian Navy are based largely on the British practice. Quality Assurance responsibilities for the Royal Australian Navy are discharged variously by the Naval Ordance Design and Inspection Branch, the overseer and superintendents of Inspection, the Naval Air Engineering oversee organisation, the Inspectors of Victualling stores and the Medical Branch staff. Some attempts have been made to rationalise the activities of the various defence inspectorates in Australia but much remain to be done if it is only required to make for overall efficiency and the elimination of those areas of confusion on the part of contractors arising from the implementation of different policies and procedures relating to Quality Control in the field of defence procurement.

Besides the Defence Production which greatly influences the Australian industry, Australian Post Office operates actively in the Quality Control field on a national basis with an approved Firms scheme which differing in a number of features from the

scheme of the same name operated by the Quality Control Branch, Department of Air. It has also as its basic aim the provision of confidence in the quality of goods produced by a contractor and for which adequately documented evidence is maintained. But in many industries who have unacceptable Quality Control, including those in specilised fields, Government Acceptance Authorities such as the Defence Service Inspectorates and the Australian Post Office have little alternative but to resort to relatively unsophisticated inspection operations. However, the provision of an Acceptable Quality Control system has not been made a mandatory pre-requisite to the awarding of the great majority of Government placed contracts. And emphasis is being placed by those responsible for the Quality Assurance operations of the Government purchasing agencies, on the continued education of Australian Manufacturing industry and its orientation towards the acceptance of the Quality Control message.

The standards of products in Australian Industry is governed by the Standards Association of Australia. Whilst there are a number of trade associations which promulgate their own standards in their respective fields, most of them have the aim of issuing standards in due course under the authority of the Standard Association of Australia (S.A.A.). Other than this, there is an appreciable amount of Australian involvement such as the Defence Services which make extensive use of detailed specifications which may arise out of local design and development or being national and international standards. For example, standards issued by the British Standards Institution, the American Society for Testing

of Materials, and by American and British Defence Authorities are regularly employed. Even the activities of the International Organization for Standardization (I.S.O.) and Authorities with similar aims are also included. A manufacturer has the authority from the Standard Association of Australia to make use of its standard mark subject to the approval of the manufacturer's Quality Control in production and results of independent tests arranged by the Standard Association of Australia. However, the ability to ensure the continued compliance of the products with the required standards is no mean task. There have been suggestions from the Government leaders to institute a National Quality Mark under Government authority. Their ideas have yet to be put into any positive action.

The National Association of Testing Authority (N.A.T.A.) of Australia has become the recognised Australian organization for coordination of testing facilities.It operates through the registration of testing laboratories run by individuals, partners, companies, local Government, State and Commonwealth Departments. It is an independent non-profit association with about 85 % of its revenue provided by the Australian Government. It registers laboratories which meet its required standard of performance and endorses test certificates issued by the authorities. The National Association of Testing assures the qualifications and experience of staffs, laboratory practice, equipment and its calibrations, laboratory accomodation etc.. It also conducts regular assessment of laboratories to ensure the standard set for registration is maintained. The contribution of the National Association of Testing Authorities has built up and maintain the status of Quality Control

in Australia. At present, the provision of the National Association of Testing Authorities certificates is a mandatory provision for many purchase specifications and this demonstrates the high order of its effectiveness.

The participation in measurement standards by the Australian Government have been highly effective and overriding. State legislation in the field of measurement standards is carried out in the National Weights and Measures and is being implemented. A hierarchy of prescribed standards and the way they can be measured and the means to measure them are provided for. This gives a unified system of Weights and Measures throughout the country.

The Training and Education of Quality Control in Australia - Australian Industry realize the wider significance of Total Quality Control which embraced both Production/Process Control and Product Quality Assurance. Therefore, the organization of Total Quality Control was formed to educate their members and influencing others as well. Education in Quality Control are actively carried out by some branches of the Institute of Engineering Inspection in Australia which is taking a lead from their parent body in the United Kingdom. Some of the major institutes of technology in Australia have included in their curriculum certificate courses of various topics in the Quality Control field. The Institute of Australian Production Engineers has also contributed to the national interest in Quality Control. A Seminar in Quality Control was held in 1967 and proved to be highly successful. It brought to the attention of the Industrial Engineering branch of the Institute of the Engineers in Australia the importance of dissemination of inform-

ation in Quality Control. A series of lectures on Quality Control was held in 1968 by the Society of Automotive Engineers.

The Non-Destructive Testing Association of Australia was founded in 1965. It has continued to grow from strength to strength through its growing membership. Other trade associations are also anxious to promote a more effective knowledge of Quality Control in their sphere of influence. Their activities and programmes quite often reflect this fact. The Productivity Councils and the Industrial Design Council Australia do not take part in promoting in a practical manner of the relationship of Productivity and Design with Quality Control.

Some essential knowledge and experience of Quality Control have still to be developed. This is the result of the neglect by some of the most successful management consultants over the past 10-15 years in Quality Control. There are only a few specialists working in the field of Total Quality Control in Australia. Dr. J. M. Juran was even invited by the longer established firms' management consultants to visit Australia and the enthusiastic response to his presence was a clear indication of the growing interest on the part of the Australian industrialists.

Due to the improved status of Quality Control in Australian industry, a three men working party of the National Public Service Board was set up to study and report on the inspection services of the Navy, Army, Air and Supplies Departments as well as the Australian Post Office and the Department of Civil Aviation. The new deal was eventuated in 1967 for Quality Assurance Practitioners engaged in the National Public Service. The status of Quality Control as an essential National activity was considerably enhanced.

Australian Industry realized the importance of Quality Control would highlight the absence in Australia, of a National Organisation developed specifically to the promotion of Quality Control in all aspects, and a few enthusiasts who had followed the activities of such overseas organisation as the American Society for Quality Control with more than passing interest. Therefore, with their efforts and through the good offices of the Chamber of Manufacturers, the Australian Organisation for Quality Control was established in 1968, and largely attracted an enthusiastic and influential membership, and enlarging into all major fields of industrial activity in Australia. And a number of activities such as lectures, discussions, training courses and plant visit were engaged in with the overseas organisations.

Regarding the Quality and the Consumer in Australian industry, there has been Government activity operating successfully by the Government authorities under local legislation relating to quality aspects of those products of the Nation's primary industries being exported, such as primarily weights and measures and safety features of a fairly wide field of consumer products. Moving into the wider field of the Quality of Consumer goods and services, Government operates a Consumer Protection Council, and ~~the~~ an extraordinary number and variety of complaints are directed to this body regarding the Quality approach of suppliers. There is also a separate body of Australian Consumer Association which was modelling from the British Consumer's Association. Its monthly journal publishes the results of tests on acquired sample products. These tests cover both locally manufactured and imported products. Still a number of Australian

industries do not implement a formal scheme of Quality Control procedures and aims for their staff to operate, Only few operated Verdor rating systems or otherwise insist on effective Quality Control by their sub-contractors, and only minority of Australian industry would be able to identify the Quality cost such as cost of defects, appraisal and prevention accuracy.

JAPAN

Since World War II, Quality Control movement has been rapidly developed in Japan. During 1946-1950, the studies of Quality Control was started with reference to the book written by W. A. Shewart. In the same time, Control Charts Sampling inspection and other Quality Control methods were introduced. Japanese Industrial Standard was then authorized to encourage the introduction of Quality Control techniques. During 1950-1954, the Statistical Quality Control was introduced, mostly for the engineers. During 1955-1960, Systematic Quality Control was most popularly employed by private enterprises, whereas Quality Control System reinforced with Total Quality Control ideas was introduced to industry. Since then Quality Control has become popular for top and middle Managements. During 1961-1965, Quality Control Circle was greatly emphasized. Since 1966 company-wide Quality Control and applications of computer for Quality Control were largely used by the industries.

In 1950, Statistical Quality Control[16] was introduced and the following modified definition was adopted:

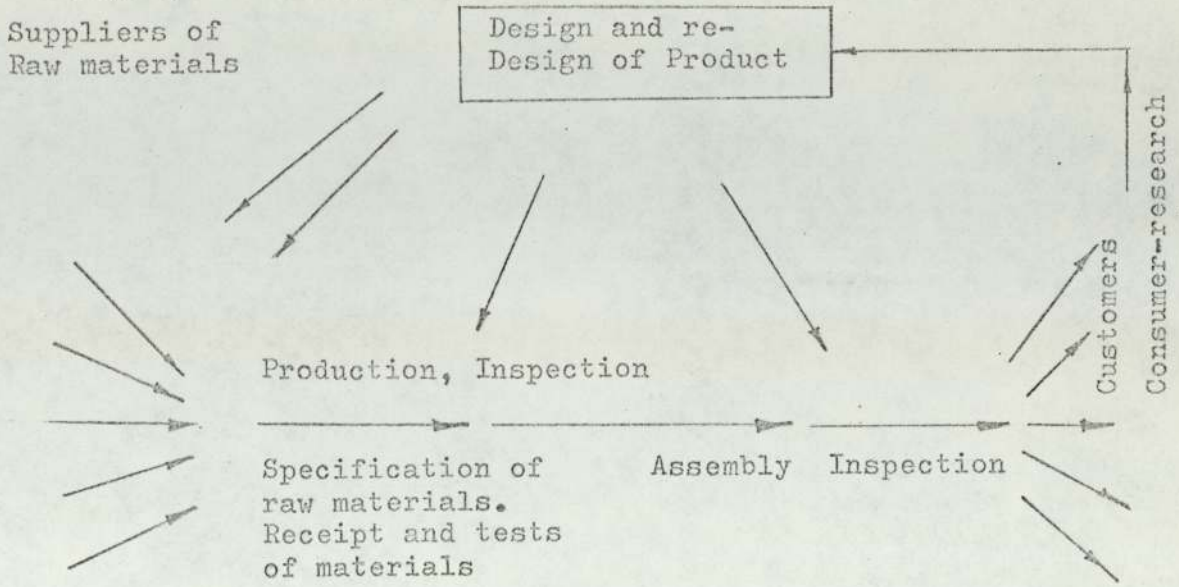
"The Statistical Control of Quality is the application of statistical principles and techniques in all stages of production, directed towards the economic manufacturing of a product that is maximally useful and has a market."

This led the Japanese industries into orbit. By pushing Japanese products to a lead in the world market, this has brought to Japan a great advance in prosperity.

Statistical Control of Quality in Japan covers Planning, Specification, Marketing and Re-design of Product. The cooperation

link work which the Japanese industries work on is shown in the following diagram.

Fig. 1. The cooperation link work of Japanese industry.



Statistical techniques assisted the Japanese industries to achieve the job of management (a) to decide on goals for the future ~~further~~, (b) to make use of knowledge and skills to achieve these aims, (c) to keep the plan flexible so that changes in direction are possible. Therefore the Statistical Quality Control holds a certain responsibilities for management. Fourteen items of statistical methods have been implemented in Japanese industries when Statistical Quality Control was put into action.

The results of applying statistical techniques are spectacular. As remarked by Dr. Deming, the productivity per man-hour has been increased at the end of the first year of application, with little new machinery. For example, one steel company saved 28% on consumption of coal per ton of steel. A big pharmaceutical company put out three times as much finished product per unit of input of raw material. A big cable company reduced greatly the amount of paper and re-work on insulated wire and cable. Many companies reduced accidents to a permanent low level. Improvement in

quality and dependability came in five years later, as predicted. Many Japanese products had earned respect to the point of fear in the world market.

Due to the deep influence of Dr. Deming and Dr. Juran who paid visits to Japanese industries, held seminars and lectures, a switchover from the Statistical Quality Control to Company-wide Quality Control has resulted. The Company-wide Quality Control activity is emphasized on a statistical thinking. Even in the "non-production" departments, statistical approaches are utilized for Quality Control activities.

Company-wide Quality Control[17,18] or Total Quality Control was originally aroused in 1953. It was not until 1966 that it received vast attention and was emphasized by the Japan industries. It covers a wider scope as compared to the American counterpart.

Dr. Juran was invited again as a lecturer to give seminars on Quality Control for top management as well as department and section heads. He stressed the roles in Quality Control in this occassion.

In order to commemorate Dr. Deming's contribution to the Japanese industries, the Deming Prize was established in 1950 to the industry. This has a great effect on promoting the practice of Quality Control in Japanese enterprises. AS the receipt of the Deming Application Prize is considered as the highest honours in Quality Control practice, many industries started Quality Control because of the Prize. Besides this Prize, a screening and citation system existed for the Japanese Industrial Standard Application Fine Works and also other system for screening companies by their suppliers such as the Self-defense Forces, the Japanese National Railways and the Nippon Telegraph and

Telephone Public Corporation. In fact, the Company-wide Quality Control activities are implemented in many cases because of these screening and prize.

Originally, the so-called "bottom-up" management instead of the "top-down" management took place in Japanese industries. Although the Company-wide Quality Control varies from company to company, but the ultimate aim is to establish the structure of a firm through making effects for Quality Assurance and cost reduction.

At the beginning when Statistical Quality Control was ~~only~~ introduced into Japan, the activities were limited to the technical departments and departments of manufacture and inspection. As the importance of company wide Quality Control has been realized, activities have been widely expanded to business, clerical, planning, controlling and other "non-production" departments. All members of the company, from the top management down to the shop-floor employees, participate in all Quality Control activities.

There are two aspects of Company-wide Quality Control, mainly Quality Assurance activities in order to achieve and secure good quality for the product, and management aspects functioning Quality Control activities to aim at structural improvement of a company.

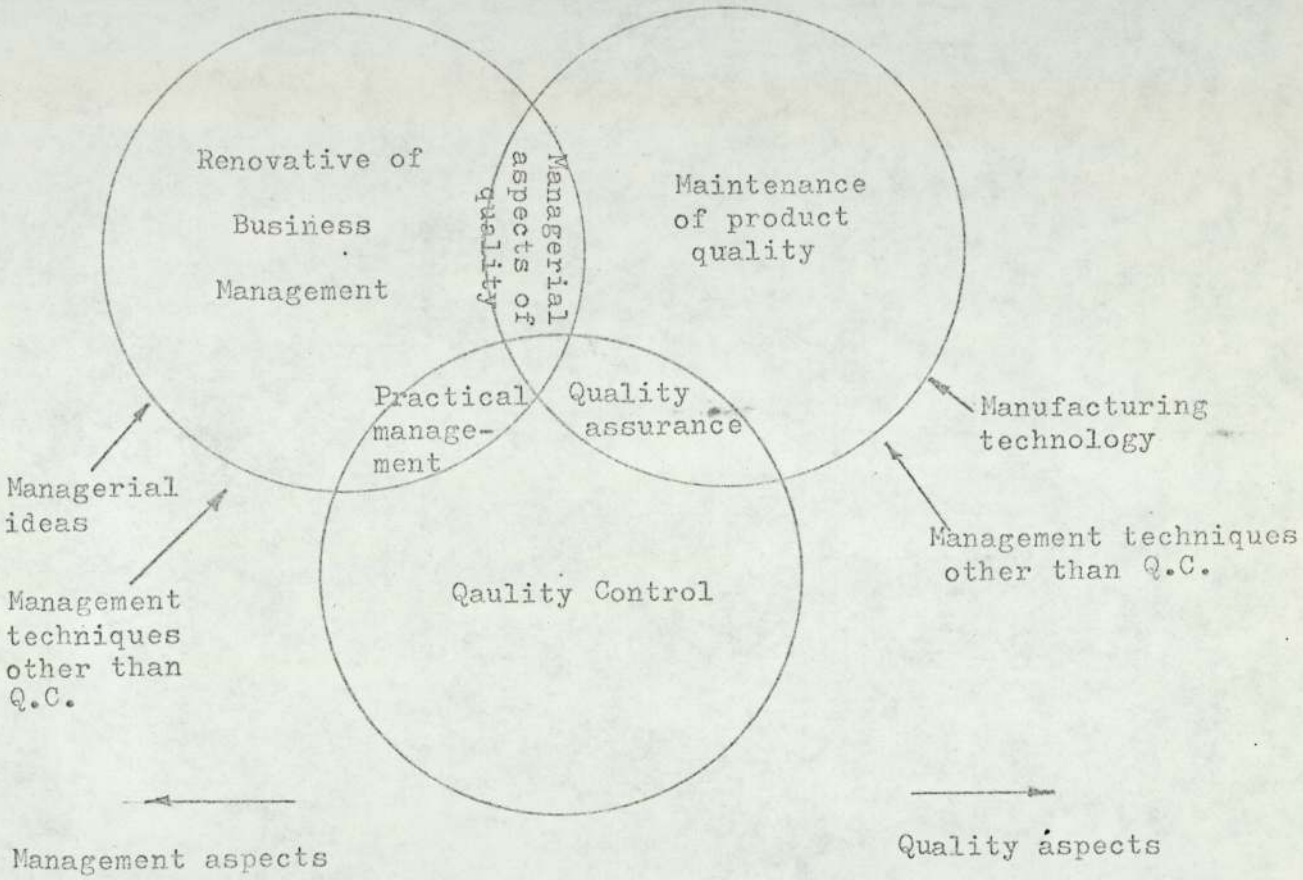


Fig. 2. Two aspects of Company-wide Quality Control.

The achievement of Company-wide Quality Control being recognized by the top management are originally suggested by the middle management of the firm, recommended by other companies' top management and participated in Conferences and courses for Quality Control.

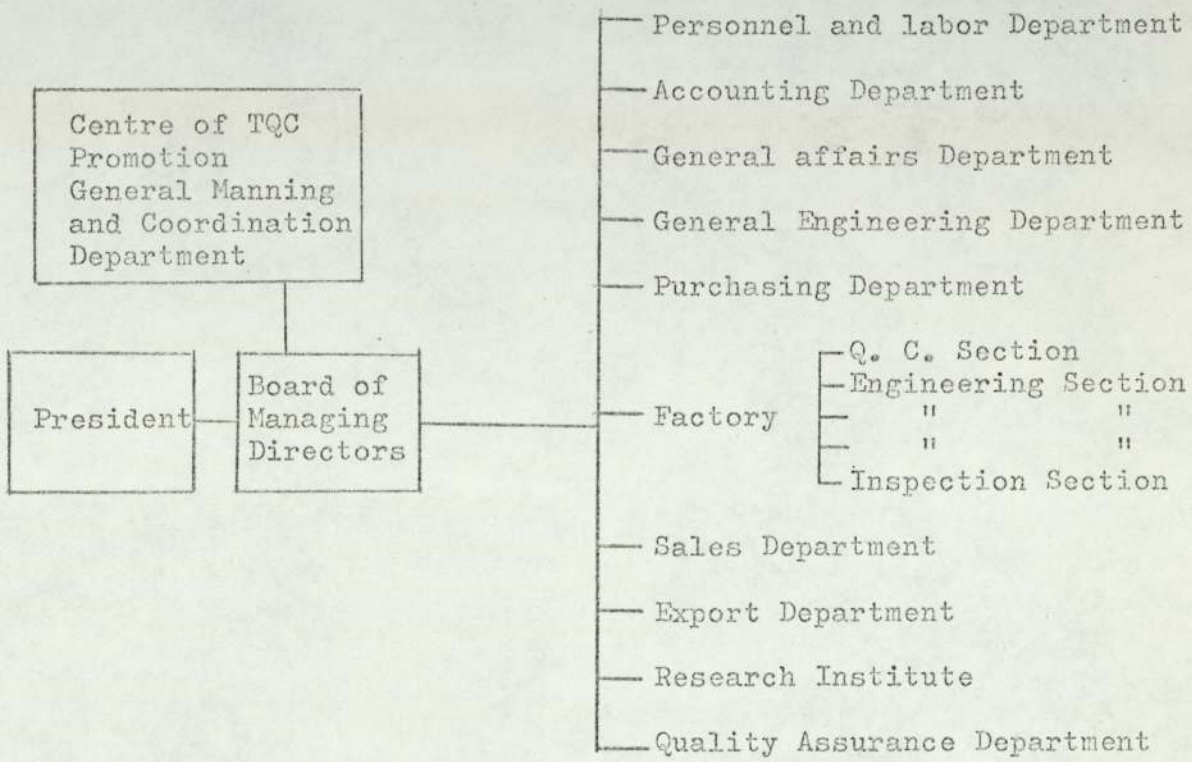


Table 1. An example of a Quality Control Organization.

When Company-wide Quality Control activities were introduced to Japanese industry, the efforts in converting the imported Quality Control Method into Japan style have been successfully made in 1961. While in 1962, rank and file workers are engaged in Quality Control activities in groups, called "QC Circles". [19-21] These QC Circles were initially created by supervision and operations in the work shops. By interchanging their opinions within and outside the company, mutual enlightenment was achieved.

This "QC Circle" was then adopted by industries abroad. At the same time, the Union of Japanese Scientists and Engineers published a monthly magazine for foreman QC Education. QC Circles act as QC activity centres in the production section of a company. After the publication of a monthly magazine for foremen's QC education, QC Circles have been continuing to make a remarkable progress in Japan and popularize in Japanese enterprises. Education for QC Circles and training efforts were carried but in Japan for a wide variety of industries. The motivation for setting up QC circles in Japanese industry came by order of seniors, urged by staffs, voluntarily or otherwise.

The effectiveness of QC Circle activities with their special techniques and methods in improving ordinary QC activities, have finally become capable of serving as assistants to engineers such as participation by QC Circle leaders in staff's task forces, joining in"on the spot observation" assisting in analyses and experiments and presenting new ideas, and also helding in introducing recent established operational methods to shop-floor.

Normally, an individual workshop has a QC Circle, which is possibly divided into sub-circles which in charge of their respective detailed work. There has also been an increase in the number of recent increase in "Joint QC Circles", which include workers of different workshops. They are made up of a process or subsequent processes, manufacturing department, inspection, maintenance or power departments and also subcontracting firms and works. Respective Circles are under supervision by respective managers. Through mutual talks and discussion, workshop shape up together improvement measures and decide which are to be implemented

with the approvals of their manager.

The result of QC Circle activities in Japanese industry is remarkable, especially in steel mill and other heavy-equipment industries.

Besides QC activities in the production department, it is also available for non-production departments, i.e. inspection, maintenance, transport, storage, book and vouchers, guest reception, clerical, design, sales, purchase and other. Also at QC Circles convertions, reports of special cases of QC Circles have been made of involving nurse, telephone operator, guard men, car drivers, typists, communications apparatus operators and waiters and waitresses. When the QC Circles have just started to be implemented in Japanese industries, a foremen serves as a leader in the circle. Since QC Circles have been subdivided into sub-circles, therefore all workers are taking parts in QC Circle activities. Individual sub-circle is composed of a leader and workers. The leader is either take turn in assuming the post or re-elected. More and more operators are vigorously particupate in QC Circles and the remark is made in the QC Circle Conventions. QC Circles are becoming more and more common even those part-timers, non-regular factory hands and operators at subcontracting firms and works are participating too.

Participants of QC Circle have made the remarkable result for Japan industry. They study strenuously for improvement techniques on Quality Control. Statistical techniques have been used by the operators in the shop-floor, such as PERT, design of experiments and multiple regression analysis. Company provides the lecturer to teach operators computer knowledges such as FORTRAN. Also where industrial engineering techniques, value

analysis, human engineering for improving environments and operating postures are taught to operators in an elementary method, and it is believed that the result of this knowledge will improve the workshop situation and also will enable the experts to negotiate with the operators in performing inspection activities at the shop-floor. As computer has been greatly used by Japanese Industries, such as on-line computers at shop-floor. Computer training course is provided to the operator.

The Education and Training of Quality Control in Japanese Industries.[22]

Quality Control is considered as a revolution in the ideas of management control to the Japanese industry. Since 1949, large number of Quality Control education and training programme has been carried out continuously in the Japanese industries in a wide circle. The aim is to convert the way of thinking of all employees including presidents.

Most of the companies have their own Quality Control course. More than several million employees received Quality Control education and training in the company. And those who participate outside the company amount to more than one hundred thousand.

The education and training program for Quality Control in existing Japanese industries include courses carried out outside companies and within companies.

The courses which are held outside companies are sponsored by the Union of Japanese Scientists and Engineers, Japanese Industrial Standard and by broadcasting. Most of the lecturers and instructors for the courses or seminars are University professors, members of Quality Control research groups and expert engineers or managers from industry, ~~and~~ who also act as Quality

Control and general business consultant to the Japanese industries.

Those courses which are conducted within the companies have been thoroughly made including president, workers and even female workers. About two thousands companies where Quality Control education program are participated in their firms. Pamphlets of fifty to two hundred pages on Quality Control have been specially prepared for workers, foremen and clerks.

Also, in Japanese industries, all the enterprises depend upon other factories and manufacturers which supply raw materials and parts. Their production cost include about 60 to 70% of raw materials and parts purchased from outside on the average. Thus, unless the quality is good, the end product has cometo be worse in quality. This has forced them to perform Quality Control in inspecting these outside materials and parts. Some companies hold seminars specially for their vendors and sub-contractors. In Japanese industries, it is usually the case of sub-contractors who get together and organize their cooperative society, through which various activities towards promotion of Quality Control and betterment of quality is performed.

The Quality Control education and training programme of Japanese industries have the following characteristics:

(1) Most of the courses outside the companies are sponsored by scientific and technical organizations especially the Union of Japanese Scientists and Engineers (JUSE),and Japanese Standards Association have held and are holding long term Quality Control courses and are the centers of Quality Control, Statistical Quality Control and Total Quality Control.

(2) A number of short-term courses from 10 to 36 hours

(2-6 days) are held throughout Japan, both within and outside companies. On the other hand, a fairly thorough education of 120 hours or longer (5-6 days a month for a period of 4-6 months) are held to educate and train not only Quality Control engineers but also various engineers.

(3) Quality Control, Statistical Method and Computer programming courses are provided by colleges and Universities to the engineering students, but no evening classes are provided for general audiance.

(4) Over 2000 companies have been performed completely the education and training program for Quality Control within the company including top management and workers. They also provide Quality Control textbooks, movie films or slide films for the education of the respective classes.

(5) In the earlier state of Japanese industries, there was a tendency towards the statistical method, but in 1954, it changed gradually Quality Control as an integral part of managements, and Japanese style company wise Quality Control has started. And this Total Quality Control is different from the general concept of Total Quality Control which was defined by Dr. Feigenbaum. That is, in Japanese industries, when Company wide Quality Control is intended to be carried out, then all the employees, from the top management to the foreman and worker, must study Statistical Quality Control and participate in Quality Control. Therefore in each of the Quality Control course, even now the lecture on statistical methods occupy more than 50-70 percent of the time.

(6) Quality Control education also provides to national and local Government officials. The Ministry of International trade and Industry is especially interested in the education of

officials concerned with the Japanese Industrial Standards.

(7) The Quality Control education provides to foreman though broadcasting between 1956-1962. More than 100,000 copies of this textbook have been distributed.

(8) The organization such as "Society of Quality Control" in Japanese industries has not been instituted. Therefore, the Union of Japan Scientists and Engineers and the Japanese Standard Association play this role. The Annual Conference of Quality Control are held under the co-sponsorship of about 20 organizations.

(9) Under the co-sponsorship of the Union of Scientists and Engineers, Japanese Standard Association, and other organizations. The "National Quality Month" started in 1960. Since then, in every November, the 'Q' mark and 'Q' flag were decided.

(10) In 1961, a magazine called "Gemba-To-QC"(QC for foreman) was published. The education and training of "QC Circles" in workshops and offices of various companies was organized. Finally, these two plans have been carried out in 1962. Since then, the Japanese industries have been getting a great many fruitful results. In August 1969, about 80,000 copies of this monthly magazine have been published, about 23,000 registered QC Circles and about 200,000 unregistered QC Circles.

Through these activities, all QC Circle members, foreman and workers, office workers and girls, have learned and self- and mutual-developed the concept of Quality Control and simple Statistical Quality Control techniques and have solved and improved many problems by QC Circle activities in their workshop.

(11) There are four periodicals to educate and promote

Quality Control in Japanese industries, such as "Statistical Quality Control" monthly periodical published by the Union of Japanese Scientists and Engineers since 1950, "Standardization and Quality Control" monthly periodical published by The Japanese Standard Association since 1950, "QC for the Foreman "(Gemba-To-QC). monthly periodical published by the Union of Japanese Scientists and Engineers since 1962, and "Reports of Statistical Application Research" quarterly periodical since 1953.

(12) The Japanese enthusiasm for education. The literacy of Japanese is nearly 100 percent. It is easy to study the textbooks of Quality Control and statistical method. More than 600 kinds of books and textbooks are available in Japan regarding Quality Control, statistical method, design of experiments and sampling inspection, etc. Thus, it is easy for the Japanese industries to be self-developed.

The education and training programme of Quality Control in Japanese industries are achieveing tremendously good results.

HONG KONG[23]

In Hong Kong, the majority of the industries are of small and medium scale. A small scale industry is simply an industrial undertaking with fifty or less employees, and a medium scale factory is one which employs fifty to two hundred employees. About 93% of the industrial undertakings in the Hong Kong Industries belong to these categories. But the number of employees in a large scale factory may be many times compared to small scale factory, thus the number of employees in the small and medium scale factories amount to 52.8% of the total employment in the manufacturing industries.

The large-scale and modern factories are owned by overseas investors or are under the joint ventures in the form of branch or subsidiary parts of their parent organisations in the U.S. or other advanced industrial countries. Well-developed Quality Control systems are operative in the parent plants and hence such systems frequently operate in the local branch in Hong Kong or subsidiary factories backed by experienced and technical know-how from the parent organizations. Frequently the Quality Control staff are sent abroad for training so as to receive the most up-to-date information and knowledge regarding developments and advancements in the techniques and management of Quality Control. For other large-scale industries which are owned by local industrialists, Quality Control techniques have also been employed, e.g. certain textile firms have invited Quality Control experts from Japan to assist in design and installation of Quality Control system in their mills, while other firms which have include Quality Control departments in their organizations

send their staff to local Quality Control training courses and also top management in many large-scale industries are presently emphasized in the Quality aspect of their production.

Quality Control has been employed by most of the large industrial concerns, covering such principal industries as textiles, electronics, electrical appliances, toys and cigarettes. The main stress is still on statistical methods. Only a few factories accepted the concept of Total Quality Control and company-wide Quality Control is introduced to the Hong Kong industries. The small and medium scale Hong Kong factories not only contribute significantly to the export economy of Hong Kong, they also play another important role as subcontractors or vendors to many of the local large factories.

However, the Quality Control which operate by the small and medium scale industry in Hong Kong compared with the large scale industry is far less satisfactory. Since the important role played by the small and medium scale factories in Hong Kong's economy has been despised, there are inadequacies and weakness have been identified among the small and medium scale factories practising Quality Control.

Quality Control is operated as a main inspection to these small and medium-scale factories, the 100% inspection of finished product was operated in order to maintain the quality of their products. If this is not applicable, then lot-by-lot inspection on a sampling basis is adopted. Frequently the techniques was not carried out in the right order. They seek to solve the problem of how to draw a good sample. Statistical sampling techniques are not performed. In conclusion, the result of sampling techniques is not significant, however, in-process inspection and incoming

goods inspection in many cases are neglected.

The system for filing documents in inadequate. In most of the small and medium-scale factories, usually data of the inspection are not properly recorded, and many other relevant data are not available. Therefore, many of the valuable feed-back information is lost and not available for evaluation.

Quality Control in small and medium scale industries is normally regarded as the sole responsibility of the inspectors or Quality Control Department. Conscientious cooperation between the Quality Control Department and other departments often constitutes an organizational problem for the Hong Kong industries. It is usually found that Quality Control is neglected at various stages of the manufacturing sequence, noticeably in the design, material purchase, producing engineering, and distribution stages of the work. Thus, the advantages of the Quality Control can be achieved only by approaching the problem in an integrated way on a company wise basis. In Hong Kong, small and medium-scale industry there is lack of appreciation.

Many of the Hong Kong small and medium factories started on a family basis run along traditional lines. Thus, the modern techniques are not easy to be accepted by the top management. Many of the management still have the idea that Quality Control is a remedial function rather than a preventive measure given to bring about a favourable quality-cost relationship for their products. They regard this as an adding up to the overall manufacturing costs just for preventing defective products from reaching the hands of the customers. It has to be convinced to management that Quality Control is aimed at producing quality products throughout all the manufacturing processes which implies

a greater profitability to bring a new attitude of mind leading to rationalization in the overall appropriation of management efforts towords quality objectives of the enterprise. Furthermore, the limitation of manpower in Hong Kong industry is particularly important, the shortage of trained personnel with the necessary knowledge and skill in Quality Control within the local manpower pool and the lack of adequate organized assistance outside industry to assist the enterprises concerned constitute immediate obstacles in introducing Quality Control to small and medium-scale industries.

In Hong Kong, there are no material industrial standards, a few official regulations governing quality requirement of domestically manufactured products and no professional organizations devoted solely to the development and promotion of Quality Control activities.

THAILAND[24]

In the manufacturing production of economic development sector of Thailand, many kinds of industries are promoted and improved by various organization. Small scale and cottage industries are under the control whereas large industries of new investments are approved by the Board of Investment as well as the Ministry of Industry.

The Industrial Promotion Department processes the approval and certification including technical training in some respects. The Thailand Management Development and Productivity Center offers management training courses for all types of industries. Advisory Committee and experts are sent out to industry as industrial consultants in order to increase the productivity.

Thai economy is very much dependent on export products. In order to keep the economic stability, The Ministry of Economic Affairs strictly control the quality of exported goods. The export standard Act has promulgated. Exporting products must be tested and certified by Government inspectors. Most of the Quality Control practiced by Governmental organization has been emphasized on the commercial commodities for exports and imports. ~~The quality of exported goods are controlled by the Ministry of Economic Affairs~~.

The standard specifications for the manufactured products are required in Thailand. A testing laboratory from the Department of Science for governmental organizations and industries is responsible for the standards of industrial products. Several technical committees and standard committee from the Ministry of Industry determine and set the scope of various industrial

products to be standardized. In Thai industry, products which are considered to be conformed to public welfare and safety regulations are compulsory whereas others are voluntary. The technical committees are responsible for drafting the formulation of standard specification and the standard committee will make decision whether the standard is compulsory or voluntary.

The Department of Industrial Promotion and Department of Science certify the certification of product quality for Thai's industry. Whereas the quality of importing products and materials are controlled by the Ministry of Economics.

When the quality of purchasing materials are specified, the Department of Science serves both the Government and private enterprises, as a central laboratory for the testing and sampling inspection. The sampling inspection and testing carried out as a routine works are made for the raw materials used in local industries.

Large scale and modern Thai's industries are approved by the Board of Investment. Usually it is associated with foreign investments. They are permitted to bring foreign expert and engineers. Thus, Quality Control system is derived from the original country. In such instance, Quality Control is managed by Quality Control engineers which are responsible for process checking and final product inspection. Statistical Quality Control and control charts such as X-Chart and P-Chart are used in those industries. Many large scale and modern Thai's industries use the skilled labour for Quality Control in the production process.

For those small scale and cottage Thai's industries, it is very ~~scarcely~~ rare to see that statistical Quality Control are being operated. Usually Quality is controlled by the skilled labour.

The method of "Quality Wise" or "number of article made" is used to determine the salary scale. In many cases, Quality Control is a minor concern, Except in food industries, where Quality Control must be applied in order to conform to the Government quality regulations.

The education and training of Quality Control in Thai's industries is limited. The actual Quality Control training course does not exist. Only some relating courses are taught in professional schools and Universities. However, the emphasis does not cover the application of industrial Quality Control. In many private and governmental organizations where training in Quality Control and standardization is required, the trainees are sent overseas for such purpose. Many trainees from the Department of Science, Thailand Management Development and Productivity Centre received their training from Japan, Netherland, India and the United States. These people are encouraged to organize Quality Control training course in the country.

The Department of Science and Department of Industrial Promotion are operating the training course of Quality Control for Thai's industries. The Thailand Management Development and Productivity Center has organized several seminars for top managers and engineers, and Quality Control techniques are included in those occasions.

The Department of Labour of the Ministry of Interior has operated a training course for unskill labour where basic background of workmanship and Quality Control in certain business is given in the course. But such training facility is limited.

The projects of study and research for initiating the improvement of present existing Thai's industries is under taken

by the Department of Science. The projects include the necessary technical and standard implementations and the Quality Control techniques. With the cooperation of the United Nation Special Fund Program, the Thailand Management Development and Productivity Center started an organization to provide a training course in industrial management and production improvement which in part concerns the Quality Control in industry.

The Quality Control system and practice have been developed but is rather slow compared to the growing rate of the industry. The application of Quality Control in Thai's industry was disintegrated or on-and-off. The Total Quality Control is hardly seen in industries. For the development of Thai's industrial enterprises, a motivation of quality mindedness together with Total Quality Control is required. The governmental and private organization should stress the quality conciousness motivation.

REPUBLIC OF CHINA - TAIWAN[25,26]

The following table summarizes the relationship between Industrial Development and Quality Control in Republic of China or Taiwan.

Stage	Period	Priority of Industrial development	Product Market	Q C Development
Rehabititation	1946-1952 before 1st 4-year plan	1. Reconstruction of war-damaged industries. 2. Development of key industries, electricity, fertilizer, textile.	Domestic	Inspection
Industrial Expansion	1953-1960 1st and 2nd 4-year plan	1. Development of export key industries. 2. Creation of light industries. Building materials, plastics, electrical products	1.Mainly domestic 2.Partly export	Statistical Quality Control, promoted by China Productivity and trade centre
Accelerated industrial expansion	1961 after 3rd 4-year plan	1. Development of export processing industries. 2. Creation of petrochemical industry. 3. Development of metal, machinery and other industries of high technoligical level.	1.Mainly export for new products	Export inspection system. Inspection grading system. Total Quality Control promoted by Government China Productivity & Trade centre Chinese Society for Quality Control.

China Productivity and Trade Centre was founded in 1955 for the specific purpose of rendering technical and managerial assistance to Taiwan industries, especially in small and medium enterprises, to increase productivity in all attempt. It also aimed to achieve ~~the~~ a higher standard of living by attaining to "better quality", "lower cost", "more profit" and "higher wages". Since then, China Productivity and Trade Centre took the initiative as one of its important services to promote Quality Control in Taiwan industries. Seminars and education training programme have ran for engineers and supervisors for industries. Pamphlets, references and books on Statistical Quality Control were also published by China Productivity and Trade Centre. With the support from the Taiwan Government, ~~Chian~~ China Productivity and Trade Centre expanded the service, and took necessary action to speed up the work of promoting Quality Control. Since China Productivity and Trade Centre was the only organization in Taiwan to promote Quality Control and to render services in helping industries to set up the Statistical Quality Control programme, thus Quality Control is implemented rapidly by Taiwan industries. And following activity was then founded.

The "Supervisory Committee for the Quality Control of Industrial and Mining Product" was founded in 1962 to achieve effectively the promotion of the application of Quality Control in all Taiwan industries, urging all the enterprises to achieve better quality of product, increase work efficiency and to lower the production costs.

A Quality Control Examination and Evaluation Team is formed each year for domestic industry to examine and evaluate the result of Quality Control implementation. Names of

the products and manufacturers passing the examination shall be sent to related organizations for priority in purchasing. Thus, the inspection grading system for export commodities and this evaluation system by the Government had made an effective contribution to the adaptation of Quality Control in Taiwan.

In order to promote the manufacturers and producers to establish Quality Control system, the Ministry of Economic Affaïrs in 1962 promulgated the regulation for Inspection, Grading, and Examination of domestic commodities manufactured by factories or plants. And this inspection grading system for exported commodities also encourage industries to have more testing equipment and personnel. Thus, this reduces the cost of production, raises the quality of their products and simplifies the export inspection procedures.

