Group 2.A

FUEL CONTENT GAUGES AND FUEL PRESSURE WARNING

(Completely revised)

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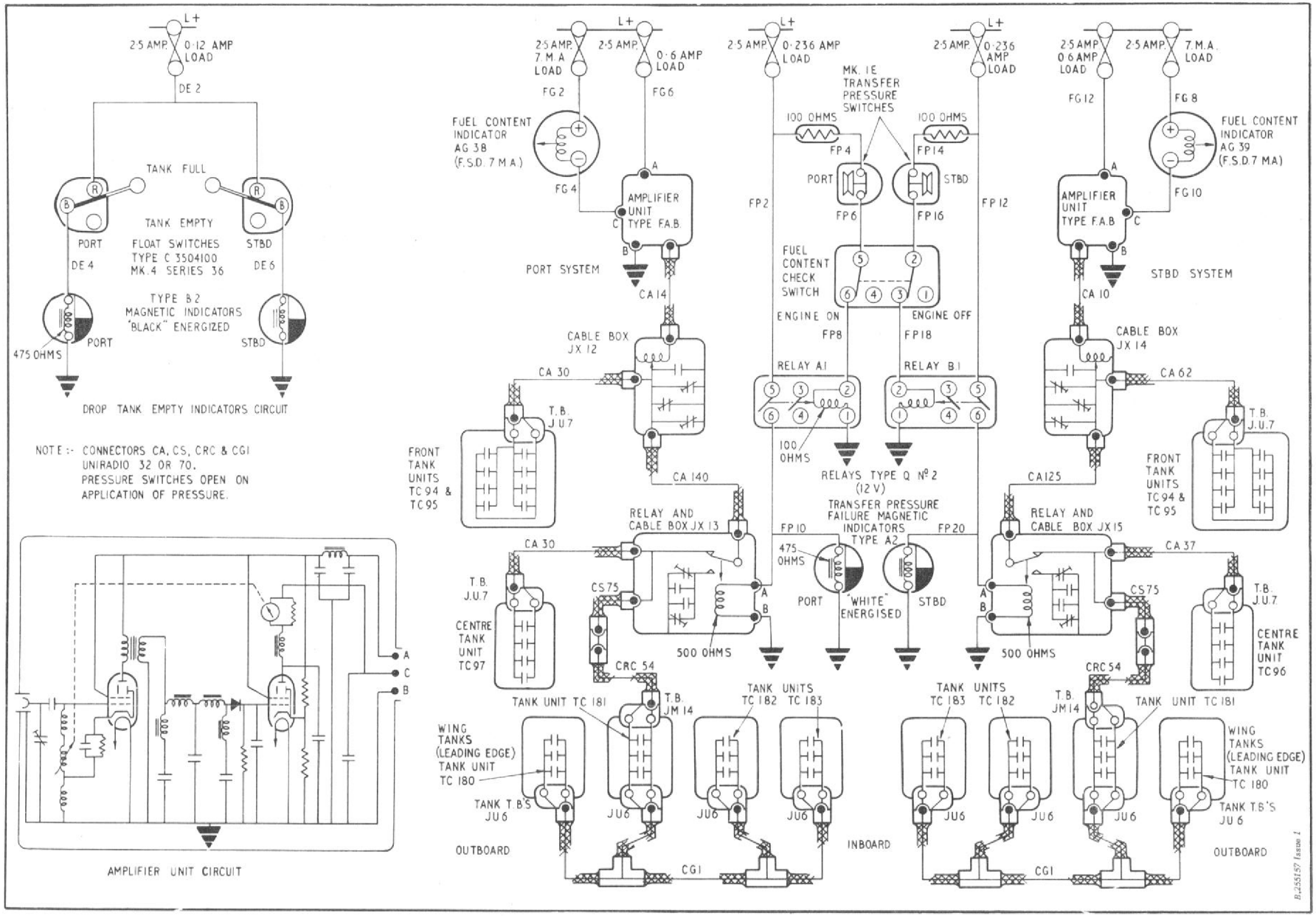

Fig.1 Fuel content, transfer pressure warning and drop tank empty indicators (theoretical)

RESTRICTED

Introduction

1. This Group contains a description of the fuel contents and pressure warning installations of this aircraft, together with the method of operation and the necessary servicing information required to maintain the equipment in an efficient condition. Routeing and theoretical diagrams of the installations are also included. For a general description of the aircraft's instrument installation reference should be made to Group 1.A. Detailed information on the standard components used, will be found in the relevant Air Publications listed in Table 1.

DESCRIPTION

Fuel content gauges and fuel pressure warning

2. This is a 28 volt electronic installation. The gauges, one for the port and another for the starboard fuel tanks, are located side by side at the top of the centre instrument panel. They give a continuous summated indication of the front, centre and wing fuel tank contents irrespective of the aircraft's attitude. The port and starboard tank systems are entirely independent except for the common d.c. supply and differ only in that the port centre tank contains a few more gallons than that on the starboard side.

3. The gauges, which are engraved in pounds *(mass)*, are actuated by strap type capacitor gauge units fitted within each tank, via two amplifier units, located on the port side of the fuselage between frames 16 and 17B. The gauge units are connected to the amplifiers, via connector boxes located adjacent to the amplifiers and in addition the gauge units in the centre and wing tanks are connected to relay boxes, which are mounted on the rear face of frame 25.

4. These relay boxes are energized by the operation of two fuel transfer pressure relays *(relays A.1 and B.1)* located on the supply panel and controlled by two transfer pressure switches mounted between frames 24 and 25 in the centre fuselage. Apart from energizing the relay boxes, the transfer pressure relays also energize two transfer failure indicators located one below each fuel gauge on the centre instrument panel.

