Chapter 45

ACTUATOR, PLESSEY TYPE CZ.80730/3/A

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Introduction

1. The CZ.80730/3/A (Jaguar) is an offset linear actuator with a maximum plunger stroke length of 2·70 in. and a normal working load of 100 lb. (max. 150 lb.).

2. The actuator incorporates a split-field, series-wound, fractional-horse-power motor which drives the plunger through a gear reduction train, a slip clutch and a lead screw. The plunger stroke length is controlled by two microswitches. The motor, with its integral electro-mechanical brake and pinion, is a complete, replaceable unit. In this chapter, the overhaul procedure is given under two headings, viz., actuators, para. 3 to 25; motor, para. 26 to 59.

OVERHAUL (ACTUATOR)

Tools and test equipment (actuator)

3. In addition to an ordinary tool kit the special tools and test equipment listed in Table 1 are required for overhauling the actuator.

TABLE 1

Special tools and test equipment (actuator)

Nomenclature	Part No.	Ref. No.
TOOLS		
Special spanner for slotted nut on 58T gear	T.353514	
Special spanner for lead screw gear nut	T.328937	
Ball bearing extractor	T.335187	
Special spanner for plug locking nut	T.353224	
Special spanner for holding plug	CZ.53700	
Crimping pliers for terminal tags	CZ.50125	
Crimping pliers for tag thimbles	T.353214	
TEST EQUIPMENT		
Insulation resistance tester	TD.2728	5G/152
Flash test set	TD.2846	

4. In addition to the test equipment listed in Table 1, equipment for setting the stroke of the actuator and carrying out the load tests is required. Details of this equipment will be found in A.P.4343S, Vol. 1, Sect. 16, Chap. 3.

DISMANTLING

5. Before commencing to dismantle the actuator, run the plunger to the extended position. Dismantle the actuator in the sequence set out below:—

(1) Slacken the locking nut and remove the front fitting from the plunger end.

(2) Unscrew the captive screw on the face of the front cover and ease the front cover forward sufficiently to gain access to the terminal block on the plunger housing. Disconnect the leads on the terminal block and remove the front cover and the plug and cable assembly. The plug and cable assembly need not be removed from the cover unless any part has to be renewed. The plug can be removed by unscrewing the locking rings, using the spanner T.353224 and the tool CZ.53700 to hold the plug.

(3) Disconnect the three leads to each limit switch. Remove the nuts and washers from each switch mounting plate and remove the switches and mounting plates.

(4) Remove the four bolts which secure the motor to the front housing of the gearbox. Remove the motor and grease guard assembly.

(5) Remove the four bolts securing the plunger housing to the front housing. Withdraw the plunger housing from the plunger. Unscrew and remove the plunger from the lead screw.

Note . . .

Any shims located between the spigot of the plunger housing and the lead screw bearing should be removed and retained. These shims should be replaced during re-assembly (*see para.* 15 (2)).

(6) Break the locking wire and remove the four screws retaining the rear end fitting. Remove the end fitting and gasket. Remove the two screws, the small plate and the rubber section from the top of the rear cover.

(7) Separate the gearbox housing from the front housing. The gear train, except for the smaller gear for the first compound gear, will normally remain with the front housing. Remove the gear and end fitting retaining plate from the gearbox