The Chinese Society for Quality Control was founded in 1962, participate with the China Productivity and Trade Centre in 1965 a system of giving prizes to persons who have shown special merit in performance in Quality Control. The Society publishes a monthly "QC Newsletter" to the Society members.

In order to promote Quality Control in various industries, many Statistical Quality Control training courses,meetings, and symposia in Quality Control are held and sponsored by the China Productivity and Trade Centre.

Zero-Defect Movement and QC Circle activities operate in various industries. In 1967, some factories put Quality Control Circle activities into practice as their priority program.

The China Productivity and Trade Centre has been the nucleus for the dissemination of Quality Control technologies. Many industrial in-plant training courses in Quality Control for the

foreman and workers are conducted by their engineers who had been trained by the China Productivity and Trade Centre. Besides local training, the China Productivity and Trade Centre selected a number of engineers and sent them abroad for further Quality Control training. Higher education of Universities and institutes in Taiwan also include Quality Control subjects in their curriculum.

In Taiwan industry, they aim to link Quality Control with the productivity improvement programmes when Quality Control was promoted in the early stage. In view of the ever-flourishing industrial development, they try to strengthen the linkage between quality improvement of products and industrial development. The Government organizations have taken all necessary effort to promote a nation-wide Quality Control.

27-29

IRELAND

Quality Control has been regarded as a costly overhead in Irish industries to be relegated to the laboratory. There has been too much emphasis on inspection, and also use the "Quality Program Requirements (MIL-Q-9858A)" originally issued by the U.S. Department of Defence which empowers an officer on behalf of the Minister for Local Government to inspect the manufacture or production of commodities on the premises of official contractors. The Minister's officer may"observe all or any of the processes of such manufacture of production and examine and observe the means employed and method used in testing such commodity."

The drive for exports has given considerable impetus to quality. The most evident is in agricultural products. Producers have been made more intimately aware of the importance of quality. Department of Agriculture and Fisheries stated in "Quality Production" that "Quality production starts on the farm". In dairy products, the quality of the final product depends on the quality of the raw material as it was produced in the farm.

Producers are encouraged to achieve high standards by bonuses which are awarded for quality produce. The bonus schemes have been particularly effective in the milk and pig industry.

The Agricultural Institute, a Government sponsored research body, has also contributed much towards improving the quality of Irish agricultural produce. Its functions include reviewing, facilitating, encouraging, assisting, coordinating, promoting and undertaking agricultural research in Ireland. It has a particular responsibility to disseminate the results of agricultural research. Aspects of the obligation are discharged through course,

conferences, lectures and demonstrations organized by the Institute. Many of these functions have focused on Quality.

Besides agriculture, the pharmaceutical and textile industry have also devoted considerable attention to Quality Control. Symposium, seminar and conference have been conducted in Ireland to promote Quality Control. As an importer of raw materials, some sectors of the Irish textile industry have found that careful control of the quality of their raw material is paid off handsomely. This approach has been particularly valuable where manufacturers have advised their suppliers, at home and abroad, of their quality requirements and procedures.

The Institute for Industrial Research and Standards of Ireland undertakes and promotes scientific enquiry which will foster the use of the state's natural resources, improve the techniques of industry and initiate new ones, and help in the exploitation of inventions. The Institute also formulates and administers standard specifications and test and analyses commodities intended for sale or public use.

The Standards Division undertakes the Institute's statutory function of formulating standard specifications and administering the Standard Mark. The right to use the Standard Mark is obtained by licence, following Institute inspection of the factory and methods of Quality Control, and sampling testing by the Standards Division. Continuing surveillance is maintained on goods bearing the Standard Mark.

The division advises the manufacturer on sampling techniques and helps in the introduction of Quality Control procedures. Where reject rates are running at an unacceptable level, other Divisions of the Institute offer help with process improvements to reduce

rejects to a minimum.

The Institute has a function to check the quality of Irish made goods in general, irrespective of whether they are covered by a standard specification. This activity is stimulated by consumer complaints, for which the Standards Division operates a testing and analytical service.

In order to promote the appreciation and application of modern Quality Control in industry and services, the Irish Quality Control Association was founded by the Irish Associate members of European organization for Quality Control and members of the American Society for Quality Control.

The Education and Training Programme for Quality Control in Irish Industries. Quality Control has featured in many Irish Management Institute courses. Renowned experts including Dr. J. M. Juran and L.A. Seden have given short courses under the auspices of the Institute.Since 1965, the School of Management Studies, College of Commence in Ireland has run a regular one-week course on Quality Control, open to participants from industry and services. The course is based on the Total Quality Control concept and endeavours to correct the over-emphasis on statistics and testing by introducing topics such as quality costs and quality motivation. A course on basic statistics for Quality Control, Quality costs, Quality audit and Quality Control and the Designer have been introduced by the school.

The universities, largely through post-graduate studies in Management and industrial engineering, have also introduced Quality Control.

A knowledge of Quality Control principles is included in many of the professional engineering syllabuses examination. As the supply of trained personnel increased, the influence of this teaching and of the introduction of statistics at lower levels of the school educational system will become more obvious.

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DENMARK

Majority of the Denmark industries are small and medium scale industries which employ between 100 and 1000 employees. The large scale firms have taken the lead with regard to the introduction of modern quality control. Most firms maintain a system of Quality Control. Danish industy in many ways resemble the American method.

In Denmark, the "Military Standard" is used almost exclusively as random sample plan. The American system with "Classification of defects" to supplement the basic specification is also widely adopted.

In Denmark, where the relatively high level of general education helped to create a quality conscious class of craftsmen. and the trend towards placing greater responsibility for the quality on operators, rather than on inspectors, is well advanced. Appropriate control cards have been introduced to further operator control.By means of these cards, the operator can note down changes in the manufacturing process. In some instances, the system has involved so far as to allow the operator to be responsible for the decision in the face of the unwanted process changes.

In Denmark, incentives usually concentrate on reward schemes. The employee, who submits an idea for a cheaper or better product, is awarded a sum of money, relative to the value of his proposal to the enterprise.

To achieve and strengthen the competitiveness of Danish industry in overseas market, the Danish Association for Quality

Control was founded in 1960 and is a member of the Danish Trade and Industry Association. The Association has the following three aims to achieve:

(1) Propagate knowledge of industrial Quality Control and industrial statistics (Purpose, organization and technique).

(2) Aid the interchange among members of recent technical and commercial advances in both industrial quality control and industrial statistics.

(3) Maintain contacts with similar organizations abroad, and keep members informed of foreign developments in these fields.

The Danish Association for Quality Control work is sought promoted through :

(1) study circles and meeting;

(2) explaining the Association's work in regular bulletins;

(3) Possible future admission to a larger coordinating body for industry.

In Danish industry, "Reliability" ~~are~~ is well appreciated at a high level. The Sintom, the organization of Nordic Co-operative Committe for Reliability founded throughout Scandinavian countries including Finland, Sweden, Norway and Denmark has participated successful activity in Reliability. Furthermore, there exists a number of laboratories and institutes with facilities to enable smaller firms to carry out necessary tests. The majority of these establishments are united by the Academy of Technical Science. The State and Danish industry have adopted the co-operative idea together with the high school. The latter organization also acts as a link between industry and research. An important immediate result of this correlation is that Denmark has established testing

facilities, in practically all fields, with equipment at industry's disposal.

Training and Education Programme in Danish Industry. Periodically, the Danish Association for Quality Control arranges shorter conference twice a year. Lectures on a common theme include Quality Control, motivation, standardization, quality and control are usually given to participants.

Inter-Scandinavian seminars are also held from time to time. Through SINTOM, they co-ordinate seminars and training activities in the Nordic Countries, and share available knowledge and experience. The Association for Quality Control regularly held a monthly meeting with lectures and discussion. They also arranged study circles to treat particular subjects. The discussion includes the following topics:

(1) Thread inspection

(2) Quality reports - technical - economical

(3) Quality, practice and training difficulties

(4) Statistical evaluation of measuring results

(5) Random sample plans

(6) Quality, elucidation and terminology

(7) Product specification

(8) Quality costs.

By applying extensive knowledge of statistical theories, and ready appreciation of quality costs, to computer techniques, Danish industry have the best prospects of maintaining and enlarging the concept of "Danish Quality."

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SPAIN

The Spanish Association for Quality Control was founded in 1961, with the support of the General Director of Engineering industries in the Ministry of Industry.

The First National Symposium for Quality Control in the Automotive Industries was organized with very encouraging results, especially the foundation of the Committee for Quality Improvement in the Automative Industries which was the first one founded in Europe. Its development and achievements motivated somehow the establishment of the Automotive Committee of the European Organization for Quality Control. And the European Committee for Quality Control was then formed in 1968. The intention of the Automotive Committee of Spanish is to hold a National Symposium at least once a year.

Since then, the Committee for Quality in the Food Industries was formed. And the Reliability Committee of the Spanish Association for Quality Control was created in 1969, and the Committee acts as the Spanish counterpart of the European Organization for Quality Control Reliability Committee. The National Symposium were frequently held for various Spanish industries.

The Spanish Association for Quality Control is a full member of the European Organization for Quality Control.

We can learn how the Quality Control is functioning in Spanish industries in the recent National Survey. A questionnaire was sent to 1250 companies of all sizes, classified into groups of homogeneous products. The number of industries in each branch was selected in proportion to the importance of that branch in

the national economy. The questionnaire was divided into three main headings as follows :

(1) Status of quality organization and interest in quality shown by top management.

(2) Means for Quality Control.

(3) Quality costs.

Among 1250 questionnaires sent, only 199 were returned which represents a 15.9% of replies. This is due to change of name and address. Because the questionnaire was somewhat sophisticated, most of the companies which do not have a formal quality assurance system have not been able to answer some of the questions, especially those related to Quality Costs.

The Status of the Quality Organization and Interest in Quality shown by Top Management. The way of fixing quality policies, objectives and instructions, acceptance authority, level of the Quality Control group in the organization, degree of interest in Quality Control by general management and participation of Quality Control in the Company's operations has been assessed. From the result it is only fair to state that the majority of companies have poor organization because of the fact that the head of Quality Department is responsible to the Production Management.

Means for Quality Control. Several questions were put to ascertain the percentage of total personnel involved in the control of quality over the total number of employees, also the distribution of quality control personnel, and the type and training of persons employed. As a result, the percentage of Quality

Control investments over the total company investments was only 5.7%. The total personnel involved in the control of quality over the total number of employees was 6.1%.

Quality Costs. In this section, the questions include:

(1) Quality Control costs as percentage over the manufacturing cost and/or net sales billed.

(2) Breakdown of Quality Control costs by Quality function.

(3) Internal losses as percentage over manufacturing cost and/or net sales billed.

(4) External losses as percentage over net sales billed.

As a result, the percentage of Quality Control Costs over the manufacturing cost was 4%, which included 17.5% of prevention cost and 82.5% of appraisal cost. And the percentage of internal losses over the manufacturing cost was 3.2, and external was 0.9%.

U.S.S.R.[32,33]

The U.S.S.R. industries have the following sixteen items for Quality System Policy of Total Quality Control.

(1) Regular Quality Rating of the output, made in compliance with the needs of the National economy and population. And in comparison with the quality of the best national and foreign products, determination of non-conformity of the quality level of products manufactured with the required one. Elaboration of measures insuring elimination of the non-conformity; implementation and follow-up of these measures.

(2) Organization of the continuous control of quality levels of the best similar products in the U.S.S.R. and abroad. Establishment of procedures for systematic development and implementation of arrangements, aimed at preventing the lag and providing for setting up advanced values and indices of quality characteristics as early as at the stage of the development of "The technical Task for Designing a New Product."

(3) Development and preparation of production of new machines, equipment, instrument, new materials and consumer goods with planned advanced quality characteristics elaborated with the account of modern achievements of science and world industry, and meeting with the requirements of our national economy and population.

(4) Establishment of a control system to follow-up quality characteristics of products-in-development. The system shall bar against manufacturing out-of-date products with low characteristics.

(5) Value Engineering for the development of new products as well as introduction into industry of paramteric series (for machines) which ensure an optimal economic effect.

(6) Development of measures aimed at the implementation of new advanced standards and specifications.

(7) Specifying of minimum mandatory requirements for the production organization and management and for production descipline at the enterprises which ensure Quality Improvement and the required Quality level stability.

(8) Arrangement of mandatory comparative and type tests of series products, and measures aimed at the development and proper use of testing facilities.

(9) The growth of reliability services and their experimental base.

(10) Preparation of highest quality products for state certification.

(11) Establishment of regular relations and systematic feedback with consumers in respect to products quality and their performance at the service stage.

(12) Implementation of Zero-Defect and "Do-It-Right-the-First-Time" systems. Organization on the planned basis work on fostering Quality-mindedness by explaining to every worker the importance of his workmanship for Quality Assurance.

(13) Implementation of measures to improve Inspection including means and ways of inspection.

(14) Improvement of staff training and education by acquainting them with manufacturing processes, quality requirements, Quality Control Methods, etc.

(15) Quality-Motivation and application and bonus systems clearly determining size of bonuses for workers and engineers, manufacturing high-quality products.

(16) Organization of competition in manufacturing high-quality products. Introduction of values and indices of quality characteristics (as most vital ones) in lists of indices for which prizes are awarded during competition and production managemers are given bonuses.

In order to perform Quality Rating in the U.S.S.R. Industries for the comparison with the highest-quality foreign and national product, "The Instructions for a procedure of Preparation and Implementation of the State Certification and Quality Audit" is required and approved by the Committee for Standards, Measure and Measuring Instruments under the Council of Ministers of the U.S.S.R. The Instructions have summarized the large experience of the national industry in Quality Rating and Quality Improvement to the up-to-date level.

The U.S.S.R. industries have accumulated a great deal of experience in methods of Quality Rating as well as in organizational activities aimed at Quality Improvement.

The practice of advanced enterprises of U.S.S.R. industries show that product quality levels must be controlled during all the stages of production, from the design stage up to the service stage.

The U.S.S.R. industries possessed relevant data about the levels attained by the foreign firm,key them in view and make comparative analyses. For instance, the Moscow "Vladimin Ilyich"

plant has a big testing laboratory which conducts comparative tests on electric motors made by other companies. As a result, the plant's Reliability Laboratory has determined (for the first time in the practice of electrical engineering) service life and reliability characteristics of electric motors certified with Quality Mark, making it possible to introduce them into a new standard for certified machines.

Research and Development Institutes are responsible for both regular control of quality levels and for systematically informing enterprises about changes which have taken place therein.

The control of product quality levels of the best foreign companies and standardization of highest quality characteristics of certified products is a base for scientifically substantiated planning of Quality Improvement indices in Annual Economic Development plans as it is stipulated by the basic principles of the economic reform.

The industry-wide certification system has been introduced since 1967 by the Ministry of Electrical Engineering of the U.S.S.R. in all plants and organizations of the Ministry. The arrangements, planned in the process of certification, along with the inter-industrial coordination and branch plans form a basis for plans of research institutes and Design Offices as well as for plants' and industry-wide plans of new technique. And the realization contributes to acceleration of technical progress.

According to the Quality Level, products are classified into three groups :

(1) Products complying with the highest technical level in the world;

(2) Products of medium technical level in the world;

(3) Products, not complying with the up-to-date technical requirements, which shoudl be modernized or their production should be cancelled.

However, the adaquate Quality Rating is the outset only for U.S.S.R. industries. Thus, Quality Rating work should be supplemented with an interacted plan of activities which envisage Quality Improvement to the up-to-date level and for stability of product quality at this level as well as further steps to improve quality, even to surpass the best quality level of the world industry.

In U.S.S.R. industry which largely emphazised on the Control over the production discipline, measures are used to introduce standards and to improve inspection and testing procedure as well as the Zero-Defect and "Do-It-Right-The-First-Time systems." They also emphasize greatly in the plans of automation and mechanization, development and application of new manufacturing processes, replacement and modernization of equipment, development of manufacturing tooling, application of advanced Quality Control means and methods as well as to the arrangement of product tests. Also they pay large attention to the activities of improving the workmanship, steps to ensure manpower stability, as well as Quality Conferences, seminars, and discussions. And also include measures to develop the material and technical source of enterprise.

The activities of U.S.S.R. industries are characterized with a trend towards constructive changes in Quality Inspection work in order to improve their role and efficiency in Production, and

concentrate the activities of Quality Inspection Departments on the incoming Inspection of raw and processed materials, parts, assemblies and units, received from the Vendors. Inspection Department also concentrated on the outgoing Inspection of Products manufactured, process control, process capacility studies, shooting the trouble and study of consumer experience.

A new technique of inspection is introduced to worker and work-places are equipped with advanced means of inspection, including automatic devices. Supplemented with motivative activities, these conditions make it possible to give up the idea that a worker's job is to manufacture parts, while that of an inspector is to accept or reject.

The concept of "Quality is up to the producer" has been practically realized in the U.S.S.R. industries. Inspection personnel is encharged with the functions of preventive inspection and quality analysis, during all stages of production as well as with the responsibility to study, propagate and implement new advanced means and methods of inspection. The U.S.S.R. industries have reinforced their Inspectors or Departments. They apply scientifically substantiated methods of statistical Quality Control in the process of production as well as sampling procedures at intermediate and final manufacturing operations, and also implement objective and efficient means of automatic control. The testing facilities are enlarged. The scope of surveys conducted under service condition are also widened. Feedback information is used for the purpose of eliminating defects.

The U.S.S.R. enterprises have established close contacts with the consumers and organized regular receipt of information

about the product performance in use. Adequate feedback ensure success in continuous Quality Improvement.

Some of the firm has organized regular surveys of the use of machines. Defects discovered are summarized and discussed at regular "Quality Hours" and a consequent corrective action is taken to remove causes of defects. As a result, the reliability of the products has became much higher as the unit failure rate has become lower.

New way of Quality motivation is searched and implemented in U.S.S.R. enterprises. The workmanship rating system of the daily job of each worker at the main assembly line is evaluated with units (points). Each tenth of the rating unit (in excess of 3.0) results in 1% increase of the wages. Thus, the total bonus can be as much as 20%. This system of incentives has proved to be extremely effective and made it possible to have a considerable improvement of workmanship during the assembly operations and to reduce the number of defects in trucks manufactured by the U.S.S.R. industries.

The incentive scheme used for engineers and technicians of the U.S.S.R. industries production departments towards Quality Improvement are the so-called "Quality Factor," i.e. correction of the bonus calculated in accordance with improvement or deterioration of the teams work in respect to quality. Thus, as a result, engineers and technicians can concentrate on elimination of errors and defects.

In the U.S.S.R., the State Quality Control is implemented on the basis of the Systems Approach towards the Quality Problem. This approach is characterized by a combination of measure

effectuated in a variety of human activities, including management, into a uniform system of purposeful and regular actions on all the levels and stages of industrial planning and management. And also make it possible to take objective decision regarding products, trends and scope of standardization, forms and methods of production which ensure the highest efficiency of efforts and costs in respect to Quality Improvement and will also allow coordination of the planning of the output volumes with the consumers' demands and with the product quality. Such planning becomes optimal in the exact sense of world.

The U.S.S.R. State Quality Control System is based upon the following economic principles :

(1) Combination of centralized management of industries with economic independence and initiative of separate plants.

(2) All the activities of control bodies at all levels of management being aimed at one common purpose, i.e. manufacture of products with optimal quality levels.

(3) Integral unity of forms and methods of Quality Control with the existing planning and management structure of the national economy.

During all the stages of formation and stabilization of optimal quality levels, an important role is played by standardization which ensure advanced decision and consistency of Quality Improvement. That is why standardization is of paramount importance in the state Quality Control System.

On the large scale the U.S.S.R. Committee for Standard and its Institute for Standardization conduct research and development activities aimed at laying down scientific basis for

standardization and Quality Control.

In the U.S.S.R., there have been developed a variety of standards, procedures and methods in the field of terminology, statistical Quality Control, choice in reliability indices, Quality Rating, Quality Planning, etc.

HUNGARY[34,35]

The first industrial research, development, educational, preview and, at the same time, control institute in Hungary - The Technological Institute Museum was established in 1883. The Technological Institute Museum regularly performed water, coal and gas analysis, tests of the chemical and physical performance of material for iron industry and metallurgy and control tests of the serviceableness and quality of machines and agricultural industrial products. This institution is the Technology and Machine Testing Institute of Hungary industries.

George Heuese of Hungary was the first to publish the results achieved with radioactive tracing experiment in the year of 1903. This remarkable result won him a Nobel Prize.

The Inspection Body for steam boilers, the Institute of Chemical and Food Testing and Metrological Institute was founded before the first World War with the aim of controlling the quality of the products. The original Hungarian Institute for Testing Electrical Equipment was founded in 1934 and was established in 1959, and is an institute with up-to-date installation. The aim is to check that cables and other electrical components conform with standards. Today, the Institute is internationally well-known. Manufacturers have the tests of their products to be put on the market made by this Institute.

After the Second World War, a whole series of individual Quality Control Institutes including the building industry, petroleum industry, power supply, industry for equipment under pressure, wood and furniture industry, paper-making industry,

rubber industry, textile industry, leather and skin industry were created for testing the quality of industrial products. Plenty of branches of agricultural and food industry, canning industry, meat industry, baking industry, sugar and sweets industry, tobacco industry, dairies, ~~wine~~ vine-growing, brewing, vegetable oil and detergent industry have testing stations. Several branches of the transport have testing stations for motor traffic, railway-traffic and navigation. Hungary has an all-Hungarian Public Health testing-control network.

The Institute for the Quality Control of Commercial goods carries out separate duties within the testing and control institutes. This institute regularly tests a great number of industrial products put on the market of the internal trade and watches the variation in the level of quality. Products which are to be put on the internal market required a preadmission from the Institute for the Quality Control.

The Quality Control Co. Ltd. has similarly special duties, and controls by procuration of a foreign customer or of a Hungarian factory, whether the products concerned meet the relevant quality requirements or not.

After the nationalization of Hungary in 1949, the Quality Control sections have been organized within all industrial enterprises , on the basis of a governmental regulation. These sections are divided into technical department, acceptance of purchased products, process-control, finishing product control and analysis of scrap, exploration of sources of fault, adequately detailed information towards competent managers.

The modern mathematical statistical control methods are

frequently used in Hungarian industries. The method of sampling and the statistical control of mass producs had been elaborated since 1955 by the Hungarian Office for Standardization. The Hungarian industries consider an improtant task that the factory is supplied with instruments of appropriate precision, with testing tools, and that test-rooms, factory laboratories are set up. They take precious good care of increasing professional knowledge of the personnel employed in the field of Quality Control.

With regard to legislation of Hungary enterprise, the system of guarantee is as follows :

(1) Legal rules state the products for which the undertaking of a guarantee is compulsory.

(2) The compulsory minimal duration of the guarantee is stated. The products with respect to safety and public health is keeping under control through the control institute.

The Hungarian Office for Standardization is making strong efforts towards the continued development of Quality Control requirement and co-ordination with the foreign and the international levels.

The training and education programme in the Hungarian industries include the following four main sections :

(1) A post-graduate course has been conducted for the leaders of Quality Control section gain their confirmation education.

(2) The Scientific Technical Societies conduct a course for those holding an office with an independent sphere of activities in Quality Control.

(3) A course of industrial branch or a course of the factory

has been conducted for sub-ordinate technical controllers.

(4) A basic course in the factory within the framework has been conducted for the foremen.

Besides these, there are plenty of specialized compulsory and optional course of material testers which are conducted partly by the factories and partly by the Scientific Technical Societies and by other institutions for technical controllers.

The Hungarian Scientific Societies for Machine Industry, Metrology and Automation Industry and Textile Industry contribute significantly to the development of method and organization of Quality Control as well as the training and education programme for Quality Control.

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GERMAN DEMOCRATIC REPUBLIC

The German Board for Measuring and Goods Testing being entrusted with quality and measuring assurance is the central control organ of the German Democratic Republic Council of Ministers.

The German Board for Measuring and Goods Testing is responsible for the control of product effected at minimum costs with the measuring techniques being based upon scientific knowledge as well as for the assurance of measuring uniformity.

The German Board for Measuring and Goods testing emphasizes on the national quality mark system. The quality mark awarded to the manufacturer confirms the standard which design and efficiency of his product have in relation to the standard of the international market and it confirms the assurance of steady and sample-true production guaranteed by the manufacturer's production on technology respectively.

The German realise the most important for the national economy is the scientific-technical revolution. Since this revolution mainly covers those branches of industry which produce a high portion of the total production output of their country, thus forming an important basis for raising national income and standard of living of population. German industries are permanently confronted with the world market due to their comprehensive foreign trade activities. Thus, they aim for the most important products of their national economy of the scientific-technical top level or the quality of top products of the international market. In Germany, industries regard a product highly which complies with the

scientific-technical top level represented by a top product of the international market or co-determines a top world standard in regard to its most important quality-determining properties such as efficiency and reliability and in regard if its manufacturing, operational and maintenance costs.

The German Board for Measuring and Goods Testing uses the scientific-technical top level as the national quality standard for national quality evaluations and classifications. It awards the following four quality marks :

(1) Quality Mark of the German (Q) for products whose quality complies with the scientific-technical top level or co-determines same thus representing world scale top products.

(2) Quality Mark 1 for products whose quality complies with comparable goods offered by leading industrial countries in the world market thus representing the world level.

(3) Quality Mark 2 for products whose quality is high enough to suit certain applications and whose usability and efficiency are guaranteed.

(4) Supervision Mark of the Germany for basic materials, semi-finished goods and finished goods meeting all requirements of techniques (or of the standards.)

The structure of the German Board for Measuring and Goods Testing is designed according to the product principle and largely adapted to the structure of the industry. The testing board forms the smallest independent structure unit. It is entrusted with carrying out the national quality control. About 70 testing boards are existing in close co-operation with the industry and particularly with the heads of the quality control departments within

The factories. The testing boards are located in industrial centres. They have their own chemical, physical and technical testing laboratories, in some cases the University,institutes, carry out the necessary tests on behalf of the German Board for Measuring and Goods Testing .

By the national quality evaluation and awarding of quality marks, the German Board for Measuring and Goods Testing furnishes the industry with standards and orientation on quality for its work.

The national standards are the most important basis for the national quality evaluation and for the awarding of quality marks, the connection between the German Board for Measuring and Goods Testing and the standardization authorities is extremely close. The more exact and quicker the standards for the most important products orientating towards the scientific-technical top level are worked out, the more effective will the quality mark be. If there are no standards for certain products or if certain standards are out-of-date, the German Board for Measuring and Goods Testing is entitled to effect the national quality control on the basis of its own regulations.

The German Board for Measuring and Goods Testing is entitled to effect controls, to fix quality requirements and to take quality-improving measures for all products of the industry. Test samples are taken of products from the series production, at the users' and from the trade. Irrespective of this, the factories are legally bound to report to the German Board for Measuring and Goods Testing those products for control and evaluation which are subject to the national quality control. The factories must submit a so-called product certificate in which all

technical and economic parameters of the products in question are compared with those products determining the scientific-technical top level. The products are subjected to a type or sample test. After the type or sample has been approved of, the factory is obliged to produce goods according to the sample tested. The type tests are supplemented by factory controls effected during the production directly. Both results of the technical test and the factory control are summed up, thus forming the final judgement for the classification of the products.

The classification is not carried out by one individual, but with the co-operation of valuers being combined in the so-called Valuer Committees. The Valuer Committees are consulting organs of the German Board for Measuring and Goods Testing being formed for the most important test fields under consideration of the social interest as well as of the interest of the manufacturer, user and trade. The valuer committees combine all experts working in the appropriate field in Germany. They are representatives of industry, trade, authorized repair shops, Universities, high and trade schools as well as individual consumers in the case of comsumer goods.

The quality marks have a highly moral effect upon factory teams and employees and have become a symbol for high-quality work. Apart from that, they convey important information to the buyer on the quality of the product. When being awarded a quality mark, the manufacturer is obliged to produce all products in question in compliance with the sample tested and to provide the products with the quality mark within the time of validity of the certificate. Those products most not be supplied from which the

quality mark has been withdrawn due to certain deficiencies.

The quality mark is a subject of a contract between manufacturer and buyer. If the manufacturer is not in a position to supply this product with the quality mark agreed upon due to the fact that it had to be degraded or withdrawn because of quality deterioration, the contractual agreement has been broken which causes appropriate sanctions, price cuts, etc. Apart from that, such price fixing system is existing for economically stimulating the quality development which is based upon the classifying quality marks and which economically rewards high quality and punishes low quality.

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GHANA

The Establishment Organization for Quality Control in Ghana is "The National Standards Board of Ghana" which was formed in 1967 by an enactment of the Government of Ghana.

The Board has the full responsibility for the Quality Control of locally manufactured products to the Ghana Government. The imported products from outside sources to Ghana are also expected to comply with the standards set by the Board.

The form of the Standard Board of Ghana reflects the various interests, knowledge and expertise required to ensure successful standardization. Members include the Government Ministers of Industries, Trade, Economic Affairs, Agriculture and Health. The Central organization formerly known as the Ghana Academy of Sciences is represented; and other members from the Ghana Manufacturers' Association, the Ghana Chamber of Commerce and the Ghana Institute of Engineers. The Board is led by the Minister responsible for industries. In order to function and promulgate the standards, the Board has adopted the international accepted procedure of setting up and working through Technical Committees.

The National Standards Board of Ghana realised the important role it must operate in this newly industrializing country, to assist young industry to develop on sound principles and practice with particular reference to product quality, elimination of waste and overall efficiency in the industrial activity. The initial machinery and procedures required to assist industry has operated by the Board to achieve the goal of high product quality. There is a system of factory visits, and this program is to

enable the scientific and technological staff of the board and the manufacturers to negotiate and receive the first hand information about each other's work, and to assist the co-operation of the Board and Industry.

The system of certification and marking is operated by the National Standard Board and this scheme has provided an assurance of quality to the consumer. The manufacturer was encouraged to continually produce good quality products. Quality Marks indicate that a product complies with standards. The National Standard Board of Ghana must ensure that the products comply with the Quality Standards required before a manufacturer is permitted to use the Quality Mark. The Board performs this through the following four items :

(1) Initial testing of products,

(2) Routine inspection of factories,

(3) Continuing testing of product, and

(4) Product labelling and code marking.

There is an Industrial Design Centre which consists of exhinition space where manufacturers can show their products, and the consumer can visit and offer comment or criticism on the products. It provides a focal point for manufacturer and consumer to meet and exchange ideas in the interest of improvement of the quality of the products. The National Standards Board of Ghana still face the following Quality Control problems in order to develop the Nation of Ghana into an industrializing country:

(1) Recruitment and training of necessary technological personnel.

(2) Increasing standards consciousness in industrial circles.

(3) Financial requirement for the establishment and equipment of the necessary test centres.

(4) The operation of certification schemes.

CHAPTER 3 FIELD SURVEY STUDY

3.1. Information Acquisition

In order to carry out the field survey study, the author paid a number of visits to firms for collecting information and data. Each visit varies from 2 days to a week so as to learn the actual situation of Quality Control as performed in each individual firm.

To achieve these objectives, the firms were chosen according to the sizes and were classified into groups of homogeneous products. The selected firm must also fulfil the following three significant factors :

(1) The firm must be a multiple setting with other works at a distance of over 5 miles.

(2) The firm must be part of a group of privately or publicly owned company.

(3) According to the last financial year, the total company sales value of the firm must be over £20 million.

It is believed that those firms which fulfil the above three conditions have practived quality control activities effectively in their factory.

Every industrial organization is acting both as a supplier and as a customer. The firm itself is a supplier to its customers. On the other hand, the firm is also a customer of a large numbers of suppliers who provide incoming materials which are essential to the total enterprise. Therefore, in general, these large factories are considered as having well-developed Quality Control systems and access to the most up-to-date information and knowledge regarding developments and advancements in the techniques and management of

quality control. Some of these factories may have accepted the concept of total quality control and may be in the process of introducing more advanced technologies such as application of computer and system engineering with regard to quality control.

We believe that in small-scale factories control of quality may be regard as the sole responsibility of the inspectors or the quality control department, for sorting out and rejecting defective units. The company management is normally reluctant to accept new concepts or to adopt new technologies. They may regard the concept of quality control as a remedial function rather than a preventive measure. They may consider quality control as a service adding ~~up~~ to the overall manufacturing costs just for preventing defective products from reaching the hands of the customers. We may even observe that the documentation is generally inadequate. ~~It~~ One is not surprised that hardly any data are properly recorded after inspection or sampling. Therefore, many relevant data are not available. The valuable feedback informations that are essential for the evaluation and for the improvement of quality control are also not available, hence hindering from further improvement in quality control.

Also a small private company may find difficulty in providing financial resources for obtaining specialised equipment and may well seek for financial aid in order to carry out the proposed contractual requirements. In the event of severe changes in the nation's economy, such companies may well find it difficult to continue trading. Moveover, we observe, in the large-scale factory, that the research department existed in their companyprovides a never ending search for the answers of production - more practical design and better materials, stimulated by the need to make better

products more economically.

Therefore, it is regret that the project was carried out entirely in those well-established firms in the Great Britain, and the small-scale firms have been neglected.

The survey of this project "Quality Control in Midland Industry" in Great Britain was divided into three phases which consisted of :

(1) Discussion with the head of quality department as well as the supervision staffs.

(2) Tour of the plants in the factory to study the actual situation of quality control in practice.

(3) Completion of the questionaire form.

After the individual discussion with the quality personnel, a brief knowledge of the general outline of quality that is functioning in their factory is obtained. The quality manager, the leader of the department, is asked as how ~~do~~ he leads his group towards the fulfilment of their responsibilities, how ~~do~~ they implement the economic of quality, policy and objectiveness; specification of quality; planing for quality; design of the inspection and quality control work-place; the quality control manual; organization for quality control; personnel methods for quality; compensation for inspectors; acceptance of quality; budgeting of quality control; process control; measurement; quality improvement; assurance of quality; vendor rating; statistical approach to quality control and research unit assist to further development of quality control.

Tour of the plants in the factory involves a survey of the methods of achieving and maintaining quality and reliability of the products of the manufacturing companies. It involves a study

of the practical techniques and theoretical treatments of these various techniques with a view to assess and analyse their effectiveness.

Finally, the completion of the questionaire consists of the following items:

(1) General information of the individual manufacturer.

(2) The ~~personnel~~ personal information of the head of Quality Department.

(3) Organisation for Quality.

(4) Responsibilities for Quality.

(5) Economics of quality control.

This questionaire form is done after the tour of all the plants in the factory, which give the author a clear view of how Quality Control is functioning in their factory and is completed in the presence of both parties.

A summary of the results of 26 factories is included in the appendices.

3.2. Summary of Data Acquisition

The data obtained from the survey are presented in the following Tables and Figures.

Due to the commercial ~~secret~~ secrecy in the majority of the companies, the percentage of quality control cost over the total company investment and the percentage of quality cost over the manufacturing cost which includes quality function of prevention, appraisal and failure cost are not provided. Also in some companies, the quality cost system of the department was not well performed. Therefore, it is impossible to analyse the quality cost involved in the Midland industry.

Class	Description	Survey %
1	Food	50%
2	Chemical, Allied	50%
		100%
3	Automobile industry	50.00%
4	Aircraft industry	10.53%
5	Mechanical Engineering industry	10.53%
6	Electrical Engineering industry	5.28%
7	Chemical Engineering industry	10.53%
8	Metal Goods industry	10.53%
		100%
9	Textiles industry	66.6%
10	Paper industry	33.4%
		100%

Table 2. A survey of various industry.

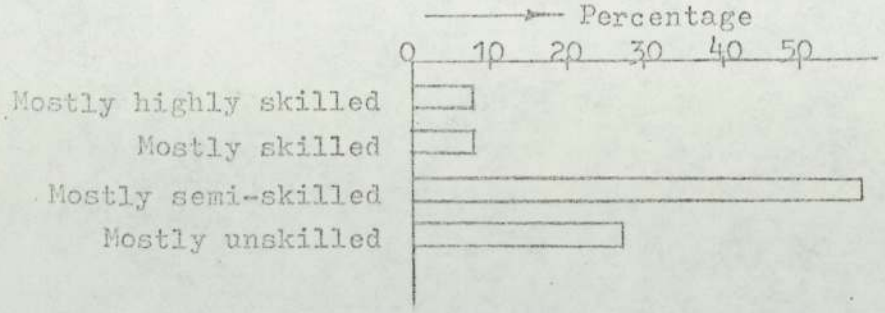


Fig. 3. Skill of labour.

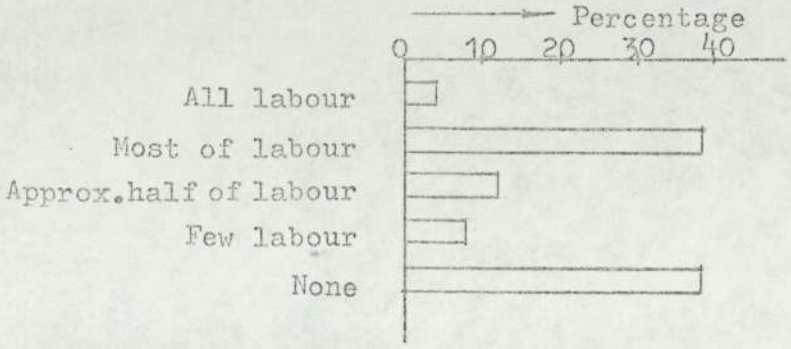


Fig. 4. Five alternative plans on performing financial incentive scheme on quality.

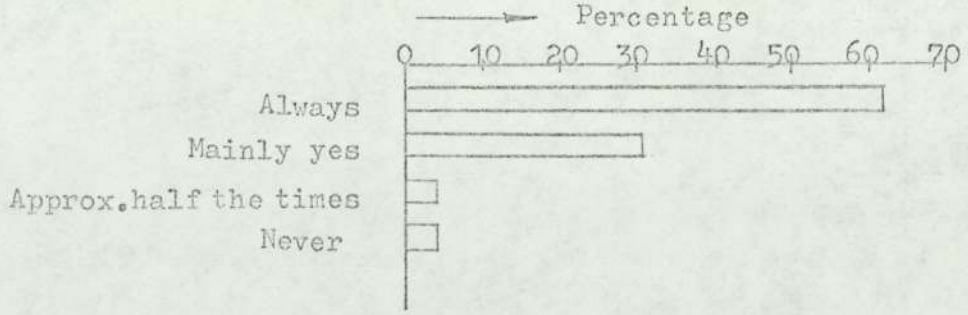


Fig. 5. Final consumer recognition on brand name.

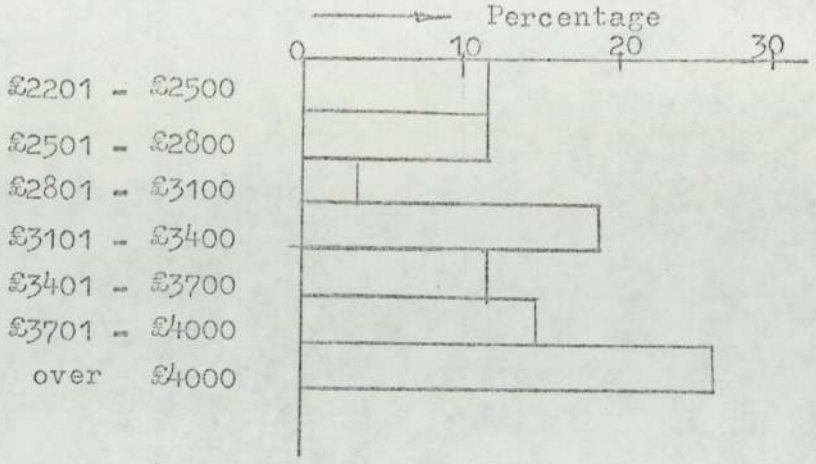


Fig. 6a. Salary Group of respondents.

