

Chapter 24

INDICATORS, ELECTRO-MAGNETIC, PLESSEY TYPES

LIST OF CONTENTS

	Para.		Para.
<i>Introduction</i>	1	<i>Preliminary procedure</i>	20
Description		<i>Electrical connection on installation</i> ...	22
<i>Eyeball and drum indicators</i>	3	<i>Installing indicator</i>	24
<i>Two-position indicators</i>	5	<i>Removal from aircraft</i>	26
<i>Principle of operation</i>	9	<i>Bayonet adapter type</i>	27
<i>Three-position indicators</i>	11	<i>Other types</i>	28
<i>Principle of operation</i>	18	Servicing	29
Installation		<i>Testing</i>	30
<i>General</i>	19		

LIST OF ILLUSTRATIONS

	Fig.		Fig.
<i>Typical drum type indicator</i>	1	<i>Panel piercing details</i>	6
<i>Sectional view of two-position indicator</i> ...	2	<i>Circuit diagram of three-position indicator</i>	7
<i>Sectional view of three-position indicator</i>	3	<i>Outline of Eyeball indicator</i>	8
<i>View of plastic window</i>	4	<i>Outline of Drum indicators</i>	9
<i>Operation of indicators</i>	5	<i>Outline of Drum (Translight) indicator</i> ...	10

LIST OF APPENDICES

	App.		App.
<i>Standard serviceability test</i>	A	<i>Indicator Types and reference numbers</i> ...	2
<i>Three-position indicator panel coding</i> ...	1		

LEADING PARTICULARS

<i>Operating voltage</i>	18 to 28.5V d.c.
<i>Power consumption</i>	1 Watt (approx.)
<i>Rating</i>	Continuous
<i>Coil resistance</i>	500 ohms $\pm$ 10 per cent.
Terminals	
7CZ 74109 (Eyeball Type Mk. 1) 8 B.A. screws in short studs (pinch action)	2 oz. (approx.)
7CZ 106565 (Drum Type Mk. 1) } 8 B.A. terminal screws	1.25 oz.
7CZ 107626 (Drum Type Mk. 2) }	
7CZ 143684 (Drum Type translight) 6 B.A. terminal screws }	

RESTRICTED

Introduction

1. The magnetic indicators described in this chapter are basically similar in design and principle of operation. Differences in signal patterns and codes are indicated by the addition of suffix numbers. Details of signal patterns and codes are given in Appendix 1 to this chapter. These instruments are designed for general use in aircraft for visually indicating one neutral and two energized signals (three-position indicators), or in the case of the two position indicators, one energized and one neutral signal.



Fig. 1. Typical drum type indicator

2. As the design of these indicators differs from that detailed in A.P.4343, Vol. 1, Sect. 23, Chap. 2, a full description is given in this chapter.

DESCRIPTION

Eyeball and drum indicators

3. These indicators consist of an armature and a pivot-mounted permanent magnet fixed inside a sphere, or drum, which is freely arranged in a permanent magnet field to maintain the armature in the neutral or un-energized position.

4. One winding of the bi-filar wound coil, when energized, will induce a north pole to the pole piece; this overcomes the permanent magnet flux of the restoring field and attracts the south pole of the armature, causing it to rotate through 90 degrees, thus exhibiting a different signal at the viewing window. The armature will rotate in the opposite direction when the other coil induces a south pole to the pole piece.

Two-position indicators

5. A view of a two position drum type indicator is shown in fig. 1 and a view showing the construction of a two-position eyeball indicator in fig. 2.

6. The indicator comprises a cylindrical body which is secured to the mounting panel by means of a coil spring and a bayonet type retaining ring. The coded indicating element is seen through a transparent plastic window at one end of the body, and at the other end there is a moulded terminal block fitted with 8 B.A. terminal screws.

7. The indicating element comprises a permanent magnet inside a moulded plastic sphere. A spindle which passes through the centre of the magnet, pivots between two supporting arms, and limits the rotation of the sphere by engaging with a stop, moulded on the sphere's surface. The sphere is held in its normal un-operated position by a helical spring, one end of which is anchored to one of the support arms and the other to the magnet.

8. An electro-magnet is housed in the indicator body with its core extended towards the permanent magnet. The coil connections are brought out to terminals in the insulated base of the unit.