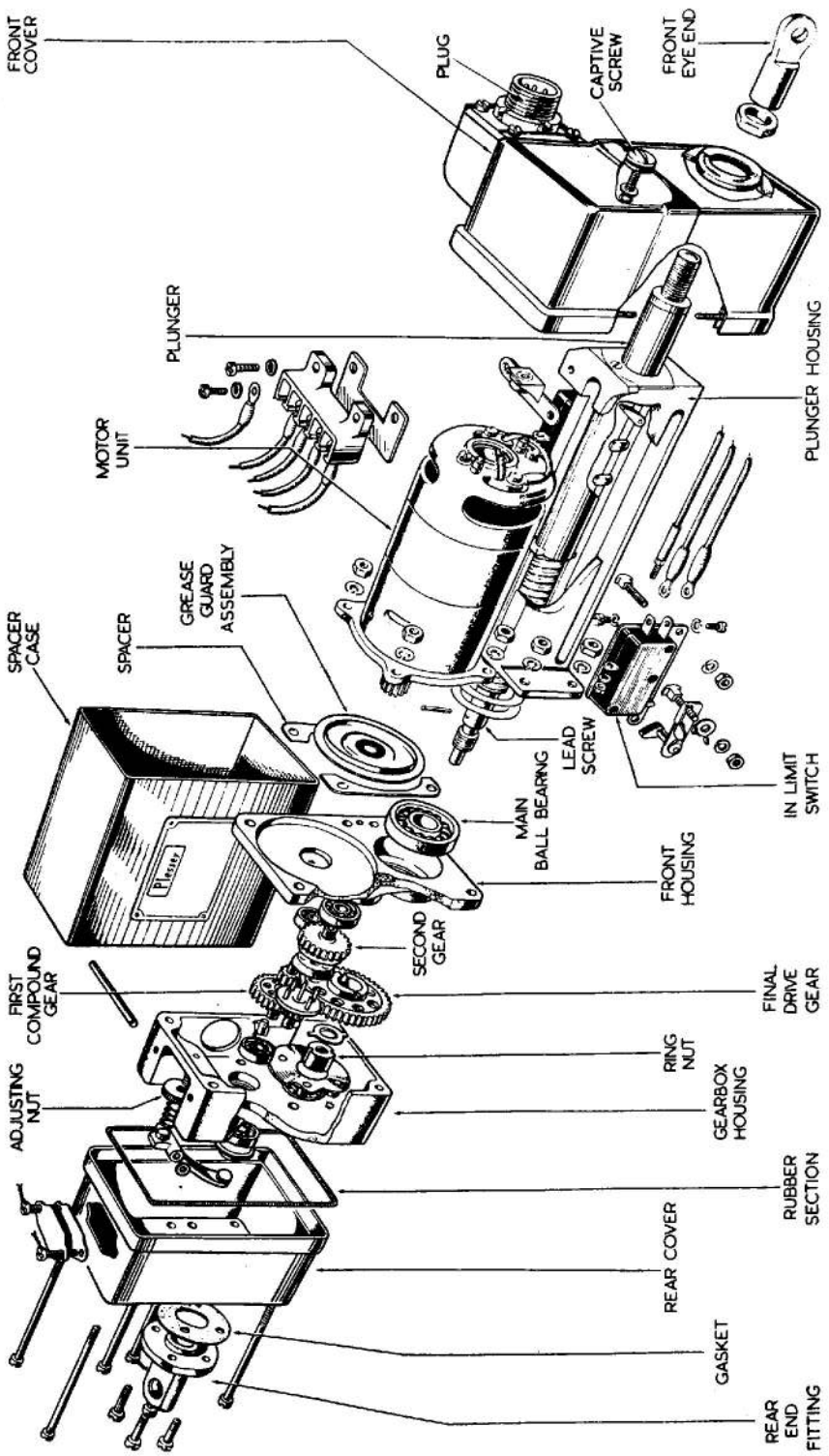

Fig. 1. *Exploded view of actuator*

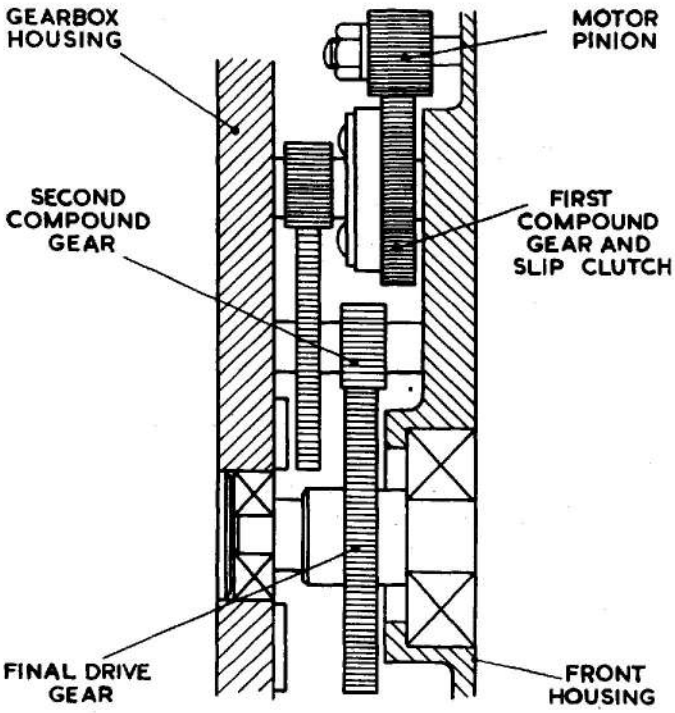

Fig. 2. *Gear train*

housing. Remove the friction drive wheel from the recess in the larger gear of the first compound gear.

(8) Heat the front housing to 100 deg. C. to facilitate the removal of the gears. Remove the second stage gear and the larger gear of the first stage.

(9) Remove the small bearing from the end of the lead screw. Using the special spanner T.314479 remove the ring nut and locking washer from the lead screw. Remove the drive pin of the final gear and withdraw the gear from the lead screw. The lead screw and bearing can now be pushed out of the front housing.

INSPECTION AND REPAIR

6. Wash all metal parts of the actuator in an approved cleaning spirit and remove all traces of grease and sludge. The parts should then be laid out and examined carefully for signs of obvious damage such as distortion, burring and scoring. After this, the parts should be checked against the Schedule of Fits, Clearances and Repair Tolerances (App. 1) and all worn parts renewed.

7. The following points must be given special attention:—

(1) Gears: The gear teeth must be examined for bruises, burrs or undue wear.

(2) Lead screw, plunger and housing: Check the part of the lead screw which supports the final drive gear. Check the linear backlash between the threads of the lead screw and the plunger (see Schedule of fits, Clearances and Repair Tolerances, App. 1). Examine the threads for scoring and other damage. Check the side play of the plunger in the front bush. Inspect the plunger ears for damage or wear.

(3) Limit switches: After an actuator has completed its overhaul life, it is recommended that the limit switches be renewed. Check the operation of each switch. When the button is depressed, a closed circuit should be indicated between the N.O. and the COM. terminals and an open circuit indicated between the N.C. and the COM. terminals. When the button is released, an open circuit should be indicated between the N.O. and the COM. terminals and a closed circuit indicated between the N.C. and the COM. terminals. This check should be repeated several times. The switch operating lever should be examined for wear and freedom of movement.

(4) Wiring: Inspect the internal wiring for chafed, worn or broken cables. Cables should be renewed where necessary and fitted in accordance with the wiring diagram (*fig.* 3).

(5) Connector plug: Plug pins should be examined for corrosion and the plug renewed if necessary.

Lubrication

8. Actuators are required to operate for a considerable period without inspection or maintenance. It is important, therefore, that cleaning and lubrication be carried out with care. Use grease XG–275 for all applications. Lubrication is to be carried out progressively during re-assembly. The parts of the actuator to be lubricated are:—

(1) Gear teeth
(2) Ball bearings
(3) Lead screw and plunger threads
(4) Bushes; thrust and sliding faces.

9. The instructions set out below should be followed when lubricating the actuator. The stated amount of grease to be applied to the

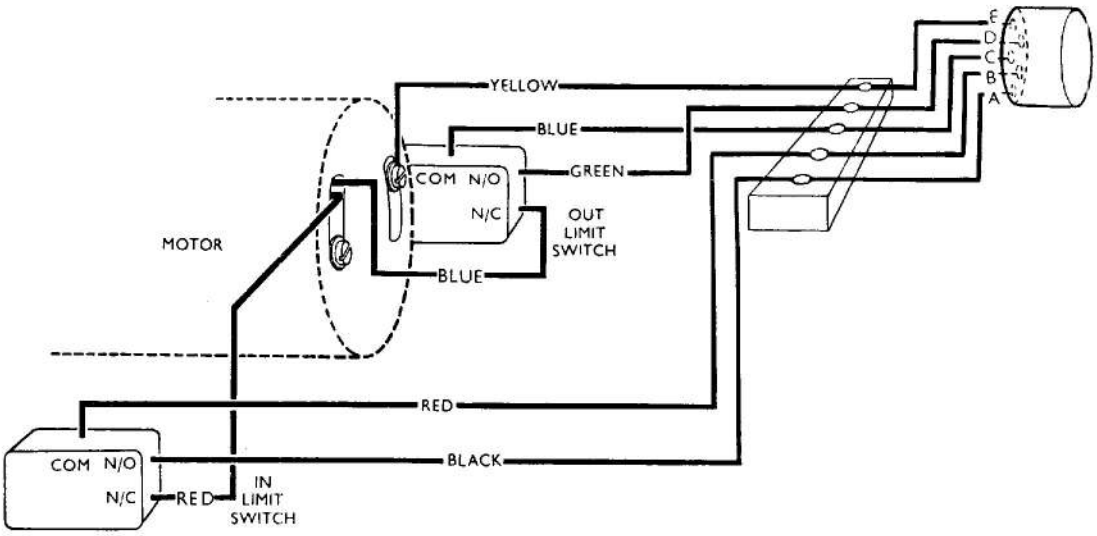

Fig. 3. *Actuator wiring*

parts must not be exceeded since over-lubrication can be as harmful as under-lubrication.

