

Toyota Engine 4a F 4a Ge Repair Manual

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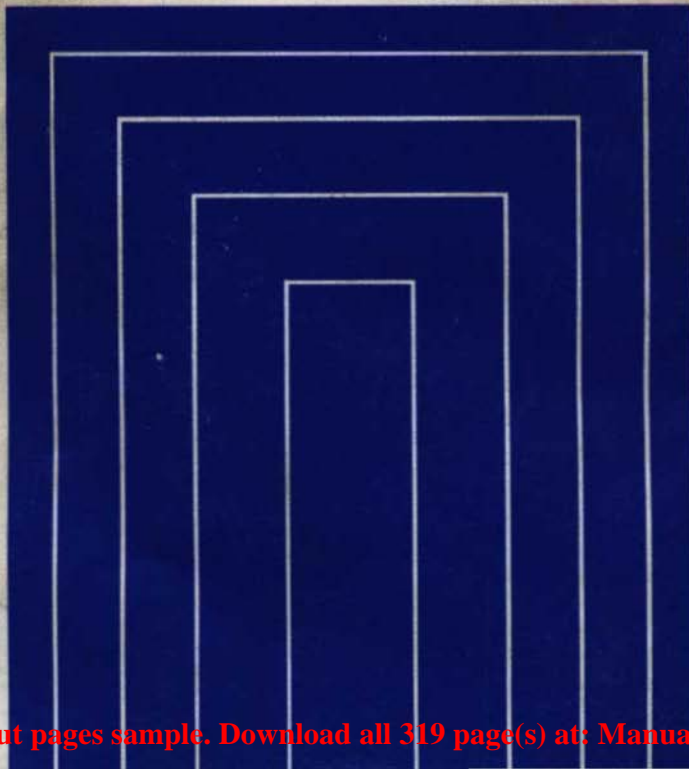
TOYOTA

4A-F, 4A-GE

ENGINE

REPAIR MANUAL

May, 1987



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HOW TO USE THIS MANUAL

To assist you in finding your way through this manual, the Section Title and major heading are given at the top of every page.

An **INDEX** is provided on the 1st page of each section to guide you to the item to be repaired.

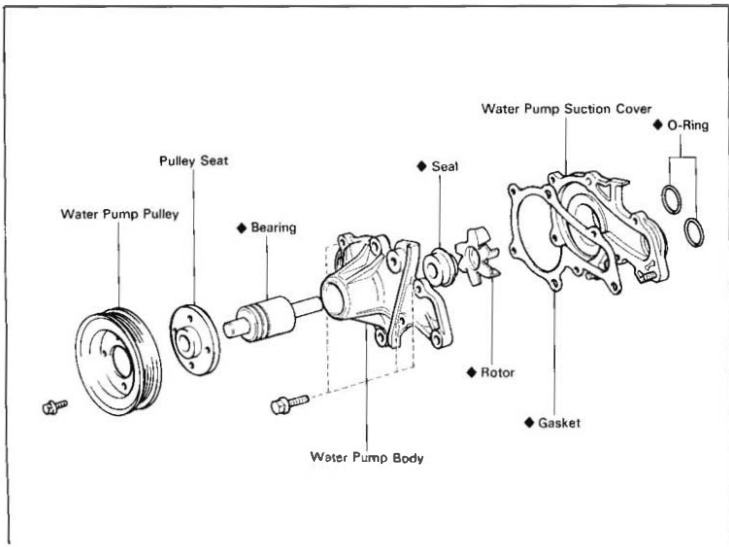
At the beginning of each section, **PRECAUTIONS** are given that pertain to *all* repair operations contained in that section. *Read these precautions before starting any repair task.*

TROUBLESHOOTING tables are included for each system to help you diagnose the system problem and find the cause. The repair for each possible cause is referenced in the remedy column to quickly lead you to the solution.

REPAIR PROCEDURES

Most repair operations begin with an overview illustration. It identifies the components and shows how the parts fit together.

