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# IGNITION TIMING

## NIPPONDENSO TRIGGER COIL SYSTEM

Normally ignition timing adjustment should not be required. It has been set at factory and it should remain correctly adjusted since every part is fixed and not adjustable. The only time the ignition timing might have to be changed would be when replacing the crankshaft, the magneto flywheel, the trigger coil or the MPEM. If the ignition timing is found incorrect, first check for proper crankshaft alignment. This might be the indication of a twisted crankshaft.

The ignition timing can be checked with either the engine hot or cold. Also, the ignition timing is to be checked at 3500 RPM with a timing light.

**NOTE:** Between 3000 and 4000 RPM, the spark advance does not change. So when checking ignition timing at 3500 RPM, a change in engine speed within  $\pm 500$  RPM will not affect the timing mark when checked with the timing light.

**IMPORTANT:** During the first 8 hours (4 hours on Summit models) the timing curve is retarded by  $2^\circ$  between 4500 RPM and maximum RPM. Because checking ignition timing is done at a lower RPM, this will not affect the 3500 RPM timing specification. There will be no further timing adjustment required before and after these hours.

No tools were available at printing time for timing procedure.

# SPARK PLUGS

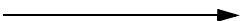
## NGK SPARK PLUG

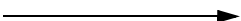
*All Models*

### NGK SPARK PLUG NUMBERING SYSTEM

Bombardier uses NGK brand spark plugs on all its snowmobile models.

The heat range identification system is:

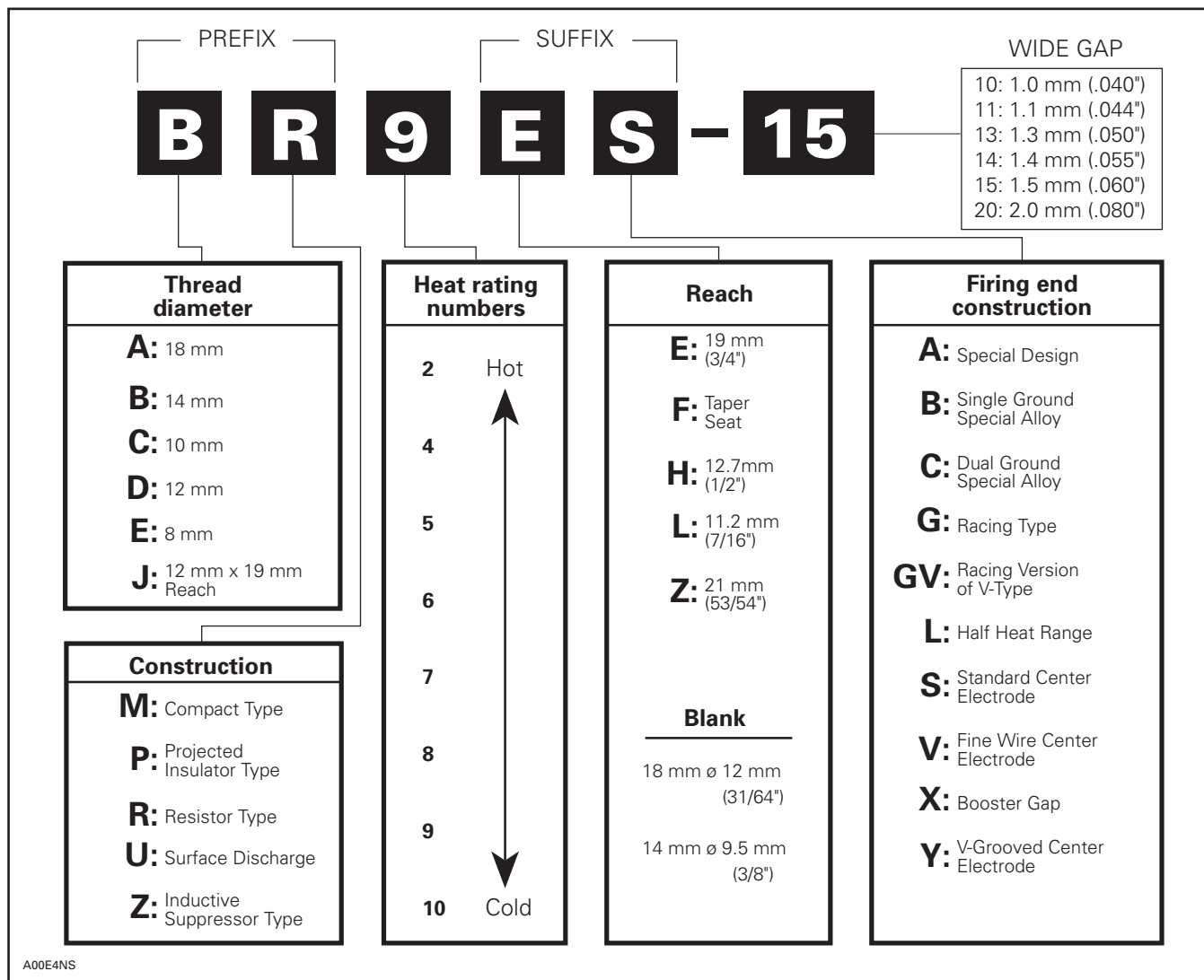
Low number            hot plug

High number           cold plug

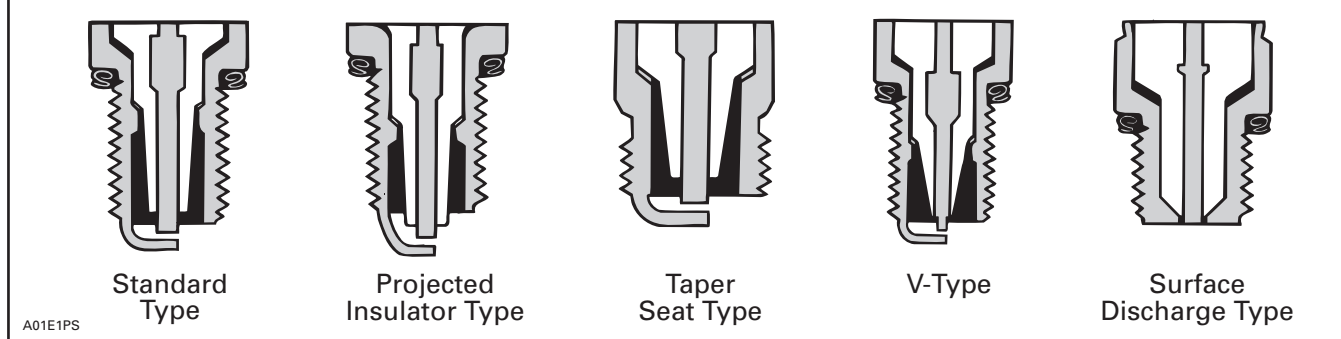
# Section 06 ELECTRICAL

## Subsection 03 (SPARK PLUGS)

### DESIGN SYMBOLS USED IN NGK SPARK PLUGS



### CROSSCUTS AND GAP STYLES OF SPARK PLUGS



## DISASSEMBLY

First unscrew the spark plug 1 turn.

