## Group 2.B.

# EXHAUST GAS THERMOMETER AND TOP TEMPERATURE CONTROL

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## LIST OF ILLUSTRATIONS



## TABLE

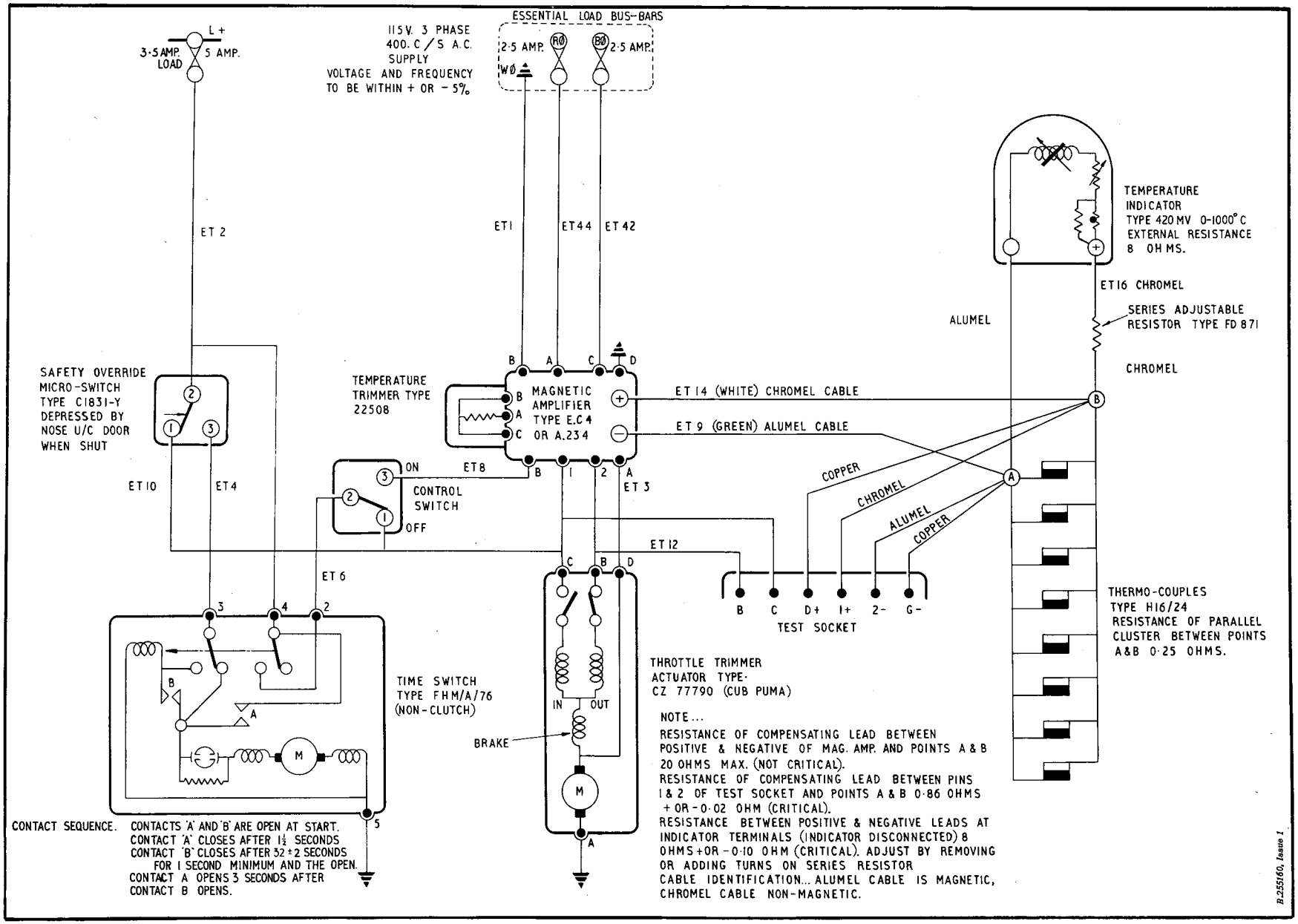


**Fig. 1. Exhaust gas thermometer and top temperature control (theoretical)**

**Introduction**

1. This Group contains a description of the engine exhaust gas thermometer and top temperature control installation, together with routeing and theoretical diagrams of the electrical circuits. A general description of the aircraft's instrument installation, will be found in Group 1.A, the removal of the instrument panels is covered in Group 1.B and the location of the instruments and their associated equipment is given in Group 1.C. Detailed information on the standard components used, together with their method of operation will be found in the relevant Air Publications listed in Table 1.

