NISSAN

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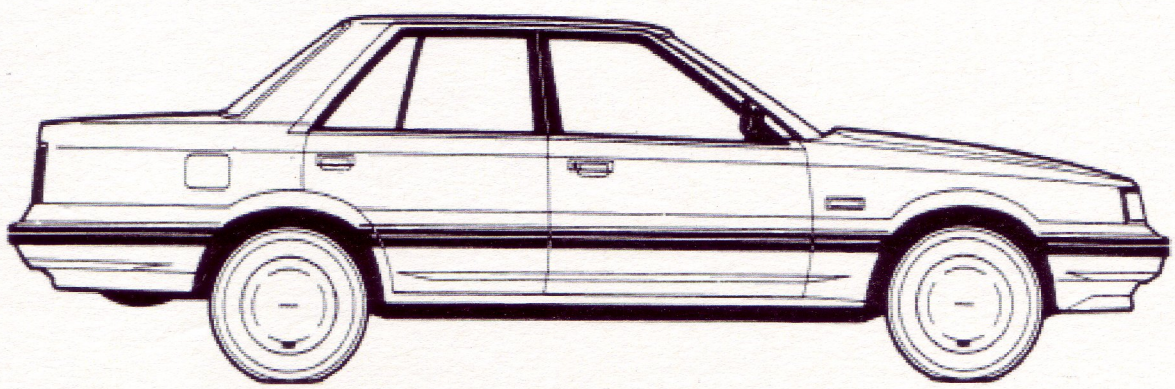
PINTARA AND SKYLINE MODEL R31 SERIES



2ND EDITION

SERVICE MANUAL

Publication Number: SM7E OR31AO

NISSAN

Model
R31 Series
Australian Built Models

Foreword

This service manual has been prepared primarily for the purpose of assisting service personnel in providing effective service and maintenance of the model R31 series.

This manual includes procedures for maintenance, adjustments, removal and installation, disassembly and assembly of components, and trouble-shooting.

This manual replaces Part No. SM6E0R31A0 (Printed June 1986)

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. If your car differs from the specifications contained in this manual, consult your NISSAN dealer for information.

The right is reserved to make changes to specifications and methods at any time without incurring any obligation to make or install similar changes on vehicles and/or parts previously purchased.

QUICK REFERENCE INDEX

GENERAL INFORMATION — GI
MAINTENANCE — MA
ENGINE MECHANICAL — EM
ENGINE LUBRICATION & COOLING SYSTEMS — LC
ENGINE FUEL — EF
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AUTOMATIC TRANSMISSION — AT
PROPELLER SHAFT — PD
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BRAKE SYSTEM — BR
STEERING SYSTEM — ST
BODY — BF
HEATER & AIR CONDITIONER — HA
ELECTRICAL SYSTEM — EL

Part No. SM7E 0R31A0 Printed in Australia

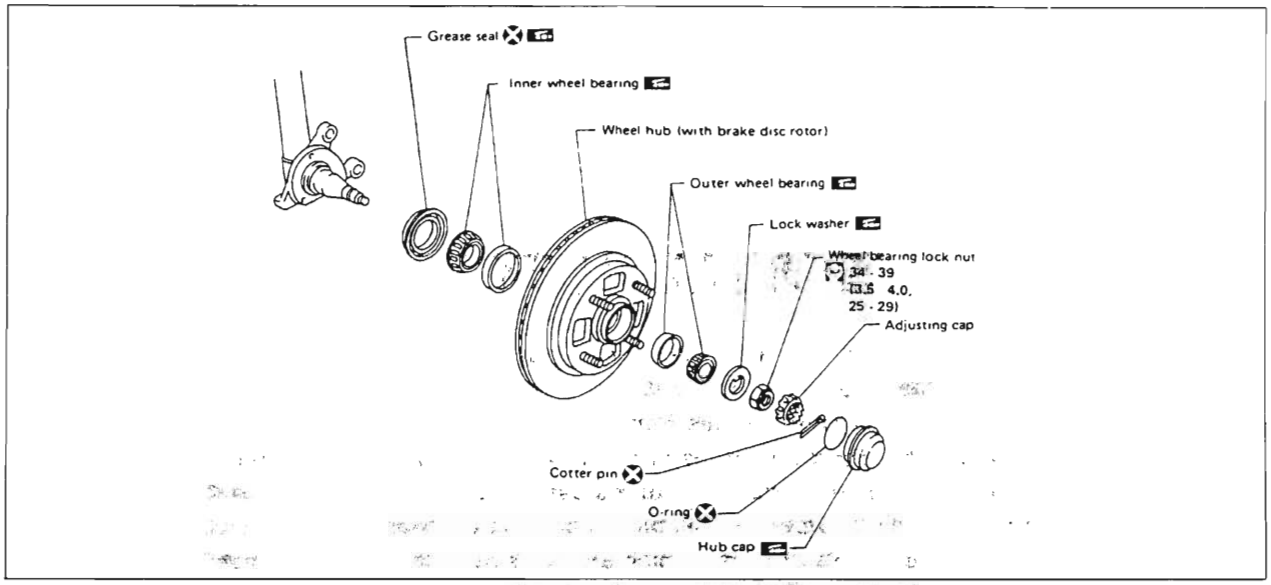
IMPORTANT SAFETY NOTICE

The proper performance of service is essential for both the safety of the mechanic and the efficient functioning of the vehicle.
The service methods in this Service Manual are described in such a manner that the service may be performed safely and accurately.
Service vaires with the procedures used, the skills of the mechanic and the tools and parts available. Accordingly, anyone using service procedures, tools or parts which are not specifically recommended by NISSAN must first completely satisfy themselves that neither their safety nor the vehicle's safety will be jeopardized by the service method selected.

► **A QUICK REFERENCE INDEX** is provided on the first page of this manual. Each section title is listed together with its abbreviation in a black tab located at the right hand edge of the page. The position of each tab corresponds to an identical tab on the first page of each section.

► The first page of each section lists the contents and gives the page numbers for the respective topics.

► Large illustrations (exploded views) contain tightening torques, lubrication points and other assembly information (see example).



► Small illustrations demonstrate important steps in procedures and relate directly to the adjacent text.

► **SERVICE DATA AND SPECIFICATIONS** are contained in each section.

► **TROUBLE DIAGNOSES AND CORRECTIONS** are also included where appropriate. This feature of the manual lists the likely causes of trouble and recommends the appropriate corrective actions to be taken.

► A list of **SPECIAL SERVICE TOOLS** is included in each section. The special service tools are designed to assist you in performing repairs safely, accurately and quickly.

► The measurements given in this manual are primarily expressed with the SI unit (International System of Unit), and alternately expressed in the metric system and in the imperial system.

► The following **SYMBOLS AND ABBREVIATIONS** are used:

: Tightening Torque
: Should be lubricated with grease. Unless otherwise indicated, use recommended multi-purpose grease.
: Should be lubricated with oil.
: Sealing point
: Checking point
: Always replace after every disassembly.

S.D.S.:	Service Data and Specifications
L.H., R.H.:	Left-Hand, Right Hand
M/T:	Manual Transaxle/Transmission
A/T:	Automatic Transaxle/Transmission
Tool:	Special Service Tools

GENERAL INFORMATION

GI

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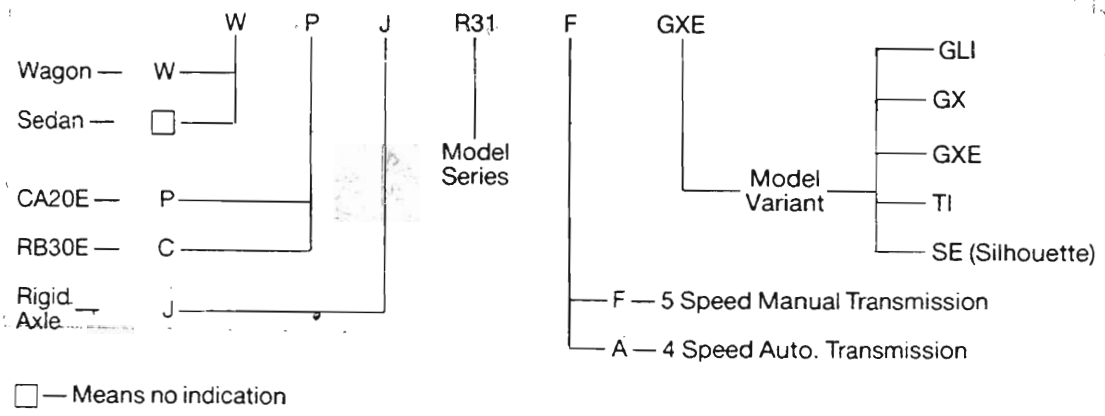
LIFTING, TOWING AND TIE-DOWN POINTS GI-5
TIGHTENING TORQUE OF STANDARD BOLTS GI-7