5. A switch, for use when it is required to check the fuel contents while the engine is not running, is provided on a bracket located on the forward face of the centre instrument panel, adjacent to the starboard fuel gauge. The switch dolly is level with the top edge of the instrument panel and may be operated from above the panel. Theoretical and routeing diagrams of the fuel content gauges and pressure warning

TABLE 1

Equipment used and Air Publication reference

Equipment Type	Air Publication
Content gauges, Type A.G.38 and 39 Gauge amplifiers, Type FAB Connection boxes, Type JX.12 and 14 Relay boxes, Type JX.13 and 15 Tank units, Type TC.94, 95, 96, 97, 180, 181, 182, and 183	A.P.1275A, Vol.1, Sect.18
Pressure switches, Mk.1E* Float switches, Type C.3504100/36 or /153	A.P.1275A, Vol.1, Sect.24
Fuel contents check switch, double-pole, change-over No.2	A.P.4343C, Vol.1, Book 1, Sect.1
Transfer pressure failure indicators, Type A.2 Drop tank empty indicators, Type B.2 Engine fuel pressure warning lamp, Type A	A.P.4343E, Vol.1, Book 4, Sect.18
Relays A.1 and B.1, Type Q, No.2	A.P.4343C, Vol.1, Book 2, Sect.3

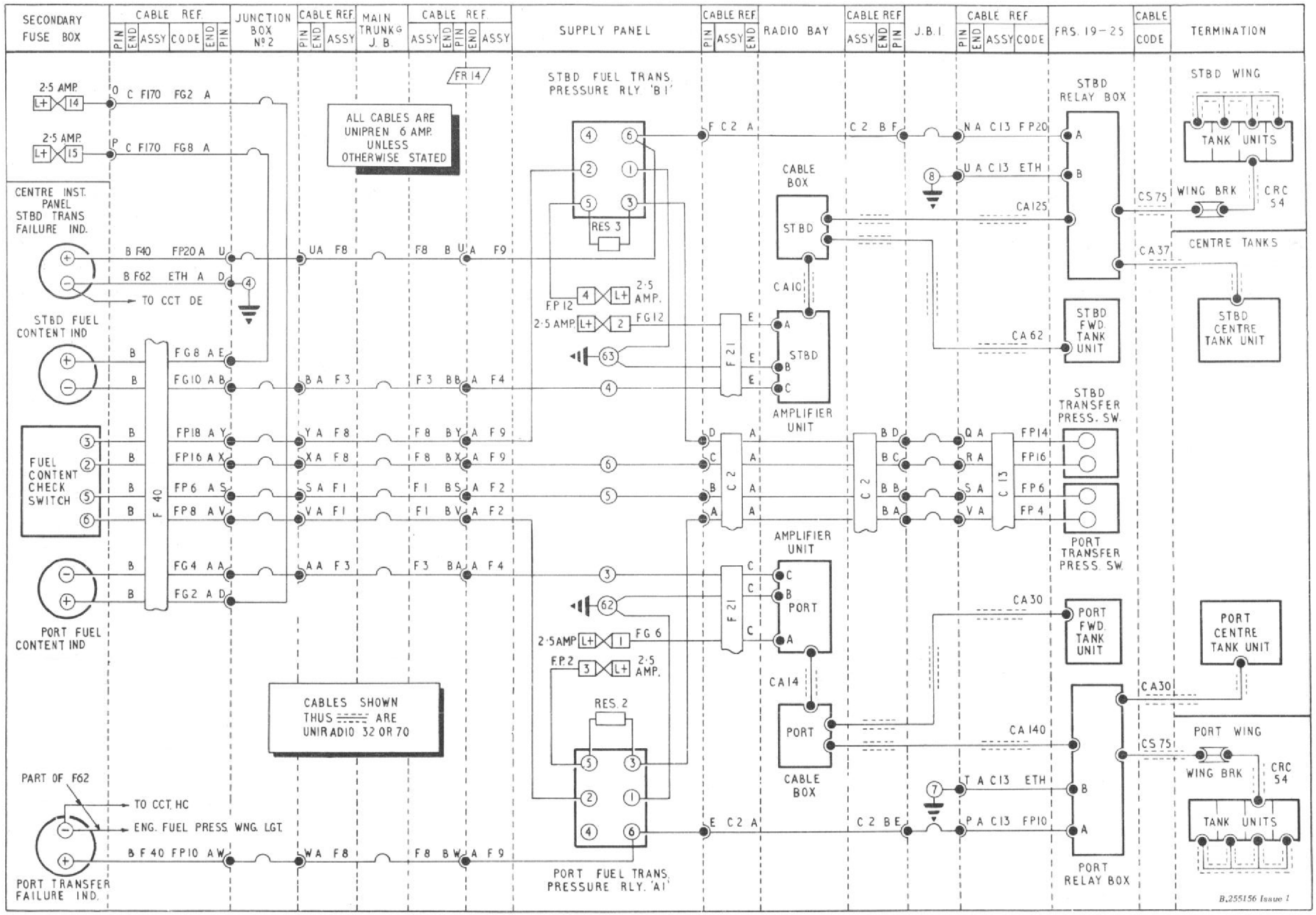

Fig.2 Fuel content and fuel pressure warning (routeing)

circuits are given in fig.1 and 2 and the fuel system as a whole is covered in Book 1, Sect.4, Chap.2. Reference should be made to the Air Publications listed in Table 1 for a full description of the fuel gauge equipment, together with the principle of operation.

Operation

6. As each fuel gauge and its associated amplifier is separately fused and provided with independent control equipment, it is only necessary to follow the operation of one gauge to understand the circuit. The gauge and amplifier are both energized from the main positive supply and commence operation immediately the battery master switch is placed in the ON position. With transfer pressure in the tanks, the gauge will indicate the contents of the front, centre and wing tanks, but if the fuel transfer pressure fails, so preventing fuel from being transferred from the centre and wing tanks to the front tank, the transfer pressure switch will close. This will, in turn, energize the transfer pressure relay, A.1 or B.1, which will energize the fuel gauge relay box and the transfer failure indicator. The indicator will then give warning of transfer failure by showing WHITE and the relay box will disconnect the centre and wing tank gauge units from the amplifier and insert a fixed capacitor into circuit, the value of which, corresponds to that obtained when the centre and wing tanks are empty. The gauge therefore, will only indicate the fuel contents of the front tank, as this is the only fuel available to the engine under conditions of fuel transfer pressure failure.

