HEADQUARTERS SIGNALS COMMAND ROYAL · AIR · FORCE

REPORT No: 4

HEADQUARTERS SIGNALS COMMAND

REPORT NO. 4

Engineering Evaluation of Radar Type 14 Mark 8 for use in an Airfield Surveillance role.

by

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SUMMARY

Engineering Evaluation of Radar Type 14 Mk. 8 and Associated Equipment for use in an Airfield Surveillance role.

An engineering appraisal of Radar Type 14 Mk. 8 has been conducted with a view to its being adapted for use in an airfield surveillance role.

Comparisons have been made with Air Staff Requirement No. 2077 (2nd Edition) and with the capabilities of the Cossor 787 Surveillance Radar Equipment. In addition, a discussion is offered of the limitations of the equipment and the effort required to adapt it for either static or mobile use. Certain modifications are discussed and the introduction of circular polarisation, supply voltage regulation and the switching of ranges displayed are recommended.

It is concluded that notwithstanding the low speed of scan and absence of M.T.I., a very useful service is offered incorporating good pick-up range, clear display and reliability. A static arrangement for airfields in the U.K. is likely to make the most economic use of the equipment, but a mobile version could be introduced if a need existed and this could incorporate P.A.R. displays if required.

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Introduction

1. Radio Engineering Instruction No. 2431 calls for an Engineering Appraisal of the Radar type 14 Mk. 8 in respect to its suitability for use as an airfield surveillance radar equipment. This report is based on engineering trials carried out at R.A.F. Tangmere during August, 1959 using a convoy comprising one RVT.502 (Radar type 14 Mk. 8), and RVT. 510 (Operations vehicle) and two RVT. 550, (50 KVA. power vehicles) A Canberra from No. 245 Squadron was used for flight trials.

2. The R.E.I. also calls for a comparison of the Radar type 14 Mk. 8 with the Cossor 21 equipment. In this report the comparison is made between the Type 14 Mk. 8 and the Cossor 787, which is a development of the Cossor 21. An evaluation of the Cossor 787 S.R.E. is given in Report No. 3 of 1959 issued by this H.Q. The equipments are examined with close reference to Air Staff Requirement No. 2077 (2nd edition) as detailed in Appendix 'A' of this report. The main features of the equipment are quoted in Appendix 'B'.

3. It will be shown that although the Radar type 14 Mk. 8 fails to meet the A.S.R. 2077 in some ways (the most important of which is its low speed of aerial rotation) it can be adapted to provide a reliable airfield surveillance service giving better cover than that available from equipments now in use.

4. Alternative methods of using the equipment in either a static or mobile manner are discussed.

Discussion on the limitations of Radar Type 14 Mk. 8 in the surveillance role.

5. The rotational speed of the Radar Type 14 aerial cannot be increased above 6 revolutions per minute and this feature may place some restrictions on its use as a surveillance radar. In the interval between successive paints an aircraft travelling at 600 m.p.h. would change its position by 1.67 miles. However, it is envisaged that the Radar Type 14 would be used to feed aircraft into P.A.R. from the airfield circuit and under these circumstances it would be handling aircraft travelling at speeds of 200 m.p.h. or less. Thus landing aircraft would change their position by about half a mile between successive paints. It is considered that the clarity of paint on the P.P.I. together with the good afterglow characteristics of the tube would adequately compensate for this relatively slow rate of aerial rotation.

6. Consideration must be given, however, to the possibility of the intrusion into the circuit of a high speed aircraft and the ability of the Radar Type 14 to plot its course and to detect changes sufficiently quickly for the possibility of a collision to be averted. The Radar Type 14 provides very good cover at low angles of elevation giving pick-up ranges of 20 miles at 1,000 ft. and 35 miles at 5,000 ft (for an aircraft of echoing area 20 sq. metres) and this compensates to some extent for the low rate of scan. With this type of cover therefore and the long afterglow tube, a Controller should be able to detect and plot such an intruder and have sufficient time to take any necessary action to avoid a collision. Even with a 2 sq. metre target travelling at 600 m.p.h., some 30 secs would be available after detection and direction had been established.

7. The time required for collision avoidance action depends upon:-

(a) The time to determine the proximity and course of an intruder.

(b) The time for instructions to be decided upon and passed to the aircraft under control.

(c) The time for the aircraft to change course.

The former can be satisfied by the observation of three definite P.P.I. paints, and this will take some ten seconds longer with the Radar type 14 Mk. 8 than with the Cossor 787 operating on its lower aerial speed, or fourteen seconds longer than the Cossor 787 operating at its higher aerial speed.

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8. The improvement in cover provided by the Radar type 14 (indicated in Figures 1, 2 and 3 of this report) will tend to compensate for this longer time, by permitting the intruder to be observed earlier than would have been the case with the Cossor 787. Moreover, this intruder would be illuminated by twice as many pulses per aerial revolution in the case of the Radar type 14 and this decreases the risk of missed paints. Although the Cossor 787 should, at its greater scan speed, display twenty paints in the time taken for the Radar type 14 to display six, it is unlikely to achieve this figure because of the greater risk of missed paints at high scan speeds.