Model Variation

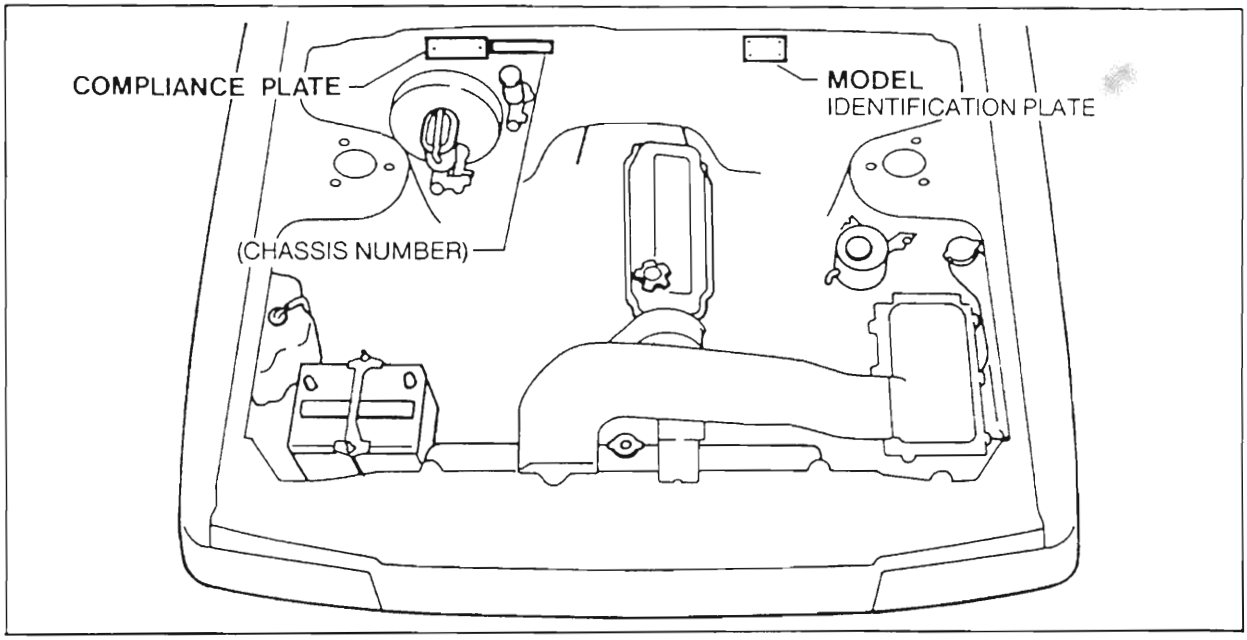
	Model Code	Commencement Chassis No.	Engine Type	Trans-mission Type	Differ-ential Carrier	Rear Axle Ratio	Road Wheel	Tyre Size
SEDAN	PJR31FGLI	V00001	CA20E	FS5W71C	Borg Warner Type No. M78	4.111:1	5.5JJ 14 Steel	P185 75SR14
	PJR31AGLI	"		4N71B				
	PJR31FGX	"		FS5W71C				
	PJR31AGX	"		4N71B				
	PJR31FGXE	"		FS5W71C				
	PJR31AGXE	"		4N71B				
	CJR31FGX	V50001	RB30E	FS5W71C		3.700:1		195 70HR14
	CJR31AGX	"		E4N71B		3.889:1		
	CJR31FGXE	"		FS5W71C		3.700:1		
	CJR31AGXE	"		E4N71B		3.889:1		
	CJR31ATI	"		E4N71B		3.889:1	6.0JJ 15 Alloy	P205 60HR15
	CJR31FSE	"		FS5W71C		3.700:1		
	CJR31ASE	"		E4N71B		3.889:1		
WAGON	WPJR31FGLI	W00001	CA20E	FS5W71C		4.111:1	5.5JJ 14 Steel	P185 75SR14
	WPJR31AGLI	"		4N71B				
	WPJR31FGX	"		FS5W71C				
	WPJR31AGX	"		4N71B				
	WPJR31FGXE	"		FS5W71C				
	WPJR31AGXE	"		4N71B				
	WCJR31FGX	"	RB30E	FS5W71C		3.700:1		195 70HR14
	WCJR31AGX	"		E4N71B		3.889:1		
	WCJR31FGXE	"		FS5W71C		3.700:1		
	WCJR31AGXE	"		E4N71B		3.889:1		

Model Coding



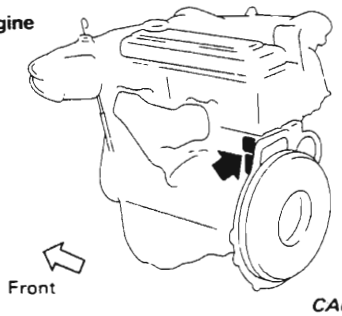
□ — Means no indication

Identification Number



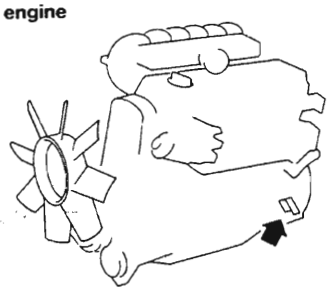
ENGINE SERIAL NUMBER

CA20E engine



CA0027

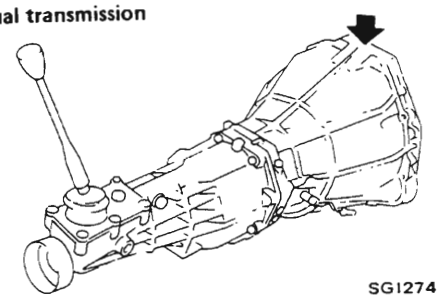
RB30E engine



A MA-005

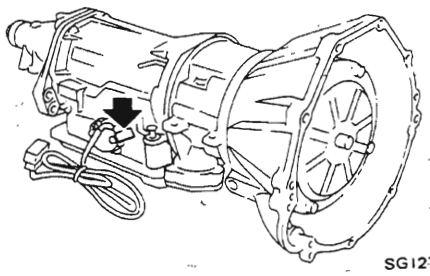
TRANSMISSION NUMBER

Manual transmission



SG1274

Automatic transmission



SG1273

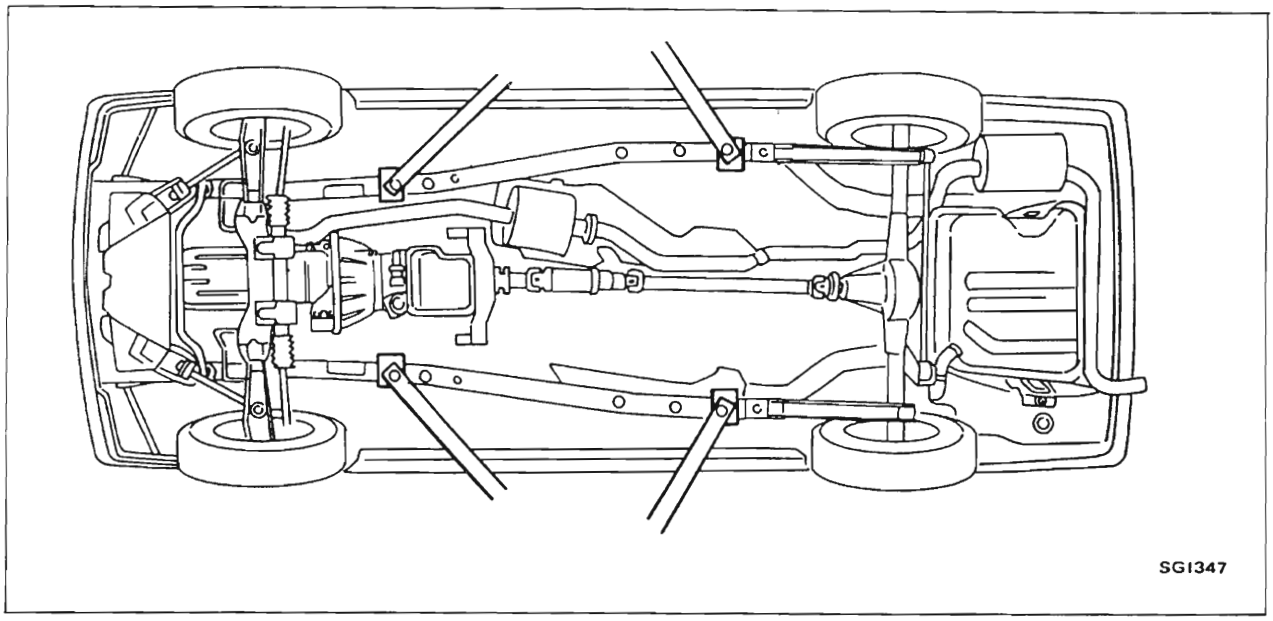
VEHICLE DIMENSIONS

Item \ Model		Sedan	Wagon
Overall length	mm (in)	4,653 (183.2)	
Overall width	mm (in)	1,690 (66.5)	
Overall height	mm (in)	1,395 (54.9)	
Wheelbase	mm (in)	2,610 (102.7)	
Tread			
Front	mm (in)	1,434 (56.5)*	
Rear	mm (in)	1,410 (55.5)	
Min. ground clearance	mm (in)	150 (5.9)	

* Some early production vehicles were built with a front track of 1,425 mm.

2-pole Lift

WARNING:
When lifting the vehicle, open the arms as wide as possible and ensure that the front and rear of the vehicle are well balanced.
When setting arm, be careful not to allow the arm to interfere with the brake pipe and fuel pipe.



Towing

CAUTION:

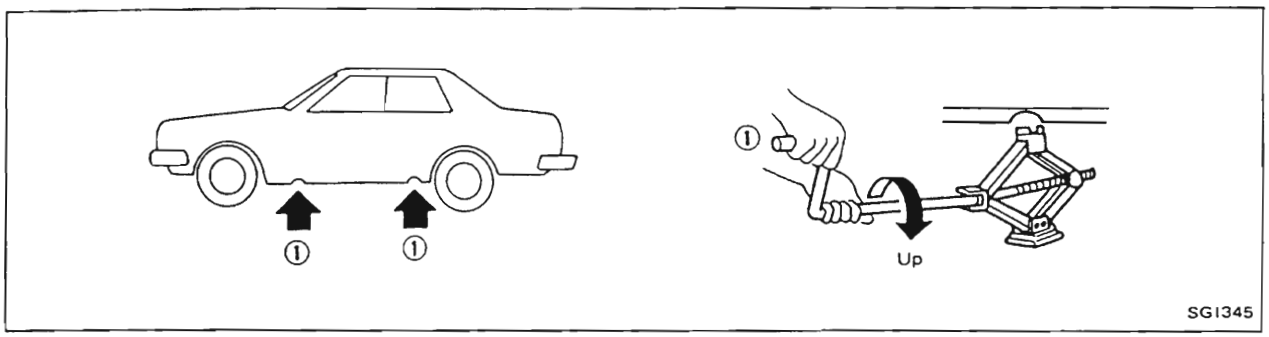
a. **Before towing, make sure that the transmission, axles, steering system and power train are in good order. If any unit is damaged, a dolly must be used, or the vehicle must be transported using a flat top tow truck.**
b. **If the transmission is inoperative, tow the vehicle with the rear wheels off the ground, or with the propeller shaft removed.**
c. **When the vehicle is towed with its front wheels on the ground, secure the steering wheel in a straight ahead position with the ignition key turned in "OFF" position.**
d. **When the vehicle is towed with the rear wheels on the ground, restrict towing speed and distance as follows:**
   Automatic Transmission – speed less than 30 km/h and distance less than 30 km.
   Manual Transmission – speed less than 80 km/h and distance less than 80 km.
   or remove propeller shaft to prevent damage to the transmission.
   Note: If propeller shaft is removed, fit plug to rear of transmission to prevent oil loss.
e. **Always tow vehicle with transmission in Neutral.**
f. **Do not apply lateral force to the towing hooks.**
g. **Do not attach towing cables to tie down hooks.**

LIFTING, TOWING AND TIE-DOWN POINTS

WARNING:

a. Never get under the vehicle while it is supported only by the jack. Always use safety stands to support frame when you have to get under the vehicle.
b. Place wheel chocks at both front and back of the wheel which is diagonally opposite the jack position.