(1) The grease should be applied with a suitable tool. Brushes should not be used owing to the danger of bristles or hairs becoming detached and lodging in the mechanism.

(2) The lubricant is to be worked into the spaces between the gear teeth round the whole circumference of each gear.

(3) Each side of the ball bearings is to have grease pressed into the space between the inner and the outer races for a distance of one-third of their circumferences. If one side of a bearing is inaccessible, then two-thirds of the accessible side should be covered. The bearings should then be rotated to work the lubricant into the bearing.

(4) The spaces between the threads of the lead screw should be filled with grease for a radial distance of one quarter of its circumference over the total length of the screw. The plunger should then be screwed on to the lead screw to spread the grease evenly around the screw. The excess grease removed by the plunger should then be wiped off.

(5) Smear bushes, thrust and sliding faces with grease. For very small bushes a leather swab may be used.

Application of varnishes

10. During re-assembly of the actuator, all sleeving, rubber sleeves and internal terminal moulding, internal screw and bolt heads, nuts and washers are to be coated with an approved varnish Ref. No. 33B/937. After assembly, all external screw and bolt heads, nuts and washers, external edges of gaskets and the external faces of the plug moulding are also to be coated with varnish.

Sealing and locking

11. As the actuator is assembled, coat all screw threads (with the exception of the screws of the limit switches), with Wellseal compound. The joints between the spacer case and the rear and front covers are also to be sealed with Wellseal compound.

12. Lock all drilled head screws with 22 S.W.G. locking wire. Fit new tab washers at all points indicated in the exploded drawing (*fig.* 1). All tab washers must be locked with the tabs formed over the largest possible radius.

Gaskets

13. When fitting gaskets, ensure that all traces of old gaskets have been removed and that the metal surfaces are cleaned and inspected. The new gaskets must be coated on each face with Wellseal compound and care must be taken that no dirt adheres to the surface of the gaskets after applying the compound. The gaskets should be left for ten minutes to allow the solvents to 'flash-off' before making the joints. All excess compound must be cleaned off after assembly.

Soldered joints

14. Where a soldered joint is made, the solder must not be allowed to run back along the conductor as this will stiffen the cable and render it liable to fracture.

ASSEMBLING

15. When all parts have been thoroughly cleaned and renewed where necessary, and when the motor has been overhauled in accordance with the instructions in para. 26 to 59, the actuator is to be assembled in the sequence set out below:—

(1) Fit the main bearing to the lead screw. Heat the front housing to 100 deg. C. and fit the lead screw and bearing to the housing. Fit the drive pin to the lead screw and assemble the final drive gear, engaging the drive pin in the slot in the hub of the gear. Fit the ring nut and a new tab washer so that the turned back portion of the washer fits in the slot of the ring nut. Tighten the nut and peen the washer into the slot in the gear hub.

(2) Screw the plunger on to the lead screw.

Note . . .

Before assembling the plunger housing to the front housing, shims are to be inserted between the plunger housing spigot and the ball bearing to control the bearing end float. If no new parts have been fitted, fit the shims which have been removed during dismantling. Where a new part or assembly is being fitted, measure the depth from the face of the outer race to the face of the housing with a depth gauge. Measure the length of the plunger housing spigot. Fit shims to make up the difference between the length of the plunger housing spigot and the depth of the outer race (see fig. 4). Assemble the plunger housing to the front housing and secure it temporarily with two of the main fixing bolts fitted in diagonally opposite holes.

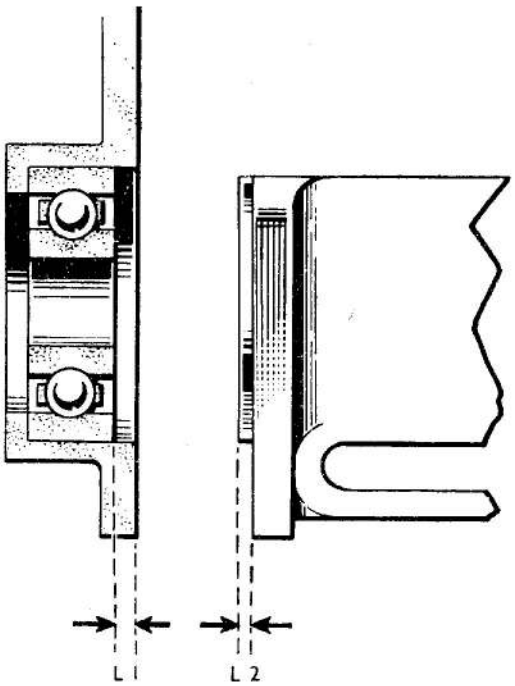

Fig. 4. *Shim measurements*

(3) Check the freedom of movement of the plunger by turning the drive gear. Assemble the slip clutch compound gear. Heat the front housing to 100 deg. C. and fit the gear in the front housing. Fit the second stage compound gear, engaging the smaller gear of the slip clutch and the final drive gear. Fit the ball bearings to the ends of the gear spindles and to the end of the lead screw.

(4) Remove the two bolts securing the plunger housing to the front housing.

(5) Position the thrust disc in the gearbox housing with the domed side against the clutch lever. Position the retaining plate of the end fitting screws in the gearbox housing with the small cut-away section of the plate, clearing the bearing housing above the plate.

(6) Carefully locate the gearbox housing on the front housing by means of the two dowels, so that the bearings of the gear train are simultaneously located in the gearbox housing.