9. There are two ways of increasing the number of paints per minute but each has its limitations.

(a) By using two aerial heads back to back on separate vehicles, the display can be arranged to give the output from each head alternately over the same sector of 180°. In this way the number of paints per minute over a sector of 180° may be increased from 6 to 12. The disadvantages are that with the limited number of R.V.T. 502 available this would be an extravagant use of two vehicles per station, and from an operational point of view the ability to scan over only 180° might not be acceptable.

(b) There is a facility on the display unit to change from the complete rotation of the aerial head to a sector sweep. Any sector may be selected and the sector may have any width up to 120°. In this way the number of paints in a particular area may be increased to 8-10 per minute. Once again the disadvantage lies in the limited arc over which the aerial head will scan.

10. The Radar Type 14 Mk. 8 is not fitted with M.T.I. and a modification to provide this facility would be such a major task that it is not considered to be practicable. On the test site at Tangmere the permanent echo clutter extended to almost 5 miles and this is the sort of figure to be expected at most airfields in the U.K. However, the existing method of controlling aircraft on an approach is to hand over from the surveillance radar to P.A.R. at between six and ten miles and so at most airfields the lack of M.T.I. would be no handicap. It must be stressed however that each airfield at which it might be proposed to instal Radar Type 14 Mk. 8 would have to be surveyed to ensure that the permanent echoes on the approach bearing do not extend beyond the P.A.R. hand-over point.

11. Examination of the vertical coverage diagrams (Figures 1, 2 and 3) will show that the Radar Type 14 Mk. 8 has a better performance than any other surveillance radar at present in use on airfields, giving better cover at low and high altitudes. It gives a maximum range at 30,000 ft of 67 miles (aircraft echoing area 20 sq. metres) against 52 miles at the same height for Radar 787 without a polariser. The range would be further improved by the use of a Travelling Wave Amplifier. Such a modification would be expected to increase the range of the radar by between 20 and 25% but would require considerable design work.

12. The Radar Type 14 Mk. 8 is not fitted with a circular polariser and therefore some trouble is to be expected from rain clutter. However, a circular polariser has been designed by Signals Command and is at present being manufactured. An assessment of its performance will form the subject of a separate report.

Work involved in adapting the Radar Type 14 Mk. 8 for the airfield surveillance role.

13. The Radar Type 14 Mk. 8 may be used either as a static installation (at permanent airfields) or as a mobile installation (overseas, or in a tactical role), and it is proposed to deal with each type of installation separately.

14. Static Installation. This would employ either a mobile head (R.V.T. 502) or a static one, depending upon the availability of equipment. In the former case the installation of the aerial head would be a simple and straightforward matter for it could be driven onto a suitable hardstanding and jacked up using the levelling jacks provided on the vehicle. To avoid deterioration, the prime mover could be removed. In the case of the static type of head, a brick plinth consisting of a hut with a reinforced roof would be necessary to support the

/aerial

aerial and to house an alternator to provide the 180 volt 500 cycles supply.

15. The P.P.I. displays (Display Units Type 60) could be installed in suitable positions in the airfield control tower (one for general surveillance and one adjacent to, and for use with P.A.R.). The associated control equipment and the information generator could be housed in the equipment room of the tower. The Works Services associated with such an installation would be little more than providing power points and floor fixings.

16. Using the cables supplied with the R.V.T. 502 it would only be possible to place the aerial head 225 yards away from the display. Two sets of cables could be used to increase this distance to 450 yards. Beyond this distance low loss cables (e.g. U.R. 86) would be needed to provide remote displays in the tower from a head up to 5,000 yards away. It is considered that there would be no requirement to exceed the figure of 5,000 yards at airfields in U.K.

17. Mobile Installation. The aerial head for this type of installation would be R.V.T. 502, set up on a suitable hardstanding. Normally two power vehicles R.V.T. 550 would be required but the full load of the equipment could be supplied by one R.V.T. 550 provided that it was modified to include a suitable voltage stabiliser. This single modified power vehicle would also suffice to supply power to the display vehicle.

18. The R.V.T. 510 which contains the displays associated with the Radar Type 14 Mk. 8 also contains displays and control equipment for height finding radar. There are comprehensive telephone facilities but R/T is not fitted. As such, the R.V.T. 510 is unsuitable for use as a mobile operations vehicle. There are two possible solutions, namely, either modifying the R.V.T. 510 by removing all unwanted equipment and fitting V.H.F. and U.H.F. R/T facilities; or installing the P.P.I. displays, control equipment, information generator and R/T equipment in a new container. The new container could also contain the P.A.R. display so that approach and talk down would be carried out from the same point. A study has been made which confirms that the required items of equipment could be installed in a Container Body Mark 5 although the inclusion of the P.A.R. display would tax the capacity of this vehicle almost to its limit. A rough estimate of the effort required for this installation is of the order 1,000 to 1,500 man-hours per vehicle and considerable design drawing effort would also be necessary. A Mobile Air Conditioning Unit type R.V.T. 181 would be needed as an addition to the convoy.