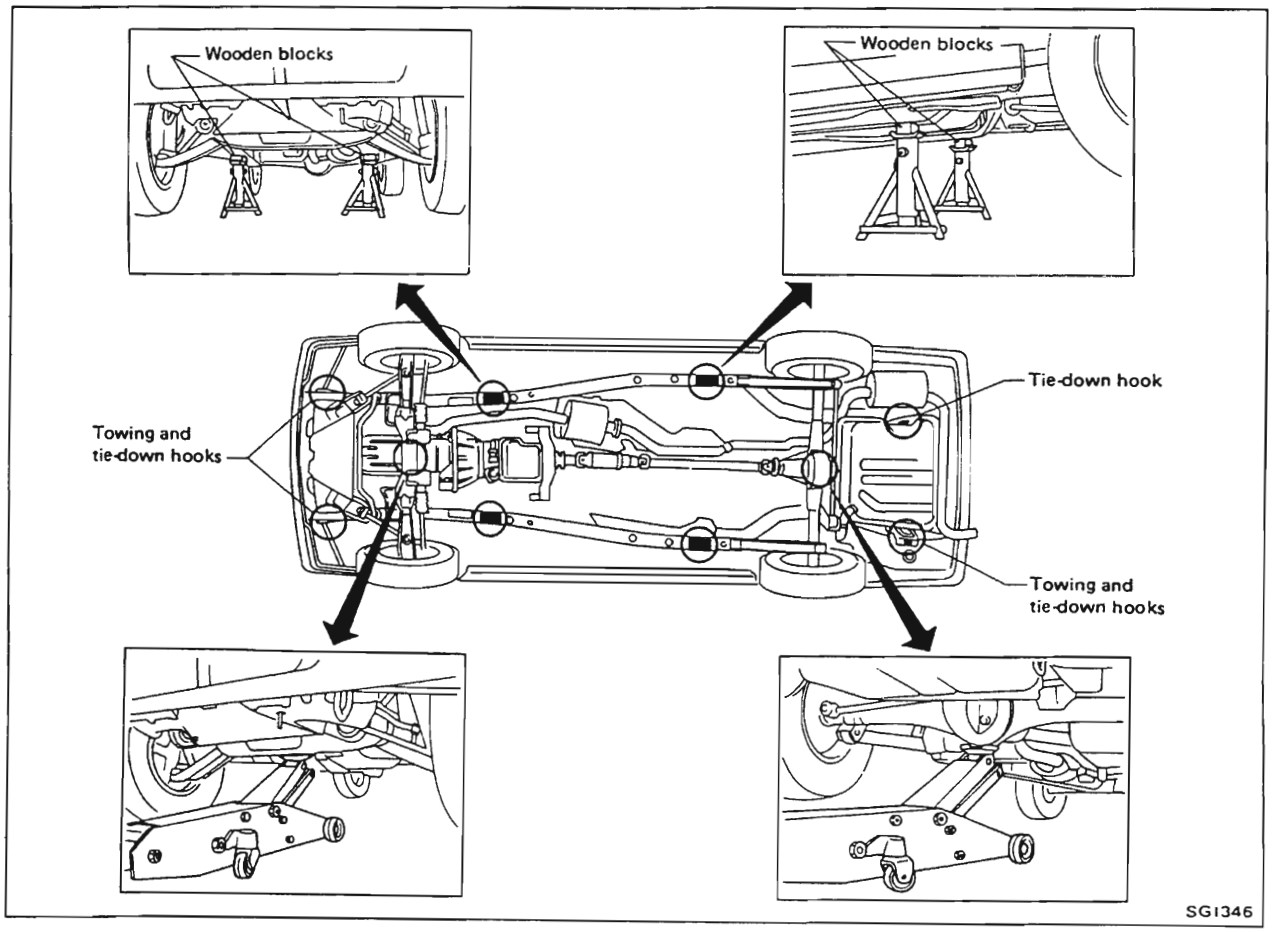
Pantograph Jack



Garage Jack and Safety Stand

CAUTION:

- Place a wooden or rubber block between safety stand and vehicle body when the supporting body is flat.



TIGHTENING TORQUE OF STANDARD BOLT

Grade	Bolt or nut size	Bolt or nut diameter* mm	Pitch mm	Tightening torque		
				N·m	kg-m	ft-lb
4T	M6	6.0	1.0	3 - 4	0.3 - 0.4	2.2 - 2.9
	M8	8.0	1.25	8 - 11	0.8 - 1.1	5.8 - 8.0
			1.0	8 - 11	0.8 - 1.1	5.8 - 8.0
	M10	10.0	1.5	16 - 22	1.6 - 2.2	12 - 16
			1.25	16 - 22	1.6 - 2.2	12 - 16
	M12	12.0	1.75	26 - 36	2.7 - 3.7	20 - 27
			1.25	30 - 40	3.1 - 4.1	22 - 30
	M14	14.0	1.5	46 - 62	4.7 - 6.3	34 - 46
7T	M6	6.0	1.0	6 - 7	0.6 - 0.7	4.3 - 5.1
	M8	8.0	1.25	14 - 18	1.4 - 1.8	10 - 13
			1.0	14 - 18	1.4 - 1.8	10 - 13
	M10	10.0	1.5	25 - 35	2.6 - 3.6	19 - 26
			1.25	26 - 36	2.7 - 3.7	20 - 27
	M12	12.0	1.75	45 - 61	4.6 - 6.2	33 - 45
			1.25	50 - 68	5.1 - 6.9	37 - 50
	M14	14.0	1.5	76 - 103	7.7 - 10.5	56 - 76
9T	M6	6.0	1.0	8 - 11	0.8 - 1.1	5.8 - 8.0
	M8	8.0	1.25	19 - 25	1.9 - 2.5	14 - 18
			1.0	20 - 27	2.0 - 2.8	14 - 20
	M10	10.0	1.5	36 - 50	3.7 - 5.1	27 - 37
			1.25	39 - 51	4.0 - 5.2	29 - 38
	M12	12.0	1.75	65 - 88	6.6 - 9.0	48 - 65
			1.25	72 - 97	7.3 - 9.9	53 - 72
	M14	14.0	1.5	109 - 147	11.1 - 15.0	80 - 108

1. **Special parts are excluded.**
2. **This standard is applicable to bolts having the following marks embossed on the bolt head.**

Grade	Mark
4T	4
7T	7
9T	9

*: Nominal diameter

M 6
- 6 — Nominal diameter of bolt threads (Unit: mm)
- M — Metric screw threads

MAINTENANCE

MA

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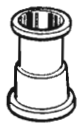
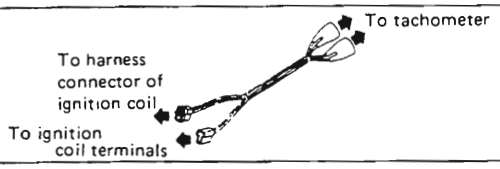
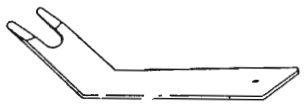
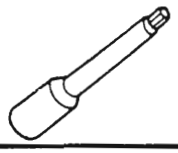
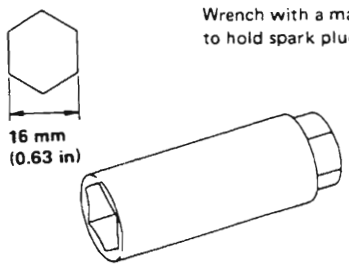
SPECIAL SERVICE TOOLS

Tool number Tool name	Description	Engine application	
		CA20E	RB30E
77777-00019 Radiator cap kit adapter		X	X
77777-00020 Ignition coil adapter harness		–	X
E3M5 (Litchfield) plug remover		X	X
ST10120000* Cylinder head bolt wrench		–	X

