PASSING OUT TEST JOBS

BY

LIEUTENANT N. H. CARD, R.N.

HISTORY

Some fifty years ago the initial entry of Boy Artificers started to work upon the first Admiralty Passing Out Test Job, and it is a solemn thought that since then, well over a hundred tests have been set and thousands of candidates have, by this means, proved their ability to take their place in the Fleet as tradesmen and artificers. The job which tested the merits of this first class of boys was a radius link and block for a small reciprocating steam engine, and I am assured that it was made the hard way. Very little machining was allowed, and all the surplus metal had to be removed by means of a hammer and chisel and a file.

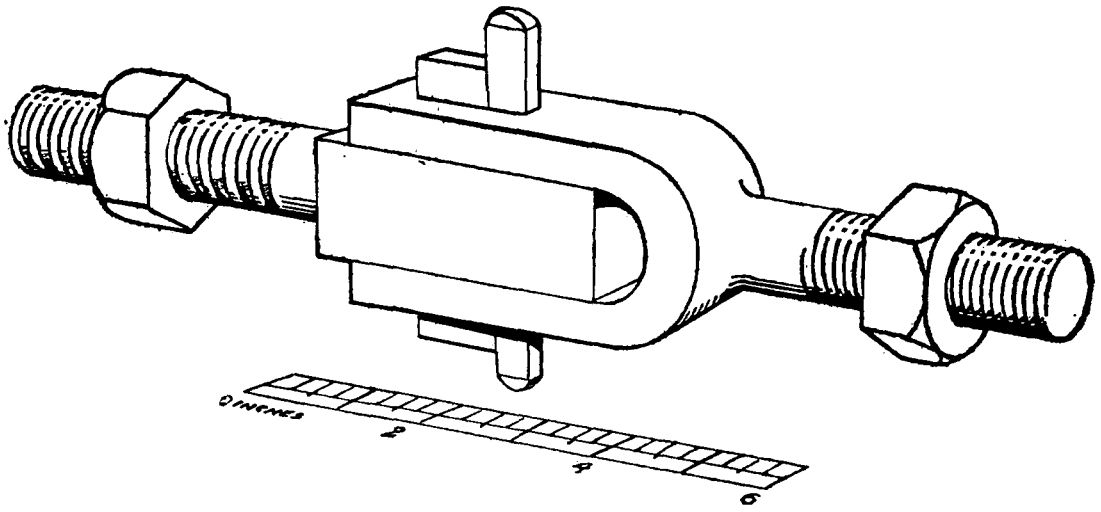
Soon after this, there appeared a test job for the fitters and turners which remained a standard until 1919 and a smaller edition is, to this day, used as a trade test for direct entry engine room and ordnance artificers. This job was known officially as the ' strap, block, gib and cotter ' and unofficially ' Jack's hard lump '. It is a pity that the name of the inventor of this ingenious work has been lost in the mists of antiquity, for what could have been more fitting than that a Division or Block at *Caledonia* should have been named after him.

During the period in which the ' strap and block ' was standard, the artificer apprentices (then known as boy artificers) were trained in two mechanical training establishments which rang the changes between the three Home Ports, *Fisgard* at Portsmouth, *Tenedos* at Chatham and *Indus* at Devonport. The rivalry between these establishments was deadly, and extended from the sports field to the work-bench ; nearly as much interest was taken in the passing out results as in the inter-port football matches. Each passing-out class tried to beat, not only its contemporary in the rival ship, but also the existing record for the job. The passing-out class almost had a period of physical training before starting the job and nothing was allowed to interfere with the marathon of the test. There was even a legend that the mess caterer helped in the struggle to pass out by arranging for the boys' diet to have a bias towards red meat during the test job period, and towards fish during the written examination.

Each boy had a carefully cherished set of lathe tools and a battery of chisels that he had made during his term at the outside trades and some of the luckier ones had acquired a short end of Mushet steel with which they hoped to clip off a few precious minutes during the roughing down stages.

The forgings for the job were produced locally and there were awful rumours that they were specially chilled for the job. This was probably untrue, but the casualties amongst the chisels and lathe tools were very heavy.