Example:



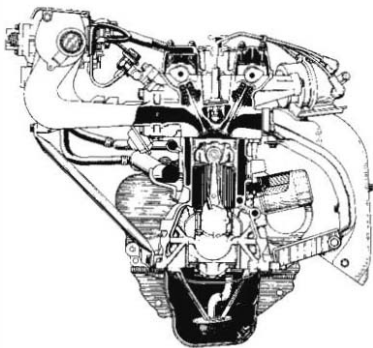
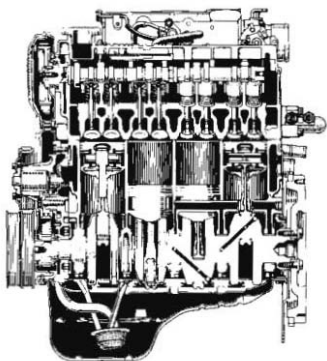
ABBREVIATIONS USED IN THIS MANUAL

AAP	Auxiliary Acceleration Pump
A/C	Air Conditioner
AS	Air Suction
A/T	Automatic Transmission
BTDC	Before Top Dead Center
CB	Choke Breaker
DP	Dash Pot
ECU	Electronic Controlled Unit
EFI	Electronic Fuel Injection
EGR	Exhaust Gas Recirculation
ESA	Electronic Spark Advance
EX	Exhaust (manifold, valve)
Ex.	Except
FIPG	Formed in Place Gasket
HIC	Hot Idle Compensation
HAI	Hot Air Intake
IG	Ignition
IIA	Integrated Ignition Assembly
IN	Intake (manifold, valve)
ISC	Idle Speed Control
LH	Left-hand
LHD	Left-hand Drive
LLC	Long Life Coolant (Year Around Coolant)
MP	Multipurpose
M/T	Manual Transmission
O/S	Oversized
PCV	Positive Crankcase Ventilation
RH	Right-hand
RHD	Right-hand Drive
RON	Research Octane Number
PS	Power Steering
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
S/W	Switch
TDC	Top Dead Center
TP	Throttle Positioner
T-VIS	TOYOTA-Variable Induction System
TVSV	Thermostatic Vacuum Switching Valve
TWC	Three-way Catalyst
U/S	Undersized
VSV	Vacuum Switching Valve
w/	With
w/o	Without

DESCRIPTION

4A-GE ENGINE

The 4A-GE engine is an in-line 4-cylinder 1.6 liter DOHC 16 valve engine.



The 4A-GE engine is an in-line 4-cylinder engine with the cylinders numbered 1-2-3-4 from the front. The crankshaft is supported by 5 bearings specified by the inside of the crankcase. These bearings are made of aluminum alloy.

The crankshaft is integrated with 8 weights which are cast along with it for balancing. Oil holes are built into the center of the crankshaft for supplying oil to the connecting rods, pistons and other components.

This engine's ignition order is 1-3-4-2. The cylinder head is made of aluminum alloy, with a cross flow type intake and exhaust layout and with pent roof type combustion chambers. The spark plugs are located in the center of the combustion chambers.

The intake manifold has 8 independent long ports and utilizes the inertial supercharging effect to improve engine torque at low and medium speeds.

Exhaust and intake valves are equipped with irregular pitch springs made of oil tempered silicon chrome steel wire which are capable of following the valves even at high engine speeds.

Both the exhaust side cam shaft and the intake side cam shaft are driven by a single timing belt. The cam journal is supported at 5 places between the valve lifters of each cylinder and on the front end of the cylinder head. Lubrication of the cam journal and cam is accomplished by oil being supplied through the oiler port in the center of the camshaft.

Adjustment of the valve clearance is done by means of an outer shim type system, in which valve adjusting shims are located above the valve lifters. This permits replacement of the shims without removal of the camshafts.

The resin timing belt cover is made in 3 pieces. A service hole is provided in the No.2 belt cover for adjusting the timing belt tension.

Pistons are made of highly temperature-resistant aluminum alloy, and a depression is built into the piston head to prevent interference with valves.

Piston pins are the full-floating type, with the pins fastened to neither the piston boss nor the connecting rods. Instead, snap rings are fitted on both ends of the pins, preventing the pins from falling out.









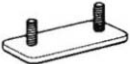
The No.1 compression ring is made of steel and the No.2 compression ring is made of cast iron. The oil ring is made of a combination of steel and stainless steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. Compression rings No.1 and No.2 work to prevent the leakage of gas from the cylinder and the oil ring works to scrape oil off the cylinder walls to prevent it from entering the combustion chamber.

