GROUP 2 A

FUEL CONTENTS GAUGES AND FUEL PRESSURE WARNING

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ILLUSTRATIONS

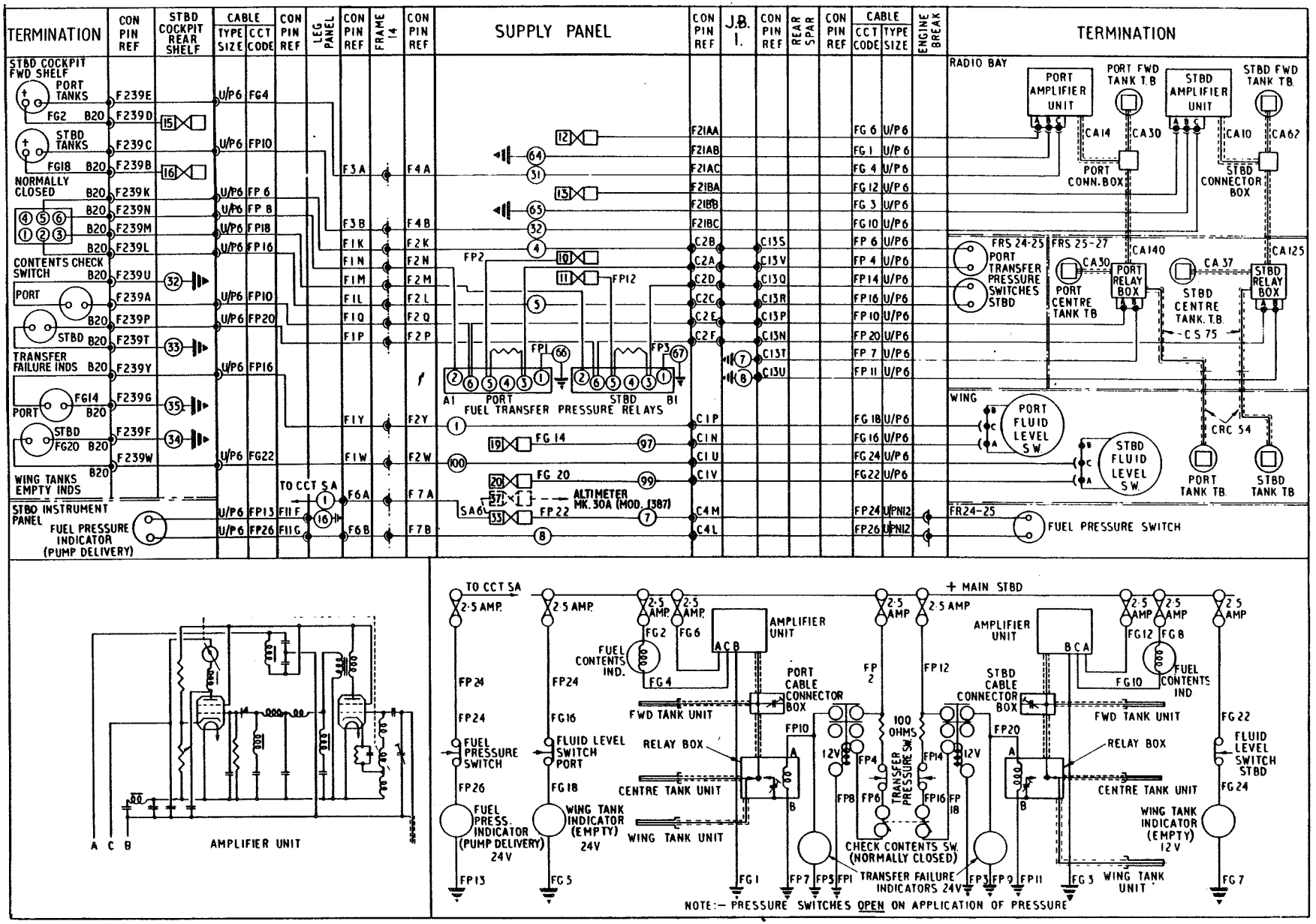
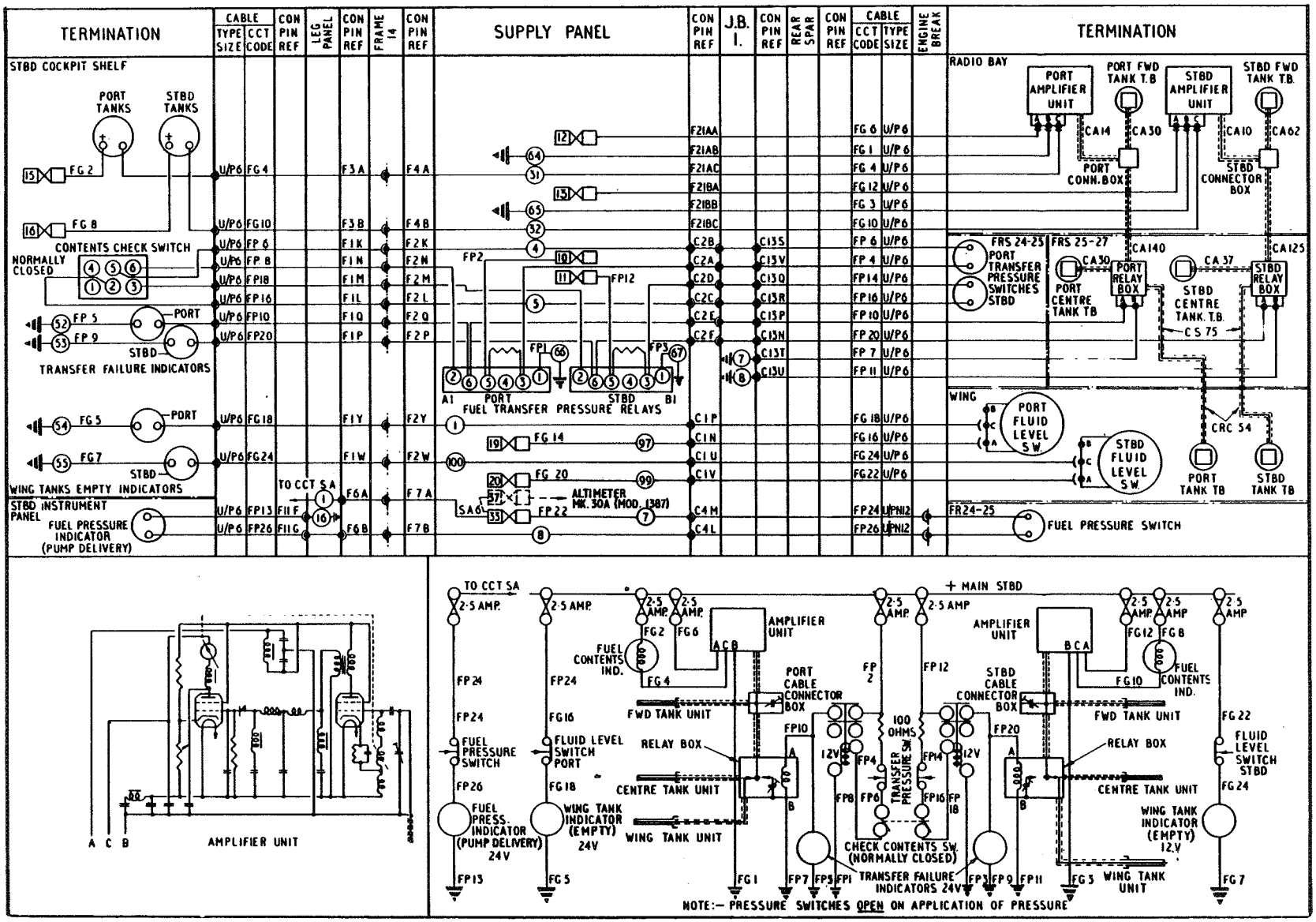