Clean the spark plug and cylinder head with pressurized air, then completely unscrew.

### **WARNING**

Whenever using compressed air, always wear protective eye wear.

## HEAT RANGE

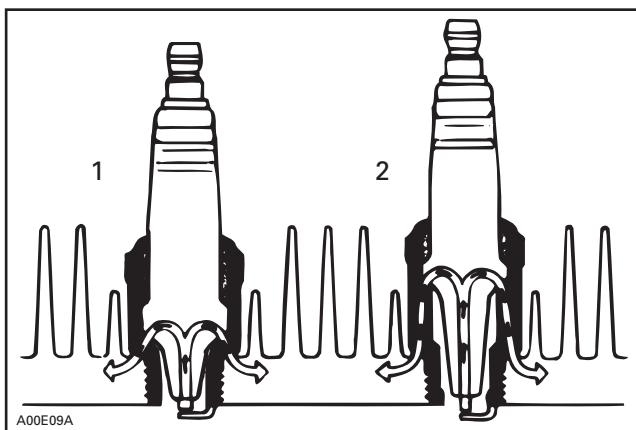
The proper operating temperature or heat range of the spark plugs is determined by the spark plug ability to dissipate the heat generated by combustion.

The longer the heat path between the electrode tip to the plug shell, the hotter the spark plug operating temperature will be — and inversely, the shorter the heat path, the colder the operating temperature will be.

A **cold** type plug has a relatively short insulator nose and transfers heat very rapidly into the cylinder head.

Such a plug is used in heavy duty or continuous high speed operation to avoid overheating.

The **hot** type plug has a longer insulator nose and transfers heat more slowly away from its firing end. It runs hotter and burns off combustion deposits which might tend to foul the plug during prolonged idle or low speed operation.



1. Cold  
2. Hot

**CAUTION:** Severe engine damage might occur if a wrong heat range plug is used.

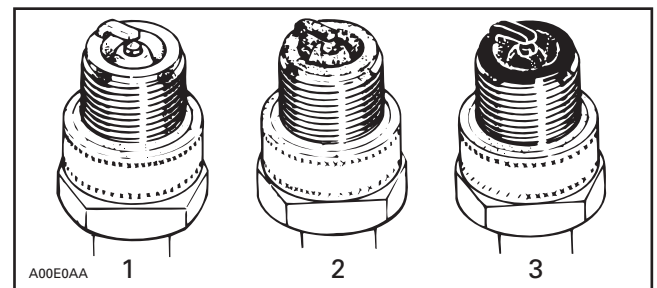
A **too hot** plug will result in overheating and pre-ignition, etc.

A **too cold** plug will result in fouling (shorting the spark plug) or may create carbon build up which can heat up red-hot and cause pre-ignition or detonation.

## FOULING

Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are: prolonged idling, or running on a too rich mixture due to a faulty carburetor adjustment or incorrect fuel and/or fuel mixing. The plug face of a fouled spark plug has either a dry coating of soot or an oily, glossy coating given by an excess either of oil or of oil with soot. Such coatings form a conductive connection between the center electrode and ground.

## SPARK PLUG ANALYSIS



1. Overheated (light grey)  
2. Normal (brownish)  
3. Fouled (black)

The plug electrode and piston dome reveal the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining the plug electrode and the piston dome.

## SPARK PLUG INSTALLATION

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap according to TECHNICAL DATA 10.
2. Apply anti-seize lubricant (P/N 413 701 000) over the spark plug threads to prevent possible seizure.

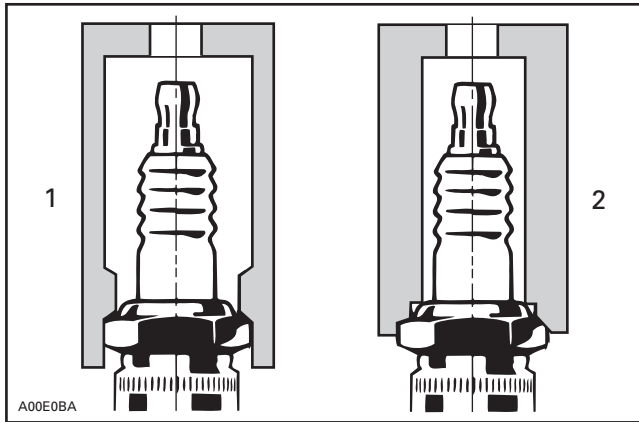
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## Section 06 ELECTRICAL

### Subsection 03 (SPARK PLUGS)

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3. Hand screw spark plug into cylinder head and tighten with a torque wrench and a proper socket.



1. Proper socket  
2. Improper socket

## SPARK PLUG TIGHTENING TORQUE

MODELS	SPARK PLUGS	TORQUE N•m (lbf•ft)
All models	NGK	27 (20)

# BATTERY

## BATTERY TESTING

There are 2 types of battery tests: unloaded and loaded. An unloaded test is made on a battery without discharging current. It is the simplest and commonly used. However, be aware that the voltage test can be good while the battery has not enough power to start the engine. A load test gives more accuracy of the battery condition.

### Unload Test

Check charge condition using a multimeter.

With a multimeter, voltage readings appear instantly to show the state of charge. Always respect polarity. A fully charged battery will have a reading of 12.6 Vdc.

### Load Test

This is the best test of battery condition under a starting load. Use a load testing device that has an adjustable load.

Apply a load of 3 times the ampere-hour rating of the battery. After 14 seconds check battery voltage; if battery is in good condition, it will have at least 10.5 Vdc.

## REMOVAL

### WARNING

Battery BLACK negative cable must always be disconnected first and connected last.

### WARNING

Never charge or boost battery while installed on vehicle.

Unfasten battery retaining strap.

Withdraw battery from vehicle.

## CLEANING

Clean the battery, battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush.

## INSPECTION

Visually inspect battery case for cracks or other possible damage. If case is damaged, replace battery and thoroughly clean battery support and close area with water and baking soda.

### WARNING

Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect battery posts for security of mounting.

## BATTERY STORAGE

Disconnect and remove battery from the vehicle.

The battery must always be stored in fully charged condition.

Clean battery terminals and cable connections using a wire brush. Apply a light coat of dielectric grease (P/N 413 701 700) or petroleum jelly on terminals.

