

Chapter 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>	24
<i>Construction</i>	3	<i>Electrical system</i>	15	<i>Installing the feel units</i>	27
<i>Feel unit mountings</i>	7	<i>Auto pilot control</i>	20	<i>Precautions during tests</i>	28
<i>Balance arm</i>	8				
<i>Loose equipment</i>	10	OPERATION		SERVICING	
<i>Control console</i>	11	<i>Calibrator installation</i>	22	<i>General</i>	29
		<i>Failure warning system testing</i>	23	<i>Electrical system proving</i>	30

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 artificial feel units in current use are included as an appendix. Information on the feel units and the associated electrical system is contained in Sect.3, Chap.4, and Sect.6, Chap.10 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

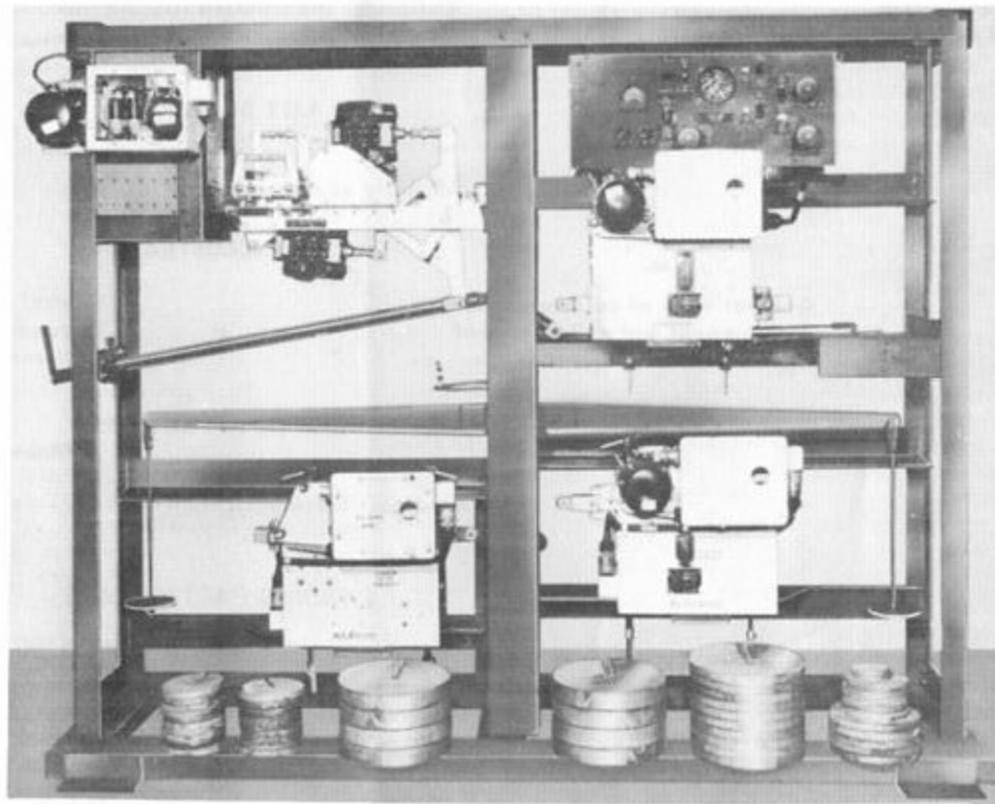


Fig.1 General view of calibrator

RESTRICTED

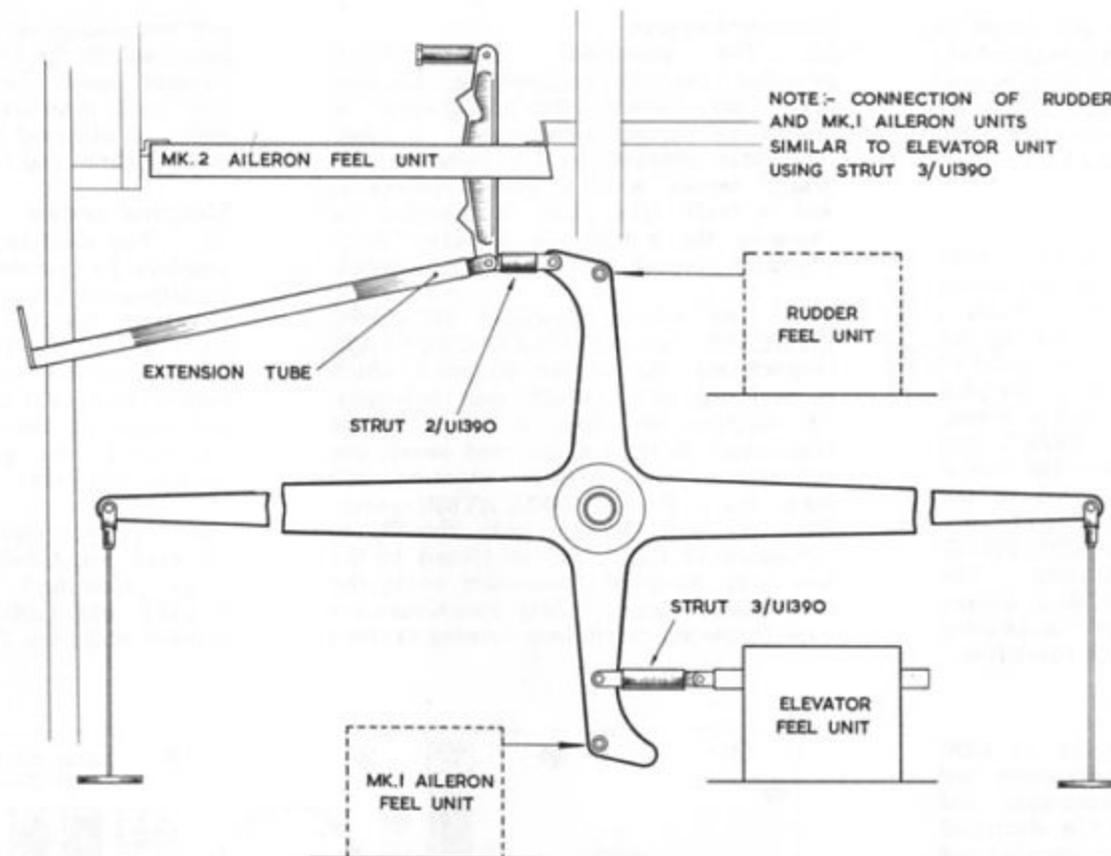


Fig.2 Arrangement and connection of feel units

mounted outside the calibrator structure. 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 of the unit, and in addition, the lower members are provided with an ex-

tension 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 mounted 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/U.1390 being used for Mk.2 aileron units, and Item 3/U.1390 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.

