

DECCA

**Navigator
Mk 19**

Operating Instructions

The Decca Navigator Company Limited

THE DECCA NAVIGATOR MARK 19

OPERATING INSTRUCTIONS

April 1971

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THE DECCA NAVIGATOR MARK 19

Operating Instructions

1. EQUIPMENT

Mark 19 is a multi-purpose Decca Navigator airborne receiver, capable of operation with numerical indicators and/or with a pictorial display. Details of the receiver and of the associated meter displays are given in a publication entitled "Decca Navigator Mark 19: Background Notes".

These instructions cover airborne installations comprising the following units:

Receiver

Antenna (this differs as between aircraft types)	
Antenna amplifier	Type 1995A
Receiver unit	Type 1904A
Control unit	Type 8954A or B
Decometers (red, green, purple)	Type 274
Lane identification meter	Type 275
Zone identification meter	Type 1956A or B

Flight Log

Computer	Type 1910A
Control unit	Type 1905B
Display head	Type 961M

The decimal readout unit Type 8965, which replaces the decometers and lane identification meter in some installations, is not described in this publication.

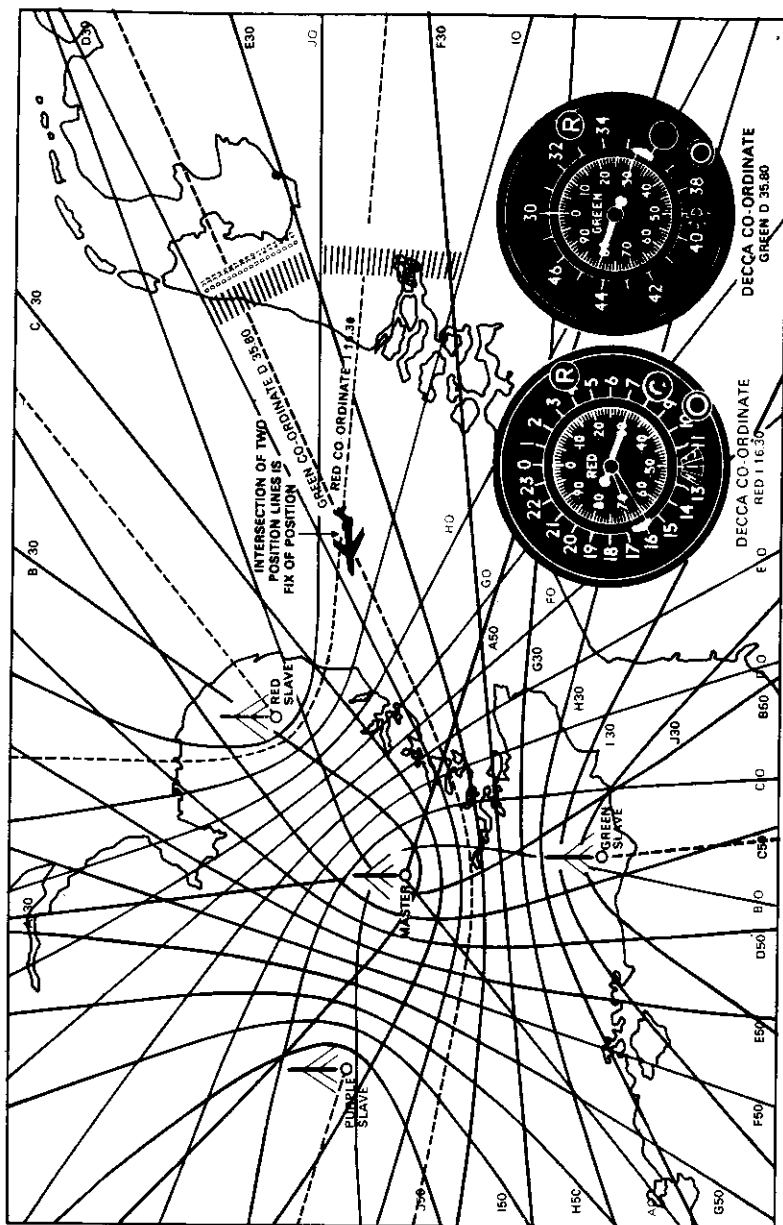


Fig. 1. Plotting a fix from two decometer readings

2. THE MARK 19 RECEIVER

2.1. Position fixing (Fig. 1)

The three decometers are designated red, green and purple, to correspond with the colours in which the respective position-line patterns produced by a Decca chain are overprinted on maps and charts. The patterns are divided into zone and lane units and the decometer includes a window indicator for the zone letter and a rotating pointer for the lane number (Fig. 2). A second pointer sweeps a scale marked in hundredths of a lane.

