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MINISTRY OF AVIATION

AIRCRAFT TORPEDO DEVELOPMENT UNIT

HELSTON
CORNWALL

PROGRESS REPORT

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S E C R E T

Ministry of Aviation,
Aircraft Torpedo Development Unit,
Helston,
Cornwall.

3rd May 1965

Progress Report No 1/65

TDU/61/06

Aircraft Torpedo Development Unit

Half-Yearly Progress Report

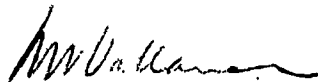
April 1965

This report concerns the work completed during the period 1st November 1964 to 30th April 1965.

The number of trials completed increased over comparable periods in recent years; Wessex clearance trials in respect of DME buoys and Depth Charges have been made on behalf of A. & C.E.E.

This Unit participated in the Wessex F.S Mk 5 Winterisation trials in Canada and recommendations have been made in respect of Mk 44 torpedo and fuze design, and minor modifications to flight-in-air material have been initiated.

Arrangements have been provisionally made with R.A.E. permitting the use of a Canberra BI.6 aircraft as the test vehicle for high speed release trials of Mk 44 torpedoes.



Superintendent

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PART I - AIRCRAFT INSTALLATION AND PROGRESS

1.1 VF SUK 118 Mk 1

- (a) 2 x 18" Mk 30 - Full release clearance now given. Tests completed.
- (b) 2 x UK Mk 44-0 - Aircraft to Pod 5050 (i.e. with Mk 44 torpedo presetter fitted) now being cleared for torpedo release.
- (c) 2 x Mk 43-3 (primary battery) - Clearance recommended to A. & N.E.F. and H(d), with copy of letter to U.S. (U). (Naval).
- (d) 2 x 250 lbs Mark 11 depth charges - Clearance trials completed. Includes recommendation for re-positioning No 1 Mark 1 fuze unit on rear boom located to accept the depth charge arming wire.
- (e) 8 x DUT buoys - Carriage and release trials have been completed on behalf of A. & N.E.F. and the aircraft clearances recommended for Vessex HLS Mk 1 and Mk 3.

1.2 VLSP HLS Mk 1

- (a) 2 x Mk 43-3 (primary battery) - Torpedo release trials in progress
- (b) 2 x UK Mk 44-0 - Release trials completed. Clearance recommended to A. & N.E.F.

1.3 CAVNET Mk 3

2 x UK Mk 44-0 - Cleared for release of torpedoes from pylon installation at speeds up to 180 knots in level flight. Trials to investigate release of torpedoes at higher speeds and in dives, not exceeding 30° or 240 knots air speed, completed. The full clearance is being recommended to A. & N.E.F.

1.4 SW SWANSON Mk 2 and Mk 3 (Phase 3)

- (a) 18" Mk 30 and (b) UK Mk 44-0

Mk 3 Phase 3 aircraft - Interim torpedo release clearance issued by A. & N.E.F. in December 1964 following joint A. & N.E.F./A.F.D.U. torpedo release clearance trials.

Full torpedo release clearance trials completed in February 1965.

Mk 2 Phase 3 aircraft - Aircraft expected July/August 1965 for torpedo dropping trials.

NOTE - Full details of progress made in respect of these installations are given in Part II or Part III under the appropriate project headings.

PART II - TORPEDO AND MINE PROJECTS2.1 18" Mk 30 torpedo(a) Release from helicopter aircraft(i) Vessex HAS Mk 1

Action Mk 30 now cleared for release over speed range Hover to Maximum, at heights of 30 ft and above. Item completed.

(b) Release from fixed wing aircraft

Both action (primary battery) and exercise (secondary battery) torpedoes have been released satisfactorily from Shackleton Mk 3 Phase 3 aircraft during recent trials. Item completed.

2.2 Mk FC 43-3 torpedo

D.C.M.(U) N.O.D. (Naval) requires the Royal Navy to have a facility for Mk 43-3 torpedoes, fitted with the Canadian built Mk FC 78 Mod 0 primary battery, to be released from Vessex and Asp aircraft.