Fig.1 Fuel content gauges and pressure warning (routeing and theoretical, pre-Mod 228)

▶ (Mod 1429 added) ◀



▶ **Fig.1A Fuel content gauges and pressure warning (routeing and theoretical, pre-Mod 228) – pre-Mod 1429** ◀

Introduction

1. This group contains the description and operation of the aircraft fuel contents and fuel pressure warning circuits, together with information on the servicing required to maintain the equipment in an efficient condition. Routeing and theoretical circuit diagrams are included. A general description of the aircraft instrument installation is given in Group 1 A and the location of the instruments and their associated equipment is given in Group 1 C. The removal of the cabin starboard shelf is described in Group A 2 of Chapter 1. Detailed information on the standard items of equipment used will be found in the Air Publications listed in Table 1.

DESCRIPTION

Equipment details

Fuel contents gauges

2. This is a 28-volt electronic installation comprising two independent fuel gauging circuits. One of these circuits is used in gauging the contents of the port fuel tanks and the other is similarly used for the starboard fuel tanks. Each gauge gives a continuously indicated summation of the contents of the related fuel tanks, irrespective of aircraft attitude.

3. The circuits and gauges are identical except that, as the port centre tank contains a few more gallons than the starboard centre tank, the port gauge is calibrated to show a slightly greater amount of fuel at full scale deflection. The gauges are both calibrated and engraved in pounds *(mass)* and are actuated by strap-type capacitors fitted within each tank. The capacitors in the front tanks are connected to the gauges via two cable boxes and two amplifiers located between frames 16 and 17B on the port side of the fuselage. The capacitors in the centre and wing tanks, are in addition, connected via cable and relay boxes mounted on the rear face of frame 25.

