

1999 Toyota RAV4

1999-2000 STARTING & CHARGING SYSTEMS Generators & Regulators

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Generators & Regulators

DESCRIPTION & OPERATION

NOTE: This article also applies to Lexus LX470. For Lexus LX470, refer to Land Cruiser, unless otherwise indicated.

The generator is a small, high RPM, high performance type with an internal Integrated Circuit (IC) voltage regulator which controls charging system voltage. A transistor inside IC regulator controls generator voltage output to maintain a constant voltage. Charging system voltage is maintained within an operating range of 13.2-15.1 volts. See **GENERATOR REGULATED OUTPUT SPECIFICATIONS** table under NO-LOAD TEST under ON-VEHICLE TESTING for specific model operating ranges. For generator rated ampere output, see **GENERATOR RATED AMPERE OUTPUT SPECIFICATIONS** table.

When ignition is turned on, battery voltage flows from generator terminal "L" through IC regulator to ground, causing discharge warning light to come on. When engine starts, generator RPM increases, which increases generator output voltage. When generator output voltage is greater than battery voltage, voltage to recharge battery flows from terminal "B". At the same time, voltage at terminal "L" increases and the potential difference between battery and terminal "L" ceases, causing discharge warning light to go off.

GENERATOR RATED AMPERE OUTPUT SPECIFICATIONS

Application	Amperes
Avalon, Camry, Camry Solara & Corolla	80
Celica	
A/T	80
M/T	70
Land Cruiser	80 Or 100
RAV4	90
Sienna	100
Tacoma	
4-Cylinder	70
V6	90 Or 100
Tundra	
V6	70 Or 80
V8	70 Or 100
4Runner	
4-Cylinder	70
V6	60

ADJUSTMENTS

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NOTE: New belt refers to a belt which has been used 5 minutes or less on a running engine. Used belt refers to a belt which has been used more than 5 minutes on a running engine. After installing new belt(s), run engine for at least 5 minutes and recheck tension.

BELT TENSION

4-Cylinder

Check belt tension using Burroughs Tension Gauge (BT-33-73F) at longest belt run. Adjust belt tension if necessary. See **BELT TENSION SPECIFICATIONS (4-CYLINDER)** table.

NOTE: Corolla uses an automatic belt tensioner. Adjustment is not required.

BELT TENSION SPECIFICATIONS (4-CYLINDER) ⁽¹⁾

Application	New Belt Lbs. (kg)	Used Belt Lbs. (kg)
Camry, Camry Solara & RAV4		
Generator		
With A/C	140-190 (64-86)	100-120 (45-54)
Without A/C	100-150 (45-68)	75-115 (34-52)
Power Steering	95-145 (43-66)	60-100 (27-45)
Celica		
Generator		
With A/C	170-180 (77-82)	95-135 (43-61)
Without A/C	100-150 (45-68)	75-115 (34-52)
Power Steering	99-121 (45-55)	44-77 (20-35)
Corolla	(2)	(2)
Tacoma & 4Runner		
A/C	135-185 (61-84)	80-100 (36-45)
Generator	116-169 (53-77)	66-88 (30-40)
Power Steering	135-180 (61-82)	85-120 (39-54)
(1) Measure belt tension with Burroughs (BT-33-73F) tension gauge.		
(2) Automatic belt tensioner is used. Adjustment is not required.		

V6

Check belt tension using Burroughs Tension Gauge (BT-33-73F) at longest belt run. Adjust belt tension if necessary. See **BELT TENSION SPECIFICATIONS (V6)** table.

