

Group 8

TEST EQUIPMENT
ARTIFICIAL FEEL UNIT CALIBRATOR

LIST OF CONTENTS

DESCRIPTION	Para.		Para.		Para.
<i>Introduction</i>	1	<i>Pneumatic system</i>	13	<i>Feel unit testing</i>	22
<i>Construction</i>	3	<i>Electrical system</i>	15	<i>Installing the feel units</i>	25
<i>Feel unit mountings</i>	7	<i>Auto-pilot control</i>	19	<i>Precautions during tests</i>	26
<i>Balance arm</i>	8				
<i>Loose equipment</i>	10				
<i>Control console</i>	11				

OPERATION

<i>Calibrator installation</i>	20
<i>Failure warning system testing</i> ...	21

SERVICING

<i>General</i>	27
<i>Electrical system proving</i>	28

LIST OF TABLES

	Table
<i>Schedule of parts</i>	1

LIST OF ILLUSTRATIONS

	Fig.		Fig.
<i>General view of calibrator</i>	1	<i>Control panel</i>	3
<i>Arrangement and connection of feel units</i>	2	<i>Pneumatic system</i>	4
		<i>Calibrator wiring diagram</i>	5

LIST OF APPENDICES

	Appendix
<i>Feel unit testing</i>	1

LEADING PARTICULARS

Type	1/U1390
Ref.No.	26DC/95217
DIMENSIONS	
Length (overall)	75 in.
Height	60 in.
Width	22.5 in.
Weight	210 lbs.
Supply voltage	28 volts d.c.

RESTRICTED

DESCRIPTION

Introduction

1. The calibrator 26DC/95217 is designed to facilitate bay servicing of the artificial feel units. It provides individual mountings for the different types of feel units, and enables them to be functionally tested throughout their normal working range. The control console which is the means of control during feel unit testing, can be removed from the calibrator and used for 'in situ' testing of the aircraft artificial feel failure warning systems.

2. This chapter contains a description of the calibrator and the servicing requirements. Test schedules for the respective types of feel units are included as an appendix. Information on the feel units and the associated electrical system is contained in Sect.3, Chap. 4 and Sect.5, Chap.1, Group 6 of this publication.

Construction

3. The calibrator framework is an accurately constructed box frame structure built from mild steel channel and angle sections. It consists of a top frame mounted by six main vertical supports on a rectangular base. Four lugs attached to the base side members enable the calibrator to be firmly anchored to the ground or floor, and adjustable bolt assemblies are fitted one to each lug for levelling purposes.

4. A stowage cupboard and a control console occupy the top portion of the framework. At the left hand position a support frame accommodates the cupboard, which is equipped with seven shelves for stowage of the loose equipment supplied with the calibrator. The control console is mounted at the right hand position on two angle brackets, and is secured by two knurled attachment bolts passing through the top frame. Below the console, a

platform fitted with two hinged clamping bolts is provided for mounting a battery which can be used as an alternative power supply for operating the electrical system.

5. The lower section of the framework accommodates a balance arm and individual mountings for the four types of feel units. The balance arm pivots between the two centre supports of the framework, and is mounted by two ball bearings located in housings attached one to each support. Precision fitted relative

to the balance arm, the feel unit mountings are arranged two each side of the structure (fig.1).

6. Two three-roller bearings, similar to those used in the aircraft flying control system, are attached to a swivel plate fitted at the left hand end of the structure. The bearings support an extension tube used when calibrating Mk.2 aileron feel units to transmit input rod movement to a dial gauge, which for this application is mounted outside the calibrator structure.