Fuel transfer pressure failure warning

4. Two identical transfer pressure failure warning circuits are associated with the fuel gauging systems. Each includes a pressure switch, mounted between frames 24 and 25 in the centre fuselage, and closed by loss of transfer pressure in the related tank system. When closed, the pressure switch of either circuit supplies, via the fuel contents check switch, the energizing circuit of one of a pair of relays mounted on the supply panel. When these relays, A.1 in the port circuit and B.1 in the starboard circuit, are energized, a

TABLE 1

Equipment type and Air Publication reference

Equipment	Air Publication
Fuel contents gauges, Type A.G.38 and 39 Amplifier units, Type FAB/18 Cable boxes, Type JX.12 and JX.14 Cable and relay boxes, Type JX.13 and JX.15 Tank units, Type TC.94, 95, 96, 97, 180, 181, 182 and 183	A P 112G–0725–1 and 6
Engine pump failure pressure switch, Type T.P.5266/1	A P 113D–1500 Series
Transfer pressure switch, Mk.1E*	A P 113D–1500 Series
Float switches, Type C.3504100/1 and /2	A P 112G–1109–1
Tumbler switch, D.P./C.O., Type XD493 No.1	A P 113D–1100 Series
Transfer pressure and tanks empty magnetic indicators, Type A.2	A P 113F–0615–1
Warning lamp, Smiths CFP/24/23 or Rotax H2805	A P 113F–0200 Series
Drop tanks – Empty, magnetic indicators Type B.2	A P 113F–0615–1
Relays, Type Q, No.2	A P 113D–1328–1

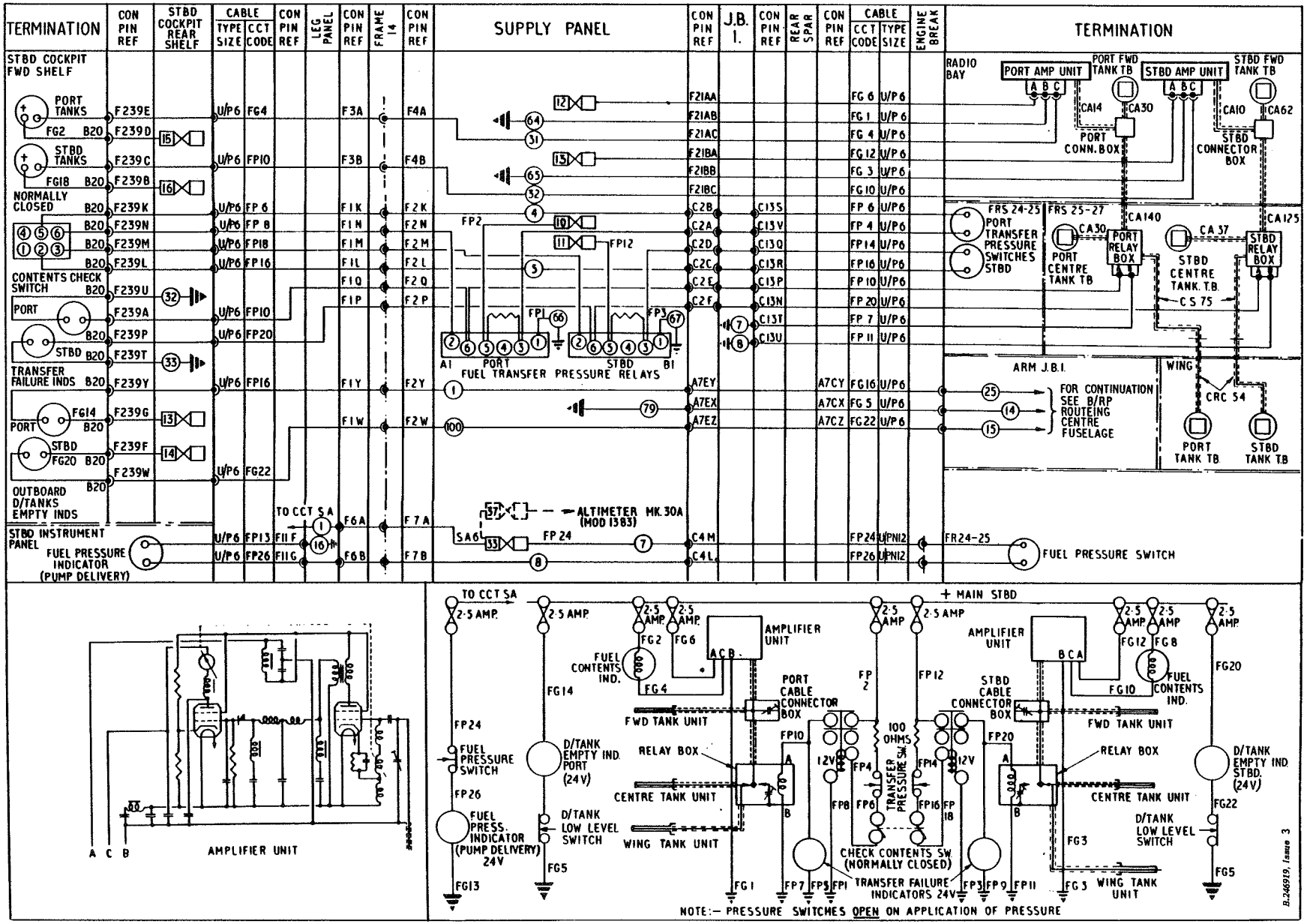
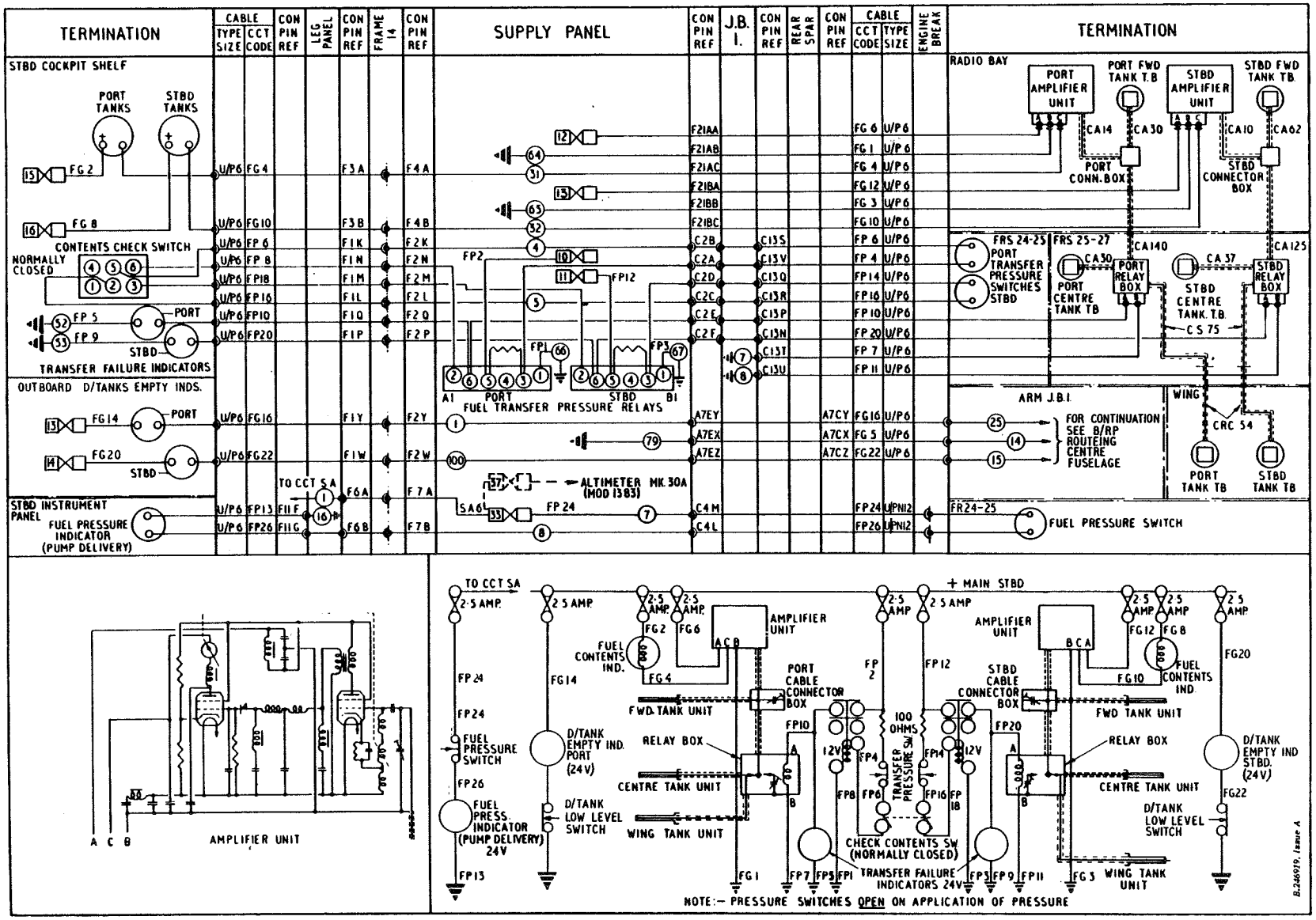