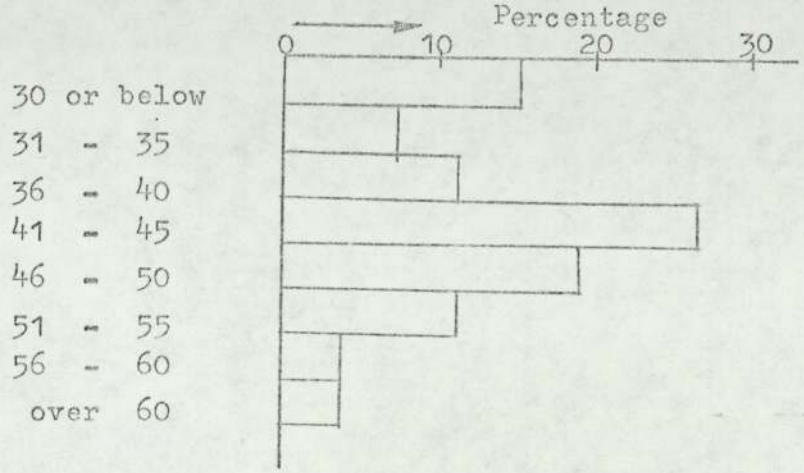


Fig. 6b. Age group of respondents.

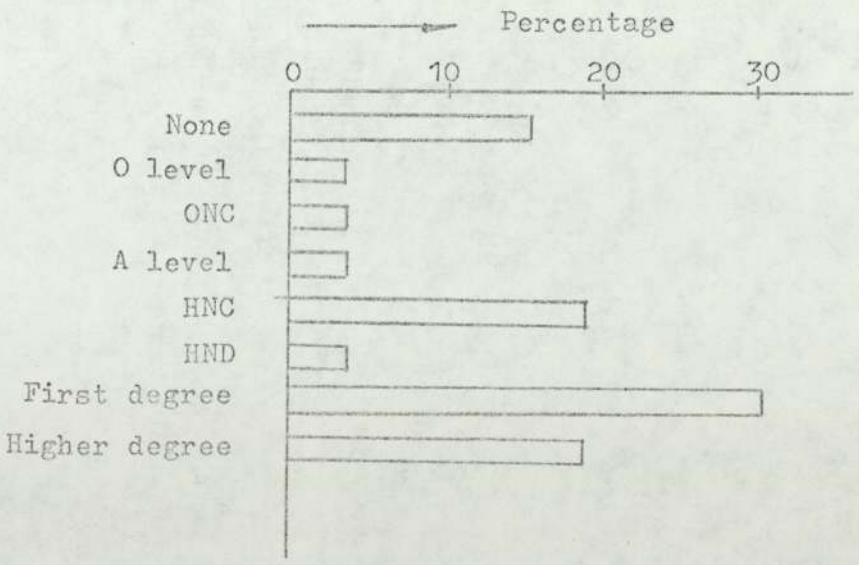


Fig. 6c. Qualification of respondents.

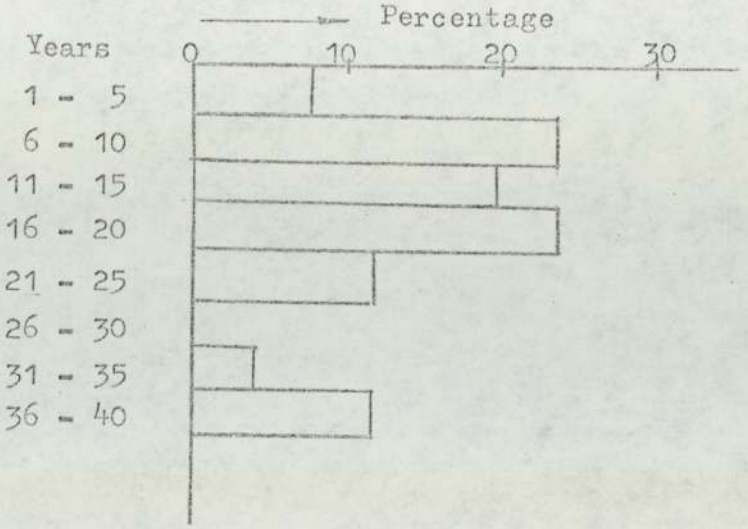


Fig. 6d. The years of service of respondents with their employers.

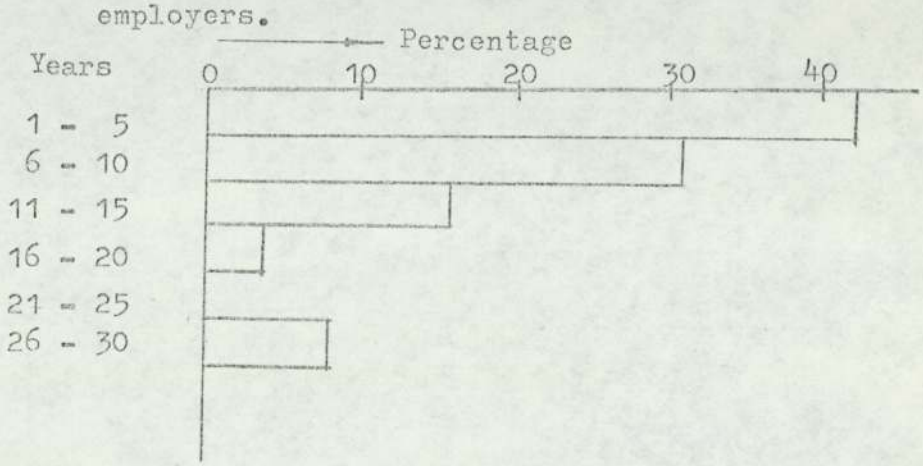


Fig. 6e. Length of experience in quality field

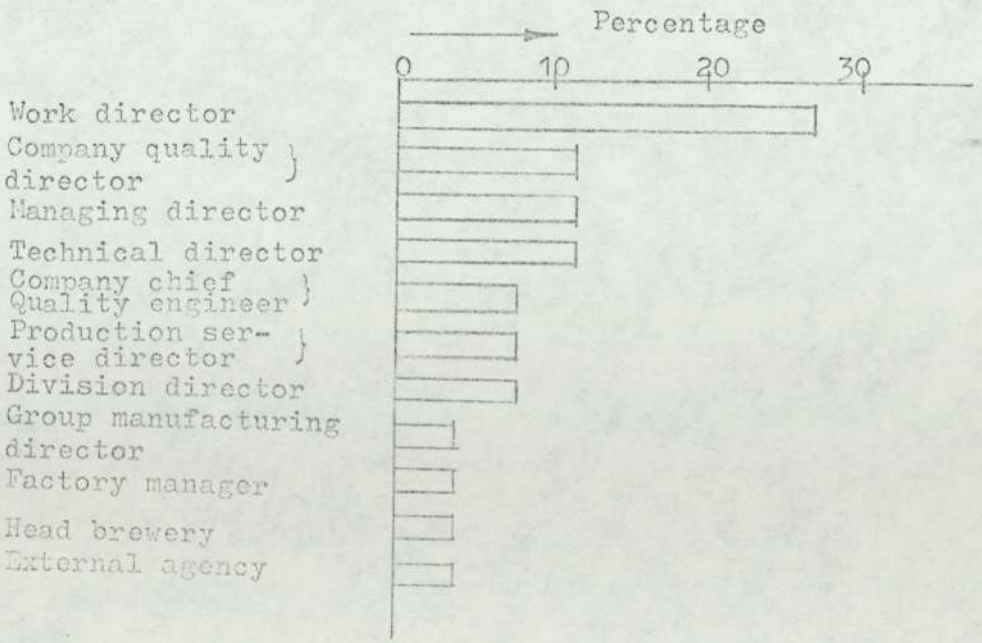


Fig. 7. Person of respondents report to.

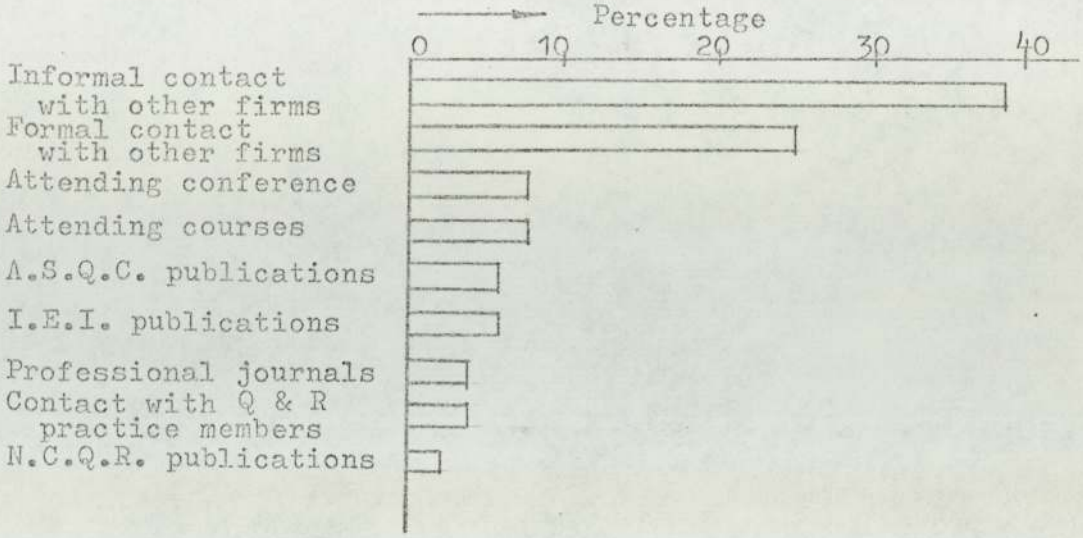


Fig. 8. The external valuable source of quality control to respondents.

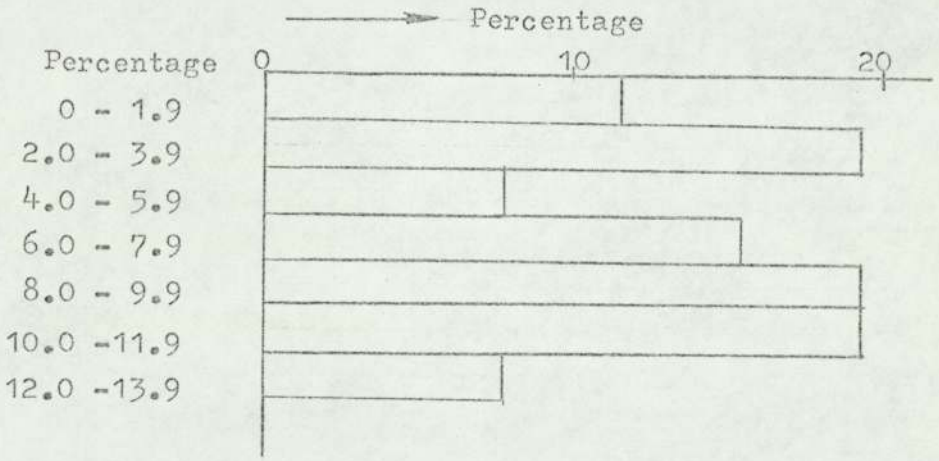
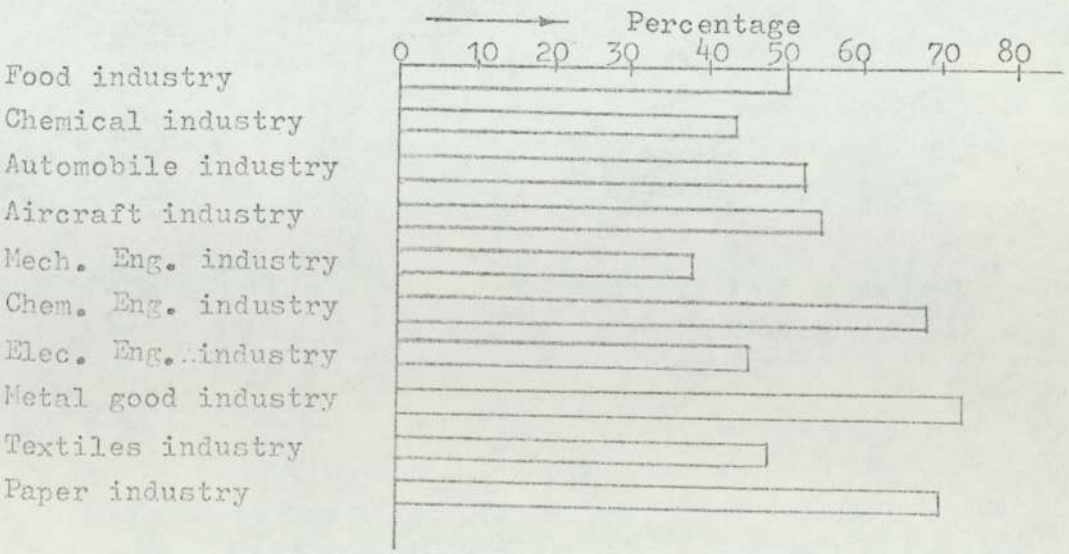


Fig. 9. % Grouping of total quality control personnel over the total work force.



Fog. 10. Percentage of bought out component in various industries.

Description	% over total work force	% direct inspection task	% indirect inspection task
Food	1.5	78.4	21.6
Chemical	2.9	88.5	11.5
Automobile	8.2	91	9
Aircraft	10.4	90.8	9.2
Mechanical	10.7	86	14
Chemical	6.5	90	10
Electrical	4	89	11
Metal good	6.3	89.5	10.5
Textile	9	94.5	5.5
Paper	3.5	100	0
Average	6.8	89.77	10.23

Table 3. Percentage of total quality control personnel over the total work force and the percentage of direct and indirect inspection task.

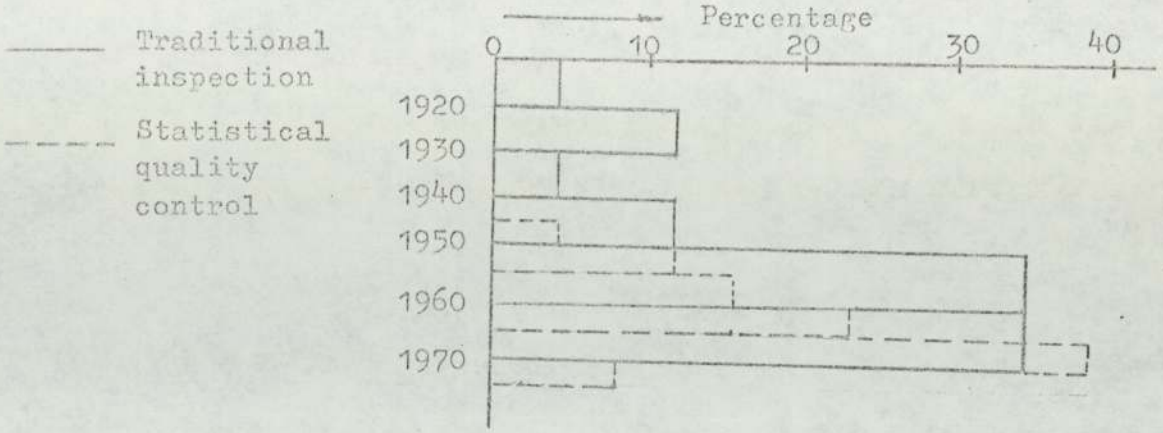


Fig. 11. Transformation of traditional inspection to Statistical Quality Control.

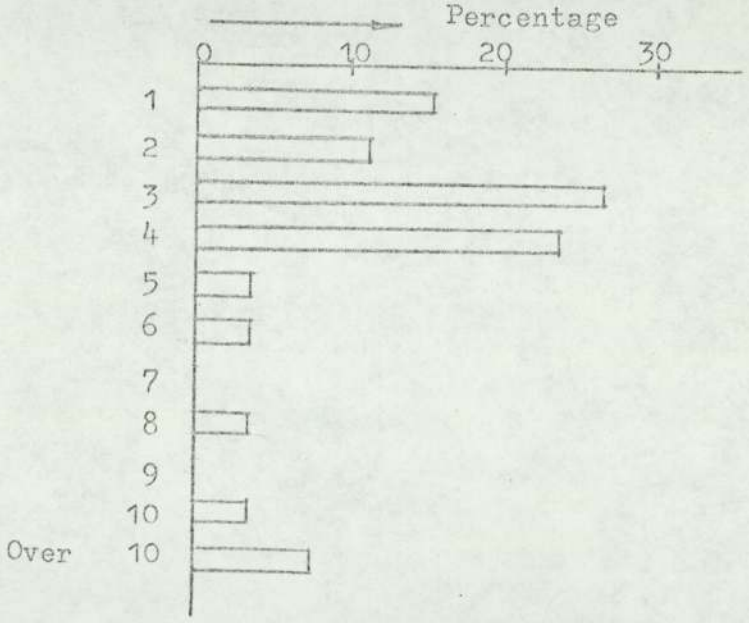


Fig. 12a. Number of AQL operated.

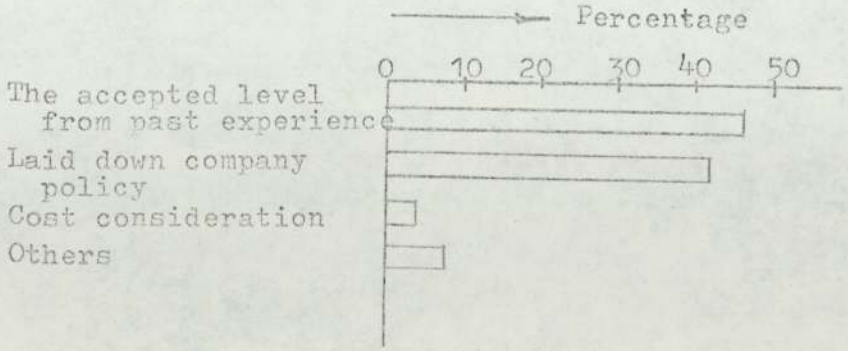


Fig. 12b. Choice for AQL.

	Description	Completely	Partially	None
1.	Quality audit or assurance	73.08%	26.92%	0 %
2.	Quality instruction manual	57.63	42.37	0
3.	Vendor rating	34.60	46.17	19.23
4.	Training inspectors and testers	69.23	26.92	3.85
5.	Warranty payments analysis	42.31	15.38	42.31
6.	Scrap and rework costing	65.39	19.23	15.38
7.	Process capability studies	26.92	62.54	11.54
8.	Environmental engineering	23.07	42.37	34.60
9.	Certification by external bodies	30.78	53.84	15.38
10.	Customer panels	30.78	46.15	23.07
11.	Product specifications	46.15	53.85	0
12.	Process specifications	30.77	65.38	3.85
13.	Test and inspection specifications	76.93	23.07	0
14.	On a incoming goods, S.Q.C.	30.77	57.69	11.54
15.	On a in-process basic, S.Q.C.	50.00	46.15	3.85
16.	In final inspection, products are checked	50.00	50.00	0
17.	Department provides report to	88.56	11.54	0

		Yes	No
18.	Separation of inspection Q.C.	73.08%	26.92%
19.	Separation of reliability activity	57.63	42.37
20.	Deal directly with Government contracts	66.40	33.60
21.	Resident of Government inspector	23.07	76.93
22.	O.R. year program performance	73.08	26.92
23.	Use of quality consultants	23.07	76.93

Table 4a. Summary of quality performance by percentage.

Description	Result
Food	Average
Chemical, Allied	Average
Automobile industry	Average
Aircraft industry	Good
Mechanical engineering industry	Average
Chemical engineering industry	Average
Electrical engineering industry	Average
Metal good industry	Average
Textiles industry	Average
Paper industry	Poor

Table 4b. Summary of various industries in quality performance.

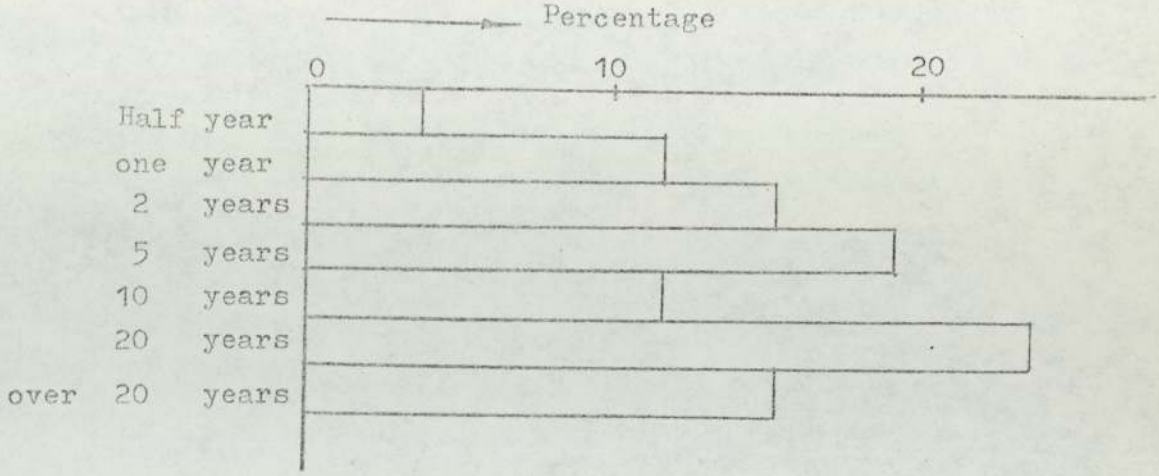


Fig. 13a. Model life of the best selling product.

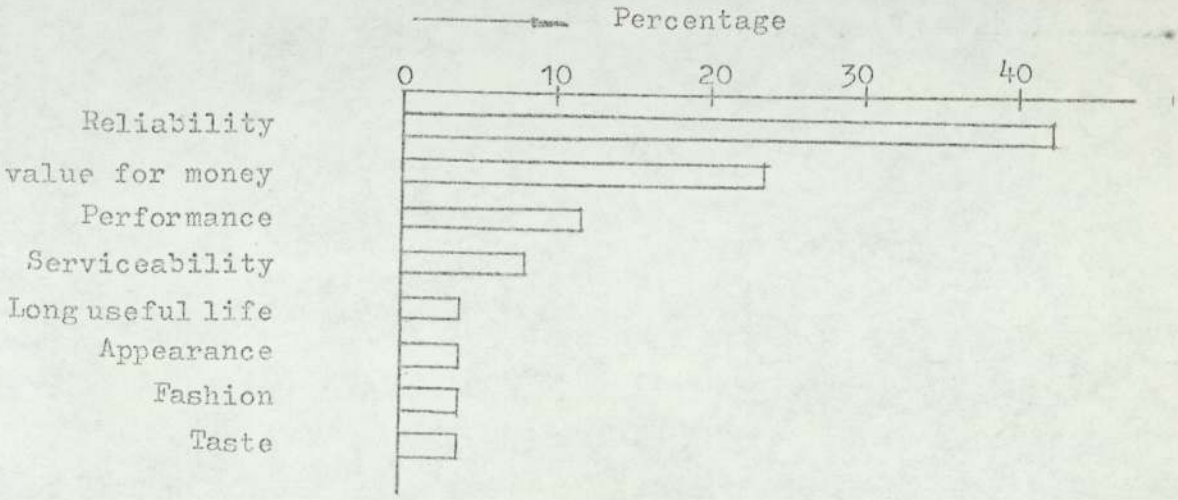


Fig. 13b. The characteristics of the best product.

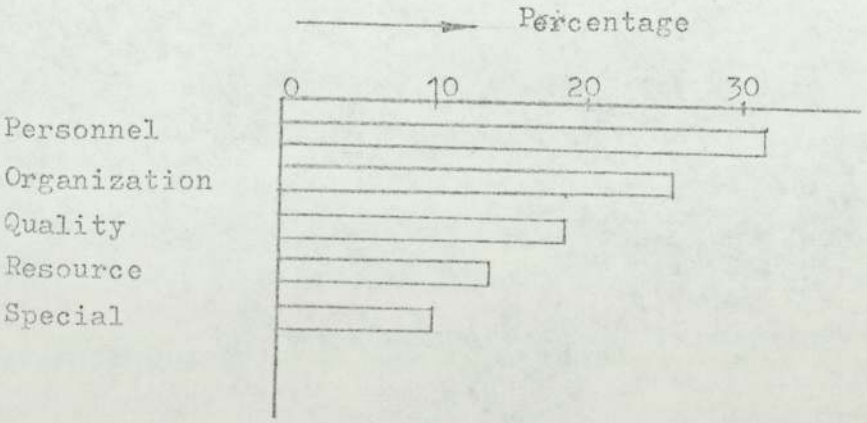


Fig. 14. Classification of problem area allocated to quality control by percentage.

Classification	Frequency	%
Personnel	41	31.5
Organisation	33	25.4
Quality	24	18.5
Resource	18	13.8
Special	14	10.2
Total	130	100%

Table 5a. Classification of problem area allocated to quality control.

	Description	Frequency	%
1.	Training supervision	10	24.39
2.	General management	8	19.51
3.	Motivation	6	14.63
4.	Training operator	5	12.20
5.	Production	5	12.20
6.	Labour force	2	4.87
7.	Implementation	1	2.44
8.	Lack of personnel	1	2.44
9.	Loyalty and technical competence of staff	1	2.44
10.	Strong descipline of work procedure in factory generally	1	2.44
11.	Industrial relation	1	2.44
	Total	41	100

Table 5b. Details of problems related to personnel.

	Description	Frequency	%
1.	In-coming product	16	48.50
2.	Communication	4	12.11
3.	Varying customer standards	2	6.06
4.	High volume of quality	2	6.06
5.	Clear and concise specification	1	3.03
6.	Classification of specification	1	3.03
7.	Segregation of defective work	1	3.03
8.	Time available for adequate prove testing of new product	1	3.03
9.	Variability of materials	1	3.03
10.	Bad storage	1	3.03
11.	Handling	1	3.03
12.	Lack of specification for semi-skill operation	1	3.03
13.	Lost of time before action to be taken	1	3.03
	Total	33	100

Table 5c. Details of problems related to organization.

	Description	Frequency	%
1.	Maintenance of quality standard	6	25.00
2.	Quality cost	6	25.00
3.	Vistual standard	3	12.50
4.	Sampling problem	1	4.17
5.	Measurement problem	1	4.17
6.	Justment of quality by customer is subjected	2	8.31
7.	Lack of inspector in quality audit	1	4.17
8.	Warrantly payments analysis	1	4.17
9.	In-process control in machine shop	1	4.17
10.	Uniformity of product	1	4.17
11.	Stability of Product	1	4.17
	Total	24	100

Table 5d. Details of problems related to quality.

	Description	Frequencies	%
1.	Process variability	4	22.22
2.	Technical problem	2	11.10
3.	Dimensional instability	2	11.10
4.	Complexity of equipment	1	5.56
5.	Complex function testing	1	5.56
6.	Complex manufacture	1	5.56
7.	Drawing tolerance too tight	1	5.56
8.	Adequate tooling	2	11.10
9.	Lack of research information	1	5.56
10.	Obtaining required performance characteristic	1	5.56
11.	Variability of small batch size	1	5.56
12.	High cist of test equipment	1	5.56
	Total	18	100

Table 5e. Details of problems related to resource

	Description	Frequencies	%
1.	Hygiene	2	14.44
2.	Precision plastic moulding	1	7.15
3.	Polishing problem	1	7.15
4.	Taste	1	7.15
5.	Analytical control	1	7.15
6.	Medical safety	1	7.15
7.	Water leak	1	7.15
8.	Paint	1	7.15
9.	Damage	1	7.15
10.	Finish	1	7.15
11.	Welding Brazing	1	7.15
12.	Microbiological control	1	7.15
13.	Decoration of tin plate	1	7.15
	Total	14	100

Table 5f. Details of problem related to special.

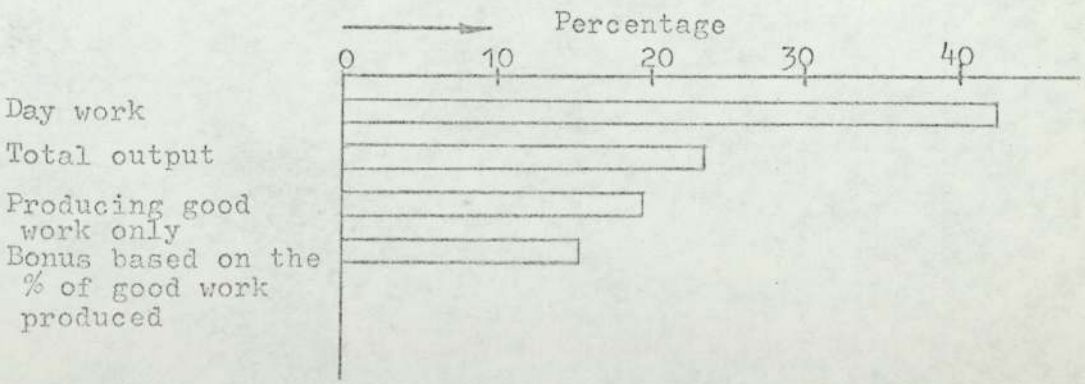


Fig. 15. Paid rate of operator.

3.3. Analysis of Results

The summary of the data obtained from the survey have provided us a clear picture of the present situation of quality control in the Midland industry.

Table 2 shows the actual survey carried out in the various industries.

3.3.1. General information of the Manufacturer

It is generally agreed that one of the basic requirements for achieving product quality on an economical basis is an effective process control system. For the most economical and effective control, the responsibility should reside with the operator. Self-control by the labour force can be made effective when the process control system has been engineered with proper consideration of both the technical requirements and the human factors. Therefore, it is important to understand the skill of labour, which may affect the process control system.

Also we understand that it was not many years ago that the industries practiced the profession of quality control, ignoring the human factors when it came to planning for process control. However, attitude and objectives have changed very considerably in recent years, and it is now generally recognized that the human factor is one of the extremely important factors to the success of the control mission. We know that financial incentive scheme, as a new way of quality motivation, is considered to be one of the human factors. We believe that this scheme is extremely effective and makes it possible to have a considerable improvement of workmanship operation and reduces the number of defects in the products. Therefore, to motivate operator towards quality improve-

ment, the operator will have to concentrate on the elimination of errors and defects.

Fig. 3 shows that among the factories surveyed, about 84% employ mainly semi-skilled and unskilled workers.

Fig. 4 shows that about $\frac{2}{3}$ of the factories surveyed run a financial incentive scheme on quality. 38% of the manufacturers apply this scheme to most of the workers.

In Fig. 5, the histogram shows that one of the significant factor among the factories under survey is that the majority ~~have carried out within the~~ established firms since very high percentage (about 92%) of the manufactured products or brand names are recognized by the final consumers.

3.3.2. Quality leadership information

The leader of the Quality Department makes the appropriate final decision as to what the company quality policy must be, both on an overall basis and with respect to specific product offerings. Since quality is an area in which all major functions must be involved, it is only the leader who can give the creative and final direction to major quality programs in the business. It is only the leader who by his leadership and example can inspire and direct the organization with the positive attitudes which alone assures the type of quality impact that his customers wish.

As a quality leader, he must lead his group towards fulfilment of their responsibilities. His ability will determine to a great extent the effectiveness of his group. In most instances, the effectiveness of the quality group is directly related to the morale within the section. ~~Although~~ We believe that it is possible for a technical group to have high morale but still produce

inadequate results. However, in contrast, low morale group can never yield good results. As the head is the most important single cause of good and bad morale within the group, he must have the ability to achieve results by encouragement, stimulation, development, and guidance of effort.

We realize the important role of the quality head's function. Therefore it is a general interest in this survey to include his personal information.

Fig. 6a shows that about 73% of the head's salary is over £3100 per year. The mean is £3528 per year, while the standard deviation is £754. It is understood that the standard deviation is small.

In Fig. 6b, it can be seen that majority of respondents fall in the age group of 41 - 50. The mean is 42 years and the standard deviation is 9.

The education background of the quality head is shown in Fig. 6c. About 50% of the respondents hold at least a first degree. Furthermore, 73% of the total surveyed are chartered engineers.

In Fig. 6d and 6e, the histograms tell the length of time the respondents have joined the company and their experience in the quality field. $\frac{2}{3}$ of the total respondents are working in their present companies from 6-20 years. However, the mean is 17 years and the standard deviation is 10. The same proportion of respondents have participated in the "Quality Game" between 1-5 years and 6-15 years. The mean is 8 years and the standard deviation is 7.

The top management that our quality and reliability man report to is shown in Fig. 7. More than $\frac{2}{3}$ of the respondents ~~are~~ report~~ed~~ to work managers or the company quality and reliability

top management. It is glad to know that now the companies do not delegate the responsibilities for quality control to the manufacturing department head. It is believed that both quality and quantity minded of manufacturing departments, with heavy manufacturing schedules, create a pressure to lower the acceptable standard and sacrafice quality to quantity.

The formal and informal contact with other firms had resulted a great interest to quality and reliability man. It is possible that they gain and exchange the knowledge of quality control field, which enlarge their knowledge in their practice. The results are shown in Fig. 8.

3.3.3. Quality Organisation

Quality Control means to organise quality at the most economical cost to users and to incorporate and maintain it in the products. The quality organisation has the assignment of responsibity and authority for the quality of product. The organisation itself has an aspect of control extending to process control, cost control, development, production, distribution, etc. It is a direct concern in all the stages of product development. It also includes the quality management, education, etc, which play a role in the development, maintenance and improvement of quality.

In promoting quality control of the product, the quality organisation is incorporated, under the company top management's quality control policy, in the business planning control system of all departments from design to sales. Quality organisation comprises the necessary preparations to carry out the objectives.

Quality organization must be considered in relation to the whole sequence of activities through which a market requirement, results in full-scale production and sale.

Table 3 shows the percentage of total personnels involved in the control of quality over the total number of employees and also the distribution of quality control personnel in various industries. The table shows that an average of nearly 7% of quality personnels over the total work force is practising in the Midland industry. Fig. 9 shows the histogram of the percentage of the quality personnel over the total workforce. The mean is 7% and the standard deviation is 3.8%.

The percentage of bought out components with their individual industry is shown in Fig. 10. However, among the $\frac{2}{3}$ of the industries surveyed, the bought out components vary from 45% to 60%.

In Fig. 11, the histogram shows the translation of traditional inspection system to statistical quality control with the year of commencing. 45% of the factories started the quality control after 1965.

The number of Accepted Quality Levels(AQL) operated and the decision of AQL operated in various factories are shown in Fig. 12a and 12b. Half of the factories surveyed are concentrated on either 3 or 4 AQL's. 90% of AQL performed in the industry are under consideration of either on the accepted level from past experience or laid down their individual company policy. Also in 85% of the factories surveyed the sampling for these AQL are work based on DEF-131-A.

The assessment is estimated by fixing the quality objectives,

policies and instruction, acceptance authority, level of the quality control group in the organisation, the depth of interest in quality control by management and functioning of quality control in the company. Table 4a and 4b show the summary of the data obtained.

It is fair to say that the large percentage of companies are with average organization.

In Fig. 13a, the histogram shows the model life of the best selling product. It is fair to say that 80% of these products are maintained in the market for more than 5 years, with some of them even over 20 years. And the best product characteristic is "Reliability" or "Value for money" which is shown in Fig. 13b.

The problem area and detail that influence the promotion towards the quality control in industries are shown in Table 5a-f and Fig. 14.

It is obvious that the organisation and personnel are the two hardest problems to face ~~with.~~ Only in the organisation area, 50% of the problem is existed with in-coming product.

The ~~paid rate~~ payment method for labour is shown in Fig. 15. $\frac{2}{3}$ of the industries surveyed have the wages paid according either to day work or total output. The rest are paid on bonus schemes.

CHAPTER 4 COMMENT AND CONCLUSIONS

4.1. Comment

4.1.1. Financial incentive scheme on quality

1. The factory should provide a financial incentive scheme on quality for operator as well as inspector. The scheme or plan may determine on the circumstance of the individual company which may vary from one to another, to promote the operator and inspector towards quality improvement and quality-mindedness.

Example showed that[39] since 1966, the North American Van Lines, when the programs of this financial incentives on quality commenced, the quality measurements have indicated a steady improvement in quality of performance of about 10% per year.

2. The program of this financial incentive on quality may be measured through the standard work per day derived from time study. The management may have to set the target for this standard work. Therefore, the performance efficiency may be determined from the actual output divided by the standard output.

4.1.2. Education and training for operator

1. ~~The~~ In promotion of more productivity or skilled operators, the education and training of technical field to labour is necessary. This may include in the plant training course and refresher courses. The orientation education is important to operator. Lack of technical knowledge ~~for~~ of his job ~~is not capable for him to achieve~~ will prevent him from achieving a fair result. Therefore at the present world level of technical innovation, the operator should contribute to his own ~~intention to~~ advancement in the technical field.

2. To achieve the quality control activities more effectively

and fruitfully, it is essential to provide quality control training to operators. He must be trained including the performance of sophisticated quality control techniques, so that he knows how to measure his output.

3. Operator must be trained in use of equipment operation. This may vary with the complexity of the operation. The instructions for self-control checklist procedure should be in a standard format. Operation conditions, inspection required and corrective actions should be written as clearly as possible in a standard format.

4. Having realised the important role played by the human factors in the quality assurance, the labour should be trained to be responsible and proud of their tasks. For the satisfaction of his work he must be conscious, revolutionary towards his work. Every product is the joint effort of every employees in the factory, thus the fulfilment of individual work is necessary. Fig 16 shows[40] the training procedure which exists in one of the Japanese manufacturing company.

4.1.3. Leadership

Normally the head of the quality control department should be a qualified person, for example, in an engineering firm, this should be a qualified engineer. He must have a good background knowledge of the philosophy and methods of quality control. He must also have a real appreciation of statistical theory and practice especially those less obtuse methods used day by day in the field of quality control, also in the promotion of implementing new advanced technologies, to aim for better quality and lower costs.