* Special tool or commercial equivalent

COMMERCIAL SERVICE TOOL

Tool name	Description	Engine application	
		CA20E	RB30E
Spark plug wrench		X	X

RECOMMENDED PERIODIC MAINTENANCE AND LUBRICATION SCHEDULE

Item	*MAINTENANCE OPERATION* Periodic maintenance should be performed at number of kilometres or months whichever comes first.	Number of kilometres in thousands	1	10	20	30	40	50	60	70	80	90	100
		Number of months		6	12	18	24	30	36	42	48	54	60
	UNDERHOOD MAINTENANCE												
1	Inspect condition, attachment and routing of all hoses, pipes and ducting. Look for leaks, deterioration and wear.			×	×	×	×	×	×	×	×	×	×
2	Inspect engine compartment components for damage and deterioration. Look for leakage from fluid reservoirs and engine.			×	×	×	×	×	×	×	×	×	×
3	Check fluid levels, (i.e. brake and clutch master cylinders, coolant reservoir, battery, washer, bottle, automatic transmission, power steering reservoir). Check engine oil at 1000 km.		×	×	×	×	×	×	×	×	×	×	×
4	If fitted with air conditioning, check refrigerant charge quantity.			×	×	×	×	×	×	×	×	×	×
5	Check condition and tension of external drive belts.		×		×		×		×		×		×
6	Inspect ignition wiring, distributor cap and rotor.				×		×		×		×		×
7	Adjust intake and valve clearances (CA20).		×		×		×		×		×		×
8	Check PCV System.				×		×		×		×		×
9	Change engine oil.			×	×	×	×	×	×	×	×	×	×
10	Replace engine oil filter.			×	×	×	×	×	×	×	×	×	×
11	Change engine coolant (L.L.C.)						×				×		
12	Change brake fluid.					×			×			×	
13	Replace fuel filter.						×				×		
14	Replace air filter. ②						×				×		
15	Replace spark plugs.				×		×		×		×		×
16	Check idle R.P.M.		×	×	×		×		×		×		×
17	Check ignition timing.				×		×		×		×		×
18	Check exhaust gas sensor.					×			×			×	
19	Replace camshaft drive belt. (CA20 only)												×
	UNDER VEHICLE MAINTENANCE												
20	Inspect suspension, steering system and drive train for damaged, loose, worn or missing parts. ①			×	×	×	×	×	×	×	×	×	×
21	Check exhaust for damage, leaks and security. ①			×	×	×	×	×	×	×	×	×	×
22	Check oil levels in manual transmission and differential.		×	×	×	×	×	×	×	×	×	×	×
23	Check all brake pads for serviceability. Inspect brake system for leaks, deterioration and loose, damaged or missing components.			×	×	×	×	×	×	×	×	×	×
24	Inspect fuel system components for leaks, damage, deterioration and security. ①			×	×	×	×	×	×	×	×	×	×
25	Inspect for leaks from engine, transmission, rear axle, steering system and clutch hydraulic system.			×	×	×	×	×	×	×	×	×	×
26	Check condition of tyres including spare.		×	×	×	×	×	×	×	×	×	×	×
27	Repack front wheel bearings.							×					×
	OUTSIDE AND INSIDE MAINTENANCE												
28	Check seat belt webbing condition, buckle and retractor mechanism operation and anchorages.			×	×	×	×	×	×	×	×	×	×
29	Check operation of instruments and controls (Inspect wiper blade operation).			×	×	×	×	×	×	×	×	×	×
30	Check operation of all lights.		×	×	×	×	×	×	×	×	×	×	×
31	Check operation of inhibitor switch.			×	×	×	×	×	×	×	×	×	×
32	Check stroke and operation of clutch, foot brake and park brake.			×	×	×	×	×	×	×	×	×	×
33	Lubricate locks, hinges and hood latch.			×		×			×			×	
34	Body maintenance inspection.				×		×						

The numbers in circles alongside maintenance items indicates that, that item may require additional or more frequent service if driven continuously under the correspondingly numbered condition below:
① When driving along rough and/or muddy roads. ② When driving in dusty conditions.
In addition to the foregoing, vehicles used under conditions exposing them to excessive mud and/or corrosive materials — boat launching, driving along beaches, driving on tracks through fertilized paddocks, etc. — must be thoroughly flushed with fresh water to remove any deposited mud or corrosive material.

TERMINOLOGY
INSPECT: Visually observe and, where necessary, apply force to components to ascertain security.
CHECK: Make a physical measurement for comparison with a service specification (e.g. brake pad thickness, fluid level).

RECOMMENDED FUEL AND LUBRICANTS

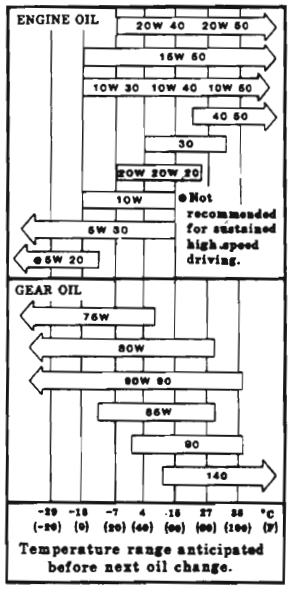
FUEL

Use unleaded fuel only with a minimum octane rating of 92 R.O.N.

LUBRICANTS

Item		Specification	Remarks
Engine Oil		SAE Specification SF (MIL-L-2104B)	Refer to Recommended SAE Viscosity Chart
Gear Oil	Transmission	API GL4 (MIL-L-2105)	
	Manual Steering	CASTROL EPL1 Grease	
	Power Steering	DEXRON 2	
	Differential	API GL5 (MIL-L2105C) (SAE 80W-90)	Models with S.R.D. should use APIGL5 (SAE 90 LS)
Automatic T/M		DEXRON 2	
Multi Purpose Grease		NLGI Grease No. 2	Lithium Base Soap
Brake and Clutch Fluid		D.O.T.3 (F.M.V.S.S. No. 116)	F.M.V.S.S. (Federal Motor Vehicle Safety Standard)
Anti-freeze		NISSAN L.L.C.	Long Life Coolant

SAE VISCOSITY NUMBER



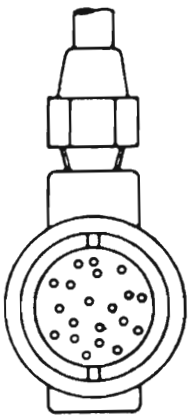
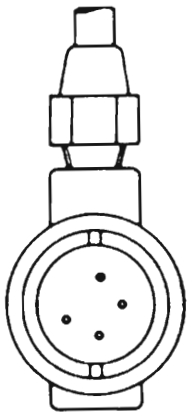
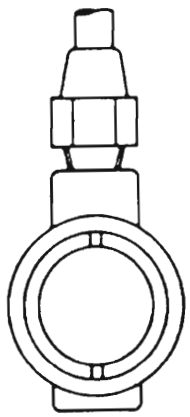
APPROXIMATE REFILL CAPACITIES

			LITRE
Fuel tank		Sedan	61
		Station Wagon	61
Coolant	CA20E		8.4
	RB30E		9.6
Engine	CA20E With oil filter change		3.4
	CA20E Without oil filter change		2.6
	RB30E With oil filter change		4.4
	RB30E Without oil filter change		4.0
Transmission	M/T		2.0
	A/T		7.2
Rear axle			1.7
Power steering gear			1.0
Manual steering gear		Packed with 30-50 cc of grease on assembly	

Checking Air Conditioning Refrigerant Level

CONDITION

- Door window: Open
- A/C switch: ON
- TEMP. lever position: Max. COLD
- FAN lever position: Maximum speed
- Check sight glass after a lapse of about five minutes.

Amount of refrigerant / Check item	Almost no refrigerant	Insufficient	Suitable	Too much refrigerant
Temperature of high-pressure and low-pressure lines.	Almost no difference between high-pressure and low-pressure side temperature.	High-pressure side is warm and low-pressure side is fairly cold.	High-pressure side is hot and low-pressure side is cold.	High-pressure side is abnormally hot.
State in sight glass.	Bubbles flow continuously. Bubbles will disappear and something like mist will flow when refrigerant is nearly gone.  AC256	The bubbles are seen at intervals of 1 - 2 seconds.  AC257	Almost transparent. Bubbles may appear when engine speed is raised and lowered. No clear difference exists between these two conditions.  AC258	No bubbles can be seen.
Pressure of system.	High-pressure side is abnormally low.	Both pressures on high and low-pressure sides are slightly low.	Both pressures on high and low-pressure sides are normal.	Both pressures on high and low-pressure sides are abnormally high.
Repair.	Stop compressor immediately and conduct an overall check.	Check for gas leakage, repair as required, evacuate and recharge system.		Discharge refrigerant from service valve of low pressure side.

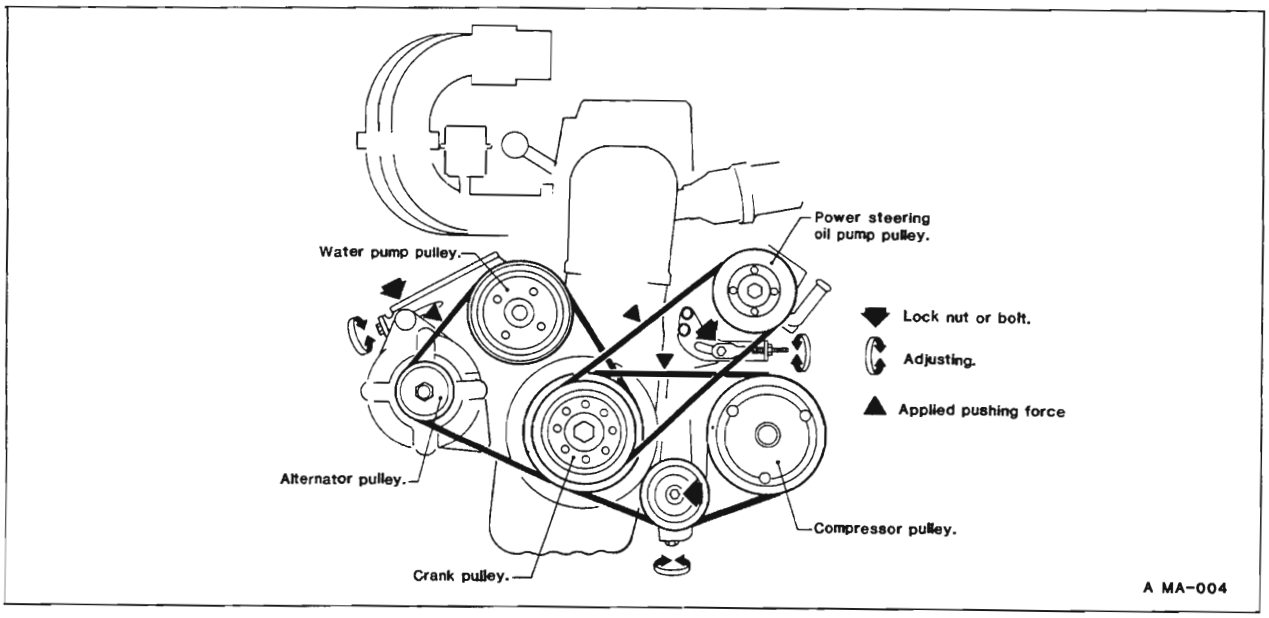
Checking Drive Belts

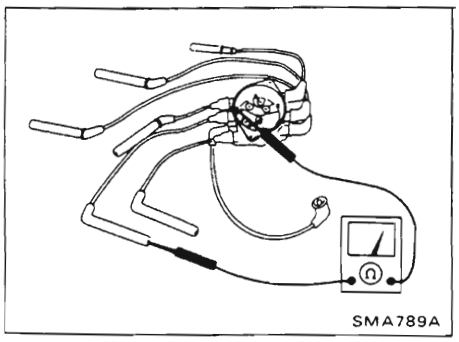
1. Inspect for cracks, fraying, wear or oil adhesion. Replace if necessary.
2. Check drive belt deflections by pushing midway between pulleys.