The cylinder block is made of cast iron. It has 4 cylinders which are approximately 2 times the length of the piston stroke. The top of the cylinders is closed off by the cylinder head and the lower end of the cylinders becomes the crankcase, in which the crankshaft is installed. In addition, the cylinder block contains a water jacket, through which coolant is pumped to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A dividing plate is included inside the oil pan to keep sufficient oil in the bottom of the pan even when the vehicle is tilted. This dividing plate also prevents the oil from making waves when the vehicle is stopped suddenly and thus shifting the oil away from the oil pump suction pipe.

STANDARD BOLT TORQUE SPECIFICATIONS

HOW TO DETERMINE BOLT STRENGTH

	Mark	Class		Mark	Class
Hexagon head bolt	 Bolt head No 4- 5- 6- 7-	4T 5T 6T 7T	Stud bolt	 No mark	4T
	 No mark	4T			
Hexagon flange bolt w/washer hexagon bolt	 No mark	4T	Welded bolt	 Grooved	6T
Hexagon head bolt	 Two protruding lines	5T			
Hexagon flange bolt w/washer hexagon bolt	 Two protruding lines	6T			
Hexagon head bolt	 Three protruding lines	7T		4T	

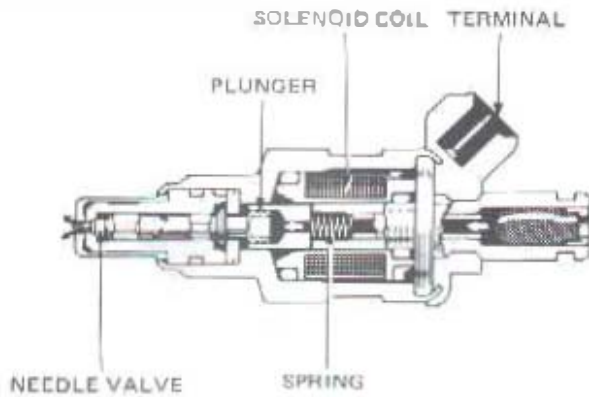
SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt			Hexagon flange bolt		
			kg-cm	ft-lb	N-m	kg-cm	ft-lb	N-m
4T	6	1	55	48 in.-lb	5.4	60	52 in.-lb	5.9
	8	1.25	130	9	13	145	10	14
	10	1.25	260	19	25	290	21	28
	12	1.25	480	35	47	540	39	53
	14	1.5	760	55	75	850	61	83
	16	1.5	1,150	83	113	-	-	-
6T	8	1	65	56 in.-lb	6.4	-	-	-
	8	1.25	160	12	16	-	-	-
	10	1.25	330	24	32	-	-	-
	12	1.25	600	43	59	-	-	-
	14	1.5	930	67	91	-	-	-
	16	1.5	1,400	101	137	-	-	-
6T	6	1	60	69 in.-lb	7.8	90	78 in.-lb	8.8
	8	1.25	195	14	19	215	16	21
	10	1.25	400	29	39	440	32	43
	12	1.25	730	53	72	810	59	79
	14	1.5	-	-	-	1,250	90	123
7T	6	1	110	8	11	120	9	12
	8	1.25	260	19	25	290	21	28
	10	1.25	530	38	52	590	43	58
	12	1.25	970	70	95	1,050	76	103
	14	1.5	1,500	108	147	1,700	123	167
	16	1.5	2,300	166	226	-	-	-

FUEL SYSTEM

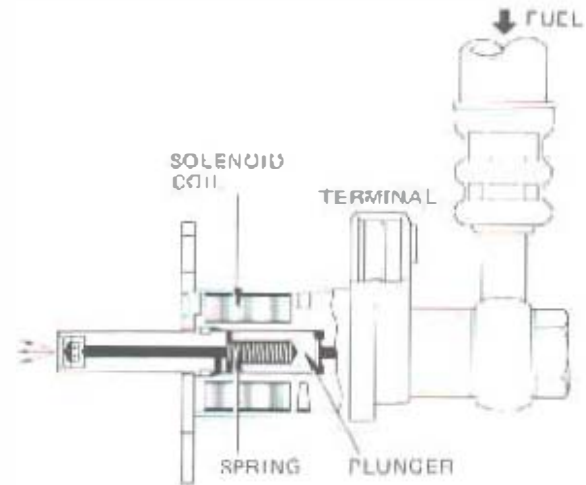
● INJECTOR ● COLD START INJECTOR

INJECTOR



The injector performs the injection of fuel in accordance with a computer-calculated injection signal. When a pulse from the computer is received by the solenoid coil, the plunger is pulled against spring tension. Since the needle valve and plunger are a single unit, the valve is also pulled off of the seat and fuel is injected as shown by the arrows. Because the needle valve stroke is fixed, injection continues as long as the needle valve is open and fuel volume is controlled by the duration of the electrical pulse.