A decometer reading provides a position-line, expressed as a zone, lane and lane-fraction. The printed Decca patterns are numbered to correspond with the meters and a pair of meter readings gives a position-fix as the intersection of two position-lines. Normally the fix is obtained from whichever pair of patterns (red/green, red/purple or green/purple) cuts at the best angle and the third reading is discarded.

The zone letters start at the master end of the master/slave baseline and are marked A to J, this sequence being repeated as required to cover the total number of zones. On the baseline, the zones are of the same constant width (about 10 km) for all three patterns.

Each zone contains 24, 18 and 30 red, green and purple lanes respectively. The lane numbering starts at the master and runs 0-23 for red, 30-47 for green and 50-79 for purple. On the baseline the lanes of a given pattern are of constant width averaging about 400 m for the three patterns.

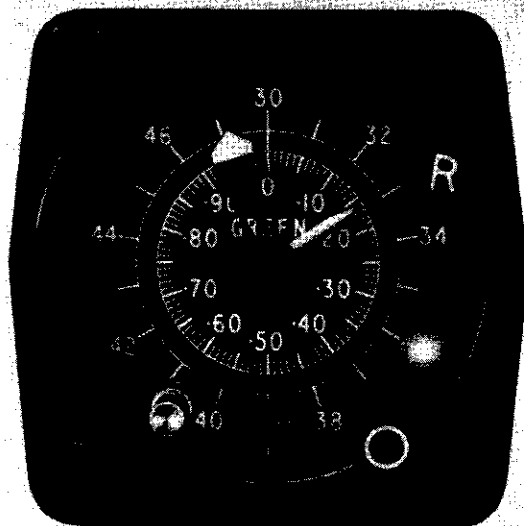


Fig. 2. Decometer Type 274

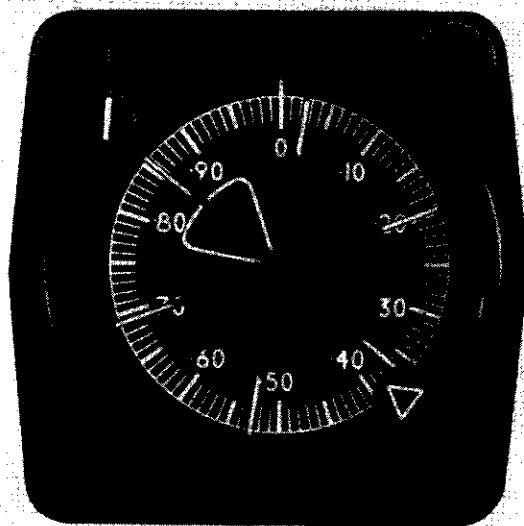


Fig. 3. Lane identification meter Type 275

2.2. Lane identification

When the equipment is switched on, each decometer fraction pointer automatically takes up the correct position in the lane (subject to the correction of errors by referencing - para 2.4.). The lane pointer and zone dial, however, must be set initially by hand; these indicators are driven by gearing from the fraction pointer shaft and keep count of the zone and lane values as the aircraft passes through the patterns. To check this counting process, and to provide for the possibility that the user may not know the starting position to within the tolerance of plus/minus half a lane that is required for setting the lane pointer correctly, a sequence of lane identification (L.I.) signals is transmitted three times per minute.

These signals actuate a lane identification meter, which has a decimal scale and a sector-shaped indicator together with a concentric, six-arm vernier pointer (Fig. 3). The function of the sector is to select which of the six vernier pointers is the correct one to use for taking the reading when an L.I. signal is received. The scale is identical to the fraction scale on the decometers and thus enables the L.I. readings to be related to the decometer lane position: a quick check can be obtained simply by observing that the operative vernier pointer and the lane pointer of the appropriate decometer are parallel.

