

THE RE—ORGANISATION OF TRAINING OF RADIO MECHANICS

It has been apparent for some time past that the diversity and scale of fitting of Radar and W/T apparatus in ships were calling for degrees of knowledge and all-round workmanlike ability among Radio Mechanics, and especially among the "W's", which were getting beyond the practicable scope of the course. Instruction is bound, in time, by drafting requirements and there was no possibility of carrying out, along the old lines, the extension of from 4 to 6 months on the whole course, which appeared to be the minimum requirement. The drafting margin in the R.N. Barracks, Portsmouth, has dropped to a minus quantity due to the heavy calls arising from imminent large operations. Accordingly, no increase in course involving a "spotting correction" of from 400-600 men, could be attempted. It has therefore been decided to revise the old ideas of the man and his course and to try and produce in the same time, a man who should more closely resemble the "servicing" engineer of shore practice than his predecessor.

A NEW COURSE.

With this idea in mind, various conferences have been held with Admiralty departments, the training officers concerned and at times, with representatives of the Technical Colleges. The future course for the man, taking the same time as the old course, has been agreed at :-

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| Technical College | 20 weeks. |
| H.M.S. Valkyrie (Radar) | 14 weeks for R's, 9 weeks for W's. |
| H.M. Signal School (W/T) | 5 weeks for W's. |

The Technical Colleges have been instructed, and have agreed, to give more and more attention to the practical side of Radio work and maintenance. To assist in this and to give more propaganda value to the course, approval has been obtained for the installation of Radar types 291 and 286PQ in Technical Colleges.

Adequate supplies of testing gear, oscilloscopes, Avometers, Taylormeters and *Wec Meggers*, etc., have been ordered for them and they are also to be supplied with Types TW.12, 52, wavemeter G.73, B.28's, P.14's and P.16's for testing, dissecting and re-assembling purposes. In addition, endeavour is being made to apply a "mechanical aptitude" test to all trainees prior to acceptance for course.

WORKSHOP TRAINING.

Approval in principle has been obtained for all Radio Mechanics, on qualifying in H.M.S. Valkyrie, to be drafted for a month's practical training in Sherbrooke House, Glasgow. This is mainly workshop training on available types of Radar set, each man carrying out fault-finding and repair on various panels. It has not yet been possible to implement this addition to the course owing to the lack of ratings caused by the manning situation, but it will be included as and when the position eases. Endeavour will be made to extend this period. Only a few mechanics have so far taken this one month's course.

Approval in principle has also been obtained to make it policy that Radio mechanics drafted to sea to work on their own, should have at least three months experience as qualified Radio Mechanics. Obviously, this can be improved upon in order to obtain men with a year's experience in these jobs, but again, the drafting situation does not at present allow even the three month's experience policy to be put into force.

It will be appreciated that the problem of improving the product is mainly concerned with getting a better "W" - in Radar, W/T and mechanical dexterity - and it is obvious that instruction is greatly handicapped by the impossibility of arranging a course, however, intensive, which could take the place of a four to five years' apprenticeship in Radio engineering. A course to last from 18 to 24 months would certainly provide a man not only capable of repair and maintenance work but of expert fault-finding as well. But until such a course can be introduced it is as well that the following points should be remembered :-

- (a) The Radio Mechanic produced under the old scheme of training, which will be in force until the end of October, was designed to have a theoretical foundation on which he could build, by practice, experience and further instruction, a sound knowledge of Radio Maintenance and repair.
- (b) The Radio Mechanic produced after the end of October will be a man who has a fifty-fifty theoretical and practical foundation. Although knowing the actual sets better and having a greater knowledge of maintenance and repair work, his theoretical knowledge will be appreciably less than his predecessor's. He will however be able to build this up - again by practice, experience and further instruction. It is considered that he will be quicker in spotting the simple faults which cause 75% of the breakdowns at sea. In addition, he will be far more at home with test gear and his mechanical dexterity and ability with tools should be improved fifty per cent.

Technical training at "Valkyrie" will be concentrated on the following sets :-

"W's" Types 291, 271P/C, 276/7 and T.I.U. etc., 285M3/P4, L.17, Test Gear 251/3/M and 242,

"R's" as above plus revision, and types 79/281/B, 243 and skiatron.