Clean battery casing and caps using a solution of baking soda and water. Rinse battery with clear water and dry well using a clean cloth.

Store battery on a wooden shelf in a cool dry place. Such conditions reduce self-discharging to a minimum.

## ACTIVATION OF NEW BATTERY

### WARNING

Never charge or boost battery while installed on vehicle.

**CAUTION:** Prior to charging the battery, always remove it from the vehicle.

Connect a 10 A battery charger for a few hours.

**NOTE:** It is recommended to verify the battery charge once a month. If necessary, fully charge battery.

### WARNING

Do not place battery near open flame.

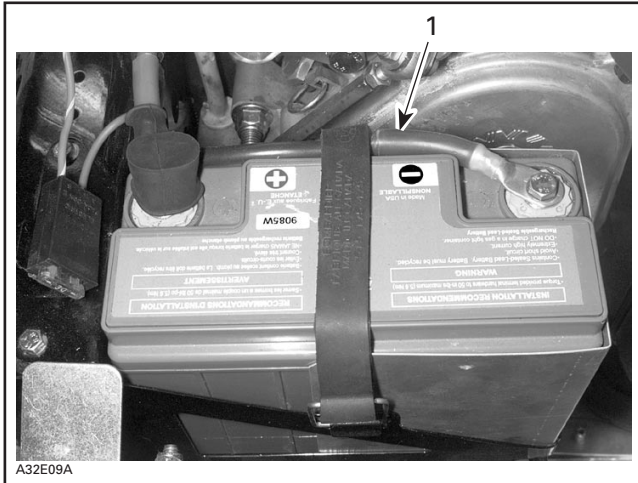
## Section 06 ELECTRICAL

### Subsection 04 (BATTERY)

#### INSTALLATION

Position battery onto battery support on vehicle.

Fasten battery retaining strap making sure that negative cable is positioned as illustrated.



1. Negative cable under battery strap

#### **⚠ WARNING**

Always connect the battery cables exactly in the specified order. Connect RED positive cable first, then BLACK negative ground cable.

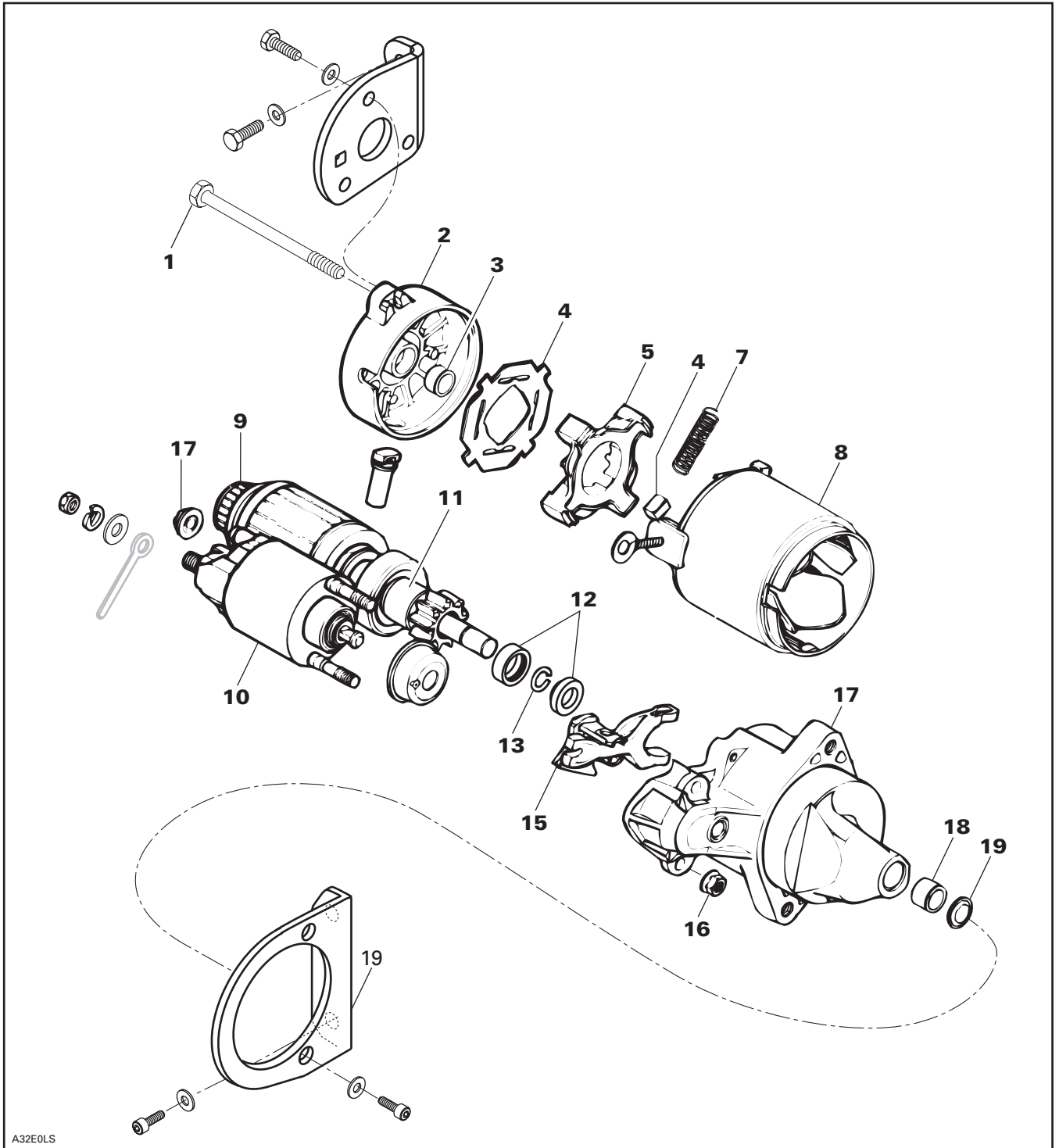
Apply silicone dielectric grease (P/N 413 701 700) on battery posts and connectors.