As a head of quality control, normally he has to make recommendations when company quality policy changes are considered, and

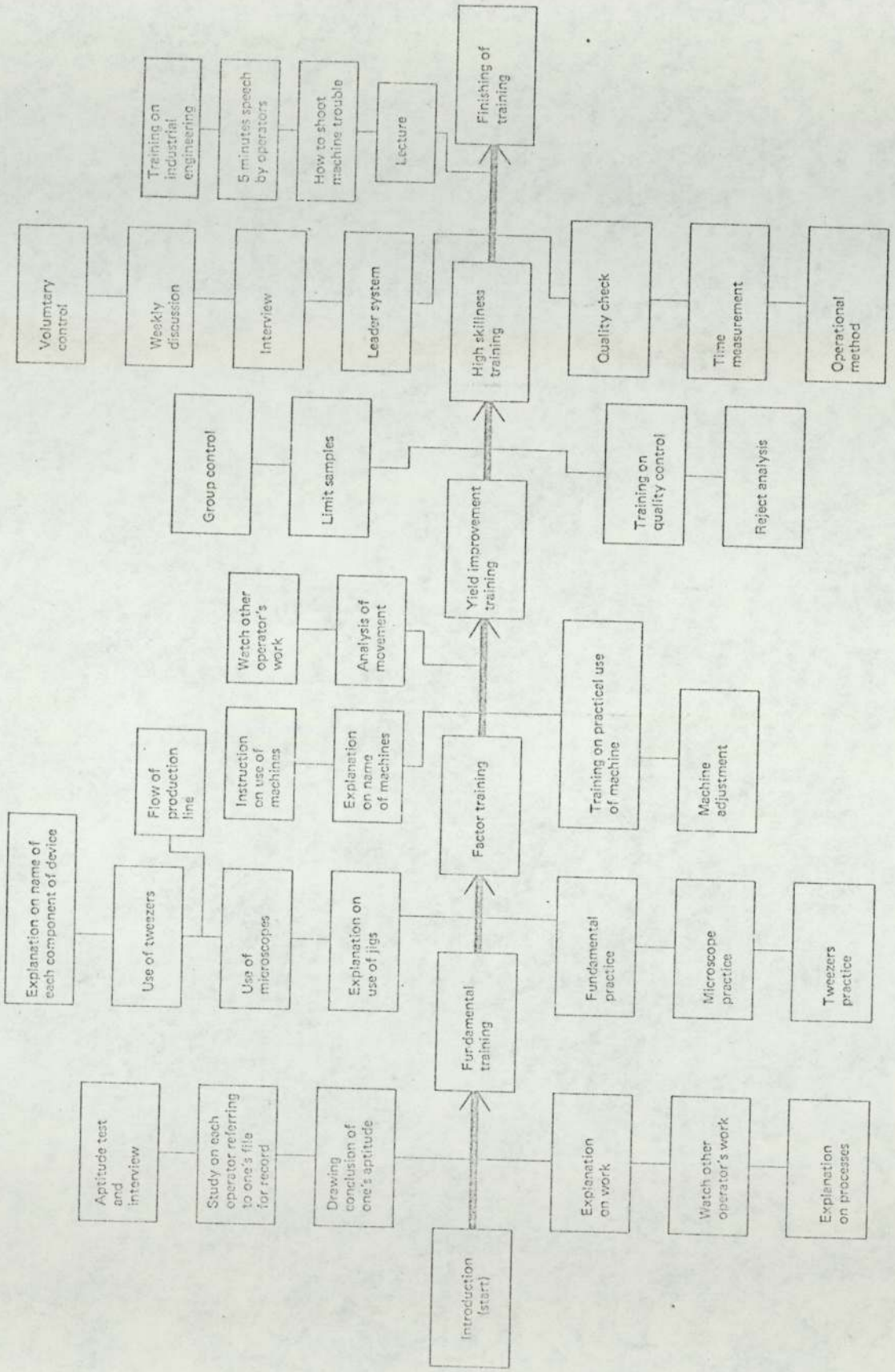


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Fig. 16. Operator training programme.

to implement the decisions of this quality policy; ensure effective liaison within and outside the company on quality matters and that a uniform approach is made where this is desirable and practicable, consider and improve quality control procedures and criteria for inclusion in the quality manual. He has to contribute his knowledge to establish the quality standards of new products within the design specification, to monitor the introduction of new products in order that the required quality level is rapidly achieved and potential sources of troubles are quickly dealt with. He will lead the department to overall quality and reliability function, successfully perform and assist production management in their responsibility to manufacture to the specification and standards, and audit that the finished products do in fact comply with them.

Therefore, the experience, academic qualification, salary and age are important characteristics of the head of quality control. The results obtained from the histogram show that these characteristics do not spread over a wide range. Since the standard deviation is small, therefore, it shows that the sample selected was satisfactory.

4.1.4. Quality Control personnel

1. Although the average percentage of total personnel involved in the quality control over the total work force and the standard deviation show a fair result, it is difficult to draw a conclusion from this result. It appears that there is a lack of international or national standards or data to compare. In author's opinion, the ideal case should be 10%. However, in some automobile industries, the result is only 3%. Consequently, the results obtained will

provide the Midland industry to make comparisons among themselves.

2. In an organization, a complete administrative coverage is almost impossible with insufficient man power. Therefore to promote the creative quality control activities, the department has to fulfil the staff required, and the staff should be well distributed.

4.1.5. Year of Commencing Statistical Control of Quality

Comparing the rapid growth of quality control in America or the spectacular explosion in Japan with the progress in the Midland industries, it appears that the progress of the Midland industries was not exciting. Even that the statistical quality control had been implemented since 1945, it is fair to say that it was not until about 1966 that in the British National Campaign of Quality Reliability year, the statistical quality control has become the most popular in the Midland industries.

4.1.6. Acceptable Quality Levels (AQL's)

1. The effectiveness and satisfaction of AQL performance to the Midland industries is well established. It is understood that the AQL's are greatly emphasized by the Midland industries. The standard of AQL's which is set by the Ministry of Defence DEF-131-A, is very well implemented, not only in the Midland industries but also throughout the nation.

2. In some industries the AQL's are designed under the company own schemes. The example in Fig. 17a-17o shows that in one of the Mechanical Engineering industry, due to the extremely high volume of production, the comparison was carried out at the request of the quality engineer in an effort to reduce the total amount of sampling required while maintaining the same standard of inspection. This

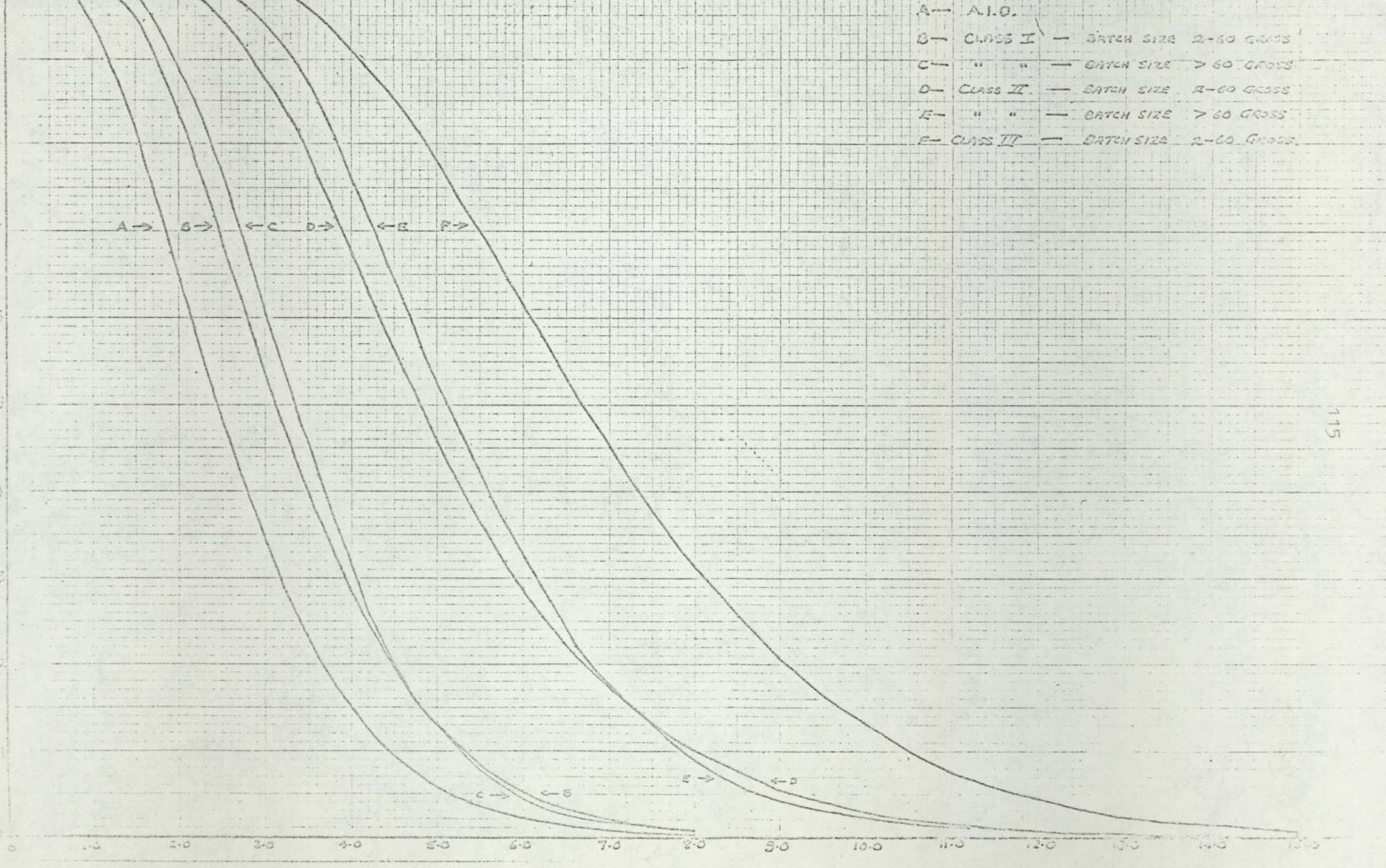

Fig. 17a Final Double Sampling Operating Characteristic Curve

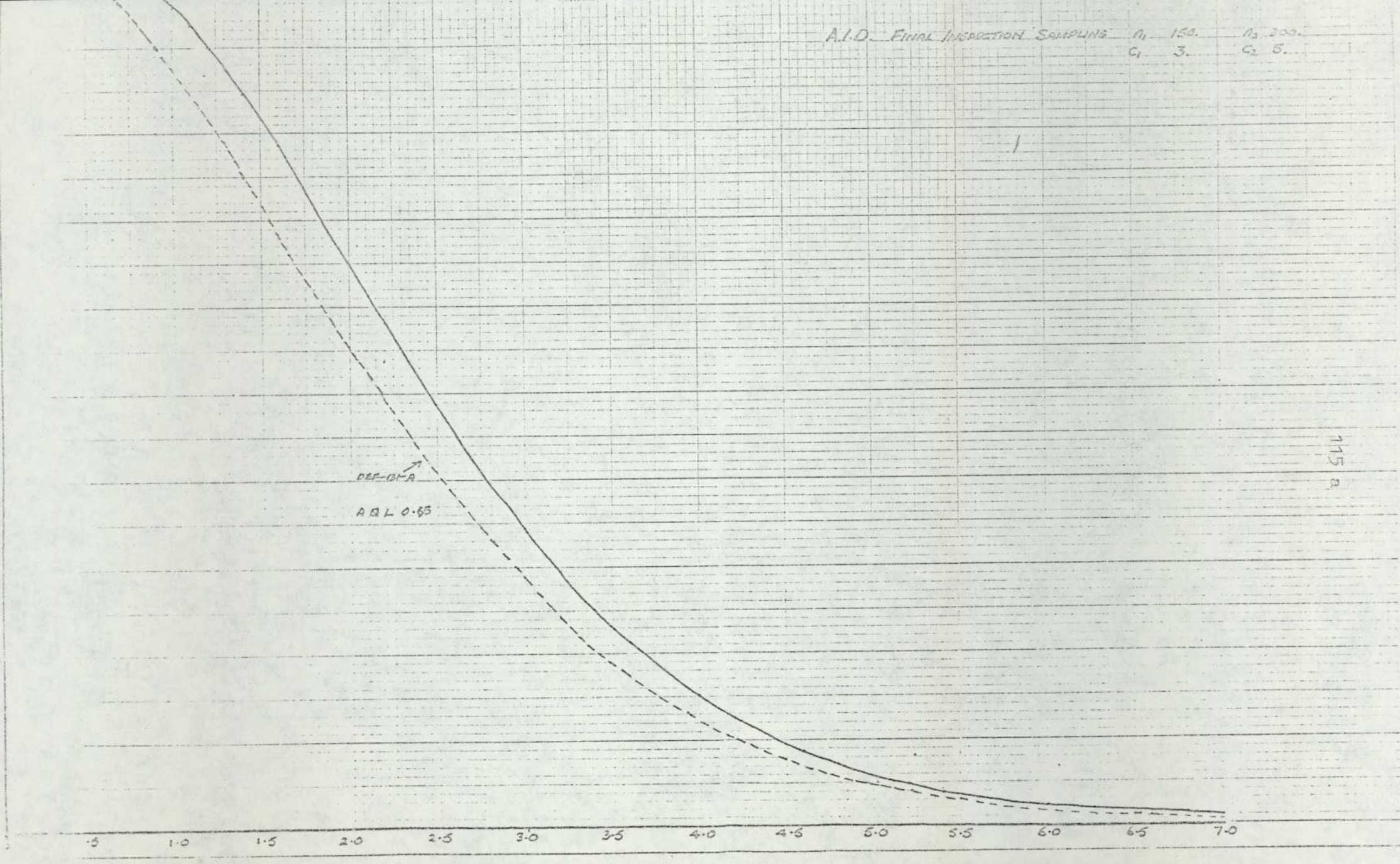

Fig. 17b Double Sampling Operating Characteristic Curve

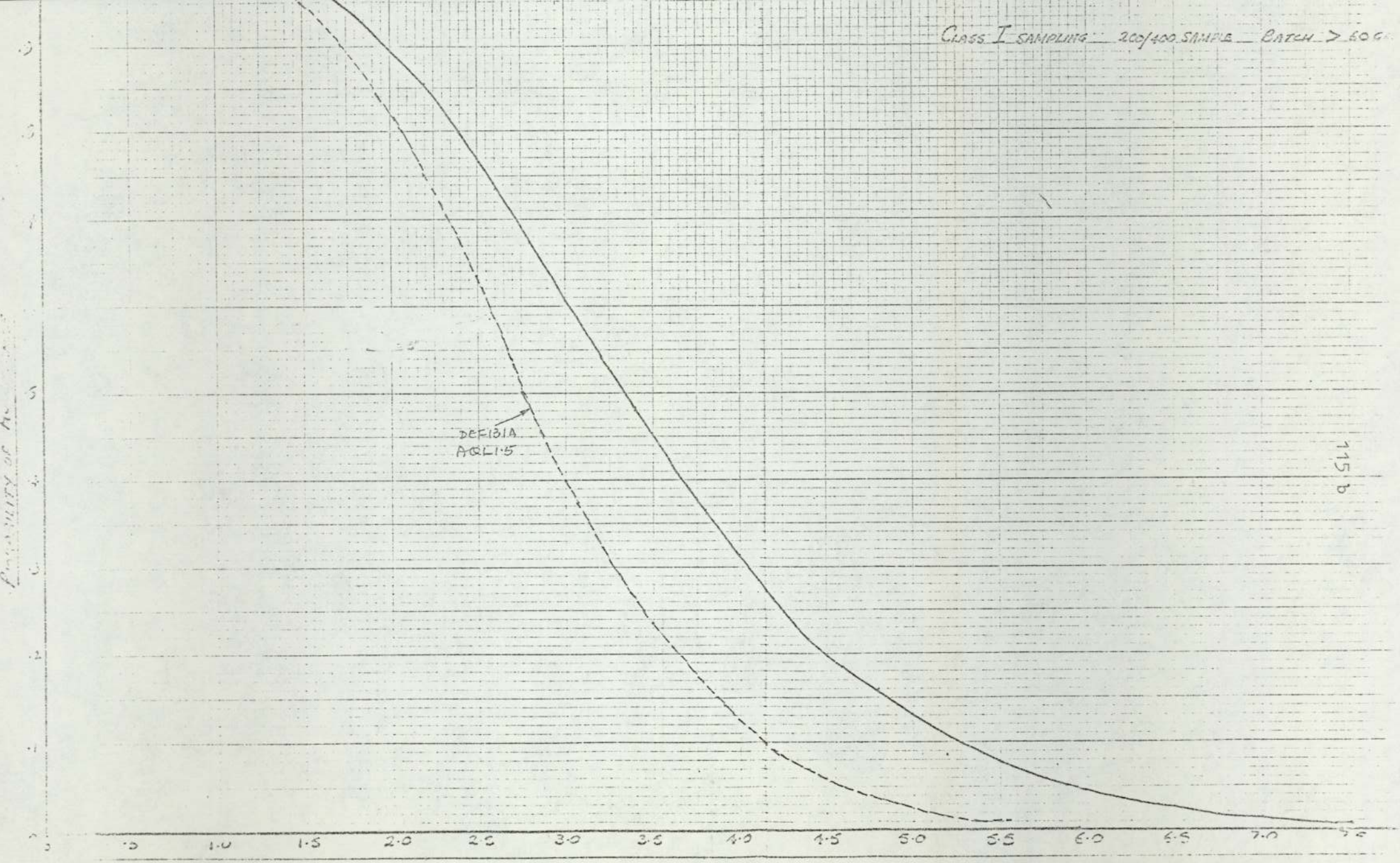

Fig. 17c Double Sampling Operating Characteristic Curve

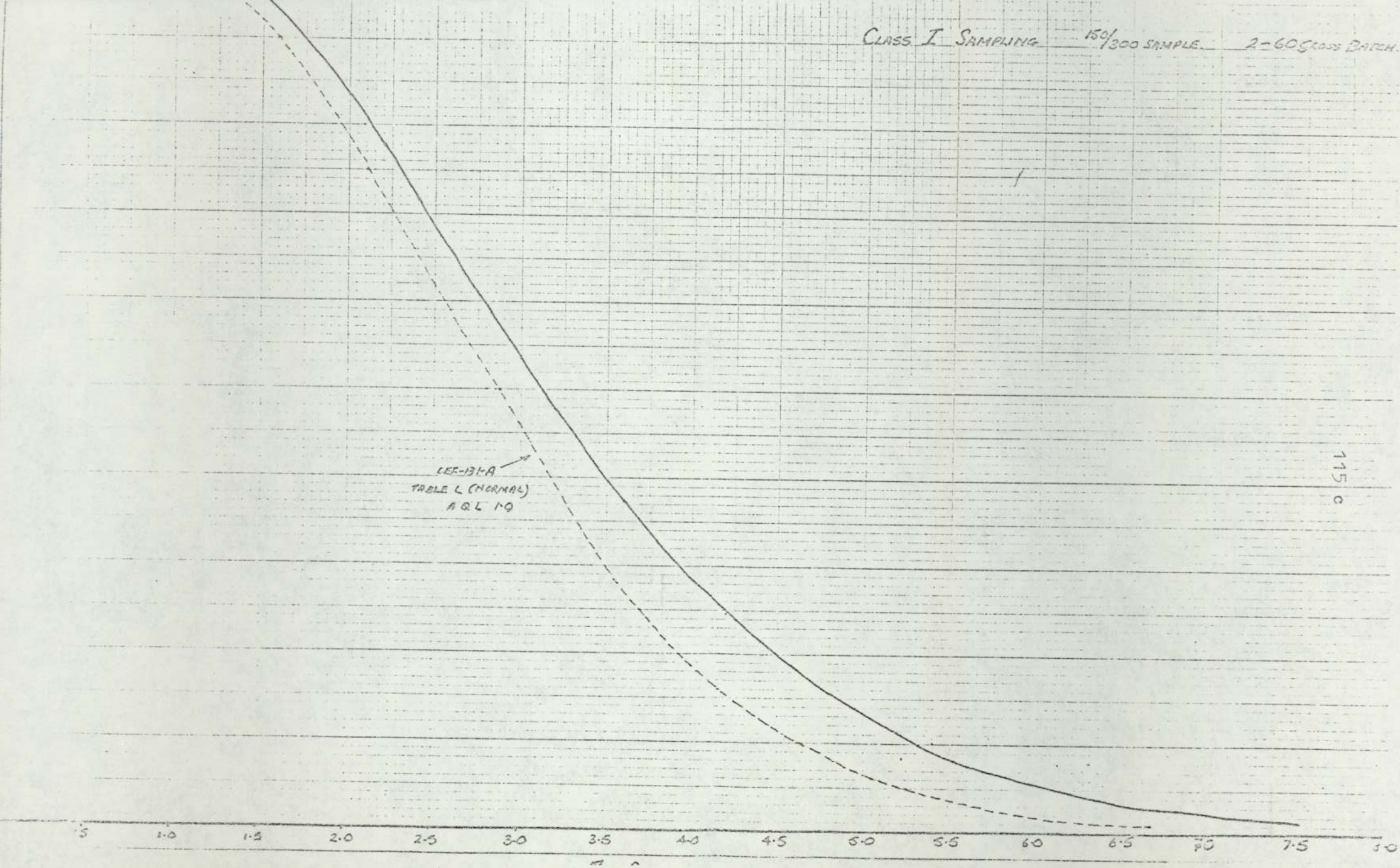

Fig. 17d Double Sampling Operating Characteristic Curve

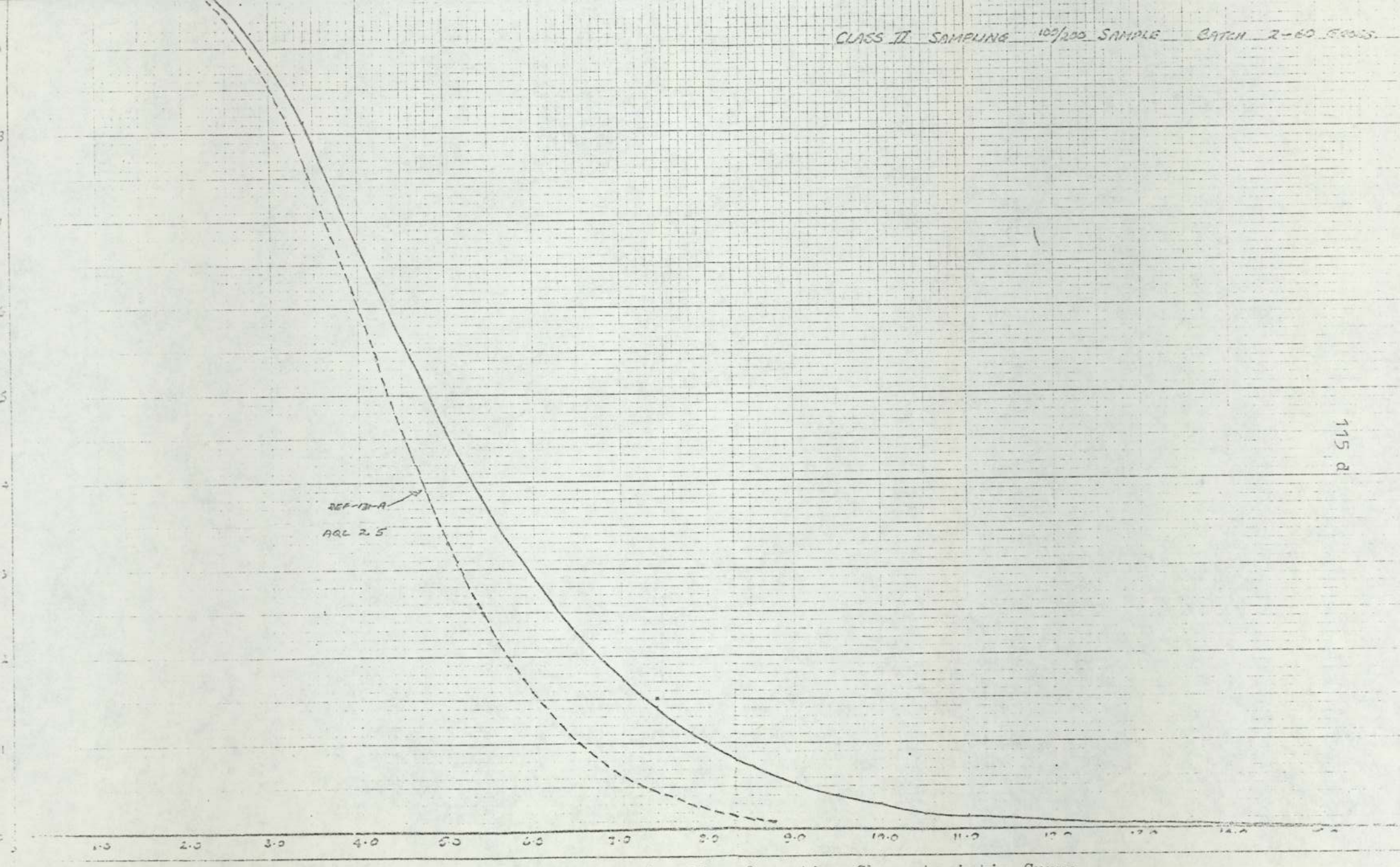

Fig. 17c Double Sampling Operating Characteristic Curve

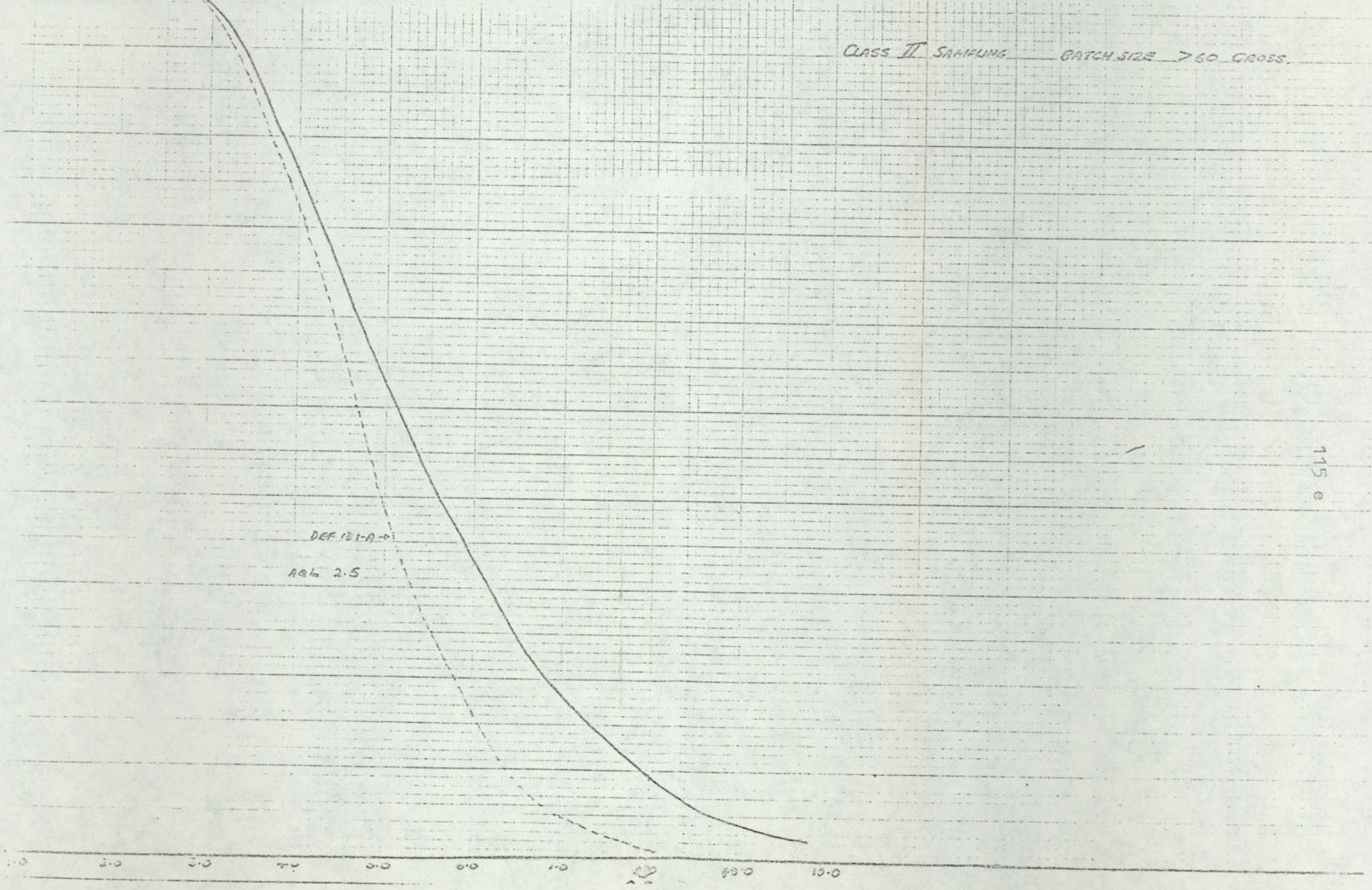

Fig. 17f Double Sampling Operating Characteristic Curve

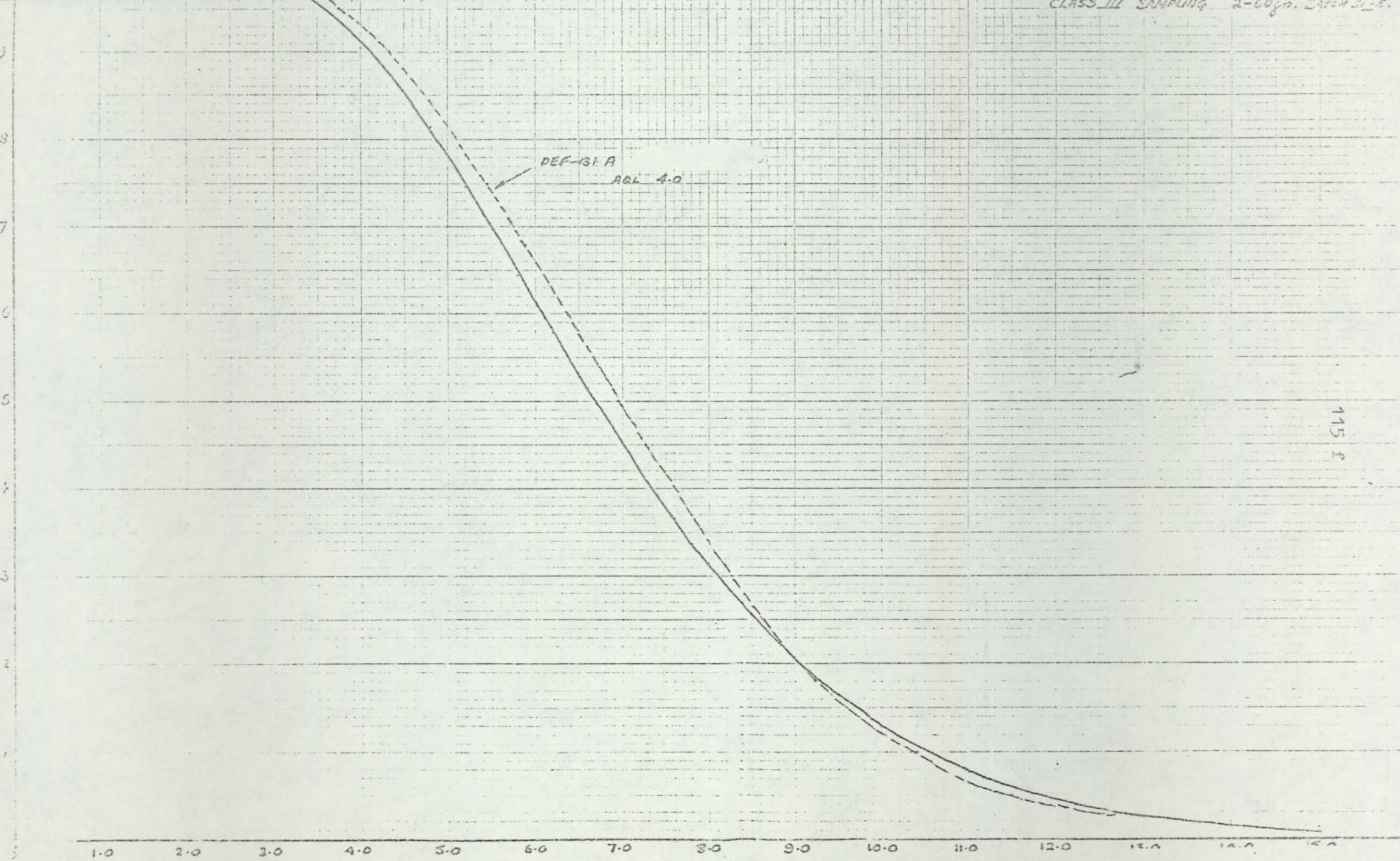

Fig. 17g Double Sampling O.C. Curve

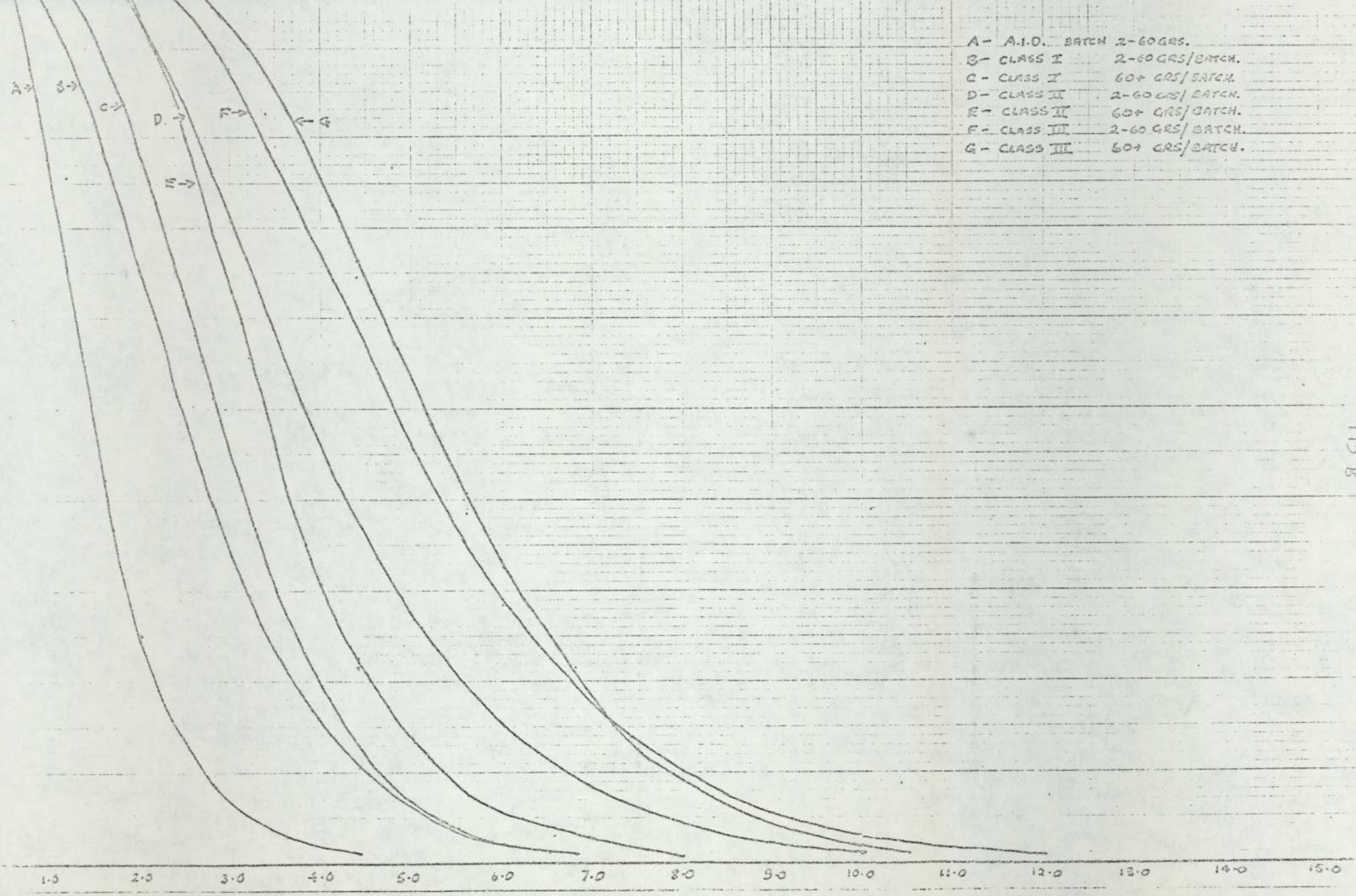

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Fig. 17h . O.C. Curve — Interprocess Sampling .

