PLANNED MAINTENANCE

ITS PRACTICAL APPLICATION

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Introduction

Is the Navy getting the best out of the present planned maintenance system? Fleet Orders give details of how to shuffle and deal the cards, and the schedules give the basis of the job to be done. But little has been said on how to play the hand. In this article various points are raised as food for thought in an attempt to answer this question.

Maintenance is nothing new. In the past working hands have been plentiful and maintenance haphazard, but with advanced equipment, in spite of the design effort to make it reliable, there is a requirement for considerably more maintenance effort and the labour to do it is at a premium. The new word is ' planned '.

Briefly the object of planned maintenance is to produce the maximum, or at least a known and acceptable, materiel efficiency with the minimum effort, and as a result to cost that effort in terms of complement or support with a suitable allowance for breakdown repairs which can never be completely eliminated.

The only place that information and data regarding the actual state of materiel efficiency and the maintenance and defect work load is available is in the Fleet. It is up to Headquarters and Class Authorities to tell the Fleet exactly what information is required and in what form, and provide them with tools to feed back this information.

In order to avoid any waste of effort the frequency of any planned maintenance should, ideally, be that which ensures that the routine is carried out just before the likelihood of breakdown or unacceptable fall off in efficiency. The maintenance work carried out, therefore, should be sufficient for the equipment to operate satisfactorily for the ensuing period.

Maintenance can be split broadly into two parts :

(*a*) *Unskilled*—This generally covers those short routine jobs carried out at fairly frequent intervals which can be done by anyone. The user/maintainer concept can be carried out to the full and probably the best term to describe the work is ' Servicing '.

(*b*) *Skilled*—Those jobs which are carried out at longer intervals and in general require skilled or semi-skilled manpower. The term ' maintenance ' is used subsequently to describe these particular items.

This ' maintenance ' can again be split broadly into two :

(*i*) *Examination*—This entails the detailed examination of various components to ascertain their condition, followed by the renovation or renewal of the parts as necessary to restore them to within prescribed limits.

(*ii*) *Testing*—This comprises suitable functional tests to establish that an equipment continues to operate to a specified standard.

Probably the best way to study the planned maintenance problem is on the basis of the work-study rhyme—

> ' I keep six honest serving men
> They taught me all I knew
> Their names are WHAT and WHY and WHEN
> And HOW and WHERE and WHO '.

The interrogative ' why ' is a common factor. The first point to consider is ' what '.

Quality (What)

From the foregoing it is clear that the material state must be to a known and defined standard on completion of a routine. This standard is best defined as ' Quality '. It may be expressed in figures, such as dimensions, or a description of condition. This quality, which is of prime importance, is not generally defined in the schedules. It must be.

The first essential is to know what is the specified achievement of any equipment and then to know the limits of quality of the various components which will allow the specification to be met. All too often this specification has never been defined and the limits of quality are not shown in any handbook or drawing.

It is a Headquarters function to make sure all this information is available to the Fleet. At some time or other the specification must have been decided, otherwise the equipment could never have been designed, and in order to meet this specification the makers must be well aware of the allowable limits of quality.

Schedules supplied to the Fleet to get planned maintenance started have been built up on :

(*a*) Makers recommendations
(*b*) Tradition
(*c*) Personal experience of the compiler
(*d*) Guesswork.

This is not to decry the effort of Class Authorities who have had a prodigious job. Even though the main task of getting the initial schedules out to the Fleet is completed, there is still a very real need for additional information regarding specification and quality, which surely must be available or can be procured.

Given these schedules and information it is now up to the Fleet to feed back data ; as, for existing schedules, experience in the field is the only reliable source for amendments.

Schedules at present are all too sketchy with terms such as ' examine ' and ' inspect ' without even any qualification as to exactly which part of a component is to be inspected and what it is to be examined for, in terms of quality. So that in the meantime, where defined quality is not forthcoming from Headquarters, it is up to the Fleet to get down to writing these definitions clearly and concisely.

This is not easy. Take gearing as an example ; how can one state in precise terms when a gear tooth is no longer fit to do its job ? One might say that is why professional engineers are borne in the Fleet to make such decisions. However, the more that quality can be clearly defined, then the man on the job can get on with it without interruption and without supervision because he knows exactly what he has to do.

