ECLIPSE

OPERATION AND SERVICE INSTRUCTIONS
and
PARTS CATALOG

Direct Cranking Electric Starters

Types 396, 397, 398, 400, 401, 402, 403, 404, 602, 756, and 817

CHAPTER 46 PART A

OPERATION AND SERVICE INSTRUCTIONS

Direct Cranking Electric Starters

Types 396, 397, 398, 400, 401, 402, 403, 404, 602, 756, and 817

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Figure 1—Typical E-80 Starter

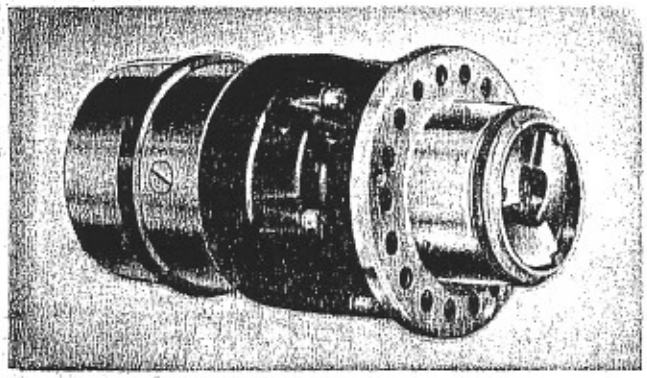


Figure 2—Typical F-141 Starter

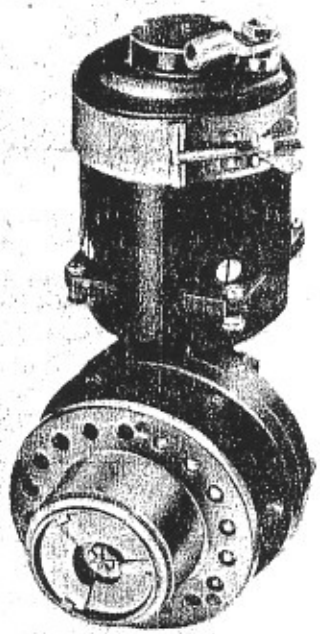


Figure 3—Typical Y-150 Starter

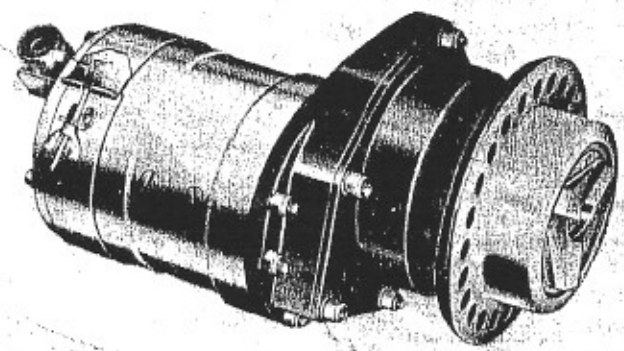


Figure 4—Typical A-160 Starter

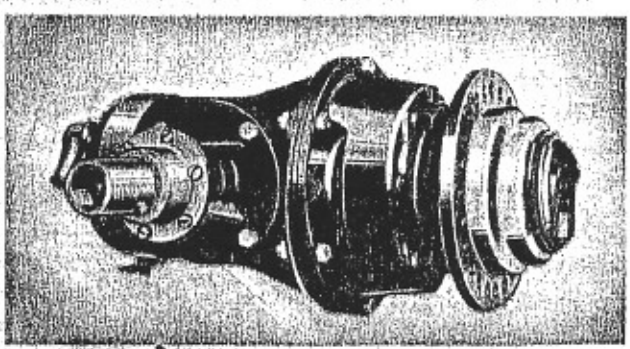


Figure 5—Typical E-160 Starter

SECTION I
DESCRIPTION

1. IDENTIFICATION.

This chapter is applicable to all Eclipse types 396, 397, 398, 400, 401, 402, 403, 404, 602, 756, and 817 direct cranking electric starters. For AAF, Navy, and British type designations refer to the index.

2. GENERAL DESCRIPTION.

The units are all of the same basic construction, consisting of a series wound electric driving motor, reduction gearing, overload torque release which consists of an adjustable multiple disc clutch, automatic engaging device, and driving jaw.

3. SPECIFICATIONS.

The various types differ mainly with regard to voltage, capacity, clutch setting, gear ratio, and the presence or absence of an emergency hand crank mechanism. The units are furnished either shielded or unshielded, with one grounded terminal post or two insulated posts for one-wire grounded or two-wire insulated systems, respectively, with either 3 or 12 tooth driving jaws and 5-, 6-, or 7-inch SAE mounting flange.

Eclipse Type	*Rated Voltage*	*Clutch Setting*	*Capacity*	*Hand Crank*
396 (Y-150)	12	200 lb-ft	450 cu in.	No
397 (E-80)	12	300 lb-ft	750 cu in.	No
398 (F-141)	12	350 lb-ft	1000 cu in.	No
400 (E-160)	12	550 lb-ft	1830 cu in.	Yes
401 (E-160)	24	550 lb-ft	2600 cu in.	Yes
402 (E-160)	12	550 lb-ft	1830 cu in.	No
403 (E-160)	24	550 lb-ft	2600 cu in.	No
404 (E-160)	12	550 lb-ft	1830 cu in.	Yes
602 (A-160)	24	925 lb-ft	3350 cu in.	No
756 (E-80)	24	300 lb-ft	750 cu in.	No
817 (E-160)	24	550 lb-ft	2600 cu in.	Yes

SECTION II
INSTALLATION AND OPERATION

1. GENERAL.

In order to assure proper operation of the equipment, the following procedure should be observed at the time of installation.

2. PREPARATION FOR USE AFTER STORAGE.

Starters which have been in storage for a period exceeding 1 year, should be forwarded to an overhaul activity for cleaning, relubrication, and test prior to installation on the engine. This relubrication is extremely important as failure to take the above precautions will permit dried out lubricants to remain in the starter making cranking difficult with resultant loss in starter performance and causing serious damage due to improper lubrication. Refer to AAF T. O. No. 03-1-1.

3. MOUNTING STARTER.

Before mounting the starter on the engine, remove the cover over the starter jaw which is provided for shipping and storage purposes only. To install the starter, remove the engine crankcase plate and gasket covering the starter drive and mounting flange. Examine the end of the engine crankshaft and ascertain if the engine jaw and starter jaw are of the same type and are of the correct rotation for proper engagement. With the engine gasket removed the distance from the mounting flange to the outermost part of the engine jaw must be $1\ ^{11}/_{16}$ inches $\pm\ ^{1}/_{32}$ inch. The clearance between the engine jaw and starter jaw must be not less than $^{1}/_{16}$ inch or more than $^{1}/_{8}$ inch when the latter is fully retracted. Wipe the mounting flange clean and replace gasket. The

mounting flange of each starter is provided with a number of mounting holes to permit locating the starter in different positions in order to facilitate installation.

CAUTION

Avoid installation of Y-150 starters with motor housing tilted more than 60 degrees from the vertical as oil may seep into motor housing and foul the commutator.

NOTE

When installing Y-150 starters on Warner engines, refer to applicable engine manufacturer's instructions for special adapting parts.

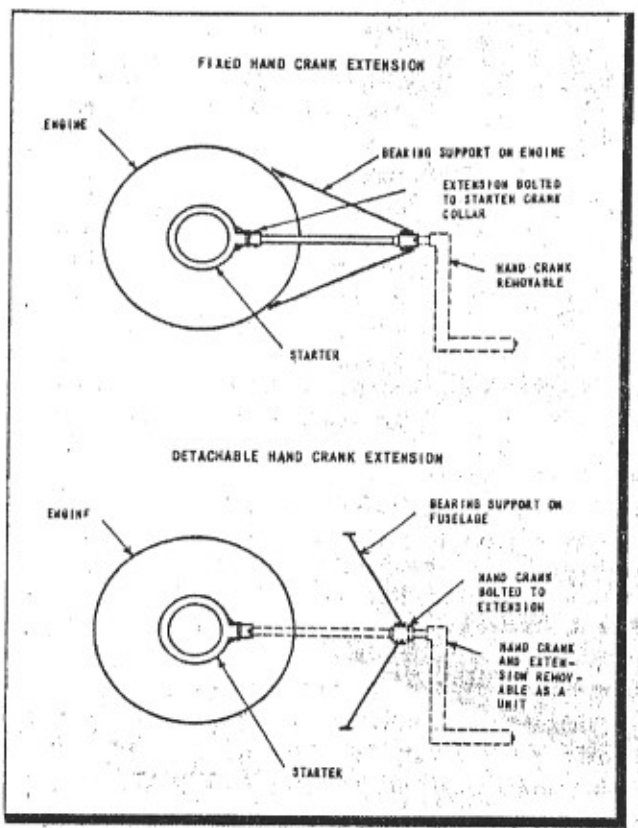


Figure 6—Installation of Hand Crank Extension

4. HAND CRANK AND EXTENSION.

Some E-160 starters are furnished with a hand crank attachment (specifications chart, paragraph 3., section I), but due to the gear ratio of the starter and the high compression ratios of modern engines this hand crank cannot be used, except under ideal conditions, to hand crank engines with a displacement exceeding 1,000 cubic inches. The main purpose of this attachment is to facilitate magneto timing. The hand crank and extension assembly furnished with the E-160 starter consists of a rod having a pin at the tapered end, a sleeve that must be assembled to the rod, and a pin. The sleeve contains a spiral slot and two holes, one at each end drilled through both sides of sleeve. The extension assembly may be mounted directly on the starter or it may be permanently attached to the hand crank so that it is removed from the airplane when not in use. The methods of installation which govern the above choice are outlined below.

a. DETACHABLE EXTENSION.—If it is desired that the hand crank and extension be removable as a unit, the external mounting support bearing should be attached to a structural member of the fuselage. Remove the bolt supplied with the starter crank collar. Allowing for the fact that the extension rod must be inserted a distance of 1¼ inches into the extension sleeve and that the sleeve must project beyond the outer end of the external mounting support bearing to clear the bolt holding the crank to the extension, determine the length of extension required and cut to length. Using the hole drilled through the tapered end of the sleeve as a pilot, drill through the extension rod and ream extension rod and sleeve to a diameter of .250 inch, plus .001 inch, minus .000 inch. Press in pin, supplied with extension assembly, flush with OD of sleeve. Press out pin in hand crank and bolt hand crank to sleeve using the bolt and nut supplied with the crank collar of each starter.

b. FIXED EXTENSION.—If it is desired that the extension assembly be permanently attached to the starter, the external mounting support bearing should be mounted directly on the engine or shock mounted to a structural member of the fuselage. Remove the bolt supplied with the crank collar of each starter. Allowing for the fact that the extension rod must be inserted a distance of 1¼ inches into the extension sleeve and that the sleeve must project beyond the outer edge of the mounting support bearing to clear the spiral slot, determine the length of extension required and cut to length. Make certain that the spiral slot in the extension sleeve is correct for the rotation of the starter. Using the hole drilled through the tapered end of the sleeve as a pilot, drill through the extension rod, and ream rod and sleeve to a diameter of .250 inch, plus .001 inch, minus .000 inch. Insert pin supplied with extension assembly flush with OD of sleeve. Press out the pin in the tapered end of the extension rod, and bolt assembly to the crank collar of the starter using the bolt and nut supplied with starter.

c. UNIVERSAL JOINT.—If the construction of the fuselage or engine nacelle is such that it is impossible to use a straight extension, a universal joint may be located between the crank collar and the mounting support bearing. The latter should be of the self-aligning type.

d. EXTERNAL MOUNTING SUPPORT BEARING.

(1) If the engine is rigidly mounted to the fuselage or nacelle, the external mounting support bearing should also be rigidly mounted regardless of the type of extension used. When used on a shock mounted engine the bearing can either be rigidly mounted to the engine or shock mounted on the fuselage. (See figure 6.) In any case, it is recommended that a self-aligning ball bearing be used on all installations taking care to provide for lubrication of the bearing.

(2) Should a plain bronze bearing be utilized for supporting the hand crank extension, it is recommended that the length of bearing surface be kept as short as possible and that a clearance of .005 inch be maintained between the OD of the extension sleeve and the ID of the bearing.

(3) Care should be taken that the alignment of the extension shaft is as accurate as possible in order to facilitate hand cranking and prevent undue strain on the starter housing during hand crank operation.

5. WIRING.

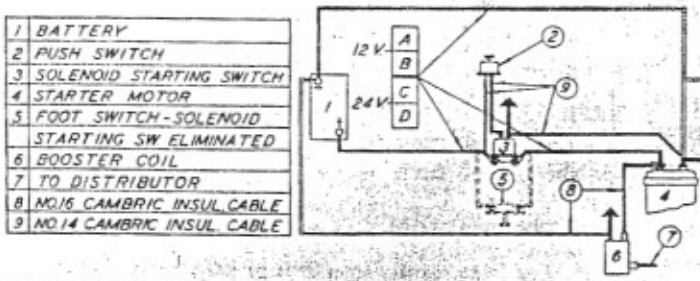
a. Starters, incorporating one terminal post, are designed for one-wire grounded operation only and are grounded internally. Units having two terminal posts are designed for either one-wire or two-wire grounded or two-wire insulated operation.

b. When intended for one-wire operation, one terminal post incorporates a steel grounding washer; however, prior to making connections examine the motor terminals to determine the system utilized. In addition, refer to the name plate date to ascertain the proper voltage required.

c. The same precaution should be noted when installing the accessories used with the starter, and when installing grounded systems on airplanes having shock mounted engines, be sure engines are securely grounded to airplane structure.

d. See figures 7 and 8 for proper cable sizes.

12 VOLT SYSTEM				24 VOLT SYSTEM			
TABLE BASED ON 2 V CABLE DROP AT 500 AMPS.				TABLE BASED ON 4 V CABLE DROP AT 300 AMPS.			
LET.	WIRE SIZE	CIR. MIL AREA	TOTAL CABLE LENGTH NOT TO EXCEED	LET.	WIRE SIZE	CIR. MIL AREA	TOTAL CABLE LENGTH NOT TO EXCEED
A	# 0	105,500	40 FEET	C	# 2	66,370	33 FEET
B	# 2	66,370	25 FEET	D	# 4	41,700	21 FEET



NOTE: ALL GROUND WIRES MUST BE CONNECTED TO THE ENGINE

MOTORS FITTED WITH TWO TERMINALS MAY BE CONVERTED TO ONE WIRE GROUNDED SYSTEMS BY REPLACING THE INSULATING WASHER ON EITHER TERMINAL POST WITH A GROUNDING BUSHING.

TWO WIRE SOLENOID SWITCHES MAY BE CONVERTED TO ONE WIRE GROUNDED SYSTEMS BY REPLACING EITHER TERMINAL INSULATING BUSHING WITH A GROUNDING BUSHING.

TO CONVERT ONE WIRE GROUNDED BOOSTER COIL FOR TWO WIRE UNGROUNDED OPERATION REMOVE THE GROUNDING WASHERS AND INSULATE THE PRIMARY TERMINAL POST.

MOUNT ALL BOOSTER COILS ON A GROUNDING BASE AS THE SECONDARY WINDING IS GROUNDED INTERNALLY FOR BOTH ONE AND TWO WIRE SYSTEMS. THE GROUNDING BASE MUST BE GROUNDED TO THE ENGINE.

NOTE: FOR ONE WIRE GROUNDED SYSTEMS USE SECTIONED LINES ONLY. FOR TWO WIRE UNGROUNDED SYSTEMS DISCONNECT ALL GROUND WIRES AND USE FULL LINES IN ADDITION TO SECTIONED LINES.

#14 SOLENOID SWITCH WIRE MAX. PERMISSABLE LENGTH 33 FT.

#16 BOOSTER COIL WIRE - MAX. PERMISSABLE LENGTH 50 FT.

Figure 7—Typical Wiring Diagram for E-80, F-141, Y-150, and E-160 Starter

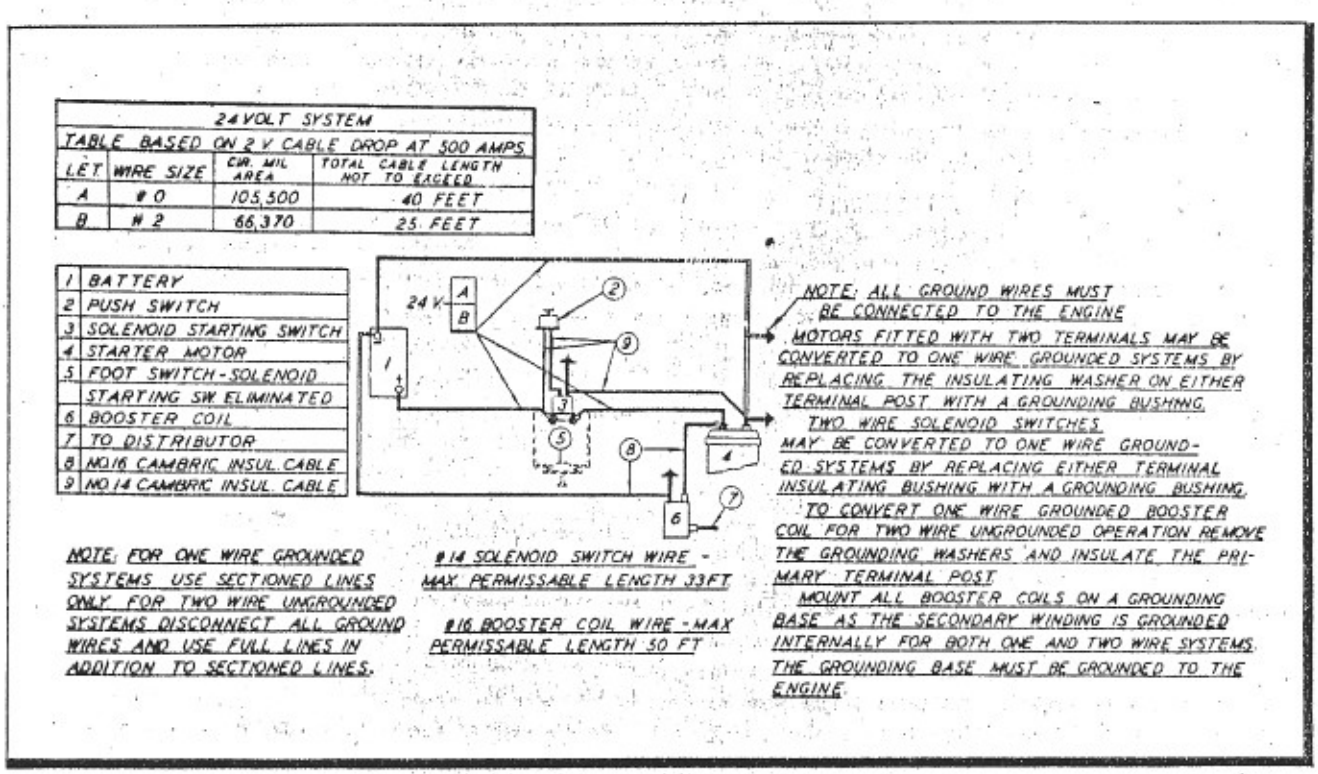


Figure 8—Typical Wiring Diagram for A-160 Starters

6. ACCESSORIES.

A direct starting switch of the foot type, or a remotely controlled solenoid switch, may be employed to control the starters. In either case, refer to the typical wiring diagrams (figures 7 and 8), for all wire sizes and connections. Details regarding the installation of control switches and the booster coil, if used, should be obtained from the chapters covering the individual units. To insure a hot spark during the cranking period, a booster coil is recommended for use with starters to supplement the spark of the engine magnetos.

7. PRINCIPLE OF OPERATION.

a. When the battery circuit is closed, torque is transmitted from the driving motor through the reduction gearing to the driving barrel which contains the multiple disc clutch, automatic engaging mechanism and the driving jaw. The purpose of the multiple disc clutch is to provide a release should the static torque of the engine be too large due to climatic conditions or other abnormal situations such as engine backfire which would damage the starter mechanism.

b. The automatic engaging mechanism consists of an internally threaded spline nut and an externally threaded screw shaft which moves longitudinally in the spline nut and causes the starter jaw to travel out at zero rpm until it meshes with the engine jaw. When the engine starts, the rotation of the engine jaw being faster than that of the starter jaw causes the latter to automatically disengage.

c. Return the starter control switch to the "NEUTRAL" position to open the starter circuit as soon as the engine fires.

8. OPERATION.

For best results in starting, prepare engine in accordance with instructions in the applicable engine Technical Order and operate starter either by pressing the foot switch or by operating the push switch controlling the solenoid switch, depending upon the method employed.

CAUTION

Should the engine fail to start readily, the cause should be ascertained immediately to avoid running down the storage battery.

SECTION III
INSPECTION, MAINTENANCE, AND LUBRICATION

1. INSPECTION AND MAINTENANCE.

NOTE

In accordance with T. O. No. 00-20A-2 a summary of the period inspections prescribed herein will be entered on the Master Airplane Maintenance Instruction Forms maintained in the back of the Form 41B for the airplanes affected.

When properly installed and operated, the starters should not require any attention between major overhaul periods other than that outlined below.

COLUMN NO. 22—IGNITION AND ELECTRICAL.

50-HOUR INSPECTION.

a. ELECTRICAL CONNECTIONS.—Remove window strap and examine motor for dirty or loose connections. Clean and tighten all connections. Replace all defective wiring.

b. BRUSHES.

(1) Examine brushes. They should be a free fit without excessive side play. Binding brushes and brush boxes should be wiped clean with a cloth moistened with undoped gasoline. Do not use fuels which contain lead compounds as the lead will plate on the commutator and cause poor commutation and impair starter efficiency. Worn brushes should be replaced before their maximum wear limit is reached to insure proper operation between inspection periods. The maximum permissible brush wear for the various types of starters is as shown in table 1.

TABLE 1

Starter	*New Length*	*Minimum Length*
E-80	1/2 inch	11/32 inch
F-141	17/32 inch (useful length)	9/32 inch
Y-150	9/32 inch (useful length)	3/32 inch
A-160	11/16 inch	1/2 inch
E-160	1/2 inch	11/32 inch

(2) Where the proper facilities are available new brushes should be run in on the motor until a 50 percent seat is obtained.

(3) If the above method is not feasible, brushes may be seated by inserting a strip of No. 0000 sandpaper between the brush and the commutator with sanded side next to the brushes and pulling in the direction of rotation. Repeat until brushes are at least 50 percent seated.

CAUTION

DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. REMOVE SAND OR METAL PARTICLES WITH COMPRESSED AIR.

c. BRUSH SPRINGS.

Check brush spring tension and replace springs if tension is not within limits as given in table 2.

TABLE 2

Starter	*Minimum Pressure (oz)*	*Maximum Pressure*	*Test*
E-80	24	28	End of spring 1/16 inch above brush box
F-141	40	44	Compressed to 7/16 inch
Y-150	41	43	Compressed to 7/16 inch
E-160	24	28	End of spring 1/16 inch above brush box
A-160	24	28	End of spring 1/8 inch above brush box

d. COMMUTATOR.—Rough or dirty commutators should be smoothed and polished with No. 0000 sandpaper. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. After sanding, clean thoroughly to remove all sand particles, otherwise excessive wear of brushes and commutator will result. Very rough or badly pitted commutators must be turned on a lathe in accordance with the applicable overhaul instructions in this chapter. (See index.)

e. CRANK EXTENSION SUPPORT BEARING.—After every 50 hours of engine operation the crank extension support bearing should be lubricated with engine oil.

2. LUBRICATION.

Starters are properly lubricated at the factory and should require no lubrication except at overhaul.

SECTION IV
SERVICE TROUBLES AND REMEDIES

1. SERVICE TROUBLES.

In all cases of starter failure or improper operation, the trouble should be investigated immediately to prevent further damage to the unit. DO NOT ATTEMPT TO OPERATE A STARTER WHICH IS NOT FUNCTIONING PROPERLY.

NOTE

Disassembly of faulty units should only be done by an overhaul activity. If no such repair depots are accessible, return units to the manufacturer for inspection, repair, and test.