19. As stated in paragraph 16, the aerial head could be located up to 5000 yards away from the Operations vehicle but it is envisaged that in the mobile role the aerial head, operations vehicle and power vehicle would be close together and certainly within the 225 yard limit set by the cable lengths. In these circumstances, cable storage could be arranged on the technical vehicles, thus doing away with the need for a cable carrying vehicle. If air transportation was required only three technical vehicles would have to be moved. The cable storage problem could be further simplified if it was agreed that a fixed rate of aerial rotation only was required, thereby reducing the number of control cables between the R.Vs.T. 502 and 510 by 3.

Modifications suggested for Airfield Surveillance role

20. The power taken by the Radar type 14 and associated equipment could all be provided by one R.V.T. 550. It has been the practice however to include a second power vehicle in the convoy so that the total load is shared and the effect of short duration load changes is not communicated to all parts of the equipment. The addition of a suitable voltage stabiliser would eliminate the need for one of the two power vehicles normally associated with the Radar type 14 convoy. (See paragraph 17).

21. A simple modification was introduced during the trial to provide a stepped selection of range displayed on the Console type 60. With this arrangement the display could be switched to pre-determined settings of 20, 50 and 100 miles.

22. The incorporation of a Signal Frequency Amplifier (Travelling Wave Tube) was mentioned in paragraph 11. This modification has been considered in some detail since it would provide a means of bringing the maximum range of the equipment very close to that specified in A.S.R. 2077, by effecting an improvement

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in Receiver Noise Figure of approximately 3 dbs. The engineering aspects of the modification would entail a considerable amount of effort and it is considered that for reasons of time and economy the change is not merited. It has already been mentioned that the pick-up range of the Radar type 14 is superior to that of equipments now in airfield surveillance use, and also to that of the Cossor 787.

23. A circular polariser has been designed and will be tested when its manufacture has been completed. The results of the tests will be reported at a later date.

24. The modifications necessary for adapting the equipment associated with Radar type 14 for airfield surveillance are discussed in paragraphs 14 - 18, in connection with both mobile and static uses. Appendix C lists the items of control and display equipment required.

Trials conducted in connection with this Appraisal.

25. The convoy consisted of the following vehicles:-

RVT 502 - Radar type 14 Mk. 8

RVT 510 - Operations vehicle.

RVT 540 - Cable carrying vehicle.

RVT 550 - 50 KVA Power vehicles (Qty. 2).

The Radar equipment and Vehicles are adequately described in existing Air Publications which are listed in Appendix 'F'. These are sufficient for all documentary and servicing requirements.

26. RVT. 550 supplies the required 230 volts 50 c.p.s., single phase supply from a diesel-electric generating set. A mains control switchboard is incorporated on the vehicle.

27. RVT. 502 has mounted upon it the radar cabin which houses transmitter and receiver, associated test gear, aerial turning motor and slip ring unit together with the aerial system. The latter consists of a 25 ft. x 5ft. 6 inch reflector (cosecant ^{2}) fed from a slotted waveguide. The equipment cabin rotates with the aerial system and levelling is arranged by hydraulic jacking on the vehicle. Mounted on a platform of this vehicle is a 180 volt 500 c.p.s. alternator and a servo amplifier unit. RVT. 502 can be remoted from RVT. 510 up to a maximum distance of 225 yards with cables supplied.

28. RVT. 510 was designed for use as a mobile G.C.I. Control room and is intended for use with several radar heads. Of the displays available only the two P.P.I. Consoles type 60 and the necessary section of the information Generator Rack were needed during the evaluation. The Console type 60 incorporates a 12" long-persistence P.P.I. display with full off-centering facilities and a time base display continuously variable from 10 to 120 nautical miles range.

29. RVT. 540 is a cable carrying vehicle and serves no other function.

30. Flight trials using Canberra aircraft were conducted, to produce vertical polar diagrams for reflector tilt angles of 2°, 1° and 0°. They established that with a mechanical tilt of 2° the reliable control area (i.e. 80% reliability) for a Canberra extends without breaks over a vertical arc of 22°, with a maximum range of 65 nautical miles at 35,000 feet. On a target of echoing area of two square metres the maximum range is calculated to be 38.5 nautical miles at 19,000 feet. (See Fig. 1).

31. With the reflector set to 1°, or 0°, tilt, there is a reduction in the vertical angle of coverage, accompanied by some increase in maximum range at lower altitudes as indicated on Fig. 2, but the cover at 1,000 feet remains appreciably the same. The operational selection of tilt is to some extent dependent on the permanent echo pattern; at Tangmere the p.e.'s extended to 5 miles with the 2° tilt and increased to 7-8 miles at zero tilt.

32. The performance of the equipment was noticeably consistent through the trial. Mechanical and electrical breakdowns were few and were quickly remedied by mechanics who had been trained in servicing the equipment.