Principle of operation

9. With the electro-magnet not energized, the eyeball is held against one stop in the normally unoperated position by its restoring spring; one half of the spring being visible through the transparent window.

10. With the electro-magnet energized, the coil is polarized, repelling the end of the magnet nearest the core and attracting the opposite end. The eyeball rotates through approximately 180 degrees, exposing the other half of the sphere, i.e.—the alternative signal.

Three-position indicators

11. The indicator body is a cylinder fitted with a flange on which is formed a panel locating pip. All indicators are held in their mounting panels by a spring and retaining ring, or by a bayonet plug adapter.

RESTRICTED

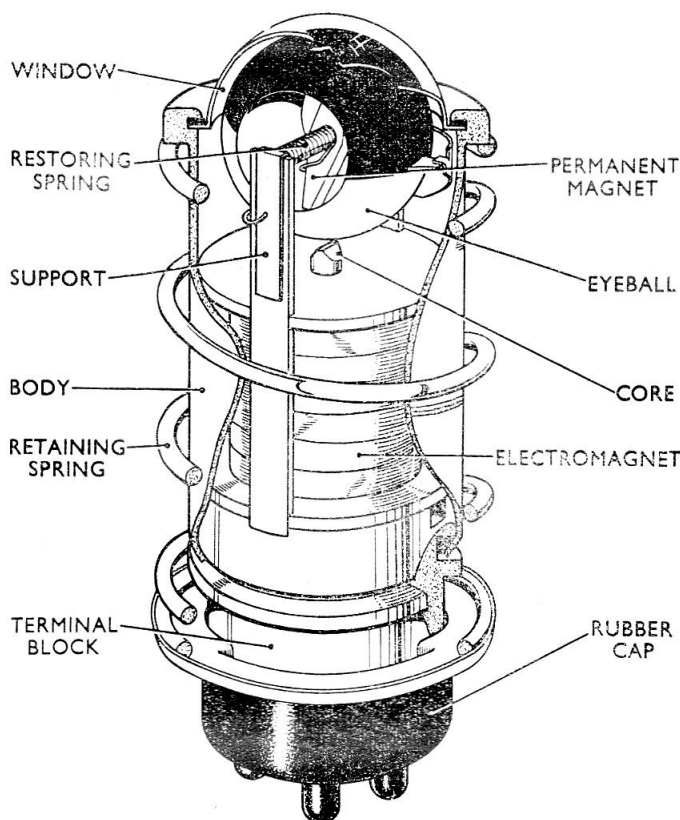


Fig. 2. Sectional view of two-position indicator

12. The coded indicating element is seen through a plastic window as a pattern (App. 1, fig. 1). A translucent window, which is fitted to the indicator 7CZ 143684 is specially shaped. The other end of the indicator is closed by a moulded terminal block which is detachable on indicator 7CZ 74109.

13. A bifilar wound solenoid, with its coil lying along the unit axis, provides the magnetic field which actuates the indicating element.

14. The indicating element is either a moulded plastic sphere (eyeball) or drum, displaying coded signal patterns in three positions, some of which may be fluorescent. The element can turn on a central spindle, mounted at right angles to the solenoid core, the amount of movement being limited by

a stop pin. Located within the element, at right angles to the spindle is a permanent magnet; interaction between the field of this magnet and the energized solenoid, will cause the element to rotate.

15. A second permanent magnet is fixed below the solenoid in the same plane as the element magnet (fig. 3) and is termed the restoring magnet. From the magnet a pair of soft iron polepieces pass outside the solenoid and terminate at the same height as the element spindle. This magnetic system centralizes the element when there is no signal applied to the solenoid.

16. Drum indicators are provided with a rubber protective cap through which electrical leads are threaded before they are screwed to the moulded terminal block.

