

# STARTING SYSTEM

16200010122

## GENERAL INFORMATION

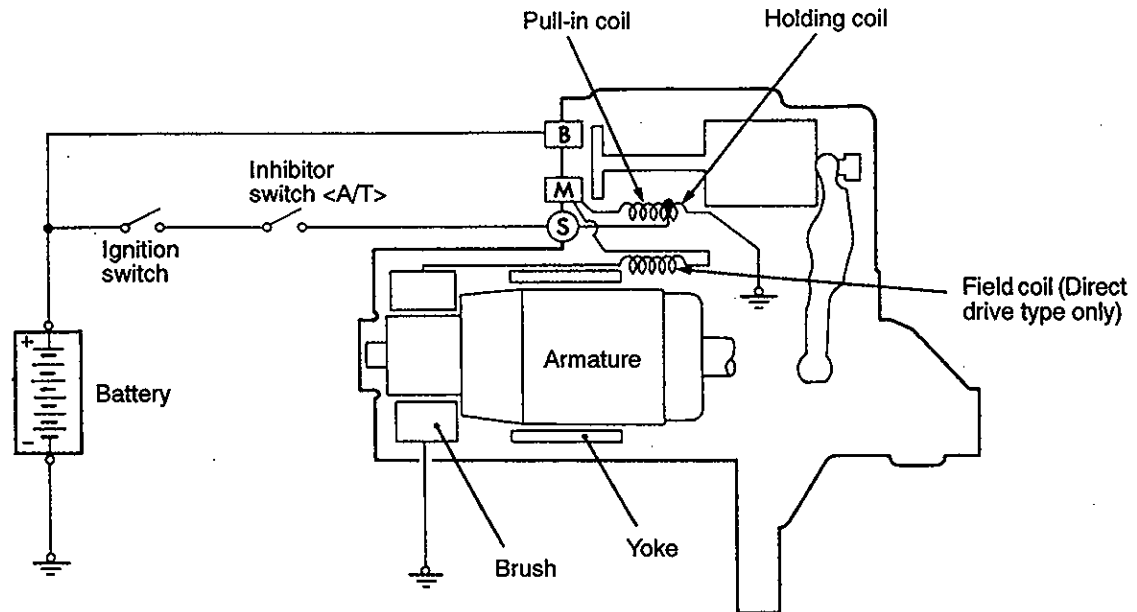
If the ignition switch is turned to the "START" position, current flows in the coil provided inside magnetic switch, attracting the plunger. When the plunger is attracted, the lever connected to the plunger is actuated to engage the starter clutch. On the other hand, attracting the plunger will turn on the magnetic switch, allowing the B terminal and M terminal to conduct. Thus, current flows to

engage the starter motor.

When the ignition switch is returned to the "ON" position after starting the engine, the starter clutch is disengaged from the ring gear.

An overrunning clutch is provided between the pinion and the armature shaft, to prevent damage to the starter.

## SYSTEM DIAGRAM



9EN0288

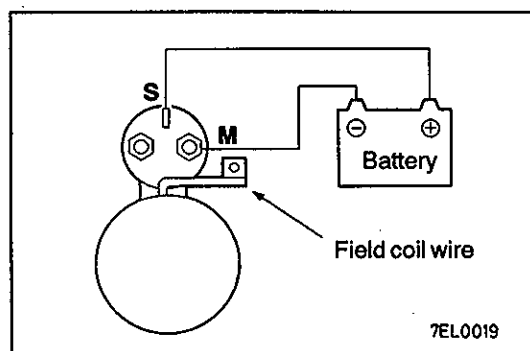
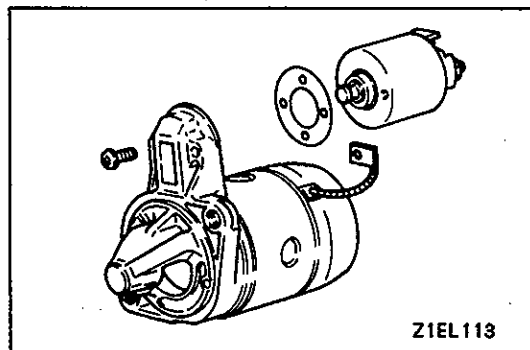
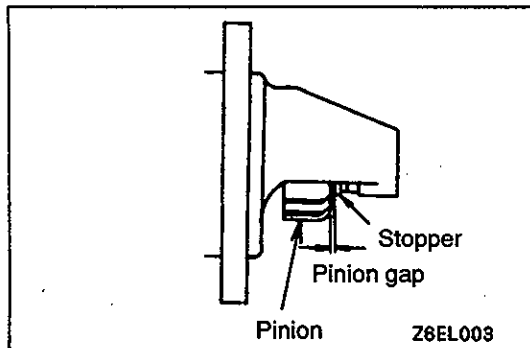
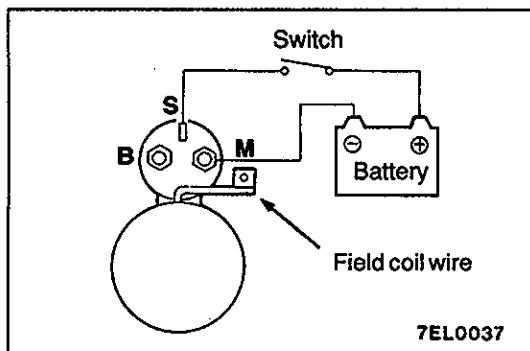
## STARTER MOTOR SPECIFICATIONS

| Items               | 4G1 – M/T – standard models | 4G1 – M/T – models for cold climate, 4G1 – A/T, 4G9 – M/T, 4G9 – A/T – standard models | 4G9 – A/T – models for cold climate |
|---------------------|-----------------------------|--|-------------------------------------|
| Type                | Direct drive                | Direct drive   | Reduction drive with planetary gear |
| Rated output kW/V   | 0.7/12                      | 0.9/12   | 1.0/12                              |
| No. of pinion teeth | 8                           | 8  | 8                                   |