## DESCRIPTION

**Exhaust gas thermometer and top temperature control**

*General*

2. The exhaust gas thermometer and top temperature control installation is provided to indicate and control the temperature of the engine jet exhaust gases, in order that the engine top temperature limits are not exceeded.

**Exhaust gas thermometer**

3. The exhaust gas thermometer is located on the pupils flying instrument panel and gives a continuous indication of the jet exhaust temperature from 0 to 1000 deg.C. The instrument is a moving coil millivoltmeter, which is actuated by eight thermocouples located in the jet pipe and the circuit incorporates an adjustable series resistor mounted on the supply panel in the radio bay. The indicator, the adjustable series resistor and thermocouples form a self-energized closed circuit which is linked, via the thermocouples to the top temperature control equipment. A detailed description of the exhaust gas thermometer, together with its principle of operation will be found in the Air Publication quoted in Table 1.

**Top temperature control**

4. The top temperature control installation is provided to adjust the throttle movement to compensate for a rise in exhaust gas temperature above the permissible maximum. The installation incorporates a magnetic amplifier and a temperature trimmer resistor, which are both located below the top radio mounting structure adjacent to frame 15. The amplifier is fed with three phase a.c. from the a.c. supplies circuit and the unit amplifies the output from the eight thermocouples located in the jet pipe. The output from the amplifier is used to operate a throttle trimmer actuator, which is located on the engine and linked with the throttle so as to partially close the throttle when the exhaust gas temperature is above the top limit and to open it again when the temperature falls.

5. The installation is only operative

**TABLE 1**

**Equipment type and Air Publication reference**

| Equipment Type | Air Publications |
|---|---|
| Exhaust gas thermometer, Type 420 MV<br>Thermocouples, Type B.9<br>Adjustable series resistor, Type FD.871 | A.P.1275A, Vol.1, Sect.17 |
| Top temperature magnetic amplifier, Type EC.4 or A.234 | A.P.4343E, Vol.1, Book 2, Sect.12 |
| Throttle trimmer actuator, Type CZ.77790 | A.P.4343D, Vol.1, Book 3, Sect.14 |
| Top temperature time switch, Type FHM/A/76 | A.P.4343C, Vol.1, Book 2, Sect. 3 |
| Override microswitch, Type C.1831Y, Mk.2 | A.P.4343C, Vol.1, Book 1, Sect. 2 |
| Top temperature control switch, Single-pole, centre-off, C.W.C., Type XD.778, No.3 | A.P.4343C, Vol.1, Book 1, Sect. 1 |