**CAUTION:** Negative battery terminal should always be disconnected **FIRST** and reconnected **LAST**.



# ELECTRIC STARTER

*ZX Series with Electric Starting*



A32E0LS

## Section 06 ELECTRICAL

### Subsection 05 (ELECTRIC STARTER)

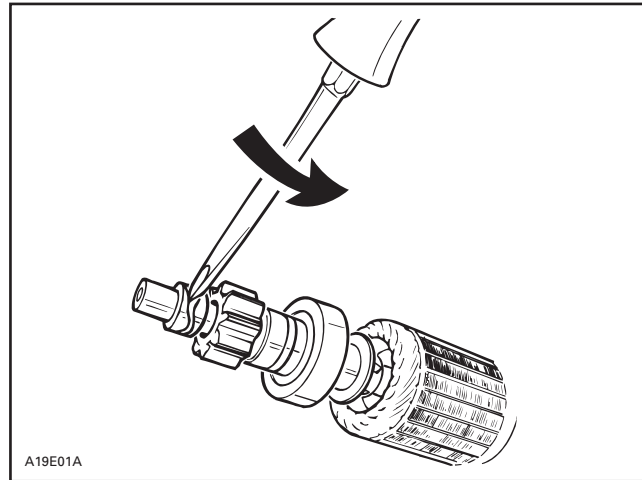
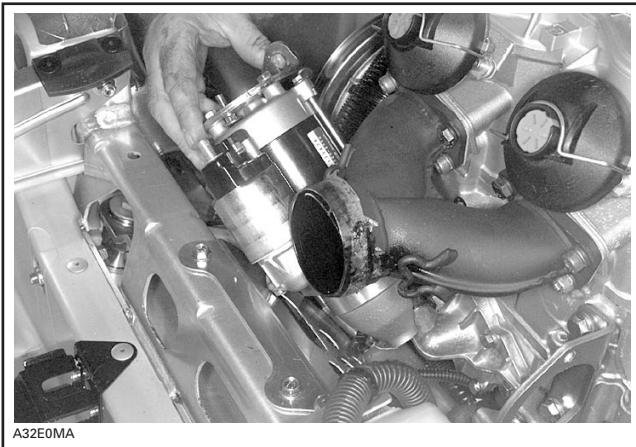
## REMOVAL

- Disconnect BLACK ground cable from battery.
- Disconnect RED positive cable from battery.

### **⚠ WARNING**

Always disconnect ground cable first and connect last.

- Remove tuned pipe.
- Disconnect RED cable and RED/GREEN wire from starter relay.
- Disconnect ground cable from MAG side bracket.
- Unbolt starter from PTO side bracket.
- Unbolt MAG side bracket from engine.
- Remove starter from engine.



TYPICAL

Twist screwdriver to separate stop collars **no. 12** thus giving access to circlip **no. 13**.

Remove outer collar, circlip then inner collar.

Remove overrunning clutch **no. 11**.

Check the wear on bushing **no. 18** by measuring the amount of radial play between the armature shaft and the bushing.

The radial play should not exceed 0.20 mm (.008 in). If greater, replace the bushing. To replace, press out the old one toward bushing cover and press in a new one with a bushing pusher. The correct size of the bushing pusher to use is given on next illustration.

**CAUTION:** Support drive housing adequately to prevent damage when pressing bushing.

## DISASSEMBLY

Disconnect bare wire linking starter and relay.

Remove nuts **no. 16** then relay **no. 10** by lifting and pulling to disengage from drive lever **no. 15**.

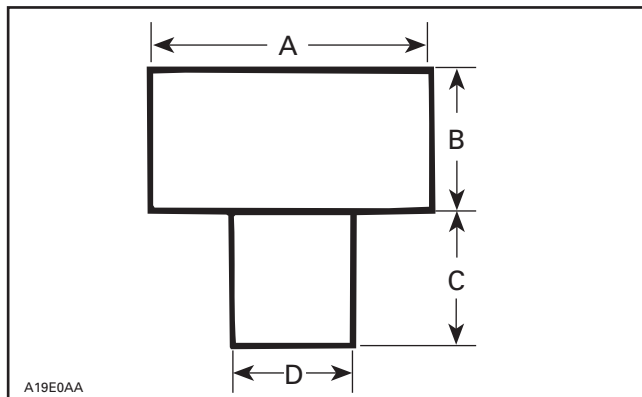
Unscrew starter screws (long) **no. 1** then pull yoke **no. 8** with end frame **no. 2** to separate from drive housing **no. 17**.

Pull armature **no. 9** with drive lever **no. 15**.

Remove insulator **no. 4** then brush springs **no. 7** being careful not to lose them since they will be projected out.

Pull brush holder **no. 5** from yoke **no. 8**.

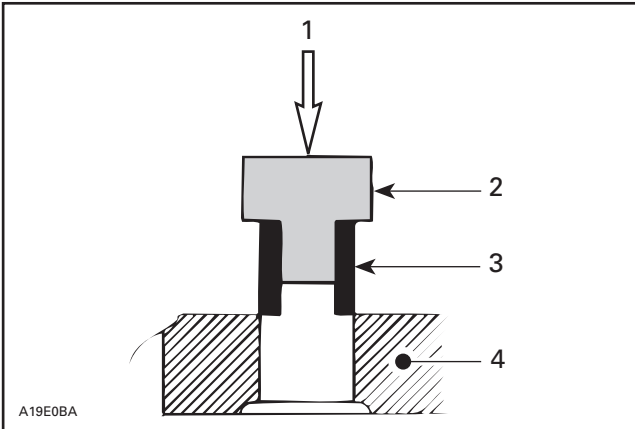
Insert blade of a small screwdriver between stop collars.



BUSHING PUSHER

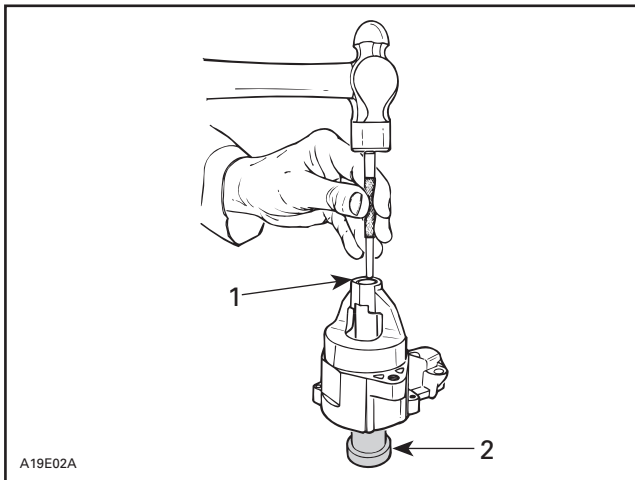
- A. 16 mm (5/8 in) diameter
- B. 13 mm (1/2 in)
- C. 11 mm (7/16 in)
- D. 11.0 mm (.433 in)

**Section 06 ELECTRICAL**  
**Subsection 05 (ELECTRIC STARTER)**



1. Press-in
2. Bushing pusher
3. Bushing
4. Drive housing

Install bushing cover no. 19 then, using a punch, stake bushing cover in place.