The successive readings on the L.I. meter are identified by signal lamps on the decometers or on the zone identification meter, as detailed in para 3.2. for the normal MP (multipulse) L.I. signals and for the earlier V (Mark 5) type. Provision is made for "freezing" an individual L.I. reading for ease of observation, particularly when taking the master reading during setting-up.

2.3. Zone identification

Lane identification leaves only the necessity for the user to know initially which zone of each pattern he is in, so as to be able to set up the decometer zone dials. Knowledge of position for this purpose need not be more accurate than plus/minus 5 km since the minimum zone width is about 10 km. Prior knowledge of position or visual observation will generally provide this information, but zone identification transmissions are radiated, three times per minute, from all Decca chains of the MP (multipulse) type. These actuate a meter which shows, for each pattern in turn, which zone the aircraft is located in within a known group of five zones.

The Z.I. meter scale (Fig. 4) has a single pointer and a scale with five divisions. The full scale is marked ABCDE and FGHIJ, but the user is assumed to know, as stated above, which of these five-zone groups he is in. The readings appear in the order master-red-green-purple. The sequence is indicated by the three lamps under the meter scale. The "master" reading should always be near zero (zero is the upper division on the scale, between EJ and AF) and forms a confidence check such that the remaining readings are suspect if the master reading is outside tolerance.

2.4. Referencing

To check instrumental errors, a synthetic reference signal can be applied to the receiver at will, using the REF setting on the receiver control unit. All decometer fraction pointers should then read zero and can be adjusted to zero by a knob on each meter face. The L.I. pointers are referenced in this way with V-type L.I. signals only; on MP chains, the master signal and not the REF facility is used for zeroing the L.I. meter (para 5.1.5.).

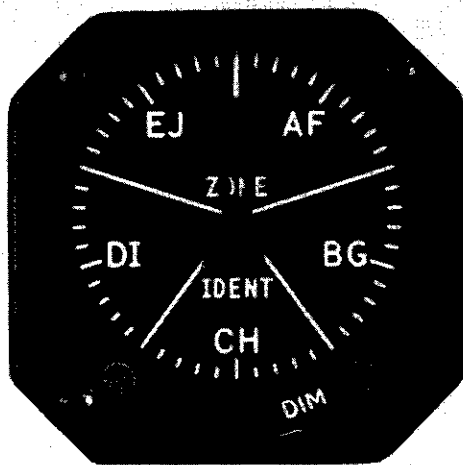


Fig. 4. Zone identification meter Type 1956



Fig. 5. Receiver control unit Type 8954

3. CONTROLS AND INDICATOR LAMPS

3.1. Receiver control unit (Fig. 5)

Function switch positions

- OFF Disconnects receiver from power supply.
- REF Decometer fraction pointers and (with V chains only) L. I. pointers should be zeroed at this setting.
- LOCK Puts receiver into "fast lock" state for signal acquisition. Freezes decometer movements (which would otherwise be random during locking) to allow user to set zone and lane indicators.
- OP Normal setting.
- HOLD Freezes L. I. pointer to assist in taking a reading.

Chain switch

Sets receiver to frequency of required chain using the chain code numbers 00-10 and suffix letters A-F (e. g. English Chain 05B).

Triple indicator lamp

- Amber: Indicates that the LOCK setting of the function switch has been selected.
- Red: Warning and HOLD.
- Green: REF.

The red warning ("alarm") lamp lights, when the function switch is at OP, if reception of the master or any slave signal falls below a predetermined standard. It also indicates a malfunction in the LOCK and REF states, and overrides the amber and green indications.

3.2. Decimeters

Zero knob. Marked with a white circle. Enables the fraction pointer to be set to zero when referencing.

Reset knob. Marked R. Used for setting the lane pointer (press to engage). This knob also turns the zone dial, but it is quicker to use the zone reset button for this.

Zone reset button. Located at 7 o'clock on the meter face. Pressing and releasing the button increases the zone dial reading by one zone.

