# Chapter 63

# ACTUATOR, WESTERN, TYPE UA2342/B

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**Introduction**

**1.** The linear actuator, Western, Type UA2342/B, has a normal working load of 250 lb. with a maximum of 375 lb.

**2.** The actuator incorporates a split field, series wound, reversible fractional horse power motor (normally operating from a 28-volt d.c. supply) which drives the piston through a gear reduction train and lead screw.

**3.** The piston stroke length is controlled by four snap action limit switches mounted in pairs at each end of the piston housing. Each pair comprises a primary and an emergency switch, the emergency switch only becoming operative if the primary switch fails. Should the primary and emergency switches fail, the piston is arrested by mechanical stops, one being provided by the inboard end of the screwed plug and the other by a flat on the piston

housing. There is also a mid-position switch to provide remote indication of the datum trim position.

**4.** The motor, with its integral electro-magnetic brake, is a complete replaceable unit.

## DISMANTLING

**5.** After the actuator has been removed from the aircraft and before commencing dismantling, connect the electrical lead to a 28-volt d.c. supply and run the actuator to the approximate centre of its stroke. Disconnect the electrical supply and proceed to dismantle as follows:—

### Terminal block cover and electrical connection

**6.** The terminal block cover should first be removed in the following sequence:—

(1) Unscrew the cable nut, withdraw the compression ring and sealing ring, take out four ch.hd screws which connect the terminal block cover to the gearbox unit, and slide the cover over the electrical lead sufficiently to obtain access to the terminals.

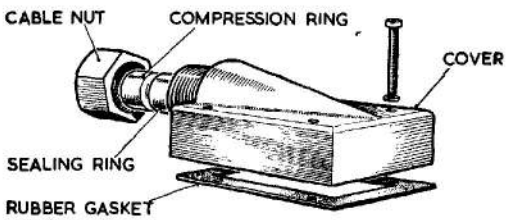


**Fig. 1. Terminal block cover**

(2) Detach all wires from the terminals, remove the terminal block cover and retain the rubber gasket.

### Motor, gearbox and piston units

**7.** These three main units should then be separated from each other in the following manner:—

(1) Unscrew the stiffnuts from the four through bolts which connect the three units and withdraw the bolts.

(2) The piston unit may be pulled away from the gearbox unit. drawing the electrical leads clear of the terminal block terminals and retaining the gasket for re-assembly.

(3) The motor unit can be pulled away from the gearbox unit and the gasket removed and retained.

### Piston unit (limit switches)

**8.** Dismantling of the limit switches and the mid-position switch may now be proceeded with.

(1) Take out three ch.hd. screws which hold the end plate to the ring plate and remove the end plate and the cover.

(2) Take out two csk.hd. screws (which have been locked by peening) which attach the ring plate to the piston housing and remove the ring plate.

(3) The two trip rods, complete with contact arm assemblies, springs and operating lugs, can now be lifted out and should not be further dismantled unless repairs or renewals are required.

(4) Take the nuts and washers from the studs which attach the two mid-position contact block assemblies to the switch mounting blocks and remove the assemblies.

(5) Take out the ch.hd. screws which hold the four limit switches to the mounting blocks and remove the limit switches.

(6) Take out the csk.hd. screw and remove the spring contact and trip mounting block from the piston.

### Piston unit (piston and worm)

**9.** The piston and worm assembly should next be dismantled.

(1) Drive out the taper pin and unscrew the screwed plug from the end of the piston.

(2) Take out two csk.hd. screws which hold the bearing housing to the piston housing and separate the bearing housing (complete with ballrace, piston, worm, washers and ring nuts) from the piston housing. The gasket between the two housings to be retained for re-assembly.

(3) Unscrew the worm from the piston.

(4) If it is necessary to remove the ballrace from the worm, proceed as follows:—

(a) Remove the locking pin from the bearing housing and outer ring nut, and unscrew the ring nut from the bearing housing.

(b) Withdraw the worm assembly (consisting of worm, ballrace, washer, lock washer and inner ring nut) from the bearing housing.

(c) Bend down the lock washer, unscrew the inner ring nut and remove both washers and the ballrace from the worm.