Trouble	*Probable Cause*	*Remedy*
a. Starter motor fails to operate or operates at too low speed.	(1) Low voltage due to discharged battery.	*(a)* Check and recharge if necessary.
	(2) Loose or corroded battery terminals.	*(b)* Clean, tighten, and coat with petrolatum, Specification No. AN-VV-P236.
	(3) Wiring not properly connected, loose or high resistance connections.	*(c)* Refer to applicable wiring diagram (figure 7 or 8) and clean and tighten all connections.
	(4) Brushes binding in brush boxes.	*(d)* Remove and clean as directed under paragraph 3., section III, this chapter.
	(5) Worn brushes (see chart under paragraph 3.*b.*, section III, this chapter).	*(e)* Replace and seat new brushes as instructed under paragraph 3., section III, this chapter.
	(6) Brushes not properly seated.	*(f)* Reseat as instructed under paragraph 3., section III, this chapter, using No. 0000 sandpaper.
	(7) Excessive brush side play.	*(g)* Replace and seat as instructed under paragraph 3., section III, this chapter.

Trouble	*Probable Cause*	*Remedy*
	(8) Dirty commutator.	*(h)* Smooth and polish with No. 0000 sandpaper. See paragraph 3., section III, this chapter.
	(9) Eccentric, rough or pitted commutator.	*(i)* Remove and proceed as instructed in applicable part of this chapter. (Parts B to F, see index.)
	(10) Shorted, grounded, or open circuit in starter motor.	*(j)* Disassemble and test as instructed in applicable part of this chapter. (See index.)
	(11) Starter switch inoperative.	*(k)* Insert jumpers across switch terminals; if starter then operates, switch must be replaced.
b. Starter operates but fails to crank engine.	(1) Friction ring spring tension too low.	*(a)* Check spring tension with MT-237. Replace if tension is less than 9 ounces.
	(2) Slipping clutch.	*(b)* Disassemble, clean, replace worn parts, lubricate, and reassemble as instructed in applicable part of this chapter. (See index.)
c. Arcing brushes.	(1) See trouble *a.* above.	*(a)* Items *(d)* to *(j)*.

SECTION V
MAJOR OVERHAUL

At every major engine overhaul, the starter and associated accessories should be removed from the airplane and forwarded to an overhaul activity, or returned to the factory for overhauling. This procedure constitutes a complete disassembly of the units and involves the use of special tools and equipment available only at the above place.

SECTION VI
SHIPMENT AND STORAGE

1. PACKING FOR SHIPMENT.

For domestic shipment, units should be wrapped in waterproof paper and packed securely in a wooden box (Army Specification No. 23-53). Packing for export is identical except that the case should be lined with waterproof paper and fastened with metal straps. For AAF units, cases are to be marked for shipment in accordance with the latest issue of AAF Specification No. 100-2.

2. STORAGE.

No special preparation is required prior to placing starters in storage except that they be individually wrapped in waterproof paper and stored in a dry, cool place.

SECTION VII

PARTS CATALOG

Reference to T. O. No. 03-1-5 is required when ordering service replacement parts. Refer to the applicable cross-sectional assembly drawing for identification of part number and local quantity of parts required. To determine part name, refer to numerical list of service parts. When ordering parts, specify part name and number as well as type, model, and style letter appearing on name plate of unit for which parts are desired.

CHAPTER 46 PART B

OVERHAUL INSTRUCTIONS

Direct Cranking Electric Starters

Types 397 and 756

TABLE OF CONTENTS

SECTION I
DESCRIPTION

1. IDENTIFICATION.

This chapter is applicable to all Eclipse types 397 (12-volt) and 756 (24-volt) direct cranking electric starters. For AAF, Navy, and British type numbers, refer to the index of this Technical Order.

2. GENERAL DESCRIPTION.

The units consist of a heavy-duty, series wound, electric driving motor, reduction gearing, multiple-disc clutch, automatic engaging device, baffle plate oil seal and driving jaw.

a. MOTOR.—The motor consists of a set of four field coils into which the pole shoes are assembled and attached to the yoke. Two terminal posts protrude from the motor front head (commutator end), one of which incorporates a steel grounding washer when used on one-wire grounded systems. The ball-bearing mounted armature rotates within the yoke and field coil assembly. The commutator, on the antidrive end of the armature shaft, contacts the four brushes which are mounted on an insulated brush board attached to the motor front head. The drive end of the armature is supported by a ball bearing mounted in the intermediate head. The ball bearing incorporates an oil seal to prevent possible leakage of engine oil into the motor.

b. REDUCTION GEARING.—The drive pinion is located between the two ball bearings supporting the planetary cage, and is keyed to the armature shaft. The compound planetary gears, mounted on ball bearings in the planetary cage, are driven by the drive pinion and rotate in the fixed annulus gear, at the same time driving the internal gear cut into the driving barrel.

c. DRIVING BARREL.—The driving barrel contains a multiple disc clutch under adjustable spring tension. The alternate discs are splined to the driving barrel on the OD and to the spline nut on the ID. The tension of the clutch springs is controlled by the clutch adjusting nut which is threaded to the spline nut and may be rotated inward or outward to raise or lower the clutch setting. The spline nut is an internally threaded nut member which engages with a longitudinally movable screw shaft which, in turn, is splined to the starter jaw.

d. BAFFLE PLATE AND STARTER JAW.—The baffle plate assembly, attached to the mounting head, incorporates an oil seal which fits snugly around the shank of the starter jaw to prevent leakage of engine oil into the starter. Three friction shoes are assembled around the driving jaw. Each shoe incorporates a tooth that fits into a corresponding slot in the jaw. The three shoes ride on the curved lip of the baffle plate. The friction between the shoes and baffle plate is controlled by a spring which also serves to hold the shoes in place. The friction shoes prevent rotation of the starter jaw until the screw shaft has caused it to advance into full engagement with the engine jaw.

SECTION II
DISASSEMBLY, INSPECTION, REPAIR, LUBRICATION, REASSEMBLY, AND TEST (DEPOTS ONLY)

1. GENERAL.

At the time of every engine overhaul, the starter with its accessories should be removed from the airplane and sent to an overhaul activity or returned to the manufacturer for disassembly, inspection, and lubrication.

a. CLUTCH TEST.—Before disassembling unit, check clutch setting on a Prony brake clutch test stand (tool MT-327). If the torque setting is 300 pound-feet within plus 20 pound-feet, or minus 60 pound-feet, clutch need not be disassembled except to permit final adjustment. If suitable clutch test equipment, as outlined under paragraph 15., this section, is not available and starter has operated satisfactorily up to the time of overhaul, the clutch need not be disassembled.

CAUTION

If the clutch has been left intact for two successive overhaul periods, it must be disassembled at the third overhaul.

b. ACCESSORIES—For the overhaul procedure relative to solenoid switches and booster coils, refer to the applicable chapter listed in the index to this Technical Order.

2. TOOLS.

In order to facilitate disassembly, reassembly, and adjustment of the various parts, the following tools are recommended.

Tool Number	*Description*
MT-73	Clutch adjusting nut wrench
MT-146	Slotted nut wrench for drive end armature shaft nut
MT-237	Tool for checking friction ring tension
MT-309	Bench-type screw driver
MT-327	Prony brake clutch test stand
MT-4140	Pole shoe expander
T-21626A	Pole shoe aligning plug

3. DISASSEMBLY.

a. GENERAL.—Refer to T. O. No. 03-1-5 and proceed as follows: remove the window strap and lift out the brushes, allowing springs to rest against the brush box. Separate the motor and planetary cage assemblies from the mounting head assembly by removing the six through bolts. Remove the drive end armature shaft nut, using slotted nut wrench MT-146, and pull planetary cage off the drive end of the armature shaft. Remove the drive pinion spacer, drive pinion, and motor end cage plate ball bearing.

b. MOUNTING HEAD ASSEMBLY.—Remove the friction ring spring, friction ring, meshing rod nut, starter jaw, meshing rod oil seal, spring and baffle plate assembly. At this point the driving barrel assembly may be removed from the mounting head and the screw shaft may be removed from the back end of the spline nut.

(1) CLUTCH.—If starter clutch assembly has given satisfactory operation up to the time of overhaul and is not to be disassembled, or if suitable clutch test equipment is not available, DO NOT disassemble driving barrel further. If, however, the clutch is to be disassembled, first NOTE THE DISTANCE BETWEEN THE OUTER EDGE OF THE CLUTCH ADJUSTING NUT AND THE END OF THE SPLINE NUT. Loosen the clutch adjusting nut lock screw and remove clutch adjusting nut, using wrench MT-73. Removal of the adjusting nut permits the spline nut to be slid out the back end of the clutch barrel as well as releasing the spring ring, clutch springs, and spring spacer. Remove snap ring from driving barrel and lift out the entire clutch pack at once. TIEWIRE CLUTCH PACK TOGETHER TO RETAIN THE RELATIVE ORDER OF THE DISCS. To complete the disassembly of the driving barrel assembly, remove the clutch spacer and thrust washer.

(2) PLANETARY CAGE ASSEMBLY.—Hold planetary cage assembly rigidly and remove the nuts from the three planetary cage bolts. Hold the slotted end of the planetary gear studs with a screw driver and remove the nuts from the drive end of the stud. Separate the cage plates and remove planetary gears with the studs and ball bearings attached. To disassemble the planetary gear and stud assembly, hold the gear, being careful not to damage the teeth, and tap one end of the gear stud to drive out the stud and one bearing. Then remove the ball bearings from the stud and gear, respectively.

4. STARTER INSPECTION.

After the starter gear section has been completely disassembled, thoroughly clean all parts with carbon tetrachloride, undoped gasoline, or any other suitable solvent and dry off with compressed air. Examine and check all parts for wear in accordance with the following outline and clearance chart.

a. BALL BEARINGS.—Replace bearings that are loose or rough turning. DO NOT wash new bearings removed from factory sealed boxes; simply lubricate and use. For lubrication procedure, refer to paragraph 6.*a.* For AAF units, refer to T. O. No. 29-13.

b. CLUTCH BARREL.—If the clutch has not been disassembled, simply wipe the exterior with a carbon tetrachloride moistened cloth. DO NOT immerse in carbon tetrachloride. However, if the clutch has been disassembled, thoroughly clean all parts and replace worn or scored clutch discs. The procedure for assembling and setting the clutch is outlined under paragraphs 7.*a.* and 15., this section.

c. BAFFLE PLATE.—If the oil-seal leathers are worn or torn to the extent that they are a clearance fit on the neck of the starter jaw, the baffle plate assembly should be replaced. The presence of engine oil in the starter housing indicates a worn baffle plate or meshing rod oil seal and replacement should be made.

(2) When replacement of the baffle plate oil-seal leather is required, a complete baffle plate assembly must be substituted. Do not break down the assembled unit under any conditions.

NOTE

New baffle plate assemblies should be soaked in neat's-foot oil at 37.8°C (100°F) for a period of 1 hour prior to assembly, to insure free travel of the starter jaw in the baffle plate assembly.

d. MESHING ROD OIL SEAL.—Replace the meshing rod neoprene oil seal at every overhaul and the oil-seal cup washer if distorted or cracked.

e. MESHING ROD SPRING.—Check meshing rod spring tension and replace if force required to compress it to ½ inch is less than 13 pounds.

f. SCREW SHAFT AND SPLINE NUT.—At every overhaul the screw shaft should be magnafluxed and closely examined for cracks. If the clutch has been disassembled, the spline nut should also be magnafluxed and examined for cracks. Any evidence of cracks is sufficient cause for rejection.

g. STARTER JAW.—The starter jaw should be magnafluxed and examined for wear at each overhaul. Replace if any evidence of cracks is detected or if the depth of the flat on the leading edges of the jaw teeth is less than ⅛ inch.

h. GEARS.—Replace all gears when face of teeth become worn or rolled to the extent that the original involute curvature is obliterated.

5. CLEARANCE CHART.

Table 1 is provided to facilitate the inspection of parts for wear and to check clearances when reassembling starters at overhaul:

TABLE 1

Description	*Clearance*
Planetary cage ball bearings on armature shaft	.0001L-.0008L
Planetary cage ball bearings in cage plate	.0004T-.0004L
Planetary gear ball bearings on studs	.0001T-.0006L
Planetary gear ball bearings in gears	.0002T-.0006L
Driving barrel in mounting head	.005L max
Clutch pack thrust washer	.020 inch min
Driving barrel thrust washer	.030 inch min

6. LUBRICATION.

Before assembly, all bearings, gears, and other moving parts should be lubricated according to the instructions given below. It is important that only the specified lubricants be used as they have been chosen as a result of extensive tests under various operating and climatic conditions.

a. BALL BEARINGS.—Lubricate all ball bearings after cleaning and before assembly with a light film of Navy Department Specification No. M-372, grade A, or AAF Specification No. 3560, soft grease (commercial equivalent—Royco No. 7, manufactured by the Royal Engineering Company of East Hanover, New Jersey). For proper lubrication procedure refer to AAF T. O. No. 29-1-3.

b. GEARS, PLAIN BEARINGS, AND SCREW SHAFT ASSEMBLY.—Brush all gear teeth, bearing surfaces, and splines of the screw shaft and spline nut assembly with a light coating of Bureau of Engineering Specification No. 14-g-2, No. 3592 (commercial equivalent—Royco No. 50—manufactured by the Royal Engineering Company of East Hanover, New Jersey).

c. CLUTCH DISCS.—If clutch has been disassembled, the clutch discs shall be coated with a mixture of one part by volume of Acheson graphite No. 38 as manufactured by National Carbon Company (AAF Specification No. 3593), and one part by volume of No. 1 Esso motor oil, SAE 10 W, made by the Standard Oil Company of New Jersey (AAF Specification No. 3582).

7. REASSEMBLY.

To reassemble the starter gear section, follow the disassembly procedure in the reverse order and make certain that all parts are properly lubricated as specified under paragraph 6., this section. Replace all locking devices and safety wire. In addition, observe the precautions outlined below to facilitate and insure proper assembly.

a. CLUTCH REASSEMBLY.—If worn or scored clutch discs have been replaced, or if an entirely new clutch pack has been installed, it is necessary that the clutch be "run in" before installing in the starter, in order to facilitate final clutch adjustment.

(1) CLUTCH "RUN IN."—To "run in" the clutch, first lubricate the discs as instructed above under paragraph 6., this section. Set up in clutch "run-in" stand (MT-1603), set clutch at 300 pound-feet and slip at 8½ rpm for a period of 1 hour and 30 minutes.

CAUTION

During the "run-in" period, the barrel must be cooled by circulating water through the test fixture. To eliminate the above procedure, new clutch packs already "run in" may be obtained under part No. 60344.

NOTE

If it is necessary to install new clutch discs which have not been "run in," and a clutch "run-in" stand is not available, the entire clutch "run-in" process can be accomplished by first assembling the clutch in the starter and then setting up the assembled starter on a Prony brake test stand (MT-327) as explained under paragraph 15.*b.*, this section.

b. BAFFLE PLATE REASSEMBLY.—Do not reassemble the baffle plate, friction shoes, and friction spring to the starter until after the clutch has been properly checked or set as outlined below under paragraph 15., this section.

c. MESHING ROD OIL SEAL.—Before reassembling the oil seal on the meshing rod, the neoprene washer must be cemented to the steel cup washer with 3-M weatherstrip cement EC-226, made by the Minnesota Mining & Mfg. Co. of St. Paul, Minn.

d. STARTER JAW.—With the starter jaw completely retracted, the travel to full advanced position should be $^{11}/_{32}$ inch.

e. PLANETARY CAGE ASSEMBLY.—Assemble planetary gears on studs and assemble thrust washer and gears to drive end cage plate and turn stud nuts up tight. Assemble thrust washers and motor end cage plate to the rest of the cage assembly and bolt the assembly together.

NOTE

Do not assemble motor end cage plate ball bearing in cage plate. This bearing should be assembled on the armature shaft first.

8. MOTOR DISASSEMBLY.

Remove front head bearing cap and armature shaft nut, and tap end of armature shaft with a mallet to drive shaft out of bearing. Remove the intermediate head from the drive end of the armature shaft. Remove the terminal shields and nuts and the front head to yoke screws. Separate the front head from the yoke assembly.

NOTE

DO NOT DISASSEMBLE POLE SHOES AND YOKE AND FIELD COIL ASSEMBLY, OR REMOVE BRUSH BOARD ASSEMBLY FROM FRONT HEAD UNLESS REPLACEMENT IS FOUND NECESSARY AFTER COMPLETING INSPECTION AND TEST.

9. MOTOR INSPECTION.

After motor has been completely disassembled, thoroughly clean all parts with carbon tetrachloride or undoped gasoline and dry off with compressed air except where otherwise noted. Examine and check parts for wear in accordance with the following outline and clearance chart.

a. BALL BEARINGS.—Replace bearings if excessively loose or rough turning. Do not wash new bearings removed from factory sealed boxes; simply lubricate and use. For lubrication procedure, refer to paragraph 6., this section. For AAF units, refer to T. O. No. 29-1-3.

b. BRUSH BOARD ASSEMBLY.—Inspect brush board assembly for weakened, cracked, and burned insulation and test each brush box for grounds, using a 220-volt test lamp circuit. Touch one terminal to the front head and touch the other terminal of the test lamp circuit to each brush box in turn. If the lamp lights, the brush board is grounded and the entire assembly must be replaced. To replace brush board assembly remove the two brush board screws which secure it to the front head.

c. ARMATURE.—Dip the armature in a container of carbon tetrachloride or undoped gasoline and scrub thoroughly with a stiff brush. Do not soak. Dry armature assembly with compressed air. If, however, the armature appears to be oil soaked it should be placed in an oven and baked from 2 to 4 hours at 96.7°C (200°F). This baking process allows any oil which may

have collected in crevices in the assembly to liquefy and flow out. After baking, clean armature again as instructed immediately above. After cleaning, the armature assembly should be subjected to the following tests.

(1) SHORTED ARMATURE.—To test for a shorted armature, a "growler" should be used.

(2) GROUNDED ARMATURE.—To test for a grounded armature, touch one side of 110-volt lamp circuit to the armature shaft. Touch the other terminal of the lamp circuit to the commutator bars. If the armature is grounded, the lamp will light.

(3) OPEN ARMATURE.—Inspect the commutator for black or burned commutator bars and be sure that all conductors are firmly soldered into the riser. Loose conductor or blackened commutator bars indicate the possibility of an open circuit.

(4) COMMUTATOR.

(a) Smooth commutator with No. 0000 sandpaper. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. After sanding, thoroughly clean commutator to remove all sand particles; otherwise, excessive wear will result.

(b) If the commutator is extremely rough, pitted, or badly scored, check armature for concentricity. Commutator, bearing surfaces, and shaft centers must be concentric within .0005 inch full indicator reading. If centers are not true, mount armature on a lathe and true up. Commutator may then be turned on the centers, taking a light cut across the face, repeating if necessary, to remove all evidence of pitting or scoring. An alternative method is to assemble bearings on shaft mount on a lathe in a "steady rest." Concentricity of .0005 inch must be held in any case between bearing surfaces and commutator. When turning commutator, only very light cuts should be taken as there is a decided tendency for the cutting tool to dig in at the edge of the slot and spring away at the middle of the bar. Use a sharp pointed lathe tool at a cutting speed of approximately 200 surface feet per minute. The minimum diameter to which the commutator may be turned is 1 $^{13}/_{32}$ inches.

(c) On all 24-volt units and those 12-volt units which incorporate a special high speed motor (type 397, models 19, 20, 49, and 50), after turning the commutator, undercut mica, using a cutting tool slightly wider than the slot, to a depth equal to the width of the slot. DO NOT UNDERCUT MICA ON COMMUTATORS OF STANDARD 12-VOLT UNITS.

(d) Smooth and polish the commutator with No. 0000 sandpaper at approximately 700 surface feet per minute to remove any burrs. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. AFTER SANDING, THOROUGHLY CLEAN COMMUTATOR TO REMOVE ALL SAND AND METAL PARTICLES; OTHERWISE EXCESSIVE WEAR WILL RESULT. DO NOT GET OIL ON THE COMMUTATOR AT ANY TIME.

d. RESEATING BRUSHES.—If the commutator has been turned, or the armature replaced, the brushes will not seat properly and it is recommended that they be "run in" on the motor until at least 50 percent seated. If facilities are not available for "running in" brushes, they should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator with the sanded side in contact with the brush and pulling in the direction of motor rotation which in all cases is the same as the jaw rotation of the particular unit. Be careful to keep the sandpaper in the same contour as the commutator. Repeat until brushes are at least 40 percent seated. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. WHEN SEATING BRUSHES, CARE SHOULD BE TAKEN TO KEEP MOTOR BALL BEARING FREE FROM SAND OR METAL PARTICLES. AFTER SEATING, CLEAN THOROUGHLY TO REMOVE ALL FOREIGN PARTICLES FROM THE MOTOR ASSEMBLY; OTHERWISE, EXCESSIVE WEAR WILL RESULT.

e. BRUSHES.—The maximum permissible brush wear is $^{5}/_{32}$ inch from a new length of $^{1}/_{2}$ inch, or when the remaining portion of the brush is $^{11}/_{32}$ inch. Brushes should be replaced before their maximum wear limit is reached, in order to insure satisfactory operation until the next inspection period. To insure the proper seating of new brushes, refer to instructions in paragraph *d.* immediately above. Inspect brush lead sleeving and replace if burned or frayed. When installing new brushes make sure leads are properly covered with sleeving.

f. YOKE AND FIELD COIL ASSEMBLY.—Dip yoke and field coil assembly in a container of carbon tetrachloride or undoped gasoline and scrub with a stiff brush. Dry off with compressed air. After cleaning, the field coils should be subjected to the following tests, using a test lamp circuit and a power supply of 220 volts either ac or dc. If 200 volts are not available, 110 will suffice.

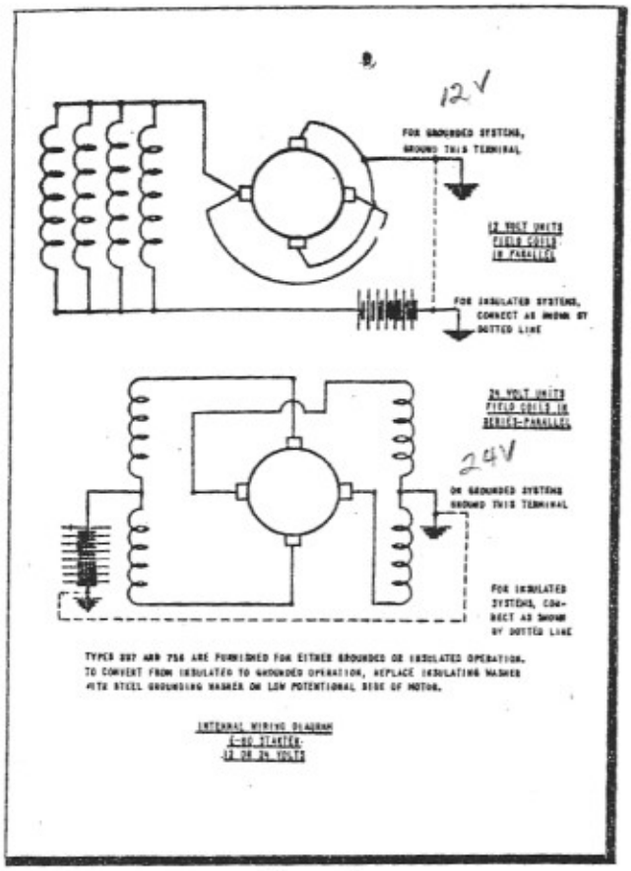


Figure 1

(1) OPEN FIELD CIRCUIT.—Due to the fact that the field coils on 12-volt motors are connected in parallel and thus have a very low field resistance, it is impossible to obtain a positive check on open circuits either by a test lamp circuit or by a Wheatstone bridge, unless all four coils are open. The presence of an open coil can best be determined after assembly when running performance tests. This condition may be detected by a low torque output accompanied by an excessive high current draw under load run. The field coils of 24-volt units, however, are connected in series, parallel through the armature (figure 1), and will give positive results when a test lamp circuit is connected across the brush terminals. Connect one terminal of the test lamp circuit to any one of the brush terminals and touch the other terminal of the test lamp to the opposite brush terminal. Repeat this procedure on the other pair of field coils and if, in either case, the lamp does not light, replace the pair of field coils.