(7) Fit the grease guard assembly to the motor with the guard collar located in the motor spigot. Ensure that the rubber disc of the guard is clear of the motor shaft. If there is any doubt about this clearance, it can be checked by measuring the current consumption of the motor with the guard removed and then with the guard fitted. If the guard is fouling the shaft, this will be indicated by increased current consumption. Fit the two spacer plates, one on each side of the motor mounting flange, and position the motor on the front housing.

(8) Fit the rear cover over the gearbox housing and secure the motor and the plunger housing with the eight main assembly bolts. Fit the plate and rubber section over the aperture on the top of the rear cover and secure it with the two screws.

(9) Fit a new gasket coated with compound (*see para.* 13) to the rear end fitting and secure the fitting with the four fixing screws.

(10) Fit the two limit switches to the plunger housing and secure them with the special screws. The anti-lock washer must be fitted to the screw nearest the operating button of the switch before fitting the nut. The nuts should not be fully tightened until the stroke setting of the actuator has been carried out.

(11) Fit the front cover, with the plug assembly fitted, to the actuator and connect the leads from the motor, the limit switches and the plug assembly to the terminal block as shown in fig. 3. Secure the front cover with the captive screw.

Note . . .
The spacer case is not to be fitted until after the actuator has been tested.

Testing after overhaul

16. After re-assembly, the actuator must be tested in accordance with the acceptance tests set out below. During the tests, the actuator must not be overheated; the rating of the motor on normal load is 1½ minutes. The test equipment (*see Table* 1) must be available.

Functional test

17. Connect the actuator to a 25 volt d.c. supply via an external control switch. With the supply applied, first to pin B and then to pin C, check that the plunger retracts and then extends respectively and that the motor brake functions satisfactorily, i.e., operates without flutter.

Initial stroke setting

18. Set the stroke of the actuator to 3 in. ± 0·03 in. for the purpose of testing.

Endurance test

19. Fit the actuator to the load test rig and with the load at 100 lb. and a supply voltage of 28 volt d.c. applied, operate the actuator for 40 cycles of the stroke. The load is to be compressive during 20 cycles and tensile for 20 cycles and the test is to be carried out at a rate of one cycle per minute.

Insulation resistance test

20. Immediately after the endurance test, the insulation resistance between all plug pins and the frame is to be measured with a 250 volt insulation resistance tester. The insulation resistance must not be less than 2 megohms on any reading. A high voltage flash test of 250 volt R.M.S. 50 c.p.s. is then to be applied between all plug pins and the frame for a period of one minute.

Performance test

21. Fit the actuator to the load test rig and with the supply connected via the test panel, set the input voltage and the actuator load at the values indicated in Table 2. Check that the current does not exceed the stated maximum and that the time for the plunger stroke is within the stated limits.

22. The following abbreviations are used in Tables 2 and 3:—

T.L.O.	Tensile stroke, load opposing
T.L.A.	Tensile stroke, load assisting
C.L.O.	Compressive stroke, load opposing
C.L.A.	Compressive stroke, load assisting.

Final stroke setting

23. The extended and retracted centres are now to be set to 9·52 in. $^{+0\cdot03}_{-0\cdot00}$ and 6·82 in. $^{+0\cdot00}_{-0\cdot03}$ respectively. The stroke setting rig T.317849 or similar rig is to be used. During the setting, a load of 20 lb. is to be applied to the actuator if a rigid end fitting is attached and a 6 lb. load if a cushion drive end fitting is assembled.

Stroke variant check

24. After the final stroke setting, check that the stroke is within the limits indicated in Table 3 with the actuator operating under the specified conditions.

TABLE 2
Actuator load test

Applied voltage	Load (lb.)	Condition of load	Time for 2 in. stroke (sec.)		Maximum current (amp.)
			Min.	Max.	
29	0	Extend	2·6	3·4	2·0
29	0	Retract	2·6	3·4	2·0
29	100	C.L.O.	4·0	5·4	3·0
29	100	C.L.A.	2·7	3·8	2·0
29	150	C.L.O.	4·0	7·0	3·5
29	100	T.L.O.	4·0	5·4	3·0
29	100	T.L.A.	2·7	3·8	2·0
29	150	T.L.O.	4·8	7·0	3·5
18	100	C.L.O.	9·0	14·5	2·9
18	100	T.L.O.	9·0	14·5	2·9
22	0	Extend	3·0	5·0	1·8
22	0	Retract	3·0	5·0	1·8
22	100	C.L.O.	5·5	9·0	3·0
22	100	T.L.O.	5·5	9·0	3·0
22	150	C.L.O.	7·0	14·0	3·5
22	150	T.L.O.	7·0	14·0	3·5

TABLE 3
Stroke variant check

Applied Voltage	Load (lb.)	Condition of Load	Maximum error on centre distance	
			Retracted	Extended
18	100	T.L.O.	+0·031 in.	—
18	100	C.L.O.	—	−0·031 in.
29	100	C.L.A.	−0·062 in.	—
29	100	T.L.A.	—	+0·062 in.

Final insulation resistance test

25. Before the final insulation resistance test, complete the assembling of the actuator. Remove the front cover. Fit a new rubber section in the groove formed between the rear cover and the gearbox housing. Fit the spacer case over the motor and the plunger housing. Fit a new rubber section into the double lip round the front cover. Fit the front cover to the actuator and connect up the terminals to the terminal block as shown in fig. 3. Secure the front cover with the captive screw. Repeat the insulation test specified in para. 20.

OVERHAUL (MOTOR)

Tools and test equipment (motor)

26. The special tools and test equipment listed in Table 4 are required for the overhaul of the motor.

DISMANTLING

27. When the motor has been removed from the actuator, dismantle it in the sequence set out below:—

(1) Holding the drive pinion with the special tool T.336913, remove the nut from the armature shaft. Using the pinion extractor tool T.336909, draw the pinion

TABLE 4

Special tools and test equipment (motor)

Nomenclature	Part No.	Ref. No.
TOOLS		
Drive pinion locking ring with feeler gauges	T.336913	
Forward bearing support	T.336905	
Bush for forward bearing support	T.336912	
Press tool for comm. end bearing	T.336916	
Press for arbor press	T.336906	
Spring checking tool	T.336908	
Torque pulley comprising:—		
Pulley	T.336917 detail 1	
Washer	T.336917 detail 2A	
Screw	T.336917 detail 3	
Collet	T.336917 detail 4	
Pinion extractor	T.336909	
Bearing extractor for ½ in. bearing	T.336907	
Bearing extractor for ⅜ in. bearing	T.336919	
Slotted screwdriver	T.336911	
Crimping pliers	CZ.50125	
Crimping jaws for pliers	Z.50102	
Hellermann sleeving tool	Type 'S'	
TEST EQUIPMENT		
Torque test rig	4CZ.94028	

and braking disc off the tapered shaft. As this is done the brake spring will force the braking disc and the attraction disc out of the housing.
Remove these together with the spring.