RESTRICTED

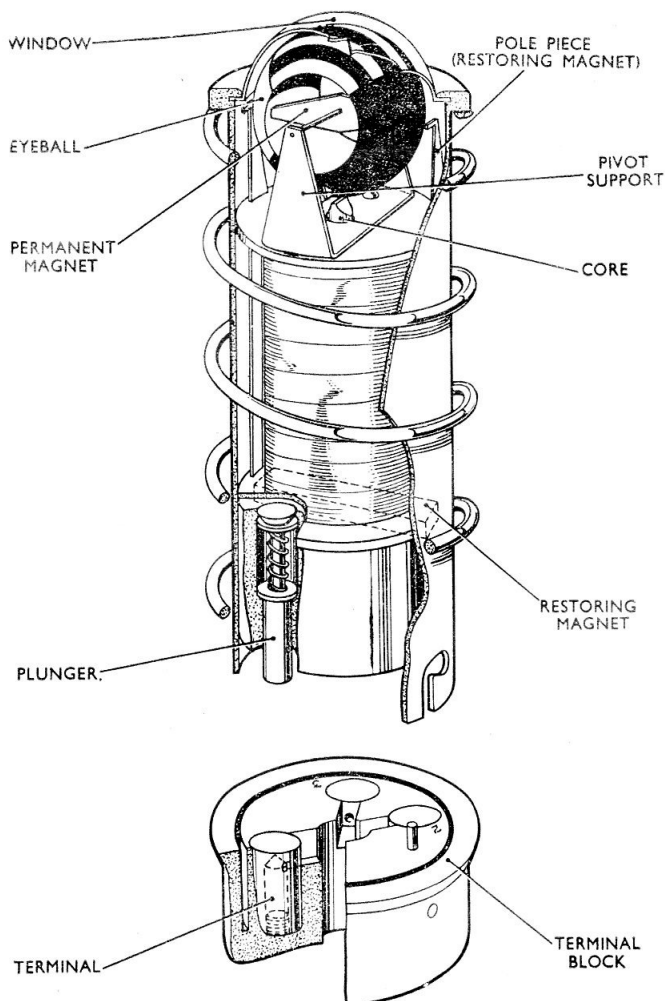


Fig. 3. Sectional view of three-position indicator

17. The eyeball indicator 7CZ 74109 is provided with a quick-release terminal block. The terminal leads for this type are clamped by grub screws to a moulded bayonet adapter, which, when plugged in, connects with spring loaded plungers fitted in the terminal block.

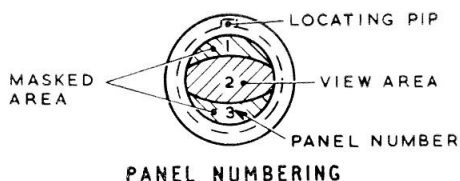


Fig. 4. View of plastic window

Principle of operation

18. When the solenoid is de-energized the restoring magnet maintains the indicating element in the central or neutral (No. 2) position. When either of the solenoid windings is energized, the element magnet will be forced to rotate in the unbalanced magnetic field and by so doing will turn the coded element to one of two alternative signal positions (1 and 3).

Note . . .

These indicators are sealed units; the case must not be removed to check the coding.

RESTRICTED

TERMINAL 1 MUST BE
CONNECTED TO -VE

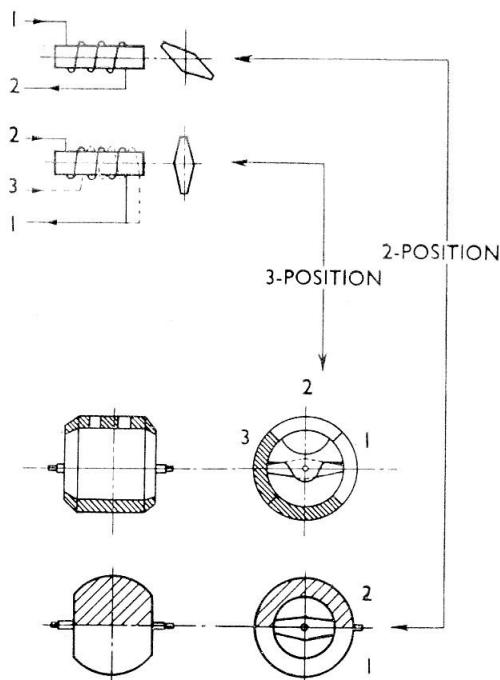


Fig. 5. Operation of indicators

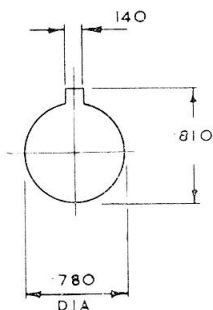


Fig. 6. Panel piercing details

INSTALLATION

General

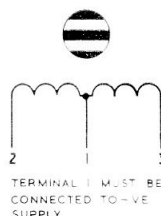
19. All indicators are single hole fixing, panel piercing details are shown in figure 6.