7. The contents check switch, which is marked ENGINE ON and ENGINE OFF is normally closed, to complete the supply from the transfer pressure switch to the transfer pressure relay. This switch is used to check the total fuel contents when the engine is not running, as under this condition the required transfer pressure may not be available to open the transfer pressure switch and the centre and wing tank gauge units would therefore be out of circuit, *(para.6)*. When the check switch is held in the ENGINE OFF position, the supplies to the transfer pressure relays are broken and this in turn de-energizes the fuel gauge relay boxes, which will reconnect the centre and wing fuel tank gauge units to the amplifiers, as during normal conditions.

Drop tank empty indicators

8. Two magnetic indicators are provided on the centre instrument panel, just below the fuel gauges, to indicate when the outboard drop fuel tanks are empty. These indicators are controlled by float switches located one in each outboard drop tank. Since the drop fuel tanks are ungauged and feed into the wing tanks, it should be appreciated that the fuel gauges *(para.2)* will show 'full contents' until such time as the drop tanks are empty. Theoretical and routeing diagrams of this circuit are given in fig.1 and 3.

Operation

9. The operation of the outboard drop tank empty indicator circuit will be obvious once reference is made to the theoretical diagram of the circuit given on fig.1. Reference should also be made to the Air Publications listed in Table 1 for a full description of the float switches and indicators.

Engine fuel pressure warning

10. Indication of low fuel pump delivery pressure is given by a warning lamp mounted below the fuel gauges on the centre instrument panel. This lamp is controlled by a fuel pressure switch situated at the bottom of the centre fuselage between frames 24 and 25. Details of the pressure switch and warning lamp will be found in the Air Publications listed in Table 1.

Operation

11. The operation of the fuel pressure indicator circuit is such that when the engine fuel pump delivery pressure falls below 3.5 lb/sq in, the fuel pressure switch contacts close and complete the supply to the warning lamp, which will be illuminated to give warning of this condition. A theoretical diagram of this circuit will be found in fig.3.

SERVICING

General

12. Apart from the servicing information given in the following paragraphs, all other servicing to maintain the fuel con-

tents and pressure warning installations in an efficient condition and the standard serviceability tests which should be applied, together with the equipment to be used and the method of conducting the tests is contained in the relevant Air Publications listed in Table 1. Before servicing or removing any of the electrically-operated equipment, the aircraft should be rendered electrically safe *(Sect.5, Chap.1, Group A.1)*.

TABLE 2. Tank units

Code	Initial capacitance (pF)	Tank
TC.94	227 + 3	Front
TC.95	287 ± 3	Front
TC.96	181 ± 3	Starboard centre
TC.97	188 + 3	Port centre
TC.180	50 + 3	Wing
TC.181	74 ± 3	Wing
TC.182	74 ± 3	Wing
TC.183	118 ± 3	Wing

Note . . .

The values and tolerances given in Tables 2, 3 and 4 are based on the use of a precision air capacitor, i.e. Sullivan Air Capacitor or Smiths Test Set Code QC.129 (Ref.6C/2214). If the Smiths Test Set Code QAA (Ref.6C/864) is used, each tolerance should be increased by 10 per cent of the tank unit value plus the tolerance in Tables 2, 3 or 4.

Fuel contents gauges

Data and tolerances on units

13. These figures are given in order that the units may be checked individually. The following equipment should be used for carrying out the tests and must be of at least the accuracy stated.

(1) Variable capacitor – Range 100 to 2300 pF. Accuracy + 1 pF at any point on its range.

(2) Milliameter * – Range O to 7.5 mA, O to 15 mA, 0-30 mA. Accuracy to BS.89 precision grade.

(3) Voltmeter – Range O to 40 volts. Accuracy to BS.89 first grade.

(4) FAB amplifier – Tested using the above instruments for conformation to the limits given in para. 20.

(5) 250 volt d.c. insulation resistance tester.

* *Alternatively, a d.c. potentiometer and standard resistance may be used.*

Tank units

14. The initial capacitance quoted in Table 2 is measured with the tank unit moist, but thoroughly drained of all kerosene fuel. Measurements must be carried out with the units well clear of all metal objects, and with the leads a minimum of three inches apart. The capacitance of flexible tank units fitted with non-detachable leads should be measured taking care to keep the unit remote from any structure which will effect the capacitance value. The unit should be suspended in air by the anchor plate, remote from the leads, at least twelve inches from any object. The live lead attached to the tank unit should be rolled up into a coil ¾ in. in diameter and kept as far away from the earth lead as possible. The earth lead may be left free. A resistance of at least 20 megohms should be obtained for a new replacement unit dry before installation. To avoid any risk of an explosion, insulation resistance tests of installed tank units should not be made under any circumstances.

Tank terminals

15. The capacitance of the tank terminals is as follows:-

Code –	JM14	Capacitance 23 ± 3 pF.
	JU6	Capacitance 23 ± 3 pF.
	JU7	Capacitance 28 ± 3 pF.

The terminals should have an insulation resistance of at least 20 megohms.

Complete tank with tank terminal

16. The capacitance values for the tanks complete with terminals is given in Tables 3 and 4. The insulation resistance of a complete tank installation, measured at the tank terminal coaxial socket should

◀ not be less than 1 megohm. To avoid any risk of an explosion, insulation resistance checks should not be carried out on units installed in used tanks. Flexible fuel tanks must be measured in ▶ the form they take installed in the aircraft and under no circumstances must they be folded during capacitance tests.

Coaxial cables

17. Coaxial cables should have a resistance of at least 20 megohms whether new or installed. Cable details are given in Table 5.