Post graduate training will be arranged as necessary for Radio Mechanics required to service the following outfits :-

Type 274, 275, 267, 268, 294 and 970. This will only apply during 1944.

Technical training of Radio Mechanics (W) at Signal School will be concentrated on Type 49, TBL as a representative American Set, Type 86M as a representative V.H/F set, and Wavemeter Outfit CI.

"WHAT'S GONE WRONG?"

A MATTER OF IMPORTANCE TO ALL W/T AND RADAR PERSONNEL.

Radio sets are always temperamental. Even domestic sets of the best make quietly sitting in the corner of the room are prone to inexplicable misbehaviour. The circuit may be technically sound, components well chosen and of ample factor of safety, assembly well done and inspection severe and critical and yet the complete unit gives trouble within a comparatively short time. The real reason may be just an unobserved kink in a reel of wire as received from the makers, or a girl eating an apple whilst assembling condensers or resistors. And we have all heard of dry or semi-dry joints. These faults can and do occur in the comparatively tranquil days of peace time production using reasonably trained labour and adequate inspection personnel. Moreover, in peace time, it was the practice to send Pre-Production Models of sets to sea for several months trials, and the lessons learnt were incorporated in all Production Models. In war time, this is impracticable, and the set has to go straight into full production from the laboratory and drawing board.

So it's not surprising that now and again a ship's set lets one down. Gun shock, vibration, heat, dampness, etc., all doubtless take their toll and the combined efforts of Research, Design, Inspection and Test Departments have not yet produced perfect sets. The best that can be said is that some types give much less trouble than others.

One of the difficulties of A.S.E. in the past has been a lack of immediate information relating either to functional or operational faults, or in the case of a breakdown, details of the actual components at fault and the apparent reason for the failure. A committee has recently been formed whose responsibilities briefly may be summarised into -

- (a) Finding out what goes wrong.
- (b) Putting it right.
- (c) Seeing it doesn't happen again.

This committee asks for the co-operation of all W/T and Radar personnel in giving adequate but pithy information regarding all failures.

UNSATISFACTORY OPERATIONAL PERFORMANCE.

In the case of unsatisfactory operational performance, the present channels should be used:-

FOR W/T EQUIPMENT.

- (i) Special reports via Administrative Authorities and Admiralty in accordance with A.F.O.1815/41 paragraph 8.
- (ii) Personal contacts with Application Officers and Ship-Fitting Officers.

FOR RADAR EQUIPMENT.

- (i) As laid down in C.A.F.O. 2509/41 i.e.

Non urgent matters by Radar Routine Reports No. 2
(at six monthly intervals).

Urgent matters by special report by letter or signal
to Admiralty sending copy to Administrative Authority.

- (ii) Personal contacts with Application Officers and
Ship-Fitting Officers.

BREAKDOWNS.

Where a failure of W/T or Radar is due to a breakdown of a mechanical or electrical component, the form S.1183 should be used.

The information specifically asked for on the Form S.1183 should be carefully entered together with the date of the breakdown and the date when the component was first brought into service.

"Description of defect" should include "reason for breakdown" and "action taken to clear". Where it is considered that the fault occurs due to weakness in design or manufacture, the actual faulty component should be sent to :-

A.S.E. Test Dept., Whitwell Hatch, Haslemere, Surrey,
accompanied by full information as per form S.1183.

Information on faulty components will be tabulated by A.S.E. and the percentage faulty of each type of equipment and component ascertained. Urgent action will be taken where any equipment is giving serious trouble.

So far, no mention has been made of valve failures. The actual life to be expected from valves of any type is known and wherever possible in addition to the actual time the valve has been in use, as nearly as possible the observed life in hours should be given.

Do not forget that both clearance of any trouble in present designs of equipment and the avoidance of similar trouble in future designs depends on the information we obtain from the user.

TEST EQUIPMENT

The complaints which are often received from harassed W/T and Radar Officers - generally by phone or personal contact - fall into two classes.

- (a) "Is there any test equipment? I've never seen any! "
- (b) "I've got stacks of test gear in my store but we've no time to use it - don't know how, anyway! "

Unfortunately there has in the past been some foundation for both these apparently contradictory statements, but strenuous efforts are being made by A.S.E. to tidy up the situation. The following notes are intended to help officers concerned, by showing them how Test Equipment is scheduled and supplied.