No machines other than drills and lathes were used and the allocation of the latter was awaited with some anxiety, for the lathes varied in age and efficiency. However, the idiosyncrasies of most of them were known and such playful habits as shedding a leading screw nut and throwing off the belt could be anticipated and remedied. Towards the end of the first World War, the training ships *Fisgard* and *Indus* acquired enough war-finished Lang variables to accommodate the passing out classes and the luck of the draw was not so much in evidence.



THE STRAP, BLOCK, GIB AND COTTER

Just before the beginning of the tests the passing-out class was issued with its sea kit. For some unknown reason this kit included a pair of duck trousers and these were used by the class as an unofficial working rig instead of the regulation overalls. Junior boys took very great care not to incommode in any way the white trousered *élite*. The time on the job was reduced to a fantastic figure, especially as its main part was sheer hard slog with the hammer and chisel. Fortunately, the casualties were few and bad cases of ' hammer rash ' were quickly cured by a liberal sprinkling of chalk.

About 1919 or 1920, there occurred many changes in the mechanical training establishments. The boy artificers were re-named artificer apprentices and the morning and afternoon pipes were changed from ' Boys to Work ' to ' Apprentices to Instruction '. A few engine room artificer apprentices were seconded to the much younger branch of ordnance artificer and later there also came electrical artificer apprentices.

But the most drastic change of all, the old ' strap and block ' was discarded and a new series of test jobs was introduced, these to be set in rotation.

The series consisted of the ' locomotive end ' (a variant of the strap and block) ; the ' claw coupling ' ; and the ' Diesel gudgeon end '. There was one other job in the series, but, as it was set only once, it was probably not very successful. The object of having a number of test jobs set in rotation was that the strap and block had become so familiar that the candidates had no need to think about it at all and it was hardly worth-while publishing the drawings. The method of tackling the job was traditional, and the sizes of the parts were known by heart. The sole remaining test was one of stamina. By having a variety of jobs the test of skill in producing to specification was brought into the picture again. There was a flashback in 1937, when one unfortunate class was set the strap and block under the old conditions with a standard time of 35 hours. To their great credit the class passed out successfully but, to this day, the survivors are rather apt to preen themselves on this accomplishment.

About this time the electrical artificers broke adrift and produced their own series of jobs more suited to their training.

While this series remained standard the competitive spirit between *Fisgard* and *Indus* was lessened, and in the early 'twenties a move was made to concentrate all the training in one establishment at Portsmouth. Apprentices were gradually drafted from *Indus* to *Fisgard* but the ' green and whites ' did not

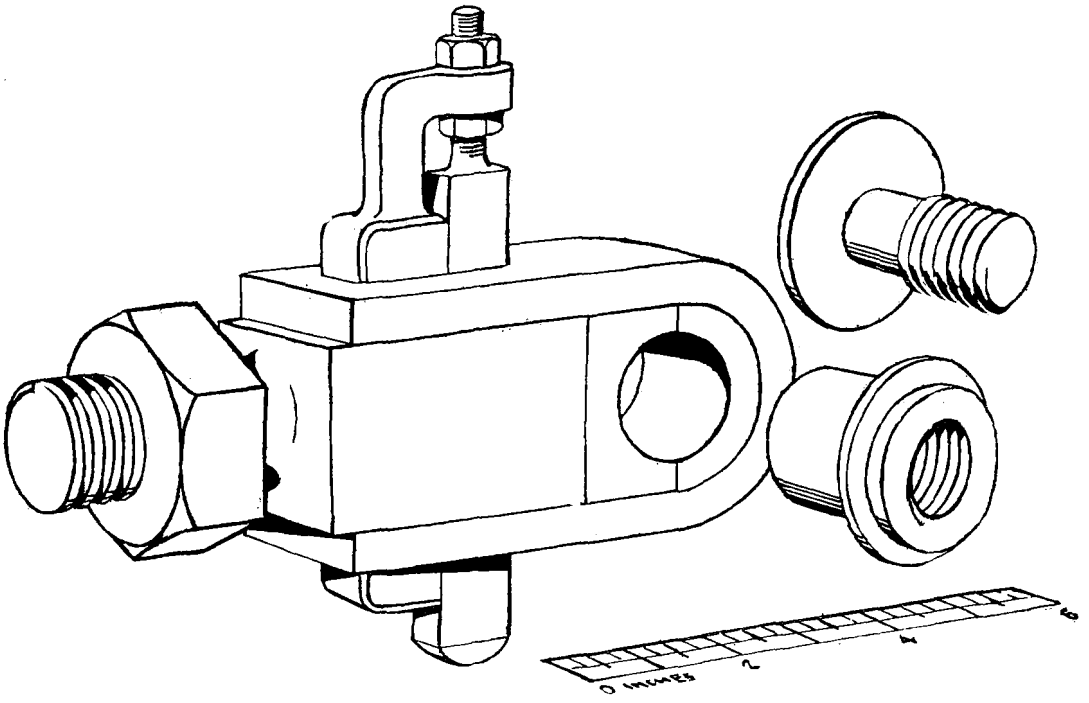
mingle very well with the ' black and whites ' in spite of the divisional system. However, the old rivalry eventually died when the M.T.E. forsook the sea and ships, and settled on dry land, first at Chatham and finally at Rosyth.