(2) Remove the lead passing through the brushgear housing from its terminal. Take out the screws holding the brush tags and remove the brushes from the holders. Take the two slotted 6 B.A. nuts off the ends of the long studs protruding through the brushgear housing. Thread the protective cap (part of bearing extractor T.336907) on to the armature shaft. Holding the yoke in one hand, tap lightly on the cap with a plastic headed mallet or similar tool until the journal on the armature shaft is clear of the forward bearing, or until the bearing leaves the brake housing. Then, guiding the leads through the holes in the brushgear housing, part the latter complete with armature from the remainder. Remove the circlip, the bearing shield and shims from the brushgear housing and using a suitable brass drift, press out the end of the armature shaft from the bearing.

(3) If it should happen that the armature shaft retains the bearing, thus removing it from the housing, the insulating washer between the housing and the brush carrier will be damaged. It must be renewed on re-assembly of the motor. Great care must be exercised in removing

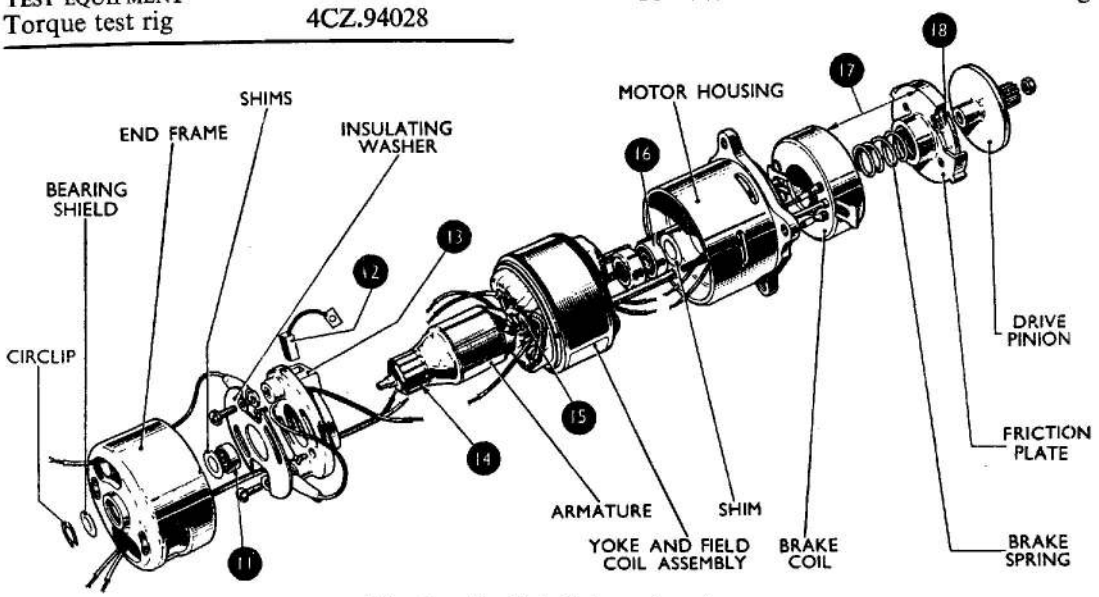

Fig. 5. *Exploded view of motor*

the bearing from the armature shaft. Use extractor tool T.336919.

(4) Remove the moulded brushgear carrier by taking out the two 6 B.A. screws, taking care not to damage the insulating washer located between the two, and not to lose the two kidney-shaped nut-plates.

(5) To remove the bearing from the housing, heat in an oven at about 100 deg. C. and press out, using a piece of $\frac{5}{16}$ in. diameter brass rod having its end face square to its axis.

(6) To separate the forward housing from the yoke, remove the thread, binding the leads to the long studs and unsolder the brake-coil lead from the solder tag on the field coil. Easing the leads through the gap between the stud and the yoke, remove the housing and brake coil from the yoke. Remove the insulating sleeves from the studs. Withdraw the brake coil assembly from the forward housing, taking care of the air-gap shims which will now be revealed and may fall away from the studs which they embrace.

(7) To remove the forward ballrace, heat the housing in an oven to approximately 100 deg. C. and press out the bearing. Remove the shim from the housing. If the bearing has remained on the armature shaft it must be carefully removed with the aid of the extractor T.336907, using the cap to protect the end of the shaft.

INSPECTION AND REPAIR

28. As far as is practicable, overhaul is dealt with assembly by assembly.

Soldering

29. When making a joint see that the solder is not allowed to run back along the conductor, since this destroys the flexibility of the leads adjacent to the joint and gives rise to breaks. When the joint is satisfactorily made and no other leads are to be soldered to the same point, coat with varnish.

Brake housing and components

30. All traces of carbon dust must be removed, both from the housing and the brake components. This is best done by loosening with the aid of a pencil-type brush and then using clean, dry, compressed air to remove it. On no account must the friction material be removed from the attraction plate as it is machined after riveting in order to obtain correct operation.

31. Examine the brake housing for damage, paying attention to the mounting flange, torque reaction slots and spigot.

32. If it is necessary to renew the housing, then either the nameplate must be transferred to the new part or a new label must be stamped with the correct serial number and fitted. In the latter case, coat the underside of the nameplate with varnish and secure with two drive screws. Coat the other side similarly. A nameplate left on a damaged housing should have the serial number obliterated.

33. Check against the Schedule of Fits, Clearances and Repair Tolerances in App. 1 that the dimension from the back of the attraction disc to the proud face of the friction lining is within permissible limits; if it is not, replace with a new assembly.

34. The brake spring must be checked for fatigue. The two-part tool T.336908 is available for this purpose. The weight required to compress the spring to a length of $\frac{5}{16}$ in. shall be 7 lb. 4 oz. $\pm$ 4 oz. With the top of the plunger level with the top of the tube the spring is compressed to a length of exactly $\frac{5}{16}$ in. Note that the plunger weight of 2 oz. must be taken into account.