## SERVICE SPECIFICATIONS

16200030081

| Items                        |                      | Standard value | Limit |
|------------------------------|----------------------|----------------|-------|
| Pinion gap mm                |                      | 0.5–2.0        | –     |
| Commutator outer diameter mm | Direct drive type    | 32.0           | 31.4  |
|                              | Reduction drive type | 29.4           | 28.8  |
| Commutator runout mm         |                      | –              | 0.05  |
| Commutator undercut mm       |                      | 0.5            | 0.2   |



## STARTER MOTOR

16200110112

### INSPECTION

#### PINION GAP ADJUSTMENT

1. Disconnect field coil wire from M-terminal of magnetic switch.
2. Connect a 12V battery between S-terminal and M-terminal.
3. Set switch to "ON", and pinion will move out.

#### Caution

This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.

4. Check pinion to stopper clearance (pinion gap) with a thickness gauge.

Pinion gap: 0.5–2.0 mm

5. If pinion gap is out of specification, adjust by adding or removing gaskets between magnetic switch and front bracket.

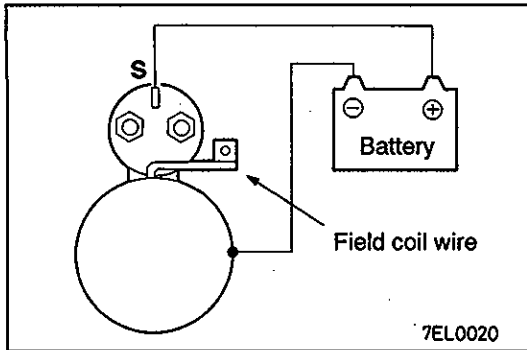
#### MAGNETIC SWITCH PULL-IN TEST

1. Disconnect field coil wire from M-terminal of magnetic switch.
2. Connect a 12V battery between S-terminal and M-terminal.

#### Caution

This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.

3. If pinion moves out, then pull-in coil is good. If it doesn't, replace magnetic switch.

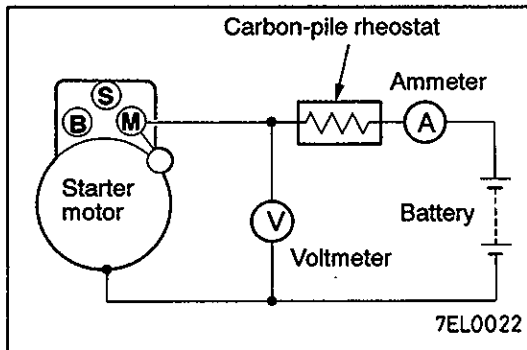
**MAGNETIC SWITCH HOLD-IN TEST**

1. Disconnect field coil wire from M-terminal of magnetic switch.
2. Connect a 12V battery between S-terminal and body.

**Caution**

**This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.**

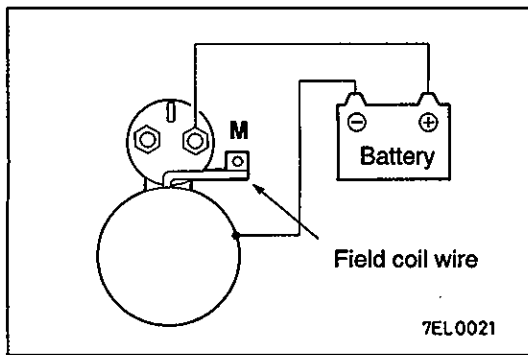
3. Manually pull out the pinion as far as the pinion stopper position.
4. If pinion remains out, everything is in order. If pinion moves in, hold-in circuit is open. Replace magnetic switch.

**FREE RUNNING TEST**

1. Place starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat in series with battery positive post and starter motor terminal.
3. Connect a voltmeter (15-volt scale) across starter motor.
4. Rotate carbon pile to full-resistance position.
5. Connect battery cable from battery negative post to starter motor body.
6. Adjust the rheostat until the battery voltage shown by the voltmeter is 11.5 V (for the direct drive type) or 11 V (for reduction drive type).
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