RESTRICTED

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 is used for Mk.2 aileron units only, and has seven connecting sockets which are individually identified.

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 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 connector 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 airspeed transmitter using the short flexible pipe. Both connectors are used for testing the failure warning system,

and are connected to the aircraft warning panel 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.

16. The elevator and rudder feel units are each connected to the system via the plugs identified SUPPLY, NORMAL/RELIEF and LIMIT SWITCHES, and for elevator units the TRACK and GLIDE plug

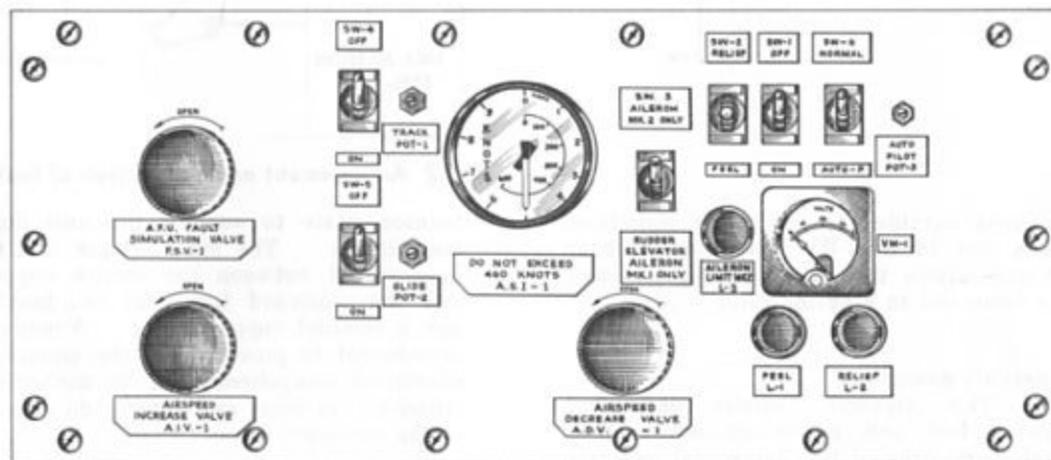


Fig.3 Control panel

◀ Aileron limit warning lamp L3 introduced ▶

RESTRICTED

is also used. As the aileron feel unit differs mechanically and in operation from the other units, an alternative supply route is provided, and connection to the system is made via the Mk.2 AILERON SUPPLY, NORMAL/RELIEF and AUTO-PILOT plugs.

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 or 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 MK.1 AILERON, 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 to indicate that the additional limit switch fitted to the aileron unit (Mod.1806) is operating.

NOTE . . .

Warning lamp L3 was introduced by G.E. Mod.1944 which also provides an additional power supply for testing feel units with Mod.1499 embodied.

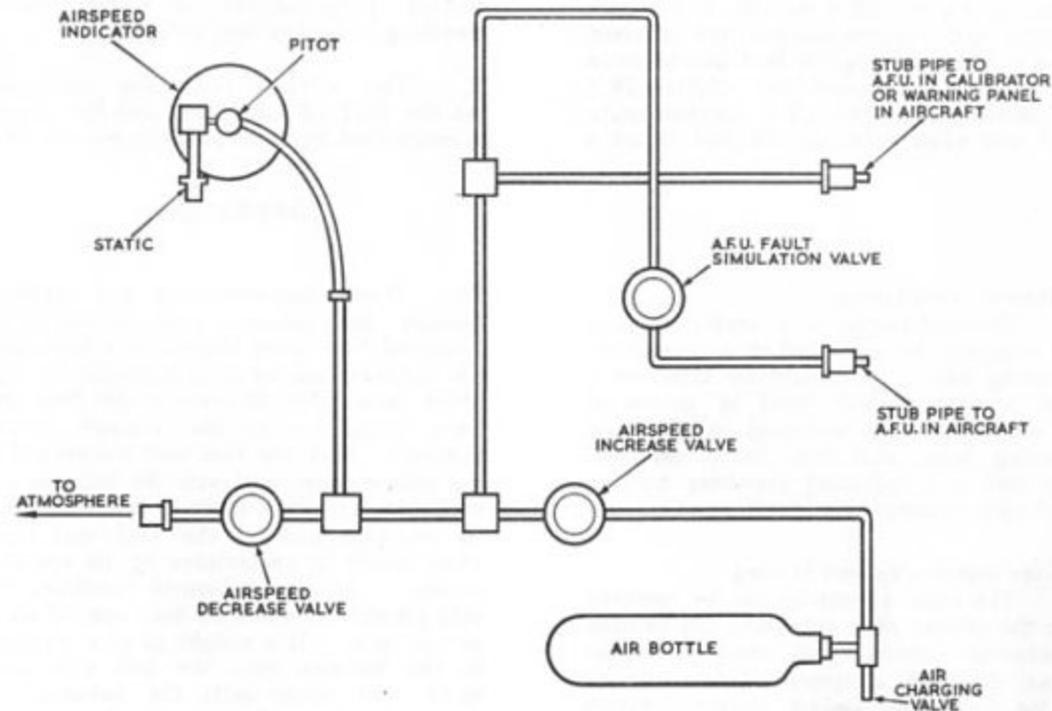


Fig.4 Pneumatic system

18. For elevator and rudder units, 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.

19. Selection of switch SW.3 to the MK.2 AILERON position prepares the circuit for connection of supplies to this type of feel unit. Subsequent selection of switch SW.2 to the FEEL position will supply the feel unit electrical component unit and the feel motor of the actuator, via the

MK.2 AILERON SUPPLY plug. The feel unit will now move to the variable movement position. Selection of switch SW.2 to RELIEF will connect a supply to the relief motor of the actuator via the NORMAL/RELIEF plug, and the feel unit will move to the unrestricted movement position.