Adjust if belt deflections exceed the limit.

Unit: mm (in)

	Used deflection		Set deflection of new belt
	Limit	Adjusted deflection	
Alternator	7.5 (0.295)	4 - 6 (0.16 - 0.24)	3 - 5 (0.12 - 0.20)
Air conditioner compressor	12 (0.47)	7 - 9 (0.28 - 0.35)	6 - 8 (0.24 - 0.31)
Power steering oil pump	15 (0.59)	9 - 11 (0.35 - 0.43)	8 - 10 (0.31 - 0.39)
Applied pushing force	98 N (10 kg, 22 lb)		

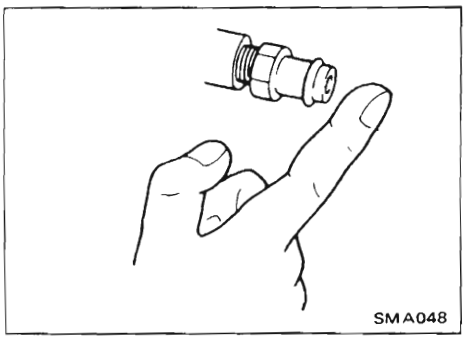




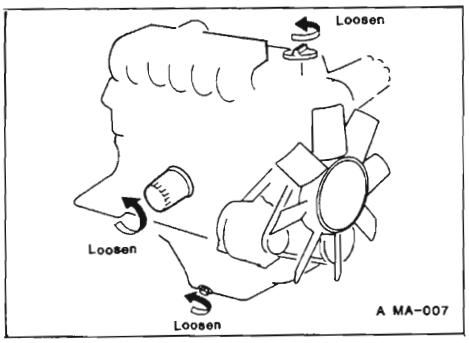
Checking Ignition Wiring

1. Check the high tension wires for cracks, damage, burned terminals and proper fit.
2. Measure the resistance of the high tension wires, by shaking it and checking for intermittent breaks.

Resistance: Less than 30 kΩ



1. Disconnect hose from P.C.V.
2. Ensure vacuum is present at valve when engine is at idle.



Changing Engine Oil and Oil Filter

1. Warm up engine, then stop it, and check for oil leakage from engine components.
2. Remove oil filler cap and drain oil.

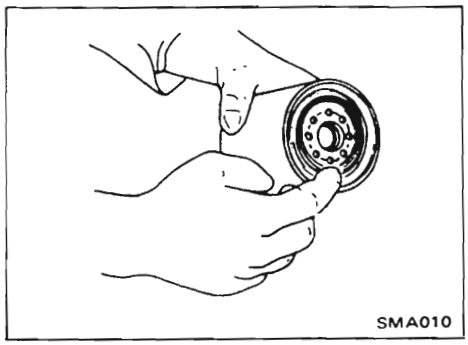
WARNING:

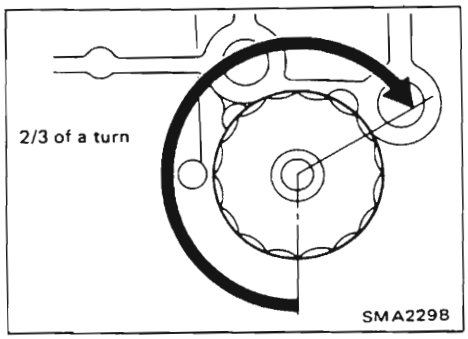
Be careful not to burn yourself, as the engine oil may be hot.

3. Clean and install oil pan drain plug with washer.

   : **Drain plug**
   29 - 39 N·m
   (3.0 - 4.0 kg-m, 22 - 29 ft-lb)

4. Remove oil filter.
5. Wipe oil filter mounting surface.
6. Smear a little engine oil on rubber gasket of oil filter.



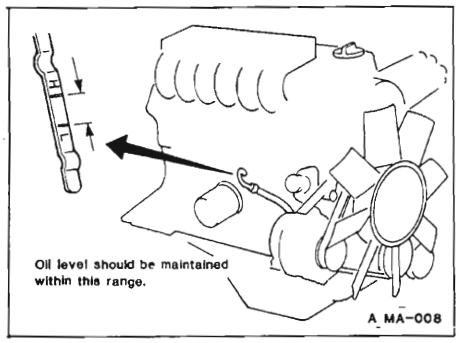


7. Install oil filter.

When installing oil filter, screw it in until a slight resistance is felt, then tighten additionally more than 2/3 turn.

8. Add recommended engine oil.

Approximate refill capacity:
With oil filter change
4.4 ℓ (3-7/8 Imp qt)
Without oil filter change
4.0 ℓ (3-1/2 Imp qt)



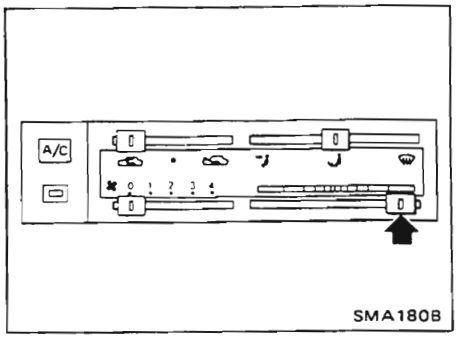
Changing Engine Oil and Oil Filter (Cont'd)

9. Check oil level.
10. Start engine. Check area around drain plug and oil filter for any sign of oil leakage.
11. Run engine for a few minutes, then turn it off. After several minutes, check oil level.

Changing Engine Coolant

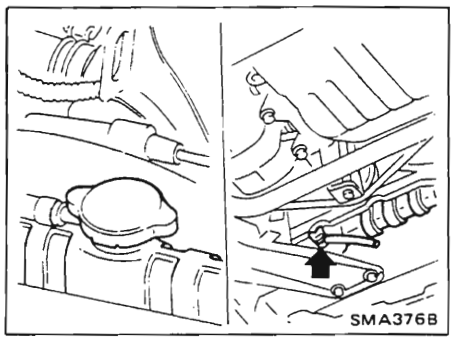
WARNING:

To avoid the danger of being scalded, never attempt to change the coolant when the engine is hot.

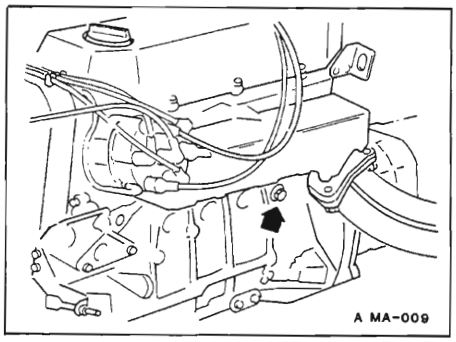


1. Drain coolant.

(1) Put heater "TEMP" control lever all the way to "HOT" position.



(2) Open drain cock at the bottom left-hand side of radiator, and remove radiator cap.



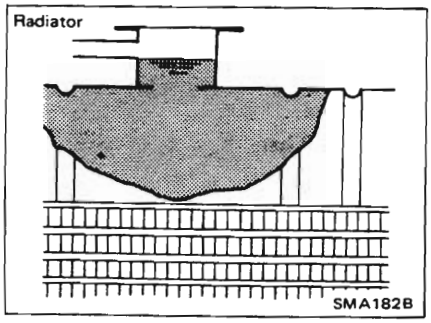
(3) Remove cylinder block drain cock and drain water completely.

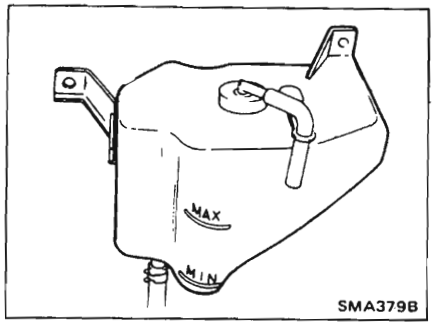
2. Refill radiator and engine with new coolant.

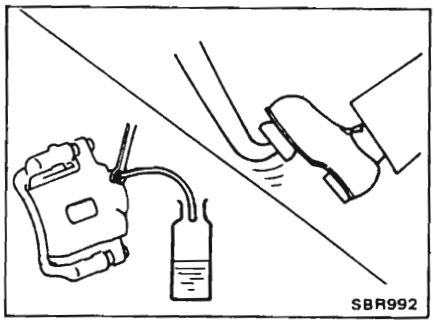
(1) Install radiator drain cock and cylinder block drain cock securely.

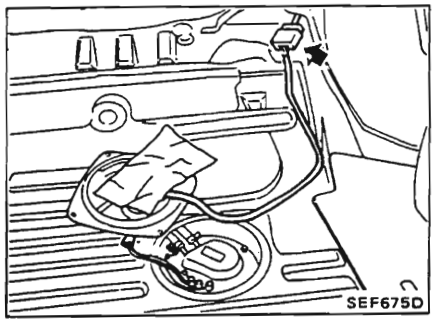
(2) Remove both air bleed screws (on inlet manifold and inlet collector) while refilling system.

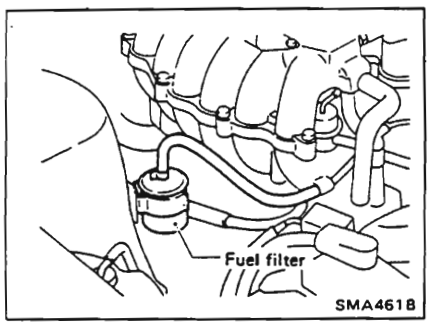
3. Replace each plug as water appears at bleed hole.











Changing Engine Coolant (Cont'd)

(3) Fill radiator and engine with new coolant up to filler opening. Follow instructions attached to anti-freeze container for mixing ratio of anti-freeze to water.

Coolant capacity: (Reservoir tank excluded)
9.0 ℓ (7-7/8 Imp qt)

Slowly pour coolant through coolant filler neck to allow air in system to escape.

(4) Tighten air relief plug.