Trials have shown that with minor modification to the torpedo battery arming lanyard and to the Vessex torpedo carrier boom this requirement can be met and clearance of the Vessex for release of Mk 43 Mod 3 (primary battery) torpedoes has been recommended to A. & A.F.E. and H(d). Further action is required by H(d) to promulgate the clearance.

Trials employing the Asp aircraft are progressing satisfactorily.

2.3 UK Mk 44-0 torpedo(a) Release from fixed wing aircraft(i) Gambet / ET Mk 3

Further trials have taken place to clear the aircraft for release of UK Mk 44-0 torpedoes, fitted with parachute attachment type T/I and breakaway band type C, from the wing pylon installation at speeds above 180 knots and in 30° dives. The trial results are being discussed with A. & A.F.E. and a full clearance is being recommended.

(ii) Shackleton Mk 3 Phase 3

A. & A.F.E. aircraft completed torpedo release trials at F.T.D.U. in February, UK Mk 44 torpedoes, fitted with T/I parachute attachment and breakaway band type C, were satisfactorily pre-set in the air, using the airborne pre-setter, and released from all Mk 44 stations on the aircraft. Torpedo running behaviour following air launch was satisfactory.

(b) Release from helicopter aircraft(i) Vessex HAS Mk 1

Vessex aircraft of 706 Squadron, Culdrose has been fitted to Mod. 5050 standard to enable torpedo release clearance trials to take place. This modification introduces the torpedo airborne presetter and modifies existing Mk 30/43 torpedo carriers to accept the UK Mk 44-0 torpedo.

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A number of runner UK Mk 44 torpedoes, fitted with parachute attachment type W/K and breakaway band type C have been released from the modified aircraft with satisfactory results. A clearance note is in preparation.

(ii) Resp HAS Mk 1

Aircraft fitted with the modified engine, and cleared to lift 9,500 lbs, has been used in trials to clear the aircraft for release and jettison of 2 x UK Mk 44-0 torpedoes. Report is in preparation

2.4 Breakaway suspension band type "C"

Full approval has been given and manufacture commenced.

Trials at the Winter Experimental Establishment in Canada showed the breakaway band to operate satisfactorily in torpedo dropping trials, but that the lanyard pull out force could reach a figure such that the associated work link was in a marginal condition.

A simple modification to the timer rack has been successfully tried to overcome this difficulty.

It is proposed to submit this modification for incorporation in subsequent production batches of bands.

2.5 UK Mk 44 airborne presetter

Operation in Shackleton and Wessex aircraft has been satisfactory.

2.6 Parachute attachment type AT/L

Production of this attachment, employed to air launch the UK Mk 44 torpedo from fixed wing aircraft, is now in progress.

Some work has taken place on a prototype inertia release mechanism which may simplify production of the attachment. Some 5 drops of dummy torpedoes fitted with the 'inertia' release have now been made. With a setting less than 8'g' the release operated satisfactorily on 3 occasions. With greater than 10'g' setting the release failed to operate at water entry of the torpedo.

Several modifications have been carried out and proving trials are in hand.

A rubber cover has been designed and produced for this attachment and initial trials are proving very satisfactory.

2.7 Delivery system for high-speed aircraft launching of UK Mk 44

Mk 46 anti-submarine torpedoes

In view of the expected in service life of the UK Mk 44 torpedo and variants, P.T.D.U. are engaged in developing a two-stage parachute system suitable for their delivery from aircraft capable of 400 knots airspeed, i.e. Shackleton replacement. The basic design has been finalised and detail drawings for the two-stage prototypes, to be manufactured at P.T.D.U., are in preparation.

A detailed design study is being carried out and a survey has been made of existing time mechanisms. As a result it has been decided to proceed with an P.T.D.U. clockwork type mechanism and work is proceeding along these lines.

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A dummy housing incorporating the system devised for the first stage parachute release has been designed and two are being made in the workshops to enable trials to be carried out investigating the bulk problems of stowing the two parachutes supplied by Messrs G.O. & Co. and the deployment of the first stage release mechanism. Blower tunnel trials are being arranged.

The design will be such that if required the attachment can be by simple modification, also be used to air launch the Mk 46 torpedo under similar conditions.

Approval is being sought for the flight evaluation of the system to be made using a BI 6 Canberra from R.A.F. Warton.

