

**Chapter 3****STARTER MOTOR, ROTAX, TYPE C14204****LIST OF CONTENTS**

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## LEADING PARTICULARS

<b>Starter motor, Type C14204</b> ... ..	Ref. No. 37F/4511
<i>Operating voltage</i> ... ..	28 volts d.c.
<i>Current</i> ... ..	650 amp.
<i>Supply characteristic</i> ... ..	1 volt drop/270 amp.
<i>B.H.P.</i> ... ..	17.5
<i>Speed</i> ... ..	6000 R.P.M.
<i>Torque</i> ... ..	15 lb. ft.
<i>Rotation (viewed from drive end)</i> ... ..	Clockwise
<i>Rating (intermittent)</i> ... ..	90 sec.
<i>Resistance of windings (at 20 deg. C.)—</i>	
<i>Armature</i> ... ..	0.000685 ohm
<i>Series field</i> ... ..	0.0016 ohm
<i>Shunt field</i> ... ..	6.64 ohm
<i>Brush spring pressure</i> ... ..	40 - 48 oz.
<i>Brush grade</i> ... ..	DM 4A
<i>Brush length—</i>	
<i>New</i> ... ..	0.305 - 0.400 in.
<i>Minimum permissible</i> ... ..	0.245 in.
<i>Commutator diameter—</i>	
<i>New</i> ... ..	2.640 - 2.650 in.
<i>Minimum permissible</i> ... ..	2.604 in.
<i>Overall dimensions—</i>	
<i>Length (to end of drive shaft)</i> ... ..	11.050 in.
<i>Diameter of housing (under lugs)</i> ... ..	6.062 in.
<i>Diameter of housing (over lugs)</i> ... ..	7.750 in.
<i>Height (axis to terminal studs)</i> ... ..	5.312 in.
<i>Weight</i> ... ..	37.5 lb.

### Introduction

1. The C14204 starter motor has been designed for the electrical starting of aircraft gas turbine engines; it develops a starting torque of 15 lb. ft. at an approximate speed of 6000 R.P.M. The rotation of the driving coupling is clockwise when viewed from the drive end of the unit.

### DESCRIPTION

2. The starter motor is a 28 volt d.c. four pole compound wound machine, with the series coils of the motor connected in series—parallel, and the shunt coils connected to each other in series.

3. The unit incorporates a yoke assembly which forms the central cylinder of the motor, the pole shoes being mounted and secured

inside the yoke. At one end of the yoke is mounted the commutator end frame, which carries the terminal block assembly and provides windows for access to the brushes; it carries the end plate assembly on which is mounted the brushgear, also a liner, where the commutator end ballrace is housed.

4. At the opposite end of the yoke is secured the drive end frame; this provides the starter mounting flanges and carries an oil seal, also the drive end roller bearing, this being clamped in position in a steel bearing housing.

### Armature

5. The armature is housed within the yoke and poleshoe assembly, and supported by two bearings located in the commutator end frame and drive end frame respectively. It is

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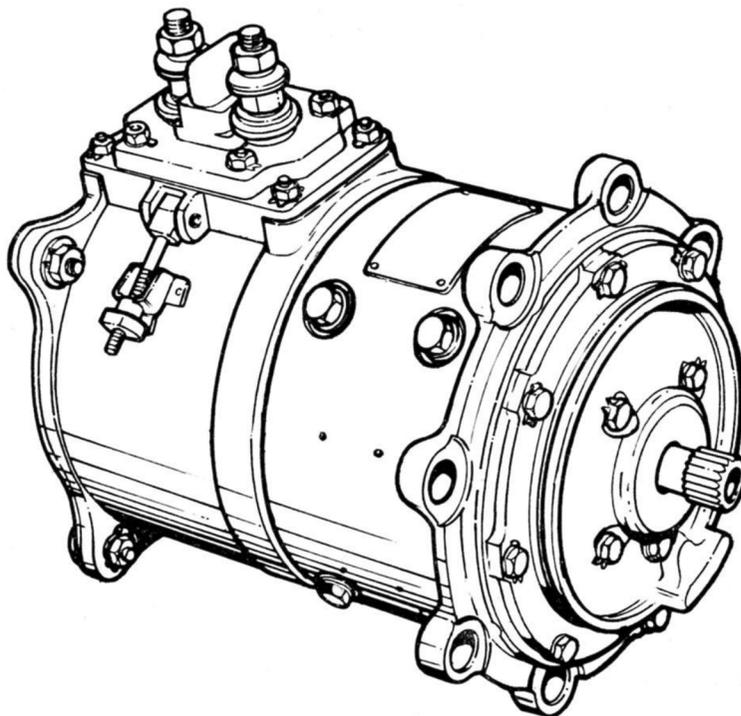


Fig. 1. Starter motor, Type C14204

a lap wound armature, with the copper conductors located in 32 slots in a laminated core.

6. The bar to bar variation of the commutator is held to within 0.0001 in., and the concentricity between the ballrace journals and commutator to within 0.001 in. total indicator reading.