CAUTION

If only one pair of coils is defective, do not loosen or disturb the other pair as this may necessitate replacement of that assembly also.

(2) GROUNDED FIELD CIRCUIT.—To test for grounded field circuit, connect one terminal of the test lamp circuit to one of the field terminals, the other field terminal being free. Touch the other lamp circuit terminal to the yoke momentarily. The lamp will light if the field is grounded.

(3) FIELD COIL REPLACEMENT.—If after completing the above tests, replacement of the field coils is found necessary, proceed as instructed below. The screw driver press (MT-309), pole shoe expander (MT-4140), and pole shoe aligning plug gage (T-21626A) of 3.021 inches diameter are the necessary tools required to replace field coils.

(a) 12-VOLT MOTORS.—Remove pole shoe screws, using MT-309, pole shoes and field coil assembly. Assemble replacement coil assembly into yoke, expand pole shoes with MT-4140 drawing up pole shoe screws with MT-309. To assure proper alignment of pole shoes and prevent interference with the armature windings, check the inside diameter of the yoke and field coil assembly with T-21626A. The complete assembly of yoke, field coils, and pole shoes must then be placed in an oven and baked at 126.7°C (260°F) for a period of 2 hours. As replacement field coils have been dipped in Harvel varnish No. 512C (specific gravity .830-.840) and partially baked before shipment, this 2-hour baking period causes the varnish to soften and flow into any crevices in the assembly and then finally harden during the remainder of the baking process. The entire procedure as outlined above results in a well bonded assembly and prevents the field coils from loosening in service.

(b) 24-VOLT MOTORS.—To replace either pair of field coils, remove only the two pole shoe screws necessary to replace the defective pair of coils, using MT-309. Remove the pole shoes and defective field coils and assemble new replacement coils in yoke. Expand pole shoes with MT-4140 and check the alignment and inside diameter of the yoke and field coil assembly with plug gage T-21626A to insure proper alignment of the pole shoe and preclude the possibility of interference with the armature assembly.

NOTE

Do not bake 24-volt field coils after reassembly.

g. INSULATORS.—Replace terminal post insulators if they are burned, worn, or cracked.

10. CLEARANCE CHART.

Table 2 is provided to facilitate the inspection of parts for wear and to check clearance when reassembling the unit.

TABLE 2

Description	*Clearance*
Front head ball bearing on armature shaft	.0003T-.0004L
Front head ball bearing outside diameter in housing	.0005T-.0003L
Intermediate head ball bearing on armature shaft	.0001L-.0008L
Intermediate head ball bearing in bushing	.0004T-.0004L

11. MOTOR LUBRICATION.

Coat the armature bearing with a light film of grease, AAF Specification No. 3560—soft, Navy Specification No. M-372, grade A (commercial equivalent—Royco No. 7—manufactured by the Royal Engineering Co., East Hanover, N. J.).

12. MOTOR REASSEMBLY.

Follow the disassembly procedure in reverse order noting the following precautions.

a. BRUSH SPRINGS.—Check brush spring tension at reassembly and replace if tension is less than 24 or more than 28 ounces as measured when spring is $\frac{1}{16}$ inch above the top of the brush box.

b. MOTOR TEST AT REASSEMBLY.—After motor has been reassembled it is recommended that it be given a free run test to check performance.

c. ELECTRICAL CONNECTIONS.—Refer to test diagram (figure 2). Connect the d-c power supply (1), which may be either a battery or a motor generator, through the carbon stack variable resistor (2), a Weston model 45 ammeter (0-100) scale using a 100-ampere shunt, and a single pole-single throw switch (6) from which a lead is connected to one of the starter terminals. Connect a Weston model 45 voltmeter across the motor terminals as shown.

d. "FREE-RUN" TEST.

(1) Loosen carbon stack to get the highest resistance possible, then close the motor circuit. Check the ance possible, then close the motor circuit. Check the motor "free-run" characteristics. Adjust the variable reparticular unit as given in table 3.

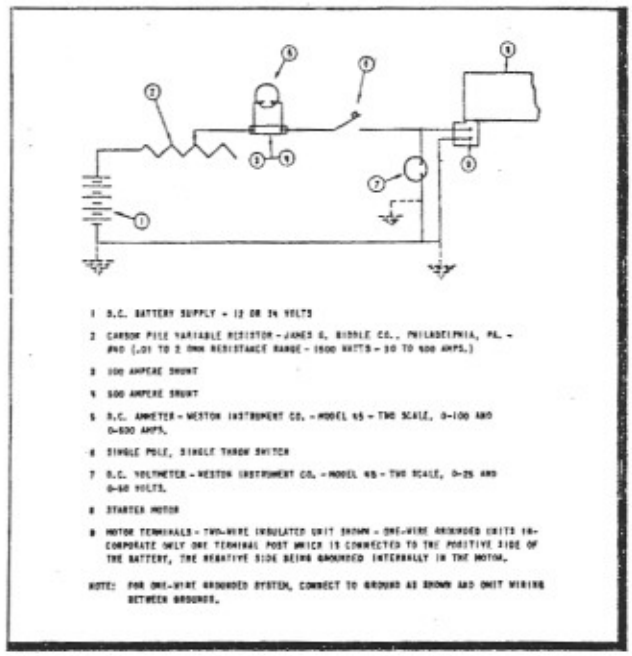


Figure 2—Schematic Electrical Test Diagram E-80 Starter

TABLE 3

Motor	*Rated Voltage*	*Test Voltage*	*Maximum Current Draw*	*Minimum RPM*
397	12	8	40	9,000
*397 (High speed)	12	8	55	13,500
756	24	16	23	9,000

*Type 397, models 19, 20, 49 and 50, incorporates a special high speed motor.

CAUTION

DO NOT APPLY MORE THAN THE ABOVE LISTED TEST VOLTAGE ACROSS MOTOR TERMINALS, AS EXCESSIVE SPEED WILL RESULT AND MAY CAUSE SERIOUS DAMAGE TO THE MOTOR.

(2) If, with 8 volts across the terminals of a 12-volt motor, the current draw is in excess of the maximum listed above for that unit, the brushes spark excessively, and the armature speed is above normal, it indicates the possibility of an open field coil, in which case the entire field coil assembly must be replaced. (Refer to paragraph 9.*f*.(1), this section.)

e. INSULATION TEST.—After "free-run" test and while motor is still hot, the unit should be checked for insulation break-down. Remove the grounding washer from the terminal post on grounded units and apply one terminal of the a-c or d-c test lamp circuit to one of the motor terminals and touch the other test lamp terminal to the motor housing. If the lamp lights, the unit is grounded and must be disassembled for replacement of worn insulation.

13. STARTER REASSEMBLY.

a. Reassemble spacer, motor end planetary cage ball bearing, drive pinion and spacer on armature shaft, first coating shaft lightly with Royco No. 5, or equivalent, to facilitate assembly. Reassemble annulus gear to intermediate head with temporary screws to hold it in place.

CAUTION

REASSEMBLE WITH RED ARROWS OUT. PRESS THE PLANETARY CAGE ON THE ARMATURE SHAFT SO THAT THE TEETH WITH THE ARROWS ON THE ANNULUS GEAR MESH BETWEEN THE TWO BEVELED TEETH OF EACH PLANETARY GEAR.

b. Reassemble armature shaft nut and cotter pin. Reassemble mounting head assembly to motor and planetary cage assembly, first removing the temporary screws holding annulus gear in place. Fasten the assemblies together with the through bolts.

14. STARTER CONVERSION

In the event that it is desired to convert a starter of one rotation to that of the opposite rotation or to change from 12 to 24 volts or vice versa, observe the following procedure. In either case the name plate of the unit should be replaced with one indicating the correct model designation and rating for the unit as converted. Refer to the applicable assembly drawing in T. O. No. 03-1-5 for part numbers involved.

a. CONVERSION (ROTATION ONLY).—To convert a starter of one rotation to the opposite rotation, disassemble to permit replacement of the field coil assembly, screw shaft assembly, spline nut, and starter jaw with equivalent parts for opposite rotation.

b. CONVERSION (VOLTAGE ONLY).—To convert a starter designed for operation from a 12-volt battery to 24-volt operation, or vice versa, disassemble to permit replacement of the armature assembly, field coil assembly and brushes, with equivalent parts, depending on the voltage required.

15. CLUTCH ADJUSTMENT AND TEST.

In order to check or adjust starter clutches and to test the units for proper operation after reassembly, a Prony brake test stand (MT-327), figure 3, with a platform scale is required. With baffle plate removed, mount starter on test stand and adjust mounting bracket of stand so that the distance between starter jaw and test stand jaw is $\frac{3}{32}$ inch when starter jaw is retracted fully. Removal of baffle plate necessitates manual engagement of starter jaw with test stand jaw. When adjusting starter clutch, as outlined below, care should be taken to gradually attain the required setting WITHOUT OVERHEATING.

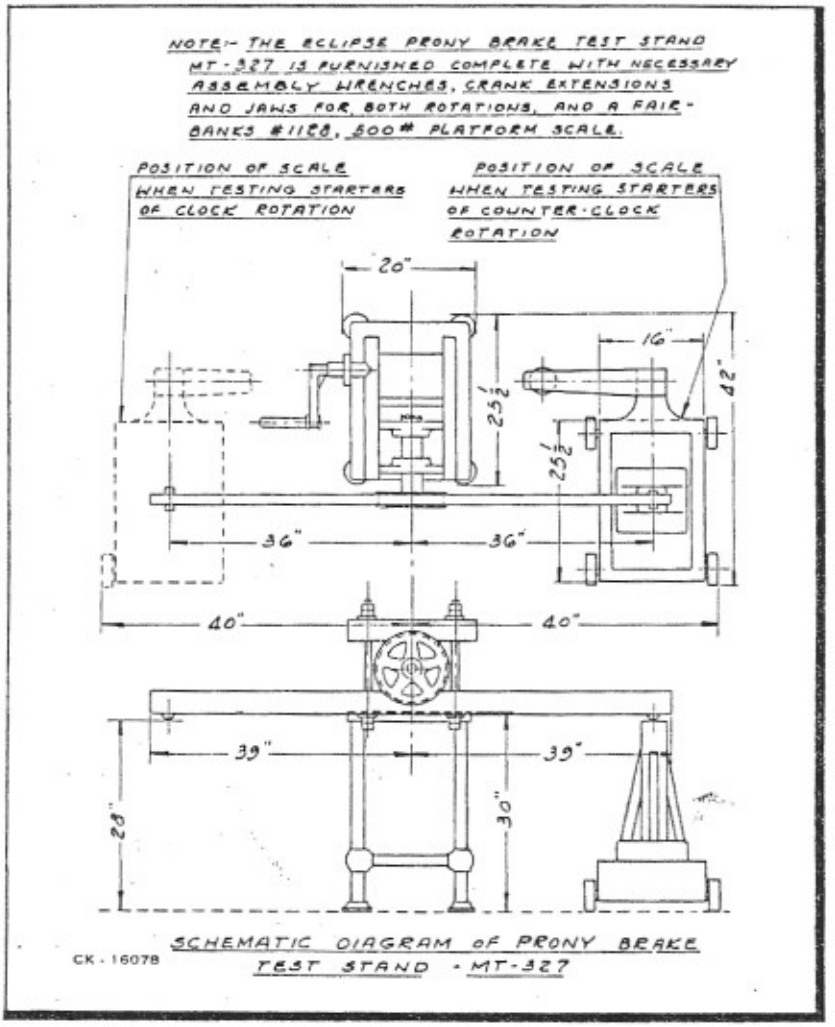


Figure 3—Prony Brake Test Stand MT-327

a. CHECK CLUTCH SETTING.—If clutch discs have not been disturbed or the setting altered during overhaul, or if a new "run-in" pack has been installed, the clutch setting may be checked as follows:

(1) Lock the brake drum and operate starter for a period of 2 seconds. Repeat the above procedure five times at 1-minute intervals. If the torque reading on the scale remains constant at 300 pound-feet within ± 20 pounds-feet, it can be considered satisfactory.

(2) To lower setting, loosen clutch adjusting nut; to raise setting, tighten nut. If in the above operation, when setting a new "run-in" clutch, the setting tends to climb, simply readjust to the proper value and give five more engagements. Repeat until setting remains constant.

(3) If when checking the setting on a clutch which has been in service, a constant reading can not be obtained for five consecutive engagements, replacement of the clutch is necessary.

b. WHEN REPLACEMENT CLUTCH DISCS HAVE NOT BEEN "RUN IN."—If the clutch discs have not been previously "run-in," observe the following procedure, bearing in mind that during the entire process the clutch barrel housing should not be allowed to heat up so that it cannot be touched with the hand. If the clutch does heat up, allow it to cool before continuing with the "run-in" process.

(1) Adjust clutch to 150 pound-feet.

(2) Lock brake and operate starter 30 times (2 seconds each time) at 1-minute intervals.

(3) After completing the 30 engagements, increase setting to 250 pound-feet. Operate starter three times (for 2 seconds each) at 1-minute intervals.

(4) Increase setting to 300 pound-feet and operate three times as above.

(5) Allow clutch to cool for ½ hour.

(6) After cooling, operate starter 20 times (2 seconds each time) at 1-minute intervals. If clutch setting shows a tendency to climb (readjust to 300 pound-feet and repeat engagement until setting remains constant for 20 engagements.

(7) Allow clutch to cool for ½ hour.

(8) After cooling, engage starter three times as a final check that the correct setting is maintained.

16. PERFORMANCE TESTS.

Connect starter motor as shown (figure 2) under paragraph 12.*b.*, this section, and reassemble unit on Prony brake test stand (figure 3) and proceed as follows:

a. FREE RUN.—Operate the starter for 2 minutes and check the terminal voltage, current draw, and motor speed against the following chart. It should be noted that a free run speed that is excessively high indicates the possibility of an open field in the case of 12-volt units.

Bat. Voltage	*Terminal Voltage*	*Amp (Max)*	*RPM (Min)*
12	10	50	9,000
*12 (H.S.)	10	65	14,000
24	20	30	9,000

*Type 397, models 19, 20, 49 and 50, includes a special high speed motor.

b. LOAD RUN.—Apply a load of 200 pound-feet to the starter and check starter performance against the figure given below. Do not close ammeter circuit until it has begun to turn, as the initial surge of current may damage the instrument. The motor must deliver the minimum speed, using not more than the maximum current as given below. On 12-volt units if the torque output is low, the current draw is excessively high, and the brushes spark, one or more of the field coils may be open as explained under paragraph 9., this section.

Bat. Voltage	*Terminal Voltage*	*Amp (Max)*	*RPM (Min)*
12	8.8	275	2600
*12 (H.S.)	7.3	440	2600
24	17.6	155	2600

*Type 397, models 19, 20, 49 and 50, includes a special high speed motor.

17. FINAL REASSEMBLY AND TEST.

a. Remove starter from test stand and reassemble baffle plate, friction shoes, and friction spring. Tests have proved that the clutch adjusting nut lock is not necessary.

b. Check the friction ring assembly on the baffle plate to ascertain if spring has sufficient tension to hold the starter jaw in position so that it will advance full forward to mesh with the engine jaw before starting to rotate. If the jaw fails to advance when the starter is operated, or if the spring tension, as measured with Tool MT-237 is less than 9 or more than 15 ounces, replace the friction spring.

SECTION III

PARTS CATALOG

Reference to T. O. No. 03-1-5 is required when ordering service replacement parts. Refer to the applicable cross-sectional assembly drawing for identification of part number and local quantity of parts required. To determine part name, refer to numerical list of service parts. When ordering parts, specify part name and number as well as type, model, and style letter appearing on name plate of unit for which parts are desired.

SECTION IV

PACKING FOR SHIPMENT

1. PACKING FOR SHIPMENT.

For domestic shipment, units should be wrapped in waterproof paper and packed securely in a wooden box (Army Specification No. 23-54). Packing for export is identical except that the case should be lined with waterproof paper and fastened with metal straps. For AAF units, cases should be marked for shipment in accordance with AAF Specification No. 100-2, latest issue.

2. STORAGE.

After completing overhaul and prior to installing starter on engine, it is recommended that reference be made to part A, this section, for the installation procedure. However, if the unit is to be placed in storage first, no special preparations are necessary other than to wrap each unit individually in oiled waterproofed paper and store in a cool, dry place.

Publication No. 36U-7-8-9-B
Supersedes Pub. No. 97-18

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

E-80 DIRECT CRANKING ELECTRIC STARTERS

NOTE

All Ball Bearings used on equipment of our manufacture are specially selected by Eclipse-Pioneer for each specific application. Bearings purchased through other sources may not meet application specification with the result that unsatisfactory unit operation may be experienced.

UTICA DIVISION
UTICA, NEW YORK

Bendix AVIATION CORPORATION

Printed in U.S.A.

