



Delco Remy Electricals India Limited

**WP 220 STARTER MOTOR
SERVICE MANUAL**

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General Description:

The WP 220 Starter Motor is a pre engaged Motor and provides high starting torque in a compact light weight package by using a high speed motor through a reduction gear unit.

The engine starting system includes battery, starter motor and ignition switch. When ignition switch is 'ON' the solenoid is energized and moves the plunger. This in turn actuates the shift lever which moves the drive forward and engages with Flywheel ring gear. After full engagement of pinion to the ring gear the starter motor rotates and cranks the engine.

As the engine starts, pinion over runs to prevent damage on the Armature assembly caused by excessive rotation speed until switch contact is opened. However, switch 'OFF' the starter motor immediately after the engine starts to prevent the Armature and Drive damage.

The WP 220 Armature is dynamically balanced and rides in sealed ball bearing & Bush. Fiber glass banding and varnish impregnation are used for added Armature strength. The molded bar commutator receives electrical power through radially positioned one piece brushes. Constant pressure brush springs are used for even brush wear and long brush life.

On-Vehicle Service

To independently test the cranking motor, it is necessary to remove it from the engine.

However, before doing this, checks should be made to ensure that the problem is with the starter motor and not with the engine, battery, wiring or switches. When the other possible problem sources have been eliminated then remove and test the starter motor. Comparison of test results with the trouble shooting chart, table 1 will aid isolating the problem within the starter motor to specific components. This will determine the repair or repairs needed to restore the starter motor to serviceability.

Battery Tests

Realistic testing as well as successful operations requires a fully charged battery capable of supplying the current the starting system is to test the battery. Follow Vehicle or Battery manufacturers' instructions.

Wiring & Switches

Visually inspect all wiring and switches in the starting circuit for damages and loose or corroded connections. This includes all ground connections. Clean and tighten connections as required. Replace the damaged wiring or components.

Continuity check

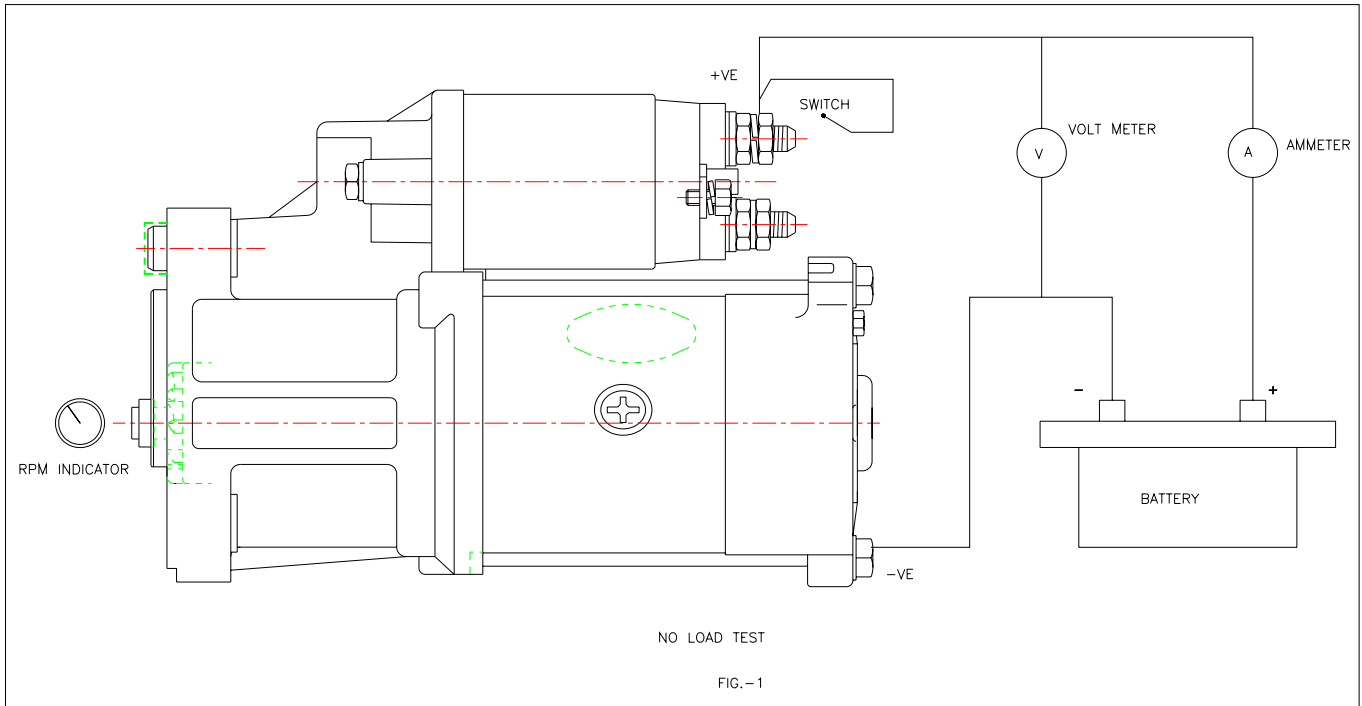
Use Voltmeter and check terminal voltage at starter motor. The voltage should be normal.