35. Examine the drive pinion for wear and renew if necessary.

36. The two leads attached to the solder tags on the brake-coil assembly must be renewed. The approximate lengths required are $3\frac{1}{2}$ in. and $1\frac{3}{4}$ in.

37. Check the continuity of the brake coil. The resistance must be between 0·85 and 1·0 ohm at 15 deg. C.

38. Renew, if necessary, the insulating sleeving on the long studs using 2 mm. bore tubing (yellow).

Yoke and field coil assembly

39. Clean the assembly as described in para. 31 and make a general examination for damage. Check the continuity of each field coil. The resistance must be between 1·75 and 2·1 ohms at 15 deg. C. The wiring leads must be renewed and this must be carried out by removing and replacing only one lead at a time. This is very important since the leads are colour coded by means of sleeving in order to obtain the required rotation. It is

suggested that the long leads from the field coils are tackled first, one at a time, and that the link between the common tags be replaced last. The length of each flying lead is 6 in. See that all leads are immediately sleeved with the correct colour code, renewing if necessary.

Brushgear

40. Thoroughly clean the brushgear, removing the carbon dust as described in para. 30. Examine the moulding for damage and replace if necessary. Check the brush pressure as follows. Slide new brushes into the holders; do not secure the tags at this stage. With a standard spring or dial type gauge, measure the pressure at the face of the brush when it projects $\frac{1}{32}$ in. from the holder. The pressure must be between $3\frac{1}{2}$ and $4\frac{1}{2}$ oz. (100-130 grammes). If it is not so the brushgear assembly must be renewed.

Armature assembly

41. Clean thoroughly and examine for damage. The commutator is best cleaned with a piece of clean white linen. Check the resistance between any pair of diametrically opposite segments. The resistance must be between 0·85 and 1·03 ohms at 15 deg. C.

42. Measure the shaft journals for wear and see that they are within the limits given in App. 1.

43. Check the commutator for wear (*see App.* 1). If a track more than 0·005 in. deep is present it must be trued by skimming. During this process it should be run on the shaft journals, not between centres. The diameter over the segments must not be less than 0·470 in. at the completion of skimming. This must be followed by undercutting the mica 0·024 in. to 0·026 in. wide and 0·025 to 0·026 in. deep.

44. Using a 250 volt insulation resistance tester, measure the insulation resistance of all wound assemblies, viz. brake coil, field coils, armature. The resistance must not be less than 2 megohms in each instance.

Bearings, cleaning and lubricating

45. Immediately prior to lubrication, bearings must be cleaned at least three times in lead free white spirit. After cleaning, dry out the bearings with a supply of clean, dry, compressed air from a low pressure line. Do not allow the air to spin the races as, with no grease present, the resulting metal to metal contact can damage the bearings. Carefully examine the bearings for wear or damage and renew if necessary. If in any doubt about the condition of a bearing, always renew. Re-grease immediately after drying.

46. Each side of the bearing must be lubricated with grease XG-275 pressed into the space between the inner and the outer race for a distance of one-third of its circumference. If one side is inaccessible then two-thirds of the accessible side must be covered.

47. The bearing must then be rotated by hand to work the grease into the ball tracks.

ASSEMBLING

48. Assemble the motor in the sequence set out below:—

(1) The drive end bearing is dealt with first. If a new bearing is to be fitted, it must be selected from stock to give the correct fit as stated in App. 1. Clean and lubricate in accordance with the instructions in para. 45 to 47.

(2) Heat the brake housing in an oven to approximately 100 deg. C., making sure that the bearing recess is perfectly clean. Drop the 0·005 in. steel shim into the recess. Support the housing on tools T.336905 and T.336912 and using T.336906 in an arbor press, press the bearing fully home in the recess shielded side uppermost.

(3) Place the brake coil assembly into the brake housing with the leads adjacent to the slot in the periphery of the housing. Slide the lengths of 2 mm. yellow tubing on to the studs.

(4) Offer up the yoke assembly to the brake housing, noting that the two are radially located by the dowel pin on the yoke and the slot in the housing.

(5) Immediately before assembly, coat the spigot face of the yoke assembly with varnish.

(6) The two leads from the brake coil must be fed through the yoke assembly on either side of the stud and to the outside of the stud, i.e. between field coils, the stud and the outer casing, not on the inside of the stud. Make the soldered connection between the shorter brake coil lead and one of the field coil

solder tags. Sleeve the longer lead from the brake coil with yellow tubing to the point where it emerges from the field coils. With two complete turns of glass thread, bind the two field coil leads and the longer brake coil lead to the studs.

(7) In order to fit the armature shaft into the drive end bearing and to fit the comm. end bearing and brush gear housing, it is essential to support the partly assembled motor on the inner race of the drive end bearing. The tool T.336905 is designed for this purpose.

(8) Having the motor supported drive end downward on the tool, feed the threaded end of the armature shaft into the drive end bearing. Using a brass cap over the other end of the shaft, press the armature fully home into the drive end bearing.

(9) Refit the brushgear assembly, without brushes, into the brushgear housing over the insulating washer. If this was damaged during dismantling, it must be renewed. Refer to fig. 5 when securing the housing with the two 6 B.A. screws, the spring washers and the two nut plates.

(10) Clean and lubricate the comm. end bearing in exactly the same way as the drive end one. If it is to be renewed, select the correct size from stock. Refer to App. 1 when selecting the bearing.

(11) Heat the housing assembly in an oven to approximately 100 deg. C., making sure that the bearing recess is clean. Coat the spigot face of the yoke assembly with varnish. Place the housing in position on the yoke assembly, feeding the leads through the appropriate holes. Support the inner race of the drive end bearing on the tool T.336905. Using tool T.336916, press home the bearing into the housing, its unshielded side outermost, and fully on to the armature shaft journal.

(12) Fit the two 6 B.A. nuts on the stud ends with their spring washers and, taking each nut a turn or fraction of a turn alternately, tighten the whole assembly.

(13) Shims of 0·005 in., 0·020 in. and 0·002 in. thickness are used to pack out the gap between the bearing and the bearing shield. Select shims so that, when the shield is in position, the outermost shim still has a little clearance. On no account must they be tightly clamped by the bearing shield.