Test Equipment

33. The test equipment supplied or fitted in RVT. 502 and RVT. 510 is adequate; a list is provided in Appendix 'D'.

Mobility

34. The vehicles have undergone trials at the Fighting Vehicles Testing Establishment; the following limitations are applicable:

Class A roads	-	20 m.p.h. maximum
" B "	-	10/15 m.p.h.
Cross country	-	5 m.p.h. maximum

Conclusion

35. Although the equipment fails to meet the A.S.R. 2077 in some ways, including slow aerial rotation, lack of M.T.I. and circular polarisation, and insufficient coverage range, it would provide a useful performance in either a static or a mobile role. The static arrangement would be by far the more economic as the displays and associated units could be installed in an Airfield Control Tower with little trouble. The mobile version would involve ideally an installation in a new container, incorporating display, control and communications equipment and perhaps P.A.R. displays. The work involved in producing this installation would be of the order of 1000-1500 man-hours per vehicle plus design effort.

36. Mobility of the convoy would be improved by the elimination of one power vehicle and the cable carrying vehicle, and the substitution of a Container Body Mark 5 in place of the existing RVT. 510, but it is recommended that a Mobile Air Conditioning Unit, type RVT. 181 should be added.

37. It is likely that the chief operational drawbacks will be the absence of M.T.I. and the low speed of aerial rotation. However it has been shown that M.T.I. is not essential when a surveillance radar is used in association with P.A.R. and that to a considerable extent the slow rate of scan is compensated by increased range at low altitude and more reliable painting.

* Amended in accordance with letter S.C/2159/15/RE1 dated 17th Dec 1959

Appendix 'A'

Comparison of A.S.R. with the appraisal results

A.S.R. Reference		Air Staff Requirement	Cossor 787 Performance (Figures in brackets indicate with polariser)	Radar type 14 Mk. 8
2(b)		Panclimatic	Equipment not panclimatic. Temperate zones only.	Equipment not panclimatic, but has functioned successfully in tropical climate using the fitted atmospheric control units and additional refrigeration plant.
2(c)		Transportability	Air transportability claimed by Manufacturer. Consoles may be remoted. Extra vehicle required for transporting aerial. One Beverley aircraft.	Complete convoy is air transportable. Five Beverley aircraft.
2(f)		Standby Equipment	Model examined did not contain standby equipment however space available to fit.	No standby equipment is fitted. Space not available in RVT. 502.
3(c)		Communications	Communications facilities not fitted. Space available for one TR 5043 and power pack only.	None fitted. Space could be made available.
4(a)	(i)	Range N.M. 2 sq. metre target - 50	~~36~~ 28 (~~28~~ (22)	38.5
	(ii)	Azimuth Coverage Degrees 0-360	0-360	0-360
	(iii)	Elevation coverage degrees $\frac{1}{2}$ - 45	3-20 (4-17)	3-25
	(iv)	Maximum altitude feet 40,000	~~25,000~~ 20,000 (~~20,000~~ (18,000).	35,000 (Canberra a/c 20 sq. metre target) 19,000 (2 sq. metre target)
5(a)	(i)	Range accuracy:- ± 150 ft. or ± 2% of range whichever is the greater.	± 3%	± 2%
	(ii)	Beam azimuthal width. degrees:- 1 ($\frac{1}{2}$ power points)	1	1
	(iii)	Range discrimination feet:- 750	1000	1000
	(iv)	Aerial rotation speed:- At least 20 (revs. per min.)	12 (M.T.I. optimum performance) or 20 (M.T.I. poor performance)	0 - 6 or Sector sweep 20° to 120°
6		Consoles remoting yards:- 2000	4000	225 (mobile) $\frac{1}{2}$ mile (static) may be in excess of this with special low loss cables. (Maximum 5000 yards)
6(a)	(i)	Time base duration:- 0-20 NM either 5 or 2 NM range marks at Controllers discretion 0-50 NM, range marks every 5 NM.	0-10 NM Range marks 1 NM int. 0-25 NM " " 5 " " 0-50 NM " " 10 " " 0-100 NM " " 20 " " (Simple mod. necessary to provide other range scales)	~~0-20 NM~~ As modified ~~0-2 NM~~) 0-50 ") range marks 5 or 10 NM intervals 0-100 ") Previously 0-10/120 NM variable with range marks at 5 or 10 NM intervals.
	(ii)	CRDF Slave:- one	None fitted	None fitted