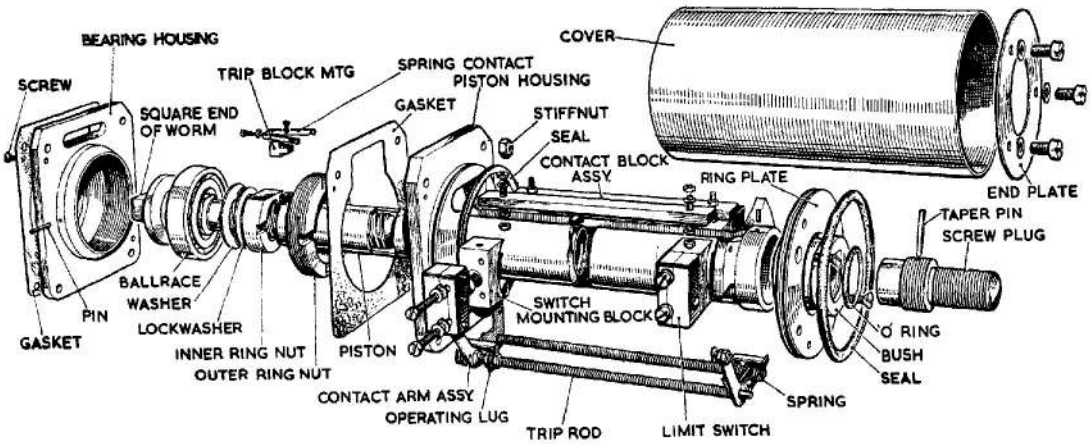


**Fig. 2. Piston unit**

(5) If the ballrace only requires inspection and cleaning, remove the outer ring nut and its locking pin and withdraw the worm assembly as in (a) and (b) above.

**Gearbox unit**

**10.** The gearbox unit to be dismantled as follows:—

(1) Take off the external circlip and outer retaining washer from the coupling end of the final carrier and draw the complete gear assembly out of the annulus from the opposite end.

(2) Take off the 'E' clip and shim washers from the final carrier shaft. The shims restrict gearbox end float and their positions should be noted for re-assembly.

(3) Remove the gear carriers in their sequence, taking care to retain the planets on their respective pins.

(4) Planet gears on 1st stage carrier can be removed after taking off the 'E' clips and shim washers. These shims restrict end float of 1st stage and their positions should be noted for re-assembly.

**Note . . .**

*All other planets are free on the carriers.*

(5) Remove the internal circlip and inner retaining washer from the gearbox.

(6) The annulus may be removed from the gearbox if necessary, after taking out the locating screw.

(7) The terminal block may be removed from the gearbox, if necessary, after taking out two csk.hd. screws and lifting block and the varnished glass out the tape.

**Motor unit (motor and pinion)**

**11.** The motor and pinion should now be removed as follows:—

(1) Take out the two csk.hd. screws which hold the motor end cap to the motor housing.

(2) Withdraw the motor (complete with end cap and pinion) out of the housing.

(3) Drive out the parallel pin and remove the pinion from the armature spindle.

**Motor unit (solenoid brake)**

**12.** The solenoid brake should next be dismantled:—

(1) Take off the lock nut and spring washer which hold the brake disc in position.

(2) Unscrew the brake disc (left-hand thread) from the armature spindle.

(3) Pull off the brake shoe, bush, spindle bush and brake spring from the armature spindle.

**Motor unit (brushes)**

**13.** The brushes should now be removed as follows:—

(1) Take out the screws.

(2) Raise the springs, taking care not to strain them.

(3) Mark the brushes and withdraw them from their holders.

**Motor unit (armature and ballraces)**

**14.** The armature and ballraces may now be taken out:—

(1) Unscrew the two barrel nuts from the tie rods.

(2) Extract the armature with end cap and both ballraces attached.

(3) Remove the circlip and shims from the drive end of the armature spindle.

(4) Withdraw the spindle from the end cap ballrace and push the ballrace out of the end cap, care being taken to retain the 'O' ring.

(5) The ballrace at the commutator end may now be pulled off the armature spindle.

**Motor unit (brake solenoid and brushgear)**

**15.** The brake solenoid and brushgear should now be removed:—

(1) Tap the tie rods with a plastic or hide hammer and withdraw the solenoid and brush mounting.