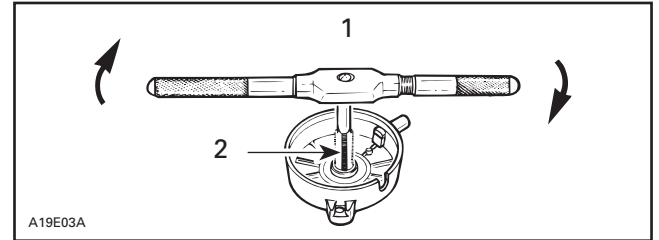
1. Stake bushing cover
2. Support

**3, Bushing (end frame)**

Check the wear on bushing no. 3 by measuring the amount of radial play between the armature shaft and the bushing.

The radial play should not exceed 0.20 mm (.008 in). If greater, replace bushing as follows:

Using a 12 mm tap, cut threads into bushing so that the tap contacts the end frame. Continue to rotate tap until the bushing comes free.



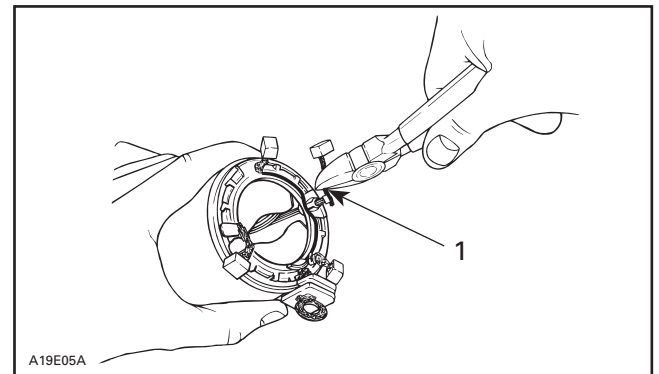
1. Turn until bushing goes out
2. 12 mm tap

To install new bushing, use the same bushing pusher as for drive housing bushing installation.

**6, Brush**

To replace brush no. 6, proceed as follows:

Cut brush wire close to connector at the welded portion.



1. Cut close to connector

Remove burrs with a file on the remaining welded portion.

**CAUTION:** Be careful not to damage plastic portion of yoke.

Place spare brush plate edge against yoke connector edge (welded portion).

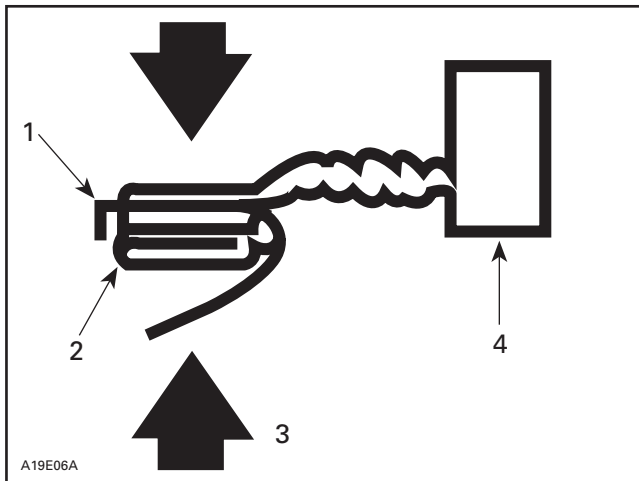
Crimp plate over yoke connector with a pair of pliers.

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## Section 06 ELECTRICAL

### Subsection 05 (ELECTRIC STARTER)

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1. Plate edge
2. Yoke connector
3. Crimp
4. Spare brush

Solder the crimped portion.

**CAUTION:** Do not overheat and quickly perform soldering to prevent solder from flowing to the brush through the wire. Preferably use a heat sink.

## CLEANING AND INSPECTION

### CLEANING

**CAUTION:** Armature starter yoke ass’y and drive unit assembly must not be immersed in cleaning solvent.

Clean brushes and holder with a clean cloth soaked in solvent. Brushes must be dried thoroughly with a clean cloth.

Blow brush holder clean using compressed air.

#### **WARNING**

Always wear safety goggles when using compressed air.

Remove dirt, oil or grease from commutator using a clean cloth soaked in suitable solvent. Dry well using a clean, dry cloth.

Clean engine starter gear teeth and drive unit (clutch).

**NOTE:** Bushings must not be cleaned with grease dissolving agents.

Immerse all metal components in cleaning solution. Dry using a clean, dry cloth.

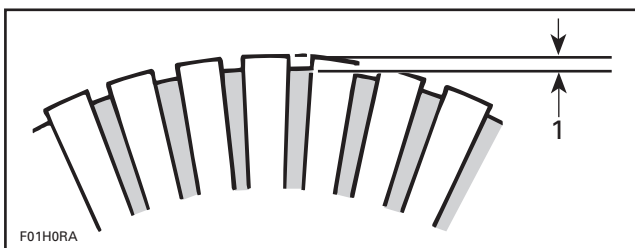
### INSPECTION

#### Armature

**NOTE:** An ohmmeter may be used for the following testing procedures, except for the one concerning the shorted windings in the armature.

Check the commutator for roughness, burnt or scored surface. If necessary, turn the commutator on a lathe, enough to remove grime only.

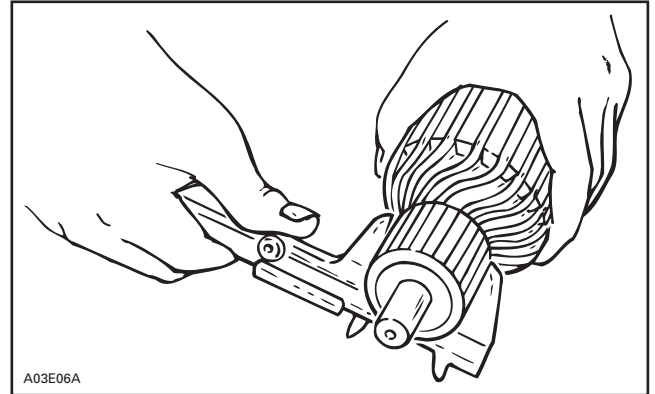
Check the commutator for mica depth. If the depth is less than 0.20 mm (.008 in), undercut the mica. Be sure that no burrs are left and no copper dust remains between the segments after the undercutting operation is completed.



1. Commutator undercut 0.20 mm (.008 in)

Check the commutator out-of-round condition with V Blocks and an indicator. If the commutator out-of-round is more than 0.40 mm (.016 in), the commutator should be turned on a lathe.