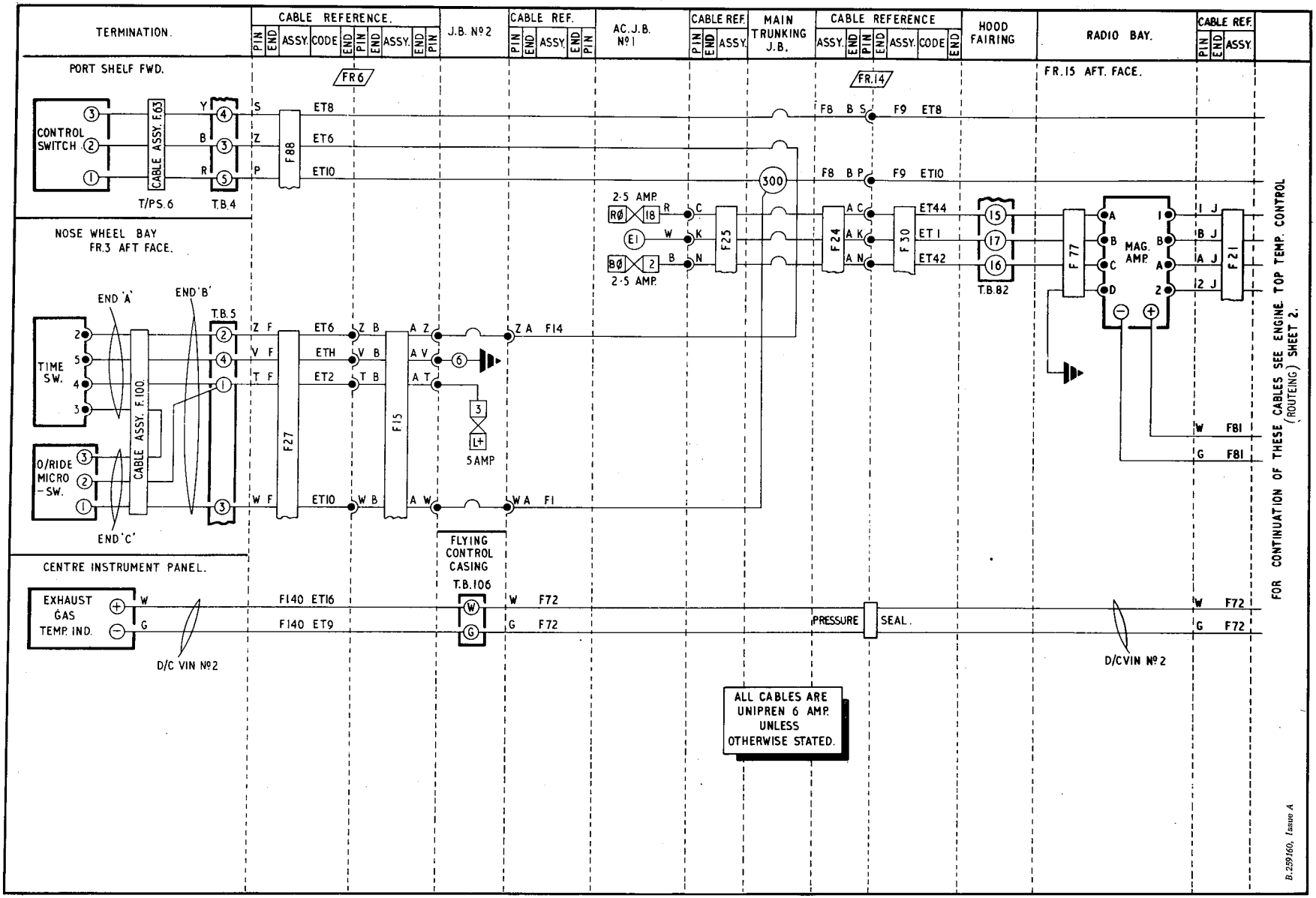


**Fig.2. Exhaust gas thermometer and top temperature control (routeing sheet 1)**

when the aircraft is airborne, being overridden by a microswitch controlled time switch. This arrangement permits unrestricted use of the throttle during take off and allows time for settled flight conditions after retracting the alighting gear. The microswitch and time switch are located on the aft face of frame 3, the microswitch being operated by the nose wheel fairing door. An ON/OFF cut-out switch is provided above the forward portion of the cabin port shelf to enable the installation to be rendered inoperative, in flight, if an emergency should make this necessary.

**Operation**

*Power supply*

**6.** The magnetic amplifier is supplied with three phase a.c. immediately the a.c. supplies circuit commences operation, but the top temperature control installation does not become operative until the aircraft is airborne and the undercarriage is retracted.

**7.** When the aircraft is airborne and the undercarriage is retracted, the nose wheel fairing door operates the override microswitch, which in turn energizes the time switch. After the required time sequence the time switch connects the d.c. supply from a fuse in junction box 2 to the magnetic amplifier via the control cutout switch when in the ON position and renders the installation operative.

**Control of throttle setting**

**8.** If the exhaust gas temperature, as measured by the thermocouples and fed to the magnetic amplifier, rises above the permissible maximum, the amplifier will feed the throttle trimmer actuator so that it partially closes the throttle. When the exhaust gas temperature falls, the output of the thermocouples will decrease and the amplifier will then feed the actuator in such a manner as to open the throttle. For a description of the engine top temperature control equipment, reference should be made to the Air Publications listed in Table 1.

## SERVICING

**General**

**9.** Apart from the following servicing information, all other servicing required to maintain the installation 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 the electrically-operated equipment, the aircraft must be rendered electrically safe, *(Sect.5, Chap.1, Group A.1)*.