#### Bearings

7. A roller bearing is fitted at the drive end of the armature with a ballrace positioned at the commutator end; both bearings are selected to give a specific clearance fit in their respective housings and on the armature shaft bearing diameters.

#### Yoke and field coils

8. Interposed between the commutator end housing and the drive end frame is the yoke and field coils assembly. The four shunt coils are connected in series and have 100 turns per pole; the four series field coils are connected in series parallel and have 6 turns

per pole. Field connectors and associated lugs are silfos brazed to coil leads brought out externally.

#### Brushgear assembly

9. The brushgear assembly comprises four double brush boxes, having eight brushes spring loaded on assembly to the commutator by 16 springs operated by eight trigger assemblies. The brush boxes are secured to the brush gear moulding by eight special screws, and locked in position with cup-washers that are crimped to the head of the screws. The complete brushgear moulding assembly is finally secured to the commutator end plate by four hexagon headed bolts.

#### Terminals

10. The terminal posts are mounted and secured in a moulded terminal block by lock-nuts and associated locking washers, the complete assembly being secured to a machined platform secured to the commutator end frame assembly.

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11. The positive terminal post is connected internally to the series field coils, and the negative terminal post connected internally direct to the brush box and one side only of the shunt field coils.

#### End frames

12. Four special bolts secure the commutator end plate and brushgear assembly to the commutator end housing. The window strap assembly encloses the four brush inspection apertures in the commutator end housing; it is secured by a knurled nut and associated locknut, fitted to the movable lever which is secured to the catchpiece of the terminal block top casting.

13. Eight hexagon head bolts secure the drive end frame to one end of the yoke; the external spigot of the end frame serves as the main location to the mating register of the associated equipment for mounting the unit.

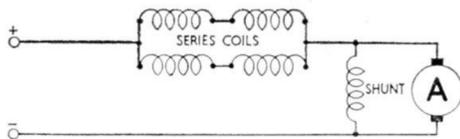


Fig. 2. Circuit diagram

#### Operation

14. Operation of this electric starter is characteristic of a four-pole compound wound motor. As there is no gear assembly, the drive connection, which is an integral part of the shaft, rotates at the speed of the armature and in a clockwise direction when viewed from the drive end.

15. When the motor is running on no load, the shunt winding limits the motor to within its operating range.

#### Electrical connections

16. Electrical connection is made to two 0.375 in - 24 UNF. terminals, mounted on a moulded terminal block at the commutator end of the machine. External cable leads connect the starter to the associated starting panel.

#### INSTALLATION

17. For installation purposes, the starter is provided with a mounting flange having eight holes  $0.500 \begin{smallmatrix} +0.005 \\ -0 \end{smallmatrix}$  in. diameter equally spaced on a 6.875 P.C. diameter within 0.007 in. of true position; integral with the flange is a locating spigot  $4.504 \begin{smallmatrix} +0 \\ -0.002 \end{smallmatrix}$  in. diameter

#### SERVICING

18. To service the starter, first remove the window strap from the commutator end to gain access to the brush springs and brushes. Lift the brush spring triggers and check the brush spring pressure.

19. Brush spring loading should be within 40-48 oz., checked with a spring balance (Ref. No. 1 H/97).

20. Check the length of brushes to ascertain if they are long enough to function satisfactorily until the next servicing period. The minimum permissible length is 0.245 in. If new brushes require fitting, it will necessitate removal of the unit from the aircraft in order that new brushes can be properly bedded to the commutator.

21. Check that the brushgear is free from carbon deposit and that the brushes slide freely in their boxes without any tendency to bind. If a brush appears to be binding, this may be due to an accumulation of carbon dust in the box. Loose dust may be removed with a jet of dry air.

22. Badly chipped or cracked brushes should be removed and new ones fitted. Check the brush spring pressure given in para. 19, and ensure that the spring balance is attached to the lip of the brush spring triggers the reading to be taken when the spring is level with the top of the brush box.

#### Lubrication

23. The ball and roller bearings of the motor are pressure filled  $\frac{1}{3}$  full with grease XG-275 and should not normally require lubrication during servicing periods.

