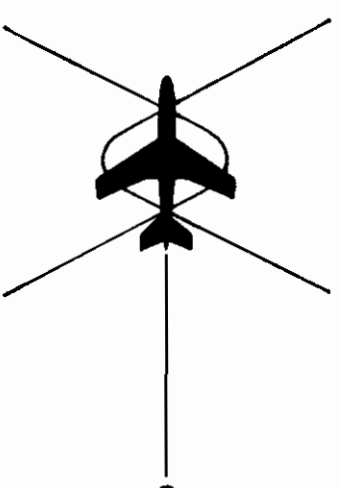
OPERATING INSTRUCTIONS FOR THE DECCA NAVIGATOR MARK 8A

AN/ASN-72



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OPERATING INSTRUCTIONS

FOR

THE DECCA NAVIGATOR MARK 8A

(Issue 4 — November 1965)

1. THE RECEIVER MARK 8A

1.1. Equipment

The equipment comprises the following:

Receiver	Type 908
Control box	Type 918
Decometers (three)	Type 274Z
Lane identification meter	Type 275B

The radio input to the receiver is obtained from the Decca aerial via a pre-amplifier (e.g. Type 803) mounted close to, or integral with, the aerial assembly. The receiver drives three Decometer indicators, a lane identification meter and, through a computer unit, a Flight Log pictorial display. The Flight Log is described in Sections 4 and 5 (pages 11-15).

1.2. The Decometers

The three Decometers are designated red, green and purple respectively, to correspond with the colours in which the position line patterns produced by a Decca chain are printed on maps and charts. The Decometer dials (see Fig. 1) are numbered in the *lane* and *zane* units into which each pattern is divided.

The fraction-pointer of each Decometer makes one revolution per lane and sweeps a scale divided into hundredths. This pointer takes up its own position automatically and gives

FIG. 1 Decometer Type 274Z

The reading is C5.86
The zone reset button is to the left of the zone indicator.
The L.I. lamp is above the zero knob (0)

a fractional reading which is not affected by the settings of the lane pointer or the zone dial. The lane and zone indicators are driven through the gearing by the fraction pointer shaft.

The Flight Log automatic plotter is the normal Decca Navigator display for aircraft use. A position-fix can, however, be plotted manually on a map or chart overprinted with the numbered Decca grid, by reference to the Decometer readings. The aircraft's position on the map is at the intersection-point of the position lines indicated by the readings from two of the meters; the normal practice is to obtain a fix from whichever

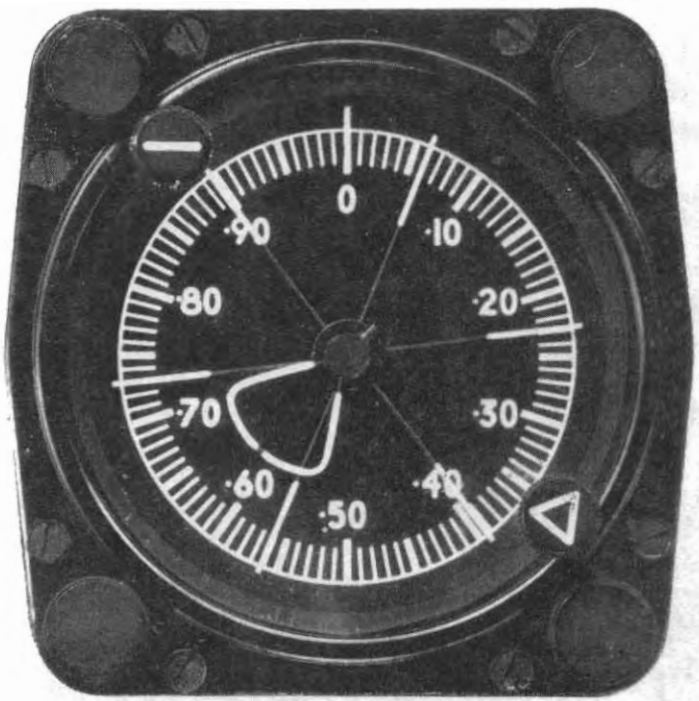

FIG. 2 Lane Identification Meter Type 275B

The sector pointer serves only to select which vernier pointer to read: in this example the correct vernier pointer is at .56 on the scale.

pair of patterns gives the best angle of cut and to discard the reading from the third Decometer.

The lane-width amounts to a few hundred yards on the baselines between the stations, and expands only to a mile or two at the edge of the chain coverage area. The Decometers of the Mark 8A receiver divide the lanes into hundredths and accordingly the equipment has high positional accuracy.