ALLOWANCE OF TEST EQUIPMENT.

Items of Radar Test Equipment which are allowed on a basis of 1 per ship or establishment are scheduled in Establishment List E506 for Testing Outfits TOA, TOB, TOC and TOD. (This list can be obtained on demand from S.N.S.O.(H); copies are held by all PRADO'S). Other items of Test Equipment which are allowed on a basis of 1 per set are included in the E list for the sets themselves.

Outfit TOA is allowed to ships and services (excepting Trawlers and below) where no Radar Officer is borne, and includes the minimum requirements for maintaining the particular sets fitted. (Items of test gear applying to other sets will not be supplied).

Outfit TOB is allowed to ships, Captains (D) afloat, and other services in which a Radar Officer is borne, and includes all necessary equipment for ordinary servicing and maintenance of the particular sets fitted. (Items of test gear applying to other sets will not be supplied.)

Outfit TOC is a comprehensive outfit for issue to maintenance and fitting-out bases.

Outfit TOD is allowed to Captains (D) ashore and Coastal Force bases; it includes all requirements for servicing and maintaining the radar equipment of destroyers and coastal craft, together with W/T Wavemeter Outfit GN (which is scheduled in Establishment List E588).

Other items of W/T test gear, particularly wavemeters, not covered by E506 are at present supplied in association with particular W/T equipment in accordance with various A.F.O.'s.

FORTHCOMING IMPROVEMENTS.

The entry into service of new equipment - particularly Types 276, 277 and 293- has necessitated the development of new Test Gear. List E506 is therefore under revision and the opportunity is being taken to make certain that it will adequately cover the requirements of new and existing Radar equipment, whilst eliminating obsolete or redundant test gear. In addition, the revised list will include Test Outfits for Combined Operations bases, and a new schedule of Test Equipment for W/T gear is also being prepared.

SUPPLY OF TEST EQUIPMENT.

All Radar test gear is plan packed in accordance with Schedule M530, copies of which are held by P.R.A.D.O's, R.E.A.'s etc. and issued without demand, as supplies permit, when the respective sets are allocated. Unfortunately, this cannot be done when sets are allocated from "Pools", e.g. Types 251M and 253; in these cases a signal should be made to S.N.S.O.(H) as soon as fitting is begun.

Retrospective supply of deficient items will be made without demand.

HANDBOOKS.

Efforts have been made to include instructions for the use of items of Test Equipment relevant to a particular set, in the handbook for that set; where this has not been possible, separate handbooks have been issued.

The use of equipment included in outfit TOC for Types 282/3/4/5 is described in C.B.4324(1)R, "Handbook for Test Equipment, Outfit TOC, Part I".

All remaining items in Outfits TOA/B/C/D will be covered in subsequent parts of C.B.4324, the preparation of which is now well advanced.

TOOL KITS FOR RADAR OFFICERS.

Many Radar officers have not yet demanded tool kits to which they are entitled - presumably because the existence of these kits is not sufficiently well known.

The kits are scheduled in three lists, in Establishment List E506 (pp.155-163 of the current issue) List "A" being allowed to Radar Officers afloat and Radar Maintenance Officers. These kits have to be taken on personal charge; officers requiring them should demand them from S.N.S.O.(H) stating the "chargeable authority in accordance with A.F.O.1096/43.

SHIP TO AIR COMMUNICATION USING V. H/F.

Early in the war Fighter Command R. A. F. developed a V. H/F R/T communication system in the band 100 - 124 mc/s for control of aircraft in order to get an increased number of channels to deal with the growing number of planes and to use a portion of the spectrum when the interference level was considerably below that in the H/F band previously used. This has had wide repercussions in the Navy.

The effect was first felt in home waters when it became necessary to fit convoy escorts with fighter sets to enable them to communicate with, and pass information to aircraft employed on convoy escort and protection.

With the extension of Fighter Command V. H/F system to foreign parts, the need for fitting ships became more important particularly in the Mediterranean where long range fighters were commonly used for fleet protection and use was made of R. A. F. ground station equipment in cruisers and above for controlling fighters and attention was first given to the problem of working two or more channels of communication simultaneously from one ship.