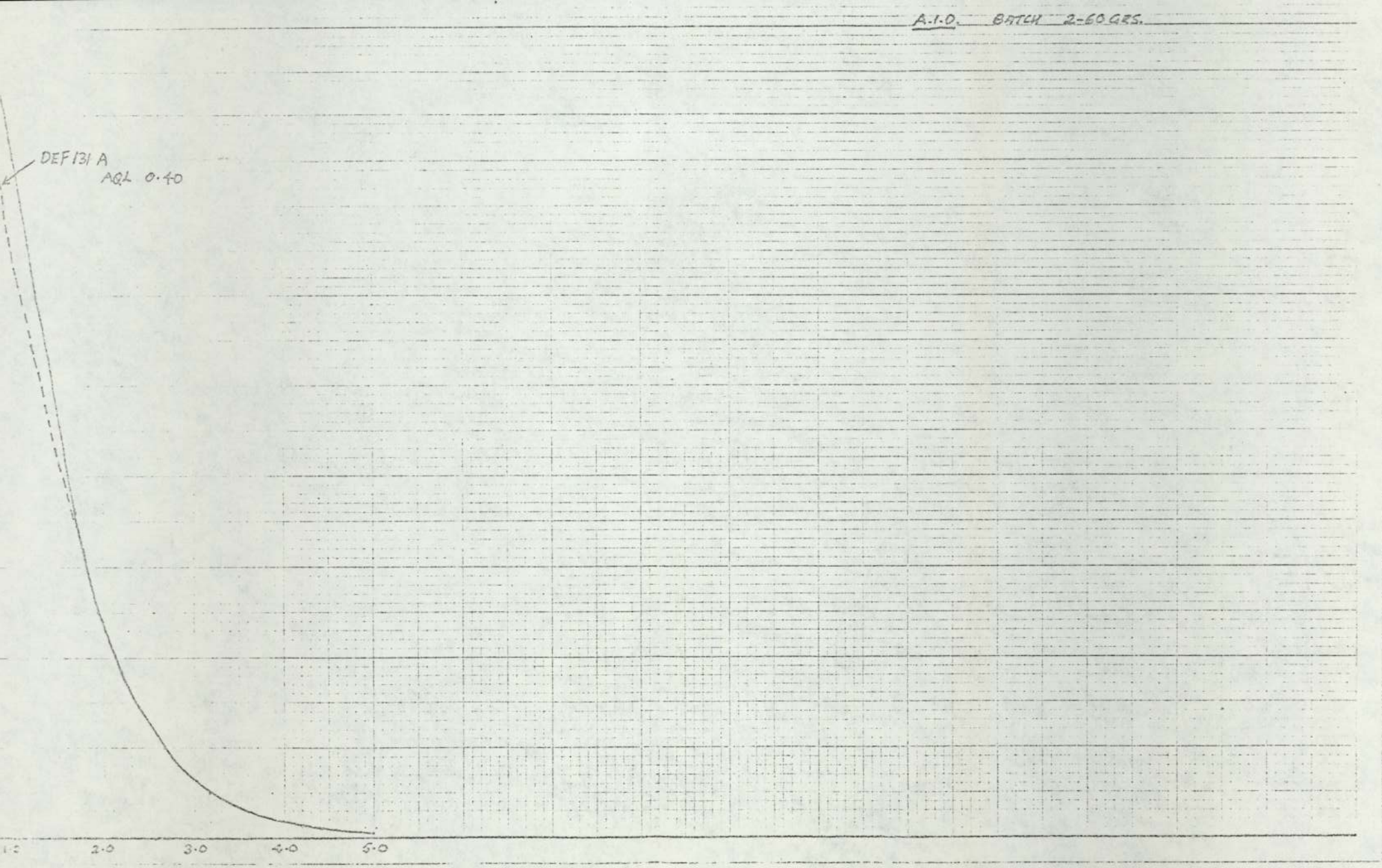

Fig. 17i O.C. Curve -- Interprocess Inspection

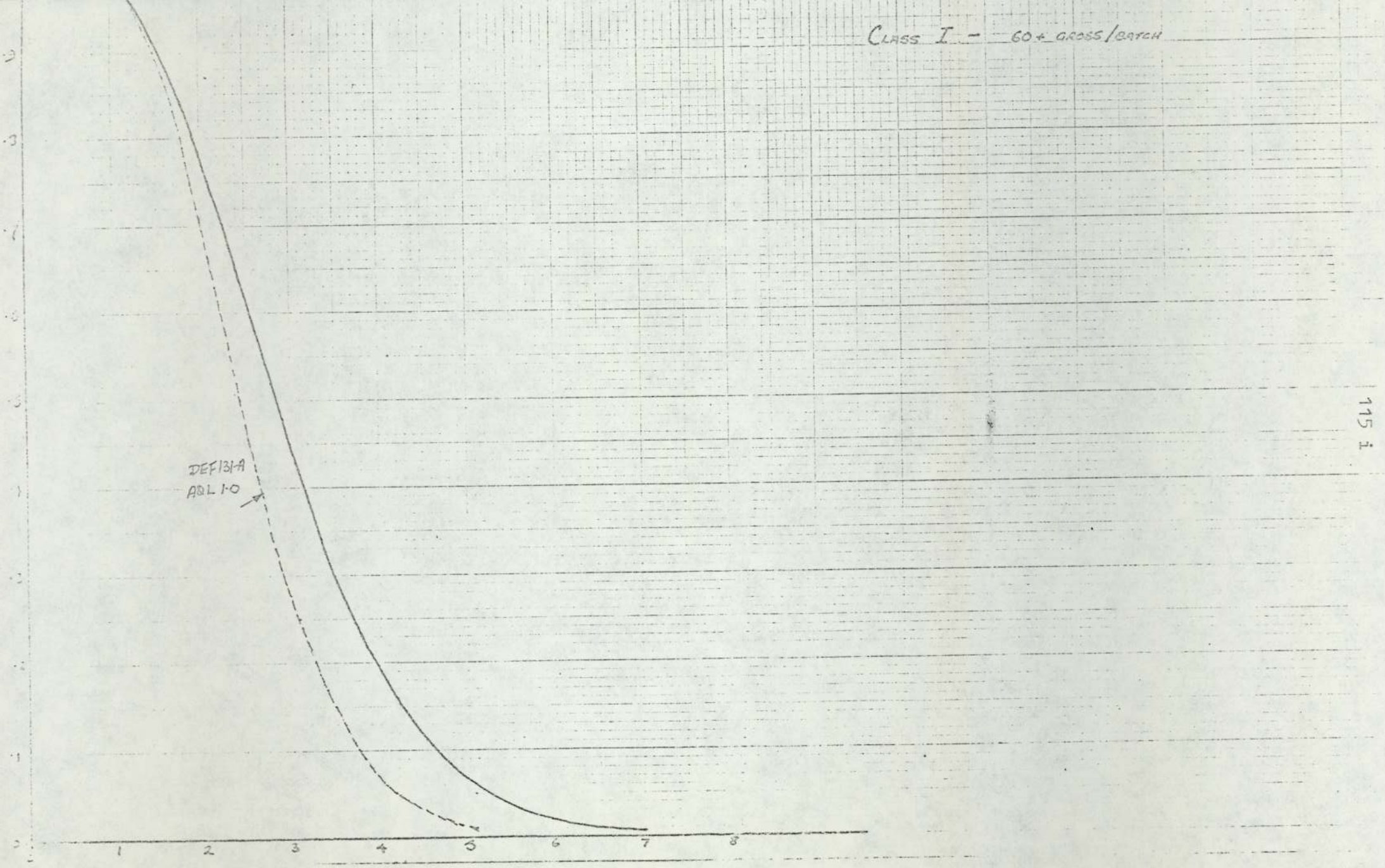

Fig. 17j O.C. Curve — Interprocess Inspection

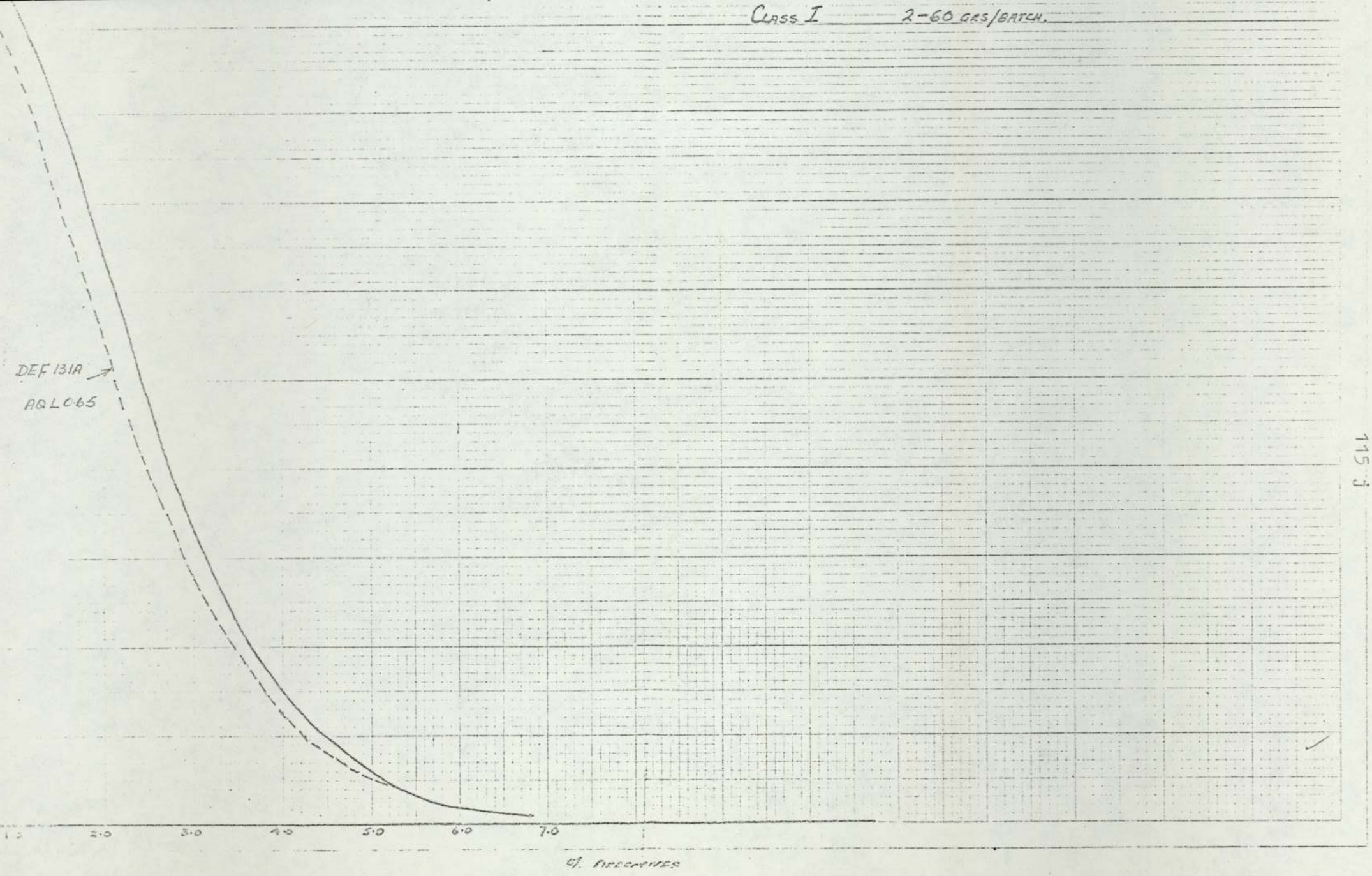

Fig. 17k O.C. Curve -- Interprocess Inspection

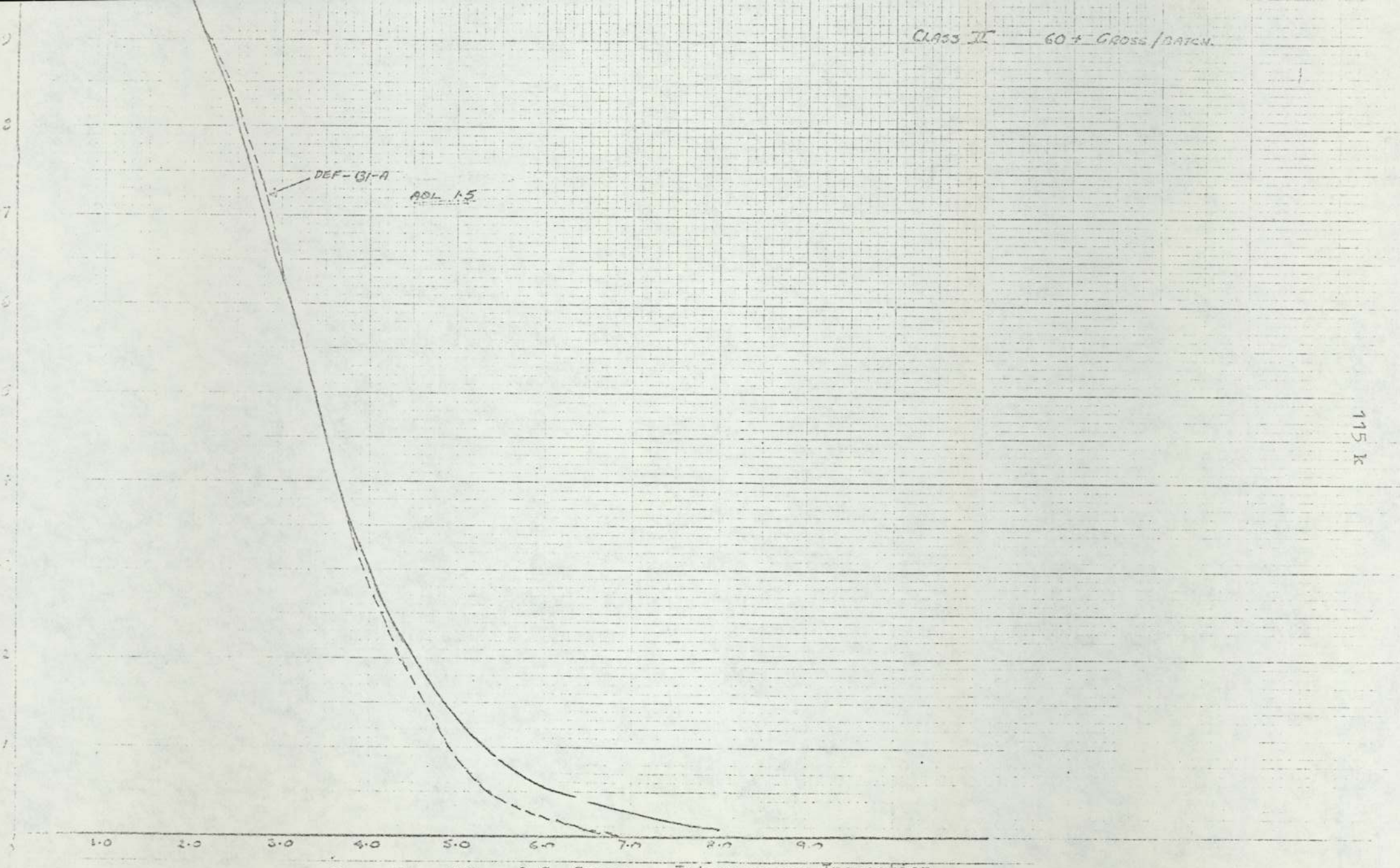

Fig. 171 O.C. Curve -- Interprocess Inspection

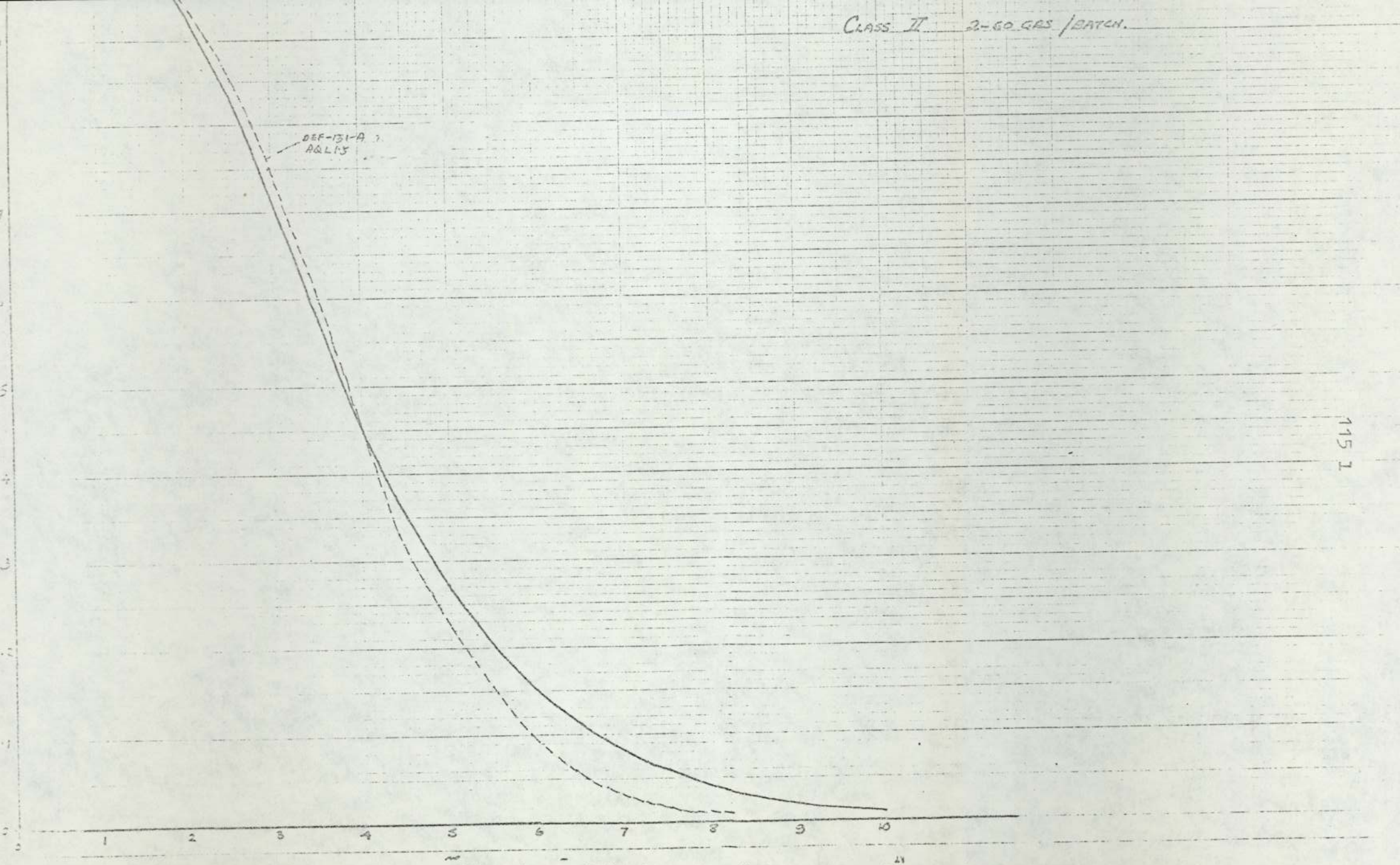

Fig. 17m O.C. Curve -- Interprocess Inspection

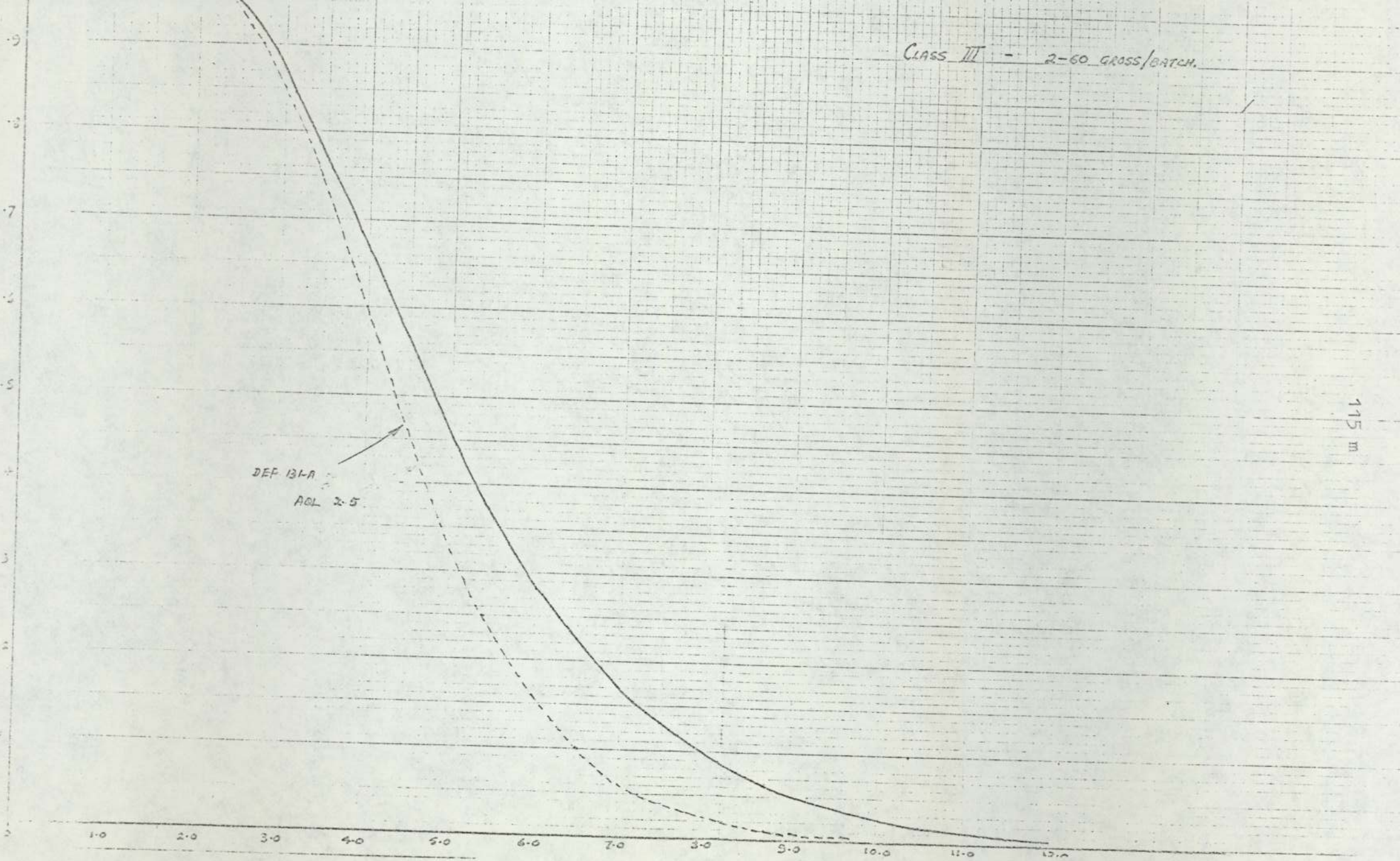

Fig. 17n O.C. Curve -- Interprocess Inspection

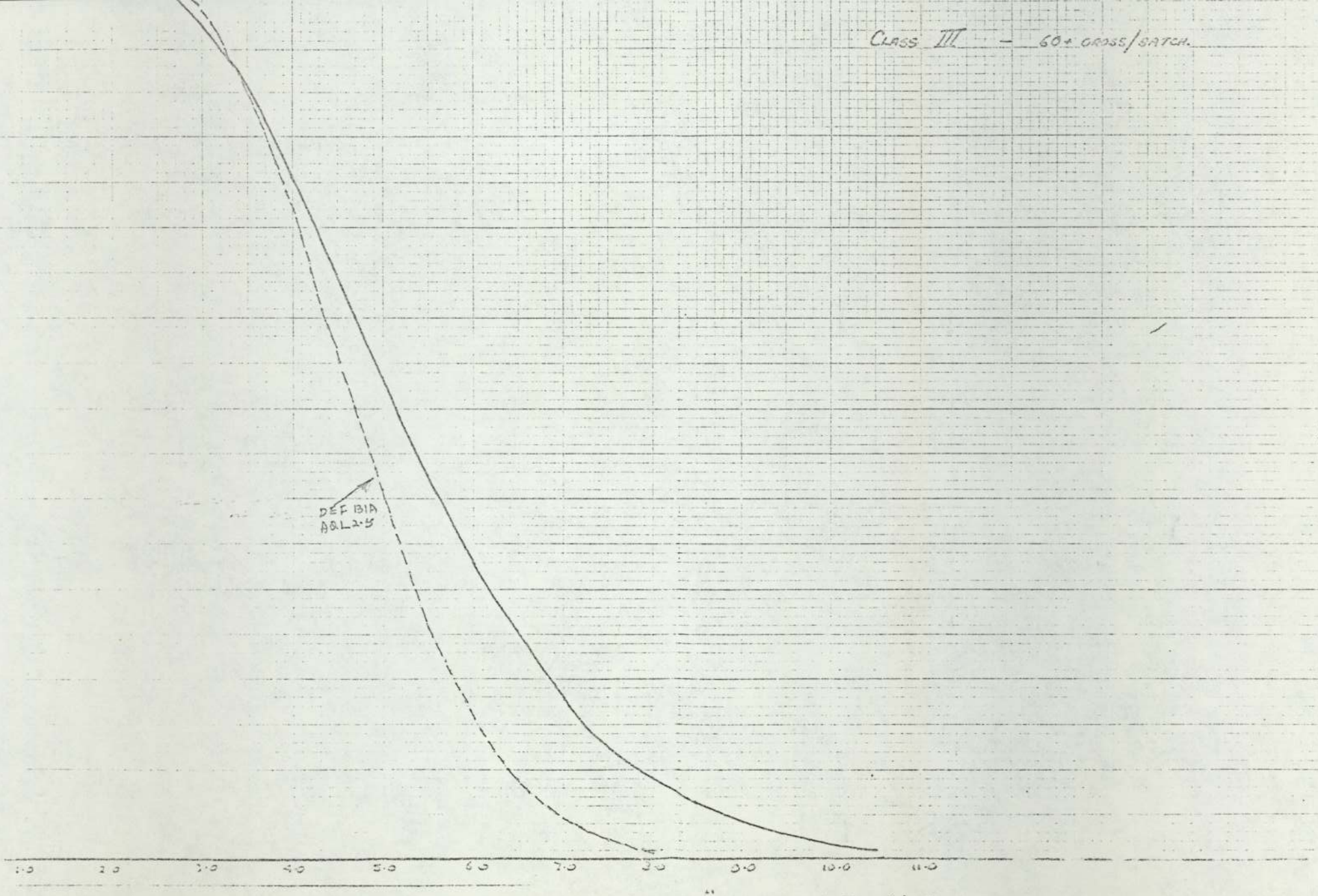

Fig. 17o O.C. Curve -- Interprocess Sampling

sampling plan was carried out under company's own scheme since the company was established. To compare the present company double sampling plan and DEF-131-A sampling plan, the results were obtained both for interprocess and final inspection. The table of comparison between DEF-131-A and the company own plan is consulted, it is seen that in many cases, the values obtained from DEF-131-A are smaller than the equivalent company own tables for double sampling, and in all cases, the DEF-131-A single sampling procedure results in a reduction in sampling over the equivalent company's own double sampling plans. This occurs with a similar, if not slightly tighter inspection characteristic. It is a very encouraging example that our quality control is looking forward to achieve better technique in producing the same product while still maintaining the good quality standard and reducing the cost.

3. However, AQL really means a commitment of imperfect material before we commence the work. Instead of letting either the supplier or the factory itself to set the standard, the operation sets the standard. Therefore, an AQL os not a management standard.

However, would you accept an article that you know in advance that a certain percentage will be defective? Therefore, an AQL is not ideal.

4. We understand that Zero Defects has been successfully employed in sectors of American industry. These Zero Defects is a management standard, a standard that management can convey to the employees to help them to achieve "Do the job right the first time." The Zero Defects program is based on the fact that errors are caused by two factors, i.e. lack of knowledge and lack of attention. The industry should seek the way to achieve and implement this powerful technique. Lack of knowledge can be measured and fulfiled.

Lack of attention is a set of mind, which requires a suitable training to change his attitude, and individual should be encouraged the response of enthuseastic towards the goals. Zero Defects is not a motivation method; it is a performance standard.

4.1.7. Quality instruction manual

The quality instruction manual content should at least include the following items:

1. The approval of specification: The design engineer has to submit his specification of a new design of a product in detail, for the approval and examination by a meeting of specialised engineers in the factory, representatives from quality department, design department, production service department, industrial engineering department, and sales or service department. Therefore, the necessary action to eliminate the potential quality hazards can be visualized through this Committee meeting by their knowledge, expreience and service, and the successful of production and quality function can be carried out. This meeting enable close co-operation between design, production and inspection in order to meet the responsibilities.

2. Planning for quality control : The detailed instructions of the operation sheet for setting up and operating of the manufacturing process must provides all necessary requirements, for deciding the manufacturing process, specifying the machines, fixtures, tools, gauges and test, equipments required. These are either responsibility of the industrial production department and in conjunction with the quality control department they ensure the means by which production will control quality to the required specification.

Production planning is responsible for deciding and providing the methods by which the design will be produced to the required quality standard. The operation sheet details the methods and equipments for the manufacture and quality control of the part.

3. Verification of production sample: For any new parts, the details of production conditions are inspected and recorded in the formal inspection form. Therefore this information is available either to the customer or the company concerned. In this case, the process capabilities studies are necessary to carry out.

4. Process control during production: The quality control department is responsible to ensure that the products conform to the specifications. During the production, the inspection staff of the quality control department should audit the quality of the job produced, and periodic samples are taken for measurement and visual inspection.

~~The~~ Statistical quality control charts ~~of accumulative chart~~, attributes ~~or~~ variables ~~charts~~ are used for manufacturing to the specification by the methods defined on the operation sheets and controlling the quality of ~~that~~ manufactured ~~by means of the~~ production quality checks & similar details. The quality control staff should see that the products are carried into effect in the works. The quality of the various processes is audited during production. The control chart are used where desirable or appropriate.

5. Authority of control quality: When the quality produced during production is unsatisfactory, the production supervisors, foremen, operators, quality control staff and inspectors, who are responsible and the authority of individual cases should be clearly notified in this item.

6. Supplier quality assurance: To ensure supplier quality, the quality instruction manual should include the two activities: (a) the vendor rating of the supplier's quality control must be estimated; (b) In order to ascertain the effectiveness of the supplier's quality control, one must implement the sampling planning schemes for incoming components.

The method of Vendor Rating and inspection procedure for various incoming products have to be clearly notified and the various forms for supplier quality assurance have to be designed in detail.

7. Quality audit system: For the semi-final and final finished assemblies products, sample is taken at random for detailed examination. This job is carried out in addition to the normal process control during the production and inspection activities. This work is usually undertaken by the quality audit engineer.

The procedure of the items to be audited must be stated in detail. This final quality confirms that the required standards have been meet and therefore the customers can depend upon the quality and reliability of the products.

8. Quality failure feedback system: This system of feedback is provided to assist production department in meeting the specification in future and preventing errors. The action should be immediately taken by the production to find when and where the quality failure ~~cause,~~ arose to ascertain the cause, and corrective action can be taken. In this item, the feedback flow chart is necessary and important. It will ~~provide~~ enable the factory to receive the feedback information quicker and go to the right ~~link.~~ source.

9. Quality costs: This quality cost must be prepared and recorded on a periodic basis, and this must be subdivided into various sub-

items, such as cost of inspection, incoming material quality control cost, production service costs, costs of scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to breakdown of machine, loss of output due to defective raw material, rectification, 100% check viewing, quality guarantee, and cost of selling a good product in a lower grade.

10. Training for quality control: This is necessary for both quality control and production department employees, since quality is everyone's business. Therefore the quality control training is aimed to achieve all employees work force to make them aware of their responsibilities and to provide them with knowledge of any necessary technique. The training must be well programmed.

It is believed that the above ten items for quality instruction manual is a minimum requirement. Some of the items will be discussed in detail when compare to the data obtained from the survey.

11. It is fair to say that the quality instructions manual is not established in the Midland industries. The result obtained from the survey is that only about 57% of the factories surveyed has completely operated this formal scheme.

4.1.8. Quality Audit or Assurance

1. It is fair to state that the quality audit is only limited to the final finished assemblies products in the Midland industries. However, it may be comprised of product audit, process audit and system audit. The main purpose of these audits is not only to limit the product to meet the required specifications, but also to ensure that the quality control has been fully implemented and disseminated

in all operations of the process. Moreover, the quality audit should include the company policy audit, the total quality control audit and cost control audit to produce the most economical product to meet the customer's specifications for quality assurance.

2. System audit is one of the cardinal for quality audit to meet the engineering requirements. The application of system audit is to lead the effectiveness of the administration in the company and has been successfully carried out regarding the quality control. It includes the establishment of the quality instruction manual which are fully utilized for specific function at specific organizations.

3. To ascertain that in-process operations, which mainly refer to the special processes, such as non-destructive tests, welding brazing, decoration of tin plate, water leak, are fully carried out, it may include the operator, inspector and equipment use. Therefore the product during production will be controlled to meet the specifications.

4. The product audit is to examine that the finished assemblies product are within the engineering specifications. This is in addition to the normal inspection or quality control activity. The objective is to provide an independent check on the effectiveness of the existing procedure.

4.1.9. Bought out component

The following activities are necessary in order to achieve the bought out component to the required standard of quality in the product.

1. One of the characteristics obtained from the factory surveyed is that in some industries, bought out component can be

as high as over 85%. The bought out component is the most striking problem on quality control to the department manager. There are so-called a double industrial structure existing in the Midland industry. A great number of medium and small industries are running behind the large industry in productivity as well as quality control.

For example automobile or aircraft industry is comprehensive in nature and comprises a large number of proprietary parts makers and subcontractors. The subcontractors may be large, medium and small scale enterprises supplying the various parts to form a motor car or aircraft. Therefore, due to the structure of such automobile or aircraft industry it is essential to implement a Vendor rating formal scheme to subcontractors. Thus, a well-established quality control can be carried out. This Vendor rating is to determine the ability of the subcontractors to supply the drawing and specification.

2. Design the sampling plan for bought out component inspection to verify the efficiency of the supplier's or subcontractor's quality control. The result of the inspection should ~~keep in~~ Dept on record, so that a summary of overall picture of the quality achievement of a supplier is prepared on a periodical basis for assessment and comparison.

3. For this incoming component, the statistical quality control must be implemented to all items.

4. Planning Vendor quality relations - Although the enterprise and the supplier both carry out quality control for their products, the both parties are totally responsible for quality control application with fully understanding and co-operation on their quality control system. The large enterprise can frequently assist the

supplier to promote quality control application and give guidance. Therefore, the product quality can be improved.

5. However, the relationship between the enterprise and the supplier must be equal. They should be independent of each other, and respect their responsibilities for quality control.

6. All quality requirements set up in the specifications by the enterprise must be clear, adequate and exact to the Vendor. The expressions of this kind can easily lead to disputes between enterprise and subcontractor owing to the fact that they interpret the specification in different ways. This is one of the most important item between enterprise and Vendor. Even if the written specification is clear, there is always a possibility that ~~they~~ there may be misunderstanding by the other party.

7. To maintain the bought out component in the required standard, the suppliers are necessary and responsible for submitting essential and actual data under the enterprise's request. In this case, the supplier is responsible for the assurance of the bought out component with the full satisfaction to the enterprise.

8. To ensure the bought out component, a team of quality assurance from enterprise should be set up to survey the performance to ensure a reduction in the ~~turnover of~~ rejects from the supplier. Also the assurance of delivery, cost, term of payment and quantity of the product ~~are~~ secures information.

Moreover, it is necessary for the quality personnel to keep close contact between supplier and enterprise, ~~for a short plant visit, so that the~~ observations during ~~the~~ visits to the plant are ~~is~~ effective in discovering failure and causes ~~or~~ improving quality techniques ~~suggestion.~~

9. It is understood that in the Midland industry, the bought out component has striking effects in the quality field. We realise unless the

quality of bought out component is excellent, the end product has come to be worse in quality, therefore making the supplier enthusiastically perform quality control in the bought out component. The enterprise can hold seminars for suppliers. Through this, they may actively perform various activities towards promotion of quality control and the improvement in quality control can be achieved.

4.1.10. Quality cost system

1. One of the important characteristic to aim the objective of the quality assurance is to assist management to meet the quality specification of the customers in the most economical manner, i.e. better quality and reduced costs. It is fair to comment that the quality cost system has not been established in the Midland industries. Although in some industries they have completely operated this formal scheme, still the organization for some industries in this quality cost system is poor. Therefore, the promotion of the formal scheme is essential. It is suggested that this system can be divided into three categories[4] leading to the feature of a good total quality control program of better quality and lower costs. These three categories are failure costs, appraisal costs, and prevention costs.

2. Prevention costs: This will include quality control training and quality control department expense including the incoming component inspection costs. The process control is the most important in this item. It is necessary to provide a good process control system during production rather than after the production when the defects have occured. Eventually, it will lead to a ~~high~~ reduction in ~~appraisal and~~ failure costs. Thus a process or operation is stopped immediately even before defective job is found. Therefore it is

suggested that the introduction of a quality assurance system is necessary even though the expenditure normally increases in this area. Training cost may include those training within the company and sent out for courses.

Appraisal costs consist of costs of inspection during and post production and quality control audit. Usually the inspection cost is easy to estimate.

Failure costs include defect and complaints, and are divided into external failure and internal failure costs. Usually there are easily recognised and dealt with as they include manufacturing and process scrap and re-work costing. The strengthening of the competitive power of industrial products can only be realized through the reduction of production cost and improvement in quality. Therefore, it is suggested that the Midland industry should operate this formal scheme in detail and divide the quality cost system separately into the above three categories.

4.1.11. Process capability studies

1. Due to the unavoidable variation in the manufacturing product and process output of the machine, the analysis and evaluation of the process capability studies are necessary in industrial engineering. Therefore the basic machine tool capability can be estimated. The capability of the tooling and fixturing used can be measured and the operators' capability can be ensured. Generally, the variation of the manufactured product is caused by chance-acting forces. And this capability of a process can only be defined and measured by statistical tool.

2. It is the fact that a very large percentage of factories surveyed have poor process capability studies scheme. It is impor-

tant to study the capability of a manufacturing process. The inherent ability of the process to reproduce the desired result. We search to produce the product in accordance with the engineering specification. Therefore, the implementation of process capability studies is essential, and the ultimate precision of uniformity in dimension, color, hardness, or of some other quality characteristic can then be measured.

4.1.12. Training and education program for quality control

1. The training of the quality control program and education is limited to the quality control staff and inspector only. There are only very limited cases where quality control training is extended to the operators. The seminars or conference are also limited to quality engineers and top managements.

2. It is fair to suggest that the quality control education and training should be commonly available to employees of all levels, from the top management to the bottom employees.

3. Statistical methods should be commonly known not only to the quality engineers. All levels of company personnels should have a fundamental statistical knowledge, so that they can apply in their work when necessary.

4. The National Quality and Reliability Council, the Midland Productivity Centre, the Institute of Engineering Inspection, the Universities and colleges of the Midlands should regularly hold courses, seminars and conference not only for the top managements, quality engineers, but also the inspection staffs and operators.

5. During this survey, we realise that a large number of companies have their own training schools or centres. Therefore it is easy to make full use of the facilities, to hold courses

within the company for their employees when necessary.

4.1.13. General

1. It is believed that occasionally the industry may need a consultant when introducing new technique or program for coordination is ~~especially adequate~~ necessary. The skilful and experienced consultant can always design, assist, and correct or alter the mistake or inadequate technique that is existing in the factory.

2. The quality department should implement the warranty payment analysis scheme, especially when the quality is under guarantee.

3. The certification by external bodies or Government is the responsibility of the Government to confirm that the quality produced by the manufacturer is in accordance with the required specification. The Government can send the inspectors to the manufacturing plants whenever it is necessary, to examine the manufacturing conditions. If it is found that the manufacturing conditions are unsatisfactory, the Government can suggest for improvement of the condition and pays keen attention to the proper performance of the manufacturing system. ~~Such as~~ Germany, Japan, U.S.S.R., the Government ~~is~~ has implemented the quality standard to the industry.

4. The different cultural patterns, religions, educational development and political regime are neglected in the executing of quality control in Great Britain. Similarly in the Midland industries, the mobility of the employees is considerably larger compared to some other countries. This may be one of the reasons that causes the promotion of quality control towards the goals.

5. Professionalism is popular in this area of industry. It is more difficult for the employees to have a direct contact with the senior.

4.2. Conclusions

(1) The transformation of Statistical Quality Control into Total Quality Control is necessary in most of the industries today. In many cases, Quality Control must be functioned with the cooperations of ~~every~~ all personnel in the company. The quality and reliability of the product can meet the engineering specification only by the effective incorporation of all relevant activities both within and outside the company. Total Quality Control is an effective system covering all the channels of activity and it is closely related to the over-all management.

(2) It is fair to state that, new advanced technologies of system engineering have not been implemented in the field of quality control in the Midland Industry. Remarkable results have been obtained in the American industries after the implementation of system engineering. System engineering is thus an effective means to meet the needs of the industry for much improved productivity and profitability. The implementation of the principles of system engineering to quality control field will, as a result, bring tremendous saving to the company. Therefore it is hoped that the Midland industry will adopt these techniques in the near future.

(3) The use of computer in quality control should be encouraged. The use of computer in data collection and analysis have achieved remarkable successes. The speed of checking enables information to be fed back quickly to the production supervision and this reduces the use of material and the amount of faulty works produced. The means, rahges and the standard deviations of the product measurements can be clearly displayed. As the results are readily understood, the setters, operators and production supervisors can easily realize the variability arised.

Today, the quality of the incoming materials is one of the most striking problem. The use of computer enables a close control of the quality and in the meantime provides useful information regarding the quality of the incoming materials.

As an example of the successful application of computer process control, in one of the facories surveyed, the quality costs have been reduced by 40% per year after the installation of a computer.

Moreover, the application of the computer system will reduce the indirect job workers, improve the accuracy of quality control records, save time and increase the amount of quality control information. It will lead to "better quality" and "lower cost." Therefore the use of computer for quality control is recommended to the Midland industry.

(4) Operators are required to participate in quality control activity because operator errors and poor workmanship are ~~the main~~ important reasons for defective products. This is one of the important areas where the greatest improvement in quality can be made. Some companies are starting to be awared of the fact that the operators must be encouraged to produce products of better quality and the application of financial incentive scheme should be considered as an effective means towards this end.

(5) The Midland industry should organise more formal and informal quality control training courses within and outside the company. Quality control education should include top management and operators. All employees should have basic statistical knowledge. Quality Control training should also be extended to the subcontractors. More seminars should be given to them in order to achieve improvement in quality of incoming components.

University professors, lecturers, experienced members from the relevant research groups (for instance, the National Council for Quality and Reliability) and expert engineers or managers from the industry, should be employed to act as the Quality control and general business consultants. The industry and professional organization such as the Productivity Centre, National Council for Quality and Reliability should arrange for the engineers and technicians from industries to participate in local as well as international seminars, conferences and courses on quality and reliability for exchange of knowledge and ecperience. It is glad to see that the local quality and reliability research and practising members have played an important role in the promotion of quality control as part of the national effort towards economic growth and prosperity.

(6) The general obligation of the Government to issue certification of quality assurance has contributed towards the promotion of quality and reliability activity. Further continuation of these activities is necessary for the Midland industry. The effort of the Ministry of Defence in designing the sampling plan of DEF-131-A has been found very useful.

The results of this survey show clearly that no matter how hard is the spreading of quality control philosophy during the beginning of industrial development, the achievement in quality control goes along with the economical progress. It is also fair to state that the work of quality control has been well performed and great achievements havebeen obtained in the Midland industry. However further development of quality control activity in the Midland industry is necessary. It is also essential to implement

new advanced technologies in a better organized and widespread way.

We have seen that a rapid growth of quality control activity has led America to become an advanced industrialized country. The spectacular explosion of quality control hasalso brought Japan a great prosperity. We learn that the Zero Defects has been successfully implemented in the American industry. The QC circle has been very well established in the Japanese industry. Therefore, it is important for the companies to encourage their employees to cooperate so as to satisfy the customers' need of good-quality requirement.

The future of quality control activity in the Midland industry is bright. The futher development of quality control activity will certainly lead the Midland industry to a new phase of technical advances.