BELT TENSION SPECIFICATIONS (V6) ⁽¹⁾

Application	New Belt Lbs. (kg)	Used Belt Lbs. (kg)
Avalon, Camry, Camry Solara & Sienna		

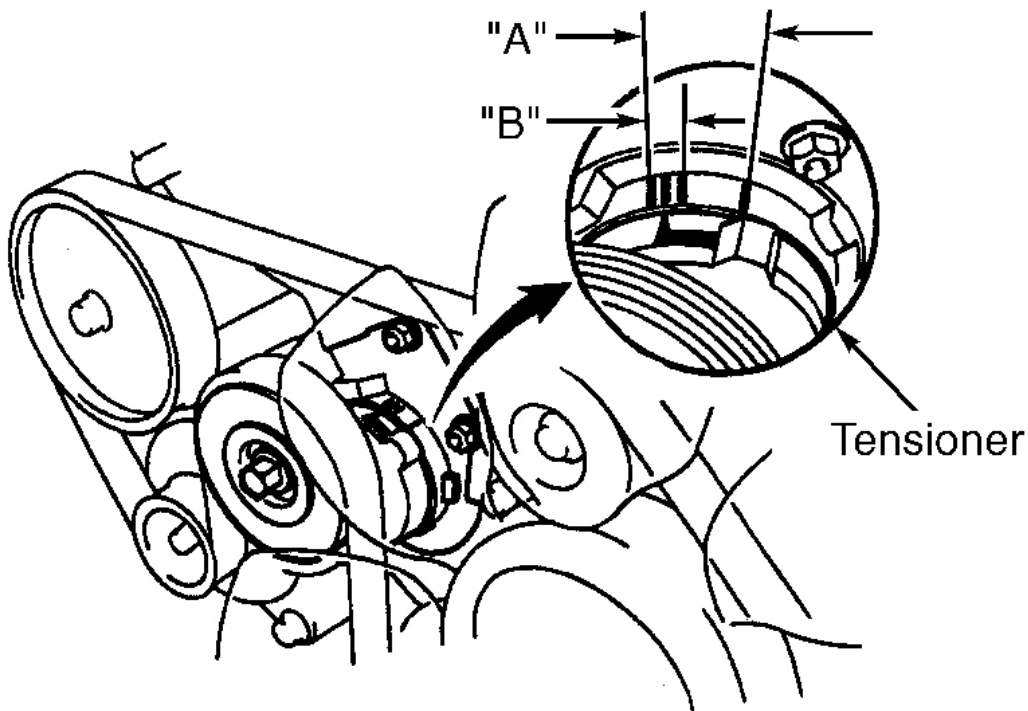
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Generator	170-180 (77-82)	95-135 (43-61)
Power Steering	150-185 (68-84)	95-135 (43-61)
Tacoma, Tundra & 4Runner		
A/C	135-185 (61-84)	80-120 (36-54)
Generator	140-180 (64-82)	80-120 (36-54)
Power Steering	135-180 (61-82)	85-120 (39-54)
(1) Measure belt tension with Burroughs (BT-33-73F) tension gauge.		

V8

Automatic belt tensioner is used on Land Cruiser and Tundra. Adjustment is not required. If belt tension is not within "A" range of automatic belt tensioner, replace belt. See **Fig. 1**.



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Fig. 1: Drive Belt Tensioner (V8)

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TROUBLE SHOOTING

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NOTE: See **TROUBLE SHOOTING** article in **GENERAL INFORMATION**.

Check all fuses, fusible links, ignition switch and appropriate relays (if equipped). Check generator output. See **NO-LOAD TEST** under ON-VEHICLE TESTING.