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-1-B 397-2-B 397-3-B 397-4-B
397-1-C 397-2-C 397-3-C 397-4-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-1-B	397-1-C	397-2-B	397-2-C	397-3-B	397-3-C	397-4-B	397-4-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845761	Plate Assy-Baffle	-	1	-	1	-	1	-	1	100
	3	48520	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	4	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	5	15132	Spring	1	-	1	-	1	-	1	-	100
	6	837637	Spring	-	1	-	1	-	1	-	1	100
	7	21582	Head-Mounting	1	1	1	1	1	1	1	1	-
	8	29150	Liner	1	1	1	1	1	1	1	1	10
	9	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	10	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	11	AN505-6-5	Screw	3	3	3	3	3	3	3	3	45
	12	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	13	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	14	13210	Washer	1	1	1	1	1	1	1	1	-
	15	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	16	90192	Nut-Spline	1	-	-	-	1	-	-	-	-
	17	121253	Nut-Spline	-	1	-	-	-	1	-	-	-
	18	90194	Nut-Spline	-	-	1	-	-	-	1	-	-
	19	121252	Nut-Spline	-	-	-	1	-	-	-	1	-
	20	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	21	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	22	843982	Pack Assy -Clutch	1	1	1	1	1	1	1	1	5
	23	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	24	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	25	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	26	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	27	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	28	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	29	90193	Shaft-Screw	1	-	-	-	1	-	-	-	-
	30	90195	Shaft-Screw	-	1	-	1	-	1	-	1	-
			Shaft Assy -Screw	-	1	-	1	-	1	-	1	
	31	121254	Shaft-Screw	-	1	-	-	-	1	-	-	-
	32	121255	Shaft-Screw	-	-	1	-	-	-	1	-	-
	33	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	34	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	35	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	36	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	37	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	38	76288	Nut	1	1	1	1	1	1	1	1	15
	39	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
	40	89633	Jaw-Starter	1	-	-	-	1	-	-	-	5
	41	121248	Jaw-Starter	-	1	-	-	-	1	-	-	5
	42	89635	Jaw-Starter	-	-	1	-	-	-	1	-	5
	43	121250	Jaw-Starter	-	-	-	1	-	-	-	1	5
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	44	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	45	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-1-B	397-1-C	397-2-B	397-2-C	397-3-B	397-3-C	397-4-B	397-4-C	
	46	46913	Stud	3	3	3	3	3	3	3	3	30
	47	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	48	117071	Washer	3	3	3	3	3	3	3	3	45
	49	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	60
	50	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	51	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	52	117071	Washer	3	3	3	3	3	3	3	3	45
	53	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	54	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	55	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	56	21529	Bolt	3	3	3	3	3	3	3	3	30
	57	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	58	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	59	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	60	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	61	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	62	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	63	21532	Spacer-Bearing	1	-	-	-	1	-	-	-	-
	64	837625	Spacer-Bearing	-	1	1	1	-	1	1	1	-
	65	21590	Screw	6	6	6	6	6	6	6	6	60
	66	18357	Washer	6	6	6	6	6	6	6	6	60
	67	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	68	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	69	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	70	21596	Yoke	1	1	1	1	1	1	1	1	-
	71	21182	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	72	21592	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	73	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	74	114036	Terminal	1	1	1	1	1	1	1	1	-
	75	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	76	21014	Screw	4	4	4	4	4	4	4	4	60
	77	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	78	836527	Bearing-Ball	1	-	-	-	1	-	-	-	20
	79	838215	Bearing-Ball	-	1	1	1	-	1	1	1	20
			Head Assy -Front	1	1	1	1	1	1	1	1	
	80	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	-
	81	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	82	50512	Board Assy -Brush	1	1	1	1	1	1	1	1	5
	83	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	84	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	85	12582	Screw	2	2	2	2	2	2	2	2	20
	86	2426	Washer	2	2	2	2	2	2	2	2	30
	87	29589	Insulator	1	1	1	1	1	1	1	1	30
	88	56334	Washer-Insulating	1	1	1	1	1	1	1	1	30
	89	6069-1	Washer	1	1	1	1	1	1	1	1	15
	90	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	91	18917-1	Nut	1	1	1	1	1	1	1	1	15
	92	29589	Insulator	1	1	1	1	1	1	1	1	30
	93	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	94	6069-1	Washer	1	1	1	1	-	-	-	-	15
	95	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	96	18917-1	Nut	2	2	2	2	2	2	2	2	30
	97	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	98	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	99	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	100	113852	Screw	4	4	4	4	4	4	4	4	60
	101	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-1-B	397-1-C	397-2-B	397-2-C	397-3-B	397-3-C	397-4-B	397-4-C	
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	102	838007	Bearing	1	1	1	1	1	1	1	1	20
	103	837626	Spacer	1	1	1	1	1	1	1	1	20
	104	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	105	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	106	80330	Cap-Front Bearing	1	1	1	1	1	1	1	1	-
	107	11558	Screw	4	4	4	4	4	4	4	4	60
	108	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	109	20506-7	Screw	4	4	4	4	4	4	4	4	80
	110	AN935-B8	Washer-Lock	4	4	4	4	4	4	4	4	80
	111	42096	Strap Assy -Window	1	1	1	1	1	1	1	1	10
	112	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	113	70448	Shield-Terminal	-	1	1	1	1	1	1	1	-
	114	70449	Cover-Shield	-	1	1	1	1	1	1	1	-
	115	16836	Screw	-	2	2	2	2	2	2	2	30
	116	33338	Washer	-	2	2	2	2	2	2	2	30
	117	28383	Bushing-Insulating	-	1	1	1	1	1	1	1	30
	118	29274	Washer	-	1	1	1	1	1	1	1	15
	119	72621	Bushing-Insulating	-	1	1	1	1	1	1	1	30
				-	A	A	-	-	A	A	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-5-B 397-6-B 397-7-B 397-8-B
397-5-C 397-6-C 397-7-C 397-8-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-5-B	397-5-C	397-6-B	397-6-C	397-7-B	397-7-C	397-8-B	397-8-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845761	Plate Assy-Baffle	-	1	-	1	-	1	-	1	100
	3	48520	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	4	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	5	15132	Spring	1	-	1	-	1	-	1	-	100
	6	837637	Spring	-	1	-	1	-	1	-	1	100
	7	21582	Head-Mounting	1	1	1	1	1	1	1	1	-
	8	29150	Liner	1	1	1	1	1	1	1	1	10
	9	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	10	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	11	AN505-6-5	Screw	3	3	3	3	3	3	3	3	45
	12	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	13	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	14	13210	Washer	1	1	1	1	1	1	1	1	-
	15	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	16	90192	Nut-Spline	1	-	-	-	1	-	-	-	-
	17	121253	Nut-Spline	-	1	-	-	-	1	-	-	-
	18	90194	Nut-Spline	-	-	1	-	-	-	1	-	-
	19	121252	Nut-Spline	-	-	-	1	-	-	-	1	-
	20	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	21	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	22	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	23	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	24	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	25	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	26	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	27	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	28	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	29	90193	Shaft-Screw	1	-	-	-	1	-	-	-	-
	30	90195	Shaft-Screw	-	-	1	-	-	-	1	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	31	121254	Shaft-Screw	-	1	-	-	-	1	-	-	-
	32	121255	Shaft-Screw	-	-	-	1	-	-	-	1	-
	33	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	34	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	35	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	36	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	37	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	38	76288	Nut	1	1	1	1	1	1	1	1	15
	39	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
	40	89633	Jaw-Starter	1	-	-	-	1	-	-	-	5
	41	121248	Jaw-Starter	-	1	-	-	-	1	-	-	5
	42	89635	Jaw-Starter	-	-	1	-	-	-	1	-	5
	43	121250	Jaw-Starter	-	-	-	1	-	-	-	1	5
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	44	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	45	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-5-B	397-5-C	397-6-B	397-6-C	397-7-B	397-7-C	397-8-B	397-8-C	
	46	46913	Stud	3	3	3	3	3	3	3	3	30
	47	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	48	117071	Washer	3	3	3	3	3	3	3	3	45
	49	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	50	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	51	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	52	117071	Washer	3	3	3	3	3	3	3	3	30
	53	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	54	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	55	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	56	21529	Bolt	3	3	3	3	3	3	3	3	30
	57	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	58	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	59	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	60	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	61	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	62	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	63	21532	Spacer	1	-	-	-	1	-	-	-	-
	64	837625	Spacer	-	1	1	1	-	1	1	1	-
	65	21590	Screw	6	6	6	6	6	6	6	6	60
	66	18357	Washer	6	6	6	6	6	6	6	6	60
	67	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	68	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	69	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	70	21596	Yoke	1	1	1	1	1	1	1	1	-
	71	21182	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	72	21592	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	73	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	74	114036	Terminal	1	1	1	1	1	1	1	1	-
	75	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	76	21014	Screw	4	4	4	4	4	4	4	4	60
	77	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	78	836527	Bearing-Ball	1	-	-	-	1	-	-	-	20
	79	838215	Bearing-Ball	-	1	1	1	-	1	1	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	80	21595	Head-Front (Sand-Casting)	1	1	1	1	1	1	1	1	-
	81	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	82	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	83	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	84	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	85	12582	Screw	2	2	2	2	2	2	2	2	20
	86	2426	Washer	2	2	2	2	2	2	2	2	30
	87	29589	Insulator	1	1	1	1	1	1	1	1	30
	88	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	89	6069-1	Washer	1	1	1	1	-	-	-	-	15
	90	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	91	18917-1	Nut	2	2	2	2	2	2	2	2	30
	92	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	93	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	94	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	95	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	96	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	97	29274	Washer	-	-	-	-	1	1	1	1	15
	98	29589	Insulator	1	1	1	1	1	1	1	1	30
	99	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	100	6069-1	Washer	1	1	1	1	-	-	-	-	15
	101	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	102	18917-1	Nut	2	2	2	2	2	2	2	2	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-5-B	397-5-C	397-6-B	397-6-C	397-7-B	397-7-C	397-8-B	397-8-C	
	103	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	104	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	105	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	106	113852	Screw	4	4	4	4	-	-	-	-	60
	107	AN935-8	Washer-Lock	4	4	4	4	-	-	-	-	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	108	838007	Bearing	1	1	1	1	1	1	1	1	20
	109	837626	Spacer	1	1	1	1	1	1	1	1	20
	110	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	111	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	112	80330	Cap-Front Bearing	1	1	1	1	1	1	1	1	-
	113	11558	Screw	4	4	4	4	4	4	4	4	60
	114	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	115	20506-7	Screw	4	4	4	4	4	4	4	4	80
	116	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	117	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	118	4072	Nut-Ring	1	1	1	1	1	1	1	1	10
	119	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	120	29274	Washer	-	-	-	-	1	1	1	1	15
	121	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	122	70449	Cover-Shield	-	-	-	-	2	2	2	2	-
	123	16836	Screw	-	-	-	-	4	4	4	4	60
	124	33338	Washer	-	-	-	-	4	4	4	4	60
	125	28383	Bushing-Insulating	-	-	-	-	2	2	2	2	60
				R	H	U	T	-	A	-	-	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-9-B 397-10-B 397-11-B 397-12-B
397-9-C 397-10-C 397-11-C 397-12-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-9-B	397-9-C	397-10-B	397-10-C	397-11-B	397-11-C	397-12-B	397-12-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy	1	1	1	-	1	-	1	-	
	2	845483	Plate Assy-Baffle	-	1	-	1	-	1	-	1	100
	3	121242	Plate Assy-Baffle	-	-	-	1	-	-	-	1	100
	4	46995	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	5	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	6	15132	Spring	1	-	1	-	1	-	1	-	100
	7	837637	Spring	-	1	-	1	-	1	-	1	100
	8	42425	Ring-Pilot	1	1	1	1	1	1	1	1	-
	9	AN500-8-6	Screw	3	3	3	3	3	3	3	3	45
	10	AN936A-8	Washer-Lock	3	3	3	3	3	3	3	3	60
	11	21536	Head-Mounting	1	1	1	1	1	1	1	1	-
	12	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	13	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	14	AN505-6-5	Screw	4	4	4	4	4	4	4	4	80
	15	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	16	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	17	13210	Washer	1	1	1	1	1	1	1	1	-
	18	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	19	90192	Nut-Spline	1	-	1	-	1	-	-	-	-
	20	121253	Nut-Spline	-	1	-	1	-	1	-	-	-
	21	90194	Nut-Spline	-	-	-	-	-	-	1	-	-
	22	121252	Nut-Spline	-	1	-	1	-	1	-	1	-
	23	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	24	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	25	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	26	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	27	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	28	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	29	13207	Nut-Clutch Adjusting	1	1	1	1	1	1	1	1	5
	30	121824	Nut-Clutch Adjusting	1	1	1	1	1	1	1	1	5
	31	11138	Screw-Clutch Adjusting	1	1	1	1	1	1	1	1	10
	32	90193	Shaft-Screw	1	1	1	1	1	1	1	1	-
	33	90195	Shaft-Screw	1	1	1	1	1	1	1	1	-
			Shaft Assy-Screw	1	1	1	1	1	1	1	1	
	34	121254	Shaft-Screw	1	1	1	1	1	1	1	1	-
	35	121255	Shaft-Screw	1	1	1	1	1	1	1	1	-
	36	121256	Screw-Meshing	1	1	1	1	1	1	1	1	10
	37	81092	Spring-Meshing	1	1	1	1	1	1	1	1	10
	38	121241	Spring-Meshing	1	1	1	1	1	1	1	1	10
	39	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	40	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	41	89633	Jaw-Starter	1	1	1	1	1	1	1	1	5
	42	121248	Jaw-Starter	1	1	1	1	1	1	1	1	5
	43	89635	Jaw-Starter	1	1	1	1	1	1	1	1	5
	44	121250	Jaw-Starter	1	1	1	1	1	1	1	1	5
	45	76288	Nut	1	1	1	1	1	1	1	1	15
	46	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-9-B	397-9-C	397-10-B	397-10-C	397-11-B	397-11-C	397-12-B	397-12-C	
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	47	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	48	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	49	46913	Stud	3	3	3	3	3	3	3	3	30
	50	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	51	117071	Washer	3	3	3	3	3	3	3	3	45
	52	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	53	21529	Bolt	3	3	3	3	3	3	3	3	30
	54	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	55	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	56	117071	Washer	3	3	3	3	3	3	3	3	45
	57	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	58	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	59	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	60	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	61	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	62	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	63	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	64	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	65	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	66	21532	Spacer	1	-	1	-	1	-	1	-	-
	67	837625	Spacer	-	1	-	1	-	1	-	1	-
	68	21590	Screw	6	6	6	6	6	6	6	6	60
	69	18357	Washer	6	6	6	6	6	6	6	6	60
	70	21524	Head-Intermediate	1	1	1	1	1	1	1	1	
	71	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	72	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	73	21596	Yoke	1	1	1	1	1	1	1	1	-
	74	21182	Coils Assy-Field	1	-	1	-	1	-	1	-	5
	75	21592	Coils Assy-Field	-	1	-	1	-	1	-	1	5
	76	12059	Post-Field	1	1	1	1	1	1	1	1	15
	77	114036	Terminal	1	1	1	1	1	1	1	1	-
	78	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	79	21014	Screw	4	4	4	4	4	4	4	4	60
	80	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	81	20504-13	Bearing-Ball	1	-	1	-	1	-	1	-	20
	82	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	83	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	-
	84	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	85	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	86	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	87	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	88	12582	Screw	2	2	2	2	2	2	2	2	20
	89	2426	Washer	2	2	2	2	2	2	2	2	30
	90	29589	Insulator	1	1	1	1	1	1	1	1	30
	91	56334	Washer-Grounding	1	1	1	2	1	1	1	2	30
	92	6069-1	Washer	1	1	1	1	1	1	1	1	15
	93	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	94	18917-1	Nut	1	1	1	1	1	1	1	1	15
	95	29589	Insulator	1	1	1	1	1	1	1	1	30
	96	82280	Washer	1	1	1	1	-	-	-	-	15
	97	6069-1	Washer	1	1	1	1	1	1	1	1	15
	98	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	99	18917-1	Nut	2	2	2	2	2	2	2	2	30
	100	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	101	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	102	7318	Cover-Terminal	1	1	1	1	1	1	1	1	100

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-9-B	397-9-C	397-10-B	397-10-C	397-11-B	397-11-C	397-12-B	397-12-C	
	103	113852	Screw	4	4	4	4	4	4	4	4	60
	104	20500-44	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	105	838007	Bearing	1	1	1	1	1	1	1	1	20
	106	837626	Spacer	1	1	1	1	1	1	1	1	20
	107	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	108	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	109	80330	Cap-Front Bearing	1	1	1	1	1	1	1	1	-
	110	11558	Screw	4	4	4	4	4	4	4	4	60
	111	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	112	20506-7	Screw	4	4	4	4	4	4	4	4	80
	113	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	114	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	115	4072	Nut-Ring	1	1	1	1	1	1	1	1	10
	116	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	117	70449	Cover-Shield	-	-	-	-	1	1	1	1	-
	118	16836	Screw	-	-	-	-	2	2	2	2	30
	119	33338	Washer	-	-	-	-	2	2	2	2	30
	120	28383	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	121	29274	Washer	-	-	-	-	1	1	1	1	15
	122	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
				A	-	A	A	A	-	A	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-13-B 397-14-B 397-15-B 397-16-B
397-13-C 397-14-C 397-15-C 397-16-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-13-B	397-13-C	397-14-B	397-14-C	397-15-B	397-15-C	397-16-B	397-16-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845483	Plate Assy-Baffle	-	1	-	-	-	1	-	-	100
	3	121242	Plate Assy-Baffle	-	-	-	1	-	-	-	1	100
	4	46995	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	5	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	6	15132	Spring	1	-	1	-	1	-	1	-	100
	7	837637	Spring	-	1	-	-	-	1	-	-	100
	8	42425	Ring-Pilot	1	1	1	1	1	1	1	1	-
	9	AN500-8-6	Screw	3	3	3	3	3	3	3	3	45
	10	AN936A-8	Washer-Lock	3	3	3	3	3	3	3	3	60
	11	21536	Head-Mounting	1	1	1	1	1	1	1	1	-
	12	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	13	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	14	AN505-6-5	Screw	4	4	4	4	4	4	4	4	60
	15	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	16	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	17	13210	Washer	1	1	1	1	1	1	1	1	-
	18	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	19	90192	Nut-Spline	1	-	-	-	1	-	-	-	-
	20	121253	Nut-Spline	-	1	-	-	-	1	-	-	-
	21	90194	Nut-Spline	-	-	1	-	-	-	1	-	-
	22	121252	Nut-Spline	-	-	-	1	-	-	-	1	-
	23	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	24	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	25	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	26	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	27	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	28	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	29	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	30	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	31	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	32	90193	Shaft-Screw	1	-	-	-	1	-	-	-	
	33	90195	Shaft-Screw	-	-	1	-	-	-	1	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	34	121254	Shaft-Screw	-	1	-	-	-	1	-	-	-
	35	121255	Shaft-Screw	-	-	-	1	-	-	-	1	-
	36	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	37	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	38	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	39	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	40	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	41	89633	Jaw-Starter	1	-	-	-	1	-	-	-	5
	42	121248	Jaw-Starter	-	1	-	-	-	1	-	-	5
	43	89635	Jaw-Starter	-	-	1	-	-	-	1	-	5
	44	121250	Jaw-Starter	-	-	-	1	-	-	-	1	5
	45	76288	Nut	1	1	1	1	1	1	1	1	15

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-13-B	397-13-C	397-14-B	397-14-C	397-15-B	397-15-C	397-16-B	397-16-C	
	46	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy.-Planetary	1	1	1	1	1	1	1	1	
	47	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	48	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	49	46913	Stud	3	3	3	3	3	3	3	3	30
	50	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	51	117071	Washer	3	3	3	3	3	3	3	3	45
	52	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	53	21529	Bolt	3	3	3	3	3	3	3	3	30
	54	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	55	46914	Washer	3	3	3	3	3	3	3	3	45
	56	117071	Washer	3	3	3	3	3	3	3	3	45
	57	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	58	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	59	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	60	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	61	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	62	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	63	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	64	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	65	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	66	21532	Spacer	1	-	1	-	1	-	1	-	-
	67	837625	Spacer	-	1	-	1	-	1	-	1	-
	68	21590	Screw	6	6	6	6	6	6	6	6	60
	69	18357	Washer	6	6	6	6	6	6	6	6	60
	70	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	71	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	72	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	73	21596	Yoke	1	1	1	1	1	1	1	1	-
	74	21182	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	75	21592	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	76	12059	Post-Field	1	1	1	1	1	1	1	1	15
	77	114036	Terminal	1	1	1	1	1	1	1	1	-
	78	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	79	21014	Screw	4	4	4	4	4	4	4	4	(0
	80	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	81	20504-13	Bearing-Ball	1	-	1	-	1	-	1	-	20
	82	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	83	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	-
	84	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	85	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	86	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	87	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	88	12582	Screw	2	2	2	2	2	2	2	2	20
	89	2426	Washer	2	2	2	2	2	2	2	2	30
	90	29589	Insulator	1	1	1	1	1	1	1	1	30
	91	82280	Washer-Insulating	1	1	1	2	-	-	-	-	60
	92	6069-1	Washer	1	1	1	1	-	-	-	-	15
	93	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	94	18917-1	Nut	2	2	2	2	2	2	2	2	30
	95	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	96	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	97	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	98	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	99	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	100	29274	Washer	-	-	-	-	1	1	1	1	15
	101	29589	Insulator	1	1	1	1	1	1	1	1	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-13-B	397-13-C	397-14-B	397-14-C	397-15-B	397-15-C	397-16-B	397-16-C	
	102	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	103	6069-1	Washer	1	1	1	1	-	-	-	-	15
	104	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	105	18917-1	Nut	2	2	2	2	2	2	2	2	30
	106	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	107	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	108	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	109	113852	Screw	4	4	4	4	4	4	4	4	60
	110	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	111	838007	Bearing	1	1	1	1	1	1	1	1	20
	112	837626	Spacer	1	1	1	1	1	1	1	1	20
	113	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	114	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	115	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	116	11558	Screw	4	4	4	4	4	4	4	4	60
	117	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	118	20506-7	Screw	4	4	4	4	4	4	4	4	80
	119	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	120	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	121	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	122	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	123	29274	Washer	-	-	-	-	1	1	1	1	15
	124	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	125	70449	Cover-Shield	-	-	-	-	2	2	2	2	
	126	16836	Screw	-	-	-	-	4	4	4	4	60
	127	33338	Washer	-	-	-	-	4	4	4	4	60
	128	28383	Bushing-Insulating	-	-	-	-	2	2	2	2	60
				U	T	Q	H	A	-	-	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-17-B 397-18-B 397-19-B 397-20-B
397-17-C 397-18-C 397-19-C 397-20-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-17-B	397-17-C	397-18-B	397-18-C	397-19-B	397-19-C	397-20-B	397-20-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845483	Plate Assy-Baffle	-	1	-	1	-	-	-	-	100
	3	846190	Plate Assy-Baffle	-	-	-	-	-	1	-	1	100
	4	46995	Plate Assy-Baffle	1	-	1	-	-	-	-	-	100
	5	75525	Plate Assy-Baffle	-	-	-	-	1	-	1	-	100
	6	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	7	15132	Spring	1	-	1	-	1	-	1	-	100
	8	837637	Spring	-	1	-	1	-	1	-	1	100
	9	AN500-8-6	Screw	3	3	3	3	-	-	-	-	45
	10	AN505-6-5	Screw	4	4	4	4	3	3	3	3	60
	11	AN936A-8	Washer-Lock	3	3	3	3	-	-	-	-	60
	12	21536	Head-Mounting	1	1	1	1	-	-	-	-	-
	13	75527	Head-Mounting	-	-	-	-	1	1	1	1	-
	14	29150	Liner	-	-	-	-	1	1	1	1	10
	15	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	16	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	17	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	18	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	19	13210	Washer	1	1	1	1	1	1	1	1	-
	20	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	21	90192	Nut-Spline	1	-	-	-	1	-	-	-	-
	22	121253	Nut-Spline	-	1	-	-	-	1	-	-	-
	23	90194	Nut-Spline	-	-	1	-	-	-	1	-	
	24	121252	Nut-Spline	-	-	-	1	-	-	-	1	
	25	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	26	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	27	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	28	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	29	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	30	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	31	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	32	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	33	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	34	90193	Shaft-Screw	1	-	-	-	1	-	-	-	
	35	90195	Shaft-Screw	-	-	1	-	-	-	1	-	
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	36	121254	Shaft-Screw	-	1	-	-	-	1	-	-	
	37	121255	Shaft-Screw	-	-	-	1	-	-	-	1	
	38	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	39	81092	Spring	1	-	1	-	1	-	1	-	10
	40	121241	Spring	-	1	-	1	-	1	-	1	10
	41	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	42	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	43	89633	Jaw-Starter	1	-	-	-	1	-	-	-	5
	44	121248	Jaw-Starter	-	1	-	-	-	1	-	-	5
	45	89635	Jaw-Starter	-	-	1	-	-	-	1	-	5
	46	121250	Jaw-Starter	-	-	-	1	-	-	-	1	5

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-17-B	397-17-C	397-18-B	397-18-C	397-19-B	397-19-C	397-20-B	397-20-C	
	47	76288	Nut	1	1	1	1	1	1	1	1	15
	48	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	49	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	50	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	51	46913	Stud	3	3	3	3	3	3	3	3	30
	52	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	53	117071	Washer	3	3	3	3	3	3	3	3	45
	54	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	55	21529	Bolt	3	3	3	3	3	3	3	3	30
	56	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	57	46914	Washer	3	3	3	3	3	3	3	3	45
	58	117071	Washer	3	3	3	3	3	3	3	3	45
	59	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	60	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	61	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	62	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	63	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	64	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	65	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	66	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	67	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	68	21532	Spacer	1	-	1	-	1	-	1	-	-
	69	837625	Spacer	-	1	-	1	-	1	-	1	-
	70	21590	Screw	6	6	6	6	6	6	6	6	60
	71	18357	Washer	6	6	6	6	6	6	6	6	60
	72	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	73	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	74	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	75	21596	Yoke	1	1	1	1	1	1	1	1	-
	76	21182	Coils Assy-Field	1	1	-	1	-	1	-	1	5
	77	21592	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	78	12059	Post-Field	1	1	1	1	1	1	1	1	15
	79	114036	Terminal	1	1	1	1	1	1	1	1	-
	80	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	81	21014	Screw	4	4	4	4	4	4	4	4	60
	82	21537	Armature Assy	1	1	1	1	-	-	-	-	15
	83	75537	Armature Assy	-	-	-	-	1	1	1	1	15
	84	20504-13	Bearing-Ball	1	-	1	-	1	-	1	-	20
	85	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
	86	836527	Bearing-Ball	-	-	-	-	1	-	1	-	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	87	50507	Head-Front (Die Casting)	1	1	1	1	-	-	-	-	-
	88	75529	Head-Front (Sand Casting)	-	-	-	-	1	1	1	1	-
	89	117360	Liner (Service)	-	-	-	-	1	1	1	1	10
	90	50512	Board Assy-Brush	1	1	1	1	-	-	-	-	5
	91	75530	Board Assy-Brush	-	-	-	-	1	1	1	1	5
	92	50511	Post-Armature	1	1	1	1	-	-	-	-	15
	93	75532	Post-Armature	-	-	-	-	1	1	1	1	15
	94	21010	Spring	4	4	4	4	4	4	4	4	40
	95	12582	Screw	2	2	2	2	2	2	2	2	20
	96	2426	Washer	2	2	2	2	2	2	2	2	30
	97	29589	Insulator	1	1	1	1	1	1	1	1	30
	98	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	99	56334	Washer-Grounding	-	-	-	-	1	1	1	1	15
	100	6069-1	Washer	1	1	1	1	1	1	1	1	15
	101	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	102	18917-1	Nut	2	2	2	2	1	1	1	1	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-17-B	397-17-C	397-15-B	397-18-C	397-19-B	397-19-C	397-20-B	397-20-C	
	103	20500-21	Washer-Lock	1	1	1	1	-	-	-	-	20
	104	14967	Lug-Terminal	1	1	1	1	-	-	-	-	-
	105	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	106	29589	Insulator	1	1	1	1	1	1	1	1	30
	107	82280	Washer-Insulating	1	1	1	1	1	1	1	1	30
	108	6069-1	Washer	1	1	1	1	1	1	1	1	15
	109	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	110	18917-1	Nut	2	2	2	2	2	2	2	2	30
	111	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	112	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	113	7318	Cover-Terminal	1	1	1	1	1	1	1	1	100
	114	113852	Screw	4	4	4	4	4	4	4	4	60
	115	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	116	838007	Bearing	1	1	1	1	1	1	1	1	20
	117	837626	Spacer	1	1	1	1	1	1	1	1	20
	118	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	119	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	120	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	121	11558	Screw	4	4	4	4	4	4	4	4	60
	122	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	123	20506-7	Screw	4	4	4	4	4	4	4	4	80
	124	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	125	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	126	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
				T	J	Q	J	C	A	T	P	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-21-B 397-31-B 397-32-B 397-33-B
397-21-C 397-31-C 397-32-C 397-33-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-21-B	397-21-C	397-31-B	397-31-C	397-32-B	397-32-C	397-33-B	397-33-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845483	Plate Assy-Baffle	-	1	-	-	-	-	-	-	100
	3	845761	Plate Assy-Baffle	-	-	-	1	-	1	-	1	100
	4	46995	Plate Assy-Baffle	1	-	-	-	-	-	-	-	100
	5	48520	Plate Assy-Baffle	-	-	1	-	1	-	1	-	100
	6	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	7	15132	Spring	1	-	1	-	1	-	1	-	100
	8	837637	Spring	-	1	-	1	-	1	-	1	100
	9	42425	Ring-Pilot	1	1	-	-	-	-	-	-	-
	10	AN500-8-6	Screw	3	3	-	-	-	-	-	-	45
	11	AN936-A-8	Washer-Lock	3	3	-	-	-	-	-	-	60
	12	21536	Head-Mounting	1	1	-	-	-	-	-	-	-
	13	21582	Head-Mounting	-	-	1	1	1	1	1	1	-
	14	29150	Liner	-	-	1	1	1	1	1	1	10
	15	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	16	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	17	AN505-6-5	Screw	4	4	3	3	4	4	3	3	60
	18	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	19	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	20	13210	Washer	1	1	1	1	1	1	1	1	-
	21	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	22	90192	Nut-Spline	1	-	1	-	-	-	1	-	-
	23	121253	Nut-Spline	-	1	-	1	-	-	-	1	-
	24	90194	Nut-Spline	-	-	-	-	1	-	-	-	-
	25	121252	Nut-Spline	-	-	-	-	-	1	-	-	-
	26	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	27	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	28	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	29	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	30	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	31	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	32	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	33	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	34	11138	Screw-Clutch Adjusting Nut	1	-	1	-	1	-	1	-	10
	35	90193	Shaft-Screw	1	-	1	-	-	-	1	-	-
	36	90195	Shaft-Screw	-	-	-	-	1	-	-	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	37	121254	Shaft-Screw	-	1	-	-	-	1	-	-	-
	38	121255	Shaft-Screw	-	-	-	1	-	-	-	1	-
	39	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	40	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	41	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	42	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	43	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	44	89633	Jaw-Starter	1	-	1	-	1	-	1	-	5
	45	121248	Jaw-Starter	-	1	-	1	-	1	-	1	5
	46	89634	Jaw-Starter	-	-	-	-	-	-	-	-	5