**Current:**

- max. 60 Amps (Direct drive type)**
- max. 90 Amps (Reduction drive type)**

**MAGNETIC SWITCH RETURN TEST**

1. Disconnect field coil wire from M-terminal of magnetic switch.
2. Connect a 12V battery between M-terminal and body.

**Caution**

**This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.**

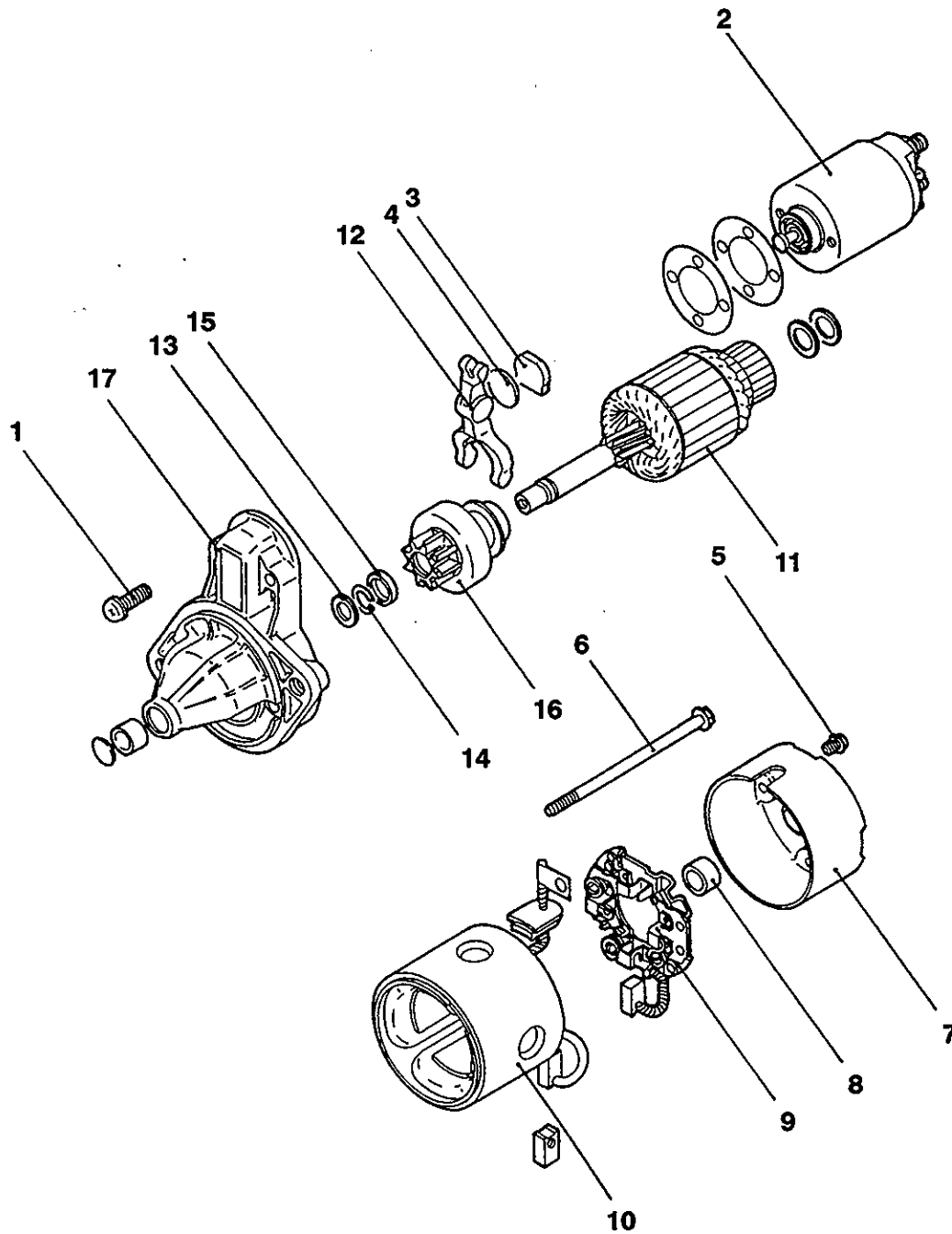
3. Pull pinion out and release. If pinion quickly returns to its original position, everything is in order. If it doesn't, replace magnetic switch.

**Caution**

**Be careful not to get your fingers caught when pulling out the pinion.**

DISASSEMBLY AND REASSEMBLY <DIRECT DRIVE TYPE>

16200120085



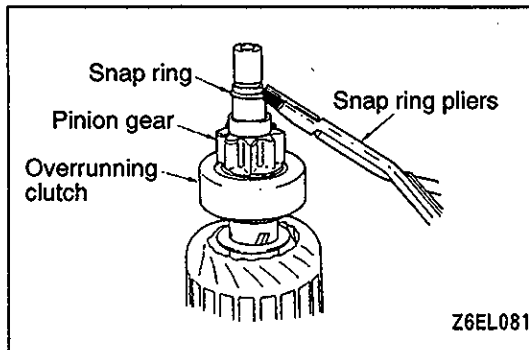
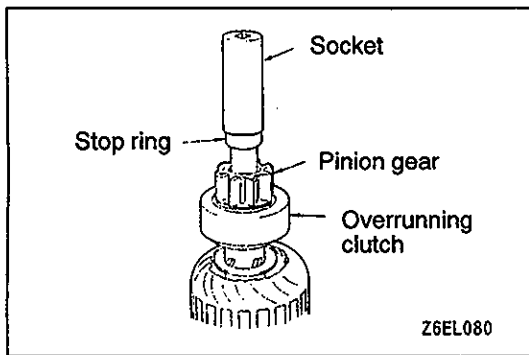
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**Disassembly steps**