Auto pilot control

20. To check operation of the elevator and aileron feel units under auto pilot control conditions, two separate resistance circuits are included in the system. 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 SW.4 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. Switch SW.5 is provided for the Mk.1 elevator units only, and when selected ON will insert a

second potentiometer into the circuit resulting in further feel reduction.

21. The aileron units are connected via the AUTO-PILOT plug and the circuit is controlled by a two-position switch SW.6

labelled NORMAL - AUTOPILOT. Selection of this switch to AUTOPILOT introduces two 330 ohm resistors and a potentiometer into the circuit causing movement of the feel unit to the high speed position.

OPERATION

Calibrator installation

22. 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

23. 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.6, Chap.10 of this publication. The connections to the aircraft warning panel 66P, and the feel unit, are clearly identified, and are made using the two long flexible pipes supplied with the calibrator.

Feel unit testing

24. 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.

25. 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.

26. 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

27. 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) For aileron units, secure the associated electrical component unit to the stowage cupboard frame using the bolts provided.

- (3) 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 struts as follows:-

(a) Strut 3/U1390 for elevator and rudder units.

(b) Strut 2/U1390 in conjunction with the extension tube for aileron units.

- (4) Make the following electrical connections:-

(a) Elevator units

Pre. and Post Mod.1499

- (i) Connect the NORMAL/RELIEF, LIMIT SWITCH and SUPPLY cables to the corresponding plugs on the console, and to the 4-pin

RESTRICTED

and 5-pin plugs on the feel unit and the 2-pin plug on the electrical component unit.

- (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 unit

Pre. Mod.1499

- (i) Connect as in sub.para. (4) (a) item (i).

(c) Rudder unit

Post Mod.1499

- (i) Connect as in sub.para. (4) (a) items (i) and (ii).

(d) Aileron unit

- (i) Connect cable assembly 32/U1390 to the Mk.2 AILERON SUPPLY and NORMAL/RELIEF plugs on the console, and to the feel unit and electrical component unit in accordance with the cable idents.

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

- (5) Connect the short flexible pneumatic pipe to the appropriate connection on the console and to the pitot connection of the feel unit airspeed transmitter.

Precautions during test

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

- (1) When applying weights for loading or unloading 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

29. 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

30. 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.

TABLE 1
SCHEDULE OF PARTS

Ref.No.	Part No.	Description	Qty.
26DC/95217	1/U1390	Calibrator, artificial feel unit	
	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
	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
5H/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
5H/87		Link, commoning	1

RESTRICTED

TABLE 1 - continued

Ref.No.	Part No.	Description	Qty.
	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
	22/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

APPENDIX 1

FEEL UNIT TESTING

LIST OF CONTENTS

	<i>Para.</i>
<i>General</i>	1
<i>Feel unit adjustments</i>	3
SCHEDULE OF TESTS	
<i>Elevator and rudder feel units ...</i>	6
<i>Aileron feel unit</i>	7

LIST OF ILLUSTRATIONS

	<i>Fig.</i>
<i>Elevator A.F.U. Load/input shaft movement limits</i>	1
<i>Rudder A.F.U. Load/input shaft movement limits</i>	2
<i>Elevator A.F.U. Auto-pilot (Track) calibration limits</i>	3
<i>Aileron A.F.U. Airspeed/stop movement limits</i>	4
<i>Typical friction calibration - rudder A.F.U.</i>	5

General

1. Prior to installation in the aircraft, each feel unit is accurately adjusted to provide the control characteristics appropriate to its particular system. To ensure that the required characteristics are maintained after bay servicing, it is necessary for the feel unit to be subjected to the function and calibration checks contained in the Schedule of Tests. These checks are made on the complete feel unit assembly comprising both the mechanical and the electrical component units. After testing, the feel unit must be retained and subsequently installed in the aircraft as a complete tested assembly. This is most important in respect to the aileron feel unit as the mechanical and electrical component units are mounted separately in the aircraft.

2. To service and test the feel units, the operator must be fully conversant with the mechanical and electrical operation of the system. This information is contained in Sect.3, Chap.4 and Sect.6, Chap.10 of this publication.

Feel unit adjustments

3. Due to the mechanical and electrical tolerances in the feel unit, adjustments are provided to enable the correct requirements to be obtained. In elevator and rudder feel units the cam can be moved in the slotted mounting holes in the fulcrum lever, and in the aileron feel unit the cam can be slightly rotated. Two electrical trimmers identified HIGH SPEED and LOW SPEED respectively, are provided to reset the balance of the Wheatstone bridge. The

positions of the cam and trimmers are initially determined by first setting the trimmers to their appropriate mid positions and then applying a suitable load to the feel unit at each airspeed indicated on the appropriate calibration sheet. The resultant input shaft movement is plotted and must lie within the limit lines applicable to the airspeed. By altering the position of the cam and resetting the trimmers, the required setting can be obtained. In elevator and rudder feel units, movement of the cam toward the pivot will normally stiffen the feel, but care must be taken to ensure that the cam does not foul any other part of the unit. The low speed trimmer will have most effect at low speeds but it should be understood that any adjustment will alter the feel at all speeds. The sensitivity

RESTRICTED

trimmer should always be set to maximum increase.