ON-VEHICLE TESTING

NO-LOAD TEST

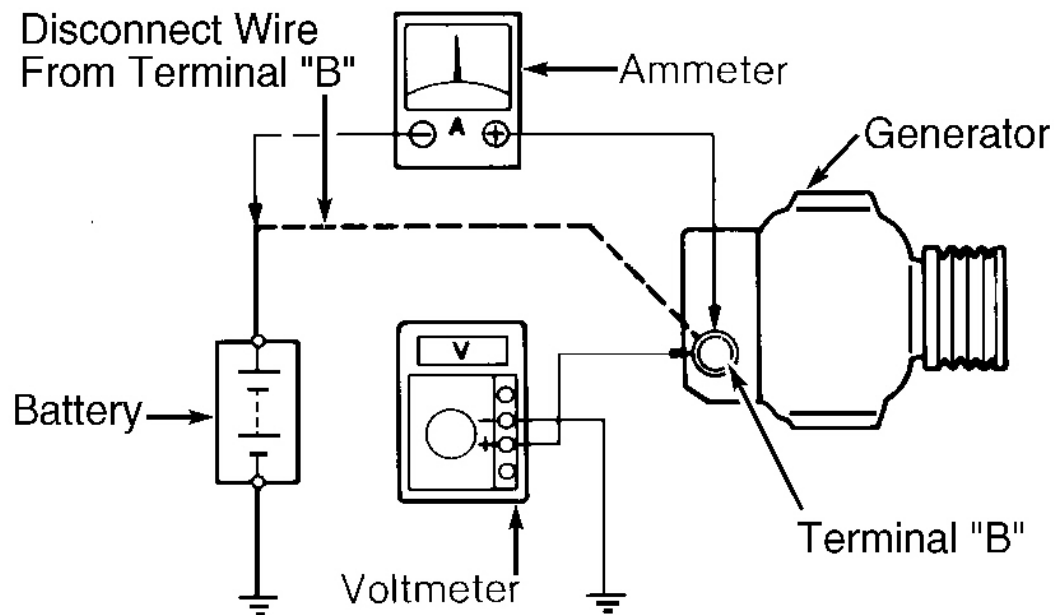
1. Disconnect battery-to-generator terminal "B" wire. See **Fig. 2** . Using an ammeter and voltmeter, connect negative ammeter lead to disconnected generator terminal "B" wire end, and connect positive ammeter lead to generator terminal "B".
2. Connect voltmeter positive lead to generator terminal "B" and negative lead to ground. See **Fig. 2** . Start engine and increase engine speed to 2000 RPM. Both meters should read within specification. See **GENERATOR REGULATED OUTPUT SPECIFICATIONS** table. If voltage is more than specified, replace IC regulator. If voltage is less than specified, go to next step.
3. Locate small hole in back of generator. See **Fig. 3** . It may be necessary to remove generator end cover to access hole. Using a probe, ground generator terminal "F" (full field) to generator case. See **Fig. 3** . If voltage is more than specified range, replace IC regulator. If voltage is less than specified range, repair or replace generator.

GENERATOR REGULATED OUTPUT SPECIFICATIONS ⁽¹⁾

Application	Amps	Volts
Avalon	10 Or Less	13.2-14.8
Camry, Camry Solara & Corolla	10 Or Less	13.5-15.1
Celica & RAV4		
With Temperature At 77°F (25°C)	10 Or Less	14.0-15.1
With Temperature At 239°F (115°C)	10 Or Less	13.5-14.3
Land Cruiser & Sienna	10 Or Less	13.2-14.8
Tacoma		
With Temperature At 77°F (25°C)	10 Or Less	13.7-14.7
With Temperature At 239°F (115°C)	10 Or Less	13.2-14.0
Tundra		
V6	10 Or Less	13.2-14.8
V8		
With Temperature At 77°F (25°C)	10 Or Less	13.7-14.7
With Temperature At 239°F (115°C)	10 Or Less	13.2-14.0
4Runner		
With Temperature At 77°F (25°C)	10 Or Less	13.7-14.7
With Temperature At 239°F (115°C)	10 Or Less	13.2-14.0
(1) Specification given is with engine speed at 2000 RPM.		