Cranking motor removal

If the battery wiring and switches are in satisfactory condition and the engine is known to be functioning properly, remove the starter motor for further testing. Refer to the Vehicle manufacturer's instructions for the proper removal procedure.

STARTER MOTOR NO-LOAD TEST

With the starter motor removed from the engine, the no load test can reveal damage that can be corrected by repair or it may indicate the need for component testing after the cranking motor is dismantled.



Test Procedure

Connect the starter motor for the no load test as shown in fig. 1 using suitable instruments, battery cables and connecting wiring. Note the following

1. Secure starter motor in a suitable test stand to check operations.
2. Use a momentary contact, push button switch in the test circuit for quick
3. release if very high current surges are encountered.
4. Close the switch and observe no load values. Following are the OK starter

Motor values

Voltage : 9.9 to 11.6 Volts
Current : 160 Amps Max.
Speed : 4000 RPM Min.

If results of the no load test are outside limits, refer to table 1 trouble shooting for possible cause and corrective action.

TABLE 1. TROUBLE SHOOTING

S.No.	Fault	Problem cause	Remarks
1	Starter motor does not Rotate when switch is Operated.	<ul style="list-style-type: none"> a. Faulty Battery. b. Terminals Corroded. c. Starter supply broken or in poor state. d. Starter Motor Short circuited. 	<ul style="list-style-type: none"> - Recharge the Battery. - Clean internal surface of connecting lugs - Battery terminal posts. - Check state of cable connecting battery and starter. - Check battery earth strap. - Check cable connection at starter motor and battery. replace battery if necessary. - Change master switch or rectify circuit. - Remove starter motor and rectify.
2.	Starter Motor rotates at high speed but does not crank the engine.	<ul style="list-style-type: none"> a. Drive assy meshes with Gear but does not drive. b. Drive assy does not mesh with ring gear. 	<ul style="list-style-type: none"> - Replace drive assy. Ensure proper connection of solenoid and shift lever.
3.	Starter motor does not Turn or low speed.	<ul style="list-style-type: none"> a. Brushes worn out. b. Brushes jammed. 	<ul style="list-style-type: none"> - Change all brushes. Ensure Free movement of brushes.
4.	Low speed with normal Or low current.	<ul style="list-style-type: none"> a. High internal Electrical resistance caused by poor Connections Defective leads or Dirty commutator. 	<ul style="list-style-type: none"> - Inspect internal wiring electrical connections and armature commutator.

S.No.	Fault	Problem cause	Remarks
5.	Low speed with high Current.	<ul style="list-style-type: none"> a. Excessive friction In bearing or gear Reduction unit, Bent armature Shaft or loose pole Shoe, bent drive Shaft. b. Armature shorted. c. Ground armature or field. 	<ul style="list-style-type: none"> - Inspect bearing armature, drive shaft and gear reduction gears. - Inspect and test armature. - Inspect armature and field Coil assy.
6.	High speed with high Current.	<ul style="list-style-type: none"> a. Field shorted. 	<ul style="list-style-type: none"> - Inspect and test field coil Assy.
7.	Starter motor cranks the Engine normally, continues when starter switch is released.	<ul style="list-style-type: none"> b. Poor function of switch. c. Short circuit in Wiring harness. d. Solenoid shunt winding open. 	<ul style="list-style-type: none"> - Replace starter switch. - Check wiring harness. - Replace defective solenoid
8.	Starter motor cranks noisy	<ul style="list-style-type: none"> a. Drive pinion teeth milled. b. Drive clutch jam -med. c. Ring gear teeth damaged. e. Plastic gear (inside Starter motor) teeth Worn out. 	<ul style="list-style-type: none"> - Replace defective drive assy - Replace ring gear - Replace plastic gear