Preliminary discussions with R.A.E. and English Electric, Warton have been satisfactory and a procedure and provisional programme agreed.

A T.I. of 2 x Mk 44 torpedoes will be attempted at R.A.E. on 5th May, 1965.

It is proposed that two dummy torpedoes will be instrumented; the first, for preliminary trials will embody an altimeter and a C.I. Type 3 scratch recorder, the second will embody accelerometer, rate gyros and a galvanometer recorder.

2.8 Delivery system for launching anti-submarine torpedoes from 150 knot helicopter

A preliminary design study has been done on this project, but work is not held up by lack of Drawing Office effort.

2.9 Twin breakaway suspension bands for UK Mk 44 torpedo

T.D.U. have been tasked by D.A. Arm with the design and development of UK twin point suspension bands for the UK Mk 44-0 torpedo, following the Joint Staff policy decision that all future UK aircraft will employ twin point store carriers.

It should be noted that N.O.D. (Naval) decision to fit twin point suspension on Wessex 5 and later Asp aircraft has been reversed.

Design work is in progress and it is intended that the bands will meet the full strength requirements of MIL. SPEC. 8591C. To leave no lanyards on the aircraft a simple time delay will be incorporated in the design.

Specimen UE twin point attachment bands have been obtained and are being evaluated.

2.10 UK torpedo project delivery system

Further discussions have taken place with the Torpedo Research Section of A.U.W. on possible delivery systems for the UK torpedo project.

With the design at present envisaged it may prove possible for the parachute system to attach to the tail cone of the torpedo, rather than to the propeller shaft. If higher parachute opening shock loads on the torpedo are then permitted a single parachute could be employed, possibly in conjunction with a protective frangible nose cap fitted to the torpedo.

A.U.W. have called a meeting of all interested authorities to discuss the torpedo and possible delivery systems and other allied problems on 27th May, 1965 at A.R.I. Teddington.

Information regarding frangible nose cones is sparse and it is suggested that a program be initiated to their use would be worthwhile.

2.11 NATO Meeting II: Mk 44-O torpedo interchangeability

The UK proposal that torpedo flight-in-air material should be treated as a separate issue from that of torpedo and component interchangeability was not adopted at the last meeting.

It was however, agreed that the UK T/L parachute attachment and the US Mk 24 attachment would be interchangeable if both were supplied with their appropriate torpedo tail nut in the parachute container. A recommendation to this effect has been submitted to C.O.D. (Naval) and C.O.D. (Air).

PART III - MISCELLANEOUS PROJECTS4.1 Helicopter Recovery

Nothing further to report, still awaiting minor modifications for incorporating in Master Drawings from C.W. Yard, Fleetlands.

4.2 AS bomb trials

There have been no further trials.

4.3 Special tools for type 'C' bands

A production batch of 20 sets of tools have been made and supplied for R.F. use.

5.4 Torpedo recovery

When using the line and grab system for recovering negatively buoyant stores, some difficulty has been experienced in handling the store inboard after it has been lifted. The problem is more acute with stores containing delicate instruments. Discussions with 1102 C.U. are about to be held with a view to producing some simple device which will enable the stores to be brought inboard with less difficulty.

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PART IV - INSTRUMENTATION AND ANALYSIS IN SUPPORT OF TRIALS

4.1 Recording peak shock loads

(a) The electronic shock register was lost during trials on 18th November 1964. A replacement was made to the same design and this was ready in early February.

Initial design work on the shock monitors has started.

(b) The original "Impactograph" recorder was lost with the shock register.

4.2 High-speed recording

This equipment is now completed.

4.3 Accelerometer calibration (vibrating beam)

The instrument is now completed, but photographic trials have yet to be made. These may show that a special mounting is necessary.

4.4 Drop test machine

The workshops have completed their work on this machine. Initial test recordings revealed some difficulty due to noise from the transducer cables. The Instrumentation Section have already made use of the facility to check the operation of the peak "g" box, and its readings were found to agree with the direct measurement. The Development Section are now using this machine to study the action of the inertia release at water entry, after which it will be used in the development of the A.T.D.U. tape recorder mount. When the more pressing commitments have been discharged it is intended to investigate the shock profiles produced by different programmers.