A.S.R. No.		A.S.R. Requirements		T.14 Mk. 8
	(iii)	Console centre off-setting:- Full off-set	Max. of one third off-set Preset)	Full off-set
	(iv)	IFF signal display:- Both consoles to be able to display I.F.F. signal	Facilities are available for display of I.F.F. on both consoles	Facilities available by modification
7		Communication:- VHF and UHF facilities with inter-communication between operators.	NIL Limited space only available. No inter-communication. See 3(c)	NIL Space could be made available.
8		Siting:- Capable of siting adjacent to P.A.R. vehicle	Siting in close proximity to P.A.R. vehicle desirable but may be limited by interference.	The head must be a minimum distance of 100 yards from any obstruction.
9(a)		Mobility:- Aerial stowage Drive at 15 m.p.h. over Class B roads, rapidly secured on land sea, air transport.	Separate vehicle required for road transporting aerial. Air transport uses a low wheel trolley arrangement. Manufacturers hold road worthy certificate No difficulties.	Aerial secured on RVT 502 10 - 15 m.p.h. over class B roads Land and sea - no difficulties Air - Possible with certain precautions. (5 Beverley aircraft).
(b)		Mobility:- Within airfield boundary	Time to bring into full service on arrival at new site estimated to be about 10 minutes.	Time to bring into full service on arrival at new site is approximately 6 hours.
(c)		Outside airfield boundary	Necessary to dismantle aerial and transport on a separate vehicle	Time to bring into full service on arrival at new site is approximately 6 hours.
10		Operating Characteristics:- M.T.I.	Efficient at 12 r.p.m. The efficiency falls off at 20 r.p.m. Blind speed multiples of 70 knots.	No M.T.I.
		Service conditions:- <u>Circular Polarisation</u>	<u>Efficient rejection of echoes from precipitation</u>	<u>No circular polariser</u>
		Temperature External 40°C to + 55°C Internal 0°C to + 55°C Humidity 85% at 55°C	No tests were possible over this range. The components will need redesign to meet full panclimatic specification.	No tests were possible over this range.
		Windage; operating 60 knots; non operating 80 knots.	Constant speed up to 55 knots. Withstand steady 70 knots.	Has operated with wind of up to 50-60 knots.
11		Handling characteristics:- Controls	Control layout as shown acceptable but not good	Equipment has already had extensive Service use and unwanted controls on Console Type 60 could be made inoperative.
		Display Consoles	Fitted adjacent to each other but can be placed anywhere	In RVT. 510 fitted adjacent to each other
12		Power supplies:- 100-125 Volts 200-250 Volts 45-65 cps	Radar works on 200-250V 45-65cps only. Aerial drive motor d.c. or a.c. single phase or 3 phase (as required)	250V 50 c.p.s. single phase

A.S.R. Requirements	787	T.14 Mk. 8
Aerials:- Mounted on installation when in use	Aerial is mounted on the forward part of the vehicle	Mounted on RVT 502
Capable of being stowed in or with the vehicle	The aerial is dismantled and transported in a separate vehicle	An integral part of RVT 502
Servicing:- Easily replaceable sub-assemblies	The indications are that the reliability should be good.	Service items available
Test equipment:- Test gear is not to be "specified to type" unless built in as an integral part of the equipment.	Test gear to meet Signals Command recommendations available from Messrs. Cossor.	Service test gear installed (See Appendix 'D')

Appendix 'B'

Radar Type 14 Mk. 8 and associated equipment - Main Features

Frequency (Nominal): 2965 Mc/s to 3045 Mc/s (S Band)

Magnetron: CV.1479) or CV.1480) or CV.1481) or CV.1482) Spot frequency

Peak Power: 500 KW Nominal

Pulse width: .6 or 1.9 uS.

P.R.F. 130/550 pps.

T.R. Cell CV. 293

T.B. Cell CV. 294

Mixer CV.364

Receiver I.F. 45 Mc/s

Bandwidth .9 to 1.3 Mc/s Bandwidth switch in 1 Mc/s position
or 3.1 to 3.7 Mc/s " " " 3.5 Mc/s "

Noise factor Overall 10.5 db

I.F. 2.5 db

Aerial:-

Rotation	0 - 6 r.p.m. continuously variable
Tilt	Manually adjustable between 0° and 4°. Tilt angle changed in 5 minutes
Az Beam width	1 degree to $\frac{1}{2}$ power points.
El Beam width	$Cosec^2$ between 3 and 25 degrees.
Polarisation	Horizontal

Display

2 - Consoles Type 60A (- 12" P.P.I. display)

Time base duration is variable between 10 and 120 miles.
By modification displays of 20, 50 and 100 miles can be selected.
P.P.I. centre off setting - Fully available.

Power Requirements -

230V single phase 50 cps, max. load 21 KW.

Normal running:

	Regulated supply	Unregulated supply
RVT. 510 Heaters off	9A	10A
" on	9A	36A
RVT. 502 Type 14	10A	36A

Alternator takes 30A on starting

Amplidyne takes 40A on starting

Appendix 'C'

List of Display and Control equipment required for either mobile or static installation

Equipment to be fitted in the air traffic control tower, or operations vehicle.

(i) Display

2 Consoles Type 60 with associated air blowing ducts and motors.

(ii) Control etc.

Rack Mounted Units:-

Amplifier Type 3679	N.B.W. (form of Anti-Jam) Not essential but if not used a minor mod. is required to complete the video signal chain.
Amplifier Type 3680	(IF and Video with Independent A.G.C.)
" " 3681	(Video and Anti-Jam, Short Time Constant cct etc.)
Marker Unit Type 27	(5 &, 10 n.m. range marks)
Rectifier Type 15	(50 volt d.c. for relays etc.)
Rack assembly Type 166	(Servo control units and power)

Distribution board and video matching units.