In 1947, another series of test jobs was started with the object of providing a pool of jobs of more interest and of more use to the candidates. Most of these jobs had a smaller edition for the ordnance artificers and for the electrical artificers who had re-entered the fold. There were no restrictions at all on the types of machines used, and the use of hand tools became old-fashioned and out-of-date. It is remarkable that, a short time before this, direct entry E.R.A. turners were being sent to a training school in London to acquire the use of hand tools, and the emphasis had been on the hammer and chisel.

All the jobs in this series had two bad faults. They had a large number of parts requiring elaborate castings or forgings, and they required special tools or machines. The production of the material became a major problem both of cost and quantity and the dockyard departments were called upon to produce some 900 items for the engine room apprentices and about 300 for the ordnance and electrical, each term. The use of special machines created bottle-necks and, as these jobs were fairly lengthy (100–120 hours), it was quite usual for the test job period to encroach on other parts of the passing-out programme. These bottle-necks were not always the fault of the design, for, on one occasion, an hours' work with a hacksaw and file was interpreted by the apprentices as a milling operation which required seven separate settings in the machine.

It had become the practice to publish the details of the marking scheme for each job with the specification and drawings. The marking schemes were based on a complicated sliding scale according to the importance of the part, with a limit to the number of marks which could be lost on each dimension. The apprentices were not long in appreciating the weakness of this system and turning it to their advantage. An extreme example of this playing to the marking scheme can be seen if the job is a square threaded spindle with the maximum penalties of 20 marks for the fit of the thread, 5 marks for the outside diameter of the thread, 5 marks for the length of the spindle, and 5 for a poor finish. The candidate tries the nut after tearing the first few threads and realizes that he will lose up to 30 marks for fit, diameter and finish, but by completing the thread carefully and chopping off the spindle half-an-inch short he need only lose 5 marks.

In 1951, it was decided to simplify the test jobs and collect a series of designs which would fit in with the new system of training and would meet the criticisms of the 1947 series. The electrical artificer apprentices were now trained at *Collingwood* and the need for two patterns of each job no longer existed as the engine room and ordnance artificers could do the same tests. As an interim measure a few experiments were tried and some valuable information was collected. For one class the test was set in two parts, one a test of fitting and the other a test of accurate turning. From the candidates' point of view this was a complete failure. The innovation of having the test in two parts completely unseated the apprentices and they started the job in a spirit of defeat. As the fitting job had been borrowed from the then current mechanicians test job series, it was rather a shock to get such bad results. Another tentative test was the ' locomotive end ' from the 1920 series. This was modified to allow more machining, and the time was extended from 90 to 100 hours. This also proved unsuccessful. From the results, it was clear that the apprentices were unable to sustain an ' all out ' effort for that length of time, and that, after 80 hours, both interest and effort seemed to flag.