4.3. SUGGESTION FOR FURTHER WORK

The reliability prediction of the automobile product is considered to be one of the important topics for further research work in QualityControl. The automobile industry of the midlands will continue to search for the optimum solution for reliability of its product design and the manufacturing process design to cope with the changes in the market structure. The three main decisions of the consumer evaluation on the automobile product are:

(1) Engine Life

(2) Reliability and

(3) Maintainability and Maintenance Cost.

Theoretically, reliability is a statistical measure which indicates a successful completion of the required engine life; but practically, it includes all the decisions of the consumer evaluation. Generally, the reliability grows with the time, with respect to design, production, inspection etc., until the quality improvement is ensured. The degree of reliability growth is directly related to the amount of effort expended and the amount of attention given to the problems as they occur. The reliability improvement activities are part of the Total Quality Assurance program.

Many decisions are involved in the reliability of the automobile. The decision-making process is often difficult when the lifetime distribution of the particular component or system is known. It becomes worse when the the lifetime distribution is unknown. When the automobile is placed in operation on a large scale, provisional decisions should

be based on the lifetime distribution of the equipment, but a reliable estimate of this distribution is not usually available until a considerable amount of failure information has been collected. The benefits may be obtained by using the Weibull distribution in Bayesian approach to decision problems involving the reliability of systems and some desideratum of the class of lifetime distributions to be examined.

The collection and analysis of field data are randomly selected from the vehicles. These, in conjunction with the analysis of the data collected from the customer complaints, allow us to understand the operational reliability in the field.

The application of this Weibull distribution theory in the reliability analysis will provide us with information to evaluate the various test results so that the reliability prediction can be achieved.

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APPENDICES

APPENDIX 1 - FACTORY A

General Information:

(1) Food industry.
(2) Company was established in 1831.
(3) The total number of employees in the factory is seven thousand five hundred.
(4) Labour is mostly un-skilled.
(5) The sex of labour force is mostly female.
(6) There is a productivity financial incentives scheme.
(7) Products are mainly supplied directly to public.
(8) Final consumers mainly can recognise the company's products.

Head of Quality Function:

(1) He is known as the Chief Quality Controller.
(2) He has been in the company for forty years.
(3) Age - 53.
(4) He is solely trained by the company.
(5) His gross salary - £4000 per year.
(6) His experiences in various functions:
    (a) Shop floor - ten years,
    (b) Quality control inspection - twenty years,
    (c) Present job - ten years.
(7) He is a member of Quality Control for American Society.
(8) The total number of employees under his responsibilities is eighty. This includes sixty five employees who perform a direct inspection.
(9) He is directly responsible to the Technical Manager.
(10) The two most valuable external sources of Quality information to him are publication of American Society for Quality Control and informal contact with other firms.

Organisation for Quality Control:

(1) System of inspection has been recorded since 1923.
(2) Statistical Quality Control system is operated since 1961.
(3) Acceptance sampling is used on some items for Incoming Products.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates,

(b) Whenever, there is a very bad batch, records are kept by the operational research department and action is taken immediately,usually if the commulative sum chart is not in control,then all the batches will be rejected.

(5) Sampling plans are introduced in 1960,when quality control transmitted to Statistical Quality Control.

(6) Types of schemes used

(a) Sampling plans based on the Philips and Dodge Romig Tables.

(b) Department operates ten different Acceptable Quality Levels (A.Q.L.).

(c) A.Q.L. are decided by the expected level of defects from past experience of the item.

(d) Sampling plans are based on attribute sampling as well as measurement.

(e) The itensity of sampling is not based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans do not decide whether a process should be allowed to commence running.

(h) On an in-process basis,Statistical Quality Control is used on particular items.

(7) Department performs complete quality function for product and process specification and partial quality function for test and inspection specification.

(8) Use of operator

(a) Operator carries out haphazard sampling.

(b) He gauges products.

(9) Use of patrol viewer

Patrol viewer carries out periodic checks on products and records the number of defective.

(10) Cummulative-sum charts are mainly used.

(11) Recording and reporting quality information:

Percentage defective,percentage returned,percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection,products are checked on sample,mainly for "fit and function".

(13) Department operates complete formal schemes related to quality audit or quality assurance and process capability studies,and operates partial schemes related to quality instructions manual,vendor rating.Training inspectors and testers do not operate formal schemes related to warranty payments analysis,scrap and rework costing,environmental engineering,certification by external bodies and customer panals.

(14) Inspection and quality control are separated.

(15) There is a separate reliability activity.

(16) Company deals directly with Government Contacts.

(17) Company had run a specific quality and reliability year programme.

(18) There is no resident government inspection staff.

(19) Department employs consultants on quality problems.

(20) The best selling product has remained virtually unchanged for the past ten years.

(21) The best product's characteristics is its taste.

(22) The percentage of material brought out is 50%.

(23) The top five problems of department in the quality field are:
   (a) Establishing the quality standard,
   (b) Fixing a scheme to quality standard,
   (c) Implementation,
   (d) Training supervision,
   (e) Fed back the information and got the result from there.

Responsibilities for quality

(1) The department head reports to the Technical Director fortnightly.

(2) The department provides written reports to top executives as well as shop supervisors.

(3) Department is responsible for the identification of faults.

(4) Production,sale,operation research,and quality control departments are responsible for the inspection function.

(5) The production department is responsible for correcting the devistion from quality standard and to report the deviation is the responsibility of the Quality Control Department.

(6) The department has the responsibility of training and educating in Quality Control methods of supervision.Inspection staffs,production operators are all introduced to quality control method.
(7) Work engineer is responsible for production gauges.
(8). Production,design and sales departments and customers have 100% co-operation in selling standards and maintaining standard.
(9) Statistical quality control is applied to jobbing work as well as long production run.
(10) The rejected batches are inspected by the production department and usually the rejected batches are scrapped for reprocess.
(11) Rejected raw material is replaced by supplier.

Economics of quality control

(1) Costs of poor quality were recorded as scrap in the semi-finished stage,scrap at final assembly,loss of output due to defective tooling,loss of output due tp machine out of commision and the loss of output due to defective raw material.
(2) Quality control costs are dealt with as an overhead on the production costs.
(3) The cost of control charting is not estimated.
(4) During the period in which quality control has been operating, the cost of poor quality as listed in (1) has been reduced.
(5) Saving is achieved through the correct matching up of processes, drawing tolerances and the elimination of the unnecessary precision.
(6) There are many examples of control charts used in weighing processes.A balance is struck between the cost of the amount given away and the loss through not given enough.
(7) There are examples of cost savings through widening drawing tolerances which were previously unnecessarily tight.
(8) The cost saving is mainly due to the psychological impact of the charts.
(9) The cost of quality control is recovered through cost savings.
(10) Engineering cost studies are made to estimate cost savings by comparing the competitor's products and by analysing

reports on defective work.

(11) Operators are paid on either the total output or for producing good quality work.

(12) Savings in the quality control costs has been achieved due to a reduction in the amount of inspection within own plant.

APPENDIX 2 - FACTORY B

General information:

(1) Food industry
(2) Company was established in 1925.
(3) Total number of employees in the factory is three thousand.
(4) All labour is male.
(5) Labour is mostly unskilled.
(6) Financial incentive of 10% of the pay rate bonus is applied to all labour.
(7) Products are mainly supplied directly to the public.
(8) Final consumers in the majority can recognise the company products.

Head of Quality information

(1) He is known as the head of the Quality Information.
(2) He has been with the company for twenty four years.
(3) He is forty eight years old.
(4) He is not a chartered engineer.However,he has completed the examinations of Institute of Statisticians.
(5) His gross salary is £4000 per year.
(6) His experience in various functions:
    (a) shop floor - six years,
    (b) production service function - twelve years,
    (c) Design and drawing office - six years,
    (d) present job - eight years.
(7) He is a member of the Institute of Statisticians.
(8) The total number of employees under his supervision is fifty three and this includes forty who perform direct inspection function.
(9) He is directly responsible to the Divisional Director.
(10) The most valuable external source of quality information to him is the formal contacts with other firms.

Organisation of Quality Control

(1) System of inspection has been recorded since 1948.
(2) Statistical Quality Control has been operating since 1960.

(3) Acceptance Sampling is used on some items for Incoming Products.

(4) Nature of product quality inspected

(a) Quality Levels fluctuates

(b) When there is a very bad batch, records are kept and action is taken to ascertain the cause.

(5) Sampling plans have been started since 1960.

(6) Types of schemes used:

(a) Sampling Plan is carried out under a combination of own schemes and DEF 131 -A.

(b) Department operates over twenty different Acceptable Quality Levels (A.Q.L.).

(c) A.Q.L. are decided by the cost of Errors in decisions.

(d) Sampling plans are based on attribute (go-no go) and measurements.

(e) The intensity of sampling is based on the result of previous samples.

(f) Sampling is carried out a continuous process.

(g) Sampling plan does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statiatical Quality Control is used as a general policy.

(7) Department performs a complete Quality Control Function on test and inspection specifications, partially on process specification, but does not perform product specification.

(8) Use of operators

Operator carries routine haphazard sampling and does not gauge or measure the product.

(9) Use of inspection

Inspector carries out statistical system sampling and he measures samples and plots them on to the control charts for Average and Range. Percentage defective, number of the defective and number of defectives per unit are also recorded.

(10) Both control charts for attribute and variables are used.

(11) Recording Quality information

Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In the final inspection,products are checked on sampling mainly on all characteristics.

(13) Department operates formal schemes completely related to Quality Audit or Quality Assurance,Quality Instruction Manual, training inspectors and testers,scrap and rework costing, process capability studies,customers panels and partially related to vendor rating,enviromental engineering.Department does not operate schemes related to warranty Payments Analysis and Certification by external authorities.

(14) Inspection and Quality Control are integrated.

(15) There is a separate reliability activity.

(16) Company has no government contacts.

(17) Department had performed a specific Quality Year programme.

(18) Department does not employ consultants on Quality Problems.

(19) The Best Selling Product has remained virtually unchanged for six months.

(20) The characteristics of the Best Product is their reliability.

(21) The percentage of material bought out is 50%.

(22) The top five problems related to the Quality field are:
   (a) Motivation of the people in Quality,
   (b) Technical problems,
   (c) Maintenance of Quality,
   (d) Sampling problems,
   (e) Measurement problems.

Responsibilities of Quality

(1) The department head reports to the Divisional Director constantly.

(2) The department provides the written report to the top executives as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) The Product Research Division is responsible for specifying the standard of Quality required.

(5) Quality information department has the overall responsibilities of Quality inspection function and reporting the deviations from the Quality standard.The Production department has the responsibility of correcting deviations from Quality standard.

(6) Training and education in the Quality Control methods of supervision,inspection staff and production operator are solely

in the hand of Quality Information Department.

(7) Production gauges are checked in their own standard rooms.

(8) Production, Quality and Marketing deparments and the customers have close co-operation in setting standards and maintaining standards.

(9) Statistical Quality Control is only applied to jobbing work and there is no long production run.

(10) The rejected batches are inspected by the Quality Information Department.

(11) The rejected raw material is replaced by supplier.

Economics of Quality

(1) Cost of poor quality were recorded as scrap at semi-finished stage, at the final stage, loss of output due to defective tooling, loss of output due to machines out of commission, loss of output due to raw material, rectification and 100% check viewing on a periodic basis are all parts of a comprehensive cost control system.

(2) Department has a separate budget from production department and Quality Control Costs are dealt with as an overhead on production cost and the approximate allocation to areas for costing estimates.

(3) The cost of Control Charting is not estimated.

(4) During the period in which quality control has been operating, the cost of poor quality as listed in (1) is required.

(5) There are many examples of control charts used in weighing processes. Balance is struck between the cost of the amount given away and the loss through given too little.

(6) Cost saving is achieved through technical action based on Control Charts and the psychological impact of the Charts.

(7) The cost of Quality Control is recovered through cost savings but cannot be calculated.

(8) Acceptance Sampling Plans are based on the Cost Considerations.

(9) The Assessment makes allowances as each defective item passes through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacturing, (b) work done on a product which is already defective.

(10) Products are guaranteed on a legal basis, basing on (1) Weights

and measures Act (2) Trades Description Act.

(11) Engineering cost studies are made to suggest cost savings by comparison with competitor's products.

(12) Operators are paid on a daily basis.

(13) Quality Control Costs have been achieved through the reduction in the amount of inspection.

APPENDIX 3 - FACTORY C

General information:

(1) Allied industry
(2) The company was established in 1857.
(3) The total number of employees in the factory is one thousand
(4) Labour is mostly unskilled.
(5) The sex of labour force is mostly male.
(6) No financial incentive is operated.
(7) Products are mainly supplied to their own agents.
(8) Final consumer mainly recongnises the company's product.

The Head of Quality information

(1) Quality Control is function in the laboratory. The senior man who is responsible for Quality function is the Technical Manager.
(2) He has been in the company for seven years.
(3) He is thirty years old.
(4) He is a chartered Engineer with M.Sc. degree in Chemical Engineering and Brewery Science.
(5) His gross salary is £3200 per year.
(6) His experiences in various functions:
    (a) Line management - three years,
    (b) Production service function - two years,
    (c) Design and drawing office - one year,
    (d) Present job - one year.
(7) He is a member of Institute of Brewery and Brewery Science.
(8) The total number of Quality and inspection function employees under his responsibities is eighteen and all of them carry out direct inspection function.
(9) He is directly responsible to the factory Head Breweries.
(10) The two most valuable exteral sources of Quality and Reliability information to him are publication of profession journals and informal contact with other firms.

Organisation for Quality and Reliability:

(1) The System of Inspection has been recorded since factory commenced.

(2) The Statistical Quality Control has been operated since 1969.

(3) Acceptance Sampling is used on some items for Incoming Products.

(4) Nature of Product Quality inspected:
   (a) Quality level fluctuates.
   (b) When there is a very bad batch, records are kept and action is taken to analysis the cause.

(5) Sampling Plans are introduced in 1969.

(6) Types of scheme used:
   (a) Sampling plan is carried out under company own schemes.
   (b) Only one Acceptable Quality Level (A.Q.L) is applied to department.
   (c) A.Q.L. is decided by laid down company policy.
   (d) Sampling Plans are based on attribute sampling as well as measurements.
   (e) The intensity of sampling increased or decreased is based on the previous sample.
   (f) Sampling is done from a continuous process.
   (g) Sampling plan does not decide whether a process should be allowed to commence running.
   (h) On an in-process basis, statistical Quality Control is used on particular item.

(7) Department performs Quality function partially related to production process and Test and Inspection.

(8) Use of operator
   Operators do not perform either sampling or inspection function.

(9) Use of laboratory Analyst
   Laboratory analysts check samples of the product, guages and measures the samples and plot them on to the Control Chart for Average and Range. He also records the defective, number defective and number of defectives per unit.

(10) Control Charts for variables are mostly used.

(11) Recording Quality information
Percentages defective, percentages returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, product are checked on sample mainly on all characteristics.

(13) Department performs formal schemes completely related to Quality Audit or Quality Assurance, Quality instruction manual and Training inspections and Testers, partially related to process capability studies. Quality department does not perform schemes related to vendor rating, warranty payments analysis, scrap and rework costing, environmental engineering, certification by external authorities and customer panels, instead these formal schemes are performed by Production department.

(14) Inspection and Quality is separated.

(15) There is no separate reliability activity.

(16) Company does not deal directly with government contact.

(17) There is no resident government inspection staff.

(18) Department never perform specific Quality and Reliability year programme.

(19) Department uses consultants on Quality Control problems.

(20) The Best Selling product has remained virtually unchanged for one year.

(21) The Best product characteristic is its value for money.

(22) The percentages of material bought out is 40%.

(23) The top five problems of department related to Quality field are:
(a) Microbilogical control,
(b) Taste,
(c) Analysical control,
(d) Raw materials,
(e) Training operator.

Responsibilities for Quality

(1) The Technical Manager reports to the Head of Brewery constantly.
(2) Department provides written reports to top executive as well as shop supervision.
(3) The department is responsible for the identification of faults.
(4) Specifying the standard of Quality required is responsible by the senior Quality Control manager of the Head office.
(5) Technical Manager has the overall responsibilities of provision of adequate testing equipment, inspection to ensure that the specified standard is maintained in each case and reporting the deviations from Quality standard.
(6) Production department is responsible of correcting the deviation from Quality standard.
(7) Training and education in Quality Control methods of Supervision, Inspection staff and Production operator are under training department.
(8) Production gauges are checked by external agency.
(9) Production and sales department and customer have 100% co-operation in setting standard and maintaining standard.
(10) Statistical Quality Control only applied to long production runs.
(11) The rejected batches are analysed in the laboratory.
(12) The rejected raw material is replaced by supplier.

Economics of Quality Control

(1) Costs of poor Quality were recorded by production department as scrap at semi-finished stage, scrap at final stage, loss of output due to defective tooling, loss of output due to machine out of commission and loss of output due to defective raw material on a periodic basis.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) Cost of control charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor quality as listed in (1) is reduced.
(5) The improvement of Quality result is not acheived by more

efficient utilisation of the equipment in subsequent process.

(6) There are examples of Control Charts used in weighing processes. There are balances struck between the cost of the amount given away and the loss through giving too little is occurred.

(7) The cost of Quality Control is recovered through cost savings.

(8) Acceptance Sampling Plans are not based on cost consideration.

(9) Cost studies are made to suggest cost saving by comparison with competitors' products.

(10) Operator are paid on daily basis.

APPENDIX 4 - FACTORY D

General information

(1) Chemical industry
(2) Company was established since 1890.
(3) The total number of employees in the factory eight thousand and one hundred.
(4) Labour is mostly semi-skilled.
(5) The sex of labour force is mostly male.
(6) No financial incentives are operated.
(7) Products are mainly supplied directly to the public.
(8) Final consumer always recognises the company's products.

Head of Quality information

(1) He is known as the Quality Controller.
(2) He has been in the company for twenty-one years.
(3) He is forty-eight years old.
(4) He is not a chartered engineer but he holds M.Sc. degree.
(5) His gross salary is over £4000 per year.
(6) His experiences in various functions:
    (a) Quality Control Analysis - twenty-one years,
    (b) Present job - six years.
(7) He is a member of Royal Institute of chemistry.
(8) The total number of employees under his responsibilities is three hundreds and twenty. This includes two hundreds and fifty employees who perform a direct Quality function i.e. Testing and Analysis.
(9) He is directly responsible to the Managing Director.
(10) The two most valuable external source of Quality information to him are publications of professional journals which related to chemical field and attending conference.

Organisation of Quality

(1) System of Testing and Analysis has been recorded since company established.
(2) The statistical Quality Control is operated in 1954.
(3) Acceptance sampling is used on all items for Incoming Products.

(4) Nature of Product Quality inspected:

(a) Sometimes Quality level fluatualtes. Avery bad batch never exists. When the Quality level is not consistent action is taken immediately to freeze the line, production is rejected and record of Analysis is kept by Quality Control department.

(5) Sampling Plans are introduced since 1954.

(6) Types of schemes used:

(a) Sampling Plan is carried out under company own schems with the combination of DEF-131-A.

(b) Department only operates one Acceptable Quality Level.

(c) A.Q.L. are decided from the post experience of the expected level of defect.

(d) Sampling Plans are based on attribute sampling and measuremants.

(e) The intensity of sampling increased or decreased are based on the results of previous samples.

(f) Sampling is usually carried out in the final process from the line.

(g) Sampling Plans do not decide whether a process should be allowed to commence running.

(h) On an in-process basis, statistical Quality Control is used as a general policy.

(7) Department performs Quality function completely related to production process and Test and Inspection specification.

(8) Operator does not perform any Quality function.

(9) Use of laboratory Analyst:

Laboratory Analyst carries out sampling for chemical Testing and Analysis, he records the results of each test, and also plot them to the control charts.

(10) Both control charts for attribute and variable are mainly used.

(11) Recording Quality information:

Percentage defective, percentage returned and percentage scrapped are recorded on a periodic basis by Production department.

(12) In final inspection, products are checked 100% mainly on all characteristics.

(13) Department operates formal schemes completely related to Quality Audit or Quality Assurance, Quality instruction manual, vendor rating, training inspectors and Tester, Process capability studies, customer panel and certification by external authorities. Quality Control department does not perform schemes related to warranty payments analysis, scrap and rework costing, environmental engineering, instead these formal schemes are completely performed by production department.

(14) Inspection and Quality Control is separated.

(15) There is no separate reliability activity.

(16) Company deals directly with government contracts.

(17) There is no resident government inspection staff.

(18) Department does not employ consultants on Quality Control problems.

(19) Department never perform any specific Quality and Reliability.

(20) The Best Selling Product has remained virtually unchange for two years.

(21) The Best Product characteristic is its performance.

(22) The percentage of material bought out is 45%.

(23) The top five problems of department related to Quality Control field:

(a) Uniformity of products,

(b) Stability of products,

(c) Correct processing,

(d) Medical safety,

(e) Hygiene.

Responsibilities for Quality

(1) The Quality Controller reports to the Managing Director constantly regarding the Quality Control problems.

(2) Department only provides written report to top executive.

(3) The section is responsible for identification of faults.

(4) The Quality Control Department has the overall responsibility for the Quality Control function, reporting deviation from the Quality standard and correcting deviation from Quality standard is responsible by production department.
(5) Training and Educations in Quality Control methods of analysts, laboratory analysts laboratory assistant and inspector are solely responsible by the Quality Control department senior officer i.e. Quality Controller, chief analyst and deputy chief analyst.
(6) Provision of adequate testing equipment is responsible by production department.
(7) Laboratory equipment are checked in the Production department.
(8) Statistical Quality Control is only applied to jobbing work. There is no long production runs.
(9) The rejected batches are scrapped due to medical safety.
(10) The rejected raw materials are replaced by supplier.

Economics of Quality Control

(1) Costs of poor Quality were recorded by Production department as scrap at semi-finished stage, final stage, loss of output due to defective tooling, loss of output due to machine of commission, loss of output due to defective raw material on a periodic basis.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) Cost of Control Charting is not estimated.
(4) The improvement of Quality result is not acheived by the efficient utilisation of the equipment in the subsequant process.
(5) There are many examples of Control Charts used in weighing processes. Balance struck between the cost of the amount given away and the loss through giving too little is occurred.
(6) The cost of Quality Control is recovered through cost savings.
(7) Acceptance sampling plans are not based on cost consideration.
(8) Cost studies are made to suggest cost saving by comparison with competitors products and by analysis of reports of defective work.
(9) Operators are paid on daily basis.

APPENDIX 5 - FACTORY E

General information:

(1) Automobile industry
(2) The company was established in 1915.
(3) The total unmber of employees in the factory is one thousand eight hundred .
(4) Labour is mostly unskilled.
(5) The labour force is approximately equal in both sex.
(6) No financial incentives are operated.
(7) Products are mainly supplied to other firms.

Head of Quality and Reliability

(1) He is known as the Quality and Reliability Manager.
(2) He has been in the company for twelve years.
(3) He is forty-two years old.
(4) He is a chartered engineer with a B.Sc. degree.
(5) His gross salary is £3300 per year.
(6) His expreience in various functions:
    (a) Line management - fifteen years,
    (b) Present job - six years.
(7) He does not belong to any professional society.
(8) The total number of employees under his reponsibilities is sixty. his includes fifty-four employees who perform a direct inspection function.
(9) He is directly responsible to company Chief Quality and Reliability Engineer.
(10) The two most valuable external sources of Quality and Reliability information to him are formal and informal contact with other firms.

Organisation for Quality and Reliability

(1) System of inspection has been recorded since 1925.
(2) Statistical Quality Control system has been operated since 1952.

(3) Acceptance sampling is not used for Incoming Product, since Incoming Product are from same companys' group.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates.

(b) When there is a very bad batch, records are kept by the department and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in 1952.

(6) Types of scheme used:

(a) Sampling Plan is carried out under company own schemes.

(b) Department operates eight different Acceptable Quality Levels (A.Q.L)

(c) A.Q.Ls are decided by laid down company policy.

(d) All sampling plans are based on attribute (go - No go) sampling.

(e) The intensity of sampling is not based on the results of previous samples.

(f) Sampling is done systematically from a continuous process.

(g) Sampling Plan does not decide whether or not a process should be allowed to commence running.

(h) On an in-process basis, statistical Quality Control is used as a general policy.

(7) Department performs partial Quality function for Product and Process specification and completely Quality function for Test and Inspection specification.

(8) Use of operator

(a) Operator carries out statistical system sampling .

(b) He gauges Products.

(9) Use of Patrol viewer:

Patrol viewer carries out hourly checks on products and plots them on to the Control Chart.

(10) Control Charts for attributes are mainly used.

(11) Recording and Reporting quality information:

Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100% mainly for fit and function.

(13) Department operates completely formal schemes related to Quality Audit or Quality Assurance, training inspectors and Testers Environment Engineering and certification by external authorities and operatives partially schemes related to Quality instruction manual warranty payments analysis, scrap and rework costly, process capability studies and customer panels.

(14) Inspection and Quality Control are not separated.

(15) There is a separate reliability activity.

(16) Company deals directly with government contracts.

(17) There is resident government inspection staff.

(18) In 1968, the company ran a specific Quality and Reliability year programme, the results were tremendously successful

(19) The Quality and Reliability Manager consults the Quality Problem with company group which does not use consultants on Quality outside company.

(20) The Best Selling product has remained virtually unchanged for past five years.

(21) The characteristic of the Best product is Reliability.

(22) The percentage of material bought out is 65%.

(23) The top five problems of Manager in the Quality field are
   (a) Motivation,
   (b) Training supervision,
   (c) Bought out component,
   (d) Organisation,
   (e) Quality.

Responsibilities for Quality and Reliability

(1) The Manager of the department reports to the company Chief Quality and Reliability Engineer fortnightly.

(2) The department provides the written report to top executives as well as shop supervisions.

(3) The section is responsible for the identification of faults.
(4) The department has the overall reponsibility for the inspection function and reporting deviation from the Quality standard.
(5) The Production department is responsible for correcting the deviation from Quality standard.
(6) Company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers have 100% co-operation in setting standards and maintaining standards.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batches are inspected by the Production department.
(11) Rejected raw material is replaced by supplier.

Economics of Quality Control

(1) Costs of poor Quality were recorded as scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling , loss of output due to machine out of commission, loss of output due to defective raw material, Rectification and Quality guarantee.
(2) Quality and Reliability department has its individual budgets.
(3) The cost of Control Charting is not estimated.
(4) During the period in which quality Control has been operating, the cost of poor quality as listed in (1) is reduced.
(5) The inprovement of quality resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) The cost saving is mostly acheived through technical action based on Control Charts.

(8) The cost of quality Control is recovered through cost saving.

(9) Acceptance Sampling Plans are based on cost consideration.

(10) The Assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.

(11) The products are guaranteed for one year or one thousand two hundred miles.

(12) The Engineering Cost studies are made to suggest cost savings by comparison with competitors' products and by analysis of reports of defective work.

(13) Operators are paid on daily basis.

APPENDIX 6 - FACTORY F

General information:

(1) Automobile industry
(2) Company was established in 1921.
(3) The total number of employees is approximately three thousand.
(4) Labour is mostly semi-skilled.
(5) Most of the labour force is male.
(6) No financial incentives are given.
(7) Products are mainly supplied to other firms.
(8) Most comsumers can recognise the companys' product.

Head of Quality and Reliability information:

(1) He is known as the Quality Manager.
(2) He has been in the company for fifteen years.
(3) He is forty-five years old.
(4) He is not a chartered engineer but he completed his C and G final examination in part-time education.
(5) His gross salary is £3200 per year.
(6) His experiences in various functions:
    (a) Shop floor - three years,
    (b) Line managemnt - four years,
    (c) Present job - eight years.
(7) He is a member of Institute of Inspection Engineering and British Institute of Management.
(8) The total number of employees under his responsibilities is two hundred and thirty-seven including two hundred and twenty employees who perform a direct inspection.
(9) He is directly responsible to Production Service Manager.
(10) The two most valuable external sources of Quality information to him is the publication of Institute of Inspection ngineering and informal contact with other firms.

Organisation for Quality

(1) System of inspection has been recorded since 1920.
(2) Statistical Quality Control system has been operating since 1959.
(3) Acceptance Sampling is used on some items for Imcoming Product.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by department and action is taken to ascertain the cause.

(5) Sampling Plans were introduced in 1961.

(6) Types of scheme used:

(a) Sampling Plan is worked on DEF -131 -A.

(b) Department operates four different Acceptable Quality Levels (A.Q.L.).

(c) A.Q.Ls are decided upon the expected level of defects from past experience and consideration of cost of inspection related to the cost of accepting a reject.

(d) All sampling Plans are based on attribute (go - No go) sampling. Measurements are taken occasionally.

(e) The intensity of the sampling increased or decreased depends on the results of previous samples.

(f) Sampling is done systematically from the continuous process.

(g) Sampling Plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used on particular items.

(7) Department performs complete Quanlity function for Test and Inspection specification and performs partially Quality function for Product and Process specification.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He gauges products.

(9) Use of Patrol viewer:

Patrol viewer checks samples of the product on periodic basis. Statistical sampling is carried out by inspector. He gauges products and occasionally he plots them on to the Control Charts.

(10) Control Charts for attributes are mainly used.

(11) Recording and reporting Quality information:
Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100%, mainly for fit and function.

(13) Department operates complete formal schemes related to Quality Audit or Quality Assurance, Quality instruction manual, Vendor rating, Warranty payment analysis, scrap and rework costing, process capability studies, certification by external authorities, training Inspectors and Testers and operates partially schemes related to environmental engineering. Department does not operate the scheme related to customer panels in which this is solely carried out by sale representative.

(14) Inspection and Quality Control is separated.

(15) There is a separate Reliability activity.

(16) Company deals directly with government contracts.

(17) There is no resident government inspection staff.

(18) Company performed a specific Quality and Reliability year programme.

(19) Department never use consultants on Quality problems.

(20) The Best Selling product has remained virtually unchanged for the past twenty years.

(21) The characteristic of the Best product is its performance of the product.

(22) The percentage of material bought out is 50%.

(23) The top five problems of Departmental Head in the Quality field are:

(a) Quality education,

(b) Segregation of defect work,

(c) Capability of planning,

(d) Drawing tolerances too light,

(e) Lack of personnel

Responsibilities for Quality

(1) The Head of the department submits a weekly report to the Product Service Director.
(2) Department provides a written report to the top executives and shop supervisors.
(3) The section is responsible for the identification of faults.
(4) Department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.
(5) The Production department is responsible for correcting deviation from the Quality standard.
(6) Company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own standard room.
(8) Production, design, sales and customers frequently co-operate in setting up and maintaining standard for required materials.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batches are inspected by the Inspection section i.e. 100% inspection.
(11) Rejected raw material is replaced by the supplier.

Economics of Quality Control

(1) Costs of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of out-put due to defective raw material, Rectification and 100% check viewing and Quality guarantee.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating the cost of poor quality as listed in (1) is reduced.
(5) The improvement of quality, resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving occurred as a result of the correct matching up of Processes and drawing tolerances and the elimination of

unnecessary precision.

(7) There are examples of cost savings through widening drawing tolerances which were previously unnecessary tight.

(8) The cost savings are due to technical action based on Control Charts and the psychological impact of the charts.

(9) Cost of Quality Control is recovered through cost savings.

(10) Acceptance Sampling Plans are based on cost consideration.

(11) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) loss time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user (tools).

(12) Products are guaranteed for one year or one thousand two hundred miles.

(13) The engineering cost studies are made to suggest cost savings in comparison with competitor's products and reports on de-defective work.

(14) Operators are paid on total output.

(15) Savings in Quality Control Costs are achieved through reduction in the amount of inspection within own plant.

APPENDIX 7 - FACTORY G

General information

(1) Automobile industry
(2) Company was established in 1905.
(3) The total number of employees in the factory is about eight hundred.
(4) Labour is mostly semi-skilled.
(5) Sex of labour force is mostly male.
(6) Financial incentives are applied to most of the labour.
(7) Products are mainly supplied to other firms.

Head of Quality information

(1) He is known as Quality Manager.
(2) He has been in the company for thirty-six years.
(3) He is fifty years old.
(4) He is not a Chartered Engineer, solely trained by company had completed trade informal apprenticeship and passed G.C.E.'o' level in full-time education.
(5) His gross salary is £3800 per year.
(6) His experiences in various functions:
    (a) Shop floor - five years,
    (b) Line management - twenty-four years,
    (c) Present job - eight years.
(7) He is a member of Institute of Inspection Engineering.
(8) The total number of employees under his responsibilities is fifty-five. This includes fifty employees who perform a direct inspection.
(9) He is directly responsible to the Director General Manager.
(10) The two most valuable external sources of Quality information to him is formal and informal contact with other firms.

Organisation for Quality

(1) System of inspection is recorded in 1942.
(2) Statistical Quality Control system has been operated since 1965.
(3) Acceptance Sampling is used on some items for Incoming Pro-

duct.

(4) Nature of Quality Product inspected:

(a) Quality leve fluctuates.

(b) Whenever there is a very bad batch, records are kept by department and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in 1952.

(6) Types of scheme used:

(a) Sampling is carried out based on DEF-131-A.

(b) Department operates four different Acceptable Quality Level (A.Q.L)

(c) A.Q.Ls are decided from the past experience, the expected level of defects.

(d) Sampling Plans are mostly based on the attribute (go - No go) sampling but in one or two stages. Quality Control Chart is applied by means of measurement.

(e) The intensity of the sampling increased or decreased is not based on the results of previous sampling.

(f) Sampling is done periodic from a continuous process.

(g) Sampling Plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used on particular items.

(7) Department performs completely Quality function for Process and Test and inspection specification and perform partial Quality function for product specification.

(8) Use of operator:

(a) Operator carries out haphazard sampling.

(b) He gauges Products.

(9) Use of Patrol viewer:

Patrol inspector checks samples of the products. Statistical Sampling is carried out by inspection. He gauges Products and occasionally he measures the samples and plot them to the Control Charts for average and range, also, for number of defectives per unit.

(10) Control Charts for attributes are mainly used.

(11) Recording and reporting Quality information:
Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly on all characteristics.

(13) Department operates completely formal schemes related to Training inspection and Testers, scrap and rework costing and Process capability studies; and operates partially schemes related to Quality Audit or Quality Assurance, Quality instruction manual, certification by external authorities and customer panels; Department does not operation schemes related to Vendor rating, Warrantly Payments Analysis and Environmental Engineering.

(14) Inspection and Quality Control are separated.

(15) There is no separate reliability activity.

(16) Company does not deal directly with government contact.

(17) There is no resident government inspection staff.

(18) Company had performed a specific Quality and Reliability year programme.

(19) Department never employed consultants on Quality problems.

(20) The Best Selling product has remained virtually unchanged for past twenty years.

(21) The characteristic of the Best product is service ability.

(22) The percentage of material bought out is 15%.

(23) The top five problems of department in the Quality field are:
(a) Training operator responsibility,
(b) Co-operation between Sale, Production and Quality department,
(c) Training,
(d) General management,
(e) Varying customer standards.

Responsibilities for Quality

(1) The departmental Head reports monthly to the Managing Director.
(2) Departments provide the written reports to top executives as well as shop supervisors.
(3) The section is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.
(5) Production department is responsible for correcting the deviation from Quality standard.
(6) Training and education in Quality Control techniques was solely in the hands of the Quality Manager and his senior staff.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales department and customers have quite freely co-operative in setting standards and maintaining standards.
(9) Statistical Quality Control applies only to long production runs.
(10) The rejected batches are inspected by Quality department.
(11) Rejected raw materials are replaced by supplier.

Economics of Quality Control

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of out put due to defective raw material, Rectification and 100% check viewing.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) Cost of Control Charting is not estimated.
(4) During the period in which quality Control has been operating, the cost of poor quality as listed in (1) is reduced.
(5) The improvement of Quality, resulted in more efficient utilisation of the equipment in subsequent processes.

APPENDIX 8 - FACTORY H

General information

(1) Automobile Industry as well as Aircraft Industry.
(2) Company was established in 1920.
(3) Total number of employees in the factory is 10500.
(4) Labour is mostly skilled.
(5) Sex of labour force is mostly male.
(6) Financial incentives are given to approximately half of the labour.
(7) Products are mainly supplied to other firms.
(8) Final consumer always recognise the company's product.

Head of Quality Information

(1) He is known as the Group Quality Manager.
(2) He has been in the company for 13 years.
(3) Age-43.
(4) He is not a chartered Engineer,but completed the H.N.C. in part-time education.He also completed trade and formal apprenticeship.
(5) His gross salary-over £4000/year.
(6) His experience in various functions:
    (a) Shop Floor-seven years.
    (b) Production Service Function-three years.
    (c) Quality Control and Inspection-seven years.
    (d) Design and Drawing Office-two years.
    (e) Present job-two years.
(7) He is a member of the Institute of Inspection Engineering and of British Institute of Management.
(8) Total number of employees under his responsibilities is 750.This includes 700 employees who performs a direct inspection.
(9) He is directly responsible to the Group Manufacturing Director.
(10) The two most valuable external sources of Quality information to him are attending conferences,informal contact with other firms.

Organisation for Quality

(1) System of inspection has been recorded since 1950.
(2) Statistical Quality Control system has been operating since 1959.
(3) Acceptance Sampling is used on all items of incoming product.

(6) Saving is achieved through the correct matching up of processes, drawing tolerance and the elimination of unnecessarily precision.

(7) There are examples of Cost Savings through widening drawing tolerances which were previously unnecessarily tight.

(8) The Cost Savings are due to technical action based on Control Charts and the psychological impact of the charts.

(9) The cost of Quality Control is recovered through Cost Saving.

(10) Acceptance Sampling Plans are based on Cost Consideration.

(11) The assessment makes allowances for allowing a defective item to pass through each inspection point.Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.

(12) Savings in Quality Control Costs are achieved through a reduction in the amount of inspection within own plant.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates,

(b) Occasionally there is a very bad batch, records are kept by department and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in 1967.

(6) Types of schemes used:

(a) Sampling Plan is carried out according to DEF-131-A.

(b) Department operates three different Acceptable Quality Levels (A. Q. L.).

(c) Acceptable Quality Levels are decided upon the expected level of defects from past experience.

(d) All sampling plans are based on attribute (go - No go) sampling as well as measuremnt.

(e) The intensity of the sampling increased or decreased are based on the results of previous samples.

(f) Sampling is done systematically from a continuous process. Basically is on periodic, depending on the volume of production of the machine.

(g) Sampling plan does not decide whether or not a process should be allowed to commence running.

(h) On an in-process basis, statistical Quality Control is used as a general policy.

(7) Department performs completely Quality function for Process and Test and inspection specifications and performs partial Quality function for Product specifications.

(8) Use of operator:

(a) Operator carries out routine sampling.

(b) He gauges Products.

(9) Use of Patrol viewer:

Patrol viewer carries out two hourly checks on products and plots them on to the Control Charts for average and range. He also records the number of defective and number of defectives per unit.

(10) Both Control Charts for attributes and variables are used,

but 75% of Control Charts for attributes are mainly used..

(11) Recording and Reporting Quality information:
Percentages defective, percentage returned, percentages rectified and percentage scrap are recorded on a periodic basis.

(12) In final inspection, products are checked 100%, mainly for fit and function.

(13) Department operates completely formal schemes related to Quality Audit or Quality Assurance, Quality instruction Manual, Vendor Rating, Training inspections and Testers, Warranty Payments Analysis, scrap and rework costing, Process Capability studies, Environment Engineering, certification by external Authorities and Customer Panels.

(14) Inspection and Quality Control are separated.

(15) There is no separate reliability activity.

(16) Company deals directly with Government Contacts.

(17) There is a resident Government inspection staff.

(18) In 1966 the Company ran a specific Quality and Reliability Year Programme. The results were very sucessful.

(19) Do not use consultants on Quality Problems.

(20) The Best selling product has remained virtually unchanged for the past five years.