Preliminary procedure

20. Remove rubber protective cap and

pierce the teats. Remove the retaining spring by releasing the retaining ring or bayonet plug. Unscrew the grub or terminal screws.

21. Switch off the indicator supply and locate the leads.



TERMINALS ENERGISED	PANELS INDICATED
1 & 2	1
NEUTRAL	2
1 & 3	3

Fig. 7. Circuit diagram of three-position indicator

Electrical connection on installation

22. With the bayonet adapter type, connect the negative lead to terminal 1. Connect one of the two supply leads to terminal 2 (nearest to locating pip) which should turn the element magnet to position No. 1. Connect the remaining lead to terminal 3, plug in the adapter and check. If the initial responses are incorrect, transpose the leads to 2 and 3 terminals. Recheck and unplug adapter.

23. With other types of indicators, if the connection of leads is to be made after the insertion of the indicator in the panel, proceed as detailed in para. 24. If the leads are to be connected before installing the indicator, feed them through the rubber cap, then through the retaining ring and spring and finally through the panel aperture. Proceed as detailed in para. 22, ignoring reference to adapter.

Installing indicator

24. With the bayonet adapter type of indicator, insert the indicator and locate the pip. Push on the spring and secure by plugging in the adapter.

25. With other types, insert the indicator and locate the pip. Push on the spring and secure it by fastening the retaining ring. If electrical connections are to be made at this stage, proceed as detailed in para. 22, ignoring reference to adapter.

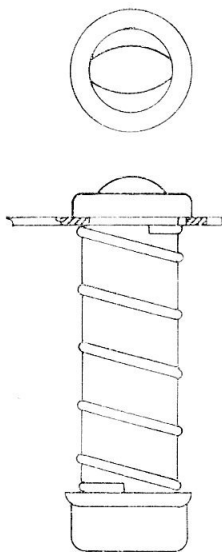


Fig. 8. Outline of Eyeball indicator

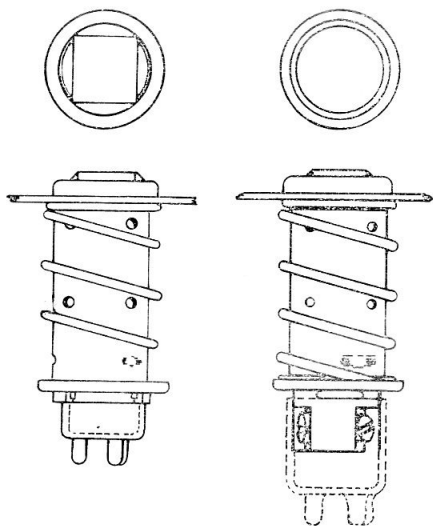


Fig. 9. Outline of Drum indicators

Removal from aircraft

26. Switch off the indicator supply.

Note . . .

If the terminal connections and mounting arrangements on the replacement indicator are identical to those of the indicator being removed, the bayonet plug, or the leads, spring, ring and cap may remain assembled.

Bayonet adapter type

27. To remove a bayonet adapter indicator, unplug the adapter, remove the retaining spring, tie the adapter clear of the metal parts and withdraw the indicator.

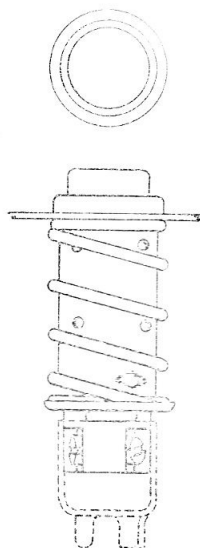


Fig. 10. Outline of Drum (Translight) indicator

Other types

28. With other types of indicator, pull back the rubber terminal cap. Release the retaining ring and spring and withdraw the indicator, complete with leads. Unscrew the terminals, remove the leads and replace the terminal screws. Secure the leads externally, clear of each other and any metal surface. If there is sufficient slack lead to pull through the panel, disconnect the leads and tie them back behind the panel. The indicator may then be unfastened and withdrawn.