(2) Unscrew the tie rods and remove the brushgear mounting from the solenoid casing, care being taken to retain the 'O' ring.

**Motor unit (field coil assembly)**

**16.** The field coil assembly should be tested in situ. If it proves defective, remove as follows:—

(1) Remove all wires from the brushbox end of the windings and close the tags down on the fields to avoid damage.

(2) Take out the grub screws which locate the field assembly in position and remove the field coils.

## INSPECTION AND REPAIR

**17.** The faults, causes and remedies table which follows, indicates the nature of the failure causes and is a guide to the inspection and repair required.

(1) Wash all mechanical parts in lead-free gasoline or white spirit until all traces of dirt and stickiness have disappeared.

(2) Measure parts for tolerances, etc., in accordance with Schedule of fits, clearances and repair tolerances given in Appendix 1.

(3) Examine gears carefully for signs of burrs or grooving. Burrs may be removed with a fine carborundum stone but chipped or grooved gears must be renewed.

(4) Check that all 'O' rings are not damaged.

(5) Information on Inspection and repair of motors is contained in A.P.4343, Vol. 1 and Vol. 6, Sect. 18, App. 1.

**Table 1**

**Faults, causes and remedies**

| Fault | Possible cause | Remedy |
|---|---|---|
| Actuator fails to start | Open circuit<br>Limit switch not making | Renew limit switch |
| | Seizure | Trace fault and correct |
| | Mechanical failure | Renew and damaged parts |
| | Breakage | Indicated by motor running but output not operating. Strip and examine, renew broken parts |
| Actuator operates slowly or lacks power | Defective motor | Check motor; see last item in Table |
| | Excessive friction in actuator | Check gears, ballraces, piston and worm |
| | Loose connection or faulty switch | Trace and correct, or renew switch |

For motor faults, causes and remedies see A.P.4343, Vol. 1, Sect. 18, App. 1

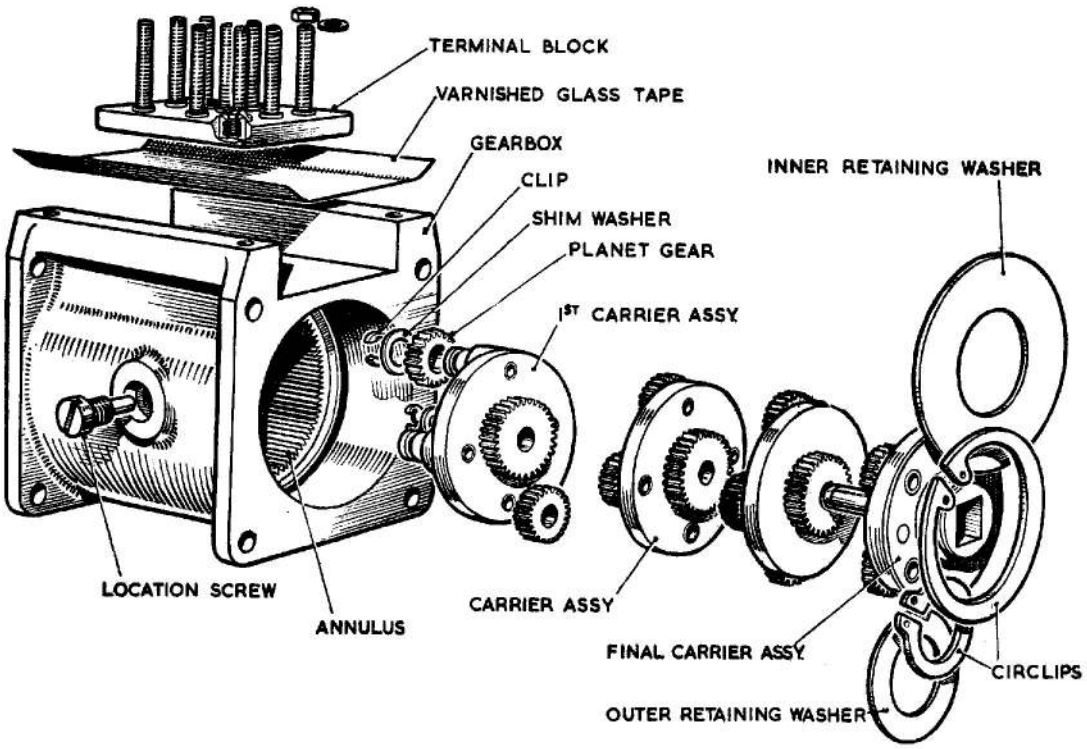


**Fig. 3. Gearbox unit**

## ASSEMBLY

### Motor unit

**18.** After completing the inspection and repair of motor and pinion it should be re-assembled in the reverse order from that used for dismantling, but the following special points should be noted:—