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-21-B	397-21-C	397-31-B	397-31-C	397-32-B	397-32-C	397-33-B	397-33-C	
	47	121249	Jaw-Starter	-	-	-	1	-	-	-	1	5
	48	89636	Jaw-Starter	-	-	-	-	1	-	-	-	5
	49	121251	Jaw-Starter	-	-	-	-	-	1	-	-	5
	50	76288	Nut	1	1	1	1	1	1	1	1	15
	51	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	52	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	53	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	54	46913	Stud	3	3	3	3	3	3	3	3	30
	55	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	56	117071	Washer	3	3	3	3	3	3	3	3	45
	57	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	58	21529	Bolt	3	3	3	3	3	3	3	3	30
	59	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	60	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	61	117071	Washer	3	3	3	3	3	3	3	3	45
	62	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	63	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	64	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	65	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	66	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	67	21531	Spacer	1	1	1	1	1	1	1	1	-
	68	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	69	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	70	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	71	837625	Spacer	1	1	-	1	-	1	-	1	-
	72	21532	Spacer	-	-	1	-	1	-	1	-	-
	73	21590	Screw	6	6	6	6	6	6	6	6	60
	74	18357	Washer	6	6	6	6	6	6	6	6	60
	75	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	76	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	77	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coil Assy	1	1	1	1	1	1	1	1	
	78	21596	Yoke	1	1	1	1	1	1	1	1	-
	79	21182	Coil Assy-Field	1	1	1	1	-	-	1	1	5
	80	21592	Coil Assy-Field	-	-	-	-	1	1	-	-	5
	81	12059	Post-Armature	1	1	1	1	1	1	1	1	15
	82	114036	Terminal	1	1	1	1	1	1	1	1	-
	83	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	84	21014	Screw	4	4	4	4	4	4	4	4	60
	85	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	86	838215	Bearing-Ball	1	1	-	1	-	1	-	1	20
	87	836527	Bearing-Ball	-	-	1	-	1	-	1	-	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	88	50507	Head-Front (Die Casting)	1	1	-	-	-	-	-	-	-
	89	21595	Head-Front (Sand Casting)	-	-	1	1	1	1	1	1	-
	90	117360	Liner (Service)	-	-	1	1	1	1	1	1	10
	91	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	92	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	93	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	94	12582	Screw	2	2	2	2	2	2	2	2	20
	95	2426	Washer	2	2	2	2	2	2	2	2	30
	96	29589	Insulator	1	1	1	1	1	1	1	1	30
	97	56334	Washer-Grounding	1	1	1	1	1	1	1	1	15
	98	6069-1	Washer	1	1	1	1	1	1	1	1	15
	99	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	100	18917-1	Nut	1	1	1	1	1	1	1	1	15
	101	29589	Insulator	1	1	1	1	1	1	1	1	30
	102	82280	Washer-Insulating	1	1	1	1	1	1	-	-	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-21-B	397-21-C	397-31-B	397-31-C	397-32-B	397-32-C	397-33-B	397-33-C	
	103	6069-1	Washer	1	1	1	1	1	1	-	-	15
	104	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	105	18917-1	Nut	2	2	2	2	2	2	2	2	30
	106	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	107	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	108	7318	Cover-Terminal	1	1	1	1	1	1	1	-	100
	109	113852	Screw	4	4	4	4	4	4	4	4	60
	110	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	111	838007	Bearing	1	1	1	1	1	1	1	1	20
	112	837626	Spacer	1	1	1	1	1	1	1	1	20
	113	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	114	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	115	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	116	11558	Screw	4	4	4	4	4	4	4	4	60
	117	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	118	20506-7	Screw	4	4	4	4	4	4	4	4	80
	119	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	120	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	121	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	122	70448	Shield-Terminal	-	-	-	-	-	-	1	1	-
	123	70449	Cover-Shield	-	-	-	-	-	-	1	1	-
	124	16836	Screw	-	-	-	-	-	-	2	2	30
	125	33338	Washer	-	-	-	-	-	-	2	2	30
	126	28383	Bushing-Insulating	-	-	-	-	-	-	1	1	30
	127	29274	Washer	-	-	-	-	-	-	1	1	15
	128	72621	Bushing-Insulating	-	-	-	-	-	-	1	1	30
				J	K	-	A	A	A	-	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-34-B 397-35-B 397-36-B 397-37-B
397-34-C 397-35-C 397-36-C 397-37-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-34-B	397-34-C	397-35-B	397-35-C	397-36-B	397-36-C	397-37-B	397-37-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845761	Plate Assy-Baffle	-	1	-	1	-	1	-	1	100
	3	48520	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	4	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	5	15132	Spring	1	-	1	-	1	-	1	-	100
	6	837637	Spring	-	1	-	1	-	1	-	1	100
	7	21582	Head-Mounting	1	1	1	1	1	1	1	1	-
	8	29150	Liner	1	1	1	1	1	1	1	1	10
	9	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	10	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	11	AN505-6-5	Screw	4	4	3	3	4	4	3	3	60
	12	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	13	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	14	13210	Washer	1	1	1	1	1	1	1	1	-
	15	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	16	90194	Nut-Spline	1	-	-	-	1	-	-	-	-
	17	121252	Nut-Spline	-	1	-	-	-	1	-	-	-
	18	90192	Nut-Spline	-	-	1	-	-	-	1	-	-
	19	121253	Nut-Spline	-	-	-	1	-	-	-	1	-
	20	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	21	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	22	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	23	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	24	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	25	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	26	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	27	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	28	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	29	90195	Shaft-Screw	1	-	-	-	1	-	-	-	-
	30	90193	Shaft-Screw	-	-	1	-	-	-	1	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	31	121254	Shaft-Screw	-	-	-	1	-	-	-	1	-
	32	121255	Shaft-Screw	-	1	-	-	-	1	-	-	-
	33	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	34	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	35	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	36	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	37	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	38	89636	Jaw-Starter	1	-	-	-	1	-	-	-	5
	39	121251	Jaw-Starter	-	1	-	-	-	1	-	-	5
	40	89634	Jaw-Starter	-	-	1	-	-	-	1	-	5
	41	121249	Jaw-Starter	-	-	-	1	-	-	-	1	5
	42	76288	Nut	1	1	1	1	1	1	1	1	15
	43	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	44	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	45	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-34-B	397-34-C	397-35-B	397-35-C	397-36-B	397-36-C	397-37-B	397-37-C	
	46	46913	Stud	3	3	3	3	3	3	3	3	30
	47	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	48	117071	Washer	3	3	3	3	3	3	3	3	45
	49	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	50	21529	Bolt	3	3	3	3	3	3	3	3	30
	51	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	52	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	53	117071	Washer	3	3	3	3	3	3	3	3	45
	54	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	55	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	56	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	57	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	58	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	59	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	60	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	61	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	62	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	63	21532	Spacer	1	-	1	-	1	-	1	-	-
	64	837625	Spacer	-	1	-	1	-	1	-	1	-
	65	21590	Screw	6	6	6	6	6	6	6	6	60
	66	18357	Washer	6	6	6	6	6	6	6	6	60
	67	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	68	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	69	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	70	21596	Yoke	1	1	1	1	1	1	1	1	-
	71	21592	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	72	21182	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	73	12059	Post-Armature	1	1	1	1	1	1	1	1	15
	74	114036	Terminal	1	1	1	1	1	1	1	1	-
	75	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	76	21014	Screw	4	4	4	4	4	4	4	4	60
	77	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	78	836527	Bearing-Ball	1	-	1	-	1	-	1	-	20
	79	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	80	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	-
	81	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	82	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	83	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	84	21010	Spring	4	4	4	4	4	4	4	4	40
	85	12582	Screw	2	2	2	2	2	2	2	2	20
	86	2426	Washer	2	2	2	2	2	2	2	2	30
	87	29589	Insulator	1	1	1	1	1	1	1	1	30
	88	56334	Washer-Grounding	1	1	-	-	-	-	-	-	15
	89	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	90	6069-1	Washer	1	1	1	1	1	1	-	-	15
	91	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	92	18917-1	Nut	1	1	2	2	2	2	2	2	30
	93	20500-21	Washer-Lock	-	-	1	1	1	1	1	1	20
	94	14967	Lug-Terminal	-	-	1	1	1	1	1	1	-
	95	7318	Cover-Terminal	-	-	1	1	1	1	-	-	100
	96	70448	Shield-Terminal	-	-	-	-	-	-	1	1	-
	97	72621	Bushing-Insulating	-	-	-	-	-	-	1	1	30
	98	29274	Washer	-	-	-	-	-	-	1	1	15
	99	29589	Insulator	1	1	1	1	1	1	1	1	30
	100	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	101	6069-1	Washer	-	-	1	1	1	1	-	-	15
	102	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-34-B	397-34-C	397-35-B	397-35-C	397-36-B	397-36-C	397-37-B	397-37-C	
	103	18917-1	Nut	2	2	2	2	2	2	2	2	30
	104	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	105	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	106	7318	Cover-Terminal	-	-	1	1	1	1	-	-	100
	107	113852	Screw	4	4	4	4	4	4	4	4	60
	108	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	109	838007	Bearing	1	1	1	1	1	1	1	1	20
	110	837626	Spacer	1	1	1	1	1	1	1	1	20
	111	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	112	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	113	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	114	11558	Screw	4	4	4	4	4	4	4	4	60
	115	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	116	20506-7	Screw	4	4	4	4	4	4	4	4	80
	117	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	118	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	119	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	120	70448	Shield-Terminal	1	1	-	-	-	-	1	1	-
	121	70449	Cover-Shield	1	1	-	-	-	-	2	2	-
	122	16836	Screw	2	2	-	-	-	-	4	4	60
	123	33338	Washer	2	2	-	-	-	-	4	4	60
	124	28383	Bushing-Insulating	1	1	-	-	-	-	2	2	60
	125	29274	Washer	1	1	-	-	-	-	1	1	15
	126	72621	Bushing-Insulating	1	1	-	-	-	-	1	1	30
				A	A	P	H	Q	K	-	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-38-B 397-39-B 397-40-B 397-41-B
397-38-C 397-39-C 397-40-C 397-41-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-38-B	397-38-C	397-39-B	397-39-C	397-40-B	397-40-C	397-41-B	397-41-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	121242	Plate Assy-Baffle	-	-	-	1	-	-	-	1	100
	3	845761	Plate Assy-Baffle	-	1	-	-	-	-	-	-	100
	4	845483	Plate Assy-Baffle	-	-	-	-	-	1	-	-	100
	5	48520	Plate Assy-Baffle	1	-	-	-	-	-	-	-	100
	6	46995	Plate Assy-Baffle	-	-	1	-	1	-	1	-	100
	7	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	8	15132	Spring	1	-	1	-	1	-	1	-	100
	9	837637	Spring	-	1	-	-	-	1	-	-	100
	10	42425	Ring-Pilot	-	-	1	1	1	1	1	1	-
	11	AN500-8-6	Screw	-	-	3	3	3	3	3	3	45
	12	AN936A-8	Washer-Lock	-	-	3	3	3	3	3	3	60
	13	21582	Head-Mounting	1	1	-	-	-	-	-	-	-
	14	21536	Head-Mounting	-	-	1	1	1	1	1	1	-
	15	29150	Liner	1	1	-	-	-	-	-	-	10
	16	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	17	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	18	AN505-6-5	Screw	4	4	4	4	4	4	4	4	60
	19	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	20	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	21	13210	Washer	1	1	1	1	1	1	1	1	-
	22	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	23	90194	Nut-Spline	1	-	-	-	1	-	-	-	-
	24	121252	Nut-Spline	-	1	-	-	-	1	-	-	-
	25	90192	Nut-Spline	-	-	1	-	-	-	1	-	-
	26	121253	Nut-Spline	-	-	-	1	-	-	-	1	-
	27	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	28	121212	Spring	9	9	9	9	9	9	9	9	90
	29	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	30	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	31	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	32	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	33	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	34	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	35	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	36	90195	Shaft-Screw	1	-	-	-	1	-	-	-	-
	37	90193	Shaft-Screw	-	-	1	-	-	-	1	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	38	121254	Shaft-Screw	-	-	-	1	-	-	-	1	-
	39	121255	Shaft-Screw	-	1	-	-	-	1	-	-	-
	40	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	41	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	42	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	43	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	44	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	45	89636	Jaw-Starter	1	-	-	-	1	-	-	-	5

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-38-B	397-38-C	397-39-B	397-39-C	397-40-B	397-40-C	397-41-B	397-41-C	
	46	121251	Jaw-Starter	-	1	-	-	-	1	-	-	5
	47	89634	Jaw-Starter	-	-	1	-	-	-	1	-	5
	48	121249	Jaw-Starter	-	-	-	1	-	-	-	1	5
	49	76288	Nut	1	1	1	1	1	1	1	1	15
	50	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	51	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	52	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	53	46913	Stud	3	3	3	3	3	3	3	3	30
	54	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	55	117071	Washer	3	3	3	3	3	3	3	3	45
	56	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	57	21529	Bolt	3	3	3	3	3	3	3	3	30
	58	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	59	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	60	117071	Spacer	3	3	3	3	3	3	3	3	45
	61	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	62	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	63	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	64	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	65	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	66	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	67	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	68	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	69	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	70	21532	Spacer	1	-	1	-	1	-	1	-	-
	71	837625	Spacer	-	1	-	1	-	1	-	1	-
	72	21590	Screw	6	6	6	6	6	6	6	6	60
	73	18357	Washer	6	6	6	6	6	6	6	6	60
	74	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	75	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	76	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	77	21596	Yoke	1	1	1	1	1	1	1	1	-
	78	21592	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	79	21182	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	80	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	81	114036	Terminal	1	1	1	1	1	1	1	1	-
	82	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	83	21014	Screw	4	4	4	4	4	4	4	4	60
	84	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	85	836527	Bearing-Ball	1	-	-	-	-	-	-	-	20
	86	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
	87	20504-13	Bearing-Ball	-	-	1	-	1	-	1	-	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	88	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	
	89	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	90	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	91	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	92	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	93	12582	Screw	2	2	2	2	2	2	2	2	20
	94	2426	Washer	2	2	2	2	2	2	2	2	30
	95	29589	Insulator	1	1	1	1	1	1	1	1	30
	96	56334	Washer-Grounding	-	-	1	1	1	1	1	1	15
	97	6069-1	Washer	-	-	1	1	1	1	1	1	15
	98	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	99	18917-1	Nut	2	2	1	1	1	1	1	1	30
	100	20500-21	Washer-Lock	1	1	-	-	-	-	-	-	20
	101	14967	Lug-Terminal	1	1	-	-	-	-	-	-	-

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-38-B	397-38-C	397-39-B	397-39-C	397-40-B	397-40-C	397-41-B	397-41-C	
	102	70448	Shield-Terminal	1	1	-	-	-	-	-	-	-
	103	72621	Bushing-Insulating	1	1	-	-	-	-	-	-	30
	104	29274	Washer	1	1	-	-	-	-	-	-	15
	105	29589	Insulator	1	1	1	1	1	1	1	1	30
	106	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	107	6069-1	Washer	-	-	1	1	1	1	-	-	15
	108	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	109	18917-1	Nut	2	2	2	2	2	2	2	2	30
	110	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	111	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	112	7318	Cover-Terminal	-	-	1	1	1	1	-	-	100
	113	113852	Screw	4	4	4	4	4	4	4	4	60
	114	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	115	838007	Bearing	1	1	1	1	1	1	1	1	20
	116	837626	Spacer	1	1	1	1	1	1	1	1	20
	117	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	118	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	119	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	120	11558	Screw	4	4	4	4	4	4	4	4	60
	121	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	122	20506-7	Screw	4	4	4	4	4	4	4	4	80
	123	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	124	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	125	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	126	72621	Bushing-Insulating	1	1	-	-	-	-	1	1	30
	127	29274	Washer	1	1	-	-	-	-	1	1	15
	128	70448	Shield-Terminal	1	1	-	-	-	-	1	1	-
	129	70449	Cover-Shield	2	2	-	-	-	-	1	1	-
	130	16836	Screw	4	4	-	-	-	-	2	2	60
	131	33338	Washer	4	4	-	-	-	-	2	2	60
	132	28383	Bushing-Insulating	2	2	-	-	-	-	1	1	60
				A	A	B	A	A	-	B	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-42-B 397-43-B 397-44-B 397-45-B
397-42-C 397-43-C 397-44-C 397-45-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-42-B	397-42-C	397-43-B	397-43-C	397-44-B	397-44-C	397-45-B	397-45-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	845483	Plate Assy-Baffle	-	1	-	-	-	1	-	-	100
	3	121242	Plate Assy-Baffle	-	-	-	1	-	-	-	1	100
	4	46995	Plate Assy-Baffle	1	-	1	-	1	-	1	-	100
	5	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	6	15132	Spring	1	-	1	-	1	-	1	-	100
	7	837637	Spring	-	1	-	-	-	1	-	-	100
	8	42425	Ring-Pilot	1	1	1	1	1	1	1	1	-
	9	AN500-8-6	Screw	3	3	3	3	3	3	3	3	45
	10	AN936A-8	Washer-Lock	3	3	3	3	3	3	3	3	60
	11	21536	Head-Mounting	1	1	1	1	1	1	1	1	-
	12	21594	Barrel-Driving	1	1	1	1	1	1	1	1	-
	13	21593	Gear-Annulus	1	1	1	1	1	1	1	1	-
	14	AN505-6-5	Screw	4	4	4	4	4	4	4	4	60
	15	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	16	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	17	13210	Washer	1	1	1	1	1	1	1	1	-
	18	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	-
	19	90194	Nut-Spline	1	-	1	-	-	-	1	-	-
	20	121252	Nut-Spline	-	1	-	-	-	1	-	-	-
	21	121253	Nut-Spline	-	-	-	1	-	-	-	1	-
	22	90194	Nut-Spline	-	-	-	-	1	-	-	-	-
	23	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	-
	24	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	25	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	26	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	-
	27	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	-
	28	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	29	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	30	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	31	11138	Screw-Clutch Adjusting	1	-	1	-	1	-	1	-	10
	32	90195	Shaft-Screw	1	-	-	-	1	-	-	-	-
	33	90193	Shaft-Screw	-	-	1	-	-	-	1	-	-
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	34	121254	Shaft-Screw	-	-	-	1	-	-	-	1	-
	35	121255	Shaft-Screw	-	1	-	-	-	1	-	-	-
	36	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	37	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	38	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	39	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	40	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	41	89636	Jaw-Starter	1	-	-	-	1	-	-	-	5
	42	121251	Jaw-Starter	-	1	-	-	-	1	-	-	5
	43	89634	Jaw-Starter	-	-	1	-	-	-	1	-	5
	44	121249	Jaw-Starter	-	-	-	1	-	-	-	1	5
	45	76288	Nut	1	1	1	1	1	1	1	1	15
	46	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-42-B	397-42-C	397-43-B	397-43-C	397-44-B	397-44-C	397-45-B	397-45-C	
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	47	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	48	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	49	46913	Stud	3	3	3	3	3	3	3	3	30
	50	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	51	117071	Spacer	3	3	3	3	3	3	3	3	45
	52	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	53	21529	Bolt	3	3	3	3	3	3	3	3	30
	54	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	55	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	56	117071	Spacer	3	3	3	3	3	3	3	3	45
	57	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	58	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	59	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	60	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	61	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	62	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	63	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	64	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	65	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	66	21532	Spacer	1	-	1	-	1	-	1	-	-
	67	837625	Spacer	-	1	-	1	-	1	-	1	-
	68	21590	Screw	6	6	6	6	6	6	6	6	60
	69	18357	Washer	6	6	6	6	6	6	6	6	60
	70	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	71	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	72	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	73	21596	Yoke	1	1	1	1	1	1	1	1	-
	74	21592	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	75	21182	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	76	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	77	114036	Terminal	1	1	1	1	1	1	1	1	-
	78	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	79	21014	Screw	4	4	4	4	4	4	4	4	60
	80	21537	Armature Assy	1	1	1	1	1	1	1	1	15
	81	20504-13	Bearing-Ball	1	-	1	-	1	-	1	-	20
	82	838215	Bearing-Ball	-	1	-	1	-	1	-	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	83	21595	Head-Front (Sand Casting)	1	1	1	1	1	1	1	1	-
	84	117360	Liner (Service)	1	1	1	1	1	1	1	1	10
	85	50512	Board Assy-Brush	1	1	1	1	1	1	1	1	5
	86	50511	Post-Armature	1	1	1	1	1	1	1	1	15
	87	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	88	12582	Screw	2	2	2	2	2	2	2	2	20
	89	2426	Washer	2	2	2	2	2	2	2	2	30
	90	29589	Insulator	1	1	1	1	1	1	1	1	30
	91	56334	Washer-Grounding	1	1	-	-	-	-	-	-	15
	92	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	93	6069-1	Washer	1	1	1	1	1	1	-	-	15
	94	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	95	18917-1	Nut	1	1	2	2	2	2	2	2	30
	96	20500-21	Washer-Lock	-	-	1	1	1	1	1	1	20
	97	14967	Lug-Terminal	-	-	1	1	1	1	1	1	-
	98	7318	Cover-Terminal	-	-	1	1	1	1	-	-	100
	99	70448	Shield-Terminal	-	-	-	-	-	-	1	1	-
	100	72621	Bushing-Insulating	-	-	-	-	-	-	1	1	30
	101	29274	Washer	-	-	-	-	-	-	1	1	15
	102	29589	Insulator	1	1	1	1	1	1	1	1	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-42-B	397-42-C	397-43-B	397-43-C	397-44-B	397-44-C	397-45-B	397-45-C	
	103	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	104	6069-1	Washer	-	-	1	1	1	1	-	-	15
	105	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	106	18917-1	Nut	2	2	2	2	2	2	2	2	30
	107	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	108	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	109	7318	Cover-Terminal	-	-	1	1	1	1	-	-	100
	110	113852	Screw	4	4	4	4	4	4	4	4	60
	111	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	112	838007	Bearing	1	1	1	1	1	1	1	1	20
	113	837626	Spacer	1	1	1	1	1	1	1	1	20
	114	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	115	20503-9	Pin-Cotter	1	1	1	1	1	1	1	1	110
	116	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	117	11558	Screw	4	4	4	4	4	4	4	4	60
	118	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	119	20506-7	Screw	4	4	4	4	4	4	4	4	80
	120	20500-22	Washer-Lock	4	4	4	4	4	4	4	4	80
	121	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	122	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
	123	70448	Shield-Terminal	1	1	-	-	-	-	1	1	-
	124	70449	Cover-Shield	1	1	-	-	-	-	1	1	-
	125	16836	Screw	2	2	-	-	-	-	2	2	60
	126	33338	Washer	2	2	-	-	-	-	2	2	60
	127	28383	Bushing-Insulating	1	1	-	-	-	-	1	1	60
	128	29274	Washer	1	1	-	-	-	-	1	1	15
	129	72621	Bushing-Insulating	1	1	-	-	-	-	1	1	30
				A	A	R	G	N	J	A	A	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-46-B	397-46-C	397-47-B	397-47-C	397-48-B	397-48-C	397-49-B	397-49-C	
	47	89634	Jaw-Starter	-	-	1	-	-	1	-	-	5
	48	121249	Jaw-Starter	-	-	-	1	-	-	-	1	5
	49	76288	Nut	1	1	1	1	1	1	1	1	15
	50	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	51	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	52	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	53	46913	Stud	3	3	3	3	3	3	3	3	30
	54	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	55	117071	Spacer	3	3	3	3	3	3	3	3	45
	56	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	57	21529	Bolt	3	3	3	3	3	3	3	3	30
	58	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	59	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	60	117071	Spacer	3	3	3	3	3	3	3	3	45
	61	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	62	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	63	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	64	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	65	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	66	21531	Spacer-Bearing	1	1	1	1	1	1	1	1	-
	67	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	68	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	69	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	70	21532	Spacer	1	-	1	1	1	1	-	-	-
	71	837625	Spacer	-	1	-	-	-	-	1	1	-
	72	21590	Screw	6	6	6	6	6	6	6	6	60
	73	18357	Washer	6	6	6	6	6	6	6	6	60
	74	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	75	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	76	838752	Spring-Floating Bearing	-	1	-	-	-	-	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	77	21596	Yoke	1	1	1	1	1	1	1	1	-
	78	21592	Coils Assy-Field	1	1	-	-	1	1	-	-	5
	79	21182	Coils Assy-Field	-	-	1	1	-	-	1	1	5
	80	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	81	114036	Terminal	1	1	1	1	1	1	1	1	-
	82	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	83	21014	Screw	4	4	4	4	4	4	4	4	60
	84	21537	Armature Assy	1	1	1	1	1	1	-	-	15
	85	75537	Armature Assy	-	-	-	-	-	-	1	1	15
	86	20504-13	Bearing-Ball	1	-	1	-	1	-	-	-	20
	87	838215	Bearing-Ball	-	1	-	-	-	-	1	1	20
	88	836527	Bearing-Ball	-	-	-	1	-	1	-	-	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	89	21595	Head-Front (Sand Casting)	1	1	-	-	-	-	-	-	-
	90	50507	Head-Front	-	-	1	1	1	1	-	-	-
	91	75529	Head-Front (Sand Casting)	-	-	-	-	-	-	1	1	-
	92	117360	Liner (Service)	1	1	-	-	-	-	1	1	10
	93	50512	Board Assy-Brush	1	1	1	1	1	1	-	-	5
	94	75530	Board Assy-Brush	-	-	-	-	-	-	1	1	5
	95	50511	Post-Armature	1	1	1	1	1	1	-	-	15
	96	75532	Post-Armature	-	-	-	-	-	-	1	1	15
	97	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	98	12582	Screw	2	2	2	2	2	2	2	2	20
	99	2426	Washer	2	2	2	2	2	2	2	2	30
	100	29589	Insulator	1	1	1	1	1	1	1	1	30
	101	82280	Washer-Insulating	-	-	1	1	1	1	-	-	30
	102	56334	Washer-Grounding	-	-	-	-	-	-	1	1	15