SERVICING

29. This type of indicator is sealed and should not be dismantled for further servicing at user units, routine servicing is therefore restricted to examination for security of electrical connections, mounting fixing, deterioration and signs of corrosion. The unit should be tested for correct operation in its relevant circuit.

Testing

30. Before installing an indicator, it should be tested in accordance with the details contained in Appendix A to this chapter.

RESTRICTED

Appendix A

STANDARD SERVICEABILITY TEST FOR PLESSEY ELECTRO-MAGNETIC INDICATORS

LIST OF ILLUSTRATIONS

	Fig.
Test circuit diagram	1

Introduction

1. The tests detailed in this appendix are intended to check the serviceability of the indicators described in Chapter 24, prior to installation, after servicing, or whenever their serviceability is suspect.

Test equipment

2. The following test equipment will be required—

- (1) Insulation resistance tester, 250V, Type C, Ref. No. 5G/152
- (2) Two voltmeters 0 to 30V d.c.
- (3) A d.c. supply, variable between zero and 30 volts.
- (4) A variable resistor capable of dropping 25 volts and dissipating 1 watt.
- (5) Volt drop trigger switch S.P.
- (6) ON-OFF Switch S.P.

TEST PROCEDURE

General

3. The equipment should be connected up as shown in fig. 1.

Maximum release voltage

4. The signal should change to neutral when the coil voltage is reduced from 28 to 3V d.c. The release voltage must not exceed 8 volts with the indicator in any attitude.

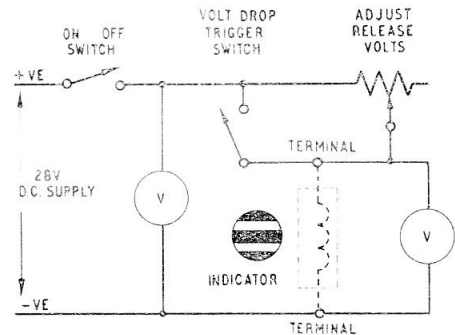


Fig. 1. Test circuit diagram

Functional test

5. The indicator should operate completely in one movement, at an applied voltage of between 12 and 16V d.c. The indicator should be checked for satisfactory operation, five times in each of four different attitudes between 12 to 16V d.c.

- (1) held horizontally—window up
—window down
- (2) held vertically—
locating pip at 12 o'clock
locating pip at 3 o'clock.

Insulation resistance test

6. Using a 250V d.c. insulation resistance tester, Type C, or equivalent, measure the insulation resistance between all terminal connections and the indicator frame; the reading should not be less than 5 megohms.

Appendix 1**THREE-POSITION INDICATOR PANEL CODING****LIST OF ILLUSTRATIONS**

Fig.

Signal patterns for three-position indicators ... 1(a) and 1(b)

Introduction

1. These panel signals are identical for all three-position indicators with the same stroke numbers. Details of signal codes for each indicator panel should be read in conjunction with the signal patterns illustrated in figure 1(a) and 1(b) of this appendix.

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/1		White B/ground		White flu. stripes on black		Black B/ground	A†
/2		White stripe on black		Yellow b/ground		White stripe on black	B
/3	O.H.	Brt. red on white	OFF	White on black	NORM	White on green	C
/4	1 and 4	Black on amber	2 and 5	White on black	3 and 6	Black on blue	D
/5		White stripe on black		Amber b/ground		White stripe on black	E
/6		White b/ground		Black b/ground		Green b/ground	F
/7	ON	White on black	OFF	White on black		Amber b/ground	G
/8		White flu. b/ground		White flu. stripes on black		Black b/ground	H†
/9	DIR.	Black on white	OFF	Black on white	AUTO	Black on white	J
/10	ON	Black on white	OFF	Black on white		Black b/ground	K
/11	ON	Black on white	OFF	Black on white	ON	Black on white	L
/12	FAULT	Red on white	FAULT	Red on white		White b/ground	M
/13		White flu. b/ground		White flu. stripes on black		Black b/ground	N†
/14		Black arrow on white		White arrow on black		Black arrow on white	P