STARTER DISMANTLING

TOOLS REQUIRED

1. Spanner No. 7
2. Spanner NO. 10
3. Spanner NO. 13
4. Philips Head Screw Driver
5. Carbon Brush Spring puller
6. A snap ring pliers
7. A socket to hit the Pinion Stopper.

Remove the starter motor from the engine (Disconnect all electrical connections before removing the starter from the engine.)

1. Removal of solenoid

- Remove the motor terminal nut.
- Unscrew the solenoid mounting bolts and with draw solenoid.

2. Removal of C E Frame

- Unscrew brush holder fixing screws
- Unscrew through studs
- Remove C E Frame.

3. Removal of Brush Holder Assy

- Remove field coil brushes from brush holder assy then separate brush holder assy

4. Complete dismantling

- Remove Yoke assy
- Remove Armature assy
- Remove gears (3 Nos)
- Remove damper
- Remove drive shaft along with gear support
- Remove shift lever

5. Removal of Drive assy (refer fig. 2)

- Remove pinion stopper (use an adequate socket Hit the pinion stopper as shown in fig. 2)

- Remove lock ring use a snap ring pliers.
- File smooth burrs if any on groove
- Remove drive assy.

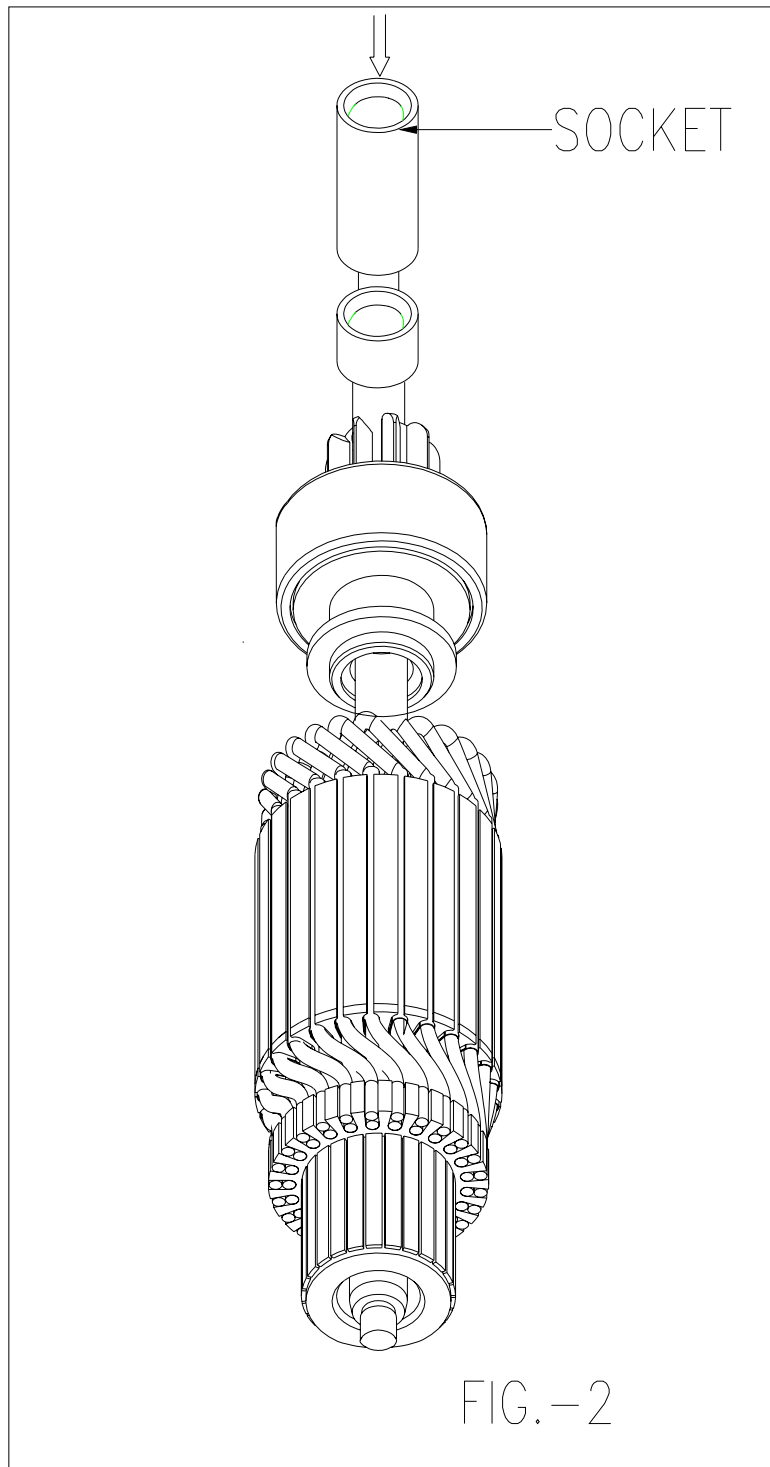


FIG.-2

INSPECTION AND TESTING OF INDIVIDUAL PARTS

1. D. E. Housing assembly

- Inspect crack or damage
- Inspect bearing condition (if any problem replace with new bearing)

2. C E Frame

- Inspect crack or damage

3. Brush Holder assembly

- Inspect carbon brushes ware. If below 11 mm replace all carbon brushes.
- To ensure free movement of carbon brushes holder.
- To check insulation between brush holder plate & positive brush holders as shown in fig 3. If defective, replace the brush holders with insul bushes.