4. The stroke of the main actuator is set by the component manufacturer to provide the operating range of the feel unit. The end fitting of the actuator is adjustable and may be moved to give a more correct setting during calibration. When setting the actuator in elevator and rudder units, the following points must be observed.

- (1) It is primarily important that fouling does not occur. With the actuator in the fully extended or retracted

positions, the fulcrum pivot must not touch the end of the slot in the slotted lever. With the cam set and the actuator fully retracted, the cam should not force the follow up ratiometer arm against its stops or against the side of the feel unit.

- (2) When fully retracted, the actuator should give a pivot setting which is slightly nearer to the input shaft end of the slotted lever than that obtained when maximum airspeed is applied. The reason for this is that as the input shaft is moved, the fulcrum lever is strained so that

the pivot setting deflects upward toward the spring unit. When this occurs, the Wheatstone bridge is unbalanced and the actuator further retracts to return the pivot to its original setting. There must therefore be sufficient actuator movement available to enable this resetting to occur at the maximum speed position.

5. No defined procedures can be specified for setting a feel unit, it is only by experience that the operator will learn how to make the desired corrections.

ELEVATOR AND RUDDER FEEL UNITS

6. The elevator and rudder feel units operate on the same basic principles and are therefore tested in a similar manner. The checks necessary and the requirements for the respective units are outlined in the following paragraphs, and apply to units of pre and post Mod.1499 standard.

Preparation for test

- (1) With the feel unit installed in the calibrator as detailed in Chap.8 para.27, proceed as follows:-

- (a) 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.
- (b) Connect a 28 volt d.c. supply to the console terminals.
- (c) Ensure that the three airspeed control valves are closed and

SCHEDULE OF TESTS

charge the pneumatic system air bottle.

- (d) Set the master switch SW.1 to ON.
- (e) Set switch SW.3 to the RUDDER ELEVATOR and Mk.1 AILERON position.
- (f) Set switch SW.2 to FEEL and check that the GREEN indicator lamp lights.
- (g) Set switches SW.4 and SW.5 to OFF.
- (h) Set switch SW.6 to NORMAL.

Cut-in and cut-out speeds

- (2) To check the cut-in and cut-out speeds:-
 - (a) Open the airspeed INCREASE valve slowly until the main actuator commences to operate and note the indicated airspeed. This is the cut-in speed.

NOTE...

Operation of the main actuator can be heard as a medium pitched hum quite distinct from the high pitched operating noise of the relief actuator.

- (b) Continue to increase airspeed slowly until the main actuator stops operating. This is the cut-out speed.
- (c) Check that the cut-in and cut-out speeds are within the following limits.

	Cut-in	Cut-out
◀ Elevator	90-100	445-465
Rudder	130-142	440-455 ▶

Symmetrical loading

- (3) Check for symmetrical loading by selecting an airspeed and applying a suitable load to the feel unit, using first the R.H. and then the L.H. weight carrier. Movement of the input shaft in each direction should be the same.

RESTRICTED

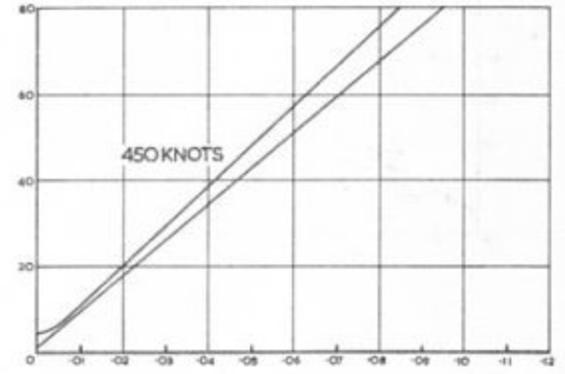
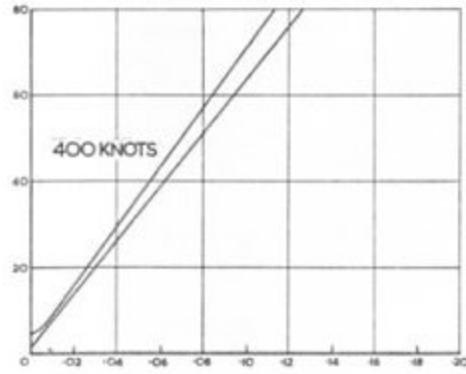
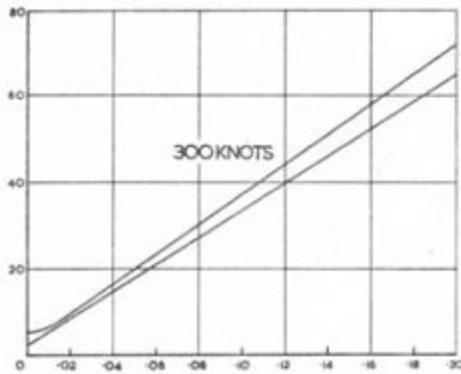
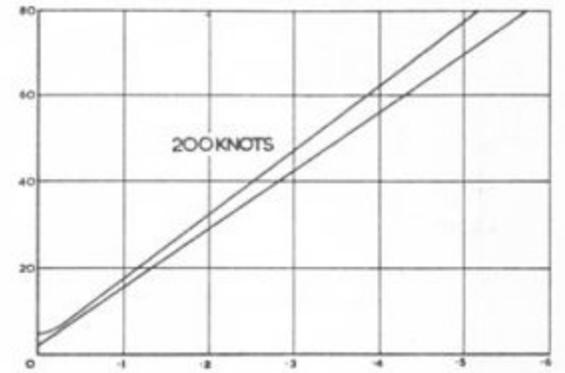
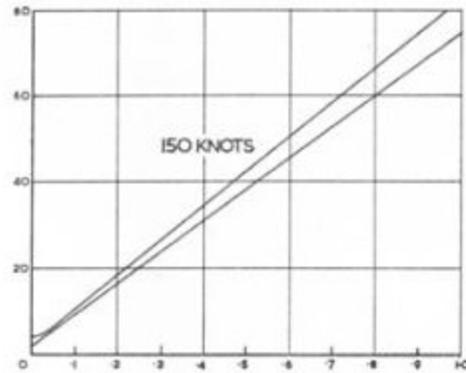
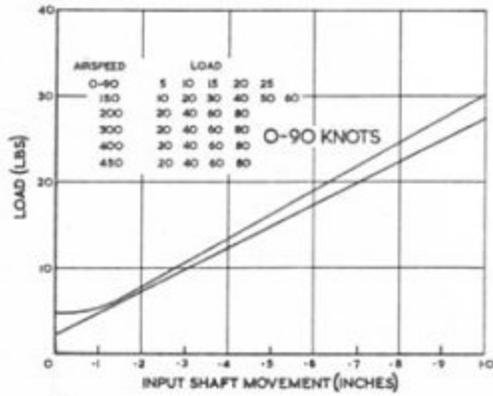