RESTRICTED

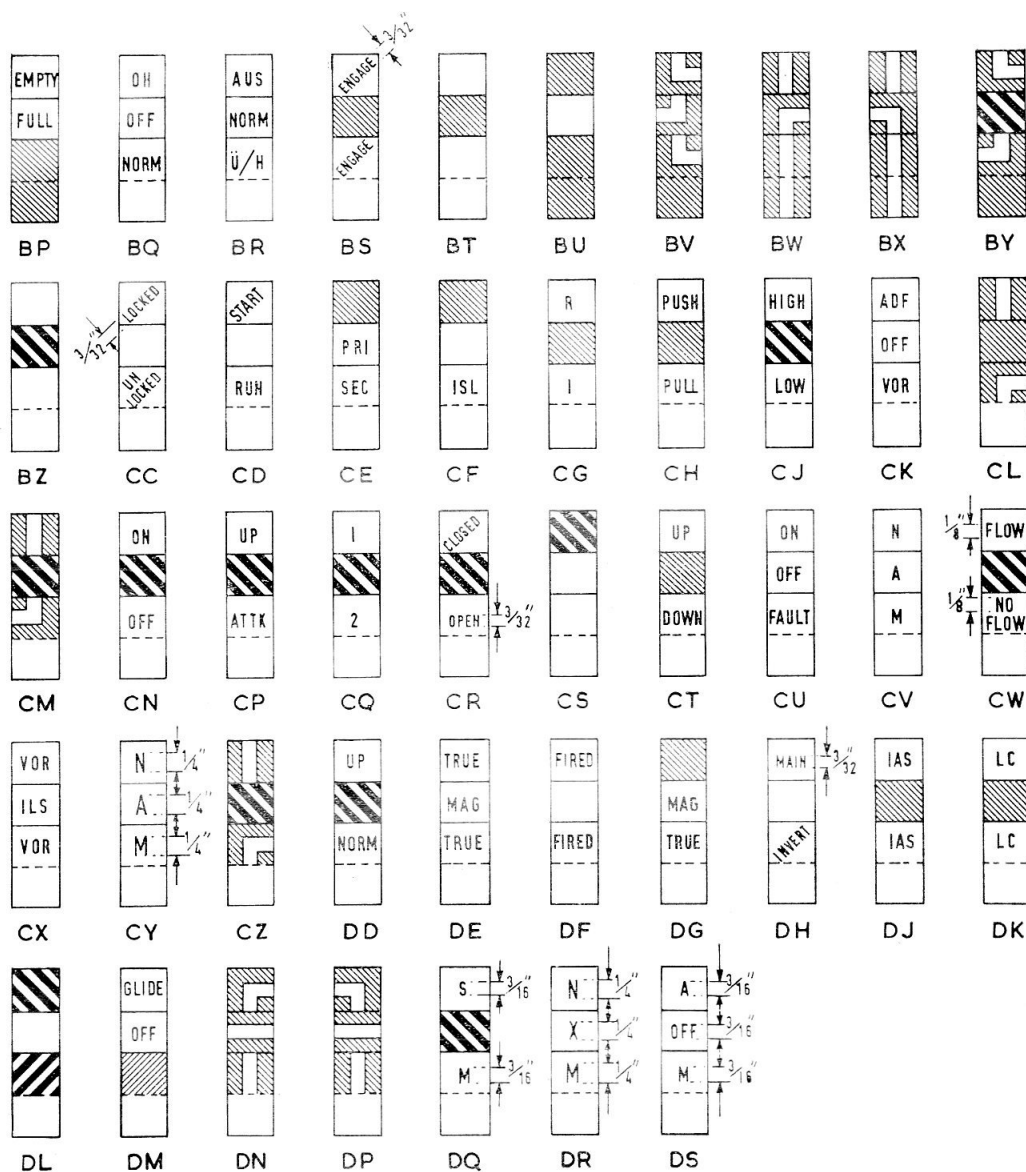


Fig. 1(b). Signal patterns for three-position indicators

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/15		White flu. b/ground		Black b/ground		White flu. diag. stripes on black	Q†
/16	OFF	White on black	ON	White on black	OFF	White on black	R
/17		Red stripe on white		Red stripe on white		Red. stripe on white	S
/18		Black b/ground	ON	Black on white		Black b/ground	T
/19	SHUT	White on black		White diag. stripes on black	OPEN	White on black	U
/20	ON	White on black	OFF	White on black		Black b/ground	V
/21		White stripe on black		White diag. stripes on black		White stripe on black	W
/22		White stripe on black		White diag. stripes on black		White stripe on black	X
/23	DIR.	White flu. on black	OFF	Black on white flu.	AUTO	White flu. on black	Y†
/24		Black b/ground	OFF	Black on white		Black b/ground	Z
/25		White stripes on black		White stripe on red		White stripe on black	AA
/26		White stripes on black		White stripe on red		White stripe on black	AB
/27		White stripe on black	OFF	White on red		White stripe on black	AC
/28	SHUT	White on black		Black b/ground	OPEN	White on black	AD
/29	EMPTY	Black on white	NO FLOW	Black on white	FLOW	Black on white	AE
/30		White stripe on black		White stripe on black		White stripe on black	AF
/31	ON	White phos. on black	OFF	White phos. on black	FAULT	White phos. on black	AG*
/32	ON	White on black	OFF	Black on white	LOW	Black on black and white diag.	AH
/33	FAIL	White on black		Black b/ground	FAIL	White on black	AJ
/34	S/BY	White phos. on black		Black b/ground	TX	White phos. on black	AK
/35	FULL	White on black	EMPTY	White on black	FLOW	White on black	AL

RESTRICTED

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/36		White stripe on black	OFF	Black on white		White stripe on black	AM
/37		White flu. stripe on black		Black b ground		White flu. stripe on black	AN†
/38		Black b/ground		White flu. b/ground		Black b/ground	AP†
/39		White stripe on black		White stripe on black		White stripe on black	AQ
/40		White stripe on black		Black b/ground		White stripe on black	AR
/41		White stripe on black		Black b/ground		White stripes on black	AS
/42		White stripes on black		Black b/ground		White stripes on black	AT
/43	OPEN	White on black		White diag. stripes on black	SHUT	White on black	AU
/44		White stripe on black	LP	White on red		White stripe on black	AV
/45	UP	Black on white		Black b/ground	DOWN	Black on white	AW