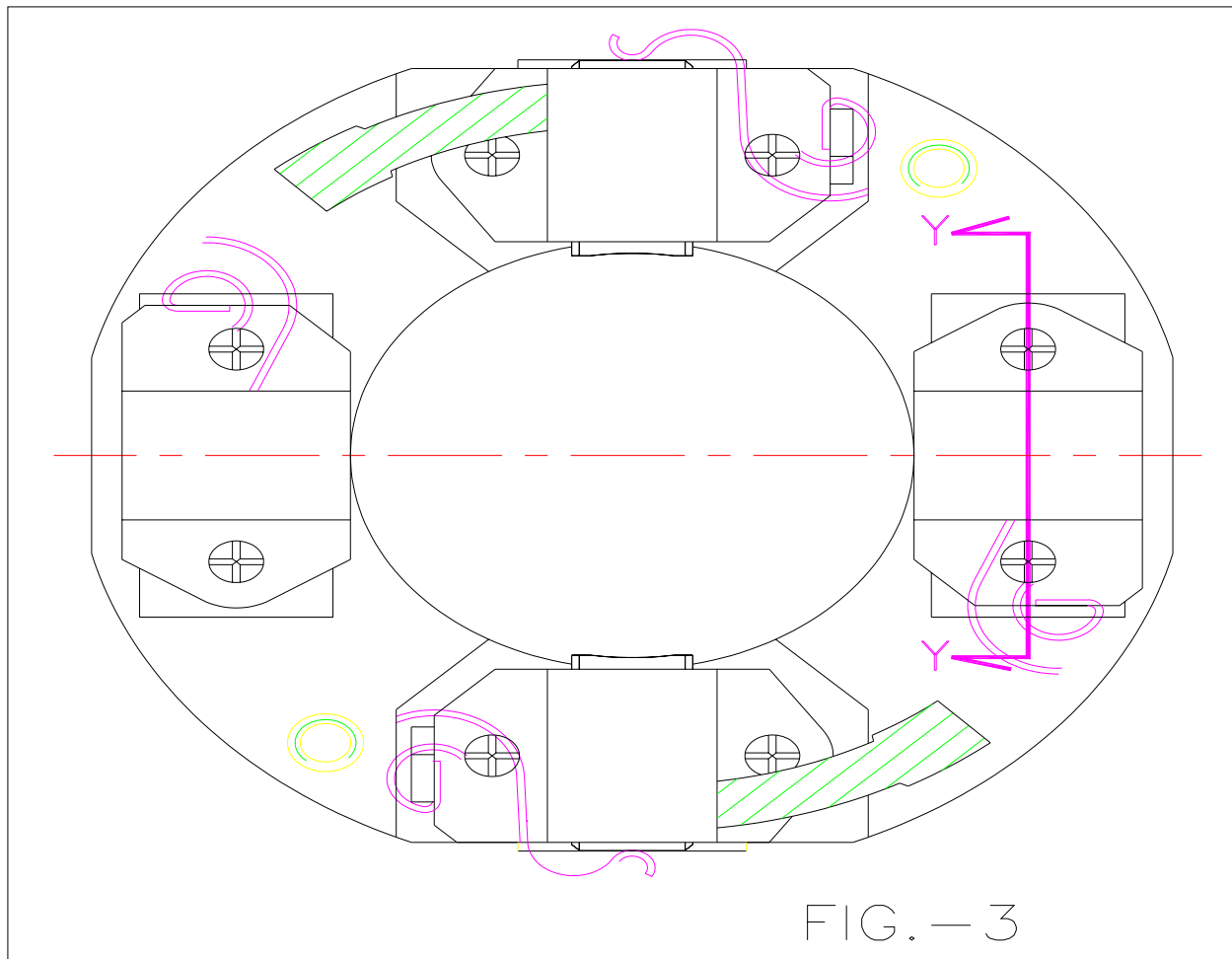