THE LOCOMOTIVE END

ANALYSIS OF REQUIREMENT

This, then, was the position when a start was made on devising the 1952 standard series of test jobs. First it had to be established what constituted a ' suitable test job '. What were the tests required, and what were to be the standards and the conditions of marking ?

These requirements could be grouped under the following seven headings :—

(*a*) The candidate must be able to read a machine drawing and from it obtain an accurate idea of the job.

(*b*) A test of ' marking out '.

(*c*) A test of machining in a lathe to fine limits.

(*d*) A test of hand work to fine limits.

(*e*) A test of assembly or ' fitting together'.

(*f*) The time allowance should be such that the candidate has time to plan his job properly before starting, without a time penalty.

(*g*) The marking scheme should be standard and watertight, so that the human element in marking becomes eliminated as far as possible.

The Drawings

Although a tradesman should be able to make an accurate job from a fully dimensioned rough sketch, a drawing to B.E.S. specifications would help the candidate to appreciate the problems of the job and to plan his method of approach.

Marking Out

This is one of the most important features of the test and one which is the most easily circumvented. The most usual shapes, the square, the hexagon and so on, can, with a little ingenuity, be set up and machined in the lathe without the necessity of marking out. It is necessary then to design an unusual shape,

or to arrange that a common shape is made difficult to machine in a lathe and must be marked out. An example of this would be to design a hexagonal nut with a collar. The ability to ' mark out ' distinguishes between the tradesman and a mass production machine minder.

Machining

Accurate machining is a straightforward matter and can be met by incorporating a square thread in the design and also by having mating parts to fine limits. Here it may be pointed out that it is a waste of effort to design a screw thread other than standard. Most modern lathes have gear change boxes which set the correct chain of wheels, and, in any case, the problem of working out the wheel ratios is solved during the first stand-easy.

Hand Work

Most parts designed for hand work look as if they could be more easily machined and it is unrealistic to constrain the candidate to remove large amounts of surplus material by hand. The specification should, then, stipulate that this part should be ' hand finished '. It is usual for these parts to be those on which ' marking-out ' is necessary and the design should be such that base and centre lines can be readily picked up. The design should also ensure that the job can be held in a vice while being worked upon, without damage to parts previously machined. This point, however, is bound up with the candidate's own planning of the job.

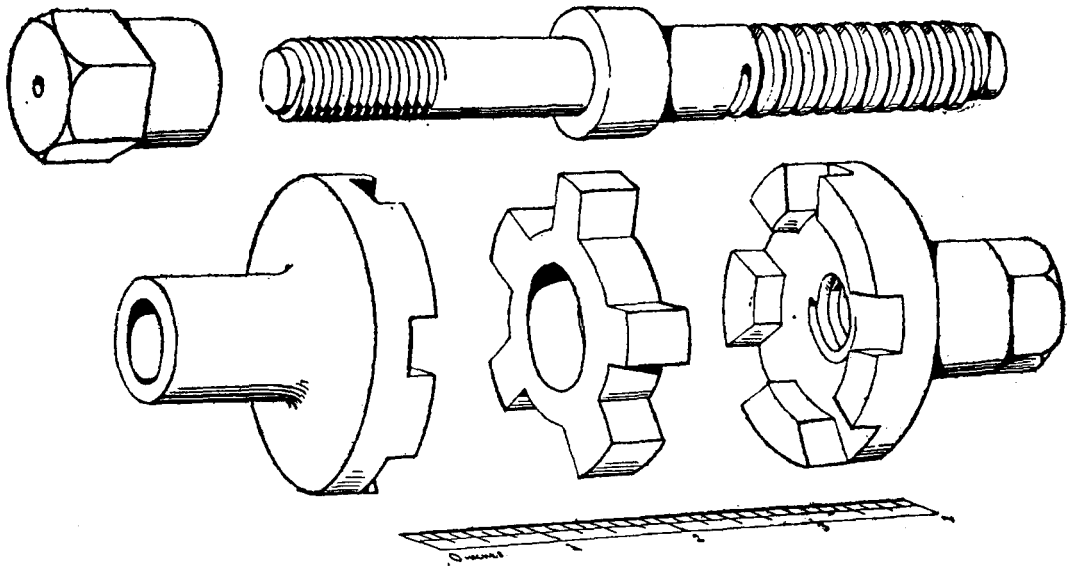
Assembly

The focal point of the whole job is its assembly. All jobs must have a ' function ' and a number of ' reverses ', but neither of these should cause the least suspicion of a ' chinese puzzle ' or trickery. Reverses are a test of accuracy of marking out and of symmetry, and by magnifying errors they give a good check on angles, which are otherwise difficult to test. It is unnecessary to have a large number of reverses for one pair of mating parts ; two at the most will usually show any inaccuracies, and any other reverses will result in penalizing the candidate more than once for the same error.