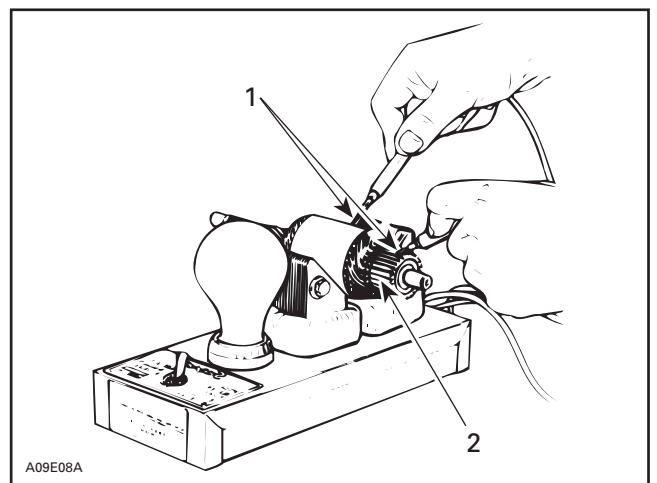
Check commutator outer diameter. If less than specified value, replace.



MODEL	WEAR LIMIT
ZX Series	27 mm (1.063 in)

#### Test for Ground Circuit in the Armature:

Use growler test probes. Check between armature core and the commutator bars. If growler lamp turns on, bars are grounded. If so, replace armature.



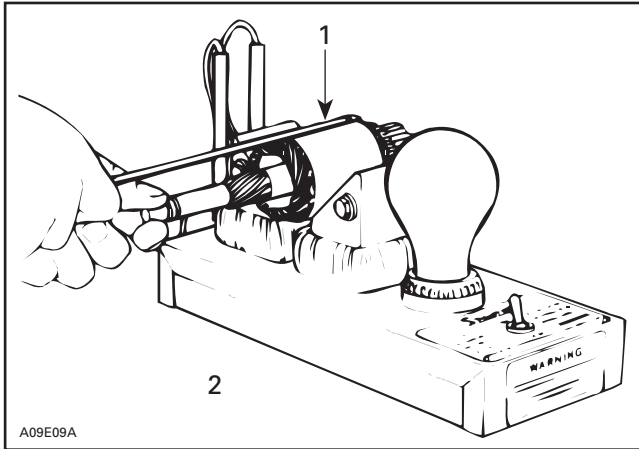
1. Test probes
2. Commutator bars

## Section 06 ELECTRICAL

### Subsection 05 (ELECTRIC STARTER)

#### Test Armature for Shorted Winding:

When the armature is rotated in the growler with a steel strip (hacksaw blade) held above it, the strip will vibrate over that area of the armature which has short circuit. Replace armature if so.



1. Steel strip (hack-saw blade)
2. Growler

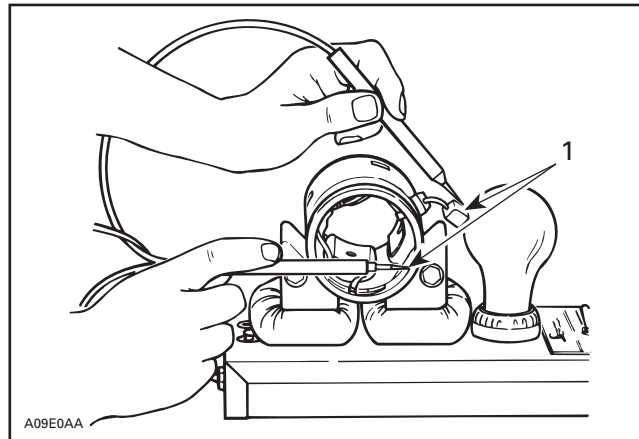
#### Test the Armature for Open Circuit:

Use growler test probes. Place one test probe on a commutator bar and the other test probe on the neighboring bar. Repeat this operation for all bars, moving one test probe at a time. If the growler lamp does not turn on, the armature circuit between these 2 bars is opened. The armature should be replaced or repaired; open circuits most often occur at the commutator riser where coils are soldered. (Burnt commutator bars are usually an indication of an open-circuit armature coil).

#### Field Windings and Brushes

##### Test the Field Winding for Open Circuit:

Use growler test probes. Place one test probe on the negative brush and the other test probe on the yoke. If growler lamp does not turn on, the field winding has an open-circuit. The yoke has to be repaired or replaced.



1. Test probes

Check the dynamic brake winding for open circuit by placing one test probe on the positive brush and the other probe on the negative brush.

If growler lamp does not turn on, the winding circuit is open-circuit and the yoke has to be repaired or replaced.

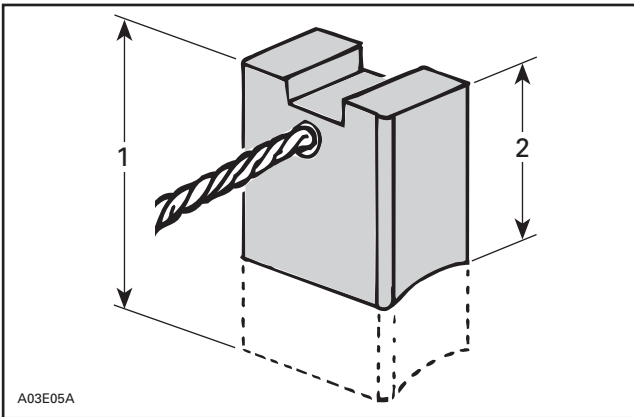
#### Brush Holder

Check the brush holder for insulation using growler test probes. Place one test probe on the insulated brush holder and the other test probe on the brush holder plate. If the growler lamp turns on, the brush holder has to be repaired or replaced.

#### Brush Length

Measure brush length. If less than the specified value, replace them.

MODEL	LENGTH	
	NEW	WEAR LIMIT
ZX Series	10 mm (.400 in)	6 mm (.236 in)



A03E05A

**TYPICAL**

- 1. New
- 2. Wear limit

**Overrunning Clutch**

The pinion of the overrunning clutch should turn smoothly in a clockwise direction, and should not slip in a counterclockwise direction. If defective, replace.

Check the pinion teeth for wear and damage. If defective, replace.

**RELAY**

Inspect connections and clean as necessary. Relay condition can be checked with an ohmmeter. Install test probes on **large** connectors of relay when it is activated (+ on RED/GREEN wire and - on relay body).

**IMPORTANT:** No current must be present on large cables when using ohmmeter, otherwise meter could be damaged.

**ASSEMBLY**

Prior to assembling, coat sliding surfaces and moving parts on armature shaft splines, overrunning clutch, relay plunger, drive lever and bushings with G.E. Versilube G 321 (P/N 413 704 000) lubricant.

Proceed as follows for assembling.

Secure drive housing in a vise.

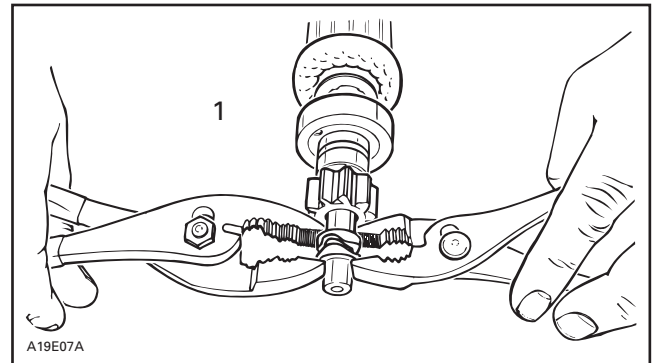
**CAUTION:** Do not overtighten since housing might be damaged.