(1) Adjust the brush pressure before assembling the brushgear to the motor. This, measured on a former of 0·52 in. diameter, should be between 1·3 oz. and 1·7 oz. This is achieved by unscrewing the brush spring adjuster locking nuts several turns, gripping the head of the bolts with tweezers, pulling out of the slots and rotating in the direction required to adjust the spring tension.

(2) Re-assemble all screws applying Ref. No. 33B/937 varnish.

(3) Draw the rubber sleeves over the tie rod nuts right up to the face of the brush box plate, after the tie rods are screwed home.

(4) Replace shims in end cap to maintain armature end float of 0·002 in. to 0·004 in., including end float in ballraces.

(5) Make sure that 'O' rings are correctly fitted.

(6) Replace spindle bush to maintain brake gap of 0·008 in. to 0·015 in.

(7) Ensure that end cap and brake solenoid locate on their respective spigots and keys.

(8) Return the brushes to their holders only when the motor is fully assembled.

### Piston unit (piston and worm)

**19.** On completion of inspection and repair, the piston and worm are to be re-assembled as follows:—

(1) If the ballrace has been removed from the worm, replace it in the following sequence:—

(a) Ensure that ballrace locates against shoulder of worm.

(b) Fit washer, lock washer and inner ring nut.

(c) Secure lock washer against the flat provided on the ring nut.

(d) Return the above assembly into the bearing housing and fit the outer ring nut and locking pin.

**Note . . .**
*Locking pin must not exceed $\frac{3}{64}$ in. diameter.*

(2) If the ballrace has not been removed from the worm, return the worm assembly (consisting of worm, ballrace, washer, lock washer and inner ring nut) into the bearing housing and refit the outer ring nut and locking pin as in (d) above.

(3) After checking that the 'O' ring fits correctly in the piston bush, and that the piston slides smoothly over its full length in the piston housing, screw the piston on to the worm.

(4) Join the piston housing to the bearing housing with gasket between and connect by two csk.hd. screws.

(5) Check that piston runs smoothly by rotating square end of worm.

**Note . . .**
*Ballrace and worm to be greased with XG-275 grease.*

(6) Screw the screwed plug into the piston so that the inboard end of the plug is 3·25 in. $\pm$ 0·002 in. from the inboard end of the piston and then replace the taper pin.

**Piston unit (limit switches)**

**20.** The limit switches and mid-position switch may now be replaced in the piston unit as under:—

(1) If the trip rod assemblies have been dismantled they should now be re-assembled complete with contact arm assemblies, springs and operating lugs.

(2) Engage the assembled trip rods in the holes provided in the piston housing, ensuring that the springs are fitted over the guide ferrules of their appropriate trip rods.

(3) Fit the ring plate to the piston housing and fasten with two csk.hd. screws. The trip rods also engage in two holes provided in the ring plate.

(4) Replace the trip block mounting and spring contact connecting same to piston by csk.hd. screw.

(5) Refit the four limit switches to the switch mounting blocks using ch.hd. screws to fasten.

(6) Replace the mid-position contact assemblies on the studs of the switch mounting blocks and fasten with nuts and washers.

(7) Re-connect wire leads.

(8) Ensure that the clearance between the end of the trip rod and the piston housing is 0·03 in. to 0·05 in. with spring expanded and switches made.

(9) For final adjustment of switches see para. 24.

**Gearbox unit**

**21.** The gearbox should be assembled in the following order:—

(1) If the annulus has been removed from the gearbox it should now be returned after the internal circlip and inner retaining washer have been fitted in the gearbox.

(2) Grease all planet gears with XG-275 grease.