- 1. Screw
- 2. Magnetic switch
- 3. Packing
- 4. Plate
- 5. Screw
- 6. Through bolt
- 7. Rear bracket
- 8. Rear bearing

- 9. Brush holder assembly
- 10. Yoke assembly
- 11. Armature
- 12. Lever
- 13. Washer
- 14. Snap ring
- 15. Stop ring
- 16. Overrunning clutch
- 17. Front bracket

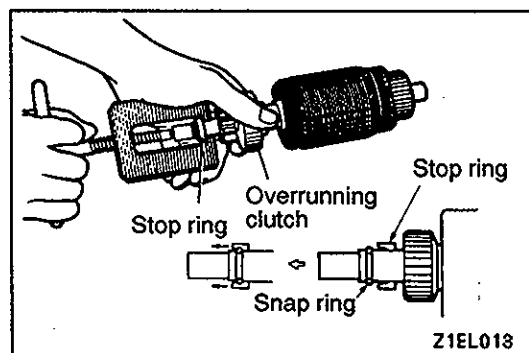


**DISASSEMBLY SERVICE POINTS****◀▶ SNAP RING/STOP RING REMOVAL**

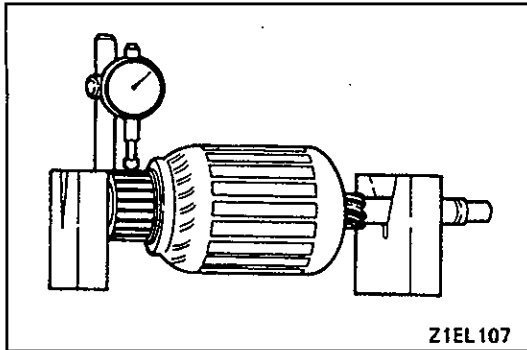
1. Press stop ring off snap ring with a suitable socket.
2. Remove snap ring with snap ring pliers and then remove stop ring and overrunning clutch.

**STARTER MOTOR PARTS CLEANING**

1. Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage insulation. Wipe these parts with a cloth only.
2. Do not immerse drive unit in cleaning solvent. Overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication from clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

**REASSEMBLY SERVICE POINTS****▶◀ STOP RING/SNAP RING INSTALLATION**

Using a suitable pulling tool, pull overrunning clutch stop ring over snap ring.

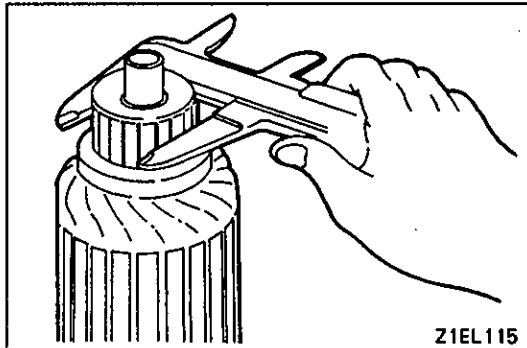


### INSPECTION COMMUTATOR

16200130088

1. Place the armature in a pair of "V" blocks and check the runout with a dial indicator.

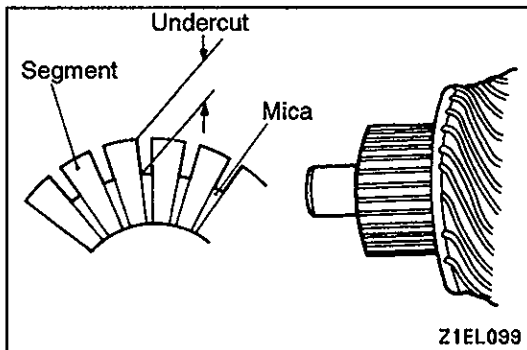
**Limit: 0.05 mm**



2. Measure the commutator outer diameter.

**Standard value: 32.0 mm**

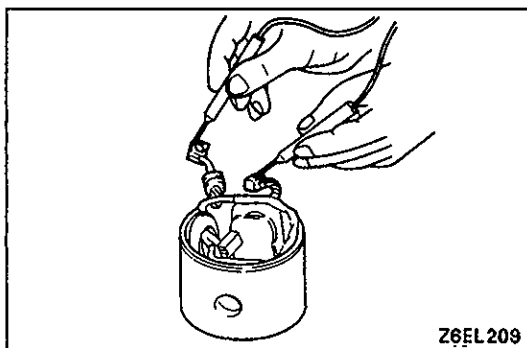
**Limit: 31.4 mm**



3. Check the undercut depth between segments.

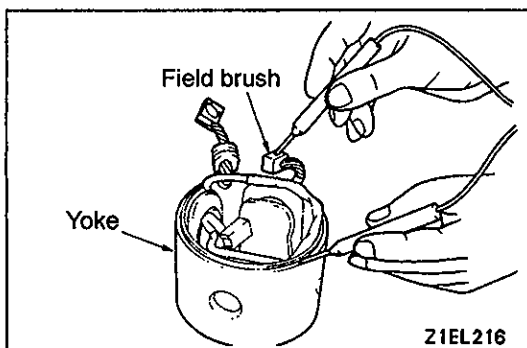
**Standard value: 0.5 mm**

**Limit: 0.2 mm**



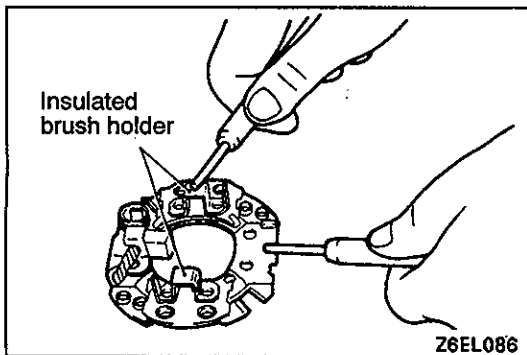
### FIELD COIL OPEN-CIRCUIT TEST

Check the continuity between field brushes. If there is continuity, the field coil is in order.