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

UTICA

SERVICE PARTS LIST

WITH RECOMMENDED QUANTITIES BASED ON ONE AVERAGE OVERHAUL OF 100 UNITS

STARTER-E-80 DIRECT CRANKING ELECTRIC

397-50-B 397-51-B 397-54-B 397-56-B
397-50-C 397-51-C 397-54-C 397-56-C

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-50-B	397-50-C	397-51-B	397-51-C	397-54-B	397-54-C	397-56-B	397-56-C	
			Detail Assembly Drawing	1	1	1	1	1	1	1	1	
	1		Plate and Friction Ring Assy-Baffle	1	-	1	-	1	-	1	-	
	2	846190	Plate Assy-Baffle	-	1	-	-	-	-	-	1	100
	3	845483	Plate Assy-Baffle	-	-	-	1	-	-	-	-	100
	4	121247	Plate Assy-Baffle	-	-	-	-	-	1	-	-	100
	5	75525	Plate Assy-Baffle	1	-	-	-	1	-	1	-	100
	6	46995	Plate Assy-Baffle	-	-	1	-	-	-	-	-	100
	7	15130	Ring-Friction	3	-	3	-	3	-	3	-	60
	8	15132	Spring-Friction Ring	1	-	1	-	1	-	1	-	100
	9	837637	Spring	-	1	-	1	-	-	-	1	100
	10	AN505-6-5	Screw	3	3	4	4	3	3	3	3	60
	11	42425	Ring-Pilot	-	-	1	1	-	-	-	-	
	12	AN500-8-6	Screw	-	-	3	3	-	-	-	-	45
	13	AN936A-8	Washer-Lock	-	-	3	3	-	-	-	-	80
	14	75527	Head-Mounting	1	1	-	-	1	1	1	1	
	15	21536	Head-Mounting	-	-	1	1	-	-	-	-	
	16	29150	Liner	1	1	-	-	1	1	1	1	10
	17	21594	Barrel-Driving	1	1	1	1	1	1	1	1	
	18	21593	Gear-Annulus	1	1	1	1	1	1	1	1	
	19	21530	Washer-Thrust	1	1	1	1	1	1	1	1	10
	20	42088	Spacer-Clutch	1	1	1	1	1	1	1	1	
	21	13210	Washer	1	1	1	1	1	1	1	1	
	22	15142	Spacer-Clutch	1	1	1	1	1	1	1	1	
	23	90194	Nut-Spline	1	-	-	-	1	-	1	-	
	24	121252	Nut-Spline	-	1	-	-	-	1	-	1	
	25	90192	Nut-Spline	-	-	1	-	-	-	-	-	
	26	121253	Nut-Spline	-	-	-	1	-	-	-	-	
	27	15191	Ring Assy-Spring	1	1	1	1	1	1	1	1	
	28	121212	Spring-Clutch	9	9	9	9	9	9	9	9	90
	29	843982	Pack Assy-Clutch	1	1	1	1	1	1	1	1	5
	30	11450	Disc-Clutch Outer	12	12	12	12	12	12	12	12	
	31	844219	Disc-Clutch Inner	11	11	11	11	11	11	11	11	
	32	14942	Ring-Lock	1	1	1	1	1	1	1	1	10
	33	13207	Nut-Clutch Adjusting	1	-	1	-	1	-	1	-	5
	34	121824	Nut-Clutch Adjusting	-	1	-	1	-	1	-	1	5
	35	11138	Screw-Clutch Adjusting Nut	1	-	1	-	1	-	1	-	10
	36	90195	Shaft-Screw	1	-	-	-	1	-	1	-	
	37	90193	Shaft-Screw	-	-	1	-	-	-	-	-	
			Shaft Assy-Screw	-	1	-	1	-	1	-	1	
	38	121254	Shaft-Screw	-	-	-	1	-	-	-	1	
	39	121255	Shaft-Screw	-	1	-	-	-	1	-	-	
	40	121256	Screw-Meshing	-	1	-	1	-	1	-	1	10
	41	81092	Spring-Meshing	1	-	1	-	1	-	1	-	10
	42	121241	Spring-Meshing	-	1	-	1	-	1	-	1	10
	43	81086	Washer-Oil Seal	1	1	1	1	1	1	1	1	15
	44	81087	Washer-Oil Seal (Rubber)	1	1	1	1	1	1	1	1	100
	45	76288	Nut	1	1	1	1	1	1	1	1	15
	46	AN380-2-2	Pin-Cotter	1	1	1	1	1	1	1	1	110

SERVICE PARTS LIST

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-50-B	397-50-C	397-51-B	397-51-C	397-54-B	397-54-C	397-56-B	397-56-C	
	47	89636	Jaw-Starter	1	-	-	-	1	-	1	-	5
	48	121251	Jaw-Starter	-	1	-	-	-	1	-	1	5
	49	89634	Jaw-Starter	-	-	1	-	-	-	-	-	5
	50	121249	Jaw-Starter	-	-	-	1	-	-	-	-	5
			Cage Assy-Planetary	1	1	1	1	1	1	1	1	
	51	46918	Cage-Planetary #1	1	1	1	1	1	1	1	1	-
	52	46917	Cage-Planetary #2	1	1	1	1	1	1	1	1	-
	53	46913	Stud	3	3	3	3	3	3	3	3	30
	54	46915	Washer-Small	3	3	3	3	3	3	3	3	45
	55	117071	Spacer	3	3	3	3	3	3	3	3	45
	56	20504-23	Bearing-Ball	6	6	6	6	6	6	6	6	90
	57	21529	Bolt	3	3	3	3	3	3	3	3	30
	58	46916	Pinion-Planetary	3	3	3	3	3	3	3	3	30
	59	46914	Washer-Large	3	3	3	3	3	3	3	3	45
	60	117071	Spacer	3	3	3	3	3	3	3	3	45
	61	AN320-5	Nut	6	6	6	6	6	6	6	6	60
	62	AN380-2-2	Pin-Cotter	6	6	6	6	6	6	6	6	660
	63	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	64	13235	Nut-Gear	1	1	1	1	1	1	1	1	20
	65	AN380-2-3	Pin-Cotter	1	1	1	1	1	1	1	1	110
	66	21531	Spacer	1	1	1	1	1	1	1	1	-
	67	21585	Pinion-Driving	1	1	1	1	1	1	1	1	10
	68	20521-7	Key-Woodruff	1	1	1	1	1	1	1	1	30
	69	20504-14	Bearing-Ball	1	1	1	1	1	1	1	1	20
	70	837625	Spacer	1	1	1	1	1	1	1	1	-
	71	21590	Screw	6	6	6	6	6	6	6	6	60
	72	18357	Washer	6	6	6	6	6	6	6	6	60
	73	21524	Head-Intermediate	1	1	1	1	1	1	1	1	-
	74	45753	Liner (Service)	1	1	1	1	1	1	1	1	10
	75	838752	Spring-Floating Bearing	-	1	-	1	-	1	-	1	10
			Yoke and Field Coils Assy	1	1	1	1	1	1	1	1	
	76	21596	Yoke	1	1	1	1	1	1	1	1	-
	77	21592	Coils Assy-Field	1	1	-	-	1	1	1	1	5
	78	21182	Coils Assy-Field	-	-	1	1	-	-	-	-	5
	79	12059	Post-Terminal	1	1	1	1	1	1	1	1	15
	80	114036	Terminal	1	1	1	1	1	1	-	-	-
	81	19715	Terminal	-	-	-	-	-	-	1	1	-
	82	21015	Shoe Assy-Pole	4	4	4	4	4	4	4	4	-
	83	21014	Screw	4	4	4	4	4	4	4	4	60
	84	75537	Armature Assy	1	1	-	-	1	1	1	1	15
	85	21537	Armature Assy	-	-	1	1	-	-	-	-	15
	86	838215	Bearing-Ball	1	1	1	1	1	1	1	1	20
			Head Assy-Front	1	1	1	1	1	1	1	1	
	87	75529	Head-Front (Sand Casting)	1	1	-	-	1	1	1	1	-
	88	50507	Head-Front	-	-	1	1	-	-	-	-	-
	89	117360	Liner (Service)	1	1	-	-	1	1	1	1	10
	90	75530	Board Assy-Brush	1	1	-	-	1	1	-	-	5
	91	50512	Board Assy -Brush	-	-	1	1	-	-	1	1	5
	92	75532	Post-Armature	1	1	-	-	1	1	-	-	15
	93	50511	Post-Armature	-	-	1	1	-	-	1	1	15
	94	21010	Spring-Brush	4	4	4	4	4	4	4	4	40
	95	2426	Washer	2	2	2	2	2	2	2	2	30
	96	12582	Screw	2	2	2	2	2	2	2	2	20
	97	29589	Insulator	1	1	1	1	1	1	1	1	30
	98	56334	Washer-Grounding	1	1	1	1	1	1	-	-	15
	99	6069-1	Washer	1	1	1	1	1	1	-	-	15
	100	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	101	18917-1	Nut	1	1	1	1	1	1	2	2	30
	102	72621	Bushing-Insulating	-	-	-	-	-	-	1	1	30

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

FIG. NO.	ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY PER ASSEMBLY								RECOMMENDED QUANTITY
				397-50-B	397-50-C	397-51-B	397-51-C	397-54-B	397-54-C	397-56-B	397-56-C	
	103	29274	Washer	-	-	-	-	-	-	1	1	15
	104	20500-21	Washer-Lock	-	-	-	-	-	-	1	1	20
	105	14967	Lug-Terminal	-	-	-	-	-	-	1	1	-
	106	70448	Shield-Terminal	-	-	-	-	-	-	1	1	-
	107	29589	Insulator	1	1	1	1	1	1	1	1	30
	108	82280	Washer-Insulating	1	1	1	1	-	-	-	-	30
	109	72621	Bushing-Insulating	-	-	-	-	1	1	1	1	30
	110	6069-1	Washer	1	1	1	1	-	-	-	-	15
	111	29274	Washer	-	-	-	-	1	1	1	1	15
	112	20500-9	Washer-Lock	1	1	1	1	1	1	1	1	20
	113	18917-1	Nut	2	2	2	2	2	2	2	2	30
	114	20500-21	Washer-Lock	1	1	1	1	1	1	1	1	20
	115	14967	Lug-Terminal	1	1	1	1	1	1	1	1	-
	116	7318	Cover-Terminal	1	1	1	1	-	-	-	-	100
	117	70448	Shield-Terminal	-	-	-	-	1	1	1	1	-
	118	70449	Cover-Shield	-	-	-	-	1	1	2	2	-
	119	16836	Screw	-	-	-	-	2	2	4	4	60
	120	33338	Washer	-	-	-	-	2	2	4	4	60
	121	28383	Bushing-Insulating	-	-	-	-	1	1	2	2	60
	122	113852	Screw	4	4	4	4	4	4	-	4	60
	123	17349	Screw	-	-	-	-	-	-	4	-	60
	124	AN935-8	Washer-Lock	4	4	4	4	4	4	4	4	80
			Bearing and Spacer Assy	1	1	1	1	1	1	1	1	
	125	838007	Bearing	1	1	1	1	1	1	1	1	20
	126	837626	Spacer	1	1	1	1	1	1	1	1	20
	127	844187	Nut-Bearing	1	1	1	1	1	1	1	1	10
	128	20503-9	Pin-Cotter	1	1	1	1	1	1	-	-	110
	129	AN380-2-3	Pin-Cotter	-	-	1	-	-	-	1	1	110
	130	80330	Cap-Bearing	1	1	1	1	1	1	1	1	-
	131	11558	Screw	4	4	4	4	4	4	4	4	60
	132	839317	Brush Assy	4	4	4	4	4	4	4	4	400
	133	20506-7	Screw	4	4	4	4	4	4	4	4	80
	134	AN935B-8	Washer-Lock	4	4	4	4	4	4	4	4	80
	135	42096	Strap Assy-Window	1	1	1	1	1	1	1	1	10
	136	4072	Nut-Wing	1	1	1	1	1	1	1	1	10
				S	U	P	V	M	L	K	K	

NOTE: KINDLY SPECIFY COMPLETE TYPE NUMBER OF UNIT WHEN ORDERING PARTS

CHAPTER 46 PART C

OVERHAUL INSTRUCTIONS

Direct Cranking Electric Starters

Type 398

TABLE OF CONTENTS

SECTION I
DESCRIPTION

1. IDENTIFICATION.

This chapter is applicable to all Eclipse type 398 direct cranking electric starters. These units are designed for operation from 12-volt battery systems. For AAF, Navy, and British type numbers, refer to the index of this Technical Order.

2. DESCRIPTION.

The units consist of a heavy duty integral driving motor, reduction gearing, multiple disc clutch and engaging mechanism, baffle plate oil seal and starter jaw.

a. MOTOR.—The motor consists of a set of field coils into which four pole shoes are assembled and attached to the inner periphery of the motor yoke, which in turn, is assembled into the motor housing. The entire assembly is held rigidly by four pole shoe screws. Two terminal posts protrude from the end of the motor housing. The ball-bearing mounted armature rotates within the yoke and field coil assembly. The drive end of the armature extends beyond the oil-seal plate and terminates in a drive pinion which engages with the first stage of the reduction gearing. The surface of the commutator on the other end of the shaft contacts the four brushes which are mounted on an insulated brush board attached to the motor housing. A removable window strap, assembled around the outer diameter of the motor housing, permits access to the brushes and commutator.

b. REDUCTION GEARING.—The drive pinion is mounted on a ball bearing in the intermediate housing and is keyed to the armature shaft. The pinion engages with the intermediate gear which drives through the sun gear to a set of planetary pinions. The planetary pinions rotate in a fixed annulus gear and are connected by studs to the driving barrel in the front housing.

c. CLUTCH AND ENGAGING DEVICE.—The clutch and engaging device is enclosed in the driving barrel. The barrel is supported by a plain bronze bearing in the front housing. The clutch consists of a set of discs under adjustable spring tension with alternate discs being splined to the barrel and an internally threaded nut member, or spline nut, which engages with a movable screw shaft splined to the starter jaw. Tension of the clutch springs is controlled by the clutch adjusting nut which is threaded to the driving barrel and may be rotated inward or outward to raise or lower the clutch setting as required.

d. BAFFLE PLATE AND STARTER JAW.—The jaw is splined to and rotates with the screw shaft which imparts longitudinal motion to the starter jaw for engagement with the engine jaw. The baffle plate assembly, which is attached to the mounting flange, incorporates a leather oil-seal element which fits snugly around the shank or neck of the starter jaw to prevent leakage of engine oil into the starter. Three friction shoes are assembled on the end of the baffle plate around the outer periphery of the starter jaw. Each shoe incorporates a tooth which fits into a corresponding slot in the jaw. The three shoes ride on the curved lip of the baffle plate. The friction between the shoes and the baffle plate is controlled by a spring which also serves to hold the shoes in place.

SECTION II
DISASSEMBLY, INSPECTION, REPAIR, LUBRICATION, REASSEMBLY, AND TESTS (DEPOTS ONLY)

1. GENERAL.

At the time of every engine overhaul, the starter, with its accessories, should be removed from the engine and forwarded to an overhaul activity, or returned to the manufacturer for disassembly, cleaning, inspection, replacement of worn parts, and lubrication.

a. CLUTCH TEST.—Before disassembling, set the unit up on a Prony brake test stand (MT-327) as instructed under paragraph 14., this section, and check the clutch setting. If the setting is found to be 350 pound-feet within plus 10 or minus 30 pound-feet the clutch need not be disassembled except to permit final adjustment, or, if suitable clutch adjusting and test equipment is not available and the starter has operated satisfactorily up to the time of overhaul, clutch

barrel assembly may be left intact. If the clutch setting does not fall within the prescribed limits, or if the starter is to be overhauled for a third time, in which the clutch has been left intact, the clutch shall be dismantled for inspection and lubrication as outlined herein.

b. ACCESSORIES.—For overhaul procedure on solenoid switches and booster coils refer to the applicable chapter as listed in the index of this Technical Order.

2. TOOLS.

In order to facilitate disassembly, reassembly, and adjustment of parts, the following tools are recommended:

Part No.	*Description*
MT-98	Wrench—Drive pinion nut.
MT-237	Tool—Friction ring tension checking
MT-309	Screw Driver—Bench type
MT-327	Stand—Prony brake clutch test
MT-806	Wrench—Clutch adjusting nut
MT-1197	Fixture—Intermediate housing assembly
MT-4140	Expander—Pole shoe
T-24460	Plug Gage—Pole shoe aligning

3. DISASSEMBLY—STARTER GEAR SECTION.

a. GENERAL.—Refer to the applicable detail assembly drawing and proceed according to the following outline. Remove window strap and lift out brushes. Detach the mounting head assembly from the intermediate housing and motor housing assemblies by removing the housing bolts, then separate the intermediate housing assembly from the motor housing assembly.

b. MOUNTING HEAD ASSEMBLY.—Remove friction ring spring, friction ring, meshing rod nut, starter jaw, lock ring, neoprene oil seal, and steel washer, meshing rod spring and baffle plate assembly. The clutch barrel assembly and sun gear may now be removed from the mounting head. From the clutch barrel stem, remove the large thrust washer, sun gear, and small thrust washer. The planetary pinions and the barrel assembly can be removed by removing the planetary stud screws, using screw driver press MT-309 and lifting off the planetary ring. DO NOT REMOVE ANNULUS GEAR FROM THE FRONT HOUSING UNLESS REPLACEMENT IS NECESSARY.

(1) CLUTCH.—BEFORE DISASSEMBLING CLUTCH NOTE THE DISTANCE THE CLUTCH BARREL EXTENDS OVER THE CLUTCH ADJUSTING NUT. Remove oil-seal sleeve, clutch adjusting nut lock, clutch adjusting nut, using clutch adjusting nut wrench (MT-806), spring ring, springs, spring spacer, screw shaft and spline nut assembly, and spline nut bushing. Remove clutch discs and clutch spacer. FASTEN CLUTCH DISCS TOGETHER TO RETAIN THEIR RELATIVE ORDER.

(2) INTERMEDIATE HOUSING ASSEMBLY.—Remove sun gear support bracket and spacer and mount intermediate housing assembly on assembly fixture MT-1197, drive end down. Remove the drive pinion nut lock and nut using MT-98, and the intermediate gear nut. Lift intermediate housing assembly off assembly fixture and press the drive pinion out of the ball bearing. Drive the intermediate gear out of the housing and remove intermediate gear ball bearings. Remove drive pinion bearing retainer, spacer, and bearing.

4. INSPECTION—STARTER GEAR SECTION.

After the starter has been completely disassembled, thoroughly clean all parts with carbon tetrachloride or undoped gasoline and compressed air, except where otherwise noted. Examine and check all parts for wear in accordance with the clearance chart, paragraph *i.*, below.

a. BALL BEARINGS.—Thoroughly wash all ball bearings with carbon tetrachloride or undoped gasoline and dry off with compressed air. Replace all ball bearings which are excessively loose or rough turning. DO NOT wash new bearings removed from factory sealed boxes, simply lubricate and use. For proper lubrication procedure see paragraph 5., this section.

b. CLUTCH BARREL.—If the clutch has not been disassembled, simply wipe the exterior with a cloth moistened with carbon tetrachloride or undoped gasoline. DO NOT IMMERSE COMPLETE CLUTCH BARREL ASSEMBLY IN CLEANING FLUID. If the clutch has been disassembled, however, thoroughly clean all parts and replace worn or scored clutch discs. See paragraphs 6.*b.* and 14., this section, for procedure on assembly, "running-in" new discs, and final adjustment.

c. SCREW SHAFT AND SPLINE NUT ASSEMBLY.—At every overhaul, if the clutch has been disassembled, the screw shaft and spline nut assembly must be magnafluxed and closely examined for cracks. Any evidence of cracks is sufficient cause for rejection and the complete assembly must be replaced in order to preclude the possibility of subsequent failure.

d. STARTER JAW.—The starter jaw should be magnafluxed at each overhaul and examined for wear. Replace if evidence of cracks is detected or if the depth of the flat on the leading edges of the jaw teeth is less than 1/8 inch.

e. BAFFLE PLATE.—If the oil-seal leathers are worn or torn to the extent that they are a clearance fit on the shank of the starter jaw, the baffle plate assembly should be replaced. The presence of engine oil in the starter housing may indicate a worn baffle plate or meshing rod oil seal, and replacement should be made. If the baffle plate oil seal is worn, the complete baffle plate assembly must be replaced. Do not break down the complete assembly under any conditions.

NOTE

New baffle plate assemblies should be soaked in neat's-foot oil at 37.8°C (100°F) for a period of one hour, prior to assembly, to insure free travel of the starter jaw in the baffle plate assembly.

f. MESHING ROD OIL SEAL.—Replace the neoprene oil-seal washer at every overhaul. Inspect the steel cup washer and replace if distorted or cracked.

g. MESHING ROD SPRING.—Replace meshing rod spring if the pressure required to compress it to 5/8 inch is less than 51 pounds or more than 59 pounds.

h. GEARS.—Replace all gears when face of teeth become worn or rolled to the extent that the original involute curvature of the teeth is obliterated.

i. CLEARANCE CHART.—Table 1 is provided to facilitate the inspection of parts for wear and to check clearances at assembly.