Approx. size of each unit:- 13.$\frac{5}{8}$" wide, 12.$\frac{1}{4}$" high and 20.$\frac{3}{4}$" deep.

Test gear (trolley mounted):-

Test set Type 402, Ref. No. 10S/16157

Monitor Unit Type 75, "10T/6136

Power Unit Type 74, " 10K/16091

Junction boxes and link connectors.

Air blowing facilities.

Test Equipment Incorporated or Supplied

RVT. 510:

Test Set type 402. Ref. No. 10S/16157

Switch Unit Monitor Type 296 Ref. No. 10F/16141

Monitor Unit Type 75 Ref. No. 10T/6136

Power Unit Type 75 Ref. No. 10K/16091

RVT. 502:-

Monitor Type 60 Ref. No. 10T/6132

Sig. Gen. Noise Type 1. Ref. No. 10S/16149

Power Unit Type 869, Ref. No. 10K/16125

Attenuator unit variable Type 115. Ref. No. 10L/16156

Spectrum Analyser Type 1 Ref. No. 10S/16147

Attenuator unit type 111 Ref. No. 10L/16031

Output tester Type 66. Ref. No. 10S/16151

Appendix 'E'

Cable Data

Cable No.	From	To		Remarks
1/1	RVT.550	RVT.510	Mains supply -	Heaters and blower
1/2	"	"	"	Ancillary Units
1/3	"	"	"	Main Radar equipment
3	RVT. 510	RVT. 502		-50V d.c. for relays and telephone.
5	"	"		Repeat back selsyn
7	"	"		Turning gear controls
8	"	"		
9	"	"		
13	RVT. 550	RVT. 502	Mains supply -	Heaters and blowers
14	"	"	"	Alternator & Radar
15	"	"	"	Turning gear
16	RVT. 510	RVT. 502	Trigger switching	
19	"	"	Trigger IN (coaxial)	
21	"	"	I.F. IN (")	
24	"	"	Earth	

The above is a list of the total cables required in normal G.C.I. working. When employed for airfield control as a mobile equipment the following changes are possible:-

Cable No. 16 is not required - the cable terminations are shorted together on RVT. 502. If it were decided to use only constant speed of aerial rotation it would be possible to dispense with cables Nos. 7, 8 and 9.

Static conditions

It is assumed that suitable mains power supplies would be available at the remote head and in the Air Traffic Control Tower and the following cables would be required: No. 3, 5, 19, 21 assuming again constant speed of rotation is acceptable.

Air Publications

A.P. 2527 B	Radar Type 14 Mk. 8 and RVT. 502
A.P. 2527 J	Radar convo, RVT. 550 and RVT. 510
A.P. 2897 NA	Consolan Type 60 and Type 60A
A.P. 2897 Q	RVT. 510

RADAR TYPE 14 MARK 8 V.P.D.