It is during this assembly that the candidate meets the test of ' diagnosis '. When the components of a job, otherwise apparently perfect, will not assemble or will not reverse, the candidate must be able to reason out the difficulty and to make the necessary adjustment without spoiling the job. The penalties for the renewal of spoiled parts should, therefore, be reduced to such a figure that the candidate is induced to renew a part found in error on assembly, and to take a pride in handing in a near-perfect job.

Time Allowance

The time factor is a controversial matter for there is a need for the slow, careful and accurate worker as well as for the rapid one and, of course, speed will come with experience and confidence. The number of hours that the job should take can be assessed by making a prototype and by ' time study '. The prototype is made under ideal conditions but there is no spirit of urgency, so that it is reasonable to expect that this time should be a fair prediction. Unfortunately, this is not always the case. Quite often a spirit of competition enters into the actual test and some hours are clipped off the standard time, while on other occasions the job seems to hang fire. In practice it is found that the modern apprentice is able to sustain the ' test job ' rate of work to a maximum of 80 hours. Beyond this time, his interest flags and the job just drifts along to a finish.



THE STAR COUPLING

The Marking Scheme

With one standard test job, there was no difficulty in assessing the results of different passing-out classes or between individuals of different classes. It is practically impossible to devise a number of jobs of equal difficulty and skill and a marking scheme is required which will reduce the final results of all the test jobs of a series to a common standard, and thus give equitable results whichever job is set. The common factors in all jobs are the dimensions, the fits, reverses and the time. All the dimensions shown on the drawings are toleranced and marks are deducted for inaccuracies beyond these limits. The fact that marks are deducted implies that the dimension has a ' value ' and this value can be found by working backwards from an inaccuracy which would be unacceptable and would lose all marks and be valued ' nil '. If deductions throughout the job are made at a standard rate of 1 mark per 0·001 error beyond the limits, the value for each dimension can be found.

For example :—	Dimension	: XX $\pm$ 0·003
	Value of dimension	: 7 marks
	Unacceptable	: XX $\pm$ 0·010

Each component is valued according to its total of marked dimensions and all marks can be lost either by one large error or by a number of smaller ones. No minus marks are carried over to another component.

By using a similar method for all components, and for the fits and reverses, the gross value for the job can be obtained. This gross value will vary with the number of components, etc., in the individual job of the series, but as the final marking is a percentage of ' marks obtained ' to the ' gross value ' there is a reasonable basis of comparison between the net result of each job throughout the series.

1952 STANDARD TEST JOBS

The general rules given above were used when designing the 1952 series of test jobs, and the majority of these, when tried out, gave an accurate picture of the ability and skill of the candidates.

There was one job, however, which was a mysterious failure. This particular job, although smaller and taking less time than the remainder, had a disproportionate number of victims to its discredit. The trouble appears to have been psychological, and it is hoped that, by writing a short note about it and by bringing it into the open, the hoodoo may be dispelled for ever.

The job was A.T.17, ' The Star Coupling ', and it consists essentially of a small brass star locked between two steel flanges and mating into them. As a change from the ubiquitous six of the hexagon, the star was designed with five points and this also gave the desired test in marking out. The trouble seemed to focus on the five points of the star which perhaps gave the candidates the feeling that they were being tricked—in any case, it was unusual, and so was viewed with some despair.