L.I. lamp. In most Mark 19 installations * the L.I. lamps on the red and green decimeters are inoperative and the purple lamp covers the three colours in succession. With an MP chain, the purple lamp gives a sequence of four flashes every 20 seconds, in the order master- $2\frac{1}{2}$ s-red- $2\frac{1}{2}$ s-green- $2\frac{1}{2}$ s-purple. The sequence also appears on the Z.I. meter lamps - see para 3.4. (On MP chains which also send V-type idents, the purple reading is given twice, making five flashes in the sequence). With V1 chains

* Some installations, designed for an earlier type of receiver, include an adapter unit with the Mark 19. All three decimeter L.I. lamps are then operative, showing the MP sequence in succession, and all light on the initial (master) signal. These installations do not include a Z.I. meter and the flight log equipment, if fitted, will differ from that described in this publication. Also, some installations include an on/off switch, on the decimeter panel, to suppress the L.I. lamp signals when these are not required.

sending idents. in the one-minute sequence red-15s-green-15s-purple-30s, the purple L. I. lamp shows this sequence unequivocally. With V2 idents., in the sequence red-20s-green-20s-purple-20s, the start of the sequence is shown by four successive flashes of the purple L. I. lamp immediately before the initial signal (red).

3. 3. Lane identification meter

Zero knobs. Marked $\triangle$ and $\ominus$ for sector and vernier respectively. Used when referencing, for setting the centre of the sector pointer, and the nearest vernier position, to zero. Press to engage.

3. 4. Zone identification meter

Z. I. lamps. These lamps, and the Z. I. meter, operate only with MP-type chains. The three lamps are red, green and purple respectively and show the Z. I. sequence in the appropriate colours, in the sequence master (all lamps on) - $2\frac{1}{2}$ s-red- $2\frac{1}{2}$ s-green- $2\frac{1}{2}$ s-purple. With MP chains this is also the lane ident. sequence. On some chains the final (purple) reading is repeated, making five signals in the sequence.

Dimmer. Lever marked DIM gives two-position: mechanical control of lamp brightness.

4. FLIGHT LOG PICTORIAL DISPLAY

4.1. Function

The flight log is an automatic plotter in which a recording pen is driven laterally, and a roll of charts vertically, in response to the Decca receiver output. The receiver is linked to the flight log display head by a computer. A separate control unit (Type 1905B) provides for chart selection, setting-up and other functions.

The flight log and the decometers work in parallel from the receiver, and respectively show the Decca fix as a continuous map display and as a set of meter readings. Operating the flight log setting control has no effect on the decometers, and operating the reset controls on the decometers has no effect on the flight log. Thus if it is desired to navigate by plotting decometer readings on a lattice map (e. g. in the event of flight log failure) the flight log may be switched off and the receiver, decometers and lane/zone ident. meters will continue to operate normally.

4.2. Control unit Type 1905B

Function switch positions. (Pull knob to turn clockwise from INT or counter-clockwise from LOCK).

- | | |
|-----|---|
| OFF | Computer and display head disconnected from power supply. |
| REF | (No connection with receiver REF facility). This setting simulates in the computer the effect of the aircraft being located at a zone |

intersection, so that adjusting the pen to the nearest zone intersection * with REF selected, brings the flight log into agreement with the receiver.

- ZONE On selecting R, G or P switch positions momentary pressure on the setting control, up or down, displaces the displayed position by exactly one zone in the red, green or purple pattern. Up adds, down subtracts.
- OP Normal operating position.
- INT Suppresses automatic lane setting and zone ident. readings. Lane ident. meter, and signalling lamps on zone ident. meter, remain operative.
- FIX Injects data from selected turret key into computer, disconnects display head from computer and starts run/fix storage (para 4. 3.).

RX ALARM lamp

Repeats red warning on receiver control unit, indicating unsatisfactory reception. To dim, turn lamp counter-clockwise.

* On charts drawn for "double-difference" co-ordinates, identifiable by having all three Decca patterns (red, green, purple) printed instead of only two, the chart reference points are black crosses and not the zone intersections.

Turret switch

Contains up to 12 keys by which the data (scale etc.) for a given flight log chart are supplied to the computer. Each key bears the code designation for its associated chart. A key is pre-selected by pressing lever and turning turret to bring that key under arrow. The key data are injected on turning function switch to FIX.