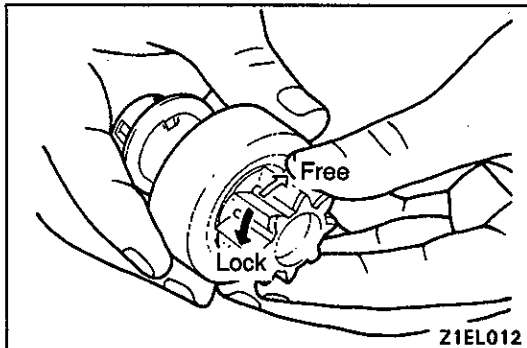
### FIELD COIL GROUND TEST

Check the continuity between field coil brush and yoke. If there is no continuity, the field coil is free from earth.

**BRUSH HOLDER**

Check the continuity between brush holder plate and brush holder.

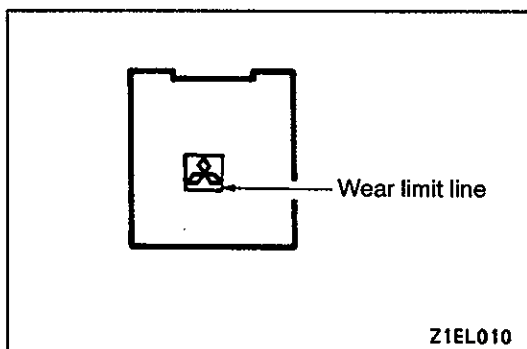
If there is no continuity, the brush holder is in order.

**OVERRUNNING CLUTCH**

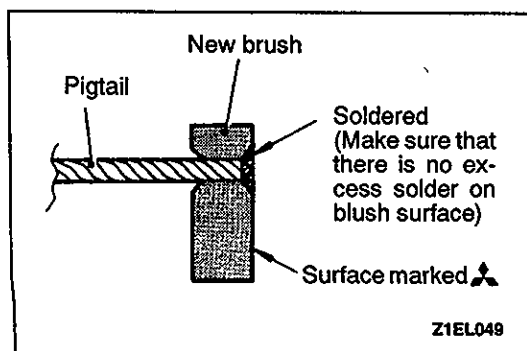
1. While holding clutch housing, rotate the pinion. Drive pinion should rotate smoothly in one direction, but should not rotate in opposite direction. If clutch does not function properly, replace overrunning clutch assembly.
2. Inspect pinion for wear or burrs. If pinion is worn or burred, replace overrunning clutch assembly. If pinion is damaged, also inspect ring gear for wear or burrs.

**FRONT AND REAR BRACKET BUSHING**

Inspect bushing for wear or burrs. If bushing is worn or burred, replace front bracket assembly or rear bracket assembly.

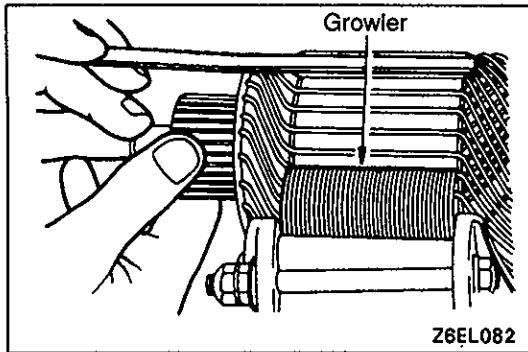
**BRUSH AND SPRING REPLACEMENT**

1. Brushes that are worn beyond wear limit line, or are oil-soaked, should be replaced.
2. When replacing field coil brushes, crush worn brush with pliers, taking care not to damage pigtail.



3. Sand pigtail end with sandpaper to ensure good soldering.
4. Insert pigtail into hole provided in new brush and solder it.  
Make sure that pigtail and excess solder do not come out onto brush surface.
5. When replacing ground brush, slide the brush from brush holder by prying retainer spring back.

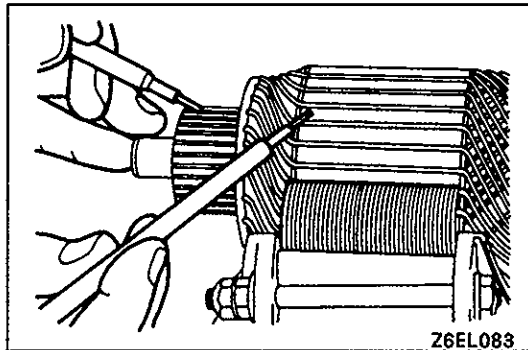




## ARMATURE TEST

### ARMATURE SHORT-CIRCUIT TEST

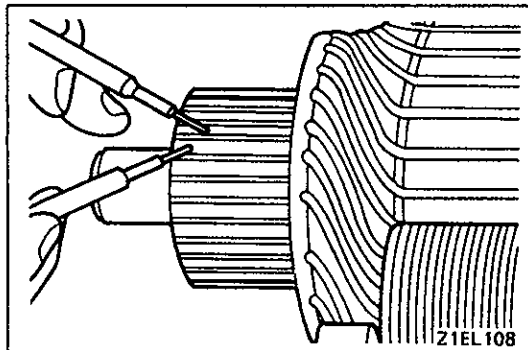
1. Place armature in a growler.
2. Hold a thin steel blade parallel and just above while rotating armature slowly in growler. A shorted armature will cause blade to vibrate and be attracted to the core. Replace shorted armature.