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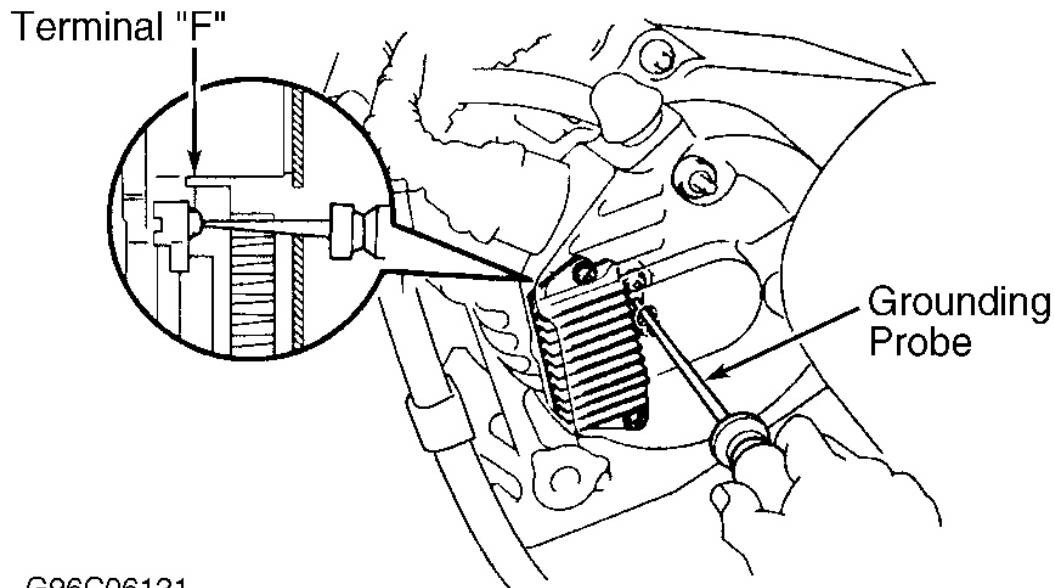
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Fig. 2: Testing Charging Circuit

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 3: Testing Generator Full Field Output (Typical)
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LOAD TEST

NOTE: If battery is fully charged, disable ignition system. Crank engine for about 15 seconds to partially discharge battery.

1. Connect an ammeter as described in **NO-LOAD TEST**, step 1). See **Fig. 2**. Start engine. Turn on high beam headlights and place heater blower control on HI. Increase engine speed to 2000 RPM.
2. Check ammeter reading. Ammeter should read 30 amps or more. If amperage is less than specified, repair or replace generator.

NOTE: If battery is fully charged, generator load test results may be less than 30 amps.

BENCH TESTING

BRUSHES

1. Brushes should slide smoothly in holders. Replace brushes if damaged or worn. On Tundra and 4Runner, new brush exposed length should be .374-.453" (9.5-11.5 mm). On all other models, new brush exposed length should be .413" (10.5 mm).
2. On all models, minimum exposed length should be more than .059" (1.5 mm). There are 2 different brush holders used. One brush holder is replaced as an assembly, and the other has replaceable brushes. If

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exposed brush length is less than minimum, replace brushes or brush holder assembly. Install new brush springs when replacing brushes.

ROTOR

1. Check rotor for open field windings by using an ohmmeter across slip rings. Rotor resistance should be within specification. See **ROTOR RESISTANCE SPECIFICATIONS** table.
2. Check rotor for shorts to ground by connecting ohmmeter between slip ring and rotor shaft. Ohmmeter should indicate no continuity. Check slip rings for wear or pitting. Standard slip ring diameter is .559-.567" (14.2-14.4 mm). Turn slip rings on lathe if necessary. Minimum slip ring diameter is .504" (12.8 mm).

ROTOR RESISTANCE SPECIFICATIONS

Application	(1) Ohms
Avalon	2.1-2.5
Camry & Camry Solara	
4-Cyl.	2.7-3.1
V6	2.1-2.5
Land Cruiser, Sienna, Tacoma, Tundra & 4Runner	2.1-2.5
All Other Models	2.7-3.1
(1) Specification given is with temperature at 68°F (20°C).	

STATOR

Connect ohmmeter between 2 stator leads. Continuity should exist between all stator leads. Connect ohmmeter between each stator lead and metal core. Continuity should not exist. If stator does not test as indicated, replace stator.

DIODES

1. With diode/rectifier assembly removed and on bench, contact positive diode plate terminal with one ohmmeter probe. Using other ohmmeter probe, contact each diode lead in same plate. Note ohmmeter reading. Reverse ohmmeter probes, and repeat tests for all diodes.
2. All diodes should show continuity in one direction and no continuity in opposite direction. If any diode is defective, replace diode/rectifier assembly.