COLD START INJECTOR



A cold start injector, installed in the center area of the air distribution chamber, is provided to improve starting when the engine is cold.

This injector functions in accordance with directions from the start injector time switch and only during engine cranking when the coolant temperature is below 35°C.

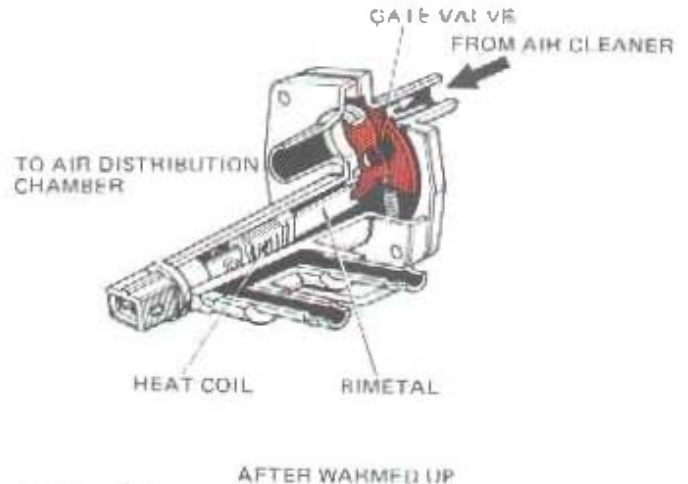
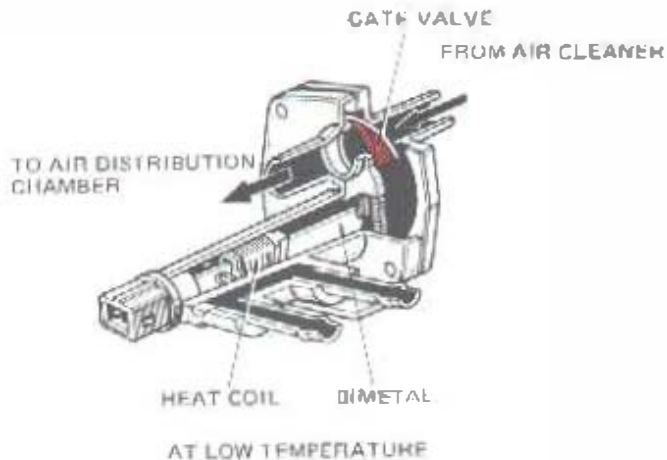
The injector tip employs a special design to improve mist spray.

When the start injector time switch signal is applied to the solenoid coil, the plunger is pulled against spring tension. Thus, the valve will open and fuel will flow over the plunger and through the injector tip. Once the engine has been started, current to the start injector is cut off and injection is terminated.

AIR INDUCTION SYSTEM

● AIR VALVE

AIR VALVE



OPERATION

The air valve is a fast idle device operated by a bimetal and heat coil to increase engine rpm when the engine is cold.

When starting a cold engine, the gate valve is open allowing air from the air cleaner to bypass the throttle valve and flow directly through the air valve to the air intake chamber.

Thus, even though the throttle valve is in the closed position, intake air volume is increased and idle speed will be slightly faster than normal (fast idle). When the engine is started, current begins to flow to the heat coil. As the bimetal is heated, the gate valve will gradually close and engine rpm will decrease.

Once warmed up, the gate valve will be fully closed, preventing air flow, and idle speed will return to normal.