### ARMATURE COIL EARTH TEST

Check the insulation between each commutator segment and armature coil core.

If there is no continuity, the insulation is in order.

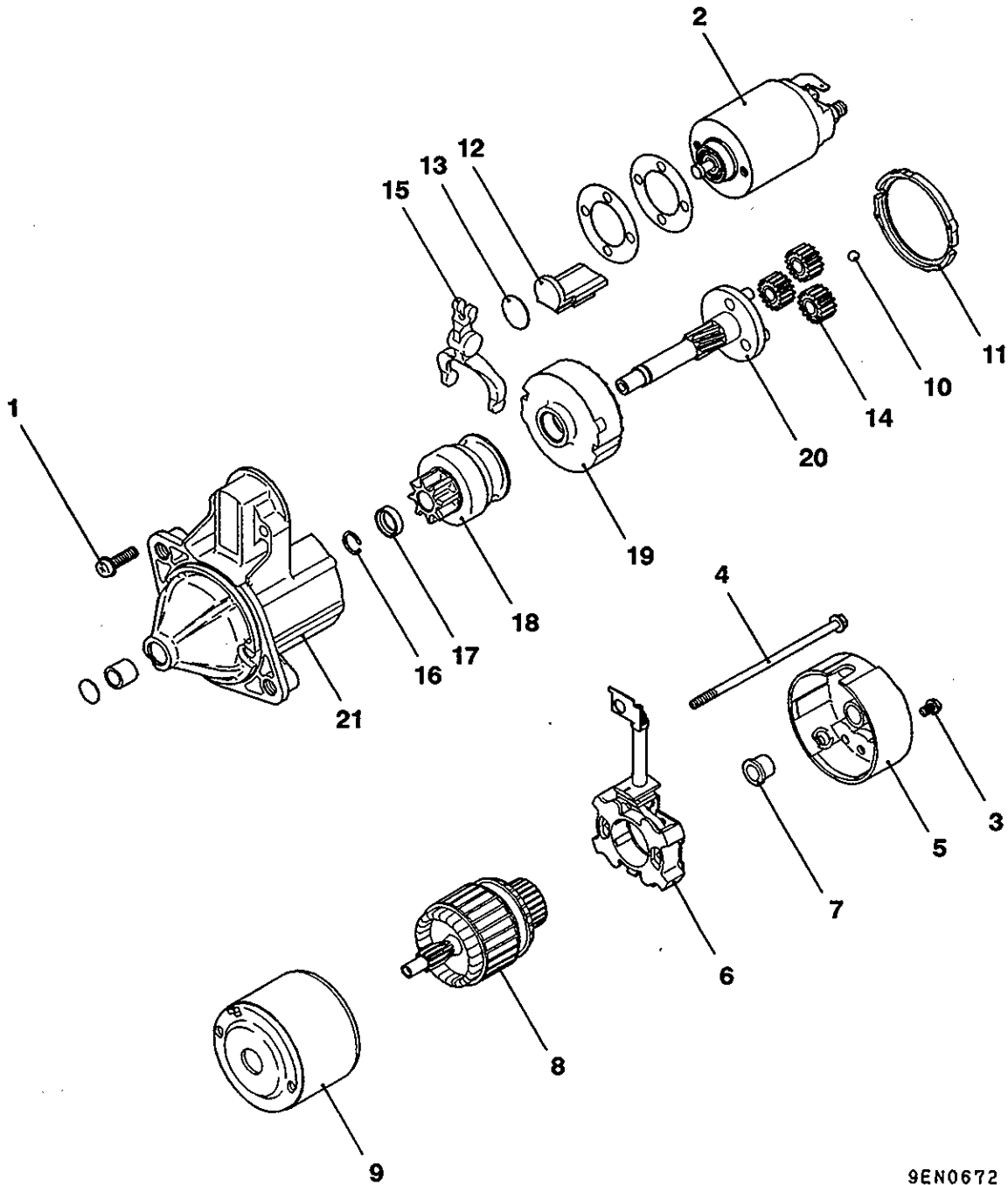


### ARMATURE COIL OPEN-CIRCUIT INSPECTION

Check the continuity between segments. If there is continuity, the coil is in order.