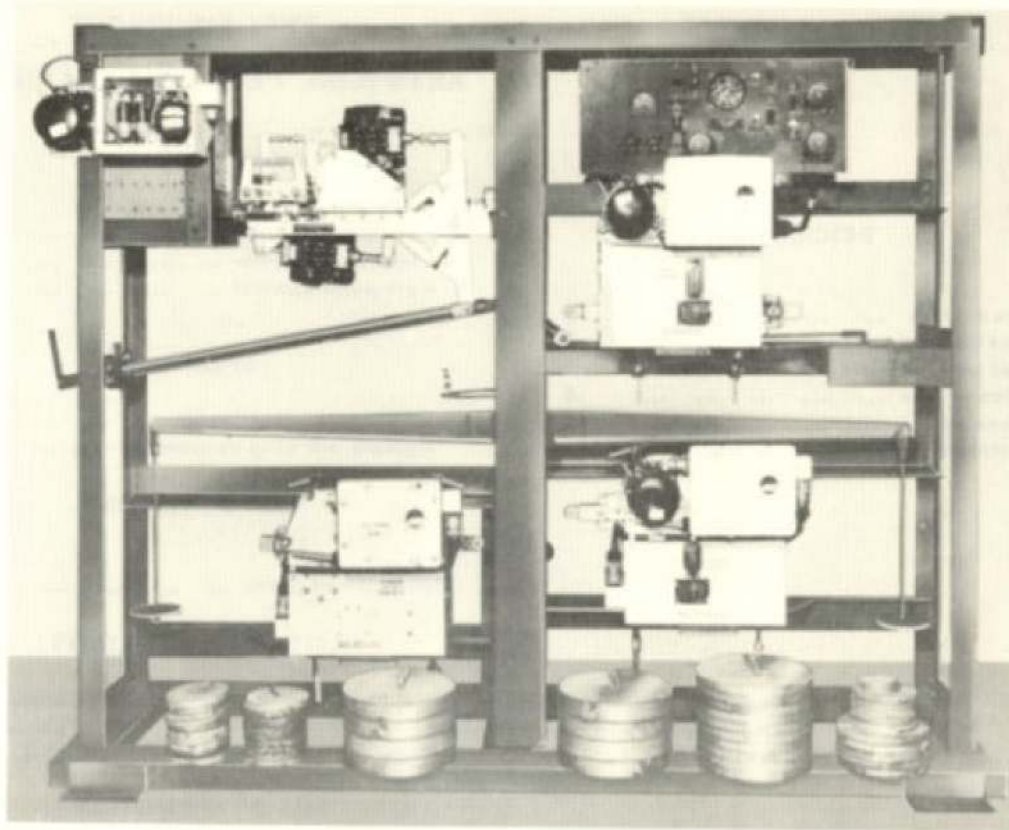


Fig.1. General view of calibrator

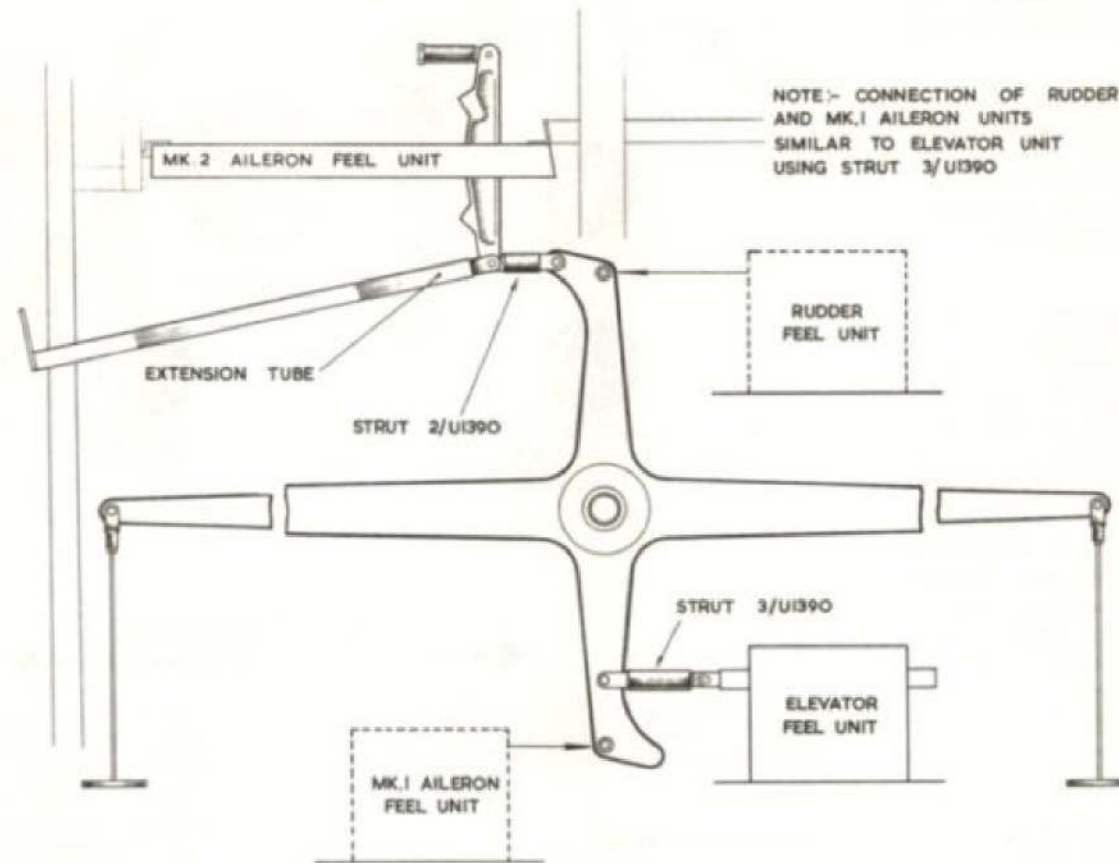


Fig.2. Arrangement and connection of feel units

When not in use the extension tube is stowed within the framework by securing the inner end in a spring clip.

Feel unit mountings

7. The elevator, rudder and Mk.1 aileron feel unit mountings are similar, each consisting of two horizontal members bolted and dowelled to the centre and end supports at the rear of the calibrator. Each member is fitted with a locating plate and two spring loaded fasteners for location and attachment of the unit, and in addition, the lower members are provided

with an extension plate to support the unit during installation. The Mk.2 aileron feel unit is mounted between the centre supports and the cupboard frame on two brackets and a vertical support plate. A separate attachment is provided for the associated electrical component unit, by anchor nuts fitted to the front and inner side members of the cupboard frame.

Balance arm

8. The balance arm is the medium through which loads are applied to the feel units. It consists of a main beam moun-

ted by bosses on a central shaft which pivots in the bearings in the calibrator framework. Two vertical lugs welded one either side of the beam centre are each fitted with two ball bearings to provide alternative connecting points for the respective feel units. To link the feel units to the balance arm, two connecting struts are provided, the shorter, item 2/U1390 being used for Mk.2 aileron units, and item 3/U1390 for all other units (fig.2). The location of the bearings in the balance arm and the length of the connecting struts ensures that when a feel