REMOVAL & INSTALLATION

GENERATOR

Removal & Installation (Land Cruiser)

1. Disconnect negative battery cable. Drain engine coolant. Rotate belt tensioner counterclockwise to release tension on belt and remove drive belt. Remove splash shield from underneath engine. Remove radiator

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reservoir tank and radiator.

2. Using Spanner Wrench (09960-10010) to keep power steering pump pulley from rotating, remove power steering pump pulley retaining nut. Remove power steering pump pulley. Remove generator mounting bolts and generator. To install, reverse removal procedure. Tighten bolts to specifications. See **TORQUE SPECIFICATIONS** .

Removal & Installation (All Others)

Disconnect negative battery cable. Removal and installation is basically an unbolt and bolt-on procedure. Tighten generator bolts to specification. See **TORQUE SPECIFICATIONS** .

OVERHAUL

GENERATOR

Disassembly

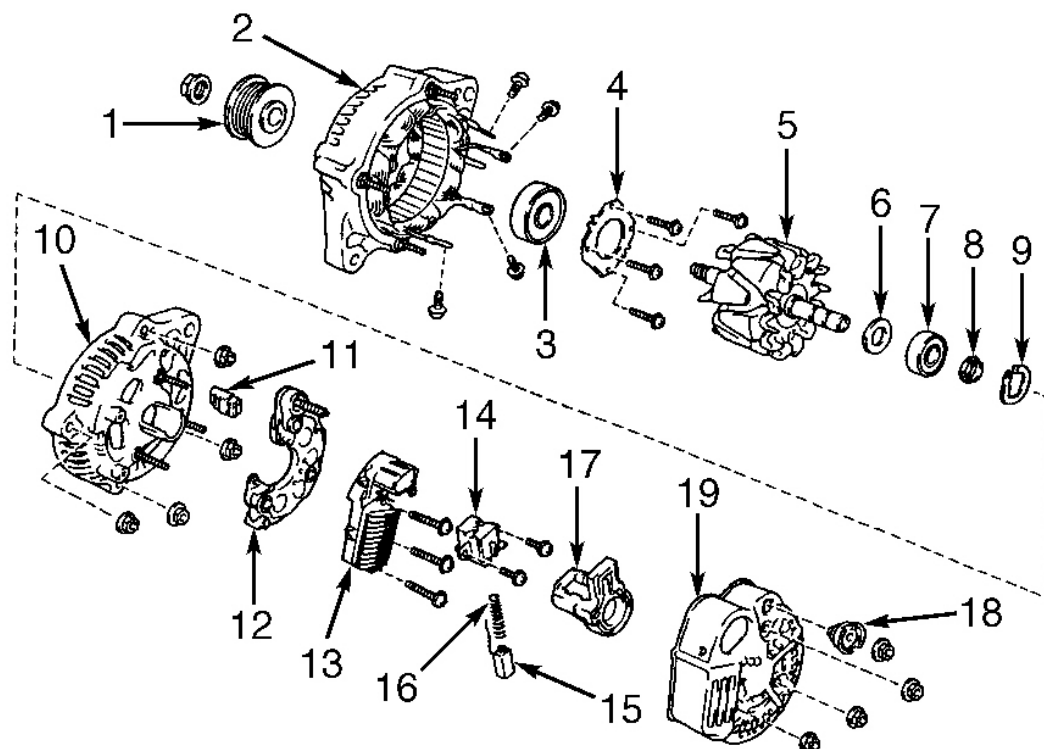
1. Remove rear end cover (if equipped). See **Fig. 4** . Remove brush holder and IC regulator. Remove diode assembly. Remove rubber insulators or seal plate (if equipped). Use generator Pulley Set Nut Wrench Set (SST 09820-63010) to remove generator pulley.
2. To remove pulley, install SST "A" and "B" to rotor shaft and tighten SST "B" clockwise to 29 ft. lbs. (39 N.m). See **Fig. 5** . Place SST "C" securely into a vise. Verify that SST "A" is secured to rotor shaft and install SST "A" and "B" and generator into SST "C". Turn SST "A" in correct direction to loosen pulley nut. See **Fig. 5** . To prevent damage to rotor shaft, DO NOT loosen pulley nut more than 1/2 turn. Remove SST "A" and "B" and generator from SST "C". Remove SST "A" and "B" from rotor shaft, and remove pulley nut and pulley.
3. Remove rectifier and frame using appropriate puller. Remove generator washer (if equipped). Remove rotor from drive end frame (stator).