Fig. 1 Elevator AFU Load/input shaft movement limits

RESTRICTED

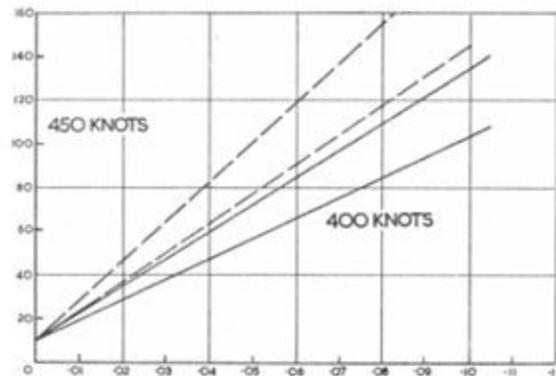
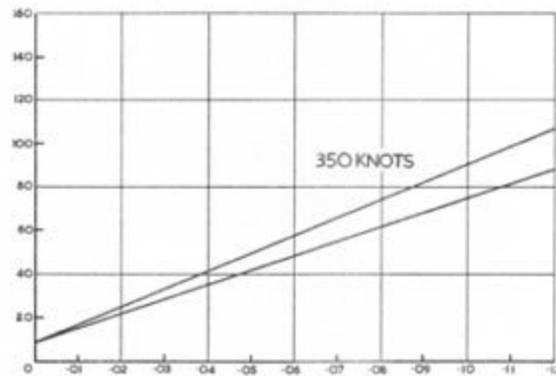
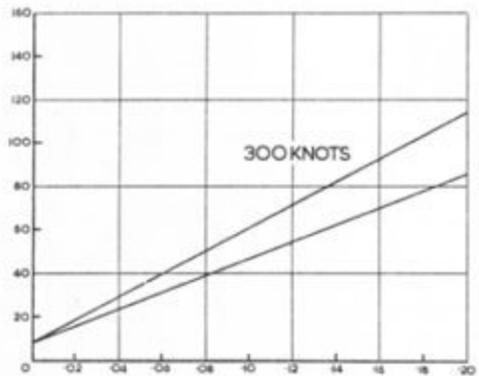
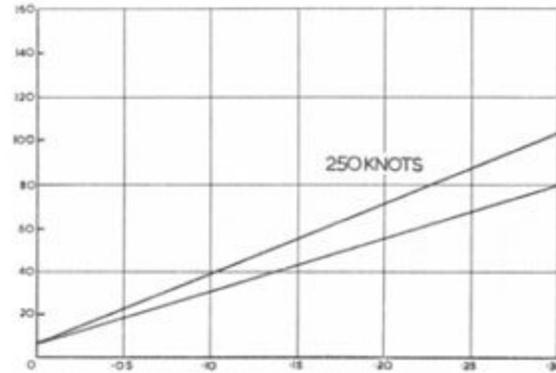
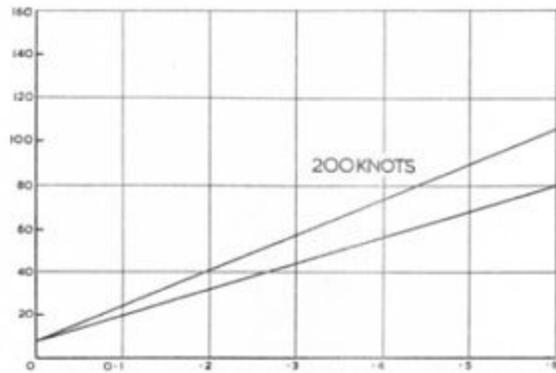
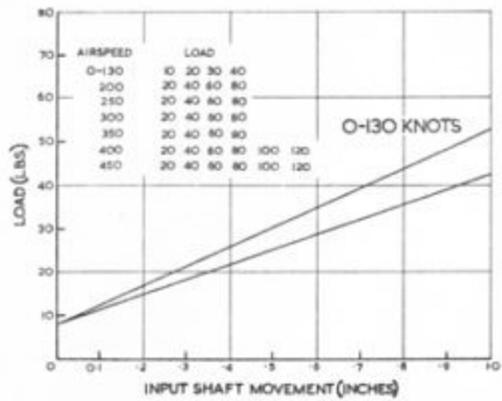


Fig.2 Rudder A.F.U. Load/input shaft movement limits

RESTRICTED

Break out force

(4) To check break out force:

- (a) Select zero airspeed.
- (b) Load the weight carrier in small increments until the input shaft moves. Check that the applied weight is within the following limits:

Elevator	2 - 4 lb.
Rudder	9 - 11 lb.