(5) Fill reservoir tank up to "MAX" level. Then close radiator cap.

Reservoir tank capacity ("MAX" level):
0.6 ℓ (1/2 Imp qt)

(6) Idle the engine until thermostat opens. (about 10 minutes)
Keep a close watch on movement of water temperature gauge needle.

(7) Stop the engine and after it cools down, refill the radiator and engine with coolant up to the filler opening. Fill the reservoir tank with coolant up to "MAX" level.

(8) Repeat steps (6) and (7) until coolant level does not go lower after running the engine.

Changing Brake Fluid

1. Drain brake fluid from each air bleeder valve.
2. Refill until new brake fluid comes out from each air bleeder valve.
   Use same procedure as in bleeding hydraulic system to refill brake fluid.
   Refer to section BR.

- **Refill with recommended brake fluid "DOT 3".**
- **Do not reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas.**

Replacing Fuel Filter

Before disconnecting fuel line, release fuel pressure from fuel line to eliminate danger.

1. Start engine.
2. Remove luggage floor mat.
3. Disconnect fuel pump connector with engine running.
4. After engine stalls, crank engine two or three times to make sure that pressure is released.
5. Turn ignition switch off and reconnect fuel pump connector.
6. Loosen clamps and replace filter.

Be careful not to spill fuel over engine compartment. Place a rag to absorb fuel.

Erase memory (code No 22) from control unit. Ref page EF 76.

Replacing Air Cleaner Filter (Viscous paper type)

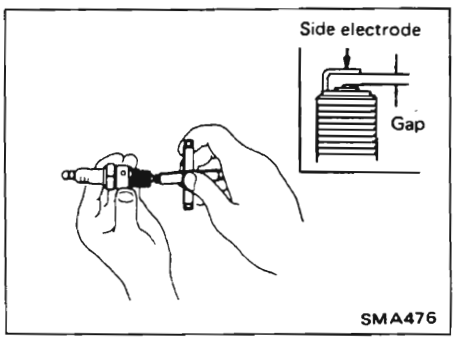
The viscous paper type air cleaner filter does not require any cleaning operation between renewal.

Replacing Spark Plugs

1. Blow out each plug cavity with compressed air.
2. Disconnect spark plug wire at boot. Do not pull on the wire.
3. Remove spark plugs with spark plug wrench.

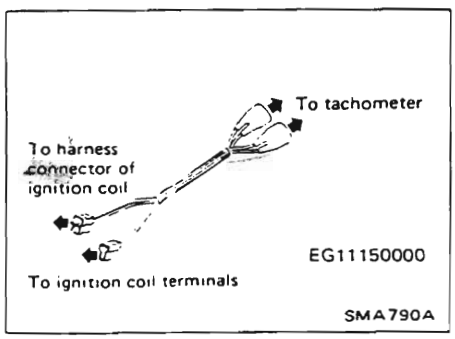
Spark plug:-

Standard type	BCP6ES-11
Hot type	BCP5ES-11
Cold type	BCP7ES-11



4. Check spark plug gap.
   Gap: 1.0 - 1.1 mm (0.039 - 0.043 in)
5. Install spark plugs. Reconnect high tension cables according to the numbers and colours indicated on them.
   Grey — Exhaust side
   Black — Intake side
   : **Spark plug**
   20 - 29 N-m
   (2.0 - 3.0 kg-m, 14 - 22 ft-lb)

Checking and Adjusting Idle Speed and Ignition Timing

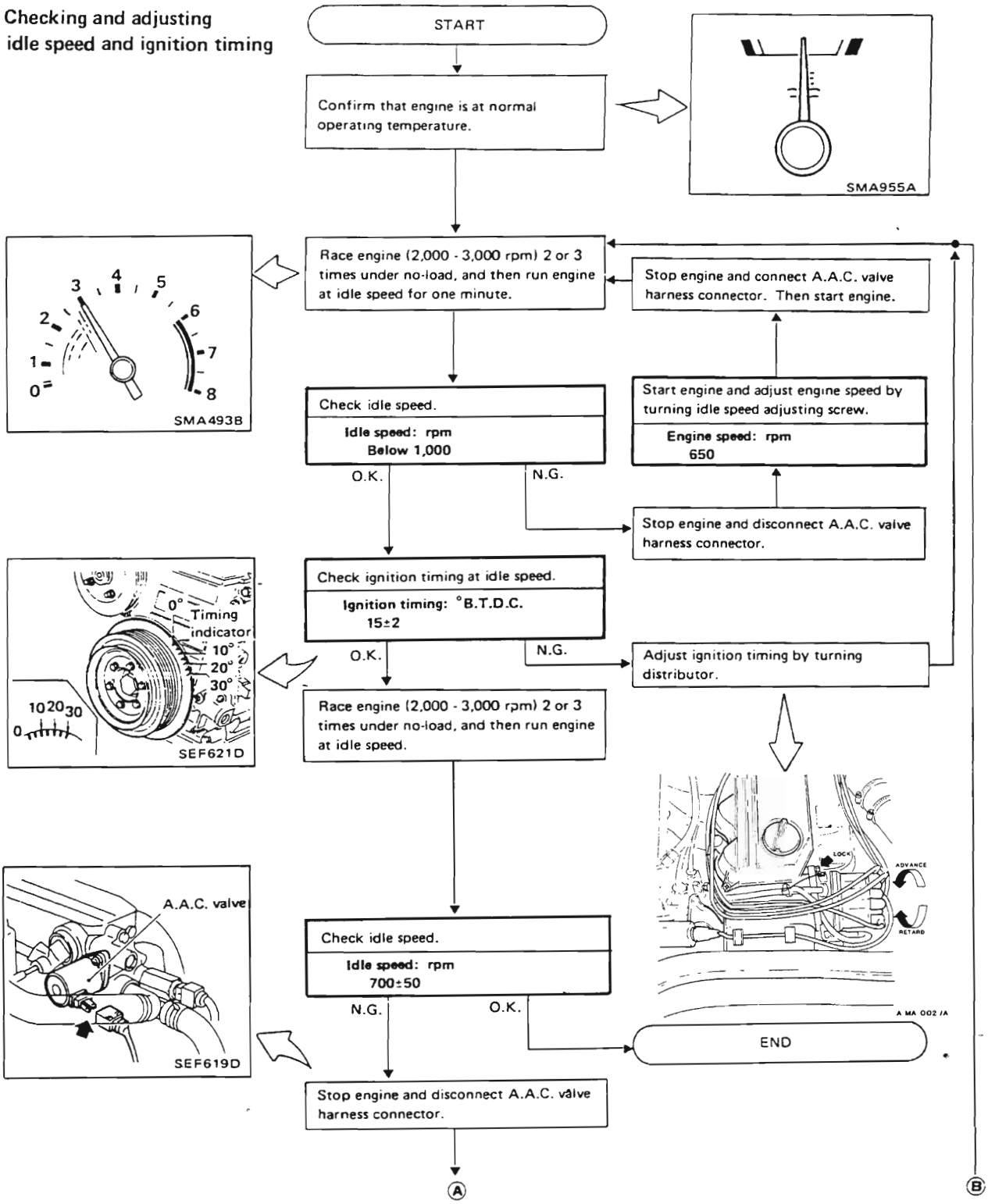


PREPARATION

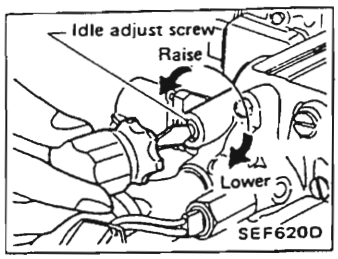
1. Set shift lever in "Neutral" position (in "N" or "P" position for the automatic transmission). Engage parking brake and lock both front and rear wheels with wheel chocks.
2. Turn off air conditioner and light switch.
3. When checking engine speed, attach adapter harness between ignition coil primary winding terminals and harness connector. Then connect tachometer to adapter harness.

Checking and Adjusting Idle Speed and Ignition Timing (Cont'd)

Checking and adjusting idle speed and ignition timing



Checking and Adjusting Idle Speed, Ignition Timing and Mixture Ratio (Cont'd)



Ⓐ

Start engine and adjust engine speed by turning idle speed adjusting screw.

Engine speed: rpm
650

Stop engine and connect A.A.C. valve harness connector. Then start engine.

Make sure that idle speed is in the specified range.

Idle speed: rpm
700±50

N.G.

O.K.

Confirm ignition timing at idle speed.

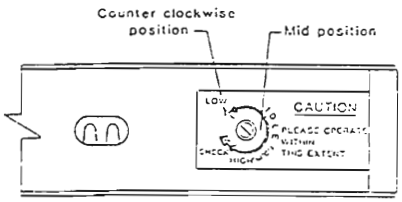
Ignition timing: °B.T.D.C.
15±2

END

Engine Idle Speed Slow

Engine Idle Speed Fast

Turn diagnostic mode selector in a clockwise direction **only between the counter-clockwise and mid position** until the correct idle speed is attained.



Note: The diagnostic mode selector must be adjusted between the counter-clockwise and mid positions to enable the O_2 sensor check function to operate for periodic maintenance checks.