4.5 Centrifugal calibrator

The design for this calibration facility is now completed and the workshops have been directed to give this a top priority so that it may be available for setting up the transducers in the shock measuring torpedo XR4.

A set of high quality slip rings and brushes has been obtained, but it has not yet been possible to test them. A simple device for obtaining accurate speed measurements is being designed.

The console to house this unit is being produced using "Midney Dorloc" constructional system.

4.6 Torpedo recorders

There is no longer a requirement for further Mk 3G torpedo recorders and this matter is no longer being pursued.

The main airborne recorders in future will be:-

(a) For flight-in-air and initial dive:

Motorised "Impactograph" and Woodhill galvanometer recorder, to be followed by a Mk 78 head.

(b) For water entry shock:

Tape recording system, backed up by shock monitors for statistical work.

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4.7 L.T.D.U. tape recording equipment

Installation in Mk 44 ex-runner torpedo of Tape Deck, Electronic Panels and shock measuring transducers are well advanced. Sub-assembly drawings and general arrangement are now being produced.

It is hoped to commence the trials programme in August/September 1965.

4.8 Instrumentation for outer ranges

The Type 303 marine radar has been supplied, the installation is held pending delivery of the photographic attachments.

4.9 Readout facility for magnetic tape results

The provision of a simple read out facility for the magnetic tape records obtained from the instrumented stores XR4 is being investigated with D.A. Arm.

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PART V - WORK CARRIED OUT FOR OTHER DEPARTMENTS

5.1 Pyrotechnics

R.A.R.D.E. development testing of the sea-cell operated Smoke and Flame float continued with a release trial of 17 stores in November, 1964 from a R.N. Gannet Mark 5 fitted with light-series carriers within the bomb bay.

A further proofing trial of $3\frac{1}{2}$ lb Smoke and Flame floats was carried out on behalf of D.I. ARM. Woolwich during the same months when 48 stores were dropped from the A. & A.E.E. Mark 3 Phase 3 Shackleton aircraft following a torpedo dropping clearance sortie. The Director, Group Captain C.H. Press, R.A.F. and members of his staff attended the trial as observers.

Arrangements were also made to drop Smoke and Flame floats and anti-submarine target indicators from a Shackleton aircraft from A.S.W.D.U. Ballykelly and, later, from the A. & A.E.E. Shackleton, but last-minute unserviceability of both these aircraft necessitated the use subsequently of a Wessex aircraft with which the trials were satisfactorily conducted.

Limited approval trials of the R.A.R.D.E. Smoke and Flame float are currently being arranged, using a Wessex aircraft, the Admiralty being unable to supply a Gannet aircraft as originally requested.

5.2 Wasp transponder aerial

Nothing further to report.

5.3 R.N. gun blast trials - Wasp helicopter

A.T.D.U. sent a three man team to participate in the Gun Blast trials which were held at H.M.S. Excellent, Portsmouth in January. One dummy Mk 44 torpedo, and one ex-runner Mk 44 instrumented for measuring in-flight vibrations were provided, together with the appropriate flight-in-air material. A. & A.E.E. co-operated in this trial by supplying the Midas recording equipment, and providing personnel to help set up and re-play the tape recordings on their playback facility.

With blast wave pressures at the helicopter of 1 lb/in^2 there was no discernible damage to the aircraft or the flight-in-air material. When the pressure was increased to $1\frac{1}{2} \text{ lb/in}^2$ parts of the canopy showed signs of damage, and the trial was terminated. Some of the results of the shock recording have been analysed, but publication of the results is awaiting re-calibration of the equipment on a shock pulse basis by A. & A.E.E.

5.4 Depth charges, aircraft 250 lbs. Mark 11
Wessex HAS Mark 1 - Carriage and release clearance

Trials to clear the Wessex HAS aircraft for the carriage, handling and release of 2 x 250 lb Mark 11 depth charges have been carried out on behalf of A. & A.E.E. Boscombe Down. The trials were carried out with inert stores only and confirmatory trials with live D.C.s are recommended.

Repositioning of the No 1 Mark 11 rear fuze unit forward of the suggested position is advised, with the use of two Johnstock clips to secure the arming wire instead of the conventional three, so as to lessen the tail-up and oscillatory tendencies of the store on release.