Feel relief check

(5) To check function of the unit under feel relief conditions:-

- (a) Select zero airspeed.
- (b) Set switch SW.2 to RELIEF. Check that the RED indicator lamp lights and the relief actuator retracts to a slightly softer feel position i.e. to move the pivot nearer to the spring unit, before tripping the limit switch.
- (c) Set switch SW.2 to FEEL. Check that the GREEN indicator lamp lights and the relief actuator extends to the normal low speed position.
- (d) Set airspeed to 460 knots. Set switch SW.2 to RELIEF. Check that the RED indicator lamp lights and the relief actuator retracts to the feel relief position.
- (e) Select switch SW.2 to FEEL and reduce airspeed to zero.

Calibration check

(6) The object of the calibration check is to determine the load/input shaft movement characteristics of the feel unit. The calibration sheets

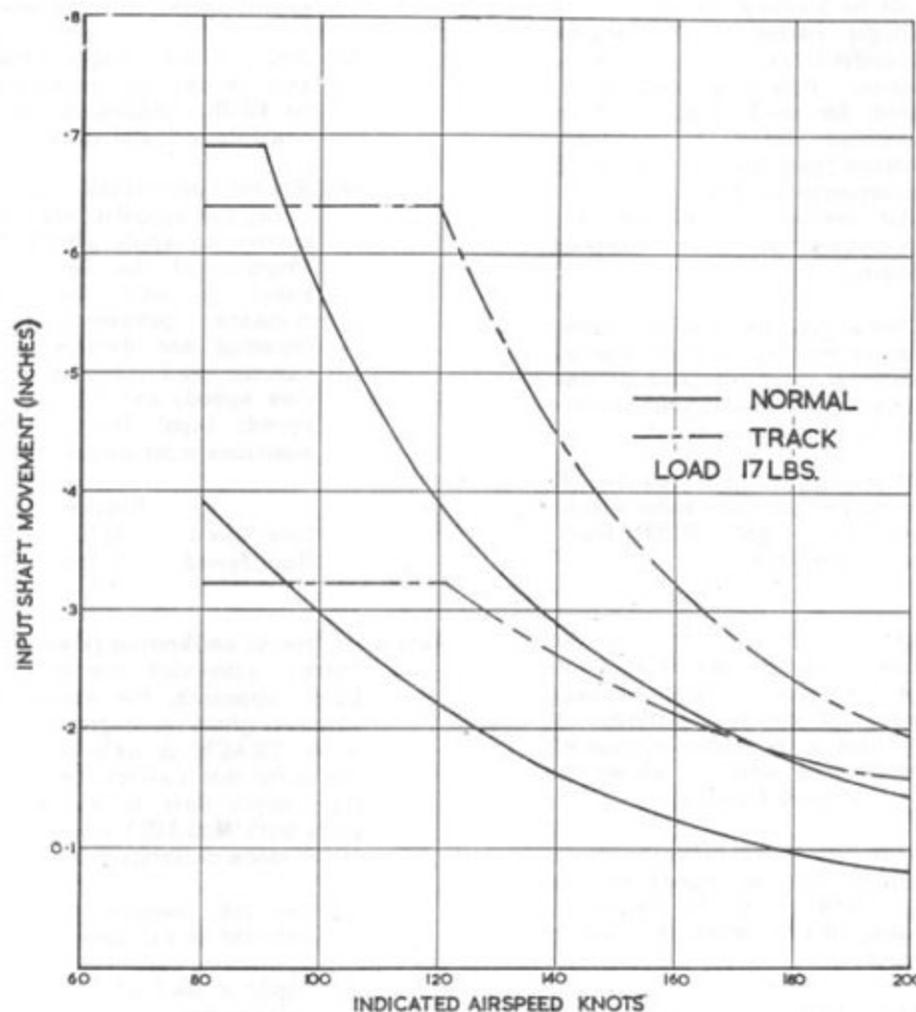


Fig.3 Elevator A.F.U. Auto-pilot (Track) calibration limits

fig.1 elevator, and fig.2 rudder, show the upper and lower limits for input shaft movement at the various speed settings. To check calibration:-

- (a) Set the dial gauge to zero.
- (b) Select the lowest airspeed appropriate to the unit being tested.

RESTRICTED

- (c) Apply PULL loads to the feel unit by loading the appropriate weight carrier in the stages specified on the calibration sheet. Plot input shaft movement for each load. When maximum load is reached, remove the load in the same increments as for loading and plot results. Repeat this procedure at each airspeed setting.
- (d) Check that the graphs plotted for increasing and decreasing loads at each airspeed setting are within the limit lines shown on the calibration sheet.
- (e) Repeat operations (b) to (d) using the opposite hand weight carrier to apply PUSH loads to the feel unit.

Friction check

- (7) Friction of the feel unit is checked at the low (pre cut-in) and high (after cut-out) airspeed settings. A typical plot to determine friction of a rudder feel unit is shown in fig.5. To check friction:-
- (a) Open the air increase valve to obtain the low speed setting i.e. 0.90 knots for elevator units, 0-130 knots for rudder units.
 - (b) Apply PULL loads to the feel unit by loading the appropriate weight carrier in increments of two lb. up to 28 lb. An initial load of 8 lb. should be applied to the rudder unit to overcome the break out force. Unload in the same increments as for loading, and plot load/input shaft movement for each increasing and decreasing load.

- (c) Increase airspeed to the high speed setting of 460 knots.
- (d) Apply PULL loads to the feel unit in two lb. increments up to 40 lb., unload by the same amounts and plot results.
- (e) Repeat operations (a) to (d) using the opposite hand weight carrier to apply PUSH loads. Friction of the feel unit is equal to half the vertical distance between the increasing and decreasing load curves, and at the 0.1 in. (low speed) and 0.01 in. (high speed) input shaft movement positions must not exceed:

	Elevator	Rudder
Low Speed	½ lb.	1 lb.
High Speed	1 lb.	1¼ lb.