CHARGING SYSTEM

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TROUBLESHOOTING	CH-2
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ON-VEHICLE INSPECTION	CH-4
ALTERNATOR	CH-7
ENGINE MAIN RELAY	CH-15

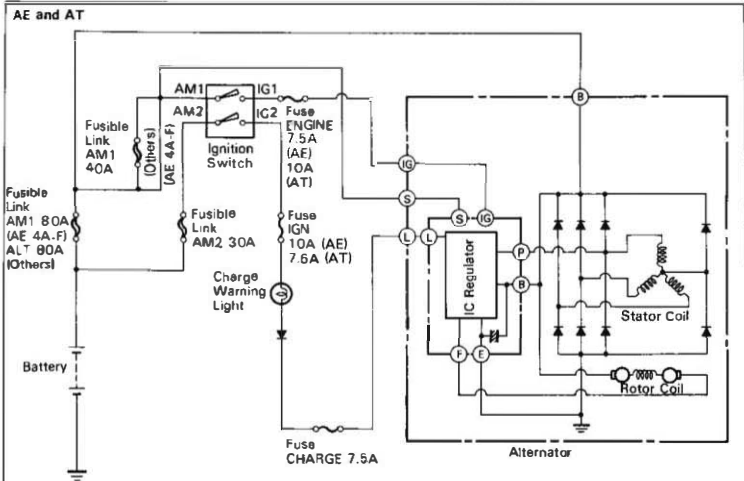
PRECAUTIONS

1. Check that the battery cables are connected to the correct terminals.
2. Disconnect the battery cables when the battery is given a quick charge.
3. Do not perform tests with a high voltage insulation resistance tester.
4. Never disconnect the battery while the engine is running.

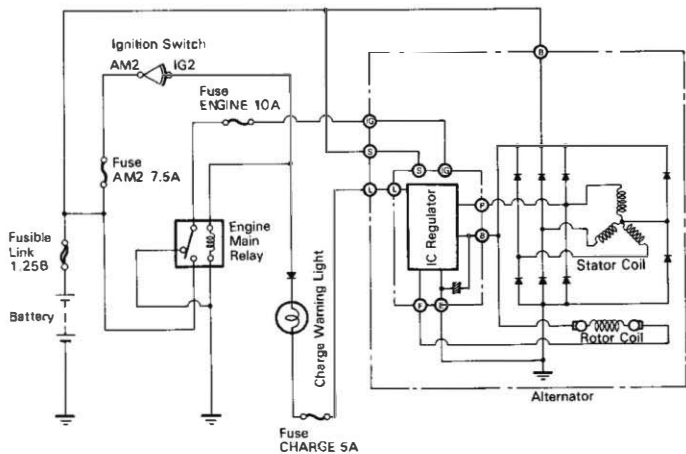
TROUBLESHOOTING

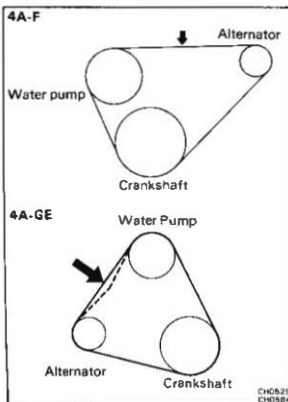
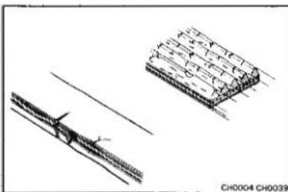
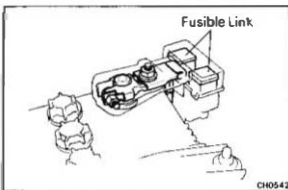
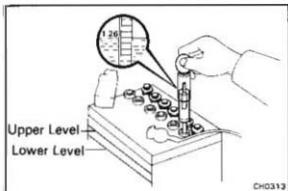
Problem	Possible cause	Remedy	Page
Discharge warning light does not light with ignition ON and engine off	Fuse blown	Check "CHARGE" and "IGN" (AE and AT) or "AM2" (AW) fuses	CH-7
	Light burned out	Replace light	
	Wiring connection loose	Tighten loose connections	
	IC regulator faulty	Replace IC regulator	
Discharge warning light does not go out with engine running (battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt	CH-4
	Battery cables loose, corroded or worn	Repair or replace cables	CH-3
	Fuse blown	Check "CHARGE" or "ENGINE" fuses	
	Fusible link blown	Replace fusible link	
	IC regulator or alternator faulty	Check charging system	
Wiring faulty	Repair wiring		

CHARGING CIRCUIT



AW





ON-VEHICLE INSPECTION

1. INSPECT BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL

- (a) Check the specific gravity of each cell.