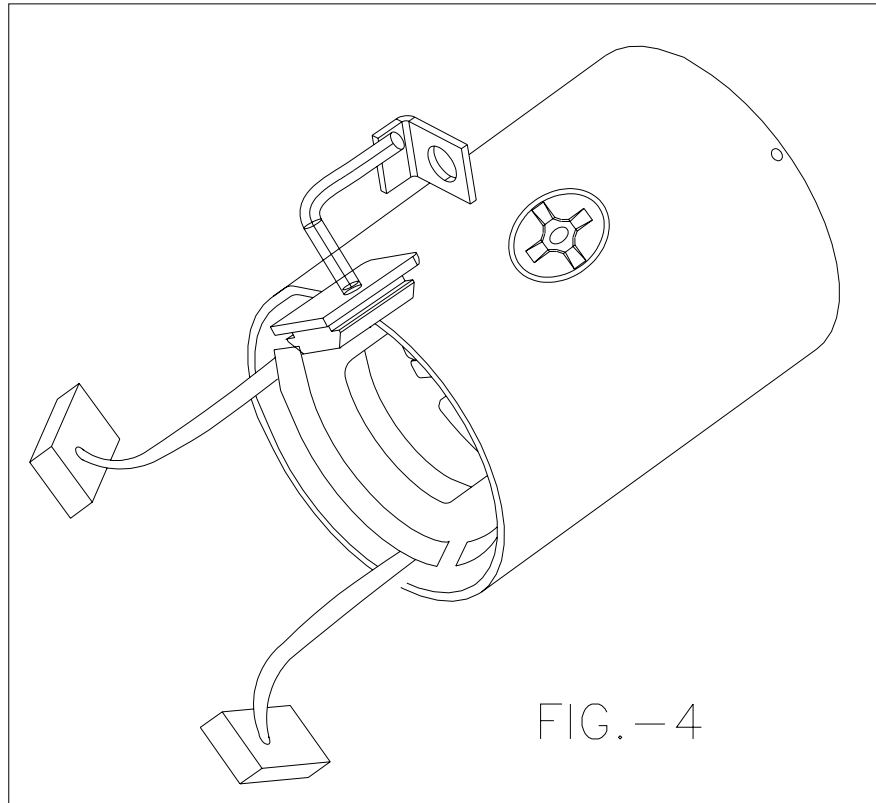