unit is installed and connected, the mechanical advantage appropriate to that unit will be obtained.

9. For applying push or pull loads to the feel units, weight carriers are attached, one to each end of the balance arm. Weights of 1/2, 1, 2, 5, 10 and 20 lb. are supplied, and when not in use are stowed on pegs fitted to the calibrator base.

Loose equipment

10. The loose equipment supplied with the calibrator comprises five extension cables, three flexible pneumatic pipes, a dial gauge and clamps for mounting the gauge. Four of the cables are identified to correspond to the markings of the plug connections on the console, and of these, one has a dual marking TRACK and GLIDE - AUTO PILOT. This cable serves two purposes and is connected to the console TRACK and GLIDE plug for elevator unit testing, and to the AUTO PILOT plug for Mk.2 aileron unit testing. The remaining cable has seven connecting sockets which are individually identified and is used for Mk.2 aileron units only.

Control console

11. The control console is of light alloy angle and plate construction and contains the controls, indicators and components associated with the electrical and pneumatic systems. For carrying and mounting the console when used for testing the aircraft artificial feel failure warning system, two handles and four rubber foot pads are fitted.

12. The controls and indicators are mounted on the front panel as shown in fig. 3. The system components are housed within the console and for access to them the front and rear panels are detachable. Six plugs and two stub pipes mounted on the left hand panel are suitably identified for connection of the extension cables and pneumatic pipes whereby the