Fig.2 Fuel content gauges and pressure warning (routeing and theoretical, post-Mod 228)

▶ (Mod 1429 added) ◀



▶ **Fig.2A Fuel content gauges and pressure warning (routeing and theoretical, post-Mod 228) – pre-Mod 1429** ◀

supply is connected to energize the transfer pressure failure indicators and the relays in the cable and relay boxes. The transfer pressure failure indicators are mounted on the cabin starboard shelf. The cable and relay boxes, as explained in para. 3, normally connect the centre and wing tank gauging capacitors to the amplifiers of the fuel gauging system. When either of these relays is energized, the centre and wing tank capacitors are disconnected and in their place, a capacitor of a pre-set valve is connected to the related amplifier. The result of this changeover is that the fuel gauge shows only the fuel contents of the front tank. This is more fully explained in para. 9.

Engine fuel pressure warning

5. Indication of low fuel pump delivery pressure is given by a warning lamp mounted on the starboard instrument panel. The lamp is controlled by a fuel pressure switch mounted on the engine.

Tanks empty indication

6. On pre-mod. 228 aircraft, indication that the wing tanks are empty is given by two magnetic indicators, one each for port and starboard; located on the cabin starboard shelf. On post-mod. 228 aircraft, provision is made for carrying drop tanks on the outboard pylons. To give indication that these are empty, two magnetic indicators, one each for port and starboard, are similarly located on the cabin starboard shelf.