(21) The Best Product characteristic is value for Money.

(22) The percentage of material bought out is 75%.

(23) The top five pronlems of department in the Quality field are:

(a) Motivation,
(b) Raw material,
(c) Control of supplier (including information and size),
(d) Time available for adequate proof testing of new Product,
(e) Training of personel.

Responsibilities for Quality

(1) Group Manager reports on monthly basis to the Group

Manufacturing Director.

(2) Department provides the written report to top excutive as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.

(5) The Production department is responsible for correcting the deviation from Quality standard.

(6) Company has its own training school and uses outside facilities when required.

(7) Production gauges are checked in their own standard room or tool room.

(8) Production, design and sales departments and customers have 100% co-operation in setting standards and maintaining standard.

(9) Statistical Quality Control applies to jobbing work as well as long production runs.

(10) Rejected batches are inspected by inspection department.

(11) Rejected Incoming Goods are replaced by supplier.

Economics of Quality Control

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective, raw materials Rectification and Quality guarantee under cost over estimate report.

(2) Department has its individual budgets based on percentage of Product cost.

(3) The Cost of Control Charting is not estimated.

(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.

(5) The improvement of Quality resulted in more efficient utilisation of the equipment in subsequent processes.

(6) Saving is achieved through the correct matching up of processes

and drawing tolerances and the elimination of unnecessary precision.

(7) Cost Saving is due to technical action based on Control Charts as well as the psychological impact of the charts.

(8) Cost of Quality Control is recovered through Cost Saving.

(9) Acceptance Sampling plans are based on Cost consideration.

(10) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.

(11) Products are guaranteed 100% on two years basis.

(12) Engineering Cost Studies are made to suggest Cost Savings by comparison with competitors' product.

(13) Operators are paid for producing good work only.

(14) Saving in Quality Control Costs has been achieved due to reduction in the amount of inspection (a) within own plant (b) within customers.plant.

APPENDIX 9 - FACTORY I

General Information:

(1) Automobile industry
(2) The company was established in 1926.
(3) The total number of employees in the factory is about twenty four thousand.
(4) Labour is mostly semi-skilled.
(5) The sex of labour force is mostly male.
(6) Financial incentives are applied to approximately half of the labour.
(7) Products are mainly supplied directly to public.
(8) Final consumer always recognises the company's product.

Head of Quality Information:

(1) He is known as Quality Manager.
(2) He has been in the company for 10 years.
(3) He is thirty-nine years old.
(4) He is not a Chartered Engineer but holds a B.Sc. degree.
(5) His gross salary - over £4000 per year.
(6) His experience in various functions:
    (a) Line management - two years,
    (b) Production service function - four years,
    (c) Design, drawing office - eight years,
    (d) Present job - five years.
(7) He does not belong to any professional society.
(8) The total number of employees under his responsibilities is three thousand and fifteen. This includes two thousand five hundred who perform a direct inspection function.
(9) He is directly responsible to Division Managing Director.
(10) The two most valuable external sources of Quality and Reliability information to him is formal and informal contact with other firms.

Organisation for Quality and Reliability

(1) The system of inspection is recorded in 1962.

(2) The statistical Quality Control system has been operated since 1962.

(3) Acceptance Sampling is used on some items of the Incoming Product.

(4) Nature of Quality Product inspected:

(a) Quality level does not fluctuates.

(b) Whenever there is a bad batch, records are kept by supplied Quality Assurance and action is take to ascertain the cause.

(5) Sampling Plans are introduced in 1970.

(6) Types of schemes used:

(a) The sampling is carried out under the company own schemes which are modified from DEF-131-A.

(b) The department operates six different Acceptable Quality Levels (A.Q.L).

(c) A.Q.Ls are decided under consideration of cost of inspection related to cost of accepting a reject.

(d) Sampling Plans are based on attribute (go - No go) sampling as well as measurement.

(e) The intensity of sampling increased or decreased is not based on previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plan does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used on particular items.

(7) The department performs completely Quality function for Product and Test and inspection specification and performs partially Quality function for Process specification.

(8) Use of Operator:

(a) Operator carries out 100% visual inspection.

(b) He gauge Products and records number of defectives per unit.

(9) Use of Patrol viewer:

Patrol viewer checks smaples of the product, gauges and

measures the sample and plots them on to the Control Charts.

(10) Control Charts for attributes are mainly used.

(11) Recording and Reporting Quality information: Percentage defective, percentive returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100% mainly on all characteristics.

(13) The department operates completely formal schemes related to Quality Audit or Quality Assurance, Quality instruction Manual, Vendor rating, Warrantly payments analysis, scrap and rework costing, certification by external authorities, customer panels and partially related to Training inspectors and Tester, process capability studies and Environmental Engineering.

(14) Inspection and Quality Control are separated.

(15) There is a separated reliability activity.

(16) The company does not deal with government contracts.

(17) There is no resident government inspection staff.

(18) The company ran a specific Quality and Reliability year programme in 1968. The result was successful.

(19) The company does not employ consultant on Quality problem.

(20) The Best selling product has remained virtually unchanged for ten years.

(21) The characteristic of the Best Product is its Reliability.

(22) The percentage of material bought out is 50%.

(23) The top five problems of department related to Quality field are:

(a) Motivation,

(b) High volume of Quantity,

(c) Maintenance of Quality and Production,

(d) Judgement of Quality by customer is subjective,

(e) Lack of research information.

Responsibilities for Quality and Reliability:

(1) The departmental Head monthly reports to the Division Managing Director.
(2) The department provides the written reports to top executive as well as shop supervisors.
(3) The section is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.
(5) The Production department is responsible for correcting the deviation from the Quality standard.
(6) The company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own tool room.
(8) Production department had the overall reponsibility for setting standards and maintaining standard.
(9) Statistical Quality Control is applied to long production runs but occasionally applied to jobbing work as well.
(10) The rejected batches are inspected by inspection department.
(11) Rejected raw material is replced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, Rectification and Quality guarantee.
(2) Quality Control Costs are not dealt with as an overhead on production costs. Department bases on Pro-rate system.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.
(5) The improvement of Quality resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes

and drawing tolerances and the elimination of unnecessary precision.

(7) There are examples of Cost Savings through widening the drawing tolerances which were previously unnecessarily tight.

(8) The Cost Saving is due to technical action based on Control Carts.

(9) The Cost of Quality Control is recovered through Cost Saving.

(10) Acceptance Sampling Plans are based on cost consideration.

(11) Assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user (machinery and tools).

(12) Products are guaranteed for one year or one thousand two hundred miles.

(13) Engineering Cost studies are made to suggest cost savings by comparison with competitor's products and by analysis of reports of defective work.

(14) Operator is paid on daily basis.

(15) Savings in Quality Control Costs is achieved due to reduction in the amounts of inspection within own plant.

APPENDIX 10 - FACTORY J

General Information:

(1) Automobile Industry
(2) The company was established in 1900.
(3) The total number of employees is twenty five thousand.
(4) Labour is mostly semi-skilled.
(5) The sex of labour force is mostly male.
(6) Financial incentives are only applied to some labour.
(7) Products are mainly supplied to own agents.
(8) Final consumer always recognise the company's products.

Head of Quality and Reliability Information:

(1) He is known as the Inspection Manager.
(2) He has been in the company for twenty years.
(3) He is fifty-two years old.
(4) He is not a Chartered Engineer, but completed O.N.C. in part-time education.
(5) His gross salary is over £4000 per year.
(6) His experience in various functions.
    (a) Shop Floor - fifteen years,
    (b) Line Management - five years,
    (c) Production Service Function - ten years,
    (d) Present Job - five years.
(7) He is a member of the Institute of Inspection Engineering.
(8) The total number of employees under his responsibilities is two thousand. This includes one thousand eight hundred employees who perform a direct inspection function.
(9) He is directly responsible to company Quality Director.
(10) The most valuable external source of Quality and Reliability information to him is formal and informal contact to other firms.

Organisation for Quality and Reliability:

(1) The system of inspection is recorded in 1966.
(2) The Statistical Quality Control system has been operating since 1966.

(3) Acceptance Sampling is used on some items for the Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by the department and action is taken to ascertain the cause.

(5) Sampling Plans are introduced since 1970.

(6) Types of schemes used:

(a) Sampling Plan is worked based on DEF-131-A.

(b) Department operateds eight differents Acceptable Quality Levels (A.Q.L)

(c) A.Q.Ls are decided from past experience of the expected level of defects and considerations of cost of inspection related to cost of accepting a reject.

(d) Department has four units, in one of the units, the intensity of the sampling increased or decreased is based on the results of previous samples.

(e) Sampling Plans are mostly based on attribute (go-No go) sampling, occasionally measurements are also used.

(f) Sampling is done in random from a continuous process.

(g) Sampling Plans do not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control are used as a general policy.

(7) The department performs Quality function completely for Test and Inspection specification and partially for Product and Process specification.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He gauges the Product.

(9) Use of Patrol viewer:

Patrol viewer carries out periodic checks on samples of the products.He also gauges as well as measures samples and plots them on to the Control Chart.

(10) Control Charts for attributes are used.

(11) Recording and reporting Quality information:
Percentage defective, percentage returned, percentage rectified, and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100%, mainly for 'fit and function'.

(13) The department operates formal schemes completely related to Quality Audit and Quality Assurance, Training inspectors and Testors, Warranty payments analysis, scrap and rework costing, Environment Engineering, certification by external authorities and customer panel, partially related to Quality instructions Manual, Vendor rating, and Process Capability studies.

(14) Inspection and Quality Control are not separated.

(15) There is a seperate Reliability activity.

(16) The company deals directly with government contracts.

(17) There is a resident government inspection staff.

(18) The company had ran a specific Quality and Reliability year programme and result was completely successful.

(19) The department does not employ consultant on Quality problems.

(20) The Best Selling product has remained virtually unchanged for the past ten years.

(21) The characteristic of the Best Selling product is its value for money.

(22) The percentage of material bought out is 60%.

(23) The top five problems of department related to Quality field are :

(a) Paint,
(b) Water leak,
(c) Mechanical problem,
(d) Industrial relation,
(e) Lack of inspector in Quality Audit.

Responsibilities for Quality and Reliability:

(1) The departmental Manager reports to the company Quality Director constantly.

(2) The department provides the written report to top executives as well as shop supervisors.
(3) The department is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting the deviation from the Quality standard.
(5) The production department is responsible for the correcting deviation from Quality standard.
(6) Company has its own training schocl and uses outside facilities when required.
(7) Production gauges are checked in their own tool room.
(8) Production, design and sales departments and customers have 100% co-operation in setting standards and maintaining standard.
(9) The Statistical Quality Control applies to jobbing work as well as long production runs.
(10) Rejected batches are inspected by the Production department.
(11) Rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, Rectification and 100% check viewing and Quality guarantee on a periodic basis.
(2) Quality Control Costs are dealt with as an overhead on production costs.
(3) The Cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating the cost of poor Quality as listed in (1) is not being reduced.
(5) The improvement of quality, resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved due to the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) The cost saving is mostly due to the psychological impact of the charts.
(8) The Cost of Quality Control is recovered through Cost Savings.

(9) Acceptance Sampling Plans are based on Cost consideration.

(10) Products are guaranteed for one years or one thousand two hundred miles.

(11) Engineering cost studies are made to suggest Cost Saving by Analysis of reports of defective work.

(12) Operators are paid on daily basis.

APPENDIX 11 - FACTORY K

General Information:

(1) Automobile Industry
(2) The company was established in 1925.
(3) The total number of employees in the factory is five thousand.
(4) Labour is mostly semi-skilled.
(5) The sex of labour force is approximately equal in both.
(6) Financial incentives are applied to most of the labour.
(7) Products are mainly supplied to other firms.
(8) Final consumer mainly regconises the company's products.

Head of Quality and Reliability Information:

(1) He is known as the Quality Manager.
(2) He has been in the company for ten years.
(3) Age - thirty seven years.
(4) He is not a Chartered Engineer, but he completed trade formal apprenticeship.
(5) His gross salary - £3500/year.
(6) His experience in various functions:
    (a) Shop floor - ten years,
    (b) Production service functions - eight years,
    (c) Present job - two years.
(7) He is a member of Institute of Engineering Inspection.
(8) The total number of employees under his reponsibilities is 450. This includes 400 employees who perform direct inspection function.
(9) He is directly responsible to work Manager.
(10) The two most valuable external sources of Quality and Reliability information to him is formal and informal contact with other firms.

Organisation of Quality and Reliability:

(1) The system of inspection is recorded in 1968.

(2) The Statistical Quality Control is operated since 1971.

(3) Acceptance Sample is used on some items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by depatment, and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in December 1971.

(6) Types of schemes used:

(a) Sampling Plan is carried out based on DEF-131-A.

(b) Department operates two different Acceptable Quality Levels (A.Q.L)

(c) A.Q.Ls are decided from the past experience of the expected level of defects.

(d) Sampling Plans are based on attribute (go - No go) sampling as well as measurements.

(e) The intensity of the sampling increased or decreased is based on the results of previous samples.

(f) Sampling is not done from a continuous process. The Sampling is usually carried out after the final process in which products are completed.

(g) Sampling Plans are used in a form to decide whether a process should be running.

(h) On an in-process basis, Statistical Quality Control is used as a general policy.

(7) The department performs Quality function completely for product process and Test and Inspection Specification.

(8) Use of Operator:

(a) Operator carries out 100% sampling if products are on critical and 10% sampling if products are on non-critical.

(b) He gauges and measures products.

(9) Use of Patrol inspector:

Patrol inspector checks samples, gauges and measures samples and plots them on to the Control Charts.

(10) Control Charts for attributes are mostly used.

(11) Recording Quality information:
Percentage defective, percentage returned, percentage rectified and percentage scrap are recorded on a periodic basis.

(12) In final inspection, products are checked on sample mainly for 'fit and function'.

(13) The department operates formal schemes completly related to Quality Audit or Quality Assurance, Quality instructions manual, Vendor rating, Warranty Payment Analysis, scrap and rework costing and customer panels, partially related to training inspectors and testers. The department does not operate schemes related to process capability studies Environmental Engineering and Certification by external authorities.

(14) Inspection and Quality Control are separated.

(15) There is no separated Reliability activity.

(16) The company does not deal with government contract directly.

(17) There is no government resident inspection staff.

(18) The department had performed a specific Quality and Reliability year programme.

(19) The department does not employ consultant on Quality problems.

(20) The Best Selling Product has remained virtually unchanged for one year.

(21) The best product's characteristic is service ability.

(22) The percentage of material bought out is 65%.

(23) The top five problèms of department related to Quality field are:

(a) Dimensional instability,

(b) Adequate tooling,

(c) Polishing problem,

(d) communication,

(e) General management.

Responsibilities of Quality and Reliability:

(1) The departmental head reports weekly to Work Manager.
(2) The department provides the written reports to top executives as well as shop supervisors.
(3) The department is responsible for the identification of faults.
(4) The Quality department has the overall responsibility for the inspection function and report the deviation from the Quality standard.
(5) The production department is responsible for the correcting the deviation from Quality standard.
(6) Training and Education in Quality Control methods of supervision, inspection staff and production operation are responsible by Quality Manager and Production Manager.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers have fully co-operation in setting standard, but maintaining standard is wholely in the hand of Quality department.
(9) The Statistical Quality Control applies to jobbing work as well as long production runs.
(10) Rejected batches are inspected in Inspection department.
(11) Rejected raw materials are either replaced by supplier or rectified or scrapped without compensation.

Economics of Quality and Reliability:

(1) Cost of poor Quality are recorded at scrap at semi-finished stage, scrap at final assembly loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and 100% check viewing on a periodic basis.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor quality as listed in (1) is not being reduced.
(5) The improvement of Quality is achieved through more efficient utilisation of the equipment in subsequent processes.

(6) Saving is achieved through correct matching up of processes, drawing tolerances and the elimination of unnecessary precision.

(7) There are examples of Control Chart used in weighing processes. Balance struck between the cost of the amount given away and the loss through giving too little is occurred.

(8) There are examples of cost savings through widening drawing tolerances which were previously unnecessary tight.

(9) The Cost Saving is due to technical action based on Control Charts.

(10) The cost of Quality Control is recovered through cost savings.

(11) Acceptance Sampling Plans are not based on cost consideration.

(12) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (1) lost of time in subsequent stages of manufacture (2) work done on a product which is already defective (3) damage to user (machinery, tools and personal injury).

(13) Products are guaranteed for one year or one thousand two hundred miles.

(14) Engineering cost studies are made to suggest cost savings by analysis of reports of defective work.

(15) Operators are paid on total output based on Rating system.

(16) Savings in Quality Control costs is achieved due to reduction in the amount of inspection.

APPENDIX 12 - FACTORY L

General Information:

(1) Automobile Industry
(2) The company was established in 1933.
(3) The total number of employees in the factory is one thousand two hundred.
(4) Labour is mostly un-skilled.
(5) The sex of labour is mosty male.
(6) Financial incentives are applied to most of the labour.
(7) Products are supplied to own agents and other firms.
(8) Final consumers mainly recognise the company product.

Head of Quality Information:

(1) He is known as the Quality Control Manager.
(2) He has been in the company for fourteen months.
(3) Age - thirty.
(4) He is a Chartered Engineer with B.Sc. degree; he also completed the postgraduate diploma in management course.
(5) His gross salary - £3400/year.
(6) His experience in various functions:
    (a) Shop floor - one year,
    (b) Quality Control and inspection - six years,
    (c) Present job - fourteen months.
(7) He is member of the British Institute of Management.
(8) The total number of employees under his resposibilities is one hundred and thirty seven. This incudes one hundred and twenty eight performing direct inspection work.
(9) He is directly responsible to work director.
(10) The two most valuable external sources of Quality information to him is formal and informal contact with other firms.

Organisation of Quality:

(1) The system of inspection is recorded since 1966.

(2) The Statistical Quality Control has been operated since 1971.

(3) Acceptance Sampling Plan is used on all items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever this is a very batch action is taken to rectify or scrap for 100% inspection.

(5) Sampling Plans are introduced in 1972.

(6) Types of schemes used:

(a) Sampling Plan is worked based on DEF-131-A.

(b) The department operates four different Acceptance Quality level (A.Q.L).

(c) A.Q.Ls are decided from the past experience of the expected level of defect and considerations of cost of inspection related to cost of accepting a reject.

(d) All sampling plans are based on attribute (go - No go) sampling.

(e) The intensity of sampling is based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Controls are only used for particular items.

(7) The department performs the Quality function completely for Test and Inspection specification partially for Product and Process specification.

(8) Use of Operator:

(a) Operator carries out statistical system sampling.

(b) He gauges samples.

(9) Use of Patrol inspector:

Patrol inspector carries out statistical system sampling but when instruments are sophisticated, the operator does not carry out any sampling.

(10) Control Charts for attributes are mostly used.

(11) Recording Quality information:
Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100% on all characteristics as weel as for 'fit and function'.

(13) Departments operate formal schemes completly related to Warranty Payment Analysis, scrap and rework costing and customer panels, partially related to Quality Audit or Quality Assurance, Quality instruction manuals, Vendor rating, training inspectors and Testers, process capability studies, Environmental Engineering and Certification by external authorities.

(14) Inspection and Quality Control is separated.

(15) There is no separate reliability activity.

(16) The company deals directly with government contracts.

(17) There is no resident government inspection staff.

(19) The department does not use consultants on Quality problems.

(20) The Best selling product has remained virtually unchanged for over twenty years.

(21) The Best product's characteristic is its performance.

(22) The percentage of material bought out is 25%.

(23) The top five problems of department related to Quality field are:
(a) In-process control in machine shop,
(b) Lack of specification for semi-skill operator,
(c) Component bought out,
(d) obtaining required performance characteristic,
(e) Production.

Responsibilities for Quality and Reliability:

(1) The departmental head reports to Work Director constantly. (short term - daily, long term - monthly written report)

(2) The department provides the written report to top executives

as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) Quality, design and sale departments liasion with customer for specifying the standard of Quality required.

(5) Quality Control department has the overall responsibilities for Quality Control and inspection function and reporting the deviations from the Quality standard. Production department is responsible for correcting the deviation from the Quality standard.

(6) The company has its own training school and uses outside facilities when required.

(7) Production gauges are checked in their own standard room.

(8) Design, sales departments and customers have 100% co-operation in setting standard and Quality Control department maintaining the standard.

(9) Statistical Quality Control applies to jobbing work as well as long production runs.

(10) The rejected batches are inspected by inspection department.

(11) The rejected raw material is replaced by supplier.

Economics of Quality:

(1) Cost of poor Quality are recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, Rectification, 100% check viewing and Quality guarantee.

(2) Quality Control Costs are dealt with as an overhead on Production Costs.

(3) The cost of Control Charting is not estimated.

(4) During the period in which Quality Control has beenoperating, loss of output due to raw material, rectification, 100% check viewing and Quality guarantee is reduced.

(5) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.

(6) There are examples of cost savings through widening drawing tolerances which were previously unnecessary tight.

(7) Cost Savings are due to a rational appraisal of requirement as a result of study.

(8) Cost of Quality control is not recovered through Cost Savings.

(9) Acceptance Sampling Plans are based on Cost considerations.

(10) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.

(11) Products are guranteed for one year or one thousand two hundred miles.

(12) Engineering cost studies are made to suggest cost savings by comparison with competitor's products and analysis of reports of defective work.

(13) Operators are paid on producing good work only.

(14) Savings in Quality Control is achieved due to the reduction in the amount of inspection.

APPENDIX 13 - FACTORY M

General Information:

(1) Air Craft Industry
(2) The company was established in 1900.
(3) The total number of employees in the factory is 20000.
(4) Labour is most highly skilled.
(5) The sex of labour is mostly male.
(6) No financial incentives are given.
(7) Products are mainly supplied to other firms.
(8) Final consumer always recognises the company's products.

Head of Quality and Reliability information:

(1) He is known as Chief Quality Engineer.
(2) He has been in the company for twenty years.
(3) Age - forty eight
(4) He is a Chartered Engineer with B.Sc. degree.
(5) His gross salary - over £4000/year.
(6) His experience in various functions:
    (a) Shop floor - five years,
    (b) Line management - twelve years,
    (c) Production service function - seven years,
    (d) Present job - three years.
(7) He is member of Institute of Inspection Engineering, American society for Quality Control and British Institute of Management .
(8) The total number of employees under his responsibilities is two thousand, including one thousand eight hundred who perform a direct inspection function.
(9) He is directly responsible to Managing Director.
(10) The two most valuable external sources of Quality and Reliability information to him is attending conference and the publications of American Society for Quality Control.

Organisation for Quality and Reliability:

(1) The system of inspection is recorded in 1954.

(2) Quality Control system is operated since 1957.

(3) Acceptance sampling is used on all items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch records are kept by the Production centre (Quality Engineer) and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in 1964.

(6) Types of schemes used:

(a) Sampling plan is carried out under company's own schemes.

(b) Department operates two different Acceptable Quality Levels (A.Q.L).

(c) A.Q.Ls are decided by laid down company policy.

(d) All sampling plans are based on attribute (go - No go) sampling as well as measurements.

(e) The intensity of sampling is not based on the results of previous samples. It is either 100% inspection or taking the fix sample.

(f) Sampling is not carried out from a continuous process.

(g) Sampling plan does not decide whether or not a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used as a general policy.

(7) The department performs completly Quality function for product, process, and Test and Inspection specification.

(8) Use of Operator:

(a) Operator carries out 100% inspection on the products.

(b) He gauges and measures the Product.

(9) Use of Patrol viewer:

Patrol viewer carrier out sample checking, he gauges and measures the sample.

(10) No Statistical Control Chart is applied in the department.

(11) Recording and reporting quality information:

Percentage defective, percentive returned, percentive

rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly on all characteristic, before final inspection, products have been checked for 100%, in this final inspection is a counter check to ensure the product is well order.

(13) Department operates formal schemes completely related to Quality Audit or Quality Assurance, Quality instructions manual, Vendor rating, Training inspectors and Testers, Warranty payments analysis, scrap and rework costing and certification by external authorities, and partially related to process capability studies, Environmental engineering and customer panels.

(14) Inspection and Quality Control are not separated.

(15) There is a separate reliability activity.

(16) The company deals directly with government contracts.

(17) There is a resident government inspection staff.

(18) The company had run a specific Quality and Reliability year programme, the results were tremendously successful.

(19) The department employs consultants on Quality problems.

(20) The Best Selling product has remained virtually unchanged for over twenty years.

(21) The Best Product's characteristic is Reliability.

(22) The percentage of material bought out is 50%.

(23) The top five problems of department related to Quality field are:

(a) Quality cost,

(b) Raw material,

(c) High cost of test equipment,

(d) General management,

(e) Motivation.

Responsibilities for Quality and Reliability:

(1) The Chief Quality Engineer provides monthly report to Managing Director.

(2) The department provides the written report to top executives as well as shop supervisors.
(3) Worker is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.
(5) Production department and Quality department are responsible for the correcting deviation from Quality standard.
(6) The company has its own training school and also uses outside facilities when required.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers has 100% co-operation in setting standards and maintaining standard.
(9) Statistical Quality Control is applied to jobbing work as well as long production runs.
(10) The rejected raw material is replaced by supplier.

Economics of Quality Control.

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, Rectification and Quality guarantee on periodic basis.
(2) Quality controls costs are dealt with as an overhead on production cost, and base on Pro-rate system.
(3) The cost of control charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor quality as listed above (1) is reduced.
(5) Improvement of Quality resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerance and the elimination of unnecessary precision.
(7) The are examples of cost savings through widening drawing tolerance which were previously unnecessary tight.
(8) The cost of Quality control is recovered through cost saving.

(9) Acceptance sampling plans are not based on cost consideration. The department hopes that in future the sampling plans can based on cost consideration.

(10) Products are 100% guaranteed on Warranty basis.

(11) Engineering cost studies are made to suggest cost savings by comparison with competitor's products and by analysis of reports of defective work.

(12) Operators are paid on daily basis.

(13) Savings in Quality Control costs are achieved due to reduction in the amount of inspection.

APPENDIX 14 - FACTORY N

General Information:

(1) Air Craft Industry
(2) The company was established in 1900.
(3) The total number of employees is two thousand eight hundred.
(4) Labour is mostly highly skilled.
(5) The sex of labour is mostly male.
(6) Financial incentive is applied to most of the labour.
(7) Products are 40% supplied to governments agencies and 60% to other firms.
(8) Final consumers always recognise the company's products.

Head of Quality and Reliability Information:

(1) He is known as Quality Manager.
(2) He has been in the company for five years.
(3) Age - forty two.
(4) He is a Chartered Engineer with a B.Sc. degree, completed postgraduate and formal apprenticeship. He also completed H.N.C in part time education.
(5) His gross salary - about £4000/year.
(6) His experiences in various functions:
    (a) Line management - ten years,
    (b) Production service function - five years,
    (c) Present job - five years.
(7) He is a member of Institute of Engineering Inspection.
(8) The total number of employees under his responsibilities is three hundred. This includes two hundred and seventy five who perform a direct inspection function.
(9) He is directly responsible to Division Director.
(10) The two most valuable external sources of Quality and Reliability information to him are publications of Institute of Engineering inspection and informal contact with other firms.

Organisation for Quality and Reliability

(1) The system of inspection has been recorded in 1952.

(2) The Statistical Quality Control system is operated since 1966.

(3) Acceptance sampling is used on some items for Incoming Products.

(4) Nature of product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by the department and action is taken immediately to ascertain the caused.

(5) Sampling plans are introduced in 1966.

(6) Types of schemes used:

(a) Sampling is carried out under company's own schemes.

(b) Departments operate three different Average Outgoing Quality Limit (A.O.Q.L).

(c) These A.O.Q.Ls are decided from past experience of the expected level and consideration of cost of inspection.

(d) Sampling plans are based on attribute (go - No go) sampling and measurements.

(e) The intensity of sampling increased or decreased is based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans are used normally to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used as a general policy.

(7) The department performs completely Quality function for product, process and Test and inspection specification.

(8) Use of Operator:

(a) Operator carries out routine sample and this scheme is layout by Quality department.

(b) He measures and gauges products.

(9) Patrol inspector:

Patrol viewer checks constantly the samples.

(10) No Control Chart is applied in the department.

(11) Recording and reporting Quality information:
Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100%, mainly for 'fit and function'.

(13) The department operates completely formal schemes related to Quality audit or Quality Assurance, Quality instruction manual, Vendor rating, Training inspectors and testers, Warranty payments analysis, scrap and rework costing, Environment engineering, certification by external authorities and customer panels and operates partially related to process capabilities studies.

(14) Inspection and Quality are not separated.

(15) There is a separate reliability activity.

(16) The company deals directly with government contracts.

(17) There is a resident government inspection staff.

(18) The company had run a specific Quality and Reliability year programme.

(19) The department does not use consultant on Quality problems.

(20) The Best selling product has remained virtually unchanged for over twenty years.

(21) The Best product characteristic is Reliability.

(22) The percentage of material bought out is 60%.

(23) The top five problems of Manager in the Quality field are:
(a) Variability of small batch size ,
(b) Complex manufacture,
(c) Complex function testing,
(d) Quality cost,
(e) Complying with government agencies and other firms contracts Quality required.

Responsibilities for Quality and Reliability:

(1) The departmental head reports constantly to Division Director.

(2) The department provides the written report to top executives as well as shop supervisors.

(3) The worker is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.
(5) The production department is responsible for the correcting deviation from Quality standard.
(6) Company has its own school training centre and uses outside facilities when required.
(7) Production, design and sales departments and customers have closely co-operation in setting standard and maintaining standard.
(8) Production gauges are checked in their tool room and standard room.
(9) The Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batch are inspected by the department and over chart the supplier.
(11) The rejected raw material are replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material etc., rectification and 100% check viewing and Quality guarantee.
(2) Quality Control costs are dealt with as an overhead on production cost, based on cost code.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor quality as listed in (1) is reduced.
(5) The improvement of Quality, resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved due to the correcting matching up of processed and drawing tolerances and the elimination of unnecessary precision.
(7) There are examples of cost savings through widening drawing tolerances which were previously unnecessary tight.

(8) The cost of Quality Control is recovered through cost saving.

(9) The assessment makes allowances for allowing a defective item to pass each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user(machinery, tools, and personal injury).

(10) Products are 100% guaranteed.

(11) Engineering cost studies are made to suggest cost saving by analysis of reports of defective work.

(12) Operators are paid on a bonus based on the percentage of good work produced.

(13) Saving in Quality Control costs are achieved due to reduction in the amount of inspection.

APPENDIX 15 - FACTORY O

General Information:

(1) Mechanical Engineering Industry.
(2) The company was established in 1890.
(3) The total number of employees is about four thousand.
(4) Labour is mostly semi-skilled.
(5) The sex of labour is approximately equal in both.
(6) Financial incentives are operated to most of the labour.
(7) Products are mainly supplied to other firms.
(8) Final consumers always recognise the company's products.

Head of Quality and Reliability information:

(1) He is known as Quality Manager.
(2) He has been in the company for thirty four years.
(3) Age - fifty two.
(4) He is not a Chartered Engineer but he has H.N.C in part time education and completed trade formal apprenticeship.
(5) His gross salary - over £4000/year.
(6) His experiences in various function:
    (a) Shop floor - six years,
    (b) Line management - nine years,
    (c) Production service function - two years,
    (d) Design and drawing office - two years,
    (e) Inspection - four years,
    (f) Present job - eleven years.
(7) He is member of the institute of Engineer inspection, British institute of Management and institute of Supervisor Management.
(8) The total number of employees under his responsibilities is two hundred and fifty. This includes two hundred and twenty employees who perform a direct inspection.
(9) He is directly responsible to work Manager or Managing Director.
(10) The two most valuable external source of Quality information to him is publications of American Society for Quality Control, Local Quality and Reliability.

Organisation for Quality and Reliability :

(1) The system of inspection is recorded since 1948.

(2) The Statistical Quality Control system is operated since 1948.

(3) Acceptance sampling is used on some items for Incoming Products.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by the department to ascertain the cause and 100% inspection is carried out.

(5) Sampling plans are introduced in 1948.

(6) Types of schemes used:

(a) Sampling plan is carried out under company's own schemes, concepts are based on Acceptable Quality Level and produces risk.

(b) The department operates four different Acceptable Quality Levels.

(c) A.Q.Ls are decided by laid down company's policy.

(d) Sampling plans are based on attribute (go - No go) measurement and visual.

(e) The intensity of sampling is not based on the results of previous samples.

(f) Sampling is not done from a continuous process. Samples are taken from the final process in which products are completed.

(g) Sampling plan does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used as a general policy.

(7) Department performs completely Quality function for product and test and inspection and partial Quality function for process.

(8) Use of operator:

(a) Operator carries out routine sampling.

(b) He gauges and measures products.

(9) No patrol inspector is employed. The sampling plans are carried out by sampler and sorter. The number of defective are recorded by sampler and put on to the chart.

(10) Control Charts for attribute are mainly used.

(11) Recording of Quality information:
Percentage of defective, percentage of returned, percentage rectified and percentage scrapped are recorded on a periodic basis, and use of computer to analysis the reason and cost of scrap.

(12) In final inspection, products are checked on sample mainly on all characteristics.

(13) The department operates completely formal schemes related to Quality audit Quality Assurance, training inspectors and testers, Warranty payments analysis and scrap and rework costing and operates partially schemes related to Quality instruction and manual, process capability studies, certification by external authorities and customer panels. The department does not operate Vendor rating and Environmental Engineering.

(14) Inspection and Quality Control are separated.

(15) There is a separate reliability activity.

(16) The company deals directly with government contracts.

(17) There is no resident government inspection staff.

(18) The company had run a specific Quality and Reliability year programme.

(19) The department employs consultants on Quality problems.

(20) The Best selling product has remained virtually unchanged for over twenty years.

(21) The Best product's characteristic is Reliability.

(22) The percentage of material bought out is 50%.

(23) The top five problems of Manager in the Quality field are:
(a) Loyality and technical competence of staff,
(b) Clear and concise specification.
(c) Strong descipline of work procedure in factory generally,
(d) Mininium cost and effective control,
(e) Co-operation between Production and Quality department.

Responsibilities for Quality and Reliability :

(1) The Manager of the department reports to the factory work Manager and the company Managing Director on monthly basis.

(2) The department provides the written report to top exexcutives as well as shop supervisors.

(3) Worker is responsible for the identification of faults.
(4) The department has the overall responsibility for the inspection function and reporting deviations from Quality standard.
(5) The Production department is responsible for correcting the deviation from Quality deviation.
(6) The company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers have close co-operation in setting standards and maintaining standard.
(9) The Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batches are inspected by the Quality department.
(11) The rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling (very slight), loss of output due to the raw material etc., rectification and 100% check viewing and Quality guarantee.
(2) Quality Control costs is dealt with as an overhead on production costs.
(3) The cost of control charting is not estimated.
(4) Savings in the Quality Control costs are achieved through the reduction in the amount of inspection within their own plant.
(5) During the period in which Quality Control has been operating the cost of poor Quality as listed in (1) is reduced.
(6) The improvement of Quality resulted in more efficient utilisation of the equipment in subsequent processes and this has been evaluated.
(7) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unneccessary precision.
(8) There were instances of the application of control charts to weighing processes. There are balances struck between the cost of the amount given away and the loss through giving too little.

(9) There are examples of cost savings through widening drawing tolerances which were previously unnecessarily tight.

(10) The cost saving is mostly due to the psychological impact of the charts.

(11) The cost of Quality control is not recovered through cost savings.

(12) Acceptance sampling plans are based on cost considerations.

(13) The assessment makes allowances for allowing a defective item to pass each inspection point cost is due to (a) lost time in subsequent stages of manufacture (b) damage to user (machinery and tools).

(14) The Engineering cost studies are made to suggest cost savings by comparison with competitors products and by analysis of reports of defective work.

(15) Quality bonus schemes are in operation. Operators are paid for producing good work only.

APPENDIX 16 - FACTORY P

General Information:

(1) Mechanical Engineering Industry
(2) The company was established in 1880.
(3) The total number of employees in the factory is about one thousand eight hundred.
(4) Labour is mostly unskilled.
(5) The sex of labour force is approximately equal.
(6) Financial incentives are given to most of the labours.
(7) Products are mainly supplied directly to public.
(8) Final consumers always recognise the company's product.

Head of Quality and Reliability information:

(1) He is known as Quality and Reliability Manager.
(2) He has been in the company for ten years.
(3) Age - sixty four.
(4) He is a Chartered Engineer with a B.Sc. degree (part-time) He also completed trade and formal apprenticeship.
(5) His gross salary - over £4000/year.
(6) His experience in various functions:
    (a) Line management - forty years,
    (b) Present job - ten years.
(7) He is a member of Institute of Inspection Engineering and British Institute of Management.
(8) The total number of employees under his responsibilities is three hundred only. This includes 250 who perform a direct inspection function.
(9) He is directly responsible to Technical Director.
(10) The two most valuable external sources of Quality and Reliability information to him is contacted with Quality and Reliability Practice member and attending conferences.

Organisation for Quality and Reliability:

(1) The system of inspection has been recorded since 1965.
(2) The system of Quality Control system bas been operated since 1965.

(3) Acceptance sampling is used on some items for Incoming Product.

(4) Nature of Quality Product inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by the department and action is taken to ascertain the cause.

(5) Sampling Plans are introduced in 1965.

(6) Types of schemes used:

(a) The sampling is carried out under DEF-131-A.

(b) The department operates three different Acceptable Quality Levels.(A.Q.L)

(c) A.Q.Ls are decided by laid down company policy.

(d) All sampling plan are based on attribute (go - No go) sampling.

(e) The intensity of sampling increased or decreased is based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control are used on particular items.

(7) The department performs completely Quality function for test and inspection specifications and performs partially Quality function for Product and Process specifications.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He gauges the products.

(9) Use of patrol viewer:

Patrol inspectors carry out periodic checks on product and record the number of defective and the faults.

(10) Though Statistical Quality Control is applied to the department, the control charts were not used but based on written record from patrol inspections and result from computer's information.

(11) Recording and reporting Quality information:

Percentage defective, percentage returned, percentage rectified percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100% mainly for 'fit and function'.

(13) The department operates completely formal scheme related to Quality Audit or Quality Assurance, Quality instruction Manual, training inspector and testers, Warranty payment analysis, scrap and rework costing and operates partially related to Vendor rating, process capability studies, Environmental Engineering, certification by external authorities and does not operate customer panels.

(14) Inspection and Quality Control are not separated.

(15) There is a separate reliability activity.

(16) The company deals directly with government contract.

(17) There is no resident government inspection staff.

(18) The company had run a specific Quality and Reliability year programme.

(19) The department does not employ consultant on Quality problems.

(20) The Best selling product has remained virtually unchanged for past twenty years.

(21) The Best product's characteristic is long useful life.

(22) The percentage of material bought out is 25%.

(23) The top five problems of the department in the Quality field are:

(a) Damage,

(b) Finish,

(c) Incoming good from supplier,

(d) Welding brazing,

(e) Dimensional accuracy.

Responsibilities for Quality and Reliability:

(1) The Head of the department reports monthly to Technical Director.

(2) The department provides written reports to top executive as well as shop floor supervisors.

(3) The department is responsible for the identification of faults.

(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.

(5) The Production department is responsible for correcting the deviation from Quality standard.

(6) Training and education in Quality Control method is performed by training department with an assistant from Quality control department.