Cable boxes, code JX13 and JX15

18. The capacitance figures given in Table 6 for both these cable boxes are box values measured at the output socket, and with all tank system coaxial cables disconnected. The box capacitance with the relay open should be 15 ± 5 pF. in each case. The JX13 *(Mod.01 and 02)* and JX15 *(Mod.01 and 02)* cable boxes, should have an insulation resistance of at least 20 megohms between the following points:-

(1) Pin A or B and earth with the relay unenergized.

(2) Output socket and earth with the relay unenergized.

(3) Output socket and earth with the relay energized.

Note . . .

The tank circuit should be disconnected during the check.

Cable boxes, code JX12 and JX14

19. Before checking a cable box in accordance with the range values given in Table 7 or 8, the trimmers must be adjusted to their nominal value (mid-setting). The range into, and out of, the box is the increase in capacitance above 2mA. It will be seen in each table that the capacitance out of the box figure is the tanks empty capacitance of the amplifier less the

TABLE 3. Fuselage Tanks
(Port and Starboard)

Tank	Empty, out of aircraft	Installed, wet and pressurized
Front	598 ± 20 pF.	643 ± 25 pF.
Centre (Port)	251 ± 15 pF.	260 ± 20 pF.
Centre (Starboard)	255 ± 15 pF.	256 ± 20 pF.

See Note after Table 2

TABLE 4. Wing tanks
(Port and Starboard)

Tank	Installed empty and dry	Installed, wet and pressurized
No.1	172 ± 15 pF.	187 ± 19 pF.
No.2	133 ± 15 pF.	148 ± 19 pF.
No.3	173 ± 20 pF.	194 + 32 pF.
No.4	102 + 15 pF.	110 ± 15 pF.

See Note after Table 2

TABLE 5. Coaxial cables

Code	Length (in.)	Capacitance (pF.)
CA.10	10	18 ± 3
CA.14	14	26 ± 3
CA.30	30	54 ± 3
CA.37	37	67 ± 3
CA.62	62	111 ± 3
CA.125	125	225 ± 5
CA.140	140	252 ± 5
CRC.54	54	97 ± 3
CS.75	75	135 ± 3

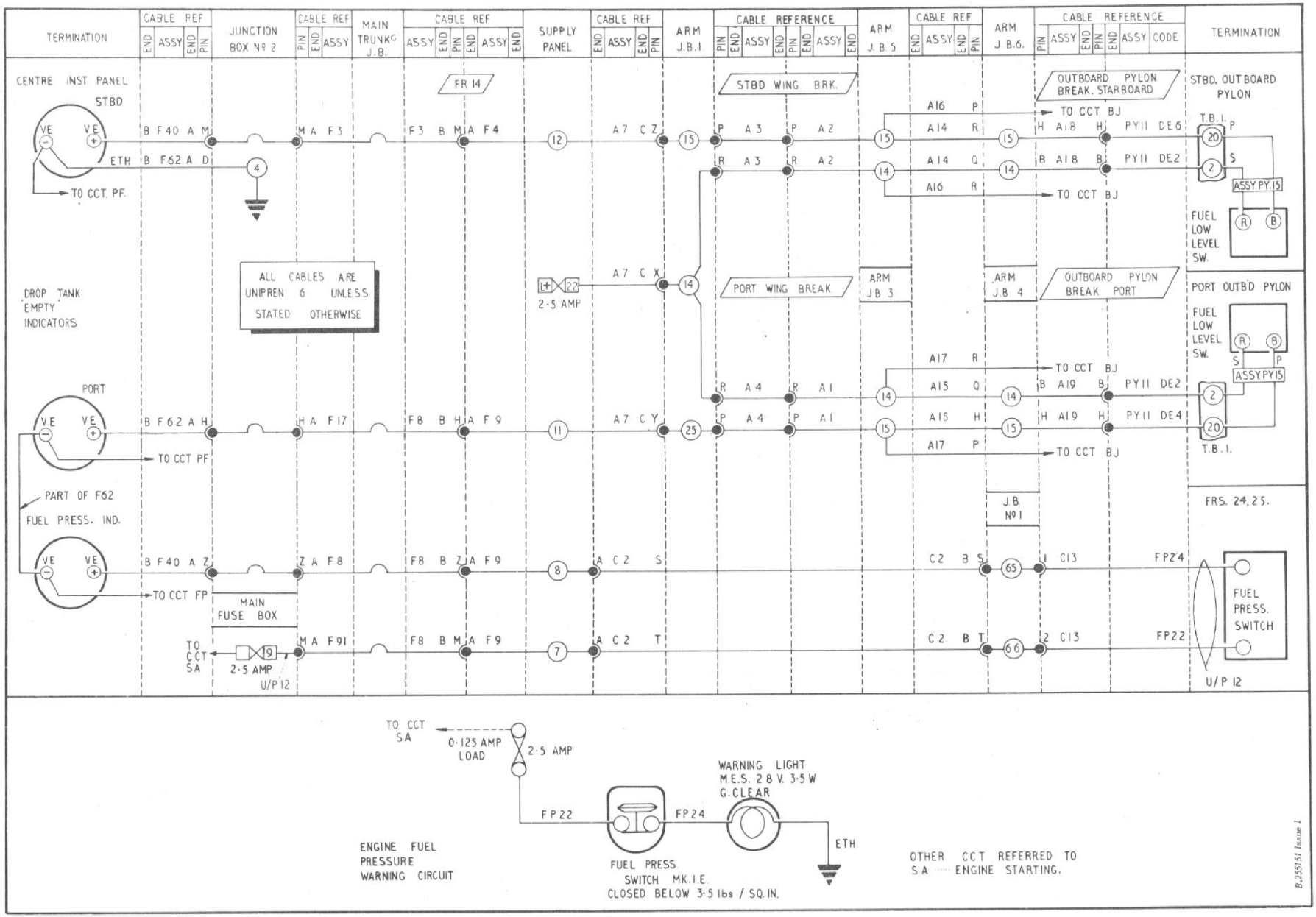

Fig.3 Drop tank empty indicators and engine fuel pressure warning

capacitance of the connecting cable. The full testing procedure is described in A.P.1275T, Vol.1, As each cable box contains a coil connected to earth, it is useless to subject them to an insulation resistance test. These units may be considered serviceable if they conform to the capacitance figures given in the tables.