KEY PRE-SEL lamp

Lights when new key is brought under arrow, goes out when FIX is selected. To dim, turn lamp counter-clockwise.

DIM

Turn counter-clockwise to reduce the back-lighting on the display head.

Flight log setting control

Left or right hand position moves pen to left or right. First pressure upwards moves chart down, and vice versa. Second pressure up or down gives fast movement for chart selection. When ZONE SLIP R, G or P is selected, the left and right positions of this control are inoperative: momentary upward pressure displaces pen by exactly one zone of the selected colour in the positive direction, down for negative.

4. 3. The run/fix facility

This facility, which is brought into use by selecting FIX on the control box, disconnects the flight log from the computer so that a chart can be changed or annotated or another chart on the roll inspected. Simultaneously it

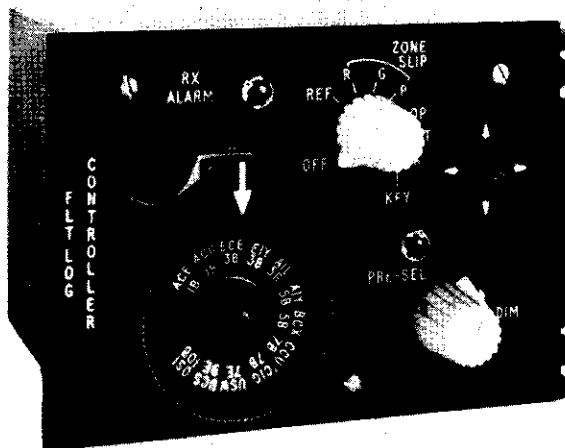


Fig. 6. Flight log control unit Type 1905B

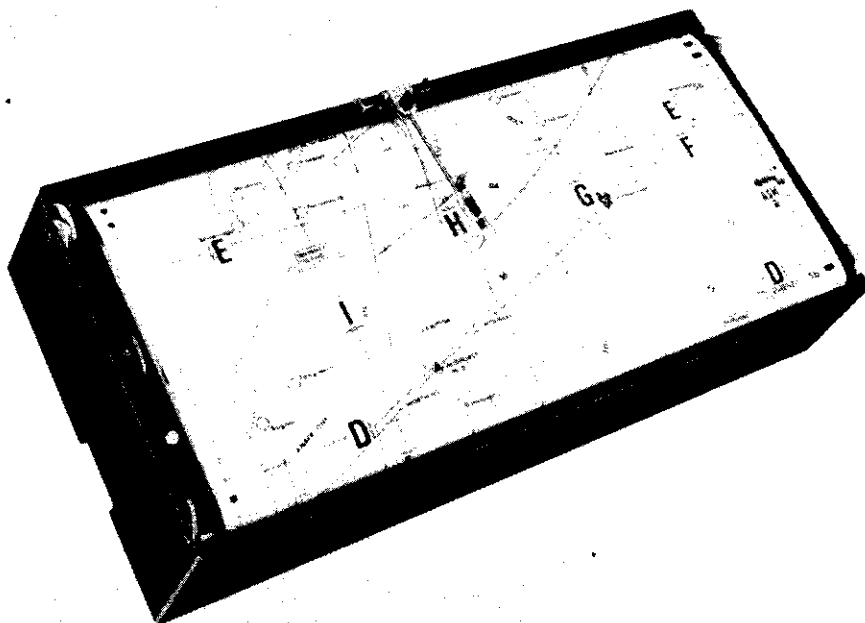


Fig. 7. Flight log display head Type 961M

starts a computer storage process which keeps track of the changes in Decca co-ordinates resulting from the aircraft's movement, so that the displayed position will not be "lost" through temporary disconnection of the display.

Run/fix provides a short-cut method of changing from one chart to another, so long as this does not involve a chain change, when there is an overlap between the old and new charts and some particular feature or co-ordinate position is clearly marked on each. On arrival at such a feature on the old chart, the user selects FIX, brings the new chart into view and places the pen on that same feature on the new chart. When OP is reselected, the display then automatically goes to the aircraft's present position.

4.4. Inserting keys in turret

To withdraw turret, first depress lever and turn turret to bring blank position under arrow. To insert a key, turn locking ring at back of turret until gap in ring permits key to be pushed fully home. Ring can then be turned to bring gap over next key position and next key can be inserted until the set is complete. To replace turret, depress lever and insert with blank position under arrow.