Auto-pilot (track) calibration (elevator only)

- (8) During auto-pilot control on an I.L.S. approach, the elevator feel unit is given a degree of relief when TRACK is selected. The limits for this calibration shown in fig.3 apply only to elevator feel units with Mod.1073 embodied. To check track calibration:-
- (a) Set the console controls as detailed in sub para.(1).
 - (b) Apply a load of 17 lb. to the balance arm.
 - (c) Increase airspeed from cut-in speed to 200 knots in 10 knot increments and plot input shaft movement at each speed using calibration sheet fig.3. Check that the graph plotted is within the NORMAL limit lines.
 - (d) Reduce airspeed to zero.

- (e) Set switch SW.4 to ON.
- (f) Increase airspeed from cut-in speed to 200 in 10 knot increments and plot input shaft movement. Check that the graph plotted is within the TRACK limit lines.
- (g) Reduce airspeed to zero and set switch SW.4 to OFF.
- (h) Apply the load in the opposite direction and repeat operations (c) to (f).

AILERON FEEL UNIT

7. The following paragraphs outline the checks necessary and specify the requirements for aileron feel units to pre and post Mod.1499 standard.

Preparation for test

- (1) With the feel unit installed in the calibrator as detailed in Chap.8 para.27, proceed as follows:-
- (a) Using the clamps provided, secure the dial gauge to the end structure of the calibrator so that the plunger contacts the striker arm of the extension tube. Set the dial gauge to obtain equal movement in each direction and set to zero.
 - (b) Connect a 28 volts d.c. supply to the console terminals.
 - (c) Ensure that the three airspeed control valves are closed and charge the pneumatic system air bottle.
 - (d) Set the master switch SW.1 to ON.
 - (e) Set switch SW.3 to the Mk.2 AILERON position.

- (f) Set switch SW.2 to FEEL and check that the GREEN indicator lamp lights.
- (g) Set switches SW.4 and SW.5 to OFF.
- (h) Set switch SW.6 to NORMAL.

Cut-in and cut-out speeds

(2) To check the cut-in and cut-out speeds:-

- (a) Open the air INCREASE valve slowly until the main actuator commences to operate and note the indicated airspeed. This is the cut-in speed and should be 148 to 155 Knots.
- (b) Continue to increase airspeed slowly and note the airspeed at which the main actuator stops operating. This is the cut-out speed and should be 368 to 375 Knots

Break out force

(3) To check the break-out force:-

- (a) Select zero airspeed.
- (b) Load the weight carrier in small increments and check that the load required to move the input shaft is not more than 1½ lb.

Feel relief check

(4) To check function of the unit under feel relief conditions:-

- (a) Set airspeed to 380 knots.
- (b) Set switch SW.2 to RELIEF. Check that the RED indicator lamp lights, and the relief motor of the actuator operates to move the feel unit to the