A report has been issued.

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5.5 DNE buoys
Wessex HAS Mk 1 and Mk 3 - Carriage and release clearance

In a trial conducted on behalf of A. & C.F.C. eight drops were made from a Wessex Mk 1 with wooden dummies from heights of 30 to 200 ft and from the hover to maximum speed. Flight vibration tests were also carried out with operational buoys to see if aircraft vibration could cause separation of the float.

The drops were unstable and bad water entries resulted. The floats remained in position during the various manoeuvres but, there were occasions when it was evident that aircraft vibration was beginning to affect the magnetic hold on the float.

Clearance for the carriage and release of the buoys from the Wessex Mk 1 has been given subject to certain precautions being observed during landing. Further it was recommended both that some form of stabilisation be introduced to control the descent of the stores, and also that a positive method should be devised to lock the float in position during flight.

Although a Mk 3 version of the aircraft was not available, clearance has been likewise recommended since this helicopter is structurally similar to the Mk 1.

The design concept of the float release system is regarded as inferior and it is felt redesign work is necessary

PART VI - ENVIRONMENTAL TESTING OF TORPEDOES
AND FLIGHT-IN-TRIAL MATERIAL6.1 Vibration measurements using Midge tape recording instrumentation

- (a)
- Shackleton MR Mk 2 Phase 2 - clearance for the carriage of Mk 44 torpedoes

The letter report showing overall vibration envelopes has been delayed due to pressure of other work; the results are finalized and the report will be issued shortly.

- (b)
- Shackleton MR Mk 3 Phase 3 - clearance for the carriage of Mk 30 and Mk 44 torpedoes

Measurements taken from two different types of vibration transducer were not in agreement and further trials were necessary to resolve this problem. As soon as the A. & A.E.E. report is issued giving acceleration versus frequency data this will be analysed at A.T.D.U. on an overall vibration envelope basis and a report will be issued.

- (c)
- Shackleton MR Mk 2 Phase 3 - clearance for the carriage of Mk 30 and Mk 44 torpedoes

Work is in hand to overhaul the two instrumented torpedoes in readiness for the carriage trials to be held at A. & A.E.E. in June/July.

- (d)
- Messex HAS Mk 1 - investigation into vibrations in Mk 30 and Mk 44 torpedoes

This task is now completed; the results were issued in A.T.D.U. Tech. Note No 1/65 in February 1965, copies of which were circulated to all interested departments.

- (e)
- Gannet AEW 3 - investigations into vibrations in Mk 44 torpedoes

Modifications made to the mounting cradle for the Midge recorder to suit the Gannet AEW 3. Recordings were made of the vibrations in a Mk 44 torpedo when carried on the starboard pylon under various flight conditions. The flight trials were completed in January, and the tape recordings are now being analysed by R.A.E. Weapons Department.

- (f)
- Vasp H/S Mk 1 - investigations into vibrations in Mk 44 torpedoes

After some initial difficulties with the recorder and the aircraft's power supply had been overcome the flight trials were completed in February 1965. The tape recordings of the vibrations present in the Mk 44 torpedo, when mounted on port and starboard carriers, are being analysed by the Weapons Department of R.A.E.

6.2 Shock measurements using A.T.D.U. tape recording equipment in Mk 44 ex-runner torpedo XRL

- (a)
- Line recovery system

The initial development trials using a line and grab system of recovery in the modified tail section of XRL were completed in April. As a result of these trials, which included four drops positively buoyant and four drops in the negatively buoyant state, minor modifications will be carried out.

(b) Water jettison system

Manufacturing work is now completed and trials will now commence to test this system of recovery in XR4.

(c) Instrumentation

The tape recorder mount and battery pack are nearing completion, and the instrument pack is progressing well. The design section are engaged upon the overall layout of the completed XR4 with a view to obtaining warshot weight at the correct C of G position. Detail designs are progressing on the transducer mounts and the switching system.

6.3 Shock measurements using other electronic instruments(a) Peak "g" recorder Mk I No 1

This shock level indicator, modified to give time durations at two pre-selected "g" levels, was used successfully on ten drops before the store in which it was installed (79) was lost on a jettison release drop on 18th November 1964. As the results from this instrument were providing valuable information for use in setting up the shock recording store XR4, workshops were requested to produce an identical unit as soon as possible and install it in 08.