MECHANICAL TILT° 2°

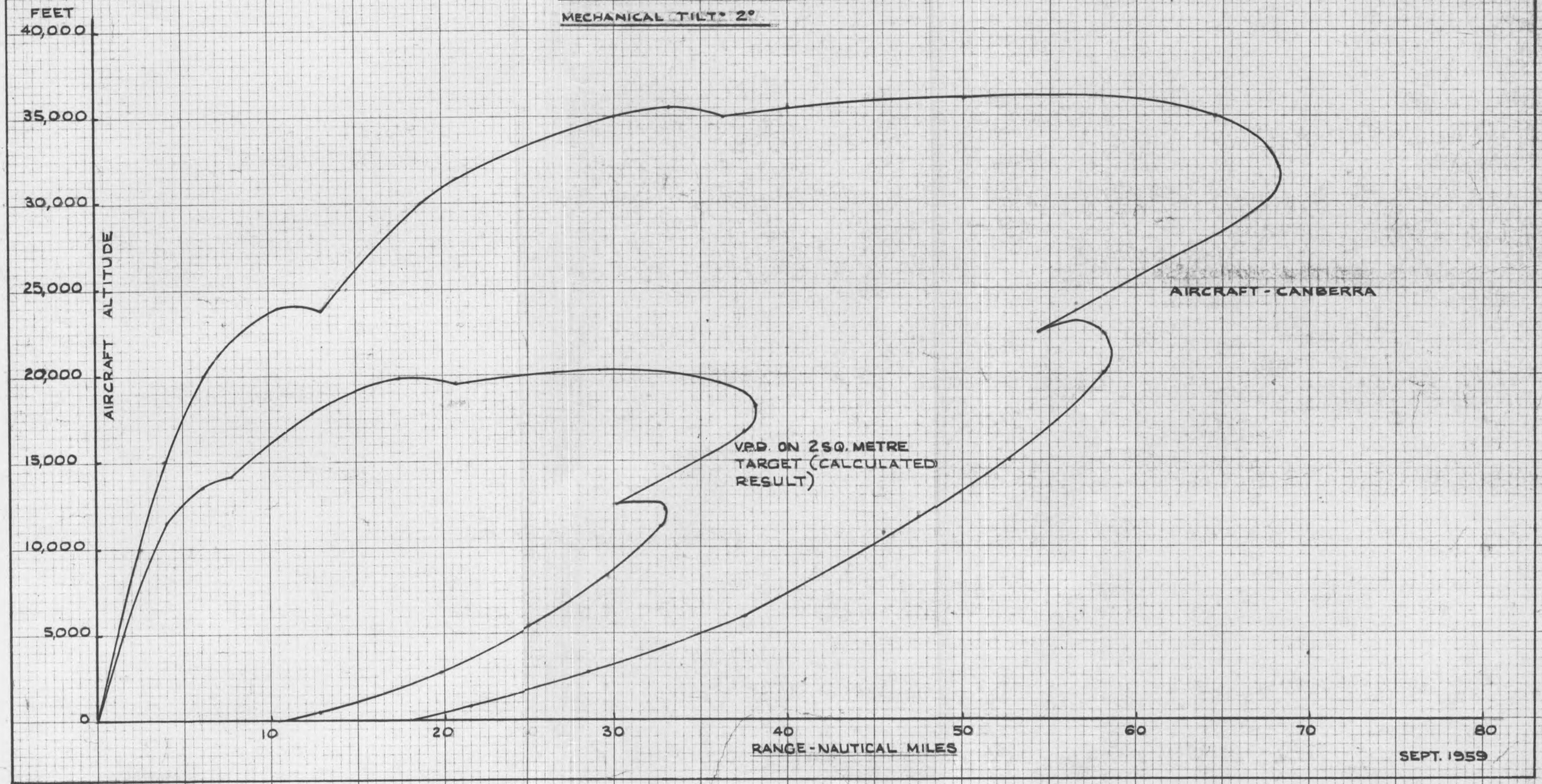

FIG. 1

RADAR TYPE 14 MARK 8 V.P.D.