Ground check of fuel contents

7. The fuel contents check switch *(para. 4)* is located on the cabin starboard shelf adjacent to the fuel gauges and is used for checking the fuel contents on the ground when the engine is not running. The switch is marked ENGINE ON and ENGINE OFF.

Operation

Fuel contents gauges

8. Except that the port gauge is calibrated to show a few more gallons than the starboard gauge, the circuits are identical and only one need be explained. The following description relates to the port circuit. The comparable starboard circuit will be readily understandable if reference is made to the theoretical circuit diagram *(fig.1 - pre Mod.228 or fig.2 - post Mod.228)*.

9. The gauge and amplifier are both connected to the main positive supply via the battery master switch and operate immediately that switch is set to the ON position. With transfer pressure in the tanks, i.e., when the engine is running, the gauge will indicate the summed contents of the front, centre and wing tanks. With the engine stopped or if the fuel transfer pressure fails, the gauge will show the contents of the front tank only.

10. In the circuit diagram it can be seen that the front tank is connected to the amplifier and gauge via the cable box JX.12. The centre tank and wing tank units are connected via a set of relay contacts in the cable and relay box JX.13. In the absence of transfer pressure, the relay in the cable and relay box JX.13 is energized by a supply from relay A.1 which is energized via the transfer pressure switch and the fuel contents check switch. The effect at the cable and relay box JX.13 is that the centre and wing tank capacitor units are disconnected from the amplifier and gauge circuit. A capacitor pre-set to a value representing empty centre and wing tanks is now connected to the amplifier and the gauge shows the contents of the front tanks only. In the absence of transfer pressure this is the only fuel available to the engine.

Fuel transfer pressure failure warning

11. When fuel transfer pressure is absent, due either to failure or to the engine being stopped, the pressure switches close to connect the supply to energize relay A.1 via the fuel contents check switch. The transfer pressure switches are set to close at 2¼ ± ¼ lbs./in.^{2} falling pressure. The relay A.1 in changing over connects a supply to the fuel transfer pressure warning indicator and to the cable and relay box JX.13. Failure of the transfer pressure produces a WHITE indication at the magnetic indicator. The operation of the cable and relay box JX.13 is explained in para.10.

Engine fuel pressure warning

12. When the engine fuel pump delivery pressure falls below 3.5 lb. per sq.in., the engine fuel pressure switch closes to connect a supply to the warning lamp.