FIG. — 3

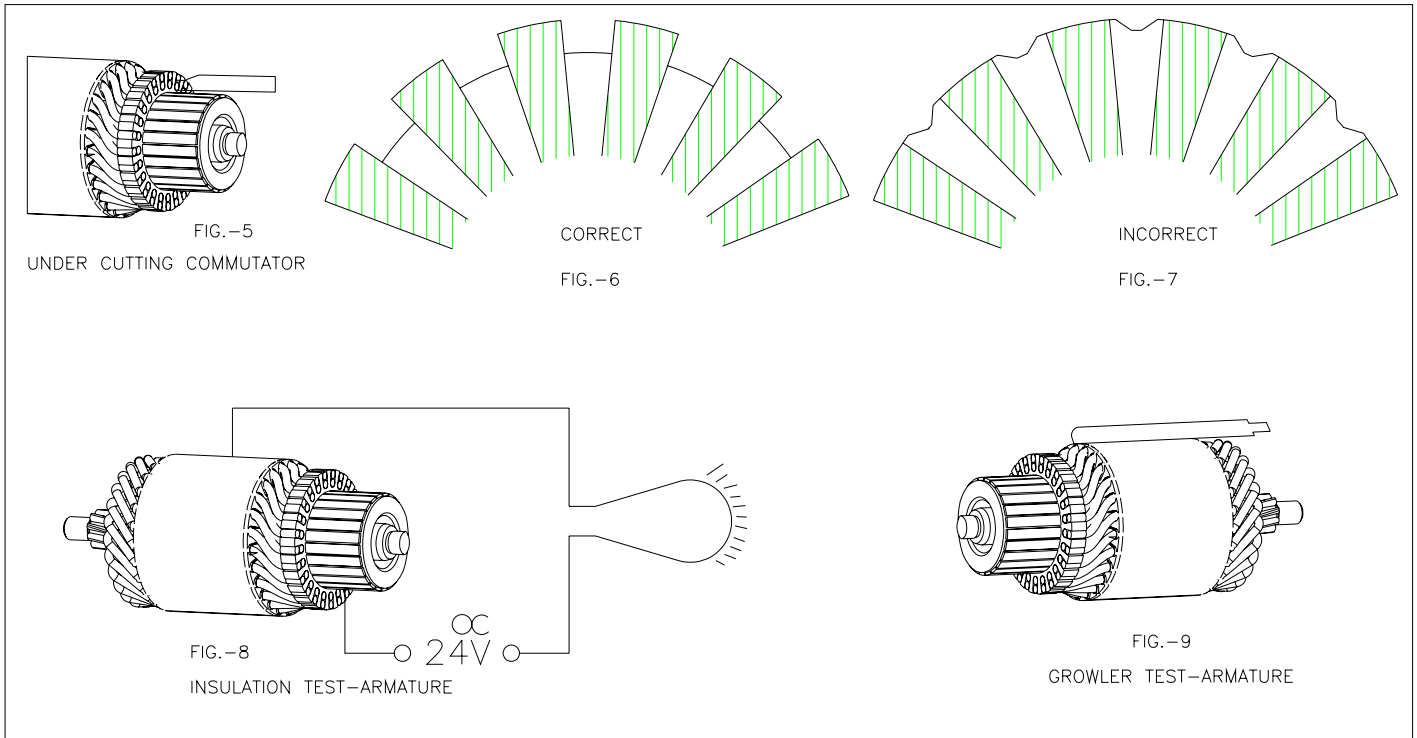
4. Frame & Field Assy

- Check insulation between frame & motor terminal as shown in the fig. 4.



5. Armature Assy

- Do not remove bearing from armature unless replacement is required.
- Clean armature, using fine emery paper or petrol moistened cloth.
- Examine the commutator and ensure that it has clean surface free from pitting.
- The commutator, if pitted, may be skimmed and polished on a lathe. If mica insulation not under cut sufficiently, further under cutting should be done as detailed in fig. 5, 6 & 7.
- Check insulation between armature shaft and commutator with a series lamp as shown in fig. 8.
- Check armature on growler to ensure that there is no short circuit as shown in fig. 9.



6. Drive Assy

- Examine wear on bush and damage of pinion teeth
- Drive assy should slide freely on armature splines
- Smear shaft helix slightly with grease before assembling the drive
- Drive pinion should rotate in only one direction, if not replace the drive Assy.

7. Solenoid Assy

- Energize solenoid with 12 V supply. Ensure plunger moves fully and freely both ways. If not operative replace the solenoid.

8. Gear Support Assy

- Gears should rotate freely in gear support
- Check gear support tooth wear, crack or damages.
- If abnormalities noticed replace gear support.

ASSEMBLY

Generally reverse of dismantling procedure, sequence in dismantling should be retracted.

Take following precautions.