/46	UP	White phos. on black		Black b ground	DOWN	White phos. on black	AX*
/47	O/C	Red on white	NORM.	White on black	TRANS.	Black on white	AY
/48	L	White on black	N	White on black	R	White on black	AZ
/49		White stripes on black		White stripe on black		White stripes on black	BB
/50	IN	Black on white		Black b ground	OUT	Black on white	BC
/51	ON	White on black	OFF	White on fire orange b/ground	ON	White on black	BD‡
/52	FULL	Orange flu. on black	EMPTY	Orange flu. on black	FLOW	Orange flu. on black	BE†
/53	L	Orange flu. on black	N	Orange flu. on black	R	Orange flu. on black	BF†
/54	EMPTY	Orange flu. on black	FULL	Orange flu. on black	EMPTY	Orange flu. on black	BG†
/55	FAST	White on black		White diag. stripes on black	SLOW	White on black	BH
/56	SAFE	White on black		Fire orange circle on black	SAFE	White on black	BJ‡

RESTRICTED

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/57		White stripe on black		Black b/ground		White stripe on black	BK
/58		White stripe on black	LP	White on red		White stripe on black	BL
/59	FAIL	Black on white		Black b/ground	FAIL	Black on white	BM
/60	OPEN	White on fire orange		White diag. stripes on black	SHUT	White on black	BN‡
/61	EMPTY	Orange flu. on black	FULL	Orange flu. on black		Black b ground	BP*
/62	OH	Orange flu. on brt. red	OFF	Orange flu. on black	NORM	Orange flu. on green	BQ*
/63	AUS.	White on black	NORM.	White on green	Ü H	Brt. red on white	BR
/64	ENGAGE	White on black		Black b ground	ENGAGE	White on black	BS
/65		White b ground		Black b ground		White b/ground	BT
/66		Black b ground		White b/ground		Black b/ground	BU
/67		White stripes on black		White stripes on black		White stripes on black	BV
/68		White stripe on black		White stripes on black		White stripe on black	BW
/69		White stripe on black		White stripes on black		White stripe on black	BX
/70		White stripes on black		White diag. stripes on black		White stripes on black	BY
/71		White b/ground		White diag. stripes on black		Black b/ground	BZ
/72	LOCKED	Black on white		White b/ground	UNLOCKED	Black on white	CC
/73	START	White on red		Black b ground	RUN	White on green	CD
/74		Black b/ground	PRI.	White on black	SEC	White on black	CE
/75		Black b/ground		White b ground	ILS	White on black	CF
/76	R	Black on white		Black b ground	I	Black on white	CG
/77	PUSH	Orange flu. on black		Black b/ground	PULL	Orange flu. on black	CH
/78	HIGH	White on black		White diag. stripes on black	LOW	White on black	CJ