(3) Insert final carrier and coupling assembly into the annulus and fit the external circlip and outer retaining washer.

(4) Drop four planet gears on to pins of final carrier.

(5) Insert the next carrier and ensure that its sun gear engages with the planets previously fitted.

(6) Repeat until all carriers and planets have been assembled in the annulus.

(7) Assemble shim washers at end of final carrier shaft to restrict gearbox end float and replace 'E' clip.

(8) The planets of the 1st stage are held in place by 'E' clips which should now be replaced together with the planet washers which restrict the 1st stage end float.

**Note . . .**
*The maximum end floats are stated in Appendix 1.*

**Motor, gearbox and piston units**

**22.** The three main units having been re-assembled and the motor having been tested in accordance with para. 27, should now be connected as follows:—

(1) Offer up the piston unit to the gearbox unit, with gasket between the two units, and engage the square end of the worm into the square hole of the final carrier and coupling.

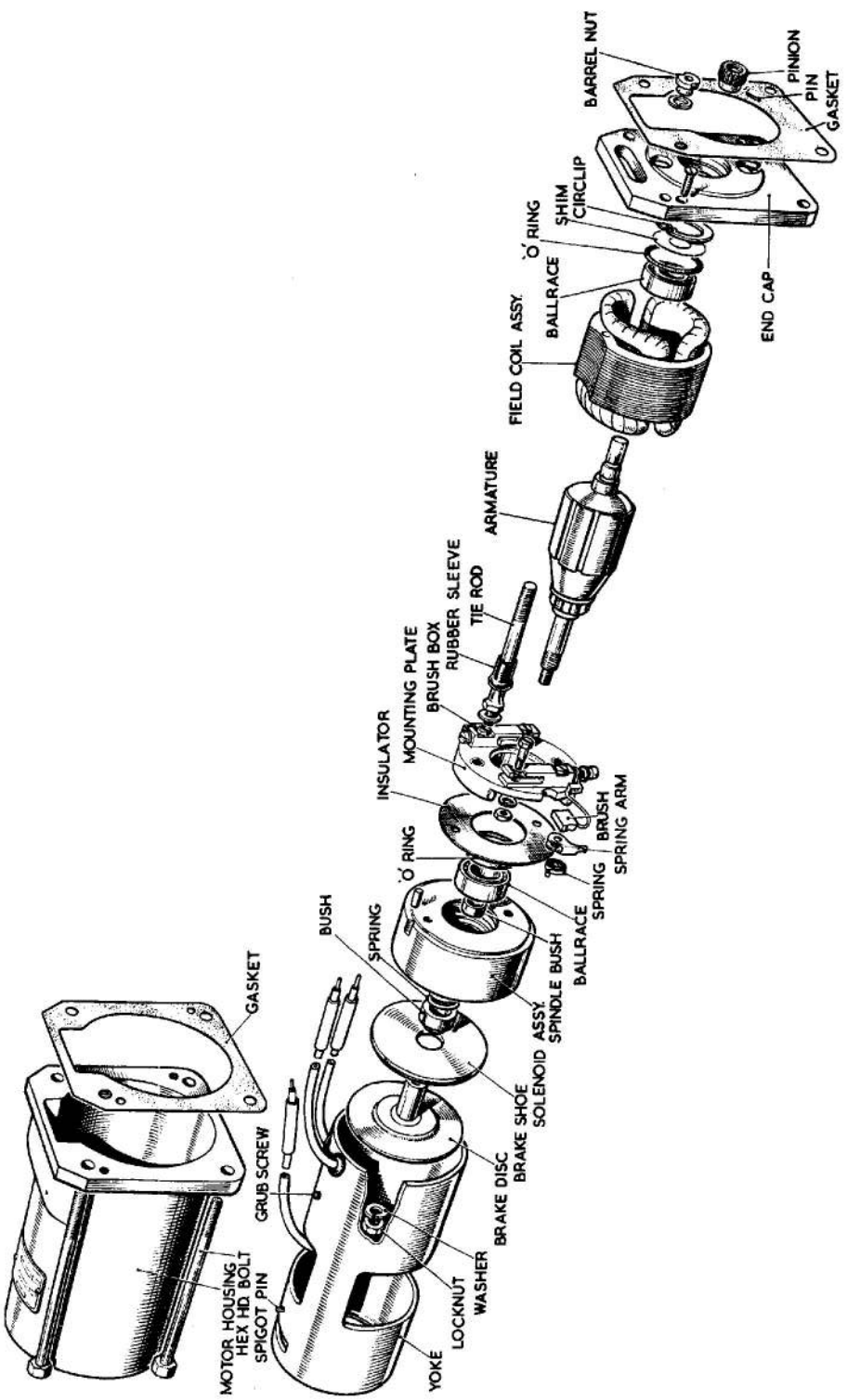


Fig. 4. Motor unit

**Note . . .**
*The piston unit cover and end plate should be left off pending final setting of switches. See para.* 24.

(2) The motor unit should be offered up to the other end of the gearbox unit, with gasket between, and the pinion engaged with the planet gears of the first carrier.

(3) Insert the four through bolts which connect the three main units and screw on the four stiffnuts.

**Terminal block cover and electrical connections**

**23.** The terminal block cover may now be fitted and the electrical connections made:—

(1) Pass the electrical cable through the entry of the terminal block cover, with the cable nut, compression ring and sealing ring threaded on the cable.

(2) Attach the wire leads to the terminals in accordance with circuit diagram in A.P.4343D, Vol. 1, Book 3, Sect. 14, Chap. 63.

(3) Replace the sealing ring.

(4) Replace the terminal block cover and rubber gasket, securing to the gearbox with four ch.hd. screws.

(5) Tighten the cable nut so that the compression ring grips the cable.

**Final assembly and switch setting**

**24.** The actuator can now be finally assembled and, if necessary, the switch settings adjusted.

(1) Ensure that the correct field lead from the motor is connected to the correct terminal by selecting the common lead (negative) from the motor and energizing each switch in turn, inching the motor as the switch is approached.