Check A.A.C. valve
Refer EF-103

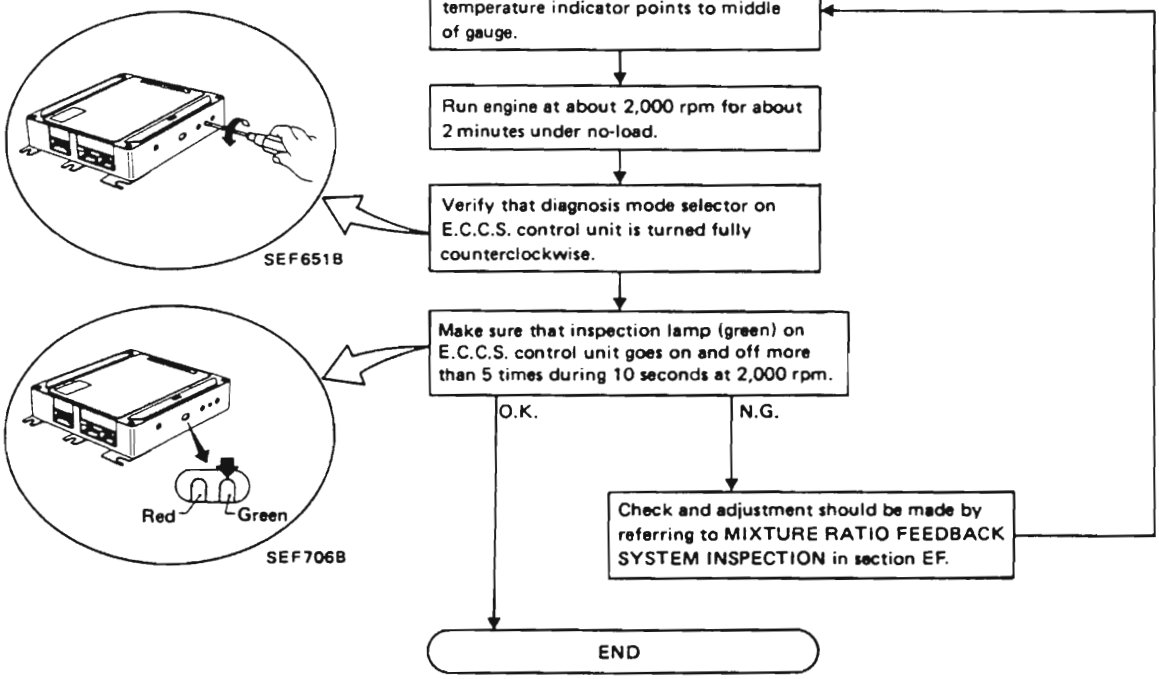
O.K.

N.G.

Ⓑ

Checking Exhaust Gas Sensor

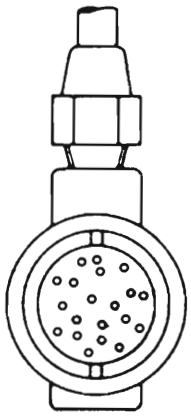
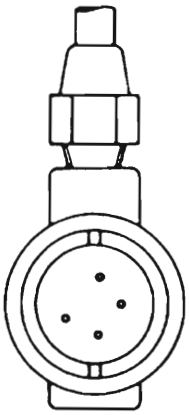
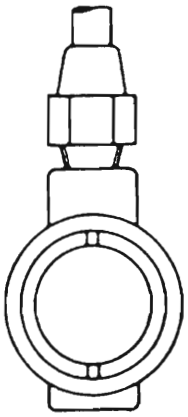
Checking procedure

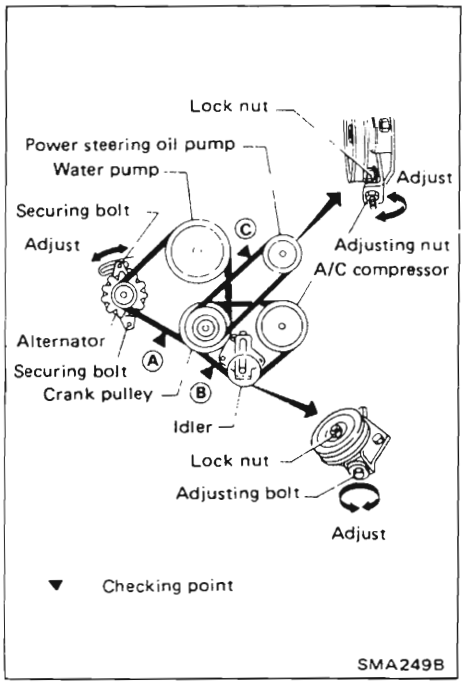


Checking Air Conditioning Refrigerant Level

CONDITION

- Door window: Open
- A/C switch: ON
- TEMP. lever position: Max. COLD
- FAN lever position: Maximum speed
- Check sight glass after a lapse of about five minutes.

Amount of refrigerant / Check item	Almost no refrigerant	Insufficient	Suitable	Too much refrigerant
Temperature of high-pressure and low-pressure lines.	Almost no difference between high-pressure and low-pressure side temperature.	High-pressure side is warm and low-pressure side is fairly cold.	High-pressure side is hot and low-pressure side is cold.	High-pressure side is abnormally hot.
State in sight glass.	Bubbles flow continuously. Bubbles will disappear and something like mist will flow when refrigerant is nearly gone.  AC256	The bubbles are seen at intervals of 1 - 2 seconds.  AC257	Almost transparent. Bubbles may appear when engine speed is raised and lowered. No clear difference exists between these two conditions.  AC258	No bubbles can be seen
Pressure of system.	High-pressure side is abnormally low.	Both pressures on high and low-pressure sides are slightly low.	Both pressures on high and low-pressure sides are normal.	Both pressures on high and low-pressure sides are abnormally high.
Repair.	Stop compressor immediately and conduct an overall check.	Check for gas leakage, repair as required, evacuate and recharge system.		Discharge refrigerant from service valve of low pressure side.



Checking Drive Belts

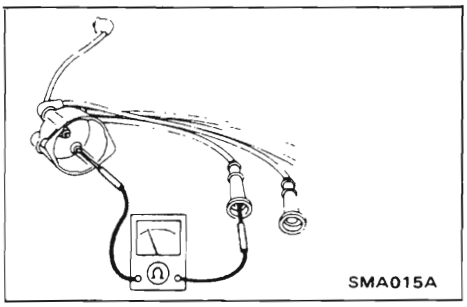
1. Inspect for cracks, fraying, wear and oil adhesion. Replace if necessary.
2. Check drive belt deflections by pushing midway between pulleys.

Adjust if belt deflections exceed the limit.

Belt deflection: Unit: mm (in)

	Used belt defection		Set defection of new belt
	Limit	Adjust	
Alternator Ⓐ	13 (0.51)	7 - 10 (0.28 - 0.39)	6 - 8 (0.24 - 0.32)
A/C compressor Ⓑ	7 (0.28)	3 - 5 (0.12 - 0.20)	3 - 5 (0.12 - 0.20)
P/S oil pump Ⓒ	15 (0.59)	8 - 11 (0.31 - 0.43)	6 - 9 (0.35 - 0.43)

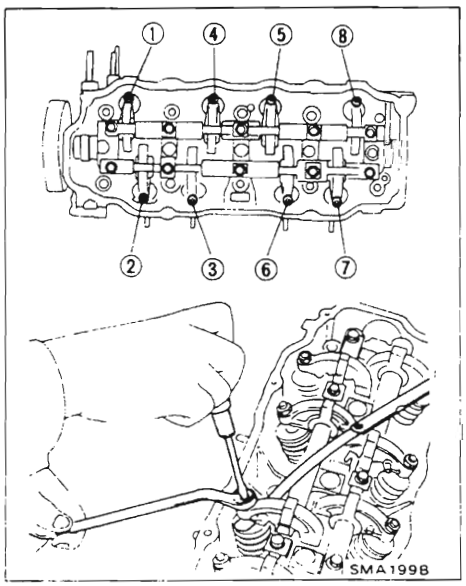
Applied pushing force: 98 N (10 kg, 22 lb)



Checking Ignition Wiring

1. Check the ignition wires for cracks, damage, burned terminals and proper fit.
2. Measure the resistance of the ignition wires, by shaking them and checking for intermittent breaks.

Resistance: Less than 30 kΩ



Adjusting Intake and Exhaust Valve Clearance

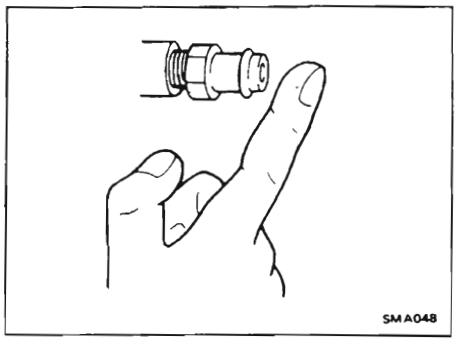
Adjustment should be made while engine is warm but not running.

1. Set No. 1 cylinder in top dead center on its compression stroke, and adjust valve clearance ①, ②, ④ and ⑥.
2. Set No. 4 cylinder in top dead center on its compression stroke, and adjust valve clearance ③, ⑤, ⑦ and ⑧.

Valve clearance:

Intake ①, ④, ⑤ and ⑧
0.30 mm (0.012 in)
Exhaust ②, ③, ⑥ and ⑦
0.30 mm (0.012 in)

Adjusting screw lock nuts
18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

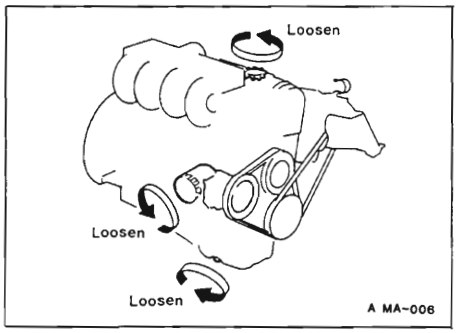


Checking Positive Crankcase Ventilation (P.C.V.) System

CHECKING P.C.V. VALVE

Disconnect hose and check P.C.V. valve to see it is operating properly.

Finger is sucked into P.C.V. valve when finger is put on P.C.V. valve during idling.



Changing Engine Oil and Oil Filter

1. Warm up engine, then stop it, and check for oil leakage from engine components.
2. Remove oil filler cap and drain oil.

WARNING:

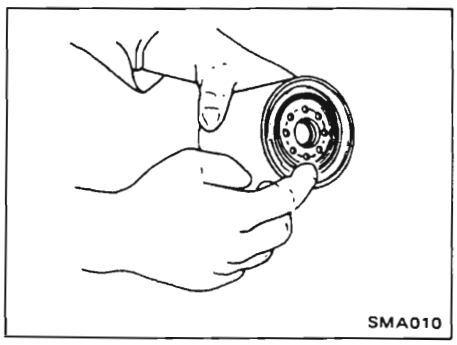
Be careful not to burn yourself, as the engine oil may be hot.