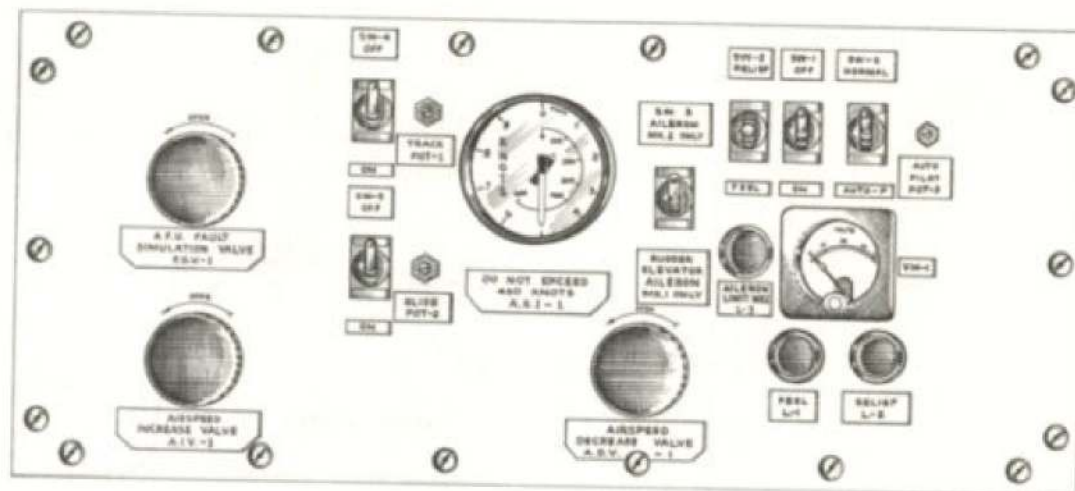


Fig.3. Control panel

◀ Aileron limit warning lamp L3 introduced ▶

test systems are linked to the feel unit. Two terminals on the right hand panel are the connections for the electrical power supply.

Pneumatic system

13. The pneumatic system (fig.4) provides the air supplies to the feel units and failure warning system for simulating varying airspeeds. A small air bottle clamped to the console base plate, serves as the system reservoir, and a cycle type pump is provided for charging the bottle via a valve which protrudes through the console rear panel.

14. Two valves identified AIRSPEED INCREASE and AIRSPEED DECREASE respectively, control the airspeed, which is recorded on a 50-600 knot indicator. Air supplies are piped to the stub pipe connectors on the console end panel, one being directly supplied, the other via a FAULT SIMULATION valve. For feel

unit testing, only the former connector is used, and is linked to the feel unit air-speed transmitter using the short flexible pipe. Both connectors are used for testing the failure warning system, and are connected to the aircraft warning panel 51P, and to the feel unit, using the long flexible pipes. In the latter application, the fault simulation valve is used to obtain an airspeed differential between the warning panel and the feel unit.

Electrical system

15. The electrical system provides the supplies for operating the feel units under conditions of variable feel, feel relief and auto-pilot control. The 28-volt d.c. input supply for the system is obtained from a suitable ground supply source or battery connected to the console terminals, and routed via the system components and controls to the group of plugs on the console end panel.