RESTRICTED

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/79	A.D.F.	White on black	OFF	White on black	V.O.R.	White on black	CK
/80		White stripe on black		Black b ground		White stripes on black	CL
/81		White stripe on black		White diag. stripes on black		White stripes on black	CM
/82	ON	White on black		White diag. stripes on black	OFF	White on red	CN
/83	UP	White on black		White diag. stripes on black	ATTN	White on black	CP
/84	1	White on black		White diag. stripes on black	2	White on black	CQ
/85	CLOSED	White on black		White diag. stripes on black	OPEN	White on black	CR
/86		White diag. stripes on black	EMPTY	White on black	FULL	White on black	CS
/87	UP	White on black		Black b ground	DOWN	White on black	CT
/88	ON	White on black	OFF	White on black	FAULT	White on amber	CU
/89	N	White on black	A	Black on red	M	Black on yellow	CV
/90	FLOW	White on black		White diag. stripes on black	NO FLOW	White on black	CW
/91	VOR	Black on white	ILS	Black on white	VOR	Black on white	CX
/92	N	White flu. on grey	A	White flu. on grey	M	White flu. on grey	CY†
/93		White stripe on black		White diag. stripes on black		White stripes on black	CZ
/94	UP	White on black		White diag. stripes on black	NORM	White on black	DD
/95	TRUE	Black on white	MAG	White on black	TRUE	Black on white	DE
/96	FIRE	White on red		Amber b/ground	FIRE	White on red	DF
/97		Black b/ground	MAG	White on black	TRUE	White on black	DG

RESTRICTED

Indicator stroke No.	Code	Supply to term. 2 (Panel 1)	Code	No. Supply (Panel 2)	Code	Supply to term. 3 (Panel 3)	Signal Pattern Reference
/98	MAIN	White on black		Amber b/ground	INVERT	White on black	DH
/99	IAS	White on black		Black b/ground	IAS	Black on white	DJ
/100	LC	Black on white		Black b/ground	LC	Black on white	DK
/101		Yellow flu. diag. stripes on yellow		Green b/ground		Red flu. diag. stripes on red	DL†
/102	GLIDE	White on black b/ground	OFF	White on grey b/ground		Black b/ground	DM
/103		White stripes on black		White stripe on black		White stripe on black	DN
/104		White stripes on black		White stripe on black		White stripe on black	DP
/105	S	Black on white		White diag. stripes on black	M	Black on white	DQ
/106	N	White flu. on grey	X	White flu. on grey	M	White flu. on grey	DR†
/107	A	White on black	OFF	White on black	M	White on black	DS

Abbreviations to colour code:

† flu = fluorescent

* phos. = phosphorescent

‡ = fire orange day-glo

brt. = bright

diag. = diagonal

RESTRICTED

Appendix 2

INDICATOR TYPES AND REFERENCE NUMBERS

Eyeball Type Indicator	Ref. No.	Drum Type Indicator	Ref. No.	Drum Type Indicator	Ref. No.	Drum Type Indicator	Ref. No.
7CZ/74109/	5CZ	7CZ 106565/	5CZ	7CZ/107626/	5CZ	7CZ 143684/	5CZ/
						13	—
1	5045	13	5925	3	7626	16	6550
				7	—		
2	5123	16	6020	16	6499	18	7279
		18	6075	18	6500	19	7539
		23	6713	19	7627	21	7540
		24	6712	20	7628	22	7541
				22	—		
				23	7304	28	6534
				30	—		
				32	6511	29	6493
				47	7629	30	7542
				76	7563	37	6551
				78	7824	38	6552
				82	7826	64	7543
				83	7822	65	7544
				84	7823	66	7545
				88	7825	67	7546
						68	7547
						69	7548
						70	7549
						72	—
						71	7550
						79	7551
						87	—
						93	7552
						95	7553
						103	—
						104	—

RESTRICTED