Assembly

To assemble, reverse disassembly procedure. Use generator Pulley Set Nut Wrench Set (SST 09820-63010) to install generator pulley. Place SST "C" securely into a vise. Install SST "A" and "B" and generator into SST "C". See **Fig. 5** . Tighten pulley nut to 81 ft. lbs. (110 N.m) in the opposite direction of disassembly. After completing assembly, verify rotor turns smoothly.

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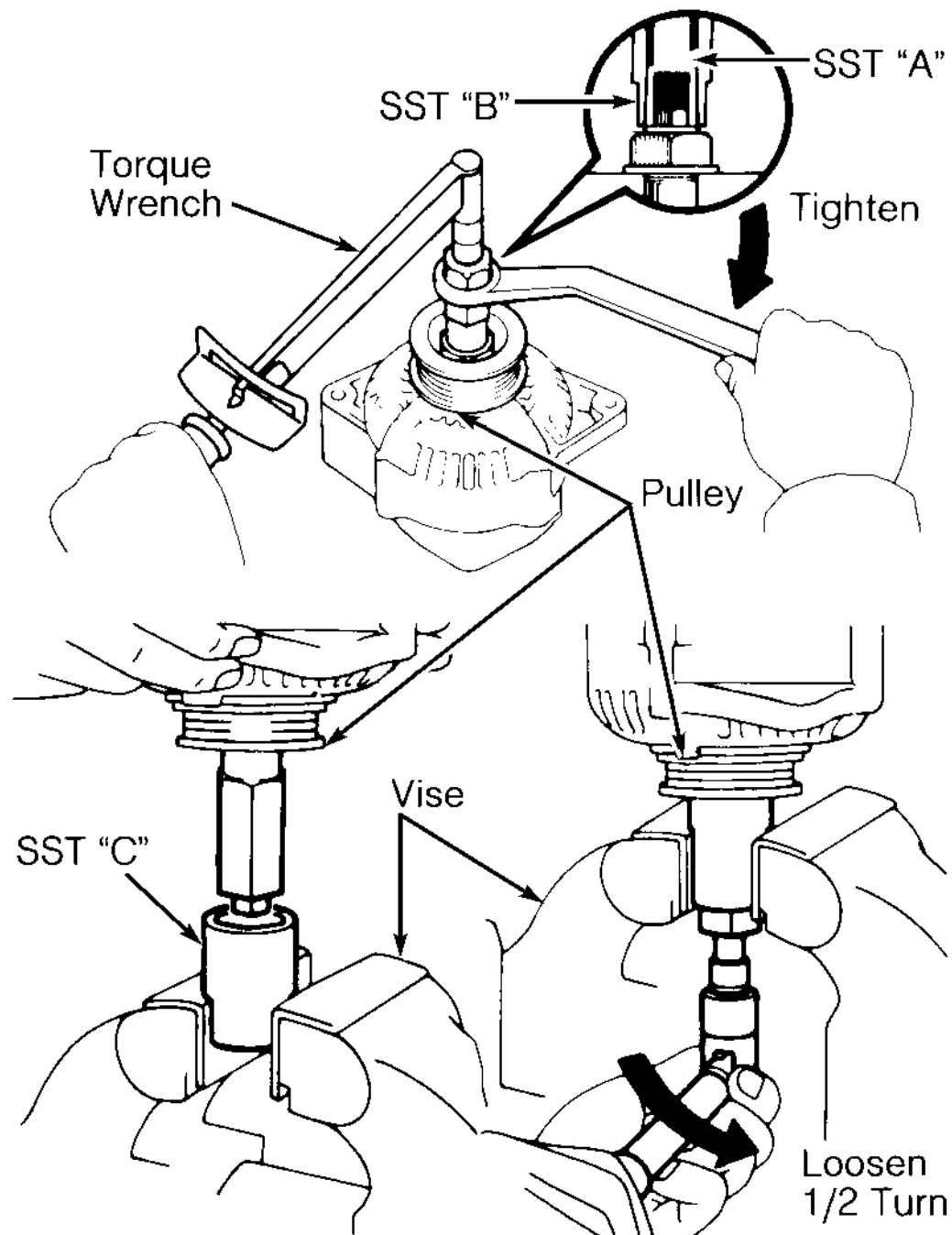