1.3. Lane Identification

The lane pointer and zone dial on each Decometer must initially be set by hand to the correct values, whereafter they keep count of the lanes and zones passed through and continu-

ously indicate the correct lane number and zone letter. It is assumed that the user will have prior knowledge of his position with sufficient accuracy to set in the correct zone letters; the lane numbers are obtained by reference to the *lane identification* meter. This is actuated three times per minute and displays the correct lane number within a zone.

The zones contain 18, 24 and 30 green, red and purple lanes respectively, the lane-widths for the three patterns being so related that, on the interstation baselines, the zones are of the same width (approximately 6 miles or 10 km) for each pattern. Elsewhere the zones expand to several times the width that they occupy on the baselines, so that in the outer part of the coverage the prior knowledge of position necessary for setting the zones need only be very approximate.

The lane identification (L.I.) meter is illustrated in Fig. 2 and is calibrated with a decimal scale. Over this scale move the sector and vernier pointers; the function of the sector pointer is simply to select which of the six vernier pointers is the correct one to use for reading-off the decimal scale when a L.I. signal is received. The decimal scale on the L.I. meter is identical to the Decometer fractional scales and thus enables the readings to be related to the appropriate Decometer. Here it is worth noting that a quick check on the agreement between the Decometers and the L.I. meter can be obtained simply by observing that the operative vernier pointer and the appropriate lane pointer are parallel. When working with a Mark 10-type chain, the L.I. pointers will normally give four small kicks, at $2\frac{1}{2}$-second intervals, before each required L.I. reading.

Each Decometer is furnished with an indicator lamp, which lights when the L.I. signal appropriate to that Decometer is being received. The lamp stays illuminated for about 3 seconds during which the L.I. reading is 'frozen' for ease of observation If the reading of any Decometer is seen to disagree with the corresponding L.I. reading, the lane pointer can be manually set by means of the knob provided.

The L.I. transmissions take place every minute in the order red, green, purple. For chains not equipped for Mark 10-type transmission the respective signals are sent out at 0, 15 and

30 seconds past the minute, and at 0, 20 and 40 seconds for Mark 10 chains. If the Decometer lamps are not illuminated in the correct sequence, which may occur at long ranges, care should be taken in reading the L.I. meter.

1.4. Referencing

In order to check and correct any errors which may develop in the equipment, due to warming-up and other temperature changes, the *referencing* facility is provided. This enables artificial master and slave signals having a precisely known relationship (zero phase-difference) to be fed into the receiver; if any Decometer or the L.I. meter gives a reading other than zero when this is done, the zero reading may be restored by adjusting the zero knob on the meter concerned. This adjustment is required primarily during the first half-hour of receiver operation, and when changing chains. When referencing in the air, the normal lane-counting function of the Decometers is suspended and care must therefore be taken to ensure that a lane error has not thereby been introduced. A lane identification check should always be carried out after referencing.

2. RECEIVER CONTROLS

These are few and straightforward, and are grouped on the meters and on the receiver control box type 918 (Fig. 3). Taking the latter first, the functions of the controls are described below.

(*a*) **Chain selector switch**
This tunes the receiver to the desired chain. The selected code number (e.g. 5 for the English chain) is indicated in a window above the control knob.

(*b*) **Lane identification switch (L.I.-OFF)**
This enables the L.I. indicator lamps to be switched off when not required.

FIG. 3 Receiver Control box Type 918

(c) **OFF-REF-OP switch**

In the OFF position no power is supplied to any section of the receiver except the control box panel lights. With the switch at REF the Decometer fraction pointers, the L.I. sector pointer and one of the vernier pointers will all move to, or near, the zero (12 o'clock) position. The pointers can then be set exactly to zero by the controls provided. Except when referencing, the switch should always be set to the normal operating position (OP). With some examples of the receiver, the reference remains inoperative until the switch has been turned to OP and back to REF.

(d) **REF and OP lamps**

These are amber and green respectively and indicate the setting of the OFF-REF-OP switch. The amber lamp lights only at the REF setting, green remains alight at REF as well as OP.

(e) **Control box panel lamps**

Three detachable lamps for panel illumination are provided, at the bottom corners and top centre. These light when the aircraft master switch is turned on.

(f) **Decometer zero knobs**

These enable the fractional pointers to be set to zero when referencing. Each zero knob is marked with a white circle and should be pushed in to engage.

(*g*) **Decometer reset knobs**
Each reset knob is labelled R. The lane pointer may be set by pushing the knob in and turning. The zone dial can also be set with this knob but it is quicker to use the zone reset button.