RESTRICTED

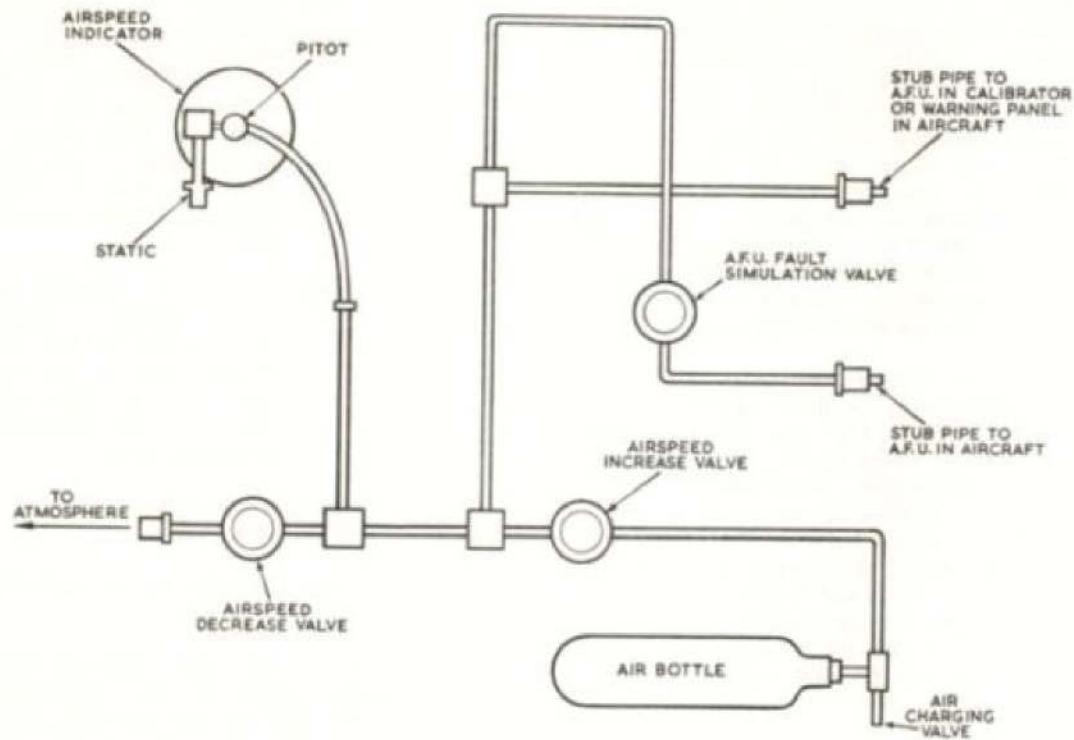


Fig.4 Pneumatic system

16. The elevator, rudder and aileron feel units are each connected to the system via the plugs identified SUPPLY, NORMAL/RELIEF and LIMIT SWITCHES. The TRACK and GLIDE plug is also used for all elevator units and for rudder and aileron units with Mod.1498 embodied.

17. The controls and indicators for the supply system consist of the following:-

(a) SW.1, a two position master switch labelled ON-OFF.

(b) A voltmeter to indicate input supply voltage.

(c) SW.2, a 3-position switch labelled FEEL-RELIEF, spring loaded to centre OFF from both positions. This switch is used in conjunction with the feel units to set conditions of variable feel and feel relief for elevator and rudder units, or variable and unrestricted movement for aileron units.

(d) SW.3, a two position switch labelled AILERON Mk.2 - ELEVATOR, RUDDER AILERON Mk.1, used to

set circuit conditions appropriate to the unit being calibrated.

(e) Two warning lamps, L1 green, L2 red, to provide indication of variable feel and feel relief conditions respectively.

(f) Red warning lamp L3 for use with Mk.2 aileron units only.

NOTE...

Warning lamp L3 was introduced by Mod. G.E.1944 which also provides an additional power supply for testing feel units with Mod.1498 embodied.

18. With the feel unit installed and connected, selection of switch SW.3 to the appropriate position will connect a supply to the feel unit electrical component unit and feel actuator via the SUPPLY plug. Selection of switch SW.2 to either position will supply the extend or retract field of the relief actuator, via the NORMAL/RELIEF plug. The feel unit will now move to the variable feel or feel relief position dependent on switch selection.

Auto pilot control

19. Two separate resistance circuits are included in the system for checking operation of the elevator and Mk.2 aileron feel units under auto pilot control. The elevator units are connected via the TRACK and GLIDE plug, and circuit operation is controlled by two 2-position ON-OFF switches SW4 and SW5, labelled TRACK and GLIDE respectively. By selecting switch SW4 to ON, a 330 ohm resistor and a potentiometer are inserted in the circuit, causing the feel unit to move to a position of reduced feel. Subsequent selection of switch SW5 to ON will insert a second potentiometer into the circuit resulting in further feel reduction. Switch SW6 is used for Mk.2 aileron units only.

RESTRICTED

OPERATION

Calibrator installation

20. The calibrator is a static rig and will normally be installed in a component servicing bay. It should be sited on a solid foundation, set level by means of the adjusting bolts provided in the base mounting lugs, and then firmly secured. The feel unit mounting members can be used as a reference for levelling purposes.

Failure warning system testing

21. The control console can be removed from the calibrator by releasing the knurled attachment screws, and used for simulating different airspeeds during checks on the associated failure warning systems as detailed in Book 2, Sect.5, Chap.1, Group 6 of this publication. The connections to the aircraft warning panel 51P, and the feel unit, are clearly identified, and are made using the two long flexible pipes supplied with the calibrator.

Fuel unit testing

22. In theory, for a given airspeed and for a given linear movement of the pilots control rods, the spring unit of the elevator and rudder feel units will be loaded to a degree dependent on the linear movement and on the mechanical advantage of the input lever. If therefore, the loading and corresponding linear movement are measured and plotted at suitable intervals throughout the normal speed range, a graph relating loading to input movement will fall within defined limits if the feel unit is serviceable but will fail to do so if the unit is unserviceable.