Amplifiers, code FAB

20. The relationship between the indicator current and capacitance with a power supply of 28 volts is given in Table 9. The amplifiers contain a 150 volts working condenser, which would be damaged by the higher Megger voltage, thus an insulation resistance test must not be carried out on these units. They may be considered serviceable if they conform to the capacitance/indicator current test figures given in the Table using the accurate test equipment referred to in para.13.

Power supply: Nominal voltage 28 volts. Current at 28 volts 0.7 amp. *(approx.)*

Capacitance: Initial *(or tanks empty)* ... ...750 pF.
Tanks full .. ..1250 pF.
Range ... ...500 pF.

Coaxial harness, code CG1

21. The capacitance of the coaxial harness is 136 ± 5 pF, and it should have an insulation resistance of at least 20 megohms.

Indicators

22. An insulation resistance test should not be carried out on the indicators. These may be considered serviceable if they conform to the figures given in Table 10.

Accuracy of the fuel gauge installation

23. It will be realised from the nature of

TABLE 6. JX13 and JX15 cable boxes

Code	Box capacitance (relay closed)	
	Trimmer at min. not more than	Trimmer at max. not less than
JX13 (Mod.01)	1157 pF	1349 pF
(Mod.02)	1160 pF	1398 pF
JX15 (Mod.01)	1166 pF	1358 pF
(Mod.02)	1169 pF	1407 pF

TABLE 7 JX.12 Cable boxes

Tanks empty capacitance into box at input socket			Tanks empty capacitance out of box	Range out of box	Range into box
Trimmer at min. not less than	Box input nominal value	Trimmer at max. not more than			
2351pF	2217pF	2083pF	724pF	500pF	1105pF

TABLE 8. JX.14 Cable boxes

Tanks empty capacitance into box at input socket			Tanks empty capacitance out of box	Range out of box	Range into box
Trimmer at min. not less than	Box input nominal value	Trimmer at max. not more than			
2390 pF	2256 pF	2122 pF	732 pF	500 pF	1090 pF

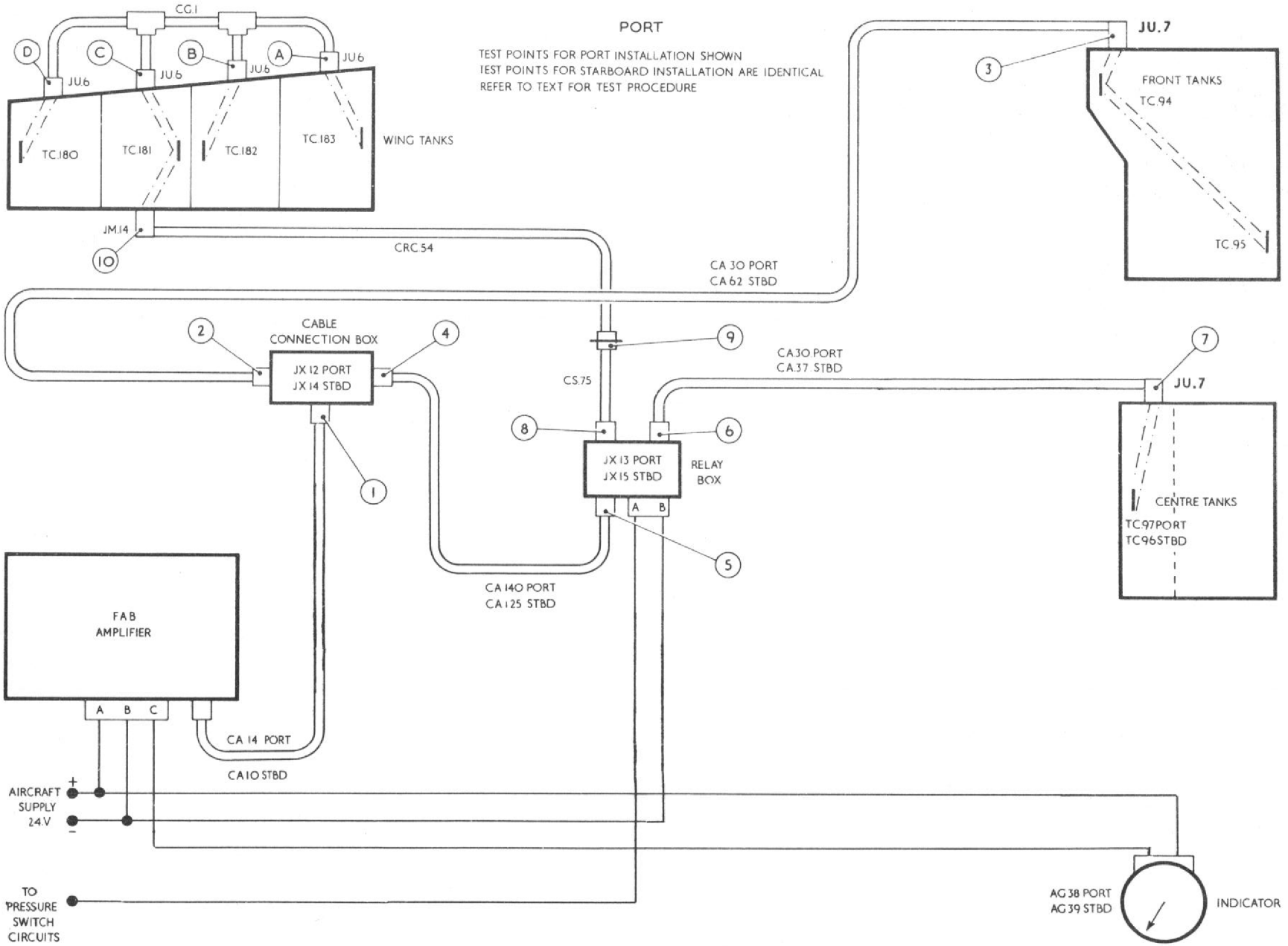

Fig.4 Fuel content gauge tank test points

the system that its accuracy depends on the supply voltage being maintained at the required figure and the physical properties of the fuel conforming to specification. Any small inaccuracies which may exist will usually stem from these two sources. The calibration of this gauge is based on a kerosine fuel having a permittivity of 2.10 and a specific gravity 0.779 at a temperature of 20 deg.C.