(*h*) **Decometer zone reset buttons**
These enable the required zone letters to be rapidly set in. Pressing and releasing the button increases the zone dial reading by one unit.

(*i*) **L.I. zero knobs**
These enable the centre of the sector pointer, and whichever vernier pointer is nearest to zero, to be set to zero when referencing. The knobs are marked with symbols to correspond with the vernier and sector pointers, and should be pushed in to engage.

3. RECEIVER OPERATION

3.1. Setting up (pre-flight)

	ACTION	NOTES
(*a*)	Set OFF-REF-OP switch to OP. L.I.-OFF switch to L.I.	Green OP lamp will light. The L.I. lamp on the purple Decometer will also light initially and will go out when the valves start to conduct.
(*b*)	Set chain selector switch to required chain.	Mechanism associated with this switch may be damaged if it is operated when the aircraft supply voltage is abnormally low. As a precaution the practice should therefore be adopted of operating this switch only when the generators are charging.

(*c*)	Set Decometer zone letters, and set lane pointers to estimated lane numbers.	In the absence of a lattice map or diagram, or when flying into the chain coverage from outside, position must be found from some other source with sufficient accuracy to identify the zone letters. The lane pointers of the Decometers should be set first to the estimated lane numbers and then checked against L.I.
(*d*)	Allow at least 5 minutes for receiver to warm up. After this period the presence of torque on the Decometers can be checked by deflecting the fraction pointers one or two tenths of a lane and noting that they return positively to the previous position.	
(*e*)	Set OFF-REF-OP switch to REF and correct the zero reading of each Decometer and the L.I. meter.	Amber lamp on control box will light (i.e. amber and green on together).
(*f*)	Set OFF-REF-OP switch to OP. Check torque as in (*d*).	Amber light will go out.
(*g*)	Check lane identification, noting that two complete sequences yield the same set of L.I. readings.	For non-Mark 10 chains, the sequence should be Red-Green-Purple at 0, 15 and 30 seconds. For Mark 10 chains the sequence should be 0, 20 and 40 seconds.

3.2. Checking reference in flight

The instrumental errors which the reference system is designed to correct are maximum (roughly a tenth of a lane) when the receiver is cold and in general reach about half maximum value after five minutes' operation. The remaining error takes about half to one hour to reduce to zero, but may vary with temperature changes in the aircraft. When the highest accuracy is required, therefore, the receiver should be referenced every 20 or 30 minutes. Since the Decometers cease to count lanes whilst referencing is in progress, there is a chance of errors of one or more lanes developing and the Decometers should therefore be carefully checked against L.I. immediately after switching back to OP.

3.3. Checking Decometers from the L.I. meter in flight

The Decometers and the L.I. meter operate independently and the cross check provided by L.I. imparts a high degree of reliability to the position fix. It is sound practice to compare the Decometers with the L.I. readings at regular intervals and to ensure that there is no discrepancy greater than half a lane. If such a discrepancy is noted, however, the Decometer concerned should be reset only if the discrepancy is consistent for three successive L.I. readings. If the discrepancy is not consistent, the readings should be re-checked after a few minutes: intermittent disagreement between the Decometers and the L.I. can occur at night, especially at distances greater than about 150 n.m. from the Master station, owing to the effect of skywave interference.

3.4. Checks on correct functioning of receiver

Reception may be checked by observing that each Decometer fraction pointer takes up its own position in a positive manner. This is done by deflecting the Decometer pointer one or two tenths of a lane by means of the reset button and then releasing it.

Another useful check on the overall functioning of the

receiver is to plot the readings of all three Decometers (having first carried out an L.I. check) on a lattice chart. The three position lines should intersect at a single point, except when on a baseline extension where they will form a small 'cocked hat'. This procedure is also a useful confirmation that the correct zone letters have been selected.

3.5. Day and night operation

Owing to the effect of the skywave-reflected signals received at night, the accuracy of the system is lower at night than by day to an extent which increases with distance from the transmitting stations. Information on the performance of the system is issued in the form of accuracy contours.

3.6. Changing chains

Turn the chain selector switch to the number of the new chain, reference the receiver, and set the Decometers as described on page 10.

4. THE FLIGHT LOG

4.1. Equipment

The Flight Log comprises the following units:

Computer	Type 9360 or 1732
Control box	Type 941
Display head	Type 961

The Flight Log is an automatic plotter which is driven, by means of servo mechanisms contained in the associated computer, in response to the output of the Decca receiver. The Flight Log control box includes a turret switch, into which keys are inserted corresponding to the different Flight Log charts on the roll in use; by turning the turret switch to bring the desired chart key into position, all the scale and other characteristics of the selected chart are fed into the computer.