Install overrunning clutch onto armature shaft. Insert inner collar onto shaft. Install a new circlip.

**CAUTION:** Always install a new circlip when servicing.

Insert **outer** collar being careful to match protrusions with notches of collars.

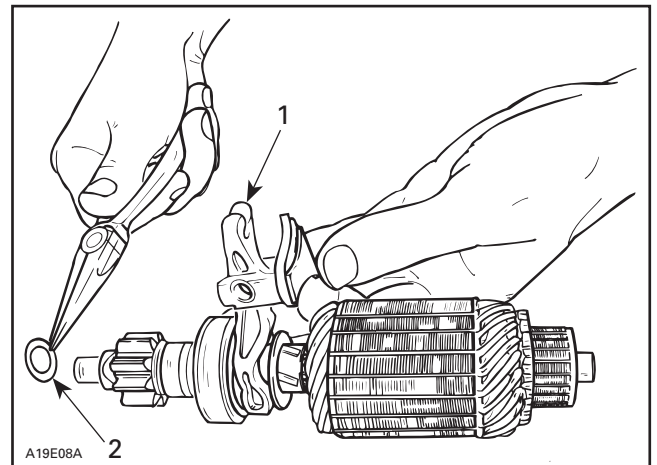
Using a pair of pliers on each side of stop collars, squeeze evenly until collars sit over circlip.



A19E07A

- 1. Squeeze evenly

Install thrust washer against outer stop collar. Place drive lever onto overrunning clutch then insert into drive housing.



A19E08A

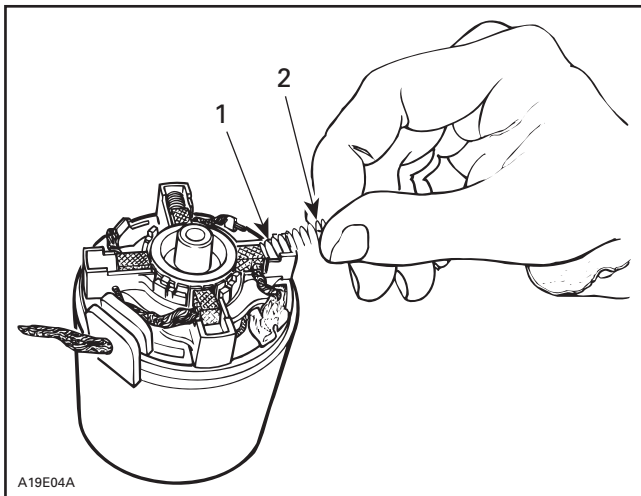
- 1. Install on overrunning clutch
- 2. Install thrust washer

Slide yoke over armature.

Install brush holder then brushes in their housings. Insert springs as follows: place one end of spring against brush, compress, then push the other end of spring onto its housing. Repeat for remaining springs.

## Section 06 ELECTRICAL

### Subsection 05 (ELECTRIC STARTER)



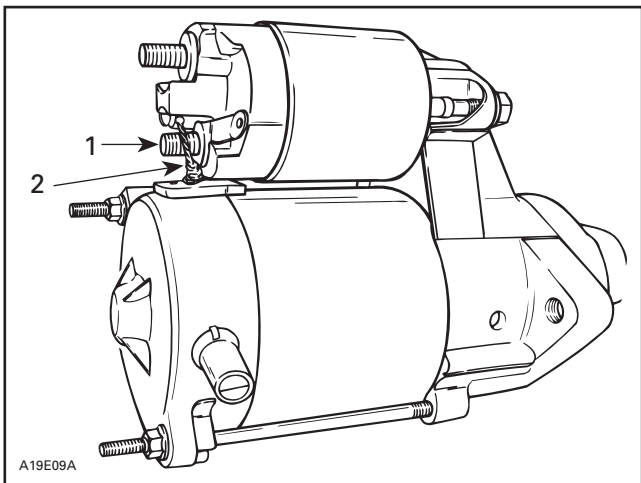
1. This end first
2. Push this end to complete

Secure insulator over brushes and springs. Properly install end frame and tighten screws.

Insert relay plunger inside of drive lever fork and secure to drive housing.

Connect starter bare wire to relay.

**NOTE:** Connect this wire on the **shorter** relay stud.

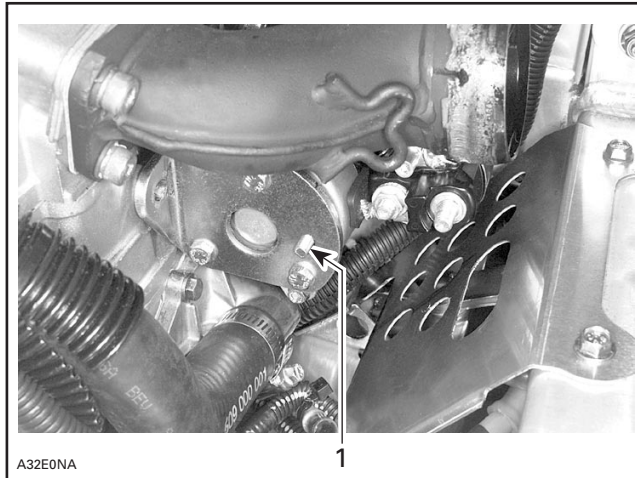


#### TYPICAL

1. Shorter stud
2. Bare wire

## INSTALLATION

Install carriage bolt in MAG side bracket before installing starter.



1. Carriage bolt must be in place before starter installation

Make sure that starter and engine mating surfaces are free of grime. Serious trouble may arise if starter is not properly aligned.

**CAUTION:** Make sure that both starter brackets are well seated against engine crankcase and starter before torquing all retaining bolts.

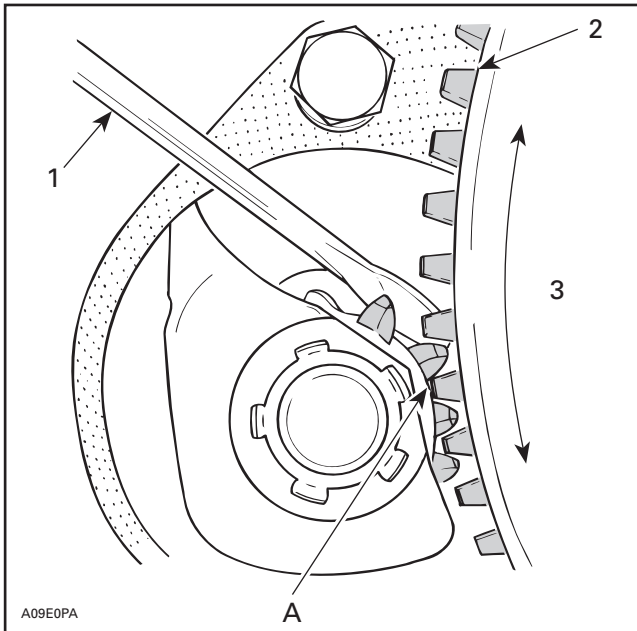
Torque all M8 bolts to 29 N•m (21 lbf•ft).