(7) Production gauges are checked by their own standard room.
(8) Product group Quality Control and customers have 100% co-operation in setting standard and maintaining standard.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batches are inspected by Inspection department.
(11) Rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and 100% check viewing, Quality guarantee, cost of setting a good product in a lower grade on periodic basis.
(2) The department has its individual budgets based on Pro-rate estimation.
(3) The department estimates the cost of control charting.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.
(5) Improvement of Quality was resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved due to the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) Cost savings are due to technical action based on Control Charts and the psychological impact of the charts.
(8) The cost of Quality Control is recovered through cost saving.
(9) Acceptance sampling plans are based on cost consideration.
(10) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user (machinery and tools).
(11) Products are guaranteed for two years.
(12) Engineering cost studies are made to suggest cost savings by

analysis of reports of defective work.

(13) Operators are paid on total output.

(14) Savings in Quality Control costs are achieved through the reduction in the amount of inspection within own plant.

APPENDIX 17 - FACTORY Q

General Information:

(1) Chemical Engineering industry.
(2) The company was established in 1908.
(3) The total number of employees in the factory is five thousand.
(4) Labour is mostly semi-skilled.
(5) The sex of labour is mostly male.
(6) Financial incentives are given to most of the labour.
(7) Products are mainly supplied to other firms.
(8) Final cosumers always recognise the company's products.

Head of Quality and Reliability information:

(1) He is known as Quality Manager.
(2) He has been in the company for seventeen years.
(3) Age - forty two
(4) He is not a Chartered Engineer but he holds a B.A. degree.
(5) His gross salary - over two thousand eight hundred pounds a year.
(6) His experiences in various functions:
    (a) Line management - seven years,
    (b) Production service function - five years,
    (c) Quality Control inspection - three years,
    (d) Present job - five years.
(7) He is a member of Institute of Inspection Engineer.
(8) The total number of employees under his responsibilities is one hundred and fifty. This includes one hundred and thirty five employees who perform a direct inspection function.
(9) He is directly responsible to Production Director.
(10) The two most valueable external sources of Quality and Reliability information to him are publication of National Council for Quality and Reliability and Institute of Inspection Engineering.

Organisation for Quality and Reliability:

(1) The system of inspection is recorded since 1917.

(2) The Statistical Quality Control system is operated since 1952.

(3) Acceptance sampling is used on all items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by laboratory and immediately action is taken to freeze the production line until it is corrected.

(5) Sampling plans are introduced since 1952.

(6) Types of scheme used:

(a) Sampling plan is worked based on DEF-131-A.

(b) The department operates three different Acceptable Quality Levels(A.Q.L).

(c) A.Q.Ls are decided from past experience of expected level of defects.

(d) Sampling plans are based on visual attribute (go - No go) sample and measurements.

(e) The intensity of sampling is not based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used as a general policy.

(7) The department performs completely Quality function for product, process and test and inspection specification.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He gauges products.

(9) Use of Patrol viewer:

Patrol inspector.checks samples of the product,gauges and measures samples. He also recorded the performance of the Quality.

(10) Control Charts for variables are mostly used.

(11) Recording and reporting Quality information:

Percentage defective, percentage returned, percentage rectified

and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, except for Air Craft, products are checked 100%, mainly for 'fit and function'.

(13) The department operates formal schemes completely related to Quality Audit or Quality Assurance, Quality instruction manual, vendor rating, training inspectors and testor, scrap and rework costing and partially related to process capability studies, Environmental Engineering, certification by external authorities and customer panels but department does not operate scheme related to Warranty payments' analysis.

(14) Inspection and Quality Control are separated.

(15) There is a separated reliability activity.

(16) The company deals directly with government contracts.

(17) There is no resident government inspection staff.

(18) The company had run an exhibition of a specific Quality and Reliability year programme.

(19) This is an international company. The department does not employ consultant outside company, but department consults the Quality problem with the company group.

(20) The Best selling product has remained unchanged for one year.

(21) The Best product characteristic is Reliability.

(22) The percentage of material bought out is 85%.

(23) The top five problems of department related to Quality field are:

(a) General management,

(b) Variability of raw material,

(c) Low level of labour to accept Quality,

(d) Lost of time before action to be taken,

(e) Production department can over take the Quality Control department decisions.

Responsibilities for Quality and Reliability:

(1) The departmental Head reports constantly to the Production Director.

(2) The department provides the written reports to top executives as well as shop supervisors.

(3) The section is responsible for the identification of faults.
(4) U.S.A head office of Quality Control department is responsible for specifying the standard of Quality required. The department has the responsibility for the inspection function and reporting deviation from the Quality standard.
(5) Technical service department is responsible for the correcting deviation from the Quality standard.
(6) The company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customer function very well in selling standard and maintaining standard.
(9) Statistical Quality Control is applied to jobbing work as well as long production runs.
(10) Rejected batches are 100% inspected by inspection department, scrapped on selling in a lower grade.
(11) Rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and 100% check viewing, Quality guarantee and cost of selling a good product in a lower grade.
(2) The Quality Control cost is dealt with as an overhead on production costs, based on Pro-rate scheme.
(3) The cost of Quality Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduceed.
(5) The improvement of Quality was resulted in more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision .
(7) There are instances of the application of Control Chart

to weighing processes and balance struck between the cost of the amount given away and the loss through giving too little.

(8) Examples showed the cost saving through widening drawing tolerance which were previously unnecessary tight.

(9) The cost saving through the technical action based on Control Charts.

(10) The cost of Quality Control is not recovered through cost savings.

(11) Acceptance sample plans are not based on cost consideration.

(12) The Assement makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) loss time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user (machinery, tools and personal injury).

(13) Products are 100% guaranteed for good product.

(14) Engineering cost studies are made to suggest cost savings by analysis of reports of defective work.

(15) Operators are paid on total output.

(16) Savings in Quality Control costs are achieved due to reduction in the amount of inspection.

APPENDIX 18 - FACTORY R

General Information:

(1) Chemical Industry
(2) The company was established since 1880.
(3) The total number of employees in the factory is one hundred and forty.
(4) Labour is mostly semi-skilled.
(5) The sex of labour is mostly male.
(6) Financial incentives are applied to only minority of the labour.
(7) Products are mainly supplied to other firms as well as own agents.
(8) Final consumers never recognise the company's product.

Head of Quality information:

(1) No Quality Department is formed in this factory, the senior man who incharge the Quality and Inspection function is Production Engineer.
(2) He has been in the company for twelve years.
(3) Age - twenty nine years old.
(4) He is not a charactered Engineer but he completed the H.N.D in part-tme education and also completed trade, formal apprenticeship.
(5) His gross salary - £2400/year.
(6) His experiences in various functions:
    (a) Line management - six years,
    (b) Production service function - two years,
    (c) Design and drawing office - one year,
    (d) Present job - three years.
(7) He does not belong to any frofessional society.
(8) The total number of employees under his responsibilities is fourteen and these employees carry out a direct inspection function.
(9) He is directly responsible to work Management.
(10) The two most valuable external sources of Quality information to him are formal and informal contact with other firms.

Organisation for Quality:

(1) The system of inspection has been recorded since 1969.

(2) The Statistical Quality Control system is operated since 1969.

(3) Acceptance sampling is used on all items for Incoming Product.

(4) Nature of product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by technical Engineer and action is taken to ascertain the cause.

(5) Sampling plans are introduced since 1969.

(6) Types of schemes used:

(a) Sampling plan is carried out based on DEF-131-A.

(b) The department operates two different Acceptable Quality Level.(A.Q.L)

(c) A.Q.Ls are decided upon the past experience of the expected level of defects.

(d) Sampling plans are based on the attribute (go - No go) sampling as well as measurements.

(e) The intensity of sampling is not based on the results of the previous samples.

(f) Sampling is done from a continous process.

(g) Sampling plan does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used on particular items.

(7) The department performs Quality function completely for product specification and partially for process and test and inspection specification.

(8) Use of Operator:

(a) Operator carries out haphazard sampling by visual.

(b) He does not gauge samples.

(9) Use of Patrol inspector:

Patrol inspector checks samples of the products and gauges and measures samples.

(10) Statistical Control Charts for attributes and variables are mostly used.

(11) Recording Quality information:

Percentage defective, percentage returned,percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked 100% mainly for 'fit and function'.

(13) The department operates formal schemes completely related to scrap and rework costing and Environmental Engineering, and partially related to Quality Audit or Quality Assurance, Quality instructions manual, Vendor rating, training inspectors and testers, process capability studies, certification by external authorities and customer panels. Department does not operate scheme related to Warranty payment analysis.

(14) Inspection and Quality are not separated.

(15) There is no separate reliability activity.

(16) The company does not deal directly with government contract.

(17) There is no resident government inspection staff.

(18) The company never run any specific Quality and Reliability year programme.

(19) The company never employs consults on Quality problems.

(20) The Best selling product has remained virtually unchanged for five years.

(21) The Best product's characteristic is Reliability.

(22) The percentage of material bought out is 50%.

(23) The top five problem of the department related to Quality field are:

(a) Variability of raw materials,

(b) Lack of standard,

(c) Labour force,

(d) General management between design and production,

(e) Communications.

Responsibilities for Quality:

(1) The Technical Engineer reports to the work Manager regarding the Quality constantly.

(2) Technical Engineer provides the written report related to Quality to top executives as well as shop supervisors.

(3) The department is responsible for the identification of faults.

(4) Technical Engineer and inspection staff has the overall responsibility for the inspection function and reporting deviation from the Quality standard.

(5) The production department is responsible for the correcting deviation from Quality standard.
(6) Training and education in Quality Control method of supervision, inspection staff, and production operators are solely in the hand of Technical Engineer.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers have close co-operation in setting standard and maintaining standards.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batches are inspected by inspection department.
(11) The rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective raw material, rectification and 100% check viewing.
(2) Quality control costs are dealt with as an overhead on production costs.
(3) Cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is remained the same without reduce.
(5) Improvement of Quality resulted is not from more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) No example of cost savings is through widening drawing tolerances which were previously unnecessarily tight.
(8) The cost of Quality Control is not recovered through cost savings.
(9) Acceptance sampling plans are not based on cost consideration.
(10) Assessment makes allowances for allowing a defective item to pass each inspection point. Cost is due to (a) lost time in subsequent stages of maufacture (b) work done on a product which is already defective.

(11) Engineering cost studies are made to suggest cost savings by analysis of reports of defective work.

(12) Operators are paid on total output based on bonus and daily work.

(13) Savings in Quality Control costs are achieved due to reduction in theamount of inspection.

APPENDIX 19 - FACTORY S

General Information:

(1) Electrical Engineering industry
(2) The company was established in 1916. It is a nationalised industry.
(3) The total number of employees in the factory is one thousand two hundred.
(4) Labour is mostly semi-skilled.
(5) The sex of labour force is approximately equal.
(6) Financial incentives apply to most of the labour.
(7) Products are supplied totally to government agencies.
(8) Final consumers always recognise the company products.

Head of Quality information:

(1) He is known as Quality Engineer.
(2) He has been in the company for forty years.
(3) Age - fifty years.
(4) He is not a chartered Engineer, but completed H.N.C in part-time education and also completed trade and formal apprenticeship.
(5) His gross salary - £3600/year.
(6) His experiences in various function:
    (a) Shop floor - fifteen years,
    (b) Line management - twenty-two years,
    (c) Present job - three years.
(7) He does not belong to any frofessional society.
(8) The total number of employees under his responsibilities is forty five. This includes forty employees who perform a direct inspection function.
(9) He is directly responsible to government agency.
(10) The valuable external source of Quality and Reliability information to him is attending courses and formal contact with other firms.

Organisation for Quality and Reliability:

(1) The system of inspection is recorded since 1966.

(2) Statistical Quality Control has been operated since 1966.

(3) Acceptance sampling is used on some items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a bad batch, records are kept by the the department and action is taken to ascertain the cause.

(5) Sampling plans are introduced since 1966.

(6) Types of schemes used:

(a) Sampling is worked based on DEF-131-A.

(b) The department operates one hundred different Acceptable Quality level (A.Q.L).

(c) A.Q.Ls are decided by laid down company policy.

(d) 90% of sampling plans are based on attribute (go - No go) sample and visual, the remaining 10% of sampling plans are based on measurement.

(e) The intensity of the sampling increased or decreased are based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Control is used on particular items.

(7) The department performs Quality function completely for test and inspection specification, partially for product and process specification.

(8) Use of Operator:

Operator performs neither sampling nor inspection function.

(9) Use of Patrol inspection:

Patrol inspector check samples, he gauges and measures samples.

(10) Control charts for attributes are mostly used.

(11) Recording Quality information:

Percentage defective, percentage returned, percentage rectified and percentage scrapped are not recorded on a periodic basis.

(12) In final inspection, products are only checked on samples, mainly on all characteristics, since 100% inspection is carried out before final inspection.

(13) The department performs formal schemes completely related Quality Audit or Quality Assurance and Quality instruction partially related to training inspectors and testers, process capability studies and certification by external authorities. The department does not operates schemes related to Vendor rating, Warranty payment analysis, scrap and rework costing, Environmental Engineering and customer panels.

(14) Inspection and Quality Control are separated.

(15) There is a separate reliability activity.

(16) The company deals directly with government contract.

(17) There is a resident government inspection staff.

(18) The company never performs a specific Quality and Reliability programme.

(19) The department does not employ consultant.

(20) The Best selling product has remained virtually unchanged for five years.

(21) The Best product's characteristic is value for money.

(22) The percentage of material bought out is 45%.

(23) The top five problems of the department related to Quality field are:

(a) General management,

(b) Training and education,

(c) Selection of staff,

(d) communication,

(e) Classification of specification.

Responsibilities for Quality and Reliability:

(1) The departmental Head reports to the government fortnightly.

(2) The department provides the written report to top executive as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) Quality department has responsibilities of inspection to ensure that the specified standard is maintained in each case and reporting deviation from the Quality standard.

(5) Engineering department has responsibility of specifying the standard of Quality required and Production department has responsibility of provision of adequate testing equipment and correcting deviations from Qualtity standard.

(6) Training and education in Quality Control methods of supervision, inspection staff and production operators is solely in the hand of Quality Engineer.
(7) Production gauges are checked in their own standard room.
(8) Production and sales department have close co-operation in setting standard and maintaining standard.
(9) The Statistical Quality Control applies to jobbing work as well as long production runs.
(10) Rejected batches are inspected by inspection department.
(11) Rejected raw materials are replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality in various stages and condition was not being recorded in the factory.
(2) Quality Control costs are not dealt with as an overhead on production costs.
(3) Cost of Quality Charting is not estimated.
(4) The improvement of Quality was resulted in more efficient utilisation of the equipment in subsequent processes.
(5) The cost of Quality Control is recovered through cost savings.
(6) Acceptance sampling plans are based on cost consideration.
(7) The assessment makes allowance for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.
(8) Engineering cost studies are made to suggest cost savings by comparison with competitors' products and by analysis of reports of defective work.
(9) Operators are paid for producing good work only.
(10) Savings in Quality Control costs are achieved due to reduction in the amount of inspection.

APPENDIX 20 - FACTORY T

General Information:

(1) Metal goods industry.
(2) The company was established in 1924.
(3) The total number of employees in the factory is about eight hundred.
(4) Labour is mostly semi-skilled.
(5) The sex of labour are mostly female labour.
(6) No financial incentives are applied to the labour.
(7) Products are supplied directly topublic, own agents and other firms.
(8) Final consumers can easily recongnise the company's products.

Head of Quality and Information:

(1) He is known as Quality Manager.
(2) He has been in the company for seventeen years.
(3) Age - thirty six years.
(4) He is not a chartered Engineer, but completed G.C.E 'A' level in full-time education and also completed commercial and informal apprenticeship.
(5) His gross salary - £2800/year.
(6) His experiences in various function:
    (a) Commercial sale - seven years,
    (b) Production service production - four years,
    (c) Present job - six years.
(7) He is a member of Institute of Packaging.
(8) The total number of employees under his responsibilities is twenty. This includes seventeen employees who perform a direct inspection function.
(9) He is directly responsible to company Quality Manager and factory general Manager.
(10) The two most valuable external sources of Quality Information to him is formal and informal contact with other firms.

Organisation for Quality:

(1) System of inspection is recorded since 1957.
(2) Statistical Quality Control system is operated since 1962.
(3) On in-coming products, acceptance sampling is used on all items.

(4) Nature of product Quality inspected:
   (a) Quality level fluctuates,
   (b) Whenever, there is a very bad batch, action is taken to ascertain the cause.
(5) Sampling plans are introduced since 1962.
(6) Types of schemes used:
   (a) Sampling plan is worked based on the combination of DEF-131-A and company own scheme.
   (b) The department operates four different Acceptable Quality Levels (A.Q.L).
   (c) A.Q.Ls are decided by laid down company policy.
   (d) Sampling plans are 75% based on attribute (go - No go) sampling and 25% are based on measurements.
   (e) The intensity of sampling increased or decreased are based on the results of previous samples.
   (f) Sampling is done from a continuous process.
   (g) Sampling plans are used to decide whether a process should be allowed to commence running.
   (h) On an in-process basis, Statistical Quality Control is used on particular item.
(7) The department performs Quality function completely for product and test and inspection, specification, but for the process specification is not performed.
(8) Operator does not perform any function in Quality.
(9) Use of Patrol inspector:
   Patrol viewer checks the samples on periodic basis, measures and gauges the samples and plots charts for average and range and percentage defective.
(10) The department uses Control Chart for attributes and variable as well as cumulative sum charts and 25% are on variables.
(11) Recording Quality information:
   Percentage defective, percentage returned, percentage rectified, and percentage scrapped are recorded on a periodic basis.
(12) In final inspection, products are checked on sample, mainly on all characteristics.
(13) The department operates formal schemes completely related to

training inspectors and tester and scrap and rework costing partially related to Quality audit or Quality Assurance, Quality instruction manual, vendor rating, process capabilities studies, Environmental Engineering, certification by external authorities and customer panels does not operates warranty payments analysis.

(14) Inspection and Quality Control are separated.

(15) There is no separate reliability activity.

(16) The company deals directly with government contract.

(17) There is no resident government inspection staff.

(18) The department had run a specific Quality Reliability year programme.

(19) The department does not employ consultant on Quality problem but always discuss and consults the Quality problem within the company group.

(20) The Best selling product, has remained virtually unchanged for two years.

(21) The Best two products' characteristic is its appearance.

(22) The percentage of material bought out is 60%.

(23) The top five problems of the department related to Quality field are:

(a) Decoration of tin plate,

(b) Variability of materials,

(c) Bought out component,

(d) Handling,

(e) Bad storage.

Responsibilities of Quality:

(1) The departmental Head reports constantly to company Quality Manager and factory general Manager.

(2) The department provides the written report to top executives as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) The department has the overall responsibility for the inspection function and reporting the deviation from the Quality standard.

(5) The production department is responsible for the correcting deviation from Quality standard.

(6) The company has its own training school and uses outside facilities when required.

(7) Production gauges are checked in their own tool room.
(8) Production, design, sales department and customers have close co-operation in setting standards and maintaining standard.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) Rejected batches are inspected by department.
(11) Rejected raw material is replaced by supplier.

Economics of Quality:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and 100% check viewing and cost of selling of good products in a lower grade.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) The cost of control charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.
(5) The improvement of Quality, was resulted from more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) There are examples of cost savings through widening drawing tolerances which were previously unnecessarily tight.
(8) The cost savings are due to technical action based on Control Charts
(9) The cost of Quality Control is recovered through cost savings.
(10) Acceptance sampling plans are based on cost consdieration.
(11) Engineering cost studies are made to suggest cost saving by analysis of reports of defective work.
(12) Operators are paid on daily work basis.
(13) Savings in Quality Control costs is achieved due to reduction in the amount of inspection, emample: the line inspections are replaced by patrol inspector.
(14) Products are not official guaranteed.

APPENDIX 21 - FACTORY U

General Information:

(1) Metal goods industry.
(2) The company was established in 1924.
(3) The total number of employees in the factory is about five hundred.
(4) Labour is mostly skilled.
(5) The sex of labour is mostly male.
(6) No financial incentive is applied to the labour.
(7) Products are mainly supplied to other firms.
(8) Final consumers are mainly not recognise the company's products.

Head of Quality information:

(1) He is known as Quality Controller.
(2) He has been in the company for fifteen years.
(3) Age - thirty two years.
(4) He is not a Chartered Engineer but complete trade and informal apprenticeship.
(5) His gross salary - £2500/year.
(6) His experience in various functions:
    (a) Shop floor - three years,
    (b) Quality Control and inspection - twelve years,
    (c) Present job - one year.
(7) He does not belong to any professional society.
(8) The total number of employees under his responsibilities is fifty. This includes forty seven employees who perform a direct inspection function.
(9) He is directly responsible to company Quality Manager and factory Manager.
(10) The two most valuable external sources of Quality information to him are informal contact with other firms and attending course.

Organisation of Quality:

(1) System of inspection is recorded since 1957.
(2) Statistical Quality Control system is operated since 1962.

(3) Acceptance sample plans are not used for Incoming Products, since it is supplied from the company group factory.

(4) Nature of Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by department and action is taken to ascertain the cause. Products are 100% inspected by recovering department.

(5) Sampling plans are introduced in 1962.

(6) Types of schemes used:

(a) Sampling plans are worked based on DEF-131-A.

(b) The department operates three different Acceptable Quality Levels (A.Q.L).

(c) A.Q.Ls are decided by laid down company policy depending on the past experience of the expected level of defects.

(d) Sampling plans are based on attribute (go - No go) sampling , measurement as well as visual.

(e) The intensity of the sampling increased or decreased are based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, statistical Quality Control is used as a general policy.

(7) The department performs Quality function completely related to test and inspection specifications and partially related to product and process specifications.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He gauges and measures products.

(9) Use of Patrol inspector:
Patrol inspector carries out hourly checks on samples, gauges and measures samples and plots them on to the Control Chart for average and range.

(10) Control Charts for variables and cumulative sum charts are mainly used.

(11) Recording Quality information:

Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly on all characteristics.

(13) The department operates formal schemes completely related to Quality Audit or Quality Assurance, Quality instruction manual, training inspectors and testers, scrap and rework costing, partially related to vendor rating, process capability studies, Environmental Engineering, certification by external authorities and customer panels, but not operated warranty payments analysis.

(14) Inspection and Quality Control are separated.

(15) There is no separate reliability activity.

(16) The company deals directly with government contracts.

(17) There is no resident government inspection staff.

(18) The company had runa specific Quality and Reliability year programme.

(19) The department does not use consultants, frequently they discuss and consults each other within company group.

(20) The best selling product has remained virtually unchanged for over twenty years.

(21) The Best product's characteristics is reliability.

(22) The percentage of material bought out is 85%.

(23) The top five problem of department related to Quality field are:

(a) Varying consumer standard,

(b) Classification of visual defect,

(c) Classification of Quality by the production department,

(d) Second hand information from the consumer.

(e) Variability of raw material Quality.

Responsibilities for Quality:

(1) The departmental Head reports to company Quality Manager and factory Manager constantly.

(2) The department provides the written report to top executives as well as shop supervisors.

(3) The section is responsible for the identification of faults.

(4) The department has the responsibility for the inspection function and reporting the deviation from the Quality standard.
(5) The Production department is responsible for correcting the deviation from Quality standard.
(6) The company has its own training school and uses outside facilities when required.
(7) Production gauges are checked in their own tool room.
(8) Production, design and sales departments and customers have close co-operation in setting up standards and maintaining standards.
(9) Statistical Quality Control is only applied to long production runs.
(10) The rejected batches are inspected by recovering department.
(11) The rejected raw materials are sent back to company group factory where the raw material is for rectified or scrapped.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and 100% check viewing and cost of selling a good product in lower grade.
(2) Quality department has its individual budgets, which is laid down by the company Quality group and final estimated by the manufacturing Manager for the maximium cost which Quality has.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.
(5) The improvement of Quality was resulted from more efficient utilisation of the equipment in subsequent processes.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the eliminati on of unnecessary precision.
(7) The cost saving is due to technical action based on Control Charts and the psychological impact of the charts.
(8) The cost of Quality Control is recovered through cost savings.

(9) Acceptance sampling plans are not based on cost consideration.

(10) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product shich is already defective (c) damage to user (machinery, tools and personal injury etc.,)

(11) Engineering cost studies are made to suggest cost savings by comparison with competitor's products.

(12) Operators are paid on daily work basis.

(13) Savings in Quality Control costs is achieved due to reduction in the amount of inspection.

APPENDIX 22 - FACTORY V

General Information:

(1) Textile industry.
(2) The company was established in 1890.
(3) The total number of employees in the factory is about one hundred.
(4) Labour is mostly semi-skilled.
(5) The sex of labour is mostly male.
(6) Financial incentives are applied to most of the labour.
(7) Products are mainly supplied to another firms.
(8) Final consumers always recognise the company's products.

Head of Quality information:

(1) A senior man who responsible for Quality in the department known as Technical Manager.
(2) He has been in the company for six years.
(3) Age - thirty two years old.
(4) He is not a chartered Engineer but holds a Ph.D degree in physics and also completed postgraduate and formal apprenticeship.
(5) His gross salay - £2800/year.
(6) His experiences in various functions:
    (a) Line management - three years,
    (b) Present job - three years.
(7) He does not belong to any professional society.
(8) The total number of employees under his responsibility is twenty five. Only nine of the employees perform direct inspection function.
(9) He is directly responsible to factory work Manager.
(10) The two most valuable external source of Quality information to him is formal and informal contact with other firms.

Organisation for Quality:

(1) The system of inspection is recorded since 1966.
(2) Statistical Quality Control is operated since 1966.
(3) Acceptance sampling is used on some items for Incoming Product.
(4) Nature of product inspected:
    (a) Quality level fluctuates,

(b) Whenever there is a very bad batch, records are kept by Technical Manager and action is taken to ascertain the cause.

(5) Sampling plans are introduced since 1966.

(6) Types of schemes used:

(a) Sampling plan is carried out under company own scheme.

(b) The department only operates one Acceptable Quality Level (A.Q.L).

(c) A.Q.L is decided by laid down company policy.

(d) Sampling plans are based on attribute (go - No go) sampling as well as measurements.

(e) The intensity of sampling is not based on the results of previous samples.

(f) Sampling is done from a continuous process.

(g) Sampling plan does not decide whether a process should be allowed to commence running.

(h) On an in-process basis, the Statistical Quality Control is not applied.

(7) The department performs Quality function partially related to product, process and test and inspection specification.

(8) Use of Operator:
Operator does not check the product.

(9) Use of Patrol inspector:
Patrol inspector checks samples of theproduction on ramdom. He also gauges and measures samples.

(10) Cumulative sum charts are mainly used.

(11) Recording Quality information:
percentage defective, percentage returned, percentage rectified, and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly on all characteristic.

(13) The department operates formal scheme partially related to Quality Audit Quality Assurance, Quality instruction manual, vendor rating, training inspectors and testers, Warranty payment analysis, scrap and rework costly, certification by external authorities and customer panels. The department does not operates scheme related to process capability studies and Environmental Engineering.

(14) Inspection and Quality Control are separated.
(15) There is no separate reliability activity.
(16) The company does not deal directly with government contract.
(17) There is no resident government inspection staff.
(18) The department never ran a specific Quality and Reliability year programme.
(19) The department never uses consultant on Quality problems.
(20) The Best selling product has remained virtually unchanged for two years.
(21) The Best product's characteristic is value for money.
(22) The percentage of material bought out is 50%.
(23) The top five problems of the department related to Quality field are:
    (a) Raw material,
    (b) Process,
    (c) Labour force,
    (d) Precision plastic moulding,
    (e) Training supervision in Quality.

Responsibilities for Quality:

(1) The Technical Manager reports constantly to the work Manager regarding the problem related to Quality field.
(2) The department provides the written report to top executives as well as shop supervisors.
(3) The department is responcible for the identification of faults.
(4) Technical Manager has the overall responsible for the inspection function and reporting deviation from the Quality standard.
(5) The production department is responsible for correcting the deviation from Quality standard.
(6) Training and education in Quality Control methods for supervision, inspection staff and production operator are solely in the hand of Technical Manager.
(7) Production gauges are checked in their own standard room.
(8) Production, design and sales departments and customers have close co-operation in setting standard and maintaining standard.
(9) Statistical Quality Control applies only to long production runs.
(10) The rejected batches are inspected by inspection department.
(11) The rejected raw materials are replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to defective tooling, loss of output due to machine out of commission and loss of output due to the raw material.

(2) Quality Control Costs are dealt with as an overhead on production costs.

(3) Cost of Control Charting is not estimated.

(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is reduced.

(5) The improvement of Quality was resulted in more efficient utilisation of the equipment in subsequent processes.

(6) Saving is achieved due to the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.

(7) The cost of Quality Control is recovered through cost saving.

(8) Acceptance sampling plans are based on cost consideration.

(9) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) loss time in subsequent stages of manufacture (b) work done on a product which is already defective (c) damage to user(machinery, tools and personal injury).

(10) Engineering cost studies are made to suggest cost saving by analysis of reports of defective work.

(11) Operators are paid on total output based on bonus scheme and daily work.

(12) Savings in Quality Control costs are achieved due to reduction in the amount of inspection.

APPENDIX 23 - FACTORY W

General Information:

(1) Textiles industry.
(2) The company was established in 1880.
(3) The total number of employees in the factory is approximately fifteen thousand.
(4) Labour are mostly semi-skilled.
(5) The sex of labour is mostly female.
(6) Financial incentives are applied to most of the labour.
(7) Products are mainly supplied to own agents.
(8) Final consumers always recognise the company's products.

Head of Quality and Reliability information:

(1) He is known as Quality Manager.
(2) He has been in the company for twenty two and a half years.
(3) Age - forty four years old.
(4) He is not a Chartered Engineer but holds a B.Sc. degree.
(5) His gross salary is £3600 per year.
(6) His experiences in various functions:
    (a) Production service function - ten years,
    (b) Customer service - ten years,
    (c) Present job - two and half years.
(7) He is a member of Institute of textile.
(8) The total number of employees under his responsibilities is four hundred and fifty. This includes of four hundred who perform a direct inspection function.
(9) He is directly responsible to Technical Director and Managing Director.
(10) The two most valuable external sources of Quality information to him is attending course and informal contact with other firms.

Organisation for Quality and Reliability:

(1) The system of inspection is recorded since 1952.
(2) Statistical Quality Control system is operated since 1957.

(3) Acceptance sampling is used on some items for Incoming Product.

(4) Nature of Product Quality inspected:

(a) Quality level fluctuates.

(b) Whenever there is a very bad batch, records are kept by the department. Products are usually supplied to substandard market.

(5) Sampling plans are introduced since 1957.

(6) Types of schemes used:

(a) Sampling plans are carried out under company own schemes.

(b) Department operates two different Acceptable Quality Levels (A.Q.L).

(c) A.Q.Ls are decided upon the type of the market required.

(d) All sampling plans are based on measurements.

(e) The intensity of the sampling increased or decreased is based on the results of previous samples.

(f) Sampling is done from a continuous process on a periodic basis.

(g) Sampling plans are used to decide whether a process should be allowed to commence running.

(h) On an in-process basis, Statistical Quality Controls are used on particular items.

(7) The department performs Quality function partially related to product, process and test and inspection specification.

(8) Use of Operator:

(a) Operator carries out routine sampling.

(b) He checks samples by visual and records number of faults.

(9) Use of Patrol inspector:

Patrol inspector checks samples and also checks the condition of the machine. He also gauges the samples.

(10) Control Charts for variable are mainly used in the department.

(11) Recording Quality information:

Percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly on all characteristics.

(13) The department operates formal schemes completely related to Quality instruction manual, training testers and inspectors Warranty payment analysis, scrap and rework costing, Environment Engineering and partially related to Quality Audit or Quality Assurance, process capability studies, certification by external authorities and customers panels but does not operate scheme related to vendor rating.

(14) Inspection and Quality Control are not separated.

(15) There is no separate reliability activity.

(16) The company does not deal directly with government contract.

(17) There is no resident government inspection staff.

(18) The company never runs a specific Quality and Reliability year programme.

(19) The department does not employ consultant.

(20) The Best selling product has remained virtually unchanged for two years.

(21) The Best product's characteristics is fashion.

(22) The percentage of material bought out is 45%.

(23) The top five problem of the department related to Quality field are:

(a) Communications in standard,

(b) Operative job attitude,

(c) Visual standards,

(d) Warranty payments' analysis,

(e) Bought-out materials.

Responsibilities for Quality:

(1) The departmental Head reports to the Managing Director and Technical Director constantly.

(2) The department provides the written report to top executives only.

(3) The department is responsible for the identification of faults.

(4) The department has the overall responsibility for the inspection function and reporting deviation from the Quality standard.

(5) The Production department is responsible for correcting the deviation from Quality standard.

(6) Training and education in Quality Control methods of supervision, inspection staff and production operation is solely in the hand of Production Manager.
(7) Production guages are checked by production department.
(8) Production, design and sale departments and customers have 100% co-operation in setting standards and maintaining standards.
(9) Statistical Quality Control applies to jobbing work as well as long production runs.
(10) The rejected batched are inspected by production department.
(11) The rejected goods are supplied to substandard market, rejected raw material is replaced by supplier.

Economics of Quality Control:

(1) Cost of poor Quality was recorded at scrap at semi-finished stage, scrap at final assembly, loss of output due to machine out of commission, loss of output due to defective raw material, rectification and cost of selling a good product in a lower grade.
(2) Quality Control costs are dealt with as an overhead on production costs.
(3) The cost of Control Charting is not estimated.
(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is remained the same without reduced.
(5) The improvement of Quality, resulted in more efficient utilisation of the equipment in subsequent process.
(6) Saving is achieved through the correct matching up of processes and drawing tolerances and the elimination of unnecessary precision.
(7) There are instances of the application of Control Charts to weighing processes and also balance struck between the cost of the amount given away and the loss through giving too little.
(8) There are examples of cost savings through widening drawing tolerances which were previously unnecessary tight.
(9) Cost savings are due to technical action based on Control Charts as well as the psychological impact of the charts.

(10) The cost of Quality Control is not recovered through cost savings.

(11) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture(b) work done on a product which is already defective.

(12) Engineering cost studies are made to suggest cost savings by comparison with competitors ' products and by analysis of reports of defective work.

(13) Operators are paid on a bonus based on the percentage of good work produced.

(14) Savings in Quality Control costs are achieved through the reduction in the amount of inspection.

APPENDIX 24 - FACTORY X

General information:

(1) Paper industry
(2) The company was established in 1880.
(3) The total number of employees in the factory is four hundred.
(4) The labour forces are mostly semi-skilled.
(5) The sex of labour is mostly male.
(6) Financial incentives are applied to proportional half of the labour.
(7) Products are mainly supplied to other firms.
(8) Final consumers always recognise the company's products.

Head of Quality information:

(1) The inspection function of the product in the factory i.e. process control is responsible by Production supervisor and raw materials are responsible by the stock controller in the laboratory.
(2) The production supervisor has been in the company for twenty years.
(3) Age - forty six years old.
(4) He is not a Chartered Engineer, he completed commercial and formal apprenticeship.
(5) His gross salary - £2400/year.
(6) His experiences in various functions:
    (a) Shop floor - six years,
    (b) Line management - five years,
    (c) Production quality control - fourteen years,
    (d) Production service function - five years,
    (e) Production service function and Quality control - three years.
(7) He does not belong to any professional society.
(8) The total number of employees under his responsibilities is fourteen. All these employees carry out direct inspection function.
(9) He is directly responsible to factory work Manager.
(10) The two most valuable external sources of Quality information to him is attending courses and informal contact with other firms.

Organisation for Quality:

(1) The system of inspection has been recorded since 1953.
(2) Statistical Quality Control is operated since 1960.
(3) Acceptance sampling is used on some items for Incoming Product.
(4) Nature of Quality product inspected:
    (a) Quality level fluctuates.
    (b) Whenever there is a very bad batch, records are kept and sent to stock controller and products are sent to laboratory for chemical analysis and test to find out the faults.
(5) Sampling plans are introduced in 1960.
(6) Types of schemes used:
    (a) Sampling plan is carried out under a combination of company own schemes and DEF-131-A.
    (b) The department operates only one Acceptable Quality Level (A.Q.L).
    (c) A.Q.L is decided by the combination of laid down company policy and from past experience of the expected level of defects.
    (d) Sampling plans are based on attribute (go - No go) sampling as well as measurements.
    (e) The intensity of sampling increased or decreased is based on the results of previous samples.
    (f) Sampling is done from a continuous process.
    (g) Sampling plan decides whether a process should be allowed to commence running.
    (h) On an in-process basis, Quality Control is used on particular item.
(7) The department performs Quality function partially for product, process and test and inspection specification.
(8) Use of Operator:
    (a) Operator carries out routine or haphazard sampling.
    (b) He gauges the samples.
(9) No patrol inspector is used. Instead production foreman carries out periodic checking on products.
(10) Control Charts for variables are mostly used.

(11) Recording Quality information:
percentage defective, percentage returned, percentage rectified and percentage scrapped are recorded on a periodic basis.

(12) In final inspection, products are checked on sample, mainly for fit and function.

(13) The department operates formal schemes partially related to Quality Audit or Quality Assurance, Quality instruction manual, vendor rating, scrap and rework costing, certification by external authorities and customer panels. The department does not operate schemes related to training inspector and testor, Warranty payment analysis, process capability studies and Environmental Engineering.

(14) Inspection and Quality Control are separated.

(15) There is a separate reliability activity.

(16) Company does not deal with government contract.

(17) There is no resident government inspection staff.

(18) The company never performs any specific Quality and Reliability year programme.

(19) The department employs consultants on Quality problems.

(20) The Best selling product has remained virtually unchanged for over twenty years.

(21) The Best Product's characteristics is value for money .

(22) The percentage of material bought out is 70%.

(23) The top five problems of the department related to Quality field are:
(a) Material bought out,
(b) On a process,
(c) Skill of labour,
(d) correct application of process,
(e) Tool failure.

Responsibilities for Quality:

(1) The production supervisor reports to work Manager constantly regarding the Quality problems.

(2) The department only provides written reports to top executive.

(3) The department is responsible for the identification of faults.

(4) All standards of Quality required is specified by customer.

(5) Production department has the overall responsibility of inspection

function, reporting the deviations from the Quality standard, and correcting the deviations from the Quality standard.

(6) Training and education in Quality Control methods of supervision, inspection staff and production operators are solely in the hand of training officer.

(7) Production gauges are checked outside external agency.

(8) Production, design and sales departments and customers have 100% co-operation in setting standards and maintaining standard.

(9) Statistical Quality Control applies to jobbing work as well as long production runs.

(10) Rejected batches are inspected by production department.

(11) Rejected raw materials are replaced by supplier for rejected products are sold at reduce rate or diverted to other job.

Economics of Quality:

(1) Cost of poor Quality are recorded by production department at scrap at semi-finished stage, scrap at final stage, loss of output due to defective tooling, loss of output due to machine out of commission,loss of output due to defective raw material, rectification, 100% check viewing and cost of selling a good product in a lower grade.

(2) Quality Control costs are dealt with as an overhead on production costs.

(3) The cost of Control Charting is not estimated.

(4) During the period in which Quality Control has been operating, the cost of poor Quality as listed in (1) is not being reduced.

(5) The improvement of Quality was resulted in more efficient utilisation of the equipment in subsequent process.

(6) Saving is achieved due to the correct matching up of processes and drawing tolerance and the elimination of unnecessary precision.

(7) The cost savings are due to the technical action based on Quality Chart.

(8) The cost of Quality Control is not recovered through cost savings.

(9) Acceptance sampling plans are not based on cost consideration.

(10) The assessment makes allowances for allowing a defective item to pass through each inspection point. Cost is due to (a) lost time in subsequent stages of manufacture (b) work done on a product which is already defective.

(11) Engineering cost studies are made to suggest cost savings by comparison with competitor's products and analysis of reports of defective work.

(12) Operators are paid for producing good work only.

(13) Savings in Quality Control costs is achieved due to the reduction in the amount of inspection.