AIRCRAFT - CANBERRA

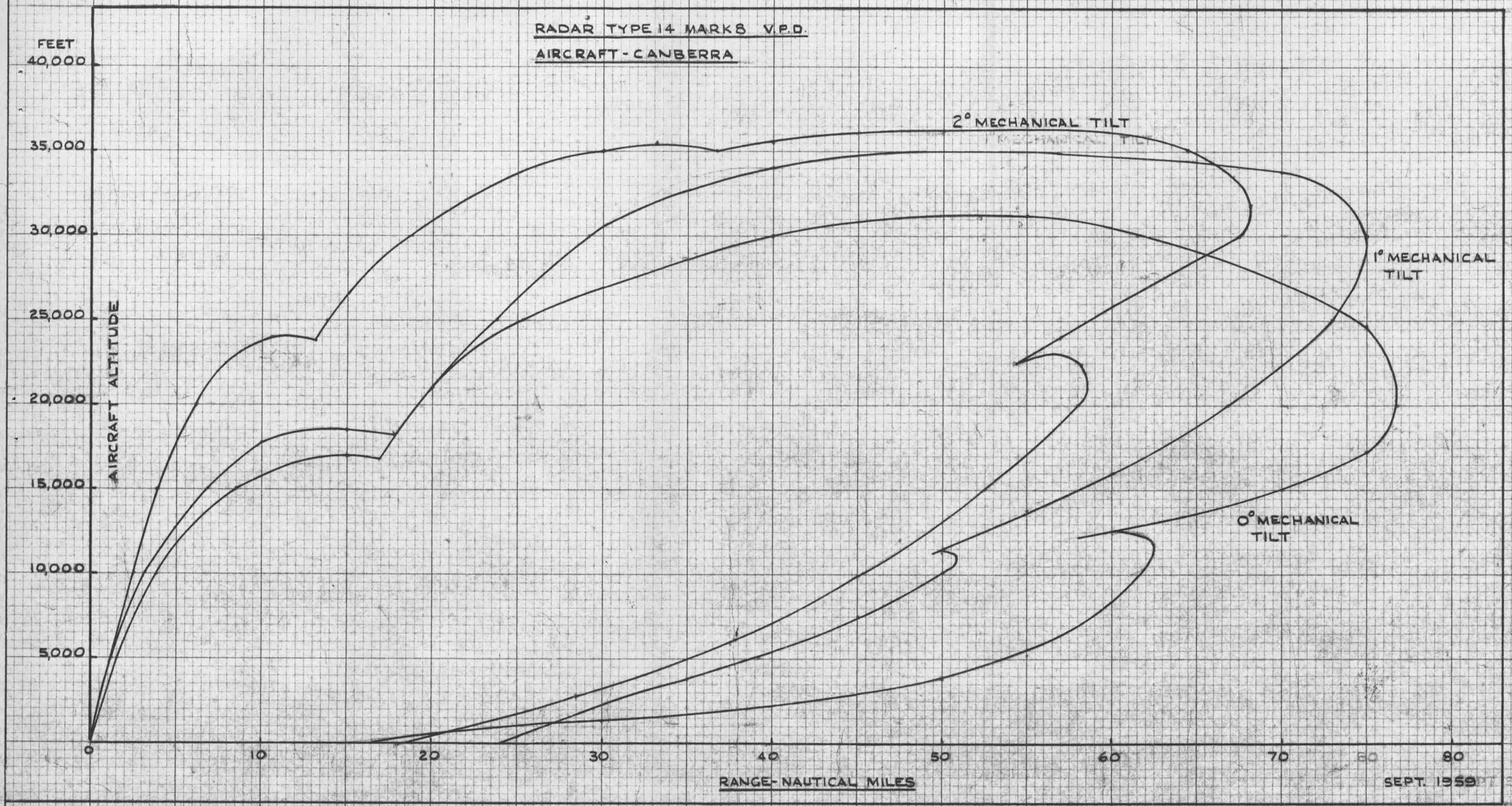

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FIG. 2

V.P.D.'s OF RADAR TYPE 14 MARK 8. COSSOR 787, & RADAR TYPE CPN 18.

AIRCRAFT:- CANBERRA (ECHOING AREA 20 SQ. METRES.)

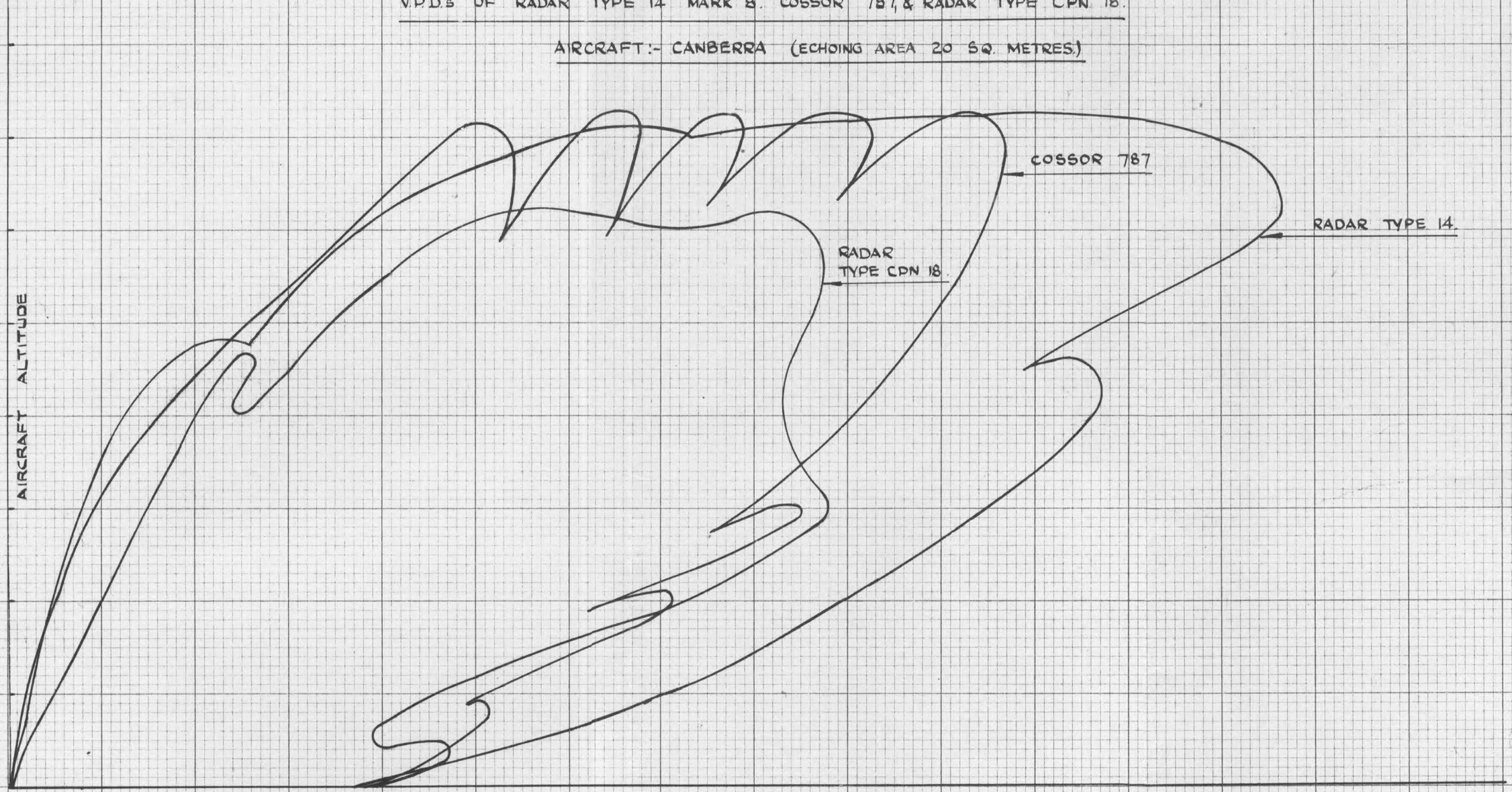

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FIG. 3.