Torque all M6 bolts to 11 N•m (97 lbf•in).

**NOTE:** Check proper engaging depth of starter pinion teeth to ring gear teeth (see illustration). Install hardened washers (P/N 503 007 900) between engine and starter supports accordingly.

**CAUTION:** Always install new self-locking fasteners.





1. Screwdriver pulling starter pinion
2. Ring gear
3. No excessive backlash
- A. 0.5 to 1.5 mm (.020 to .060 in)

Connect the RED battery cable and the RED wire to the large terminal of the relay. Connect RED/GREEN wire to small terminal of relay.

Connect BLACK cable to MAG side bracket.

Connect BLACK cable to battery.

**⚠ WARNING**

Always disconnect ground cable first and connect last.

# TESTING PROCEDURE

IGNITION SYSTEM TESTING (ZX 290 W 2000)								
PART	TEST TO BE PERFORMED	WIRE COLOR	MULTIMETER PROBE CONNECTION	RESISTANCE Ω		VOLTAGE V		NOTE
				VALUE (OHMS)	MULTIMETER SCALE	VALUE (VOLTS)	MULTIMETER SCALE	
Stop switches	Running insulation	BK and BK/YL	11-DB-C-F 11-DA-3-F	0.L	00.0 <sub>MΩ</sub>	—	—	No stop switch must be operational.
	Continuity in stop position	BK and BK/YL	11-DB-C-F 11-DA-3-F	00.0 - 00.5	00.0 <sub>Ω</sub>	—	—	Only one stop switch must be operational. Test one at a time.
	Insulation in stop position	BK/GN and BK/WH	11-DA-2-F 11-DA-1-F	0.L	00.0 <sub>MΩ</sub>	—	—	Tether cord cap must be off.
	Running continuity	BK/GN and BK/WH	11-DA-2-F 11-DA-1-F	00.0 - 00.5	00.0 <sub>Ω</sub>	—	—	Tether cord cap must be in place.
Ignition generator coil	Output	RD and BK/RD	11-DB-A-F 11-DB-B-F	11.6 - 21.6	00.0 <sub>Ω</sub>	15.0 - 30.0	00.0 <sub>Vac</sub>	—
	Coil insulation	RD and BK	11-DB-A-F 11-DB-C-F	0.L	00.0 <sub>MΩ</sub>	—	—	—
	Ground continuity	BK and engine	11-DB-C-F and engine	00.0 - 00.5	00.0 <sub>Ω</sub>	—	—	The term "engine" refers to the engine metal parts connected to the magneto housing.
Trigger coil	Resistance and output	WH/YL and BL/YL	11-DC-2-F 11-DC-1-F	190 - 300	00.0 <sub>Ω</sub>	.200 - .350	.000 <sub>Vac</sub>	—
MPEM	Output voltage	WH/BL and BK	11-DD-1-F 11-DD-2-F	—	—	25.0 - 100.0	00.0 <sub>Vac</sub>	No switch must be operational and tether cord cap must be in place.
High voltage coil	Primary winding resistance	WH/BL and BK	11-DD-1-F 11-DD-2-F	00.0 - 00.9	00.0 <sub>Ω</sub>	—	—	—
	Secondary winding resistance (spark plug cap included)	Spark plug cap Spark plug cap	In spark plug caps	19.5 K - 26.5 K	00.0 <sub>KΩ</sub>	<b>CAUTION: Do not measure high voltage coil output voltage.</b>		
	Secondary winding resistance (without spark plug cap)	BK and BK	In spark plug wires	9.6 K - 14.4 K	00.0 <sub>KΩ</sub>	<b>CAUTION: Do not measure high voltage coil output voltage.</b>		
	Secondary winding voltage	BK and engine	On spark plug wire and on engine	—	—	0.1 - 1.4	0.00 <sub>Vac</sub>	The measurement must be taken on the spark plug wire (without the spark plug).
	Insulation	Spark plug cap BK	In cap 11-DD-2-F	0.L	00.0 <sub>MΩ</sub>	—	—	—
Spark plug cap	Cap resistance	—	Spark plug side and wire side	4.0 K - 6.0 K	00.0 <sub>KΩ</sub>	—	—	—

F: Female

**NOTE:** Stop switches include the ignition switch and the emergency cut-out switch.

It is important to take note that voltage measurements must be taken while starting the vehicle using the manual starter.

Voltages obtained upon starting are proportional to the force applied onto the manual starter. A low voltage is therefore normal under a low cranking force.

Perform testing in the prescribed order and replace any parts not performing according to specifications. It is important to resume all test when replacing a component.

If not specified, the probe connecting sequence is not important.

## Section 06 ELECTRICAL

### Subsection 06 (TESTING PROCEDURE)

LIGHTING SYSTEM TESTING (ZX 290 W 2000)								
PART	TEST TO BE PERFORMED	WIRE COLOR	MULTIMETER PROBE CONNECTION	RESISTANCE $\Omega$		VOLTAGE V		NOTE
				VALUE (OHMS)	MULTIMETER SCALE	VALUE (VOLTS)	MULTIMETER SCALE	
Lighting generator coil	Output	YL	2-MO-B-F and 2-MO-C-F	00.1 - 00.4	00.0 $\Omega$	0.5 - 2.0	00.0 <sup>Vac</sup>	—
	Coil insulation	YL and engine	2-MO-(B,C)-F and engine	0.L	00.0 $M\Omega$	—	—	The term "engine" refers to the engine metal parts connected to the magneto housing.
	Ground continuity	BK and engine	2-MO-A-F and engine	00.0 - 00.5	00.0 $\Omega$	—	—	

F: Female

**NOTE:** Stop switches include the ignition switch and the emergency cut-out switch.

It is important to take note that voltage measurements must be taken while starting the vehicle using the manual starter.

Voltages obtained upon starting are proportional to the force applied onto the manual starter. A low voltage is therefore normal under a low cranking force.

Perform testing in the prescribed order and replace any parts not performing according to specifications.

It is important to resume all test when replacing a component.

If not specified, the probe connecting sequence is not important.