Lubrication during assembly

Apply grease at four places

- | | | |
|------------------------|---|---|
| 1. Drive shaft splines | } | Recommended Grease (OKS Berulub KRYO TEX EP2) |
| 2. Drive pinion OD | | |
| 3. Gear support inside | | |
| 4. Lever | | |

Tightening

Ensure proper tightening of all fasteners, bolts & screws. Following are recommended tightening torque values

- | | |
|--------------------------------|----------------|
| 1. Thro' bolt | 6.0 to 9.0 Nm |
| 2. Solenoid fixing bolt | 5.6 to 8.0 Nm |
| 3. Brush holder fixing screws | 3.0 to 4.0 Nm |
| 4. Solenoid motor terminal nut | 6.0 to 9.0 Nm. |

Sealing the Starter

Ensure proper sealing of the starter as per the fig. 10 with the following sealants

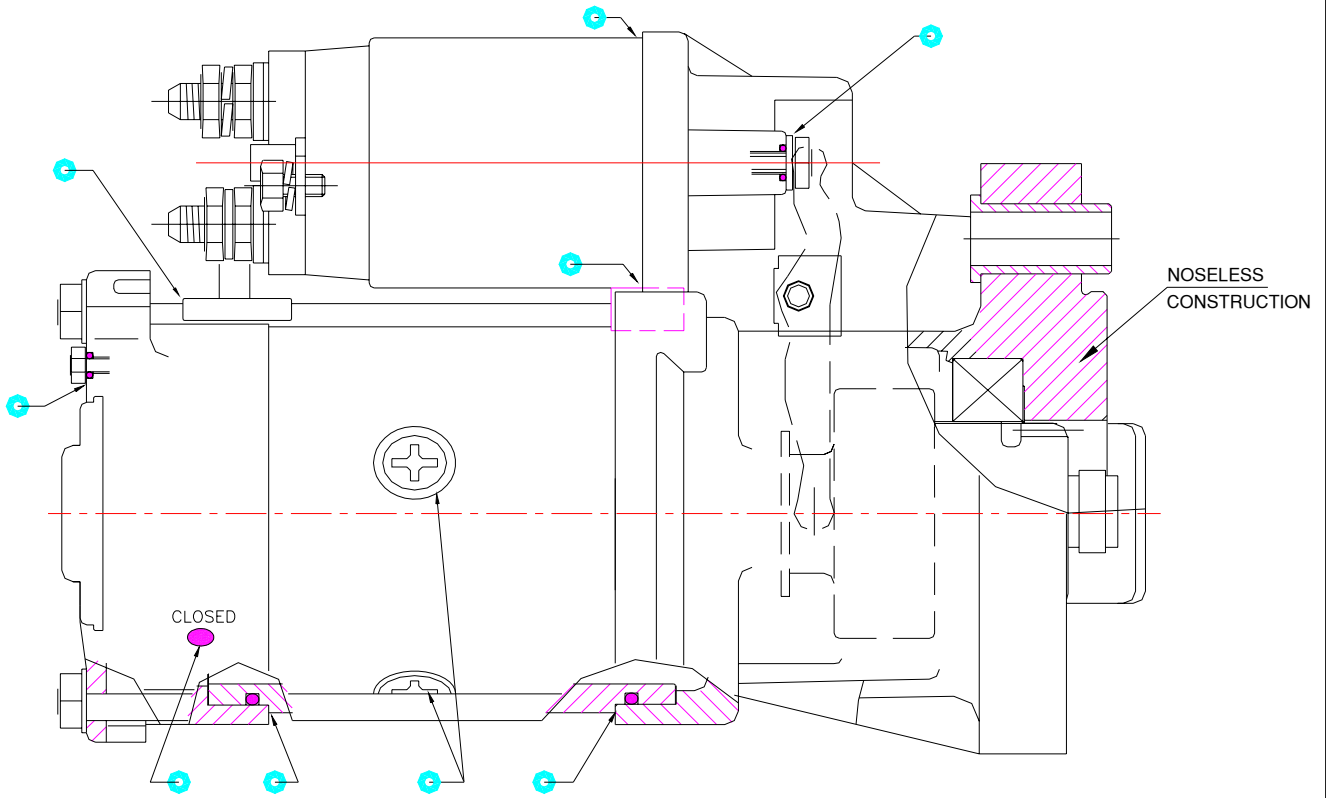
1. Anabond Thread locker – 112 stud grade
2. Anabond – AR 01 – Silicon seal
3. Anabond 871



DELCO REMY ELECTRICALS INDIA LTD.