(2) Mount the actuator so that the fully extended and contracted centres can be accurately measured.

(3) Operate the actuator over the full stroke of 2·15 in. at 28 volts d.c. and an opposing load of 250 lb.

(4) Set the main limit switches and the mid-position switch to operate within the limits shown under Leading Particulars in A.P.4343D, Vol. 1, Book 3, Sect. 14, Chap. 63. A gap of 0·03 in. ± 0·002 in. must be maintained between main and emergency switches, both inboard and outboard.

(5) Replace piston unit cover, taking care that the rubber seals remain in position in their respective recesses.

(6) Replace piston unit end plate and connect to the ring plate by three ch.hd. screws and lock washers.

## TESTING

**Test rig**

**25.** Information on the test rig for actuators is contained in A.P.4343S of this series.

**Actuator tests**

**26.** Load tests to be carried out on the actuator after repair and re-assembly are as follows:—

(1) A functional test to be performed by connecting the actuator to a 28-volt d.c. supply and applying opposing loads of zero, 250 and 375 lb. The maximum current consumption and the time the piston takes to complete its 2·15 in. travel should not exceed the following figures:—

| Load (lb.) | Max. current (amp.) | Max. time. (sec.) |
|---|---|---|
| 0 | 2·1 | 5·1 |
| 250 | 3·5 | 8·0 |
| 375 | 4·3 | 10·4 |

**Motor tests**

**27.** Before the motor unit is returned to the actuator, the following checks and tests are to be carried out on the motor:—

(1) Ensure that winding resistances are between the following limits:—

| | | | |
|---|---|---|---|
| Armature, between adjacent segments | 0·325 | to 0·475 | ohms |
| Armature, across segments | 1·35 | to 1·60 | ,, |
| Field coil | 0·65 | to 0·75 | ,, |
| Brake coil | 0·50 | to 0·70 | ,, |

(2) Check that brush pressure is between 1·3 and 1·7 oz.

(3) Ensure that brushes bed down satisfactorily over the whole circumferential width and at least 80 per cent of the area.

(4) Check for correct rotation as follows, when connected to a source of supply and when viewed on pinion end:—

(a) E and H = Clockwise

(b) E and G = Anticlockwise

(5) Operate five or six times in each direction on no load, to ensure that brake shoe pulls off satisfactorily to allow the

armature to rotate freely at a maximum terminal voltage of 18 volts.