Standard specific gravity

when fully charged at 20°C (68°F): 1.25 – 1.27

If not within specifications, charge the battery.

- (b) Check the electrolyte quantity of each cell.

If insufficient, refill with distilled (or purified) water.

2. CHECK BATTERY TERMINALS AND FUSIBLE LINKS

- (a) Check that the battery terminals are not loose or corroded.

- (b) Check the fusible links for continuity.

3. INSPECT DRIVE BELT

- (e) Visually check the belt for separation of the adhesive rubber above and below the core, core separation from the belt side, severed core, separation of the rib from the adhesive rubber, cracking or separation of the ribs, torn or worn ribs or cracks in the inner ridges of the ribs.

If the belt has any of the above defects, replace it.

- (b) Check the drive belt deflection of pressing on the belt at the points indicated in the figure with 10 kg (22.0 lb, 98 N) pressure.

Drive belt deflection:

4A-F

New belt 8.5 – 10.5 mm (0.335 – 0.413 in.)

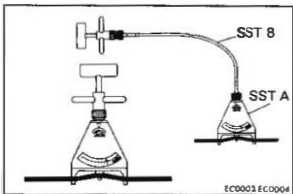
Used belt 10.0 – 12.0 mm (0.39 – 0.47 in.)

4A-GE

New belt 4 – 5 mm (0.16 – 0.20 in.)

Used belt 6 – 7 mm (0.24 – 0.28 in.)

If necessary, adjust the drive belt deflection.

**(Reference)**

Using SST, check the drive belt tension.

SST A 09216-00020

SST B 09216-00030

Drive belt tension:**4A-F**

New belt 60 – 70 kg

Used belt 40 – 55 kg

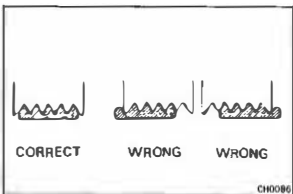
4A-GE

New belt 70 – 80 kg

Used belt 30 – 45 kg

NOTE:

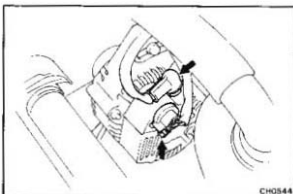
- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After installing the drive belt, check that it fits properly in the ribbed grooves.
- Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the crank pulley.
- After installing the belt, run the engine for approx. 5 minutes and recheck the deflection or tension.

**4. CHECK FUSES FOR CONTINUITY**

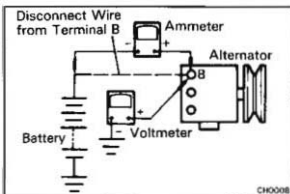
- CHARGE 7.5A (AE and AT), 6A (AW)
- IGN 10A (AE), 7.6A (AT)
- ENGINE 7.5A (AE), 10A (AT and AW)
- AM2 7.6A (AW)

5. VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

- (a) Check that the wiring is in good condition.
- (b) Check that there is no abnormal noise from the alternator while the engine is running.

**6. INSPECT DISCHARGE WARNING LIGHT CIRCUIT**

- (a) Warm up the engine and turn it off.
 - (b) Turn off all accessories.
 - (c) Turn the ignition switch to ON. Check that the discharge warning light is lit.
 - (d) Start the engine. Check that the light goes out.
- If the light does not operate as specified, troubleshoot the warning light circuit.



7. CHECK CHARGING CIRCUIT WITHOUT LOAD

NOTE: If a battery/alternator tester is available, connect the tester to the charging circuit according to the manufacturer's instructions.

(a) If a tester is not available, connect a voltmeter and ammeter to the charging circuit as follows:

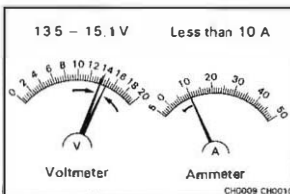
- Disconnect the wire from terminal B of the alternator and connect the wire to the negative (-) terminal of the ammeter.
- Connect the fast lead from the positive (+) terminal of the ammeter to terminal B of the alternator.
- Connect the positive (+) lead of the voltmeter to terminal B of the alternator.
- Ground the negative (-) lead of the voltmeter.

(b) Check the charging circuit as follows:

With the engine running from idling to 2,000 rpm, check the reading on the ammeter and voltmeter.