DISASSEMBLY AND REASSEMBLY <REDUCTION DRIVE TYPE>

16200120153



9EN0672

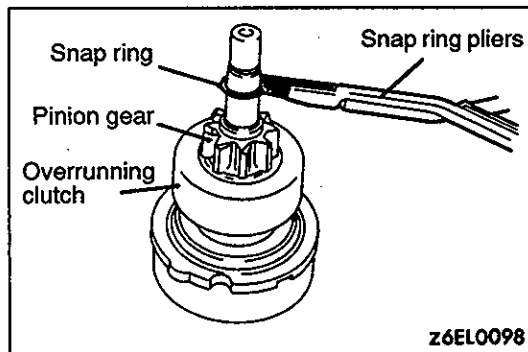
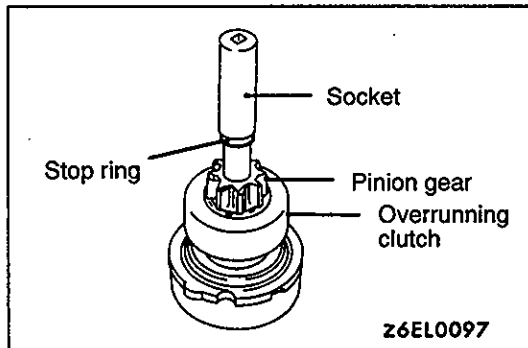
**Disassembly steps**

- |                    |                           |
|--------------------|---------------------------|
| 1. Screw           | 12. Packing B             |
| 2. Magnetic switch | 13. Plate                 |
| 3. Screw           | 14. Planetary gear        |
| 4. Screw           | 15. Lever                 |
| 5. Rear bracket    | 16. Snap ring             |
| 6. Brush set       | 17. Stop ring             |
| 7. Rear bearing    | 18. Overrunning clutch    |
| 8. Armature        | 19. Internal gear         |
| 9. Yoke assembly   | 20. Planetary gear holder |
| 10. Ball           | 21. Front bracket         |
| 11. Packing A      |                           |



**DISASSEMBLY SERVICE POINTS****◀A▶ ARMATURE/BALL REMOVAL****Caution**

When removing the armature, take care not to lose the ball (which is used as a bearing) in the armature end.

**◀B▶ SNAP RING/STOP RING REMOVAL**

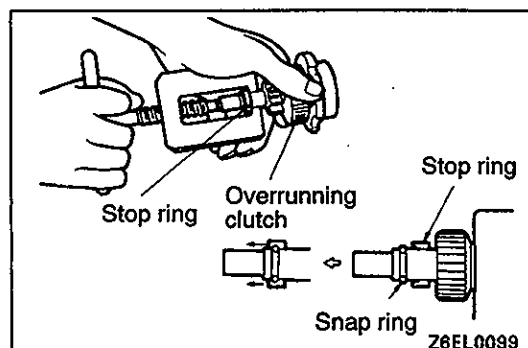
1. Press stop ring off snap ring with a suitable socket.
2. Remove snap ring with snap ring pliers and then remove stop ring and overrunning clutch.

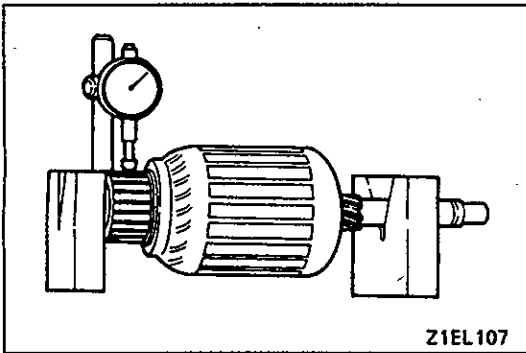
**STARTER MOTOR PARTS CLEANING**

1. Do not immerse parts in cleaning solvent. Immersing the motor assembly will damage insulation. Wipe motor assembly with a cloth only.
2. Do not immerse drive unit in cleaning solvent. Overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication from clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

**REASSEMBLY SERVICE POINTS****▶A◀ STOP RING/SNAP RING INSTALLATION**

Using a suitable pulling tool, pull overrunning clutch stop ring over snap ring.

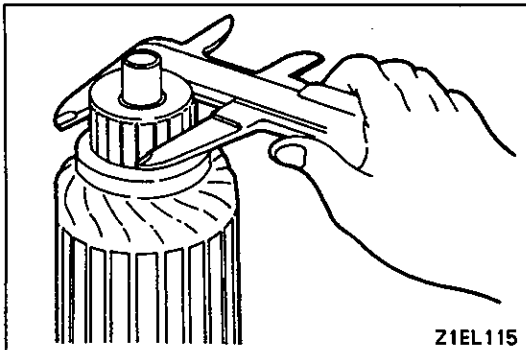


**INSPECTION**

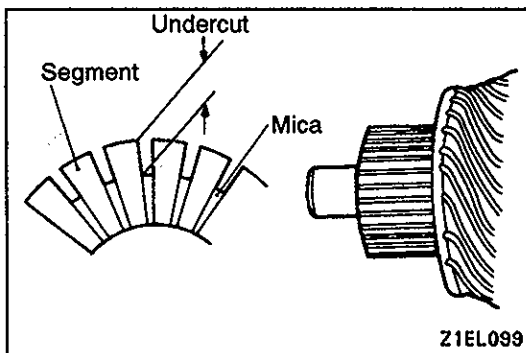
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**COMMUTATOR**

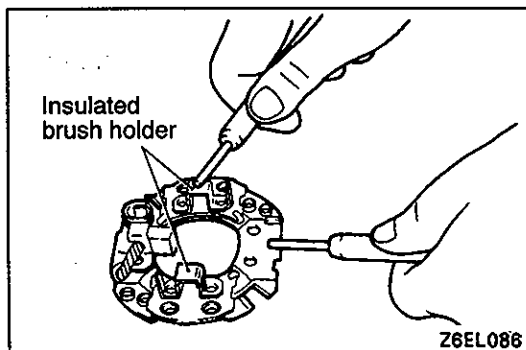
1. Place the armature in a pair of "V" blocks and check the runout with a dial indicator.