23. These measurements are obtained through the balance arm which is so designed that when linked to a feel unit, the balance arm ratio is identical to that which would be obtained if the feel unit were connected to the aircraft control system. With the feel unit connected to the balance arm, and with the balance arm unloaded, i.e. in a state of balance,

there is no deflection of the feel unit input shaft which is centralised by its centring spring. In this balanced condition the dial gauge connected to the input shaft is set to zero. If a weight is now attached to the balance arm, the feel unit input shaft will move until the balance arm comes to rest, the extent of movement being recorded on the gauge. The weight on the balance arm multiplied by the factor of the mechanical advantage is the measure of the resistance offered by the spring unit for this balanced condition.

24. The aileron feel units differ from the other units in that they incorporate variable stops, the available movement between the stops varying with airspeed. In a similar manner, stop movement can be measured relative to airspeed. As no resistance exists between the stops other than the preload of the input shaft the use of weights for loading is unnecessary, and hand pressure is applied to the balance arm to move the input shaft through the stop range and provide indication on the dial gauge.

Installing the feel units

25. To install the feel unit in the calibrator:-

- (1) Position the feel unit on the appropriate mounting and firmly secure the spring loaded fasteners.
- (2) Check that the balance arm pivots freely. Couple the feel unit shaft to the corresponding bearing on the balance arm as shown in fig.2 using the connecting strut 3/U1390.
- (3) Make the following electrical connections:-
 - (a) Elevator units.
Pre. and Post Mod.1498.
Rudder and aileron units.
Post Mod.1498.

- (i) Connect the NORMAL/RELIEF, LIMIT SWITCH and SUPPLY cables to the corresponding plugs on the console, and to the 4-pin and 5-pin plugs on the feel unit and the 2-pin plug on the electrical component unit respectively.

- (ii) Connect the TRACK and GLIDE/AUTO - PILOT cable to the TRACK and GLIDE plug on the console and to the 4-pin plug on the electrical component unit.

(b) Rudder and aileron units
Pre. Mod.1498

- (i) Connect as in sub-para.
(3)(a) item (i).

- (4) Connect the short flexible pneumatic pipe to the appropriate connection on the console and to the pitot connection of the feel unit airspeed transmitter.
- (5) Check that the airspeed control valves are closed and charge the air bottle.
- (6) Using the clamps provided, mount the dial gauge to the free end of the feel unit input shaft, so that the plunger contacts the unit end plate. Set the dial gauge to obtain equal movement in both directions and set to zero.

Precautions during test

26. The following precautions must be observed during tests:-

RESTRICTED

- (1) When applying weights for loading the feel unit, the total weight must be either increased or decreased. On no account should a load be applied which involves taking off one weight to replace it by another. Weights must be lowered gently

onto the carrier to avoid overcoming friction.

- (2) When increasing airspeed, do so slowly to avoid the risk of damaging the airspeed indicator or the transmitter. During calibration, the airspeed must always be

increasing, never decreasing. If a desired airspeed is passed, decrease to 50 knots below, and again increase airspeed to the setting required.

- (3) A maximum airspeed of 460 knots must not be exceeded.

SERVICING

General

27. Servicing of the calibrator will normally be confined to the balance arm and the pneumatic and electrical system components in the control console. To ensure smooth operation, the balance arm bearings should be suitably protected from ingress of dirt etc., at all times when the calibrator is not in use, and lubricated when necessary using grease XG-295.

The system components should be checked periodically for condition and security of connections, and the airspeed transmitter subjected to serviceability checks as detailed in A.P.1275A, Vol.1, Sect.21. When operating the air control valves, any sudden surge of pressure is an indication that the valve is sticking. This condition could result in excess pressures

being applied to the feel unit airspeed transmitter, and must be rectified immediately.

Electrical system proving

28. The electrical system can be proved using the following tests. A test lamp will be required, with a 28-volt d.c. supply connected to the console terminals.