Errors of the fuel gauge in normal flight

24. The following tables will enable an operator to obtain an approximate error from true reading caused by system inaccuracies and by various conditions of temperature, supply voltage, fuel permittivity and density. All errors are expressed as a percentage of the total indication with the exception of the fuel temperature errors which are expressed as a percentage of indicated fuel contents per degree Centigrade.

TABLE 9

Amplifier capacitance/indicator current

Capacitance (pF.)	Indicator current (mA.)
750	2.0 ± .03
823	3.0 ± .05
908	4.0 ± .05
1005	5.0 ± .05
1120	6.0 ± .05
1250	7.0 ± .05

TABLE 10 Indicators

Code AG.38		Code AG.39	
Indication (pounds X 100)	Indicator Current (mA.)	Indication (pounds X 100)	Indicator Current (mA.)
0	2.00	0	2.00
1	2.35	1	2.33
2	2.73	2	2.73
3	3.14	3	3.16
4	3.53	4	3.57
5	3.92	5	3.95
6	4.25	6	4.28
7	4.58	7	4.59
8	4.90	8	4.93
9	5.22	9	5.25
10	5.50	10	5.55
11	5.78	11	5.84
12	6.04	12	6.10
13	6.29	13	6.34
14	6.50	14	6.57
15	* 6.72	15	6.81
16	6.96	16.05	7.00
(F)16.28	7.00		

* Actual figure is 6.725. A reading of 6.72 or 6.73 - therefore, acceptable.

TABLE 11 - Temperature

Temp.	−40°C	−20°C	+ 20°C	+50°C	+70°C
Tank empty	+0.96	+0.64	0	−0.48	−0.8
1/10	+1.2	+0.8	0	−0.6	−1.0
1/3	+1.68	+1.12	0	−0.84	−1.4
2/3	+2.4	+1.6	0	−1.2	−2.0
Full	+3.12	+2.08	0	−1.56	−2.6

TABLE 12 – Supply voltage

Supply voltage	24V	28V	29V
All fuel levels	−1.5	0	+0.8

Note . . .

The fuel contents gauge is calibrated for a supply voltage of 28 volts d.c. To obtain maximum accuracy, the voltage must be adjusted to this figure.

Note . . .

(A) The figures given in Table 13 will enable an operator to calculate errors when using fuels differing in permittivity and density to those for which the gauge is calibrated (para.23). It should be borne in mind the errors given in column (4) of Table 13 are not extreme errors to be expected when using the fuels defined in column (1). The errors given are those which may be present when using fuels conforming to the permittivities and densities quoted in columns (2) and (3). The errors given have been calculated from the "highest" and "lowest" values obtained by laboratory measurement of fuel samples.

(B) Since fuel permittivity does not always vary exactly in relation to density, an error may exceed that quoted or the sign of an error may reverse. Should a fuel be employed which differs to that defined in columns (2) and (3), the mass indication for that fuel will be in error by a factor equal to $\frac{k-1}{d} \cdot \frac{do}{ko-1}$; *that is to say, the capacitance index of the fuel divided by that for the standard.*

TABLE 13 – Fuel variations

(1) Fuel	(2) Permittivity (k)	(3) Density (d)	(4) % Errors				
			Tank empty	1/10	1/3	2/3	Tank full
BRITISH							
AVTAG/DERD2486	2.035	0.739	0	–0.08	–0.3	–0.6	–0.8
(J.P.4B or F-40)	2.180	0.825	0	+0.1	+0.4	+0.8	+1.3
AVTUR/DERD2482	2.035	0.780	0	–0.6	–2.0	–4.0	–6.0
(J.P.1B or F–33)	2.165	0.810	0	+0.2	+0.6	+1.2	+1.8
AVCAT/DERD2488	2.156	0.817	0	0	0	0	0
(J.P.5B or F-42)	2.161	0.817	0	+0.05	+0.16	+0.32	+0.5
AMERICAN							
J.P.1 (MIL-F-5616	2.093	0.8030	0	–0.4	–1.2	–2.4	–3.7
or F-33	2.186	0.8479	0	–0.09	–0.3	–0.6	–0.9
J.P.3 (MIL-F-	1.997	0.7434	0	–0.5	–1.6	–3.2	–5.0
5624C)	2.270	0.8300	0	+0.8	+2.8	+5.6	+8.3
J.P.4 (MIL-F5624C	2.020	0.7467	0	–0.3	–1.1	–2.1	–3.2
or F-40	2.106	0.8251	0	–0.5	–1.7	–3.4	–5.1

(C) The fuel error given in column (4) is expressed as percentage of the quantity present and therefore falls proportionally to zero as the tanks drain.

TABLE 14

Temperature variations acting on the fuel

Condition	% Error
Temperatures above +20 deg.C.	–0.028°C
Temperatures below +20 deg.C.	–0.028°C
For 50 deg. C. fall in temperature	+1.40
For 50 deg. C. rise in temperature	–1.40

Note . . .

The correction to be made to the indicator reading, to indicate true contents, is equal in magnitude but opposite in sign to the error given.

TABLE 15 - System error

Tanks empty	±0.3 *
1/10	±0.8 *
1/3	±2.0 *
2/3	±3.7 *
Full	±5.7 *

* Includes 0.3 per cent readability error

Note . . .

Each unit of the fuel gauge is manufactured to a particular capacitance with an associated tolerance. It is, therefore, possible, although unlikely, for all these to be either high or low on tolerance. For this reason, Table 15, quoting the maximum system errors, is given.