Tanks empty indication

13. On pre Mod.228 aircraft, when the

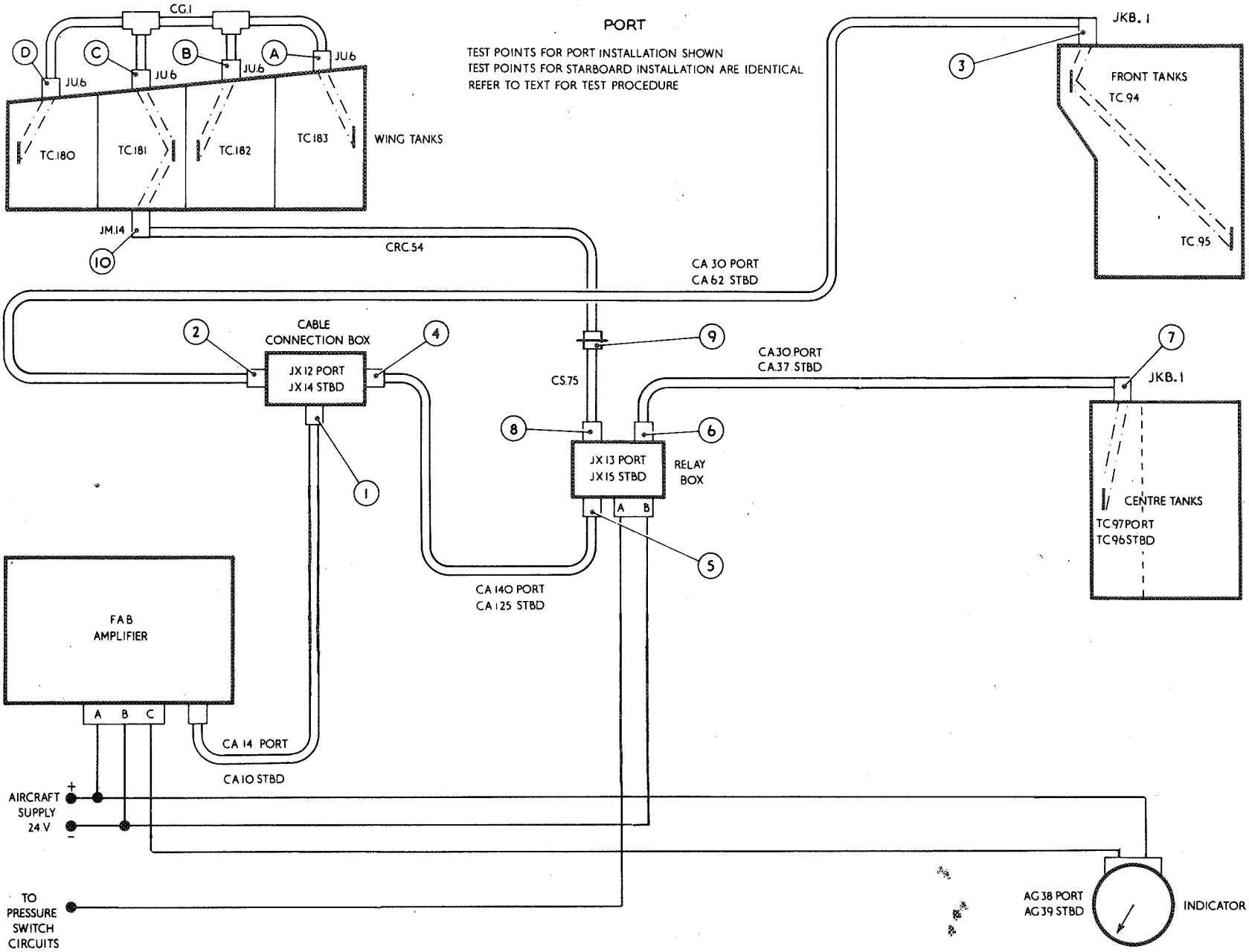


Fig.3 Fuel content gauge tank test points

wing tanks are empty, the WING TANKS EMPTY indicators are energized, and show WHITE. On post-mod.228 aircraft, indication that the drop tanks are empty is similarly given by the DROP TANKS EMPTY indicators, which are energized when the drop tanks are empty, and show WHITE.

Ground check of fuel contents

14. The fuel contents check switch is normally in the ENGINE ON position. In this position with fuel transfer pressure not available, the switch connects a supply from the fuel transfer pressure switch to the energizing coil of relay A.1. As explained in para.4, the contents of the centre and wing tanks are not shown on the gauge in these conditions. To obtain a complete summation of the fuel tank contents, the fuel contents check switch is set to ENGINE OFF. This setting disconnects the supply from the energizing coil of relay A.1 and the consequent return to normal of the relay in the cable and relay box JX.13 reconnects the centre and wing tank units to the amplifier and gauges.

SERVICING

General

15. Apart from the servicing information given in the following paragraphs, all other servicing to maintain the fuel contents 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 appropriate Air Publications listed in Table 1. Before servicing or removing any of the electrically-operated equipment, the aircraft should be rendered electrically safe, as described in Section 5, Chapter 1, Group A.1.

Fuel contents gauges

Data and tolerances on units

16. 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 0 to 7.5 mA, 0 to 15 mA., 0-30 mA. Accuracy to BS.89 precision grade.

(3) Voltmeter -
Range 0 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.23.

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

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

Tank units

17. The initial capacitance quoted in Table 2 is measured with the tank unit moist, but thoroughly drained of all kerosene fuel. The range of a unit is the increase in capacitance when totally immersed, at a temperature between 15 deg.C and 25 deg. C, in a kerosene fuel, having a permittivity of 2.10 at the temperature of test. Measurements must be carried out with the units well clear of all metal objects, and with the leads a minimum of three inches apart. A resistance of at least 20 megohms should be obtained for a new or 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.

TABLE 2

Tank units

Code	Initial capacitance (pF)	Range (pF)	Tank
TC.94	227 ± 3	243 ± 3	Front
TC.95	287 ± 3	304 ± 3	Front
TC.96	181 ± 3	184 ± 3	Starboard centre
TC.97	188 ± 3	193 ± 3	Port centre
TC.180	50 ± 3	53 ± 3	Wing
TC.181	74 ± 3	77 ± 3	Wing
TC.182	74 ± 3	77 ± 3	Wing
TC.183	118 ± 3	120 ± 3	Wing

Tank terminals

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

Code - JKB1 Mod.01 Capacitance 17 ± 3 pF.
JU6 Capacitance 23 ± 3 pF.

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

TABLE 3

Fuselage Tanks

(Port and Starboard)

Tank	Empty, out of aircraft	Installed, wet and pressurized
Front	587 ± 20 pF.	632 ± 25 pF.
Centre (Port)	240 ± 15 pF.	249 ± 15 pF.
Centre (Starboard)	234 ± 15 pF.	245 ± 15 pF.

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.

Complete tank with tank terminal

19. 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.

Coaxial cables

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

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

Cable and relay boxes, code JX13 and JX15

21. 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.

TABLE 6

JX13 and JX15 cable and relay 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

Cable boxes, code JX12 and JX14

22. 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 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.

Amplifier

23. 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.16.

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.

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			
2351 pF	2217 pF	2083 pF	724 pF	500 pF	1105 pF

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

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

Coaxial harness

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

Indicators

25. 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

26. It will be realised from the nature of 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 of 0.779 at a temperature of 20 deg.C.