4.2. Relationship between the Flight Log and the receiver

The Flight Log and the Decometers work in parallel from the receiver, and respectively shows the Decca fix as a continuous map display and as a set of meter readings. OPERATING THE FLIGHT LOG CONTROLS HAS NO EFFECT ON THE DECOMETERS, AND OPERATING THE RESET CONTROLS ON THE DECOMETERS HAS NO EFFECT ON THE FLIGHT LOG.

The Flight Log must be set so that the position of the pen on the chart, i.e. the display of the aircraft's geographical position, agrees with the Decca fix given by the Decometer readings. This involves setting the pen manually to the appropriate point in the lattice overprinted on the Flight Log, using the controls provided on the Flight Log control box for the purpose.

5. FLIGHT LOG CONTROLS AND LAMP INDICATIONS

5.1. Control Box Type 941

In addition to the turret switch already mentioned, the control box (Fig. 4) is furnished with a combined ON.OFF and facility switch, a dimmer control for the back-lighting in the Flight Log display head, and a set of four buttons for traversing the pen and chart manually. From their disposition on the panel the latter buttons are normally referred to as N, S, E, W.

Facility switch positions (Flight Log Control Box Type 941)

OFF: Flight Log and computer disconnected from power supply. In certain installations the control box panel lighting remains connected.

R, G, P. These three positions are provided for convenience in case an error should be made in first setting up, and accordingly they do not figure in the setting-up procedure given in 6.2. (p. 16). At these positions a change

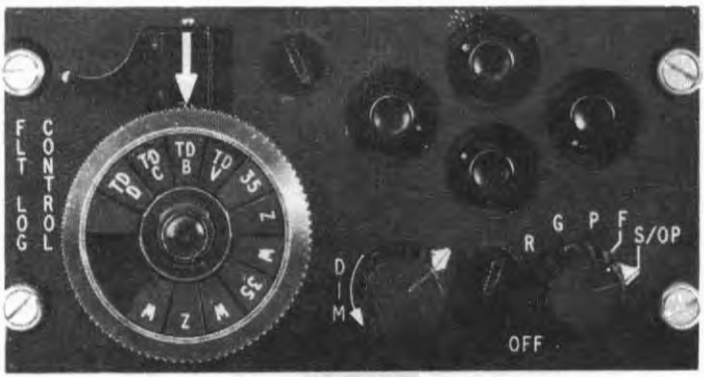

FIG. 4 Flight Log Control Box Type 941

of exactly one lane can be made in the Flight Log indication in either the red, green or purple patterns respectively. With the switch at P, for example, a change of exactly one lane in the purple pattern is made by holding down the upper or lower button (to add or subtract a lane respectively) until the Flight Log has traversed more than half a lane of that pattern. If the button is then released, the Flight Log will continue moving until it has taken up its position exactly one purple lane away from the original setting. If the button

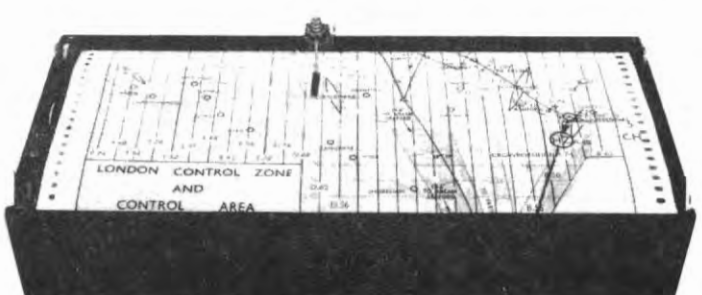

FIG. 5 Flight Log Display Head Type 961

On the left side are the chart winding thumbwheel (top), the warning lamp and dimmer (centre) and the lamp reset button (bottom).

is released before half a lane has been traversed, the pen and/or chart will 'roll back' into the previous position.

With computers Type 9360/C9 and C/9/5, the E, W buttons are inoperative at the R, G and P settings of the facility switch.

DELETED

F. In this 'Fast' setting, pressing the N and S buttons causes the paper to move rapidly through the display head in the upwards or downwards direction, as when

changing charts. The E, W buttons permit slow lateral adjustments of the pen to be made.

S/OP. This is the normal operating position of the facility switch. The N, S, E, W buttons remain operative for slow adjustments in the two co-ordinates.

5.2. Warning lamp on display head Type 961

A lamp, with its dimmer and an associated reset button, are mounted on the left-hand side of the display head. When a computer designated C9 or C/9/5 is used, the purpose of the lamp is to indicate that power is on and the reset button has no function.