Setting up fuel contents gauges

25. Before commencing to set-up the fuel gauges, ensure that the power supply to the amplifier is switched on for at least 5 minutes, by placing the battery switch to the ON position or by connecting an external supply to the aircraft's electrical system. The recommended setting-up instructions are as follows:-

(1) The supply voltage is to be 28 ± 0.5 volts.

(2) Fill and then drain the complete fuel system to the unusable fuel level.

(3) Pressurize the fuel system to the normal working pressure.

(4) Trim the summation circuits to zero, using the three trimmers marked TRIM SUM in the cable boxes JX.12 and JX.14.

(5) Depressurize the fuel system.

(6) Trim the wing and centre matching circuits to zero, using the three trimmers marked TRIM O/C in the relay boxes JX-13 and JX.15.

Checking the fuel gauge installation

26. Apart from the normal inspection for physical damage, the installation on this aircraft requires no maintenance during service other than the functional *(or tanks drained)* check. The fault location checks should be carried out, using the code QAA test set, which is described in A.P.1275T, Vol.1. The figures quoted for these checks should only be employed as a guide when using the QAA test set, the necessary standard of accuracy not being obtainable with this instrument. If, however, a unit appears to deviate greatly from the figures quoted, it should be removed from the aircraft and checked, using the accurate test equipment referred to in para.13 or alternatively, replaced by a new unit and the fault location test repeated. On no account should a unit be rejected solely on the evidence of the test set.

27. It is permissible to change a valve in an amplifier, but this must be replaced only by a Code ZAA valve supplied by Smiths Aircraft Instruments, Ltd. After a valve replacement has been carried out the amplifier must pass a capacitance indicator current test *(para.20)* again using the accurate equipment referred to previously.

Functional check

28. This check should be carried out at the times quoted in the aircraft Servicing Schedule or after any major unit of the installation is changed. The check ensures a correct reading on the indicators when the tanks are drained of all normally usable fuel, and thus acts as a guide to the correct operation of the guage. Each side of the system must be checked separately and, therefore, the following procedure must be followed out on each in turn.

29. Before commencing this test, the system should be pressurized to the normal working pressure the tanks must also have been recently filled and then drained of all normally usable fuel. It is important to note that 15 minutes should be allowed to elapse to enable the tank units to completely drain, otherwise the tank units will have a higher capacitance than that quoted. In addition, the power supply to the amplifier must be switched on at least five minutes before the check is carried out.

30. If these conditions are satisfied, the indicator should read zero contents. If not, the trimmers in either JX.12 or JX.14 cable box must be revolved until the indicators give a satisfactory reading.

31. The systems should now be depressurized. The CHECK CONTENTS switch set to ENGINE ON so that the dummy capacitances for the wing and centre tanks are now connected to their respective amplifiers. The indicator should still show zero contents, but if not, the trimmers in the JX.13 or JX.15 cable box should be used to obtain the desired reading. Whilst it is immaterial which trimmers are used to effect adjustment, under certain conditions difficulty may be experienced in setting the indicator to zero contents, in either the pressurized or unpressurized state. If such is the case, it will be necessary to adjust the trimmers of the cable box involved to the maximum capacitance setting utilising the QAA test set for the purpose.

32. The QAA test set should not be connected to any part of the circuit whilst carrying out a zero contents check. It must be realised that this check in no way guarantees the accuracy of the system throughout the range and that if this is suspect the units should be individually tested with the equipment listed in para.13.

Insulation resistance check

33. An insulation resistance check should be carried out periodically with at least the same frequency as this check is made on the remainder of the aircraft's electrical system. Using a 250 volt insulation resistance tester, the individual units should conform to the tolerances laid down in para.14 to 22. It is important to note that insulation resistance checks should not be carried out on amplifiers, cable boxes, tank units and indicators for the reasons stated previously, and that it is preferable that the tanks are completely drained of all fuel before the checks are commenced.

WARNING

No insulation tests must be performed on installed tank units under any circumstances. Application of test voltages much in excess of normal operating potentials may produce tracking within the tanks sufficient to cause ignition of the fuel gases.

Fault location checks

34. Apart from a failure in the 28 volt supply, a fault in the installation will only affect one indicator and, therefore, in the great majority of cases, it will only be necessary to carry out a check on the one system. The method of testing each system is identical, but the test values are naturally a little different owing to certain cable dissimilarities which will be found in Tables 16 and 17.

Check on amplifier and indicator

35. The first part of a fault location check is carried out by connecting the test set between an amplifier and its power supply as described in A.P.1275T, Vol.1. Move the test set's selector switch first to position 1 and then to position 2, thereby checking the power supply and current respectively into the amplifier by noting the test set meter reading; this procedure is explained in greater detail in the above Air Publication. If an unsatisfactory result is obtained, check back to the source of the power supply.

36. To test the circuit between an amplifier and indicator, turn the test set's selector switch to position 3. As the output of the FAB amplifier varies between approximately 2 and 7 mA. over the range of 'tanks empty' to 'tanks full', it follows that the test set meter reading should lie between these two limits, depending on the amount of fuel on board. If a satisfactory reading is not obtained, the fault could lie either with the amplifier and associated tank circuit or with the indicator and its circuit. To check which of these two is at fault, move the selector switch to position 4. This cuts out the circuit to the indicator, and if a satisfactory result is still not obtained, the fault must lie in the amplifier or in the tank circuit. If a satisfactory reading is obtained, the fault lies in the indicator circuit. The foregoing procedure is explained at greater length in A.P.1275T, Vol.1 and a table that summarises it appears in that publication and on the lid of the test set itself.

37. Now disconnect the tank circuit coaxial cable from the amplifier and substitute the coaxial cable supplied with the test set, connecting the other end of the cable to either of the test set's two coaxial sockets. This arrangement is also shown in A.P.1275T, Vol.1. As the test set's cable has a capacitance of 150 pF., if the variable capacitor on the set is adjusted to 600 pF., a capacitance of 750 pF. will be fed into the amplifier. Thus, if the selector switch is placed at position 3 or 4 the test set meter should read about 2 mA. This procedure should be repeated for each of the settings given in Table 9 and the amplifier checked for approximate accordance with the values given.