(14) Fit the bearing shield in the housing and secure it with the circlip. Remove the motor from the supporting tool.

(15) The terminal tag and sleeve must now be fitted to the brake coil lead. The length of each flying lead is 6 in. The tag and thimble are crimped on to the conductor with a crimping tool (*Table* 4). The sleeving is pushed over the thimble and varnished before applying the rubber sleeve with the Hellermann tool.

(16) Apply the coded sleeves to the flying leads, the 'Out' being fitted on the blue lead and the 'In' sleeve fitted on the red lead.

(17) It is convenient at this stage to carry out the rotation check and to bed new brushes. Refer to para. 50 and 51.

(18) Place the brake spring over the armature shaft followed by the attraction plate, friction lining outermost. Pass the braking plate over the shaft and, applying finger pressure to compress the spring, guide the torque reaction gears into their slots and press to the taper. Fit the 6 B.A. nut on to the armature shaft and tighten.

(19) The brake air gap which is accessible through the forward slot in the brake housing must be set to between 0·008 in. and 0·011 in. at normal room temperature. Use the feelers attached to the pinion locking ring. The gap is to be set by inserting shims through the two rearward slots in the housing after slacking off the two nuts on the brushgear housing. Having re-tightened these carefully as described in sub-para. (12) above, with some shims in position, the air gap must be checked for uniformity by rotating the driving pinion through 45 deg. and checking with the feelers through the slot. This process is to be repeated until the pinion has turned through 180 deg.

Testing after overhaul

49. After assembly, the motor is to be subjected to the acceptance tests set out below.

Direction of rotation

50. With the common terminal connected to the negative lead of an 18 volt d.c. supply and the blue lead to the positive, the armature must rotate in a clockwise direction when viewed from the drive end. The rotation is reversed when the red lead is connected to the positive.

Running in

51. Brushes must be bedded to the correct contour. This is done by running the motor in each direction alternately on no load on an a.c. or d.c. supply of about 11 or 12 volt with the brake mechanism removed. The supply voltage must be regulated so that the motor does not exceed 15,000 r.p.m. This is continued until the brushes are bedded over the complete arc and over at least 80 per cent of their area. During running in the motor should be checked periodically for overheating. After running in, the brushgear must be cleaned out with clean, dry, compressed air at a pressure of approximately 40 lb. per sq. in.

Brake air gap

52. Having set the gap, check for proper functioning by running the motor at 18 volt d.c. six times in each direction of rotation. Check that there is no excessive vibration.

Speed balance

53. The brushgear must be adjusted to give near equal speeds in both directions of rotation. This is done by slackening the two 6 B.A. screws securing the brushgear to the housing and rotating the brushgear through an arc until the speed in each direction is within 2½ per cent of the mean speed.

Torque test

54. The torque test is carried out with the motor at room temperature. By means of the torque pulley attached at the driving pinion and a torque test rig, record speed and current for torque loadings of 1·5, 3·0 and 4·0 oz. in. at 18, 25 and 29 volt d.c. in each direction of rotation. The performance of the motor must be in accordance with the figures in the table below.

55. During these tests the brushes must be observed to check sparking. Commutation is satisfactory if either blue, pin-point (continuous or intermittent) sparking is observed. Sparking with occasional or continuous yellow flashes is not acceptable.

TABLE 5

Motor torque test

Terminal volt d.c.	Torque oz./in.	R.P.M. max.	R.P.M. min.	Max. Current in amps.
18	1·5	—	9,500	2·3
18	3·0	—	3,500	3·3
25	1·5	—	16,000	2·3
25	3·0	—	10,000	3·4
25	4·0	—	7,200	4·0
29	1·5	24,000	—	2·2
29	3·0	16,000	—	3·5
29	4·0	13,000	—	4·1

56. Care must be taken during torque tests not to overheat the motor.

Insulation resistance test

57. With the motor still warm from the torque test, the insulation between the common lead and the motor frame must withstand a high voltage test of 250 volt, 50 c.p.s. a.c. supply for one minute. The insulation resistance must then be measured between the same points and must not be less than 2 megohms at 250 volt d.c.

Brake overrun test

58. With the motor running at 20,000 r.p.m. and the input voltage at 20 volt, the maximum overrun in switching off the supply shall be 15 revolutions of the braking disc except where the brake spring and frictional material are new, when it shall be 12 revolutions.

Re-check of brake air gap

59. With the motor at room temperature, the brake air gap must again be measured and, if necessary, re-adjusted and checked in accordance with para. 52.

