

## INSPECTION AS AN AID TO PRODUCTION

### OPENING REMARKS.

#### INTERCHANGEABLE MANUFACTURE: (Requirements of, etc.)

In the first instance I would like to make mention of the desirability in so far as is possible, of enquiring into interchangeability of manufactured parts.

Let us consider such every day articles as the motor car or the sewing machine. In both cases we accept, and take more or less for granted, the fact that we can obtain parts which we can ourselves assemble to the mechanism without the need for skilled fitting or further machining.

To enable this condition to be arrived at, however, much skill and care has been employed in the manufacture of components in the shop to ensure that parts from one mechanism may be replaced or transferred to another similar mechanism without detriment to its functional capacity.

The advantages of such a method of manufacture are self-obvious and there is no need to discuss this at any length.

Economy is, however, as always, one of the major controlling factors in manufacture of any part or mechanism, and therefore it is not always advisable to attempt absolute interchangeability of all parts; but perhaps to be satisfied with producing units which may be interchanged.

The Measure of Success of any manufacturing process is of course in the ultimate functional service of the particular product to the user and the ease with which spares can be fitted. Viewed simply as a question of production, the problem of interchangeable manufacture must always be solved by establishing a balance between manufacturing and assembling costs, whether the production be in quantity or in small batches, and must include the service factor on the finished product.

-----  
By the use of modern Machine Tools etc. in the production of component parts and with the advanced techniques that are today accepted as normal practice, much of the skill which had to be employed by the old time



craftsman working as he did with it, has been taken out of the job, and whilst I do not belittle in any way modern practices or intend to cast aspersions upon present day operators, I think you will agree that it is easier to produce parts to within a few tenths today, than it used to be to produce to a few thou., which brings me to the point where I would like to state why Inspection is and can be, an aid to production.

It is comparatively easy with present day practices to remove material, by one or more of many means with various types of machines, but what is not so easy is in knowing when to stop, and it is in this connection that the shop inspection justifies its existence.

To my mind there are two vitally important tasks which inspection can fulfil and which justify inspection being maintained.

Firstly, to ensure that scrap or spoiled parts are eliminated as soon as possible to save the cost of further effort on unserviceable parts.

Secondly, to ensure that completed parts will fulfil their proper functional requirements.

### INSPECTION AND TESTING

Proper inspection is one of the most important, as well as one of the most difficult tasks in manufacturing. If it is carried out in too exacting a manner, it will retard production; if it is too lenient it will permit products to go out which are not entirely satisfactory.

We all know the type of inspector who keeps strictly to the drawing without any consideration whatsoever as to whether an odd tenth of a thou outside the drawing limit really matters and who, by so doing, causes parts to be scrapped unnecessarily.

On the other hand we know the type who, because he is not 100% up to his job or who possibly has a friend who is producing the component, is inclined to close his eyes to discrepancies which really do matter. Neither of these methods of inspection is right.



Correctly applied inspection principles will ensure that all requirements are met and will promote economical manufacture. With any system of inspection the tendency of the production department is to increase output and, unfortunately, a condition sometimes arises where the standard of work produced becomes anything that will pass the inspector.

Sometimes, too, a position arises where the production department, seeking the line of least resistance, consider only detailed manufacturing problems; and inspection either allow same or insist on exact drawing requirements without regard to the ultimate function of the product. Neither form of inspection is satisfactory.

#### POSITION OF INSPECTION DEPT.

The Inspection department may well be classed as the eyes of the engineering department, it is their proper function to control the quality of the various components parts and to ensure that so far as is humanly possible, the finished product leaves the works in a condition which fulfils all the requirements of the designer.

The duties of Inspection are not compatible with those of the production department and should not be combined, but close co-operation between the two is essential.

The aim of the production department is, of course, to produce more and more of the particular product at an ever decreasing cost, and if after many operations had been carried out on a particular part, it was suddenly found to be not quite right, it would take a very brave production engineer to decide to scrap the lot and start all over again. Rather I am inclined to think he would hope to salvage them by producing other parts to match.

This is one of the main reasons why the inspection department should not be responsible to production, but be responsible solely to either the Management or the Designer.

It should always be remembered, too, that Inspection is a preventative and not a cure for mistakes.



PERSONNEL OF INSPECTION DEPT.

The Chief Inspector should have complete control of all Inspection Departments, i.e. the shop or floor inspection, detail inspection and the final or Test Inspection and the Standards Room. He must, or should be, one of those rare humans who has an impartial and judicial mind. He must be fully acquainted with the products and in this respect liaison both with design and production departments is important, and should be able to exercise his discretion at all times.

Detail inspection of components can usually be carried out quite satisfactorily, and with the aid of suitable gauges, by persons who have little mechanical knowledge - in many cases this is done by girls; after all what is generally required in this instance is to know whether or not a particular operation has been performed to produce something within an agreed tolerance.

The person in charge of the detail inspection should, however, be fully qualified and under the jurisdiction of the Chief Inspector, be able to use his own initiative.