4.5. Inserting chart spool in display head

1. Swivel display head pen to one side. Release both lower catches (located at the corners of the head) and 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 upper catches and lifting clear.

2. 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.

3. Pull approximately 12 in (30 cm) of chart from loaded spool. Lower cassette back into base and depress until lower catches engage.
4. Release upper catches and lift free end of cassette until it is perpendicular to case.
5. 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).
6. By turning the knurled thumbwheel, wind and guide approximately $1\frac{1}{2}$ turns of chart onto take-up spool. Check that perforations engage correctly in sprockets and that chart is taut.
7. Lift cassette back into base and depress until upper catches engage.

5. OPERATING INSTRUCTIONS

5.1. Pre-flight: receiver control unit

1. Select CHAIN number and letter.
- * 2. Switch from OFF to REF. (If using flight log, see para 5.2.). Lamp shows red briefly until the reference condition is operative when it changes to green. When lamp shows green, set each decometer fraction pointer to zero, using the "O" knob on the decometer. Do not zero the L.I. meter at this stage unless using a chain sending V-type ident. only.
3. Switch to LOCK. Lamp shows amber. Set up correct decometer lane numbers (if known) and wait through two ident. sequences.
4. Switch to OP (the setting for normal operation). Lamp should go out: it may flash red during switching but this has no significance.
5. Reference the L.I. meter as follows. On the first (i.e. master) ident. in a sequence, switch to HOLD (lamp shows red). Zero the centre of the sector pointer to the top "zero" position using the knob marked $\triangle$ and the nearest vernier pointer to the top "zero" position using the knob marked $\ominus$. Switch back to OP.
6. Check the respective decometer lane pointers against the L.I. vernier pointer enclosed by the sector, using the decimal scales, as each ident. lamp

* Decometer pointers will rotate during the short warm-up period. To prevent this, the function switch may be set from OFF to LOCK then, after lamp shows amber, return to REF and set decometer pointers as described in 5.1.2.

signal appears. If there is a discrepancy, adjust decometer lane pointer with knob marked R to read the same decimal value as that indicated by the respective vernier ident. reading. If the sequence is too quick to follow, wait until the required colour appears on the zone ident. meter lamps and quickly switch to HOLD: this will freeze the last L. I. reading. Switch back to OP before using HOLD for another colour. (Note that the frozen reading may only be valid for a few seconds, owing to aircraft movement).

7. Set correct zone letter on each decometer by pressing and releasing chrome button on decometer. The zone ident. meter will indicate the zone letter within a known group of five zones (A or F, B or G, C or H, D or I, E or J) for red, green and purple in succession after the initial (master) signal.

5.2. Pre-flight: flight log

Note: Items 1 and 2 below may conveniently be done before setting up the receiver. The receiver control box should be set to REF for items 1-7 below.

1. Insert required chart roll (para 4.5.) having noted key order listed at top of chart roll.
2. Insert turret (para 4.4.) after loading it with keys in chart order.
3. Depress catch and turn turret switch to select key (under arrow) for first chart required.
4. Switch from OFF to REF. (This is unconnected with receiver referencing: see para 4.2.).
5. Select required chart, using 2nd pressure on setting control.

6. Use 1st pressure to set pen accurately to zone intersection nearest aircraft's position, or to black cross when red, green and purple zones on the chart.

7. Wait for RX ALARM lamp to go out and wait for at least one identification sequence to occur.

8. Switch to OP. Pen should take up correct position on chart. If it takes up a position one or more zones in error, use ZONE SLIP by turning switch to R, G or P as appropriate and momentarily raising the flight log setting control (to add zone) or depressing (to subtract). Switch back to OP.

9. Items 4, 6, 7 and 8 above assume use of an MP chain. When at the fringe of coverage or in the presence of interference, or when using a chain sending V-type ids. only, switch to INT and set the flight log manually, as accurately as possible, to the aircraft's position given by the decometers or by some other accurate datum.

5.3. In flight

1. Operation is automatic within a given chart after setting up as above. Periodically check the decometer lane pointers against the lane ident. meter, and the pen position against the zone letter readouts on the decometers and the zone ident. meter.