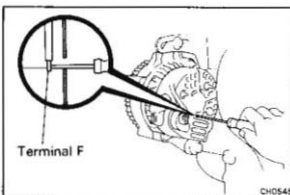
Standard amperage: Less than 10 A
Standard voltage: 13.9 – 15.1 V at 25°C (77°F)
 13.5 – 14.3 V at 115°C (239°F)

If the voltage reading is greater than standard voltage, replace the IC regulator.



If the voltage reading is less than standard voltage, check the IC regulator and alternator as follows:

- With terminal F grounded, start the engine and check the voltage reading of terminal B.
- If the voltage reading is higher than standard voltage, replace the IC regulator.
- If the voltage reading is less than standard voltage, repair the alternator.



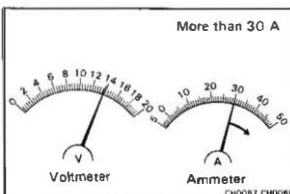
8. INSPECT CHARGING CIRCUIT WITH LOAD

(a) With the engine running at 2,000 rpm, turn on the high beam headlights and place the heater fan control switch at HI.

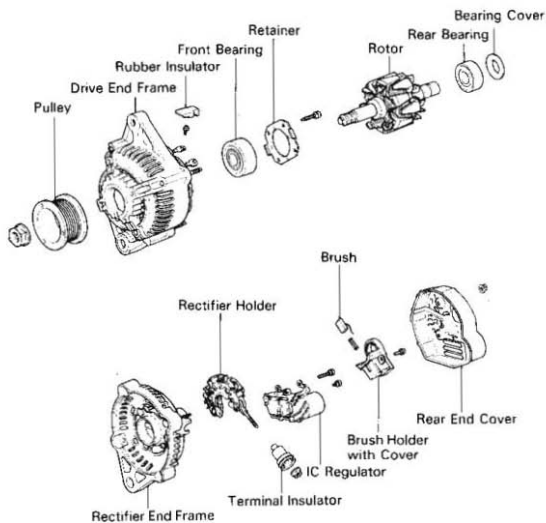
(b) Check the reading on the ammeter.

Standard amperage: More than 30 A
 If the ammeter reading is less than 30 A, repair the alternator. (See page CH-7)

NOTE: If the battery is fully charged, the indication will sometimes be less than 30 A.



ALTERNATOR COMPONENTS

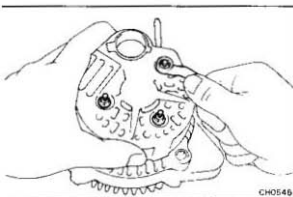


CH0548

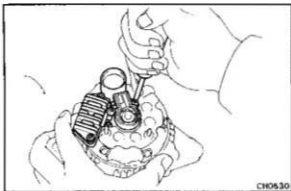
DISASSEMBLY OF ALTERNATOR

1. REMOVE REAR END COVER

- Remove the nut and terminal insulator.
- Remove the three nuts and end cover.

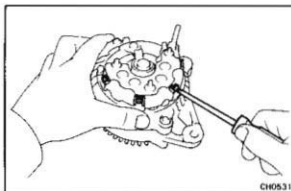


CH0548



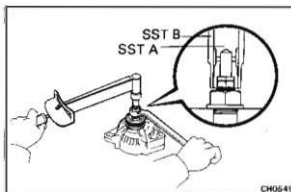
2. REMOVE BRUSH HOLDER AND IC REGULATOR

Remove the five screws, brush holder and IC regulator.



3. REMOVE RECTIFIER HOLDER

- Remove the four screws and rectifier holder.
- Remove the four rubber insulators.



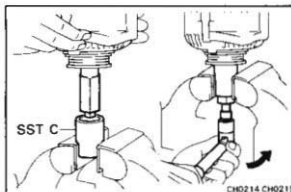
4. REMOVE PULLEY

- Hold SST A with a torque wrench, and tighten SST B clockwise to the specified torque.

SST 09820-63010

Torque: 400 kg-cm (29 ft.-lb, 39 N-m)

- Check that SST A is secured to the rotor shaft.

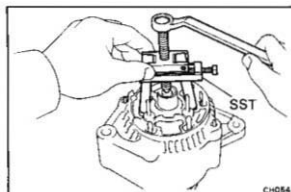


- As shown in the figure, mount SST C in a vise, and install the alternator to SST C.