DELETED

6. FLIGHT LOG OPERATION

6.1. Fitting chart spool

The chart spool is inserted in the cassette contained in the display head by releasing catches (located at the corners of the head) which hold the cassette in position. The procedure is as follows:

(a) Swivel display head pen to one side. Release both lower catches. Cassette will automatically swivel upwards from the vertical by about half an inch. Lift free end of cassette until it is perpendicular to case. (If required, the cassette can now be completely disengaged from the case by releasing the two top catches and lifting clear.)

(*b*) Pull back hinge plate on right-hand side of chart spool location. Insert loaded spool, ensuring that peg locates correctly in spool end. Close hinge plate.

(*c*) Pull approximately 12 in (30 cm) of chart from loaded spool. Lower cassette back into base and depress until lower catches engage.

(*d*) Release top catches. Cassette will automatically swivel downwards by about half an inch. Lift free end of cassette until it is perpendicular to case.

(*e*) Feed chart over free roller and sprocket roller and insert T-shaped end into slot of take-up spool.
(The term 'take-up' is used for convenience in describing the loading procedure. In use, either spool can operate as take-up depending on the direction of flight.)

(*f*) By turning the knurled thumbwheel (see Fig. 5), wind and guide approximately $1\frac{1}{2}$ turns of chart onto take-up spool. Check that chart perforation engage correctly in sprocket roller teeth and that chart is taut, after this operation has been completed.

6.2. Setting up

ACTION	NOTES
(*a*) Switch the Flight Log on by turning the facility switch to F.	Items (*a*), (*b*) and (*c*) should be performed at the same time as switching on the receiver, i.e. without waiting for it to warm up.
(*b*) Lift pen (by the lever provided) and use the N or S button to bring the desired chart into view.	
(*c*) Set the turret switch to bring the key corresponding with the desired chart into operation (i.e. to the 12 o'clock position).	

(*d*) When the receiver has been referenced and set up, use the N, S, E, W buttons to set the Flight Log pen approximately to the correct position. Turn the facility switch to S/OP and set the Flight Log accurately, with pen down.

The position of the pen in the Decca lattice printed on the Flight Log chart should agree with the Decometer readings.

6.3. In-flight checking

The lattice on the Flight Log chart enables the Flight Log indication to be checked against the Decometers at will, and it is good practice to do this at regular intervals.

6.4. Chart changing

Charts which cover specific routes are normally marked with 'change points' near the edges, and as soon as the pen reaches a change point the next chart should be selected. The key coding of the next chart is printed within a ring alongside the change point, together with a square symbol within which is shown, for convenience in chart changing, a figure indicating the number of charts on the roll that have to be skipped (if any) before the new chart comes into view. The pen is set to the correct position on the new chart by reference to the Decometers as described above.

6.5. Chain and chart changing

A change to a new Decca chain is necessarily accompanied by a chart change (see above). On a chart roll for a route involving a chain change, the change point at which the transfer to the new chain is made is marked with the Decometer readings for that point in the new chain co-ordinates. A few minutes before the actual chain change, it is convenient to set

the Decometers to these figures, setting the fastest-turning meter last. On reaching the change point, set the receiver to the new chain as in 3.6. (page 11) and change key and charts as in 6.2., finally checking the Flight Log indication against the Decometers by adjusting the pen and paper as necessary.

CHECK LIST (MARK 8A, Issue 4)

PRE-FLIGHT

1. Switch the receiver to OP (green lamp on).
   Check L.I.-OFF switch at L.I.
   Select chain.
   Set Decometer zone and estimated lane readings.

2. Switch Flight Log to F.
   Select chart and key.

3. Switch receiver to REF (amber and green lamps on).
   Set Decometer fraction pointers and L.I. pointers to zero.

4. Switch receiver to OP (green lamp on).
   Check Decometers for torque.
   Check Decometers against L.I. sequence.

5. Set Flight Log to approximate agreement with Decometers.
   Switch to S/OP, set Flight Log accurately.

CHART CHANGE

1. When pen reaches change point, select new chart and new key.

2. Set Flight Log to agree with Decometers.

CHECK LIST (MARK 8A, Issue 4)

CHART AND CHAIN CHANGE

1. Two or three minutes before reaching change point, set Decometers to new co-ordinates (set fastest turning Decometer last).

2. At change point, select new chain, chart and key.

3. Set pen at marked point on new chart.

4. Switch receiver to REF (amber lamp on).
   Set Decometer fraction pointers and L.I. pointers to zero.

5. Set receiver back to OP (green lamp on).
   Check Decometers against L.I., reset if required.

6. Set Flight Log to agree with Decometers.