Errors of the fuel gauge in normal flight

27. 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 10

Indicators

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

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
33	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 (Full)	7.00
16.28 (Full)	7.00		

TABLE 11

Temperature

Temperature	−35°C	−10°C	+15°C	+40°C
Tank empty	+0.8	+0.4	0	−0.4
1/10	+1.0	+0.5	0	−0.5
1/3	+1.4	+0.7	0	−0.7
2/3	+2.0	+1.0	0	−1.0
Full	2.6	+1.3	0	−1.3

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.26). 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 from 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.*

(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 empty.

TABLE 13

Fuel variations

(1) Fuel	(2) Permittivity k	(3) Density gm/ml. d	(4) % Errors Tank empty	1/10	1/3	2/3	Tank full
BRITISH							
AVTAG/DERD 2486	2.035	0.739	0	−0.08	−0.3	−0.6	−0.8
(J.P.48 or F-40)	2.180	0.825	0	+0.1	+0.4	+0.8	+1.3
AVTUR/DERD 2482	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/DERD 2488	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-F-5624C	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

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 content gauges

28. Before commencing to set-up the fuel gauges, ensure that the power supply to the amplifier is switched on for at least 15 minutes, by placing the battery master 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 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

29. 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.16 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.

30. 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.23)*, again using the accurate equipment referred to previously.

Functional check

31. 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 gauge. Each side of the system must be checked separately and, therefore, the following procedure must be followed out on each in turn.

32. 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.

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

34. 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.

35. 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.16.

Insulation resistance check

36. 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 tolerance laid down in para.17 to 25. 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.

Fault location checks

37. 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. The details are given in Tables 16 and 17.

Check on amplifier and indicator

38. 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; if an unsatisfactory result is obtained, check back to the source of the power supply.

39. 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 summary of the procedure is given in the Table on the lid of the test set itself.

40. 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 8 and the amplifier checked for approximate accordance with the values given.

Check on tank circuits

41. It will be seen in fig.3 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.

42. 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.

43. 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 Tables 16 and 17. The indicator should now read approximately zero contents and the test set's meter about 2mA. 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.

44. The capacitance values given have the total tolerance at each particular point quoted alongside. The desired meter reading of 2mA. should, therefore, be obtainable

TABLE 16

Test points *(port system with JKB1 Mod.01 tank terminals)*

Test Point	A Test Capacitance (pF.)	B Test Capacitance (pF.)	Adaptors and cables used	Approximate reading on Aircraft's indicator	Approximate reading on Test set meter
1	724 ± 3	570 ± 8	CC3 and CE1		
2	686 ± 28	536 ± 31	CE1		
3	632 ± 25	478 ± 30	CC3 and CE1		
4	1585 ± 127	1435 ± 130	CE1		
5	1333 ± 122	1179 ± 127	CC3 and CE1	Zero contents	2mA.
6	303 ± 23	153 ± 26	CE1		
7	249 ± 20	95 ± 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		

TABLE 17

Test points *(starboard system)*

Test Point	A Test Capacitance (pF.)	B Test Capacitance (pF.)	Adaptors and cables used	Approximate reading on Aircraft's indicator	Approximate reading on Test set meter
1	732 ± 3	578 ± 8	CC3 and CE1		
2	743 ± 28	593 ± 31	CE1		
3	632 ± 25	478 ± 30	CC3 and CE1		
4	1562 ± 127	1412 ± 130	CE1		
5	1337 ± 122	1183 ± 127	CC3 and CE1	Zero contents	2mA.
6	307 ± 23	157 ± 26	CE1		
7	245 ± 20	91 ± 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		

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.

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

46. Disconnect the coaxial harness CG1 at points A, B, C and D *(fig.3)* and connect the QAA test set to the amplifier as described in A.P.1275T, Vol.1, Using a suitable length of coaxial cable and a Pye Waymouth adaptor 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 adaptor 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.24, plus ten per cent allowance for test set inaccuracies. This method is described in greater detail in A.P.1275T, Vol.1.

47. 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 for accordance with the capacitance values given in Table 18.

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

48. 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

49. 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 adaptor, Code CC1, Capacitance 8 ± 2 pF.

Note . . .

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

REMOVAL AND ASSEMBLY

General

50. The removal of the cabin starboard shelf, which carries the fuel content gauges, contents check switch, pressure warning lamp, wing tanks *(pre-mod.228)*, drop tank empty *(post mod.228)* and transfer pressure indicators, is covered in Group A.2 of Chapter 1. Once access has been obtained, the removal of the remaining items of equipment should present no difficulty. The location of all the components is illustrated in Group 1.C.

APPENDIX 1 - PYLON/DROP TANK INSTALLATION

(ELECTRICAL CONNECTIONS)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

TABLE

Introduction

1. Attention has been drawn to the fact, that during the installation of drop tanks certain electrical cables may be damaged. In order to rectify this it is necessary to observe the following technique when installing this equipment.

General

2. The electrical connections of post Mod.555 aircraft consist of a shrouded plocket associated with the low level switch installation, and an unshrouded plocket associated with the high level switch. The shrouded plocket and low level switch are not fitted on pre Mod.555 aircraft.