Fundamentally, the job was easy. Once the brass star had been made accurately, even if it meant a second try, the remainder was just plain straightforward fitting and turning. The trick, if trick it can be called, was that the insignificant little brass star was so important and needed all possible care in marking out. The results of this job, on the two occasions on which it formed the passing-out test, showed that sufficient thought had not been given to the planning of the job and that there was an inclination to follow the lead of the fastest candidate and, in the second attempt, even to follow the methods of the first class.

Allied Trades

It is hoped that a reasonable and logical method has been evolved for testing of the fitters and turners and ordnance artificers. But what of the boilermakers and the coppersmiths ? These have not been overlooked, but progress in getting together a series of tests has of necessity been slow. Some of the jobs now done by these trades in their tests are as old as the ' strap and block ' and, not only are the methods employed traditional, but unofficial ' aids ' have gradually become accepted as part of the test. The allied trades do their jobs piecemeal in order to test their ability in the various mysteries and arts of their craft, and the ideal would be to combine all these into one omnibus job. Even so, it might still be necessary to have separate jobs such as re-metalling bearings for the coppersmiths and rolling and belling boiler tubes for the boilermakers. The important thing to bear in mind is that the Navy does not want a dozen or so funnel hinges per annum, but that it does require the dozen artificers who are able to work quarter steel plate into any desired shape.

THE OBJECT OF THE DRILL

During the apprenticeship in *Fisgard* and *Caledonia*, the apprentices are trained under supervision and a careful record is kept of the ability and industry of each individual. At the end of the training period, it should be quite easy to assess and grade the apprentice on passing out, merely by co-ordinating the records. This being so, is it really necessary to go to all this general upset of designing, setting and marking the Passing-Out Admiralty Test Job ?

In my opinion the answer to this is, Yes. The test is invaluable from the point of view of self-reliance in the young artificer.

As a prospective artificer, still under training, he is bound to be a little uncertain of himself and his ability to measure up against his shipmates, when he eventually goes to sea. The passing-out job proves, not only to the Admiralty, but, more important, to himself, that he is capable and worthy of taking his place in the Fleet. It is human nature to value lightly that which has not been worked for and earned, and the effort required to jump the final hurdle raises, in himself, his own personal status and therefore, his value to the Navy.

DEPARTMENTAL COMMENT

This survey of the art of Test Jobbing is welcomed by the Personnel Section of E.-in-C. The Author and the Section have a strong personal link for, since 1950, the Author has been the Admiralty Test Job expert, working on the Staff of the R.A.(E), Staff of the Commander-in-Chief, The Nore, but nevertheless for the Personnel Section.

At the present time, not only naval but national methods of training craftsmen are under detailed review, and the grave shortage of technologists and technicians make any sound basis for the assessment of craftsmanship invaluable. As far as E.-in-C. is aware, only the naval training of artificer apprentices, keyed as it is to a system of well planned test jobs, marked by an outside authority (Admiralty), provides a realistic base. Nevertheless, this article clearly shows the dangers of a test job system becoming an end in itself (A.T.17, the Star Coupling ; Allied Trades). This must never happen if the Navy is to possess resourceful, self-reliant, adaptable craftsmen and not mere ' mass production ' technicians.

Much thought is being given to methods of training the artificer of the future and it is proposed to ease the bondage of the test job system by making it progressive and comprehensive for marking. In this way it is intended to retain the Admiralty control of standards while, at the same time, introducing interesting and satisfactory jobs for the apprentices. Similarly, the Admiralty Passing Out Test Job Team, an unpopular commitment for officers and ratings occurring at regular intervals, could probably be replaced by a small permanent party having the advantage of better continuity.

As part of a comprehensive review of all aspects of training in the Engineering Branch which has been carried out in the past few years, the standards of craftsmanship of national service, direct entry, apprentice trained artificers and mechanicians have been compared and a common test job marking system has been evolved on the lines described in this article. This system is now being tested and mechanicians are being marked to it, though they are not yet given the full range of test jobs, which is the ultimate aim. Eventually, a common standard of craftsmanship will be thoroughly established.

This article, which reflects so well the ethics of the 'twenties and 'thirties in which many fine artificers and future officers were trained, will remind those who read it of the true meaning and value of craftsmanship, with all its demands on intelligence, stamina and balance of head, heart, and hand.