WP220 STARTER MOTOR (NOSELESS)
APPLICATION : M&M-SCORPIO

WATER SEALING ARRANGEMENT
FOR PROTECTION AGAINST
WATER ENTRY.

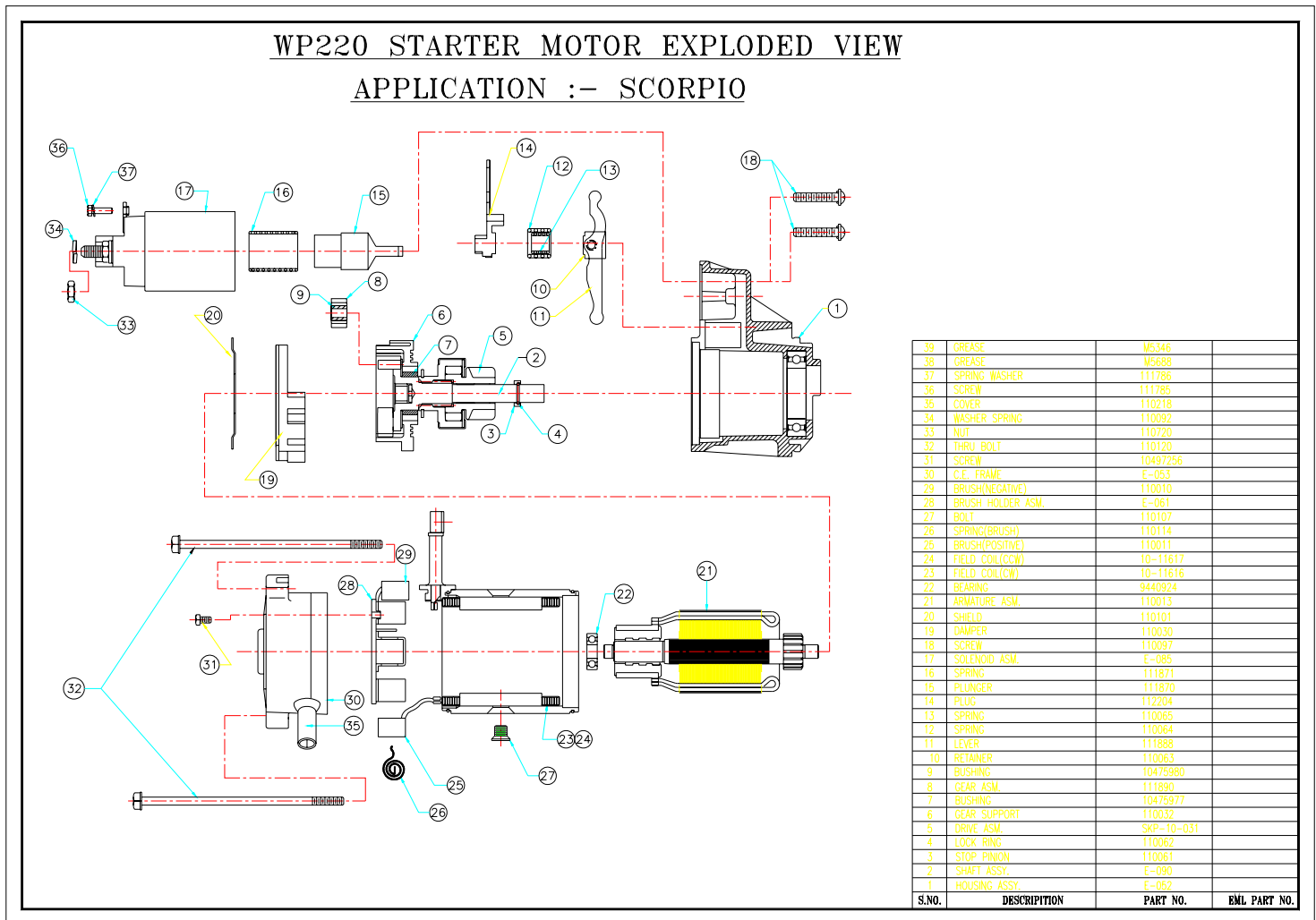


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APPLICATION OF SEALING COMPOUND

Testing after repair or overhaul

After repair, the starter motor can be tested as specified in the starter motor No-Load test.



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