3. For details of the electrical connections reference should be made to Table 1.

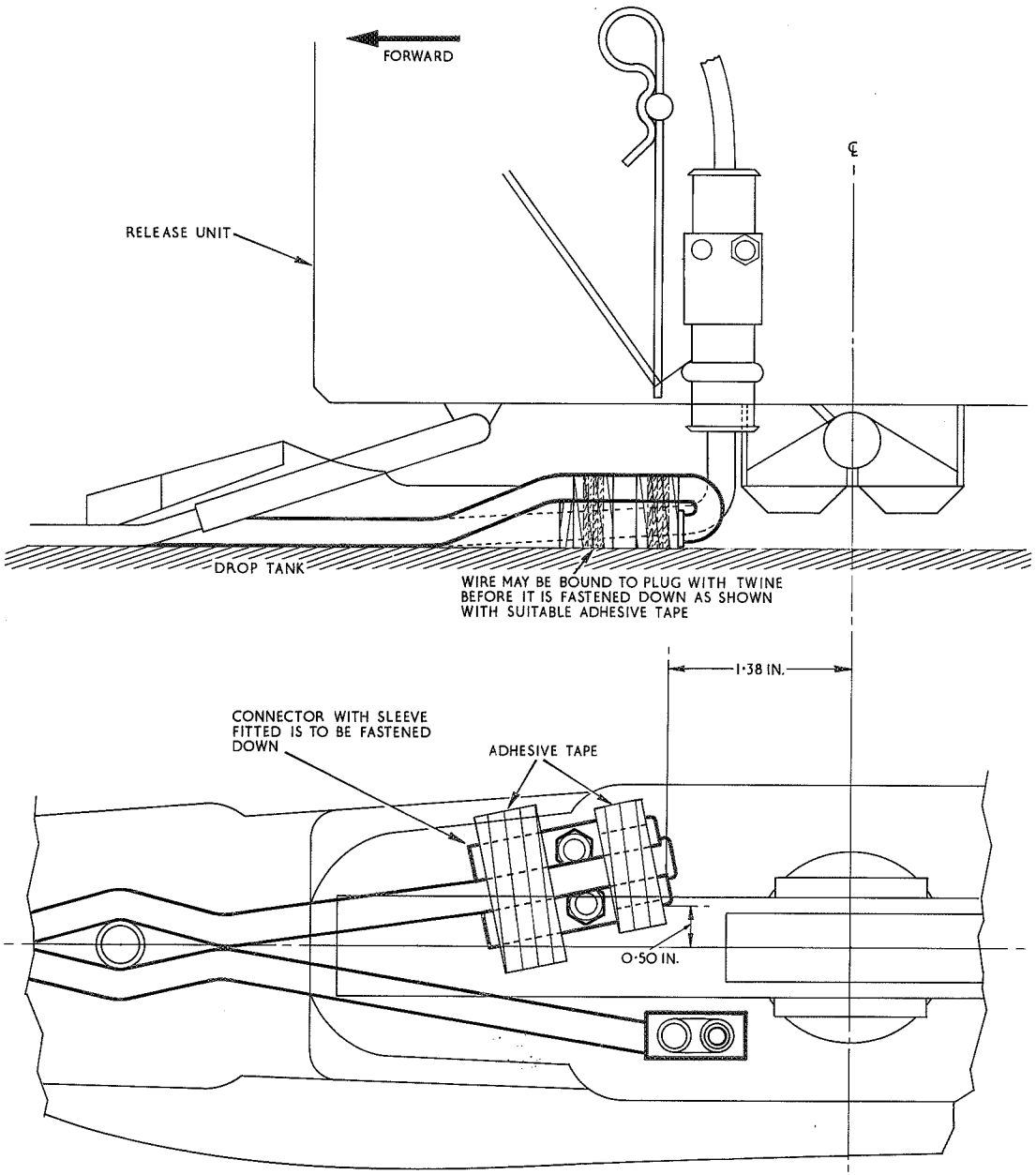


Fig.1 Stowing of low level float switch lead on mod. 555 drop tanks (pre. mod. 606)

T.P.

TABLE 1

Plocket connections of drop tanks

Unshrouded plocket connections Drop tank installation	To mate with plocket connections at
Inboard *(port)*	Outboard side of release unit.
Inboard *(stbd)*	Inboard side of release unit.
Outboard	Front face of release unit.
Shrouded plocket connections	
Pre Mod.555	Not fitted
Post Mod.555	Stow in accordance with fig.1. To avoid the possibility of the cables being trapped and damaged between the spigot and its locating hole due to the leads and securing clip riding up the spigot. The clip should be released from the cables and inverted on the spigot with the clip lugs underneath and reclipped on the cables as shown in fig.1.
Mod.574 Standard *(outboard only)*	Outboard drop tank *(port)*. Plocket to mate with that on inboard side, forward end of release unit. Outboard drop tank *(stbd)*. Plocket to mate with that on outboard side forward of release unit.
Mod.606 Standard *(inboard only)*	Inboard drop tanks. Stow in stowage located on inboard face of release unit *(port)* or outboard face *(stbd)*.