2. To change charts within coverage of same chain, by overflying a change point marked on present and next chart:

Before reaching change point, pre-select key for next chart (PRE-SEL lamp lights).

When over change point, select FIX. (PRE-SEL lamp goes out). This stops pen movement.

Lift pen, select new chart using setting control, set pen accurately to same change point.

Switch to OP. Pen will quickly take up aircraft's position on the chart. Lower pen.

3. To check chart reference (i.e. agreement between flight log and receiver):

Wait (preferably) until aircraft approaches a zone intersection (or a black cross on a "double difference" chart). Switch to REF.

Pen should go to the zone intersection. If necessary, set pen exactly on intersection.

Switch to OP.

If pen now goes to a position one or more whole zones in error, use ZONE SLIP.

4. To change to a chart for a different chain (chart code in right margin includes chain number):

Pre-select key for next chart. (PRE-SEL lamp lights).

To change, set up receiver controller as for Pre-Flight 5.1.1. to 5.1.7., and flight log controller to FIX (PRE-SEL lamp goes out). Then switch to REF and set up as for Pre-Flight 5.2.5. to 5.2.8.

5.4. Confidence checks and malfunction warnings

On the initial (master) signal in an MP sequence, the L.I. meter (after referencing) should read zero. If this reading deviates from zero by more than about 2 hundredths, or apparently requires frequent re-referencing by more than this amount, the L.I. readings may be unreliable.

If the zone ident. meter reading deviates from zero on the master signal by more than about 2 tenths of a zone (2 small divisions), the zone ident. readings may be unreliable. A consistent deviation of more than plus/minus half a zone would indicate a malfunction.

Steady RX ALARM lamp (or red lamp on receiver control unit) means inadequate reception of one or more stations. Occasional flashes of this indication may not be significant. If steady indication persists while aircraft covers a distance equal to more than half a zone, check flight log position against zone ident. as soon as lamp goes out.

THE DECCA NAVIGATOR MARK 19

Additional Controls

1. MP/V SWITCH

1.1 A variant of the receiver (Type 1904 A1) requires an additional manual control (in place of the automatic function of the Type 1904A receiver) for switching the receiver to operate either with a normal Decca chain radiating MP (multipulse or "Mark 10") signals, or with the earlier V ("Mk. V") type of chain. The switch is mounted in the crew compartment, preferably adjacent to the receiver control unit.

1.2 The upper position of the switch (MP) is the normal setting, but immediately upon selecting any one of the following chains, the switch should be set to the lower (V) setting.

Chains radiating V-type transmissions only (June, 1973)

1C	South Persian Gulf
5C	North Persian Gulf
5F	Swedish, North Bothnian
7B	India/Bombay
7C	Nova Scotia
8B	India/Calcutta
8C	Swedish, South Bothnian

1.3 Return switch to MP immediately upon selecting an MP chain.

2. SWITCH FOR USE WITH TWO-SLAVE CHAINS

2.1 Certain installations include a Slave Selector Unit Type 1904CL (mounted on the rear of the receiver) together with a five-way switch located in the crew compartment. This enables the operation of the unused receiver channel to be inhibited when working with a chain having only two slave stations. Alarm indications and random movement of the unused decometer, which would otherwise occur, are suppressed. This facility is available with receivers Types 1904A or 1904A1.

2.2 The five switch positions are labelled OFF-RED-GREEN-PURPLE-OFF, and the normal setting is the right-hand OFF position. Immediately upon selecting a two-slave chain, the switch should be set to the colour of the absent slave as indicated below.

Two-slave chains showing absent slave (June, 1973)

0A	South Baltic	Purple
2E	Holland	Purple
4A	Port Hedland, W. Aust.	Purple
5C	North Persian Gulf	Purple
6B	Cabot Straits	Purple
6E	Gulf of Finland	Purple
8B	French	Green
8C	Swedish, South Bothnian	Purple
8E	Dampier, W. Aust.	Purple

2.3 Immediately upon selecting a three-slave chain, restore the switch to the nearest OFF position (generally the right-hand, since all but one of the absent slave stations are purple).

June 1973