The person in charge of the shop as floor inspector has, perhaps, one of the most difficult of inspection duties. Part of his work in assisting the promotion of economical production is to prevent faulty parts being made, and the set-up and 'first off' of any particular operation on all parts should be very closely checked to ensure that it is well within the tolerance zone before a production run is commenced.

To do so requires the closest co-operation between the inspector and shop personnel, such as the setter or foreman, if antagonism is to be avoided.

Drawing discrepancies and incomplete data should be noted by the inspection department and steps taken to ensure that such errors are corrected immediately by Drawing Office, before a production run is commenced.

Many a part drawing is, unfortunately, issued to the shop with conflicting tolerances laid down, or in some cases incorrectly toleranced so that personal interpretation can mean two entirely different conditions. (Typical instances shown on board).



## GAUGES AND GAUGING

May I now take a little more of your time to consider the question of gauging work.

In the past it has generally been customary for the machine operator to attempt to produce with the aid of limit gauges, and for the setter to employ his mics. verniers, calipers etc. in an endeavour to set-up for a production run and to produce parts which conform to requirements.

This has often given rise to controversy due in the main to what is, after all, a human element; the differences in 'feel' of the users of such tools as the micrometer-caliper; or to the fact that whilst the setter has had to rely on his micrometer etc. the inspection department have used comparators for measuring the same part.

In my humble opinion the time is long overdue, when the operators should be provided with a suitable form of comparator for checking his job and should not have to rely on limit gauges etc. By being enabled to know the exact size of any particular part, as you do by using comparators, much valuable information can be obtained which will prove a boon to the production department; as by analysis of results obtained such things as the ability of the machine to produce within certain limits; tool wear etc., can be determined and the manufacturing programme can be planned accordingly.

Where the type of production does not, for one reason or another, lend itself to the use of comparators in the shop, then it is all the more important for the inspection department to approve the first off, and not just by saying it is 'O.K.', but by giving the setter or operator precise information as to its size etc., do much to promote a run of good work.

In the detail inspection limit gauges can be used to a great extent, as at this stage it is usual only to satisfy oneself that parts are within a specific tolerance.

In the final inspection either functional gauging or in some mechanisms, examination of the completed job and a check on its satisfactory performance are the essentials.

The personnel of the final inspection or Test House as it is sometimes called, should have a thorough knowledge of the functional requirements of the completed product, and be absolutely familiar with all the requirements of design.

Besides the shop, detail and final inspection departments, the progressive company should also have a Standards Room.

This Standards Room should, as with all the other inspection departments come under the jurisdiction of the Chief Inspector, and its main function should lie in the controlling of all gauges and equipment used.

Limit gauges, as you are well aware, gentlemen, have a nasty habit of wearing out, and unless a rigid control of these gauges is instituted which entails periodic examination of them, a very unhappy condition arises where parts made to gauge will not mate with component parts.

Particularly is this noticed when two separate factories or separate parts of a works are producing parts which are complimentary to each other but which are made to separate gauges which have been subject to wear or abuse.

Briefly, gentlemen, worn gauges will allow incorrect work to go through, and a machine set-up is not usually altered if the work is still shown as 'O.K.' to gauge.

Proper control of all gauges by the Standards Room will forestall this trouble and prevent it, rather than have the otherwise expensive alternative of locating it after it has happened.

It is sometimes the practice to employ master or reference gauges as a standard by which to judge the condition of others; but I submit that this is a rather costly procedure and, providing the standards room is equipped with suitable measuring instruments, the set of slip gauges can be accepted standard of size for the whole works.



## QUALITY CONTROL

You may wonder, gentlemen, why during this talk to you I have not stressed statistical quality control as an aid to production. I have purposely refrained from making much mention of it because it is a subject which needs to be given a great deal of thought and time if it is to be properly employed, and has been covered by people better qualified than myself to talk about it.

Under the right conditions, quality control can and does render a wonderful service to the engineer, but to my mind it can only be successfully applied if quantity production is entailed and if the plant used is in first class condition.

With these stipulated conditions applied, quality control can be successfully instituted and in some cases mechanised inspection introduced which will greatly assist both the production and inspection departments.

I have already taken up a considerable amount of your time gentlemen, but if you can bear with me a little longer I would like to show, with the aid of lantern slides, some of the typical instruments of various types which are in general use throughout the industry and which, if properly applied, can greatly assist production.

In precision measurement there is no such thing as an absolute measurement and errors must always be present, depending on such variable factors as the suitability of the instrument for a particular purpose, on the inherent inaccuracy of the instrument and on such things as the temperature variation and ability of observer.

Even the N.P.L. in their reports or certificates validate their findings by stating an accuracy of determination of measurement.

From a careful consideration of requirements it is, however, usually possible to find a suitable instrument for a particular type of measurement and the slides I am about to show you do cover a fairly representative range which can be applied both to shop and inspection.

Each has its respective advantages and disadvantages which I will explain briefly as possible.

At this stage, slides are shown.