Having defined and written down the limits of quality, then at each routine the observed quality must be recorded. This, as well as showing the state of

the equipment, can then be examined by the staff to see whether an adjustment of frequency is desirable. In recommending a change in periodicity due account must be taken of usage, or any other factor which may affect wear, that has taken place since the last inspection compared with normal.

It is not proposed to enter into the argument of calendar scale versus running hours for periodicity. For long term planning purposes a definite forecast can be made using calendar periods, and in this respect it is the simpler of the two, but the periods should not always be regarded as mandatory except in certain specified cases.

As well as observed quality a record of the replace components fitted should also be made at each inspection. Consideration of these two factors can lead to thoughts in recommending a change in design.

Detail Method (How)

Having decided what is to be done, the next problem to consider is how to do it and how to improve the efficiency of carrying out each routine and get the most out of the labour and supervision available.

A method of doing the job must be built up, whether it is the best or not, doesn't matter initially. It is a starting point which can be improved upon in due course. Having produced a method this should be analytically estimated to produce a basic time for this particular method.

For future schedules, producing this method and estimate should be a Class Authority function, but for current schedules, it is best done on the job. It will mean that on the first occasion of each routine, a certain amount of time will be spent in recording, but it will pay dividends for subsequent routines.

For ships building, a lot of this can be done during the stand-by period. Apart from anything else it relieves the monotony of wandering rather aimlessly round a half built ship all and every day.

With very little instruction any tradesman can make a pretty good shot. It does help if the drawings and ironmongery are available. It is basically a question of miming the job and noting down the sequence of events with an estimate of time.

It is not always possible to allow a time for fitting replace components unless it is known that they will be required at each routine.

There are various additional points which come out of this examination and must be recorded. Firstly, tools and materials. A complete list should be built up of everything required to do the job. These items can then be collected and taken down to the job before it is started. There should be no question of the plumber forgetting his tools.

Secondly, locations factors can be established. A particular piece of equipment may be tucked away in a corner and very difficult to get at, or a number of pipes or other fittings may have to be removed before the job can be tackled.

The third consideration is safety factors. Certain valves may have to be shut and lashed, or fuses withdrawn before the equipment is safe to work on.

Lastly drawings or handbooks which may have to be consulted should be listed.

Having established a basic time then for planning purposes, due allowance can be made for material and personnel conditions. The machine may be completely rusted up due to a salt water leak directly above it, or it may be in the top of the boiler room in the tropics and the crew may have been watch-keeping for the last fortnight.

Defects

All these points can also be applied to recurrent or one-off defects. In the long run it pays to record these details on ' important ' job cards. There should

also be an organization to link defects to any maintenance schedule which will shortly become due on the same equipment, in order to kill two birds with one stone. This can be done by overstamping the relevant job cards when they are raised, and noting the schedule number with other details such as time, personnel, tools etc. This latter information can be built up from similar former jobs.

An analytical estimate also helps with defects as it avoids the embarrassment of the Chief giving the Captain a completely bogus estimate when asked how long a certain breakdown job is going to take, It is the usual practice for it to be passed down the line to the C.E.R.A. who says 4 hours, and by the time it has come back to the Captain through the Departmental Officer, Senior and Chief, who have all added their factor of ignorance, it turns out to be 24 hours. On the other hand the Chief makes a wild guess on the spot, which is usually a gross underestimate.

Personnel (Who)

Having recorded the method by numbers the next point to decide is ' who '. On close examination it is amazing to discover the number of jobs, which were always considered to require an artificer, that can very probably be done by unskilled or semi-skilled labour.

The difficulty however in downgrading a job with a fixed complement is that one finishes up with all the M(E)s or E.M.s doing planned maintenance and is left with all the artificers for painting and scraping.

But in these days of repair by replacement artificers are becoming more diagnosticians and supervisors than craftsmen ; in which case it is all the more important that they are competent as chief petty officers. There is obviously considerable scope for the employment of G.E.C. P.O.M(E)s and equivalent on planned maintenance.

Where and When

Just two points on ' where ' and ' when '. On a servicing job such as greasing rod gearing, it is important that locations of all the grease nipples are recorded because it is always the same one, which is just out of sight, that will be missed. Consideration should also be given to grouping servicing routines in each space under one schedule card. In considering ' when ' regard must be paid that the equipment is available and not in use when it is planned to carry out the routine. and secondly, separate routines may be necessary when the equipment is running or idle, i.e. at sea or in harbour.