**Limit: 0.05 mm**

2. Measure the commutator outer diameter.

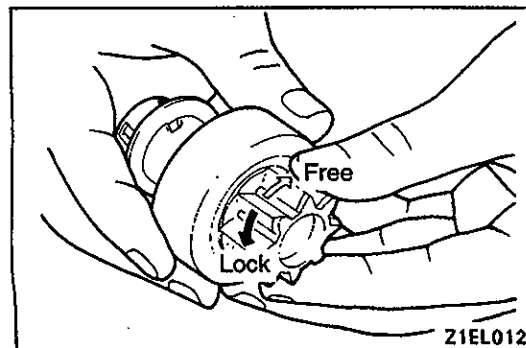
**Standard value: 29.4 mm****Limit: 28.8 mm**

3. Check the undercut depth between segments.

**Standard value: 0.5 mm****Limit: 0.2 mm****BRUSH HOLDER**

Check the continuity between brush holder plate and brush holder.

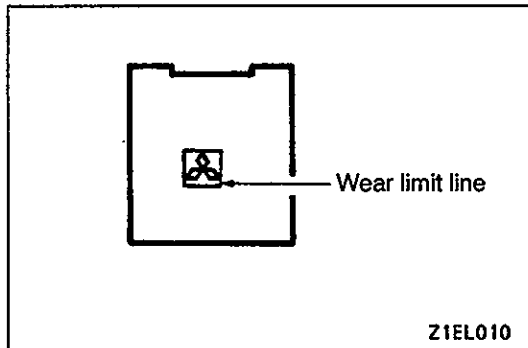
If there is no continuity, the brush holder is in order.

**OVERRUNNING CLUTCH**

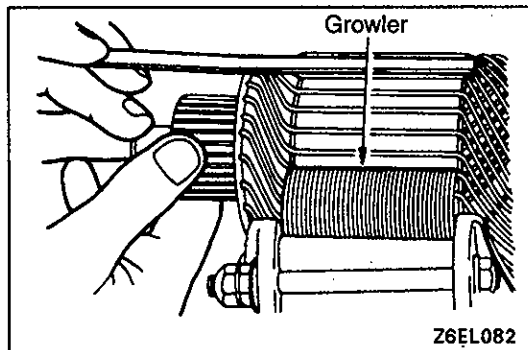
1. While holding clutch housing, rotate the pinion. Drive pinion should rotate smoothly in one direction, but should not rotate in opposite direction. If clutch does not function properly, replace overrunning clutch assembly.
2. Inspect pinion for wear or burrs. If pinion is worn or burred, replace overrunning clutch assembly. If pinion is damaged, also inspect ring gear for wear or burrs.

**FRONT AND REAR BRACKET BUSHING**

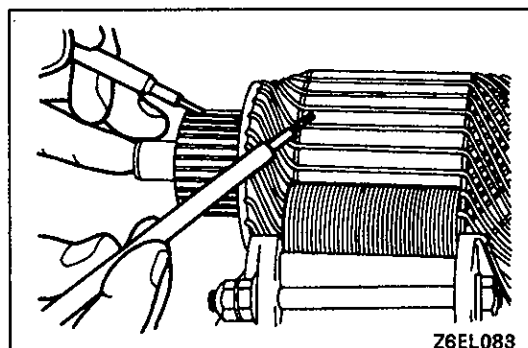
Inspect bushing for wear or burrs. If bushing is worn or burred, replace front bracket assembly or rear bracket assembly.

**BRUSH SET REPLACEMENT**

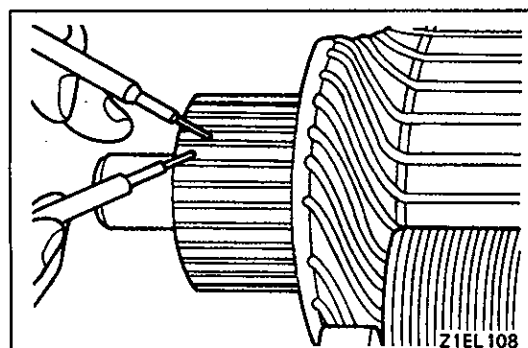
Brushes that are worn beyond wear limit line, or are oil-soaked, should be replaced.

**ARMATURE TEST****ARMATURE SHORT-CIRCUIT TEST**

1. Place armature in a growler.
2. Hold a thin steel blade parallel and just above while rotating armature slowly in growler. A shorted armature will cause blade to vibrate and be attracted to the core. Replace shorted armature.

**ARMATURE COIL EARTH TEST**

Check the insulation between each commutator segment and armature coil core. If there is no continuity, the insulation is in order.

**ARMATURE COIL OPEN-CIRCUIT INSPECTION**

Check the continuity between segments. If there is continuity, the coil is in order.