- To loosen the pulley nut turn SST A in the direction shown in the figure.

CAUTION: To prevent damage to the rotor shaft, do not loosen the pulley nut more than one-half of a turn.

- Remove the alternator from SST C.
- Turn SST B and remove SSTs A and B.
- Remove the pulley nut and pulley.



5. REMOVE RECTIFIER END FRAME

- Remove the four nuts.
 - Using SST, remove the rectifier end frame.
- SST 09286-46011

6. REMOVE ROTOR FROM DRIVE END FRAME

INSPECTION AND REPAIR OF ALTERNATOR

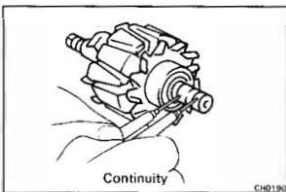
Rotor

1. INSPECT ROTOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the slip rings.

Standard resistance (cold): 2.8 – 3.0 Ω

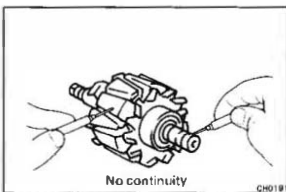
If there is no continuity, replace the rotor.



2. INSPECT ROTOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the slip ring and the rotor.

If there is continuity, replace the rotor.



3. INSPECT SLIP RINGS

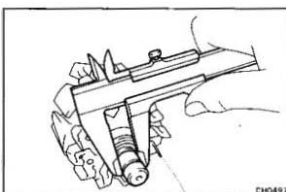
(a) Check that the slip rings are not rough or scored. If rough or scored, replace the rotor.

(b) Using calipers, measure the slip ring diameters.

Standard diameter: 14.2 – 14.4 mm
(0.559 – 0.667 in.)

Minimum diameter: 14.0 mm (0.551 in.)

If the diameter is less than minimum, replace the rotor.

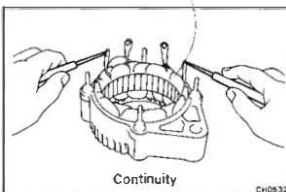


Stator

1. INSPECT STATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the coil leads.

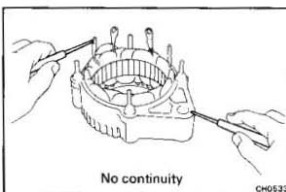
If there is no continuity, replace the drive end frame assembly.



2. INSPECT STATOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the coil leads and drive end frame.

If there is continuity, replace the drive end frame assembly.



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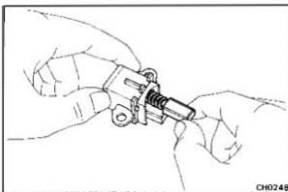


Brushes

1. MEASURE EXPOSED BRUSH LENGTH

Minimum exposed length: 4.5 mm (0.177 in.)

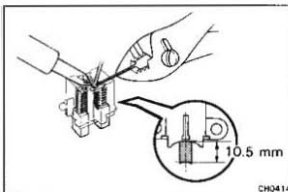
If the brush length is less than minimum, replace the brushes.



2. IF NECESSARY, REPLACE BRUSHES

(a) Unsolder and remove the brush and spring.

(b) Run the wire of the brush through the hole in the brush holder, and insert the spring and brush into the brush holder.



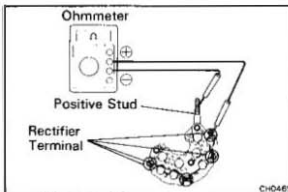
(c) Solder the brush wire to the brush holder at the exposed length.

Exposed length: 10.5 mm (0.413 in.)

(d) Check that the brush moves smoothly in the brush holder.

(e) Cut off the excess wire.

(f) Apply insulation paint to the soldered point.



Rectifier

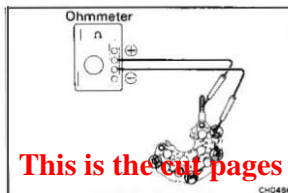
1. INSPECT POSITIVE SIDE RECTIFIER

(a) Using an ohmmeter, connect one tester probe to the positive stud and the other to each rectifier terminal.

(b) Reverse the polarity of the tester probes.

(c) Check that one shows continuity and the other shows no continuity.

If not, replace the rectifier holder.



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