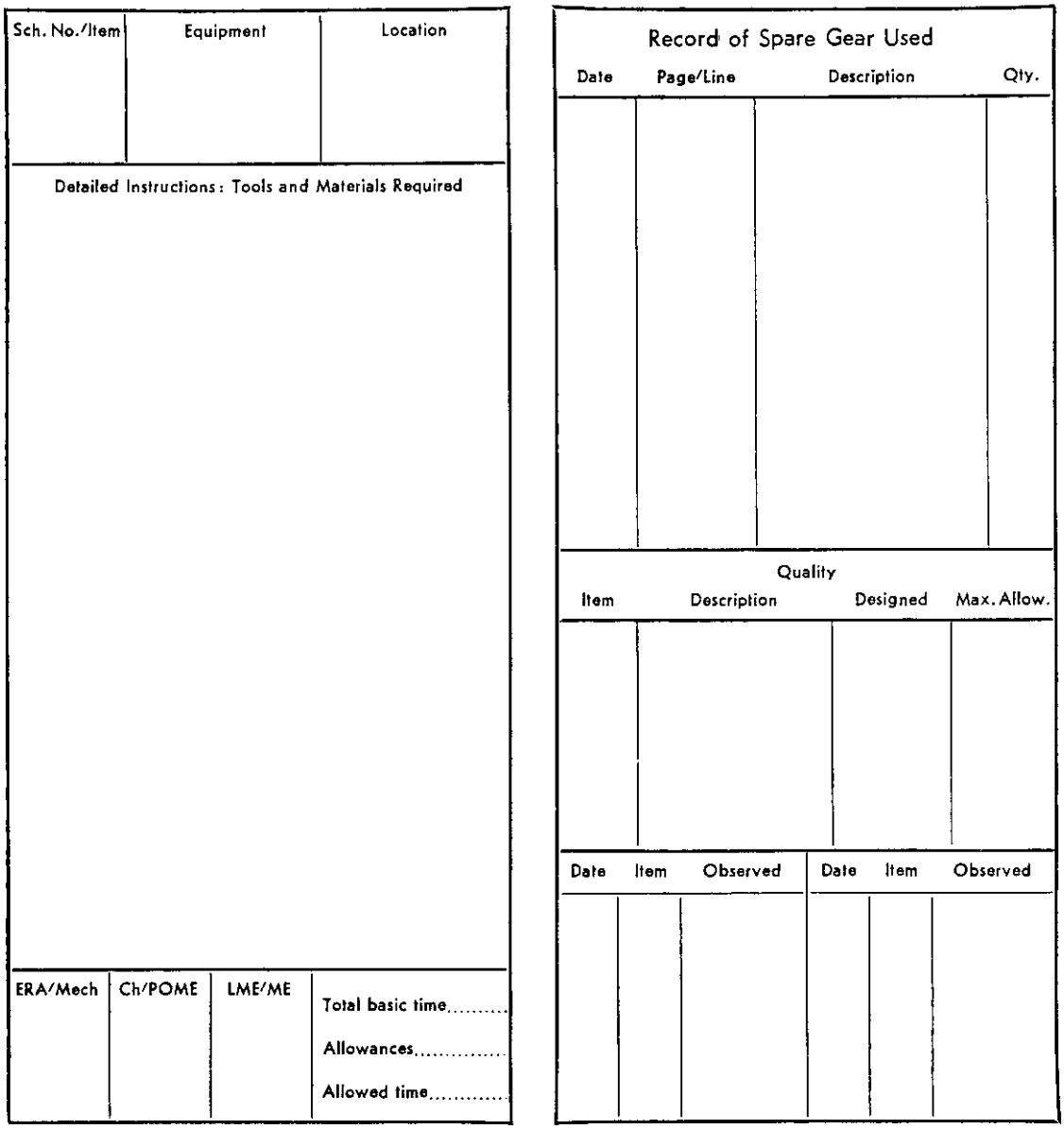
A schedule card to fit a plastic envelope and on which all the above information can be recorded is shown in FIG. I (*a*) and (*b*).