TABLE 1

Description	*Clearance*
Drive pinion ball bearing in housing	.0004T-.0003L
Drive pinion ball bearing in pinion	.0001T-.0006L
Intermediate gear ball bearings in housing	.0008T-.0000L
Intermediate gear ball bearings on shaft	.0000T-.0007L
Sun gear bushing on shaft	.0005L-.0015L
Planetary pinion bushing on stud	.0007L-.0016L
Sun gear shaft in support bracket	.0005L-.0020L

5. LUBRICATION—STARTER GEAR SECTION.

Before assembly, all bearings, gear, and other moving parts as specified, should be lubricated according to the instructions given below. The following lubricants must be used to insure proper lubrication of all starter parts. For AAF units, see T. O. No. 29-1-3:

Commercial Grease	*Manufacturer*	*AAF Specification*	*Navy Specification*
Royco No. 5	Royal Engineering Co., East Hanover, N. J.	3560 Medium	M-372 Grade B
Royco No. 7	" " " " " "	3560 Soft	M-372 Grade A
Royco No. 50	" " " " " "	3592	14-G-2
Acheson graphite No. 38	National Carbon Co., Cleveland, O.	3593	
No. 1 Esso motor oil (SAE 10W)	Standard Oil Co. of N. J.	3582	

a. DRIVE PINION BALL BEARING.—Coat with a light film of Royco No. 5.

b. INTERMEDIATE GEAR BALL BEARINGS.—Coat with a light film of Royco No. 7.

c. GEARS, PLAIN BEARINGS, AND SPLINE NUT ASSEMBLY.—Brush all gear teeth, bearing surfaces, and splines of the screw shaft and spline nut assembly with a light coating of Royco No. 50.

d. CLUTCH DISCS.—If the clutch has been disassembled, lubricate all discs with a mixture of one

part by volume of Acheson graphite No. 38 and one part by volume of No. 1 Esso motor oil.

6. REASSEMBLY—STARTER GEAR SECTION.

To reassemble the starter, follow the disassembly procedure in the reverse order and make certain that all parts are properly lubricated as specified above. Replace all locking devices and safety wire. In addition, observe the following precautions:

a. INTERMEDIATE HOUSING REASSEMBLY.—Press the drive pinion and intermediate gear ball bearings into the intermediate housing. Reassemble the drive pinion and intermediate gear into housing. Place the partially reassembled intermediate housing assembly on the assembly fixture (MT-1197) with drive end down, and tighten intermediate gear nut. Reassemble nut lock and nut on drive pinion and spacer and retainer and remove assembly from fixture MT-1197.

b. CLUTCH REASSEMBLY.

(1) Replace clutch discs in the same relative order as noted at disassembly. Tighten adjusting nut so that the barrel extends approximately the same distance over the adjusting nut as noted before disassembly. If worn or scored discs have been replaced, or an entirely new clutch pack installed, it is necessary that the clutch be "run-in" before installing in the starter in order to facilitate final clutch adjustment.

(2) To "run-in" the clutch, first lubricate the discs with a mixture of graphite and oil as instructed above under paragraph 4.*j.*, then assemble discs in barrel and set up in a clutch "run-in" stand (MT-1603). Set clutch at 300 pound-feet and slip at 8½ rpm for a period of 1 hour and 30 minutes.

CAUTION

During the "run-in" period, the barrel must be cooled by circulating water through the test fixture.

NOTE

If a clutch "run-in" stand is not available, the entire "run-in" process can be accomplished by first assembling the clutch in the starter and then setting up the assembled starter and clutch on a Prony brake test stand (MT-327) as explained under paragraph 14., this section, and follow the procedure outlined under paragraph 14.*b.*(1), this section.

c. MESHING ROD OIL SEAL.—Before reassembling the seal on the meshing rod, cement the neoprene seal to the steel cup washer with 3-M weatherstrip cement EC-226 manufactured by the Minnesota Mining and Manufacturing Co., St. Paul, Minn.

d. PLANETARY PINIONS.—It is not necessary to reassemble the planetary pinions in any specific position when meshing them with the spur pinion and fixed annulus gear.

e. BAFFLE PLATE REASSEMBLY.—Do not reassemble the baffle plate, friction shoes, and friction spring to the starter until after the clutch has been properly checked or set as outlined under paragraph 14., this section.

f. STARTER JAW.—With the starter jaw completely retracted, the travel to full advanced position should be $1\frac{1}{32}$ inch.

7. MOTOR DISASSEMBLY.

Remove motor housing bearing cap and armature shaft nut. From the drive end, remove the oil-seal assembly and armature assembly. DO NOT DISASSEMBLE POLE SHOES OR FIELD COIL ASSEMBLY UNLESS REPLACEMENT IS NECESSARY AS DETERMINED UNDER PARAGRAPH 8., IMMEDIATELY BELOW. Remove front spacer, ball bearing, and felt oil-seal washer. Further disassembly is not necessary at this time.

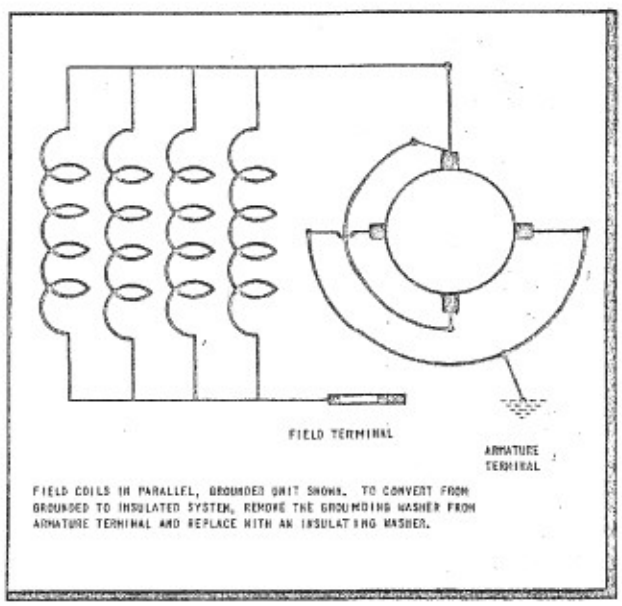


Figure 1—Schematic Internal Wiring Diagram F-141 Starter

8. MOTOR INSPECTION.

After the motor has been completely disassembled, thoroughly clean all parts with carbon tetrachloride or undoped gasoline and compressed air except where otherwise noted. Examine and check all parts for wear in accordance with the following outline and clearance chart.

a. BALL BEARING.—Thoroughly wash motor ball bearing in carbon tetrachloride, or undoped gasoline and dry off with compressed air. Replace all bearings if they are excessively loose or rough turning. DO NOT wash new bearings removed from factory sealed boxes, simply lubricate and use. For lubrication instructions refer to paragraph 4.*j*. For AAF units refer to T. O. No. 29-1-3.

b. ARMATURE.—Dip the armature assembly in a container of carbon tetrachloride or undoped gasoline and scrub thoroughly with a stiff brush. Do not soak. Dry armature with compressed air. If, however, the armature appears to be oil soaked it should be placed in an oven and baked from 2 to 4 hours at 93.3°C (200°F). This baking process allows any oil which may have collected in crevices to liquify and flow out. After baking, clean armature again as instructed above. After cleaning, the armature assembly should be subjected to the following tests.

(1) SHORTED ARMATURE.—To test for a shorted armature, a "growler" should be used.

(2) GROUNDED ARMATURE.—To test for a grounded armature, touch one side of 110-volt lamp circuit to the armature shaft. Touch the other terminal of the lamp circuit to the commutator bars. If the armature is grounded, the lamp will light.

(3) OPEN ARMATURE.—Inspect the commutator for black or burned commutator bars and be sure that all conductors are firmly soldered into the riser. Loose conductor or blackened commutator bars indicate the possibility of an open circuit.

(4) COMMUTATOR.

(a) Smooth commutator with No. 0000 sandpaper. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. After sanding thoroughly, clean commutator to remove all sand particles, otherwise excessive wear will result.

(b) If the commutator is extremely rough, pitted, or badly scored, check armature for concentricity. Commutator, bearing surfaces, and shaft centers must be concentric within .0005-inch full indicator reading. If centers are not true, mount armature on a lathe and true up.

(c) Commutator may then be turned on the centers, taking a light cut across the face, repeating, if necessary, to remove all evidence of pitting or scoring. An alternative method is to assemble bearings on shaft and mount on a lathe in a "steady rest." Concentricity of .0005 inch must be held in any case between bearing surfaces and commutator.

(d) When turning commutator, only very light cuts should be taken as there is a decided tendency for the cutting tool to dig in at the edge of the slot and spring away at the middle of the bar. Use a sharp pointed lathe tool at a cutting speed of approximately 200 surface feet per minute.

(e) The minimum diameter to which the commutator may be turned is $1\frac{5}{16}$ inches. DO NOT UNDERCUT MICA ON COMMUTATORS. Smooth and polish the commutator with No. 0000 sandpaper at approximately 700 surface feet per minute to remove any burrs. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. After sanding thoroughly clean commutator to remove all sand and metal particles, otherwise excessive wear will result. DO NOT GET OIL ON THE COMMUTATOR AT ANY TIME.

c. RESEATING BRUSHES.

(1) If the commutator has been turned, or the armature replaced, the brushes will not seat properly and it is recommended that they be "run-in" on the motor until at least 50 percent seated.

(2) If facilities are not available for "running in" brushes, then they should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator, with the sanded side in contact with the brush, and pulling in the direction of motor rotation which in all cases is the same as the jaw rotation of the particular unit. Be careful to keep the sandpaper in the same contour as the commutator. Repeat until brushes are at least 50 percent seated. DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. WHEN SEATING BRUSHES, CARE SHOULD BE TAKEN TO KEEP MOTOR BALL BEARING FREE FROM SAND OR METAL PARTICLES. AFTER SEATING, CLEAN THOROUGHLY TO REMOVE ALL FOREIGN PARTICLES FROM MOTOR ASSEMBLY, OTHERWISE EXCESSIVE WEAR WILL RESULT.

d. BRUSHES.

(1) Maximum permissible wear of brushes is 1/4 inch from a new length of $1\frac{7}{32}$ inch, or when the amount of brush remaining is $\frac{9}{32}$ inch. All of the above measurements refer to the exposed carbon portion of the brush and do not include any part of the copper cap on the top of the brush. Thus the new length of the brush is 7/8-inch over-all with a useful length of $1\frac{7}{32}$ inch.

(2) Brushes should be replaced before their maximum wear limit has been reached in order to assure proper operation until the next inspection period. To insure proper seating of new brushes refer to the instructions in the preceding paragraph *c*.

(3) Inspect brush lead sleeving and replace if burned or frayed. When installing new brushes, make sure leads are properly covered with sleeving.

e. BRUSH SPRINGS.—Check brush spring pressure with a spring compressor. Replace if pressure is less than 40 ounces or more than 44 ounces when compressed to $\frac{7}{16}$ inch.

f. MOTOR HOUSING.—Thoroughly clean motor housing with carbon tetrachloride or undoped gasoline, and dry off with compressed air. Remove the grounding washer from the grounded terminal on grounded units and test the brush board and field coil assemblies as follows:

(1) BRUSH BOARD ASSEMBLY.—With the brushes removed from the brush boxes, connect one terminal of a 110- or 220-volt lamp circuit to the brush box and touch the other lamp circuit terminal to the motor housing. The lamp will light if the board is grounded. Repeat procedure for other three brush boxes. If the board is grounded, replace it by removing the two brush board screws which secure it to the end of the motor housing.

(2) GROUNDED FIELD CIRCUIT.—To test for a grounded field circuit, connect one terminal of a 220-volt lamp circuit to one of the field coil terminals, the other field terminal being free. Touch the other terminal of the lamp circuit to the yoke momentarily. The lamp will light if the field is grounded. If the field coils have to be replaced due to a grounded circuit, proceed as outlined under paragraph 8.*g.*, this section.

(3) OPEN FIELD CIRCUIT.—Since the field coils are connected in parallel (see figure 1), a lamp circuit continuity test is no indication that all coils are in satisfactory condition, and since the field circuit resistance is very low, a resistance check by the Wheatstone bridge method is impractical. In view of this, possibility of an open field coil can best be determined after assembly when running performance tests since if one of the field coils is open, the motor at full load will draw more current than the maximum permissible limit. Of course, if the entire field circuit is open, the motor will not operate and this can be checked by connecting the two terminals of a 220-volt lamp circuit to the two field terminals. The lamp will not light if the entire field circuit is open.

g. FIELD COIL REPLACEMENT.

(1) If it is found that the field coils must be replaced, remove pole shoe screws, pole shoes, yoke, and field coils. Reassemble new coils in yoke and draw pole shoes up tight using expander MT-4140, screw driver press MT-309, and plug gage T-24460 of 2.77 inches diameter, to assure proper alignment of pole shoes and prevent interference with the armature windings.

CAUTION

When first tightening pole shoes, after replacement of coils, do not use the regular pole shoe screws. The screw heads may become scored or distorted by the yoke in pulling pole shoes up tight against the yoke. Use screws of the same diameter and thread but shorter than regular pole shoe screw by approximately the thickness of the motor housing.

(2) After reassembling field coils in the yoke, and before final reassembly in the motor housing, place in an oven and bake for 2 hours at 126.7°C (260°F). As replacement coils have been dipped in Harvel varnish No. 512C (specific gravity .830-.840) and partially baked before shipment, this 2-hour baking period causes the varnish to soften and flow into any crevices in the assembly and then finally harden during the remainder of the baking process. The entire procedure, as outlined above, results in a well bonded assembly and prevents the field coils from loosening in service.

(3) Remove the screws used to hold pole shoes in position, insert the yoke and field coil assembly in the motor housing and, using the correct pole shoe screws, draw pole shoes up tight with screw driver press MT-309. Check with plug gage T-24460 to insure proper alignment of pole shoes and preclude the possibility of interference with the armature at assembly.

b. FELT OIL SEAL.—If the felts in the motor oil-seal assembly become worn or damaged, replace the complete oil-seal assembly.

i. GASKET.—Replace the motor oil-seal gasket at each overhaul.

j. INSULATORS.—Examine terminal post insulators and replace if burned, worn, or cracked.

k. MOTOR CLEARANCE CHART.—Table 2 is provided to facilitate the inspection of parts for wear and to check clearances when reassembling the motor.

TABLE 2

Description	*Clearance*
Motor housing ball bearing in housing	.0008T-.0000L
Motor housing ball bearing on armature	.0000T-.0007L

9. MOTOR LUBRICATION.

Lubricate the motor housing ball bearing with a light coating of Royco No. 5. For AAF units refer to T. O. No. 29-1-3.

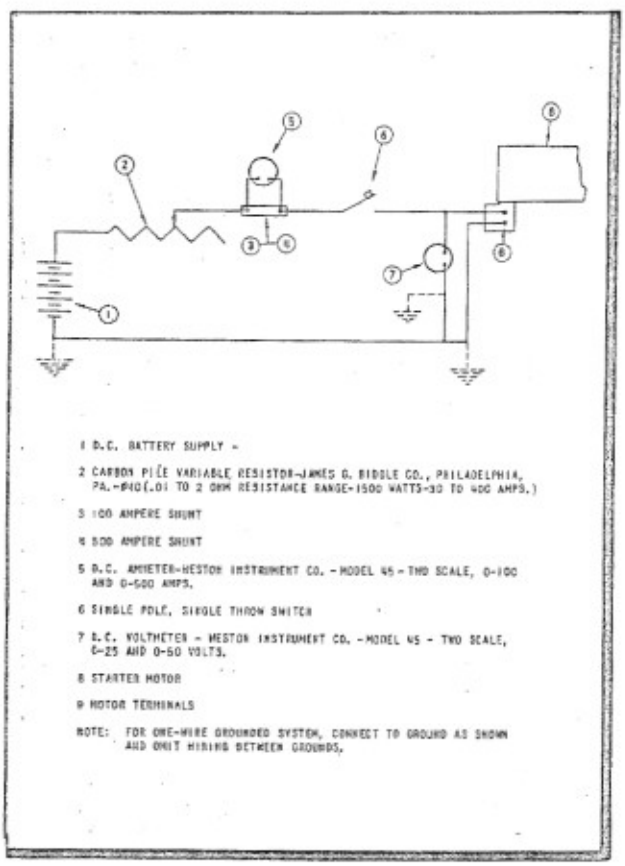


Figure 2—Electrical Test Set-Up F-141 Starter

10. MOTOR REASSEMBLY.

a. GENERAL.—Follow the disassembly procedure in the reverse order.

b. BRUSHES.—The brushes should be a free fit without excessive side play in the brush boxes. If brushes bind in the brush boxes, wipe both brushes and brush boxes clean with a gasoline moistened cloth. New brushes should be seated as instructed under paragraph 8.*c.*, this section.

11. MOTOR TEST AT REASSEMBLY.

After the motor has been reassembled, it is recommended that it be given a free run test to check performance. In order to operate the motor alone it will be necessary to assemble a temporary intermediate head to provide support for the drive end of the armature shaft. Use a discarded intermediate head, with a drive pinion and ball bearing assembled therein and attach it to the motor housing. Clamp the outer race of the motor ball bearing in the housing temporarily with a washer and a screw using the holes for the bearing cap screws, otherwise the vibration may cause the bearing to slip out of housing.

a. ELECTRICAL CONNECTIONS.—Refer to test diagram, figure 2, and connect the d-c power supply (1), which may be either a battery or a motor generator, through the carbon stack variable resistor (2), a Weston model 45 ammeter (0-100) scale using a 100-ampere shunt, and a single pole single throw switch (6), from which a lead is connected to one of the starter terminals. Connect a Weston model 45 voltmeter across the motor terminals as shown.

b. "FREE-RUN" TEST.—Loosen the carbon stack to obtain the maximum resistance then close the motor circuit. Check the motor "free-run" characteristics by adjusting the variable resistor to obtain 8 volts across the motor terminals. With the above terminal voltage the current draw should not exceed 42 amperes and the armature speed should be not less than 5500 rpm. DO NOT APPLY MORE THAN 8 VOLTS ACROSS MOTOR TERMINALS DURING "FREE-RUN" TEST AS EXCESSIVE SPEED WILL RESULT AND MAY CAUSE SERIOUS DAMAGE TO THE MOTOR. If, with 8 volts across the motor terminals, the current draw exceeds 42 amperes and the motor overspeeds, accompanied by excessive arcing of the brushes, the indications are that one or more of the field coils are open, in which case the entire assembly must be replaced as instructed above in paragraph 8.*g.*

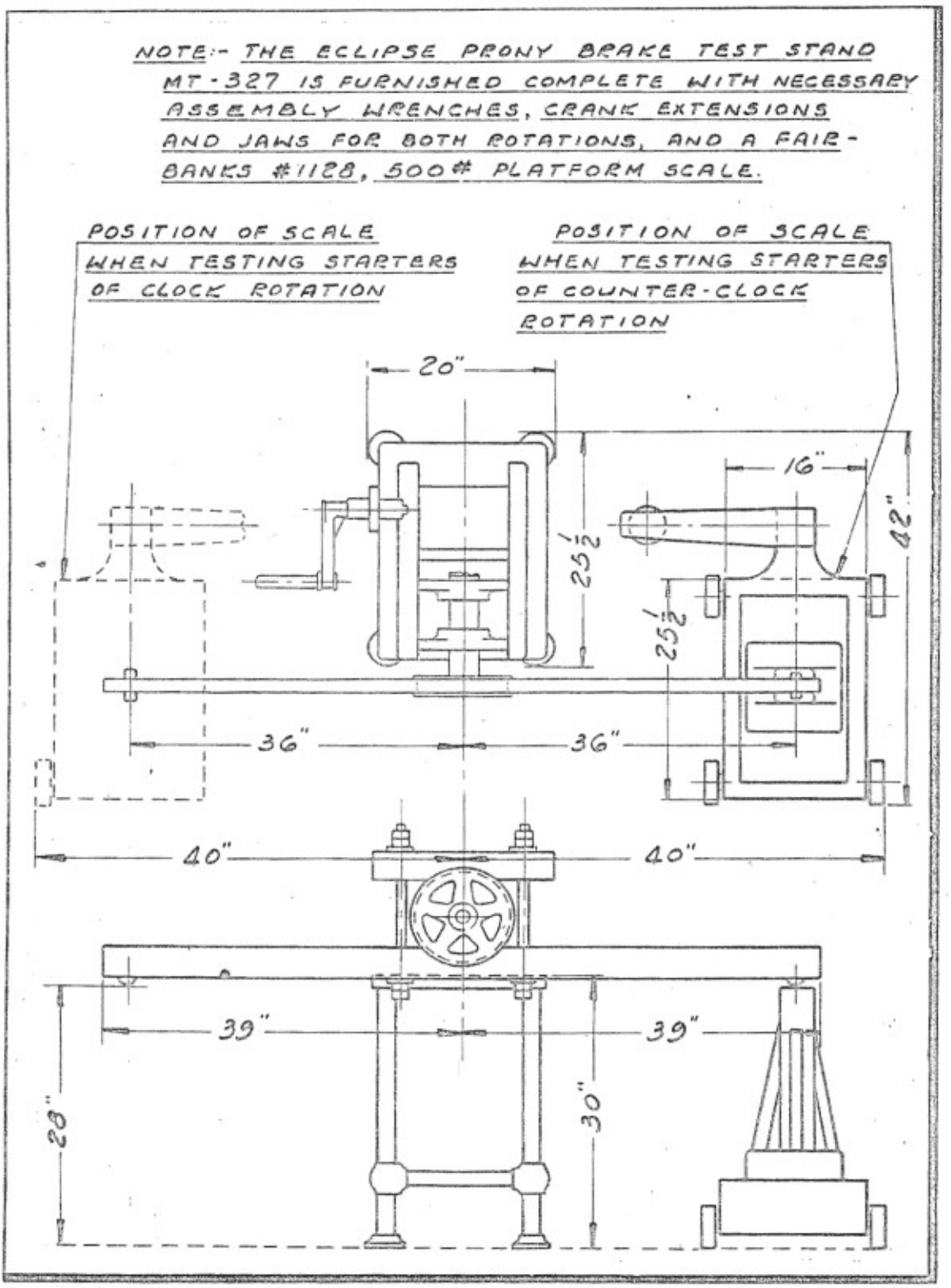


Figure 3—Schematic Diagram of Prony Brake Test Stand MT-327

c. INSULATION TEST.—After "free-run" test, and while the motor is still hot, the unit should be checked for insulation break-down. Remove the grounding washer and apply one terminal of the a-c or d-c test lamp circuit to one of the motor terminals and touch the other test lamp terminal to the motor housing. If the lamp lights, the unit is grounded and must be disassembled for replacement of faulty parts.

12. STARTER REASSEMBLY.

Remove temporary intermediate head and reassemble the proper intermediate head assembly to the motor. Attach the sun gear shaft support bracket to the intermediate head and then bolt the front housing assembly to the rest of the starter.

13. STARTER CONVERSION.

In the event that it is desired to convert a starter of one rotation to that of the opposite rotation, observe the following procedure. Disassemble to permit replacement of field coil assembly, spline nut assembly and starter jaw with equivalent parts for opposite rotation. Refer to T. O. No. 03-1-5 for part numbers involved. The name plate of the unit should be replaced with one indicating the correct model designation and rating for the unit as converted.

14. CLUTCH ADJUSTMENT AND TEST.

a. GENERAL.—In order to check or adjust starter clutches and to test the units for proper operation after reassembly, a Prony brake test stand (MT-327) with a platform scale is required as shown in the schematic diagram, figure 3. With the baffle plate removed, mount the starter on test stand and adjust mounting bracket of stand so that the distance between the starter jaw and the test stand jaw is $\frac{3}{32}$ inch when starter jaw is retracted fully. Removal of baffle plate necessitates manual engagement of starter jaw. When adjusting starter clutch, as outlined below, care should be taken to gradually attain the required setting WITHOUT OVERHEATING.

b. CHECKING CLUTCH SETTING.—If clutch discs have not been disturbed or the setting altered during overhaul, the clutch setting can be checked as follows: lock the brake drum and operate starter for a period of 2 seconds. Repeat the above procedure five times at 1-minute intervals. If the torque reading on the scale remains constant at 350 pound-feet within ± 10 pound-feet, it can be considered satisfactory. To lower the clutch setting, loosen clutch adjusting nut; to raise setting, tighten nut. After the correct setting has been obtained, allow starter to cool to room temperature and operate starter five consecutive times to determine if setting remains constant.