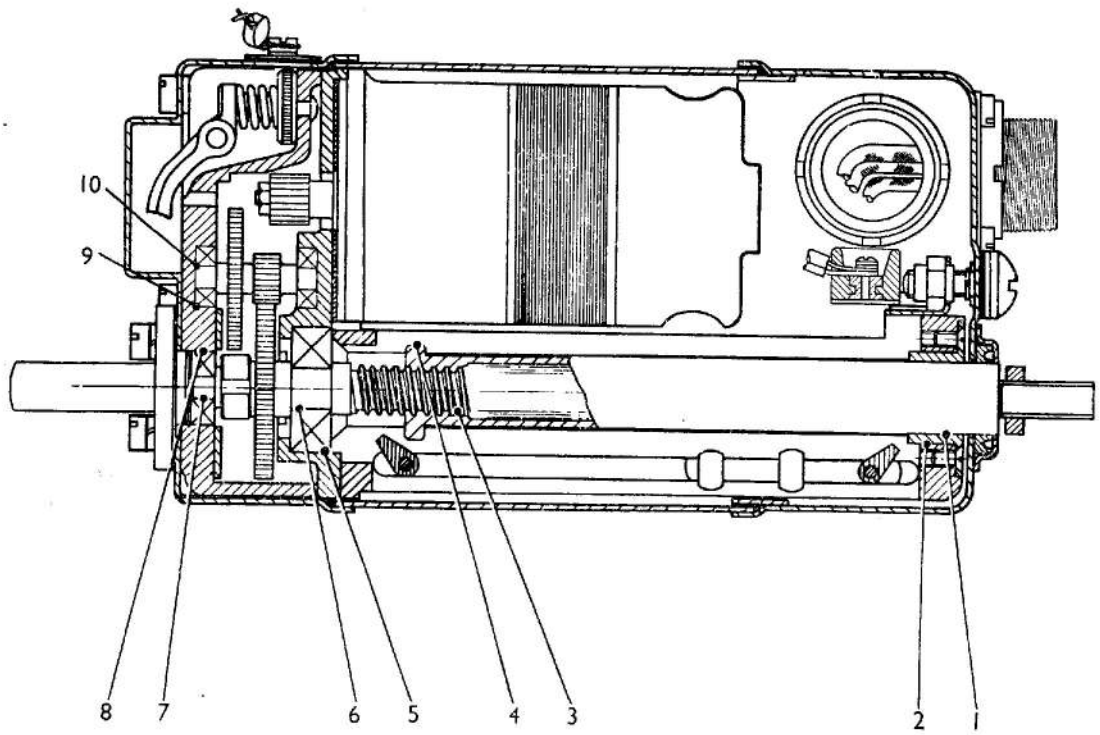

Fig. 6. *Fits and clearance diagram*

APPENDIX 1

Schedule of Fits, Clearances and Repair Tolerances (CZ.80730/3/A)

Note.—*This schedule should be read in conjunction with fig.* 6)

Item No. (1)	Description (2)		Dimension New (3)	Permissible Worn Dimension (4)	Clearance New (5)	Permissible Worn Clearance (6)	Remarks (7)
	ACTUATOR (*fig.* 6)						
1	PLUNGER IN BUSH	Plunger dia.	0·4995 in. 0·4990 in.	0·4990 in.	0·0003 in. clear. to		
		Bush bore	0·5004 in. 0·4998 in.	0·5004 in.	0·0014 in. clear.		
2	BUSH IN PLUNGER HOUSING	Bush dia.	0·6210 in. 0·6205 in.	0·6205 in.	0·0000 in. to		
		Housing bore	0·6205 in. 0·6195 in.	0·6205 in.	0·0015 in. interf.		
3	LEAD SCREW IN PLUNGER	Backlash in threads			0·0045 in.	0·006 in.	
4	PLUNGER EAR IN KEYWAY	Key width	0·249 in. 0·248 in.	0·248 in.	0·003 in. to		
		Keyway width	0·255 in. 0·252 in.	0·255 in.	0·007 in. clear.		
5	MAIN BALL BEARING IN FRONT COVER	Cover bore	0·8655 in. 0·8650 in.	0·8650 in.	0·0002 in. to		
		Bearing dia.	0·8661 in. 0·8657 in.	0·8657 in.	0·0011 in. interf.		
6	LEAD SCREW JOURNAL IN MAIN BEARING	Journal dia.	0·2757 in. 0·2754 in.	0·2754 in.	0·0005 in. interf. to		
		Bearing bore	0·2757 in. 0·2752 in.	0·2756 in.	0·0002 in. clear.		

APPENDIX 1—*contd.*

Schedule of Fits, Clearances and Repair Tolerances (CZ.80730/3/A)

Note.—*This schedule should be read in conjunction with fig. 6*

Item No. (1)	Description (2)		Dimension New (3)	Permissible Worn Dimension (4)	Clearance New (5)	Permissible Worn Clearance (6)	Remarks (7)
7	LEAD SCREW AND CLUTCH GEAR JOURNALS IN BEARINGS	Journal dia.	0·1872 in. 0·1876 in.	0·1876 in.	0·0001 in. to 0·0010 in.		
		Bearing bore	0·1877 in. 0·1873 in.	0·1873 in.			
8	LEAD SCREW AND CLUTCH GEAR BEARING IN REAR COVER	Bearing dia.	0·4779 in. 0·4993 in.	0·4993 in.	0·0002 in. interf. to 0·0007 in. clear.		
		Cover bore	0·5000 in. 0·4995 in.	0·5000 in.			
9	BEARINGS IN FRONT AND REAR COVERS	Covers bore	0·3750 in. 0·3745 in.	0·3750 in.	0·0002 in. interf. to 0·0007 in. clear.		
		Bearings dia.	0·3747 in. 0·3743 in.	0·3743 in.			
10	14-43T GEAR JOURNAL IN BEARING	Journal dia.	0·1252 in. 0·1248 in.	0·1248 in.	0·0005 in. interf. to 0·0004 in.		
		Bearing bore	0·1252 in. 0·1247 in.	0·1252 in.			
	MOTOR (*fig. 5*)						
11	BEARING IN BRUSHGEAR HOUSING	Bearing dia.	0·3944 in. 0·3940 in.		0·0007 in. clear. to 0·0002 in. interf.		
		Housing bore	0·3947 in. 0·3942 in.				
12	CARBON BRUSH LENGTH		0·385 in. 0·355 in.	0·250 in.			

APPENDIX 1—*contd.*

Schedule of Fits, Clearances and Repair Tolerances (CZ.80730/3/A)

Note.—*This schedule should be read in conjunction with fig.* 6

Item No. (1)	Description (2)		Dimension New (3)	Permissible Worn Dimension (4)	Clearance New (5)	Permissible Worn Clearance (6)	Remarks (7)
13	ARMATURE SHAFT IN COMM. END BEARING	Shaft dia. Bearing bore	0·1249 in. 0·1253 in. 0·1258 in. 0·1252 in.		Size to size 0·0001 in. interf.	Nil	Bearing selectively assembled to obtain fit in column (5)
14	COMMUTATOR DIAMETER		0·490 in. 0·495 in.	0·450 in.*			*Max. permissible wear after skimming to min. allowable dia. of 0·470 in.
15	ARMATURE SHAFT IN DRIVE END BEARING	Shaft dia. Bearing bore	0·1874 in. 0·1878 in. 0·1873 in. 0·1877 in.		0·0001 in. clear. to 0·0001 in. interf.		Bearing selectively assembled to obtain fit in column (5)
16	BEARING IN BRAKE HOUSING	Bearing dia. Housing bore	0·5196 in. 0·5192 in. 0·5197 in. 0·5192 in.		0·0005 in. clear. to 0·0004 in. interf.		
17	BRAKE AIR GAP CLEARANCE				0·008 in. 0·011 in.	0·008 in. 0·011 in.	Maintained by shimming
18	ATTRACTION DISC AND FRICTION LINING		0·120 in. 0·125 in.	0·115 in.*			*Measured from rear face to projecting surface of lining subject to the rivets being below the surface