#### Testing

24. If the serviceability of the unit is suspect, it may be tested as laid down in Appendix A.

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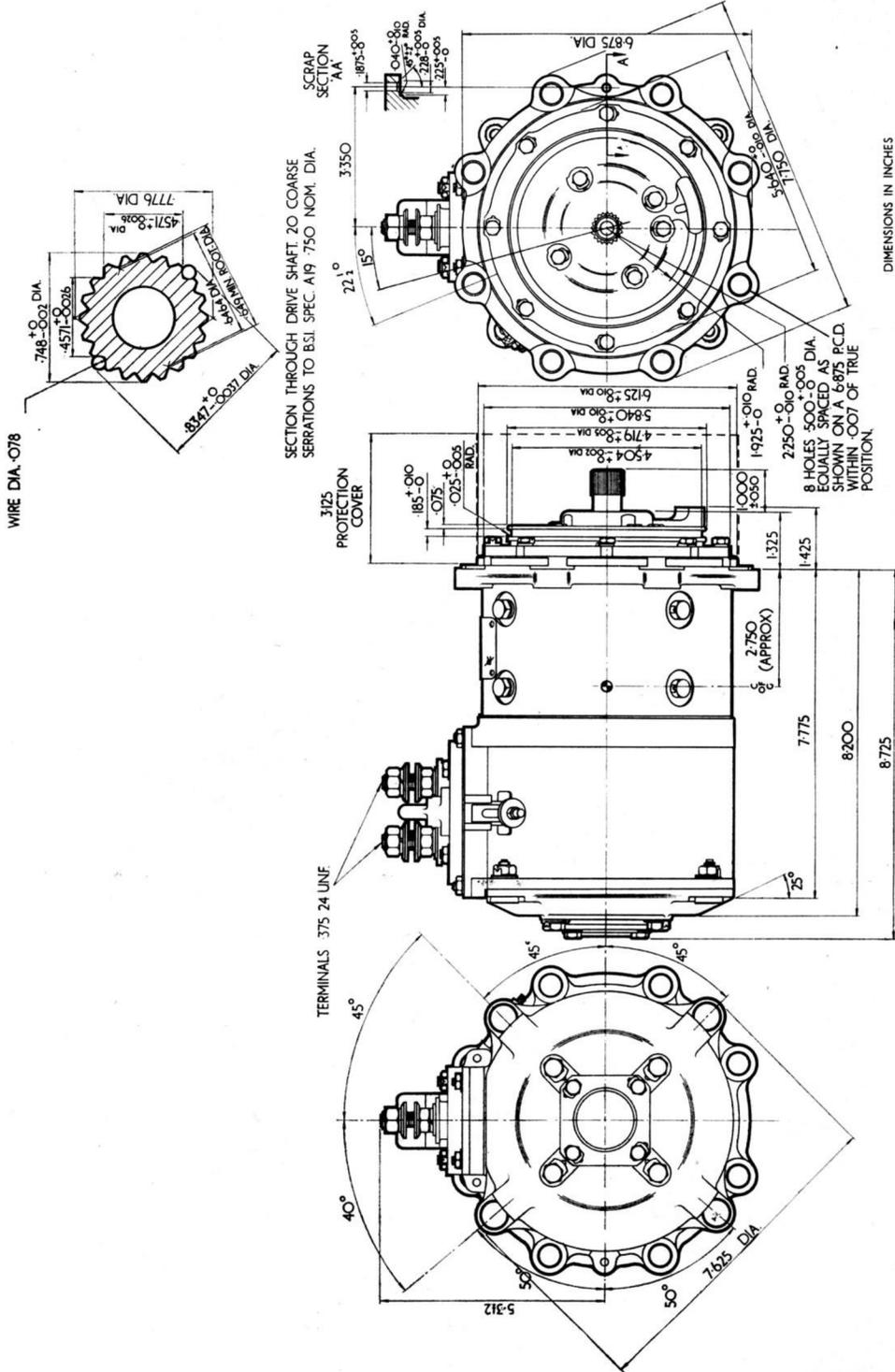


Fig. 3. Installation diagram

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## Appendix A

### STANDARD SERVICEABILITY TEST FOR STARTER MOTOR, ROTAX, TYPE C14204

#### Introduction

1. The following tests may be applied to the machine before it is put into service, or at any time when its serviceability is suspect.

#### Test equipment

2. The following test equipment is required:—

- (1) Suitable torque test set (if available).
- (2) Balance, spring, 0-4 lb. (Ref. No. 1H/97).
- (3) Insulation resistance tester Type C (Ref. No. 5G/152).
- (4) D.C. voltmeter, 0-50V range.

#### Note . . .

*If oil seal is in position during testing care should be taken to ensure that it is adequately lubricated with the appropriate grade of oil (OX-38).*

#### Testing

3. Before mounting the starter motor on the test set, check for freedom of rotating parts by turning the armature by hand. There should be no excessive end play in the bearings; a slight radial play which can just be felt by hand is permissible.

#### Brushgear

4. Check the brush length and brush spring pressure; the brush length should not be less than 0.245 in., and the brush spring pressure should be between 40-48 oz.

#### No load test

5. Run the motor for a period of two minutes with no external load and a terminal voltage of 28 volts. At the end of this period, the speed should lie between 10500 and 11500 r.p.m., and the current must not exceed 90 amp. Commutation should not be worse than slight continuous sparking for the above tests.

#### 100 per cent load test

6. Cool to room temperature. Adjust terminal voltage to 25.8 volts, and the current to 600 amp. The torque should exceed 13 lb. ft. and the speed should not be less than 5700 r.p.m. Commutation should not be worse than slight intermittent sparking, or slight continuous sparking.

#### Insulation resistance test

7. The insulation resistance should be measured between all live parts and the frame, using a 250 volt insulation resistance tester; the reading should not be less than 0.05 megohm.

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