**Exhaust gas thermometer and top temperature control tests**

**10.** These tests should only be carried out when the thermocouples are at normal ambient temperature, thus after an engine run, a reasonable time must be given to allow them to cool before the tests are made. Unless this precaution is observed considerable error will occur in the readings. Before commencing to test the installation, ensure that the resistance of the compensating leads F.81, C.65 and R.24, between the magnetic amplifier and T.B.58 do not exceed 20 ohms and that the resistance of the compensating lead R.26 from the test socket to T.B.58 is 0.86 ±0.02 ohms. Also check that the resistance at the exhaust gas thermometer terminals, with the indicator disconnected, is 8 ±0.10 ohms. If not, adjust the resistance of the adjustable series resistor by releasing the free end of the resistance wire from the clamp and removing windings from the spool, half turns at a time. When the resistance is correct, cut off the surplus wire at a length of approximately one foot from the clamp, cover this length with 1 mm. inside diameter P.V.C. tubing and re-wind on the spool, this length allows for any future adjustment. When all the above conditions are obtained, proceed as follows:-

(1) Check that the a.c. supply from the inverter is 115V ± 5 per cent, 400 C/S ± 5 per cent, 3 phase. This can be checked at the M.R.G. socket in accordance with the information given in Sect.5, Chap.1, Group E.1 and A.P.4343B, Vol.1, Book 2, Sect.16.

(2) Adjust the variable controls on the Ultra Q.E.2210 test set marked MILLIVOLT COARSE and FINE to the minimum position *(anti-clockwise)*.