Planning

Next comes the problem of planning planned maintenance, i.e. the shuffling and dealing. It is appreciated that there are innumerable ways of organizing this in detail, and methods may have to vary in each type of ship. The main feature must be simplicity, to avoid planning becoming the master and with the result that no work is done.

It is considered in larger ships that there should be an officer in charge of the organization in each department. For the new Marine Engineering set up, one of the watchkeeping E.O.s can co-ordinate for Hull, Engineering and Electrical.

In order to give this officer a worthwhile job he can also be given common workshops, spare gear and stores for all sections, which should result in a saving of manpower with an integrated staff.



(a) (b)

FIG. 1—FRONT AND BACK OF SCHEDULE CARD

This officer and his staff can then deal with the whole of the department's support facilities and the associated paperwork. This includes the production of all planned maintenance and defect fair entries, returns and reports, entries in the Master Record, ordering and accounting for spare gear, etc. This ensures uniformity, but it does necessitate close consultation with all section officers.

Servicing schedules (i.e. Monthlies, Weeklies and Dailies) should be handed out to the sections concerned and organized by the Chief or Petty Officer in charge. A marker should be retained in the P.M. office, otherwise there is no record of what cards are out and to what sections. The cards should be called in at regular intervals for checking. It is an advantage to type the dates of the month along the bottom of the cards, this helps checking by the user and the P.M. staff.

There are two alternatives in tackling servicing schedules in bulk :

(*a*) User/maintainer
(*b*) Special parties.

LIST 1. Additional tools or materials used
2. Spare gear used (page/line, description, quantity)
3. Readings taken and Quality observed
4. Any other remarks which will assist planning or carrying out the job next time.

Sch. No.	Item No.	Location	Rating	Name

Date	ERA/ Mech	Ch/ POM(E)	LM(E)/ M(E)	Time Started	Time Finished	C/ NC

FIG. 2—ROUGH RECORD SHEET

The former is favoured, although probably not quite so efficient, as it does bring home to the majority of personnel the maintenance task involved and should instil a pride in part of ship.

For maintenance (three monthly and above), as opposed to servicing, a master plan should be produced at the beginning of a commission showing each individual schedule tied to a, say, monthly calendar scale to give an even spread of work over the whole period. This ensures that each schedule comes up relentlessly when due and avoids any bunching towards the end of the commission. As the schedules are completed they should be marked off on the master plan and this provides a permanent record of achievement at a glance. As stated previously, this plan need not be regarded as mandatory and consideration can be given to advancing, deferring or omitting any schedule depending on the operational or other circumstances.

In any deviation from the plan, the section officer must be consulted as it is he who is responsible to his Head of Department for the correct and timely carrying out of maintenance in his section.

Then, consulting the master plan, say, one month's worth of schedules should be passed to the office workbox for the section officers for short term planning and then, say, one week's work to the workshop workbox for the section chief artificers for daily planning. This allows the chief artificers a proper measure of responsibility in running their section.

Chinagraph pencil can be used on the plastic envelopes to allocate the schedules to each artificer. Defect job cards can be similarly allocated in plastic envelopes.

Feed-Back

It is essential to get information back up the tree so that each schedule can be re-examined in detail and the exact state of materiel efficiency can be established.

The man on the job must, therefore, be given a rough record sheet with each schedule or job card. On this he first records the schedule number, location and his name, then on completion of the job :

(*a*) Actual time taken and manpower needed
(*b*) Observed quality for transfer to fair records

(*c*) Spare gear used
(*d*) Additional tools and material required
(*e*) Remarks which will assist planning or carrying out the job the next time.

A rough record sheet, also to fit a plastic envelope, is shown in FIG. 2.

The filling in of this rough record card may appear to be a waste of effort, but it is the whole key to the feed-back of information. With it, alterations of periodicity, consideration of design, improvements of method and the work load can all be based on recorded fact. Without it, we will never know whether we are getting the best out of planned maintenance.

To summarize the various points :

(*a*) Define quality and its limits
(*b*) Establish a job method and basic time
(*c*) List associated requirements for the job
(*d*) Decide personnel needs
(*e*) Make a master plan
(*f*) Record observed quality and replacements
(*g*) Feed back data and information from recorded facts.