Test lamp connections

◀ AUTO-PILOT plug pins C-D
SUPPLY plug pins A-B
TRACK and GLIDE plug pins C-D
Connect temporary link between SUPPLY plug pin B and NORMAL/RELIEF plug pin D
Remove temporary link
Connect temporary link between SUPPLY plug pin B and LIMIT SWITCH plug pin E

Connect temporary link between LIMIT SWITCH plug pins A-B
NORMAL/RELIEF plugs pins A-C
Mk.2 AILERON SUPPLY plug pins A-C

Switch function

Switches SW.1 and SW2 OFF
Switch SW.3 to Mk.1
Master switch SW.1 ON

Switch SW.2 to FEEL

Indication

All lamps extinguished
Voltmeter indication - 28 volts
Red lamp L2 lit
Test lamp lit
Test lamp lit
Test lamp lit

Red lamp L3 lit
Lamp L3 extinguished

Lamp L2 extinguished
Green indicator lamp L1 lit

Test lamps extinguished. ▶

RESTRICTED

Test lamp connections	Switch function	Indication
Remove temporary links NORMAL/RELIEF plug pins A-B	Switch SW.2 to RELIEF	Test lamps lit
Mk.2 AILERON SUPPLY plug pins A-B	Switch SW.2 to FEEL Switch SW.2 to RELIEF Switch SW.3 to Mk.2 AILERON	Test lamp lit Test lamp extinguished. Lamp L.2 lit Lamp L.1 extinguished. Lamp L.2 extinguished. Lamp L.1 lit
Connect temporary link between Mk.2 AILERON SUPPLY plug pins C-D NORMAL/RELIEF plug pins A-C Remove temporary link	Switch SW.2 to FEEL Switch SW.2 to RELIEF	Test lamp lit Test lamp extinguished. Test lamp lit Test lamp extinguished.

TABLE 1

SCHEDULE OF PARTS

Ref.No.	Part No.	Description	Qty.
26DC/95217	1/U1390	Calibrator, artificial feel unit	1
	2/U1390	Strut, (c/w bearing SKF/1/132498)	1
	3/U1390	Strut, (c/w bearing SKF/1/132498)	1
	4/U1390	Housing, (c/w bearing BSS/BAM/ $\frac{5}{8}$ in.)	1
	5/U1390	Housing, (c/w bearing BSS/BAM/ $\frac{5}{8}$ in.)	1
	6/U1390	Weight 2 lb.	20
	7/U1390	Weight 10 lb.	10
	8/U1390	Weight 20 lb.	8
	29/U1390	Weight $\frac{1}{2}$ lb.	2
	30/U1390	Weight 1 lb.	10
	31/U1390	Weight 5 lb.	5
	23/U1390	Tube extension	1
	1/R3460	Bearing base	2
	1/R4410	Roller, Glacier	6

RESTRICTED

TABLE 1 - continued

Ref.No.	Part No.	Description	Qty.
	1/U1555	Lever assembly	1
	Skefko 1/132498	Bearing	4
	1/U1564	Console	1
	Smiths 148/AS/PC	Indicator, airspeed 50-600 knots	1
	Bryans 1517	Valve, control	3
5Q/1693		Voltmeter 0-40 volts	1
SH/74		Block, fuse, 6-way	1
5CZ/5214		Fuse 2.5 amp.	1
5CZ/5215		Fuse, 5 amp.	5
	Colvem 10W/Z271401	Potentiometer	3
5CW/6430		Switch	1
5CW/5823		Switch	3
5CW/5822		Switch	1
	Rotax D5401	Switch	1
5CW/6453		Relay	4
5CW/6098		Relay	1
6A/1200		Resistor, 400 ohms	1
	Welwyn Elec.AW3115	Resistor, 330 ohms	3
SH/87		Link, commoning	1
	1/V5650	Block connector	2
	15/V5650	Socket	6
5CX/1635		Lamp, warning (green)	1
5CX/1069		Lamp, warning (red)	1
5L/9951273		Lamp, filament	2
	Belling Lee L1003/A	Terminal (black) type R	1
	Belling Lee L1003/A	Terminal (red) type R	1
	Graviner 127 AVE	Bottle, air	1
	Dunlop 4062	Valve assembly miniature	1
		Pump, cycle type (standard item)	1
		Loose equipment consisting of:-	
	20/U1390	Gauge dial c/w backplate No.37 (Baty model AL.17)	1
	25/U1390	Clamp, universal	1
	26/U1390	Clamp, 'G'	1
	27/U1390	Rod, holding	1
	10/U1390	Cable, assembly	1
	11/U1390	Cable, assembly	1
	13/U1390	Cable, assembly	1
	◀ 33/U1390 ▶	Cable, assembly	1
	32/U1390	Cable, assembly	1
	9/U1390	Pipe, flexible ¼ in. i.d. x 6 ft.	1
	24/U1390	Pipe, flexible ¼ in. i.d. x 15 ft.	1

RESTRICTED

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.