The R. A. F. ground equipment T1131-R1132 was designed for widely separated transmitting and receiving stations. It was early apparent that unless the selectivity of the receiver could be improved and some screening introduced between aeriels, it would be difficult to operate with a reasonable frequency spacing between channels.

In 1942 it was decided to fit all Battleships, Aircraft Carriers and Cruisers with one high power (ground) set and one low power (aircraft) set and all destroyers and 50 per cent of corvettes with a low power (aircraft) set for fighter control. A large portion of the fleet was fitted out very rapidly for the forthcoming North African operations and in the circumstances not too much attention was paid to aerial design or siting.

At about this time also, there were two further developments affecting us. Firstly the F. A. A. decided in principle to adopt V. H/F for communication with fighters and the band 126 - 150 mc/s was tentatively allocated, and supplies of British made fighter sets ran out with the result that the fleet had to be supplied with U. S. built sets with all the attendant difficulties of supply.

Consequent on these decisions it became necessary to develop new ship equipment to cover the combined R. A. F. - F. A. A. fighter bands and to investigate methods of provision of the smallest possible channel separation to enable five or more to be worked simultaneously in an aircraft carrier. The first of these was overcome by taking up a dormant R. A. F. development and putting it to production with certain changes to meet ship needs, this is now coming into service as Type 87M.

Intensive research was carried out in the frequency separation problem and also on the question of aerial siting, including full scale trials in the aircraft carriers ACTIVITY and INDOMITABLE.

The fundamental technical difficulties arising from such requirements were due to the restrictions imposed by the narrowness of the V. H/F band available and by the severely limited space in a Carrier suitable for the erection of aeriels - the chief technical problem being to avoid inter-channel interference, or more precisely to prevent the cross modulation of a relatively weak incoming signal on one channel by the simultaneous operation of a local transmitter on another when the separation of the two channels is of the order of 2 per cent of the operating frequency and when the distance between the receiving and transmitting aeriels is only a few wave-lengths.

The problem was tackled on two lines:-

- (a) By increasing the selectivity between the aerial and the grid of the first valve in the receiver without seriously affecting the sensitivity of the receiver.
- (b) By using the maximum possible separation between aerials or a system of aerials so arranged that each aerial is appreciably screened from the others while retaining the property of all-round transmission and reception.

The trials showed that by the addition of a resonator circuit between the aerial and the receiver and by careful aerial siting, working with a separation of 2 to $2\frac{1}{2}$ mc/s was possible. Where the aerials are unduly close or a less frequency separation must be used, it becomes necessary to use two such resonators in series.

These trials also showed the vital importance of height and a position as clear as possible of metal conductors for good range and all round communications. As a result of this, standard arrangements for V.H/F aerials in aircraft carriers and other ships have been prepared and a C.A.F.O.2721/43 promulgated.

Considerable difficulty had been anticipated in the design of an aerial to give equally good response over the whole of the combined frequency band. In the event for fitting at a yard arm, the plain dipole of aerial outfit APH was found to be better than any of the more complex systems tried. Work is still in hand however on the production of a good aerial for masthead fitting to replace the 'J Match' type.

Recent changes in staff requirements are calling for more V.H/F channels in one ship, the number rising to 6 or 8 or even higher. It is virtually impossible to meet such requirements without departing from the principles of screening and separation enunciated above and it seems probable therefore that they can only be met at the loss of some degree of efficiency on all V.H/F channels. Investigation is, however, proceeding on the possibility of using two aerials only, one transmitting and one receiving for all channels instead of the present system of a separate T.R. aerial for each channel.

It may be said that the present ship to air communications are satisfactory and are considerably superior to what they were a year ago; the factors contributing to this improvement are:-

- (a) Improved design of V.H/F aerials.
- (b) Use of low loss feeder cables.
- (c) Improvement in receiver selectivity.
- (d) Fitting of a tune circuit between the aerial and receiver to reduce cross modulation to a low level.
- (e) Siting of aerials as high up in the ship as possible.
- (f) Effective suppression of R.D.F. interference.
- (g) Improvement in transmitter design.