(6) Apply a torque of 4 oz. in. at a terminal voltage of 28 volts $\pm\frac{1}{2}$ volt, when the speed in each direction must not be less than 14,000 r.p.m. and the current consumption must not exceed 5 amperes.

(7) Test for armature over-run by running the motor unloaded at 28 volts and measuring the over-run after switching off. Repeat five times in each direction, when the reading must not exceed fifteen revolutions of the armature.

(8) Subject the motor to a flash test of 500 volts r.m.s. at 50 c/s a.c. between live parts and the frame for a period of one minute while the motor is still warm after a 15 seconds run in each direction on no load at 25 volts.

(9) Carry out a subsequent insulation resistance test of 500 volts after a further 15 seconds run in each direction, when the reading must not be less than 2 megohms.

(10) Test the motor for endurance with 50 starts and 50 stops in each direction with a terminal voltage of 18 volts and the motor running light. This test to be spread over a period of 25 minutes, allowing a maximum running period of 5 seconds followed by a rest period of 10 seconds. Upon completion of this test, re-check for armature over-run.

(11) Check that all nuts and screws are properly locked.

(12) The tests scheduled above are to be carried out at a room temperature of 15 deg. C.

**Insulation resistance after installation in aircraft**

**28.** Using a 250-volt insulation resistance tester, measure the insulation resistance between live parts and the frame. The reading must not be less than 2 megohms.

**29.** Due to the humidity prevalent in aircraft and at dispersal points, the minimum permissible insulation resistance shall be 50,000 ohms.

## SCHEDULE OF FITS, CLEARANCES AND REPAIR TOLERANCES

**APPENDIX 1**

All dimensions in inches

| Item No. (1) | Description (2) | Dimension New (3) | Permissible Worn Dimension (4) | Clearance New (5) | Permissible Worn Clearance (6) | Remarks (7) |
|---|---|---|---|---|---|---|
| **PISTON UNIT** | | | | | | |
| 1 | Bearing housing bore | 1·125 | — | 0·0015 | 0·0015 | |
| 2 | Ballrace o/d | nominal | — | 0·0002 | | |
| 3 | Ballrace i/d | 0·500 nominal | — | 0·0005 clear to 0·0004 interf. | 0·0005 | Bearing selected to give the fits quoted in Col. 5 |
| 4 | Worm land dia. | — | — | — | — | |
| 5 | Piston housing bore | 0·630 | 0·633 | 0·004 | 0·006 | |
| 6 | Piston o/d | 0·630 | 0·627 | 0·002 | | |
| 7 | Guide slots in piston housing, width | 0·250 | 0·255 | 0·004 | 0·007 | |
| 8 | Piston lugs, width | 0·250 | 0·248 | 0·001 | | |
| **GEARBOX UNIT** | | | | | | |
| 9 | 1st stage gear assy. | — | — | — | — | Maximum end float 0·005 |
| | Complete gear assy. | — | — | — | — | Maximum end float 0·012 |

## SCHEDULE OF FITS, CLEARANCES AND REPAIR TOLERANCES

**APPENDIX 1** (*continued*) All dimensions in inches

| Item No. (1) | Description (2) | Dimension New (3) | Permissible Worn Dimension (4) | Clearance New (5) | Permissible Worn Clearance (6) | Remarks (7) |
|---|---|---|---|---|---|---|
| MOTOR UNIT | | | | | | |
| 11 | Solenoid core bore | 0·500 nominal | — | 0·0013 | 0·0013 | |
| 12 | Shielded ballrace o/d | | | | | |
| 13 | Shielded ballrace i/d | 0·1875 nominal | — | 0·0004 clear to 0·0002 interf. | 0·0004 | Bearing selected to give the fits quoted in Col. 5 |
| 14 | Armature spindle, commutator end | | | | | |
| 15 | End cap bore | 0·500 nominal | — | 0·0013 0 | 0·0013 | |
| 16 | Shielded ballrace o/d | | | | | |
| 17 | Shielded ballrace i/d | 0·1875 nominal | — | 0 to 0·0004 interf. | as new | Bearing selected to give the interference fit quoted in Col. 5 |
| 18 | Armature spindle, drive end | | | | | |
| 19 | Brush length | 0·30 | 0·20 | | — | |