Check on tank circuits

38. It will be seen in fig.4 that every connection or test point is numbered, starting at the cable box and working to the tanks. These numbers will be found in Tables 16 and 17, together with the capacitance that must be connected at each point to give an indication of approximately 2 mA. on the test set meter and therefore a reading of zero contents on the indicator.

39. When testing at beyond points 3, 7 and 10 it is essential that the tanks be drained of all normally usable fuel and the system pressurized. If the amplifier has proved serviceable, reconnect the aircraft's coaxial cable to the amplifier and disconnect it at point 1 of the associated system. The test set's coaxial cable must now be connected to the aircraft's cable, employing the double socket clipped to the inside of the test set's lid.

40. The variable capacitor should now be set to 750 pF., less the capacitance of the aircraft's CA10 or CA14 cable, test set cable and the socket; the resultant value is the figure given in the Table. The indicator should now read approximately zero contents and the test set's meter about 2 mA. This process is repeated at each of the remaining points throughout the system, the variable capacitor value being set to the figures given in the appropriate Table as each unit is connected back into the installation until a complete check has been made.

41. The capacitance values given have the total tolerance at each particular point quoted alongside. The desired meter reading of 2 mA. should, therefore, be obtainable with the variable capacitor setting within these limits, provided that the system's trimmers are correctly adjusted. On no account should the cable box trimmer settings be altered; these settings should only be adjusted during a functional check.

42. The method of checking the units installed in the port and starboard wing tanks is a little different from that described in the preceding paragraphs, and is therefore described below.

43. Disconnect the coaxial harness CG1 at points A, B, C and D (fig.4) and connect the QAA test set to the amplifier (A.P. 1275T, Vol.1). Using a suitable length of coaxial cable and a Pye Waymouth adapter join the spare coaxial socket to any point of the harness. The variable capacitor should now be set to give a milliameter reading of, say, 5 mA., and the harness disconnected, leaving the coaxial cable and adapter all connected to the test set socket. Having noted the variable capacitor reading, it should be readjusted until the same milliameter reading is again recorded. The capacitance of the CG1 harness is obtained by subtracting the first variable capacitor reading from the second, and should be within the limits quoted in para. 21 plus ten per cent allowance for test set inaccuracies. This method is described in greater detail in A.P.1275T, Vol.1.

44. Assuming that the harness is serviceable, leave it disconnected and also disconnect the coaxial cable CRC.54 from the JM.14 tank terminal. Employing the method detailed for the CG1 harness, now check each tank at points A, B, C and D

TABLE 16. Test points (port system)

Test Point	A Test capacitance (pF.)	B Test capacitance (pF.)	Adapters and cables used	Approximate reading on Aircraft's Indicator	Approximate reading on Test set meter
1	724 ± 3	570 ± 8	CC3 and CE1		
2	697 ± 28	547 ± 31	CE1		
3	643 ± 25	489 ± 30	CC3 and CE1		
4	1611 ± 132	1461 ± 135	CE1		
5	1359 ± 127	1205 ± 132	CC3 and CE1	Zero contents	2 mA.
6	314 ± 23	164 ± 26	CE1		
7	260 ± 20	106 ± 25	CC3 and CE1		
8	1030 ± 99	880 ± 102	CE1		
9	895 ± 96	737 ± 101	CC1 and CE1		
10	798 ± 93	640 ± 98	CC1 and CE1		

for accordance with the capacitance values given in Table 18.

45. The values quoted in column A of Tables 16 and 17 are the true capacitances to be connected at each point, whilst those in column B are the true capacitances less the capacitance of the connecting cables and/or sockets. In other words, the values in column B are the actual test set variable capacitor settings, and the values in column A are the theoretical values. Both are given so that an operator may make allowances accordingly should he use a different method of connection.

Additional equipment required for checking wing tank system

46. The equipment issued with the standard QAA Mod.02 test set is insufficient when checking aircraft and/or components fitted with Pye coaxial plugs and sockets. On this particular aircraft, the wing tank system is so equipped. To meet this requirement, the following additional item with its capacitance value is given below and may be obtained through the usual channels:-

Pye Waymouth adapter, Code CC1,
Capacitance 8 ± 2 pF.

TABLE 17. Test points (starboard system)

Test Point	A Test capacitance (pF.)	B Test capacitance (pF.)	Adapters and cables used	Approximate reading on Aircraft's Indicator	Approximate reading on Test set meter
1	732 ± 3	578 ± 8	CC3 and CE1		
2	754 ± 28	604 ± 31	CE1		
3	643 ± 25	489 ± 30	CC3 and CE1		
4	1578 ± 127	1428 ± 130	CE1		
5	1353 ± 122	1199 ± 127	CC3 and CE1	Zero contents	2 mA.
6	323 ± 23	173 ± 26	CE1		
7	256 ± 20	102 ± 25	CC3 and CE1		
8	1030 ± 99	880 ± 102	CE1		
9	895 ± 96	737 ± 101	CC1 and CE1		
10	798 ± 93	640 ± 98	CC1 and CE1		

Note . . .

When the QAA Mod.04 test set is employed, no additional equipment will be required, as this set contains the Pye Waymouth adapter.

TABLE 18. Test points (Wing system)

Point into which test capacitance is connected	Value of tank unit, plus internal wiring, measured at tank terminal
A	187 ± 19
B	148 ± 19
C	194 ± 32
D	110 ± 15

REMOVAL AND ASSEMBLY

General

47. The removal of the centre instrument panel, which carries the fuel content gauges, contents check switch, pressure warning lamp, drop tank empty and transfer pressure indicators, is covered in Group 1.B. Once access has been gained, the removal of the remaining items of equipment should present no difficulties. The location of all the components is illustrated in Group 1.C.