- | | |
|-----------------------------|------------------------|
| 1. Pulley | 11. Rubber Insulator |
| 2. Drive End Frame (Stator) | 12. Diode Assembly |
| 3. Front Bearing | 13. IC Regulator |
| 4. Retainer | 14. Brush Holder |
| 5. Rotor | 15. Brush |
| 6. Bearing Cover | 16. Spring |
| 7. Rear Bearing | 17. Brush Holder Cover |
| 8. Bearing Cover | 18. Terminal Insulator |
| 9. Thrust Washer | 19. Rear End Cover |
| 10. Diode End Frame | |

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Fig. 4: Exploded View Of Generator (Celica M/T Shown; All Others Are Similar)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 5: Removing Generator Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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TORQUE SPECIFICATIONS**TORQUE SPECIFICATIONS**

Application	Ft. Lbs. (N.m)
Avalon & Sienna	
Generator Adjusting Bolt	13 (18)
Generator Pivot Bolt	41 (56)
Generator Pulley Nut	81 (110)
Camry & Camry Solara	
4-Cylinder	
Generator Adjusting Bolt	13 (18)
Generator Pivot Bolt	38 (52)
Generator Pulley Nut	81 (110)
V6	
Generator Adjusting Bolt	13 (18)
Generator Pivot Bolt	41 (56)
Generator Pulley Nut	81 (110)
Celica	
Generator Adjusting Bolt	14 (19)
Generator Pivot Bolt	40 (54)
Generator Pulley Nut	81 (110)
Corolla	
Generator Adjusting Bolt	18 (24)
Generator Pivot Bolt	40 (54)
Generator Pulley Nut	81 (110)
Land Cruiser	
Generator Mounting Bolts	29 (39)
Generator Pulley Nut	81 (110)
Power Steering Pulley Nut	32 (43)
RAV4	
Generator Adjusting Bolt	13 (18)
Generator Pivot Bolt	38 (51)
Generator Pulley Nut	81 (110)
Tacoma & 4Runner	
4-Cylinder	
Generator Adjusting Lock Bolt	21 (28)
Generator Pivot Bolt	43 (58)
Generator Pulley Nut	81 (110)
V6	
Generator Adjusting Lock Bolt	25 (34)
Generator Pivot Bolt	38 (51)

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Generator Pulley Nut	81 (110)
Tundra	
V6	
Generator Adjusting Lock Bolt	25 (34)
Generator Pivot Bolt	38 (51)
Generator Pulley Nut	81 (110)
V8	
Generator Mounting Bolts	29 (39)
Generator Pulley Nut	81 (110)
Power Steering Pulley Nut	32 (43)

WIRING DIAGRAMS

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Fig. 6: Charging System Wiring Diagram (Avalon)

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Fig. 7: Charging System Wiring Diagram (Camry)

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Fig. 8: Charging System Wiring Diagram (Camry Solara)

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Fig. 9: Charging System Wiring Diagram (Celica)

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Fig. 10: Charging System Wiring Diagram (Corolla)

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Fig. 11: Charging System Wiring Diagram (Land Cruiser)

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Fig. 12: Charging System Wiring Diagram (Lexus LX470)

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Fig. 13: Charging System Wiring Diagram (RAV4)

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Fig. 14: Charging System Wiring Diagram (Sienna)

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Fig. 15: Charging System Wiring Diagram (Tacoma)

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Fig. 16: Charging System Wiring Diagram (2000 Tundra)

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Fig. 17: Charging System Wiring Diagram (4Runner)