(b) Peak "g" recorder Mk I No 2

The new instrument was manufactured, calibrated and installed, and the first drop in the present series took place on 17th February, 1965. In assessing the results of the time-slice tests completed so far, three generalizations may be made:

(i) Plotting the time-slice duration against % "g" the maximum duration envelope indicates that at 75% of the peak "g" measured the pulse may endure for 3 m.sec; at 50% of the maximum "g" it may last for 9 m.sec; whilst at 30% a pulse length of 18 m.sec has been recorded.

(ii) At the lower "g" levels the minimum duration envelope indicated that 10g persists for not less than 3 m.sec, 8 g for 5 m.sec., and 7g for at least 10 m.sec.

(iii) There is a clear demarcation between drops made at water entry angles less than 63° and greater than 70°. The shock pulses tend to fall into two groups of roughly similar form but of different "g" magnitudes: the greater shock occurring at the higher angles of water entry.

(c) Mechanical shock indicators

For water entry shock investigation the use of Reed Gauges, Inertia Switches and Impactographs has been discontinued, as these have all proved to have inadequate response characteristics, but the Impactograph will still be used to measure parachute opening shocks.

6.4 Low temperature tests on torpedoes and flight-in-air material(a) Versox Mk 5 winterisation trial

An N.T.D.U. representative was sent to participate in the Winterisation Trials held at Fort Churchill in February/March 1965. An interim report will be issued shortly detailing the trials carried out and the recommendations made, but a summary of the main findings are listed overleaf.

S E C R E T

- (i) No difficulty was experienced in loading Mk 43 and Mk 44 torpedoes onto a Wessex Mk 5 at an outside air temperature of -33°C and windchill 2280.
- (ii) On the one mechanical jettison and one release drop carried out all the flight-in-air material functioned correctly.
- (iii) The scoopbulkhead plunger, which allows water to enter the torpedo and energise the battery, failed to open on most of the cold static tests carried out.
- (iv) The N.2 Mk I fuse was severely affected by both the cold and ice build up: the pull off loads of the plugs hydrostatic and locking increased by 200 to 300%; of which as a consequence the key ring type lanyard attachment distorted on the live drop, allowing the plugs to stay in the fuse, and the torpedo to fall un-armed.

(b) Type "C" breakaway band

As a result of the static cold tests carried out at Fort Churchill it was clear that neither low temperatures nor a reasonable amount of icing up would cause the band to malfunction. The bungees remained flexible at low temperature, and one pair were used on three successive temperature cycling tests without showing signs of deterioration. In view of these results the type C breakaway band is considered suitable for use under sub-arctic conditions, and no further low temperature tests on this component are necessary. (See paragraph 2.4).

(c) Type "R" release mechanism

Due to the very dry conditions which existed at Fort Churchill the protective cover for the type B release was not able to be tested under the conditions for which it was designed; but on one comparative test carried out using two mechanisms (one with and one without covers) only the covered one would have released at water entry. Very cold, dry weather had no serious effects on the mechanisms paddle release loads or in the relative movements of mating parts. It is felt, therefore, that no problem exists due to contraction, but that the exposed mechanism renders it liable to malfunctioning due to the ingress of snow, ice particles, or freezing rain.

This susceptibility to icing up exists, and under conditions of air temperatures below 0°C and freezing rain it could become a major hazard. For this reason it is recommended that climatic tests be initiated to investigate this problem more fully

S E C R E T

PART VII (Continuation of Summary of Drops)

<u>OTHER TRIALS</u>	<u>OBJECT OF TRIAL</u>	<u>NO. OF STORES DROPPED</u>
E/64/D	Measurement of vibration in a Mk 44 torpedo when carried on a Carnet AEW 3. (2 sorties 2 hours flying)	0
E/64/D	Measurement of vibration in a Mk 44 torpedo when carried by a Wasp helicopter. (6 sorties 2 1/2 hours flying)	0
T/63/E	Range photography test covering Canberra aircraft. (1 sortie 50 minutes flying)	0

S E C R E T

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