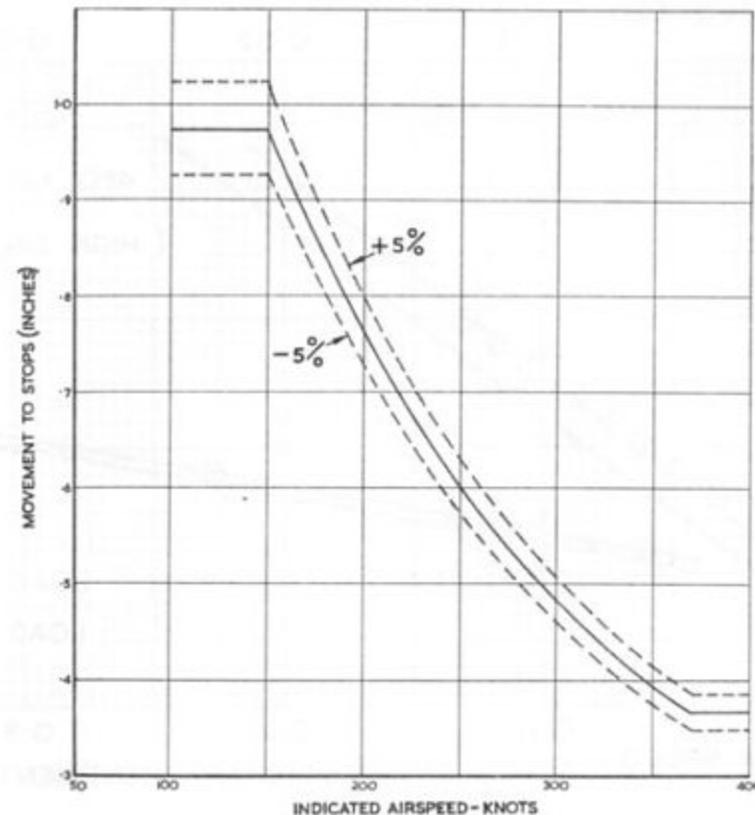


Fig.4 Aileron A.F.U. Airspeed/stop movement limits

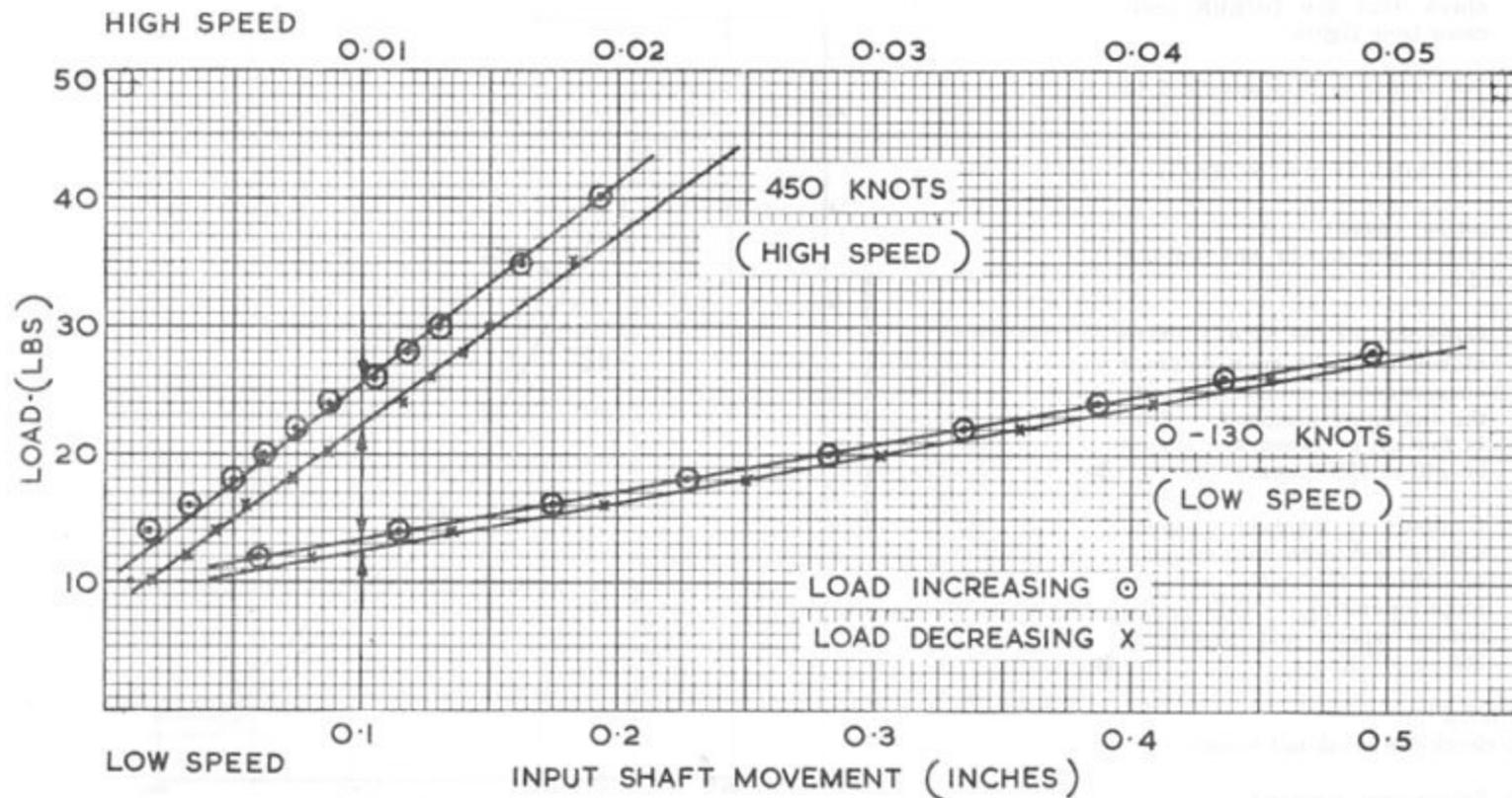
unrestricted movement position. Apply hand pressure to each end of the balance arm in turn, and check that the resultant movement of the input shaft in both directions is 0.975 ± 0.050 ins.

- (c) Set switch SW.2 to FEEL and check that the actuator extends to the normal position for this airspeed.
- (d) Set airspeed to zero.

Calibration check

(5) The object of the calibration check is to determine the airspeed/available movement characteristics of the feel unit. The upper and lower limits of movement are shown on calibration sheet fig.4. To check calibration:-

- (a) Set the dial gauge to zero.
- (b) Set airspeed to 150 knots.
- (c) Apply hand pressure to one



FRICION IS EQUAL TO HALF THE VERTICAL DISTANCE BETWEEN THE LOAD INCREASING AND LOAD DECREASING CURVES, MEASURED AT THE 0.10 IN. (LOW SPEED) AND 0.01 IN. (HIGH SPEED) INPUT SHAFT MOVEMENT POSITIONS RESPECTIVELY.

IN THE EXAMPLE SHOWN FRICTION AT LOW SPEED - $\frac{1}{2}$ LB.
AT HIGH SPEED - $1\frac{1}{2}$ LB.

NOTE . . .

FRICION OF THE ELEVATOR A.F.U. IS DETERMINED IN A SIMILAR MANNER AT THE APPROPRIATE LOW AND HIGH AIRSPEED SETTINGS.

Fig.5 Typical friction calibration - rudder A.F.U.

RESTRICTED

end of the balance arm to take up movement between the stops, and record the input shaft movement on calibration sheet fig.4. Repeat this procedure at 25 knot intervals throughout the normal speed range.

- (d) Repeat operation (c), depressing the balance arm in the opposite direction. Check that the graphs plotted in both directions are within the limit lines shown on the calibration sheet.

Auto-pilot calibration

- (6) When the auto-pilot aileron channel is engaged, the aileron authority is restricted by moving the feel unit stops toward the high speed

position. To check auto-pilot calibration:-

- (a) Select zero airspeed.
 (b) Set switch SW.6 to the AUTO-PILOT position.
 (c) Apply hand pressure to each end of the balance arm in turn, and check that movement of the input shaft in both directions is 0.425 ± 0.023 in. The auto-pilot potentiometer POT.3 may be adjusted to obtain this setting.

◀ Actuator override limit switch setting

- (7) On feel units with Mod.1806 incorporated, check function of the actuator override micro switch as follows:-

- (a) Set the controls as in sub. para.7 (1).
 (b) Set airspeed to 400 knots.
 (c) Set switch SW.6 to AUTO-PILOT and allow the actuator to run to full extent.
 (d) Insert a plate strip 24 SWG. thick between the striker pin and the micro switch plunger, and check that the red warning lamp L3 illuminates.
 (e) Remove the plate strip and check that lamp L3 extinguishes.
 (f) Reduce airspeed to zero.
 (g) Set switch SW.6 to NORMAL. ▶

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

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