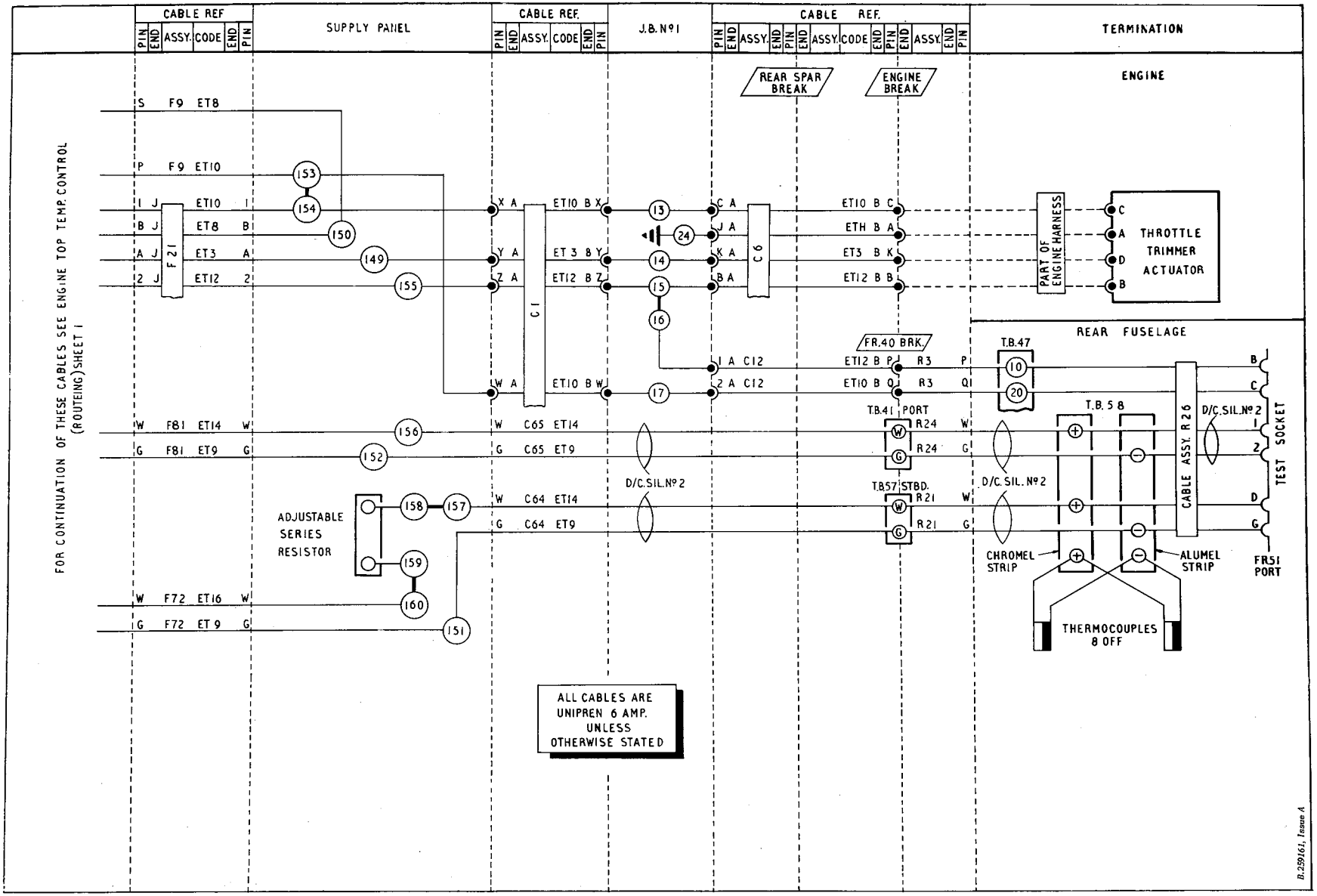


**Fig.3 Exhaust gas thermometer and top temperature control (routeing sheet 2)**

(3) Adjust the meter I so that the pointer indicates the ambient temperature as obtained from the panel thermometer.

(4) Connect the test set to the aircraft's test plug by means of connector Q.Y.2212-18.

(5) Set the switch on the test set marked METER I/STANDARD to position METER I and the SUPPLY switch to position INT supply.

(6) Ensure that the safety override microswitch in the nosewheel bay is unoperated.

(7) Connect up an external d.c. supply.

(8) The actuator should operate, or will be in the fully retracted position and the meter III pointer on the test set should be fully deflected on the rich side.

(9) Ensure that the jet pipe control switch is in the OFF position. Depress the nosewheel override microswitch and lock in this position.

(10) On completion of the time switch cycle of 32 ± 2 sec., meter III pointer should again be fully deflected on the rich side.

(11) Select the jet pipe control switch to the ON position.

**Note . . .**

*Meter III pointer on test set should be in the centre zero position.*

(12) Set the selector switch on the Ultra test set to range "F".

(13) Set aircraft throttle control to the required datum position.

(14) Start No.1 inverter, and allow to run for 5 mins.

(15) Gradually increase the coarse and fine M.V. controls, until the Meter I in the test set reads just below 700 deg.C. Check that the aircraft's temperature indicator is giving the same reading. If not, adjust by means of the zero adjusting screw. It should be noted that after such movement the screw must be turned in the opposite direction by a fraction of a turn to relieve the stresses in the compensating adjustment.

(16) Adjust the input on the coarse and fine M.V. controls until Meter I reads 700 deg.C, and then gradually increase it, taking readings at the following points.

(a) When the actuator begins to inch so as to reduce the fuel flow. *(Indicated by the pointer of Meter III oscillating from the mid scale position to about 1/3 full scale deflection on the weak side).*

(b) When the actuator ceases to inch and begins to move continuously. *(Indicated by the meter pointer coming to rest at about 1/3 full scale deflection on the weak side).*

(17) Continue increasing the input potential until the actuator stops in the fully weak position. *(Indicated by pointer of Meter III being fully deflected on the weak side).* Then reduce the input to simulate the normal control temperature again *(700 deg.C)* and repeat the procedure in the reverse direction. The meter readings this time will be on the rich side of the scale.

(18) The mean of the two readings when the actuator just commences to inch on the rich and weak side should be 700 deg.C. The readings when the actuator ceases to inch and begins to move continuously should be approximately 25 deg.C. above and below 700 deg.C.

(19) If the input readings are not within the above limits, apply correction by means of the reference voltage adjustment on the amplifier unit.

**Note . . .**

*A dead band of approximately 6 deg.C. is present in the amplifier, i.e. ± 3 deg.C. on either side of the selected datum temperature (700 deg.C.).*

(20) Operate the two-way key switch marked TEST/SET to the SET position and repeat the appropriate tests in operations 16 to 19. If the input readings are not the same as before it indicates that one or more of the thermocouples is open or short-circuited.

**Note . . .**

*This switch substitutes an equivalent resistance in place of the thermocouples.*

## REMOVAL AND ASSEMBLY

**General**

**11.** The removal of the centre instrument panel, which carries the engine exhaust gas thermometer is described in Group 1.B. Once access has been obtained, the removal of the remaining items of equipment should present no difficulties.