(1) WHEN REPLACEMENT CLUTCH DISCS HAVE NOT BEEN "RUN IN."—If the clutch discs have not been previously "run in," observe the following procedure, bearing in mind that during the entire process the starter front housing should not be allowed to heat up so that it cannot be touched with the hand. If the clutch does heat up, allow it to cool before continuing with the "run-in" process.

(a) Adjust clutch to 175 pound-feet.

(b) Lock brake and operate starter 30 times (2 seconds each time) at 1-minute intervals.

(c) After completing the 30 engagements, increase setting to 275 pound-feet. Operate starter three times (2 seconds each time) at 1-minute intervals.

(d) Increase clutch setting to 350 pound-feet and operate three times as above.

(e) Allow clutch to cool for one-half hour.

(f) After cooling, operate starter 20 times (2 seconds each time) at 1-minute intervals. If clutch setting shows a tendency to climb, readjust to 350 pound-feet and repeat engagement until setting remains constant for 20 engagements.

(g) Allow clutch to cool for one-half hour.

(h) After cooling, engage starter three times as a final check that the correct setting is maintained.

15. PERFORMANCE TEST.

Connect the starter motor as instructed under paragraph 11., this section (figure 2), and assemble unit on Prony brake test stand. (See figure 3.) Using the 500-ampere shunt on the ammeter, proceed as follows:

a. FREE RUN.—Unlock test stand brake drum to permit starter to operate without a load. Adjust the terminal voltage applied at the starter to 10.4 volts by means of the variable resistor. Under the above conditions the starter should operate at a minimum speed of 7000 rpm with a maximum current draw of 65 amperes.

b. LOAD RUN.—Adjust brake drum to provide a load of 200 pound-feet and the terminal voltage to 8.8 volts. Under these conditions the minimum speed should be 2800 rpm with a maximum current draw of 225 amperes. A low torque output, excessive sparking of brushes, with a current draw in excess of 225 amperes,

indicates the possibility of an open field coil as explained under paragraph 8.*f.*(3), this section.

16. FINAL REASSEMBLY AND TEST.

Remove the starter from test stand and reassemble baffle plate, friction shoes, and friction spring. Tests have proved that the clutch adjusting nut lock is not necessary. Check the friction ring assembly on the baffle plate to ascertain if spring has sufficient tension to hold the starter jaw in position so that it will advance freely forward to mesh with engine jaw before starting to rotate. If the jaw fails to advance when the starter is operated, or if the spring tension, as measured with tool MT-237, is less than 9 ounces or more than 15 ounces, replace the friction spring.

SECTION III
PARTS CATALOG

Reference to T. O. No. 03-1-5 is required when ordering service replacement parts. Refer to the applicable cross-sectional assembly drawing for identification of part number and local quantity of parts required. To determine part name, refer to numerical list of service parts. When ordering parts, specify part name and number as well as type, model, and style letter appearing on name plate of unit for which parts are desired.

SECTION IV
SHIPMENT AND STORAGE

1. PACKING FOR SHIPMENT.

For domestic shipment, units should be wrapped in waterproof paper and packed securely in a wooden box (Army Specification No. 23-54). Packing for export is identical except that the case should be lined with waterproof paper and fastened with metal straps. For AAF units, cases are to be marked for shipment in accordance with AAF Specification No. 100-2, latest issue.

2. STORAGE.

After completing overhaul and prior to installing starter on engine, it is recommended that reference be made to part "A" of this chapter for the installation procedure. However, if the unit is to be placed in storage first, no special preparations are necessary other than to wrap each unit individually in oiled waterproof paper and store in a cool, dry place.

RESTRICTED

FOR OFFICIAL USE ONLY

T. O. NO. 03-1-5

PARTS CATALOG
AND
INTERCHANGEABLE PARTS LIST
FOR
ECLIPSE AIRCRAFT ACCESSORY EQUIPMENT

This Technical Order replaces T. O. No. 03-1-5 dated 5 September 1942 and T. O. No. 03-1-5A dated 1 June 1944.

Published by authority of the Commanding General, Army Air Forces, and accepted by the Chief of the Bureau of Aeronautics and the Air Council of the United Kingdom. As the text was prepared prior to the adoption of AN Handbook specifications, a Technical Order number is used in lieu of an AN number.

NOTICE: This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

RESTRICTED

R. & R. DAYTON—1-24-45—4M

1 NOVEMBER 1944

ECLIPSE TYPE NO.	2 MODEL NO.	3 STYLE LETTER	4 MANUFACTURER'S DRAWING NO.	5 SUPERSEDED MANUFACTURER'S DRAWING NO.	6 AAF TYPE NO.	7 T.O. NO.	8 NAF PART NO.	9 BRITISH REF. NO.	10 OPERATING MANUAL CHAPTER	11 OVERHAUL MANUAL CHAPTER	12 AAF T.O. NO.
SOLENOID • RELAY (Continued)											
518	12	A	518-12-A	C- 80558							
518	15	A	518-15-A	C- 80001							
518	18	A	518-18-A	C- 80048				137F/56			
518	19	A	518-19-A	C- 66198				137F/23			
518	21	A	518-21-A	C- 93473							
518	22	A	518-22-A	C-112472							
518	23	A	518-23-A	C-116720							
519	1	A	519- 1-A	C- 60374				137F/131			
519	2	A	519- 2-A	C- 61949							
706	1	A	706- 1-A	C- 82001							03-5C-2
952	1	A	952- 1-A	C- 55186							
952	2	A	952- 2-A	C- 55380							
987	3	A	987- 3-A	C-114370	B-4						AN 03-5-71
SOLENOID • SWITCH & RESISTOR											
600	2	A	600- 2-A	E- 95038					26A	26B	03-1-6
824	1	A	824- 1-A	D- 94655					26A	26B	03-1-6
STARTER • CARTRIDGE											
408	1	A	408- 1-A	F- 75725		I			39A	39B	03-1-6
408	2	A	408- 2-A	F- 75725		I			39A	39B	03-1-6
408	5	A	408- 5-A	F- 93842		I			39A	39B	03-1-6
409	2	A	409- 2-A	F- 75859		II			39A	39B	03-1-6
409	8	A	409- 8-A	F- 93847		II			39A	39B	03-1-6
409	9	A	409- 9-A	F- 98080		II-ER			39A	39B	03-1-6
888	2	A	888- 2-A	F- 92393		III-ER			39A	39B	03-1-6
888	6	A	888- 6-A	F-122312		III-ER					
STARTER • A-160 DIRECT CRANKING ELECTRIC											
602	5	B	602- 5-B	F-110690					46A	46E	03-1-6
602	6	B	602- 6-B	F-110690					46A	46E	03-1-6
602	7	B	602- 7-B	F-110503					46A	46E	03-1-6
602	8	B	602- 8-B	F-110503					46A	46E	03-1-6
602	10	B	602-10-B	F-110690					46A	46E	03-1-6
602	12	B	602-12-B	F-110503					46A	46E	03-1-6
602	18	B	602-18-B	F-110690					46A	46E	03-1-6
STARTER • E-80 DIRECT CRANKING ELECTRIC											
397	4	B	397- 4-B	F- 90327					46A	46B	03-1-6
397	5	B	397- 5-B	F- 90327					46A	46B	03-1-6
397	6	B	397- 6-B	F- 90327					46A	46B	03-1-6
397	13	A	397-13-A	F- 46942-2				137F/117	46A	46B	03-1-6
397	13	B	397-13-B	F- 90328					46A	46B	03-1-6
397	14	A	397-14-A	F- 46942-1					46A	46B	03-1-6
397	15	B	397-15-B	F- 90328					46A	46B	03-1-6
397	17	A	397-17-A	F- 60348-2					46A	46B	03-1-6
397	17	B	397-17-B	F- 90328					46A	46B	03-1-6
397	18	A	397-18-A	F- 60348-1					46A	46B	03-1-6
397	20	B	397-20-B	F- 90329					46A	46B	03-1-6
397	21	B	397-21-B	F- 90328					46A	46B	03-1-6
397	43	B	397-43-B	F- 90328					46A	46B	03-1-6
397	50	B	397-50-B	F- 90329					46A	46B	03-1-6
397	51	B	397-51-B	F- 90328					46A	46B	03-1-6

L-5 NO 50

1	2	3	4	5	6	7	8	9	10	11	12
ECLIPSE TYPE NO.	MODEL NO.	STYLE LETTER	MANUFACTURER'S DRAWING NO.	SUPERSEDED MANUFACTURER'S DRAWING NO.	AAF TYPE NO.	NAVY TYPE NO.	NAF PART NO.	BRITISH REF. NO.	OPERATING MANUAL CHAPTER	OVERHAUL MANUAL CHAPTER	AAF T.O. NO.
STARTER • E-80 DIRECT CRANKING ELECTRIC (Continued)											
397	54	B	397-54-B	F-109581					46A	46B	03-1-6
397	56	B	397-56-B	F-113992					46A	46B	03-1-6
635	3	B	635- 3-B	E- 82089					46A	46B	03-1-6
635	4	B	635- 4-B	E- 82089					46A	46B	03-1-6
756	6	B	756- 6-B	F-109717					46A	46B	03-1-6
756	21	A	756-21-A	E- 85314	J-1				46A	46B	03-1-6
756	21	B	756-21-B	F- 91173	J-1				46A	46B	03-1-6
756	51	B	756-51-B	F- 91173	J-1				* 46A	46B	03-1-6
STARTER • E-160 DIRECT CRANKING ELECTRIC											
400	1	B	400- 1-B	F- 82030					46A	46F	03-1-6
400	2	B	400- 2-B	F- 82030					46A	46F	03-1-6
400	3	B	400- 3-B	F- 82030					46A	46F	03-1-6
400	4	B	400- 4-B	F- 82030					46A	46F	03-1-6
400	5	B	400- 5-B	F- 82030					46A	46F	03-1-6
400	6	B	400- 6-B	F- 82030					46A	46F	03-1-6
400	7	B	400- 7-B	F- 82030					46A	46F	03-1-6
400	8	B	400- 8-B	F- 82030					46A	46F	03-1-6
400	17	B	400-17-B	F- 82030					46A	46F	03-1-6
400	19	B	400-19-B	F- 82030					46A	46F	03-1-6
401	2	B	401- 2-B	F- 82030					46A	46F	03-1-6
401	3	B	401- 3-B	F- 82030					46A	46F	03-1-6
401	4	B	401- 4-B	F- 82030					46A	46F	03-1-6
401	5	B	401- 5-B	F- 82030					46A	46F	03-1-6
401	6	B	401- 6-B	F- 82030				137F/71	46A	46F	03-1-6
401	7	B	401- 7-B	F- 82030					46A	46F	03-1-6
401	17	B	401-17-B	F- 82030					46A	46F	03-1-6
402	2	B	402- 2-B	F- 82030					46A	46F	03-1-6
402	5	B	402- 5-B	F- 82030					46A	46F	03-1-6
402	6	B	402- 6-B	F- 82030					46A	46F	03-1-6
402	7	B	402- 7-B	F- 82030					46A	46F	03-1-6
402	19	B	402-19-B	F- 82030					46A	46F	03-1-6
403	2	B	403- 2-B	F- 82030					46A	46F	03-1-6
403	3	B	403- 3-B	F- 82030					46A	46F	03-1-6
403	4	B	403- 4-B	F- 82030				137F/130	46A	46F	03-1-6
403	5	B	403- 5-B	F- 82030					46A	46F	03-1-6
403	6	B	403- 6-B	F- 82030					46A	46F	03-1-6
403	7	B	403- 7-B	F- 82030					46A	46F	03-1-6
403	8	B	403- 8-B	F- 82030					46A	46F	03-1-6
403	12	B	403-12-B	F- 84769				137F/4	46A	46F	03-1-6
404	1	B	404- 1-B	F- 89320					46A	46F	03-1-6
404	1	C	404- 1-C	F-107358					46A	46F	03-1-6
817	1	C	817- 1-C	F-107358					46A	46F	03-1-6
STARTER • F-141 DIRECT CRANKING ELECTRIC											
398	1	A	398- 1-A	F- 18926					46A	46C	03-1-6
398	3	A	398- 3-A	F- 66865-2					46A	46C	03-1-6
398	4	A	398- 4-A	F- 66865-1					46A	46C	03-1-6
398	5	A	398- 5-A	F- 18926				137F/110	46A	46C	03-1-6
398	6	A	398- 6-A	F- 18926					46A	46C	03-1-6
398	7	A	398- 7-A	F- 61328					46A	46C	03-1-6

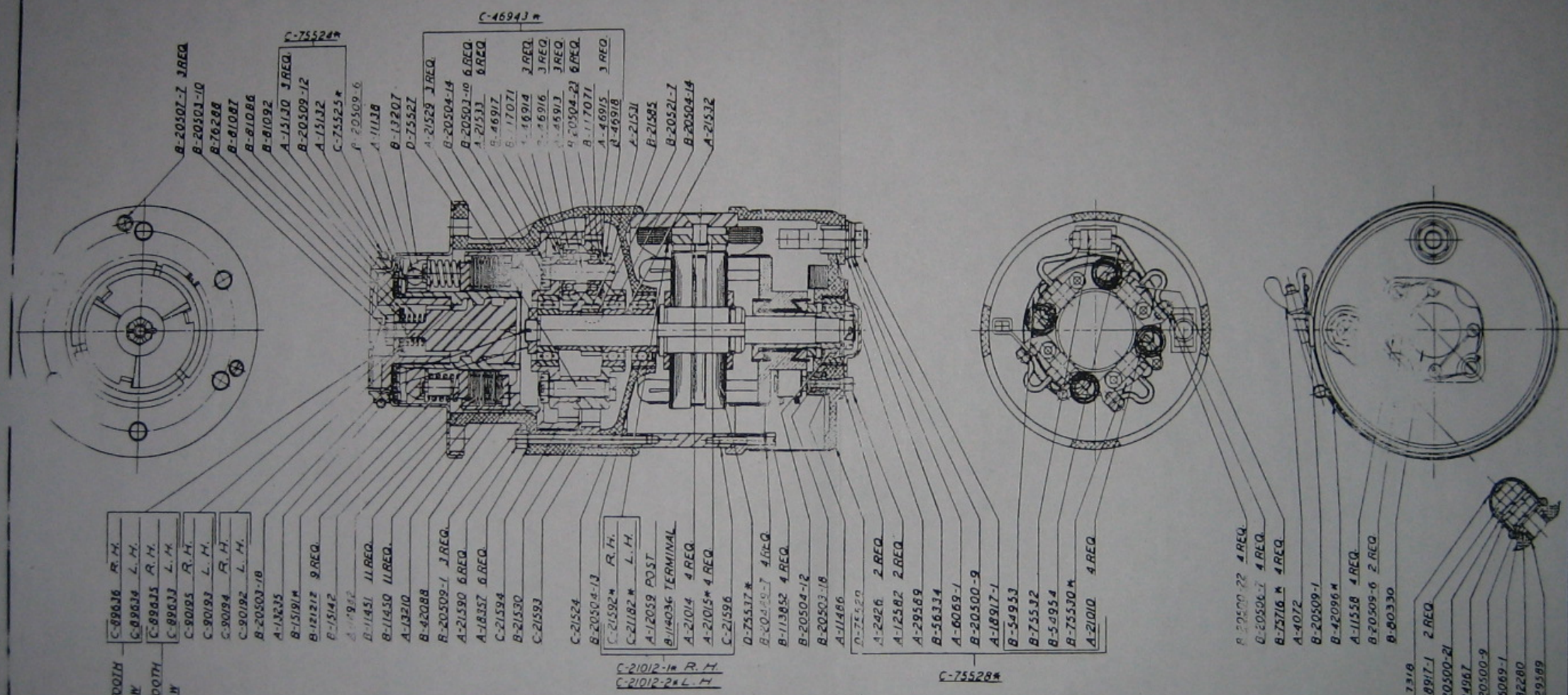
RESTRICTED

T. C. No. 03-1-5

STARTER–E-80 DIRECT CRANKING ELECTRIC

TYPE 397

MODEL 20 50



STYLE B

CHANGE LETTER

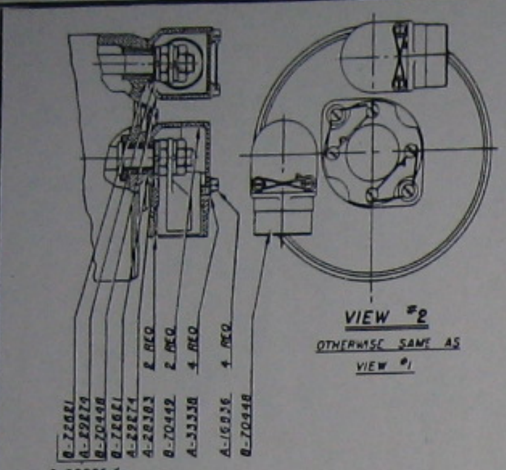
RIGHT HAND	12 TOOTHED	GROUNDED	12	397-50-B
LEFT HAND	12 TOOTHED	GROUNDED	12	397-49-?
RIGHT HAND	3 TOOTHED	GROUNDED	12	397-20-?
LEFT HAND	3 TOOTHED	GROUNDED	12	397-19-?
ROTATION	JAW	ELECT. SYSTEM	VOLTS	[illegible]

TYPE
397

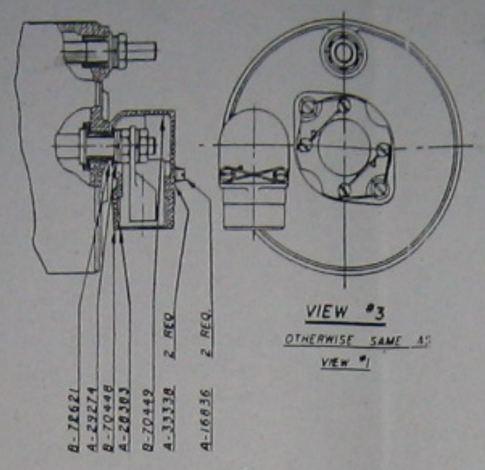
MODEL
13
15
17
21
43
51

STYLE
B

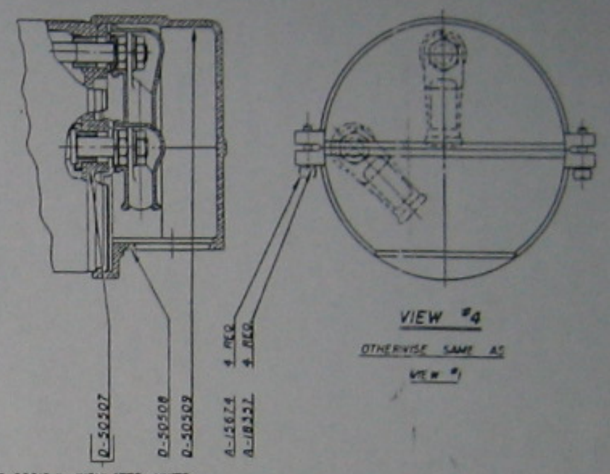
CHANGE LETTER
-



VIEW #2
OTHERWISE SAME AS VIEW #1

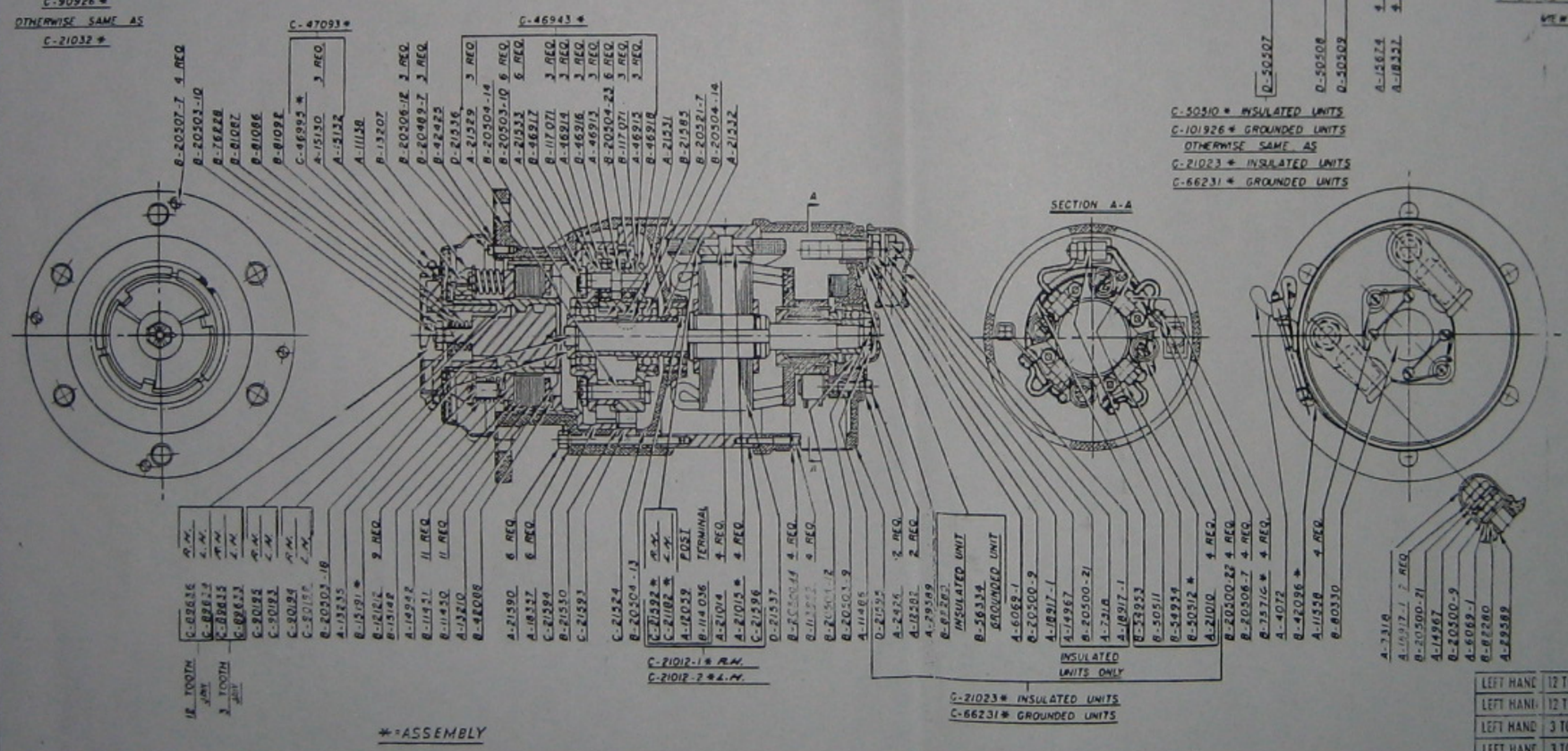


VIEW #3
OTHERWISE SAME AS VIEW #1



VIEW #4
OTHERWISE SAME AS VIEW #1

C-50510 * INSULATED UNITS
C-101926 * GROUNDED UNITS
OTHERWISE SAME AS
C-21023 * INSULATED UNITS
C-66231 * GROUNDED UNITS



VIEW #1

ROTATION	JAW	VIEW	ELECT. SYSTEM	VOLTS	MFRS. DWG. No.
LEFT HAND	12 TOOTHED	4	GROUNDED	12	397-51-8
LEFT HAND	12 TOOTHED	1	INSULATED	12	397-43-8
LEFT HAND	3 TOOTHED	4	GROUNDED	12	397-21-8
LEFT HAND	3 TOOTHED	4	INSULATED	12	397-17-8
LEFT HAND	3 TOOTHED	2	INSULATED	12	397-15-8
LEFT HAND	3 TOOTHED	1	INSULATED	12	397-13-8