3. Clean and install oil pan drain plug with washer.

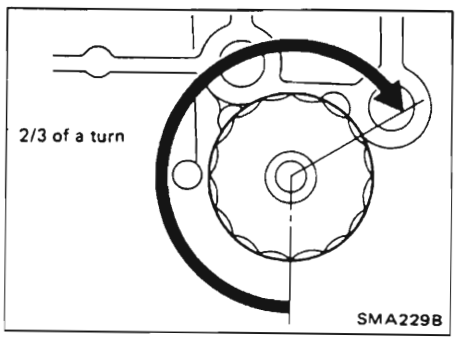
   : Drain plug

   29 - 39 N·m

   (3.0 - 4.0 kg-m, 22 - 29 ft-lb)



4. Remove oil filter.
5. Wipe oil filter mounting surface.
6. Smear a little engine oil on rubber gasket of oil filter.



7. Install oil filter.

When installing oil filter, screw it in until a slight resistance is felt, then tighten additionally more than 2/3 turn.

8. Add recommended engine oil.

Approximate refill capacity:

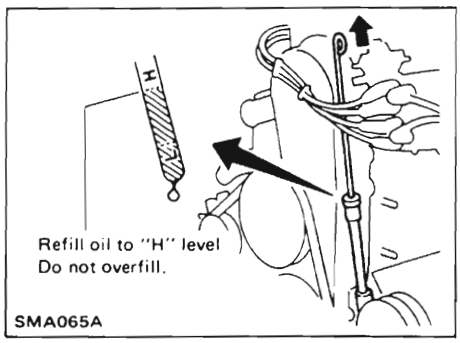
With oil filter change

3.4 ℓ (3 Imp qt)

Without oil filter change

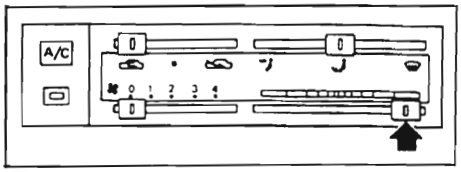
2.6 ℓ (2¼ Imp qt)

Changing Engine Oil and Oil Filter (Cont'd)



9. Check oil level.
10. Start engine and check area around drain plug and oil filter for any sign of oil leakage.
11. Run engine for a few minutes, then turn it off. After several minutes, check oil level.

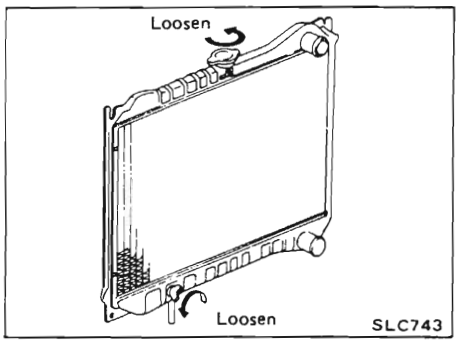
Changing Engine Coolant



WARNING:

To avoid the danger of being scalded, never attempt to change the coolant when the engine is hot.

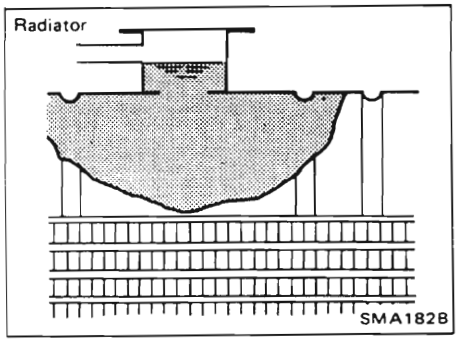
1. Put heater "TEMP" control lever all the way to "HOT" position.
2. Open drain cock at the bottom left-hand side of radiator, and remove radiator cap.
3. Close drain cock, and fill radiator with water.
4. Warm up engine and repeat steps 2, 3 and 4 one or two times to drain old coolant.



5. Fill radiator with coolant up to filler opening.
   Follow instructions attached to anti-freeze container for mixing ratio of anti-freeze to water.

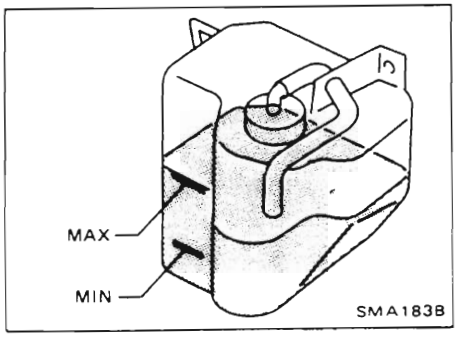
   Coolant capacity: (Reservoir tank excluded)
   7.8 ℓ (6-7/8 Imp qt)

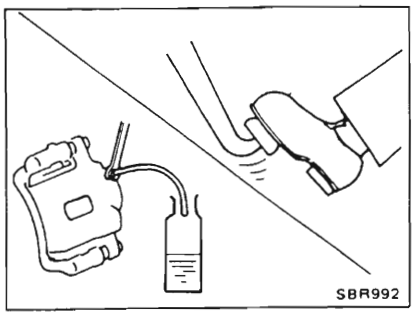
Slowly pour coolant through coolant filler neck to allow air in system to escape.



6. Fill reservoir tank up to "MAX" level.

   Reservoir tank capacity ("MAX" level):
   0.6 ℓ (1/2 Imp qt)
7. Run the engine at approximately 2,000 rpm for about one minute.
8. Stop engine and cool it down, then refill the radiator and the reservoir tank.

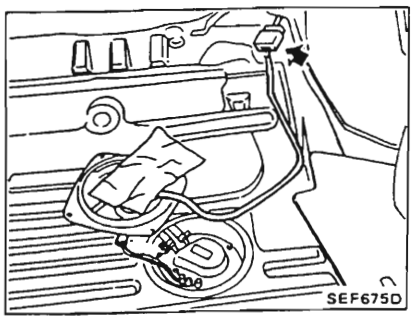




Changing Brake Fluid

1. Drain brake fluid from each air bleeder valve.
2. Refill until new brake fluid comes out from each air bleeder valve.
   Use same procedure as in bleeding hydraulic system to refill brake fluid.
   Refer to section BR.

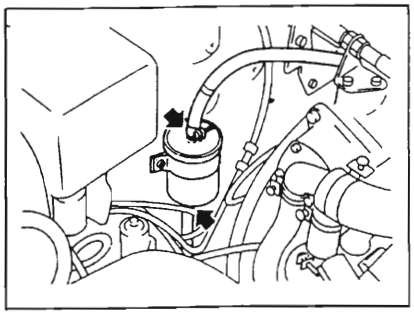
- **Refill with recommended brake fluid.**
- **Do not reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas.**



Replacing Fuel Filter

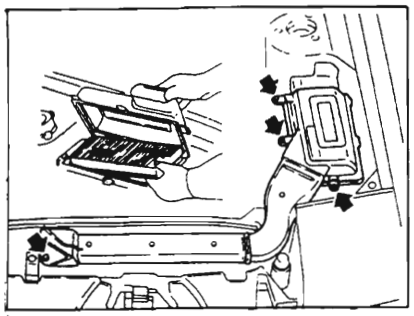
Before disconnecting fuel line, release fuel pressure from fuel line to eliminate danger.

1. Start engine.
2. Remove luggage floor mat.
3. Disconnect fuel pump connector with engine running.
4. After engine stalls, crank engine two or three times to make sure that pressure is released.
5. Turn ignition switch off and reconnect fuel pump connector.
6. Loosen clamps and replace filter.



Be careful not to spill fuel over engine compartment. Place a rag to absorb fuel.

Erase memory (code No 22) from control unit. Ref page EF-26.



Replacing Air Cleaner Filter (Viscous paper type)

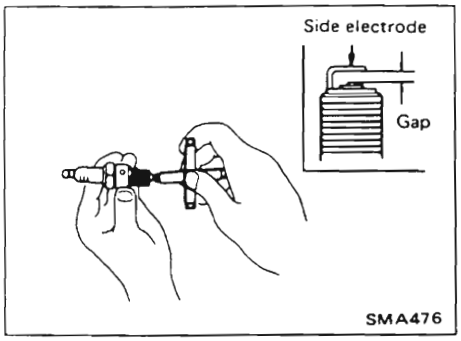
The viscous paper type air cleaner filter does not require any cleaning operation between renewal.

Replacing Spark Plugs

1. Blow out each plug cavity with compressed air.
2. Disconnect spark plug wire at boot. Do not pull on the wire.
3. Remove spark plugs with spark plug wrench.

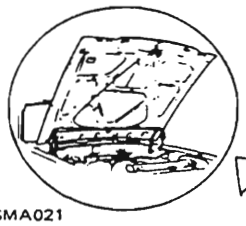
Spark plug:-

Standard type	BCP6ES-11
Hot type	BCP5ES-11
Cold type	BCP7ES-11



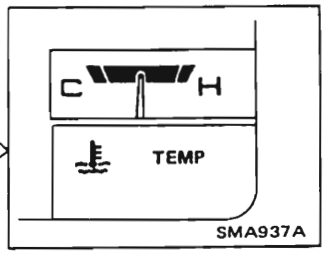
4. Check spark plug gap.
   Gap: 1.0 - 1.1 mm (0.039 - 0.043 in)
5. Install spark plugs. Reconnect high tension cables according to the numbers and colours indicated on them.
   Grey — Exhaust side
   Black — Intake side
   : **Spark plug**
   20 - 29 N-m
   (2.0 - 3.0 kg-m, 14 - 22 ft-lb)

Checking and adjusting idle rpm and ignition timing


SMA021

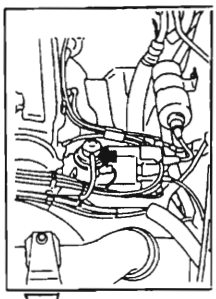
START

Start engine and warm up engine until water temperature indicator points to the middle of gauge.



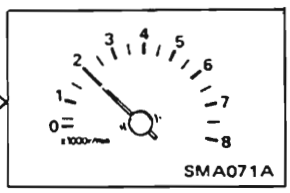
SMA937A

Open engine hood



Disconnect distributor vacuum hose from distributor vacuum controller, and plug hose with proper plug.

Run engine at about 2,000 rpm for about 2 minutes under no-load.



SMA071A

Race engine two or three times under no-load, then run engine for one minute at idle speed.

Check idle speed.

Idle speed: rpm
Below 1,000 rpm

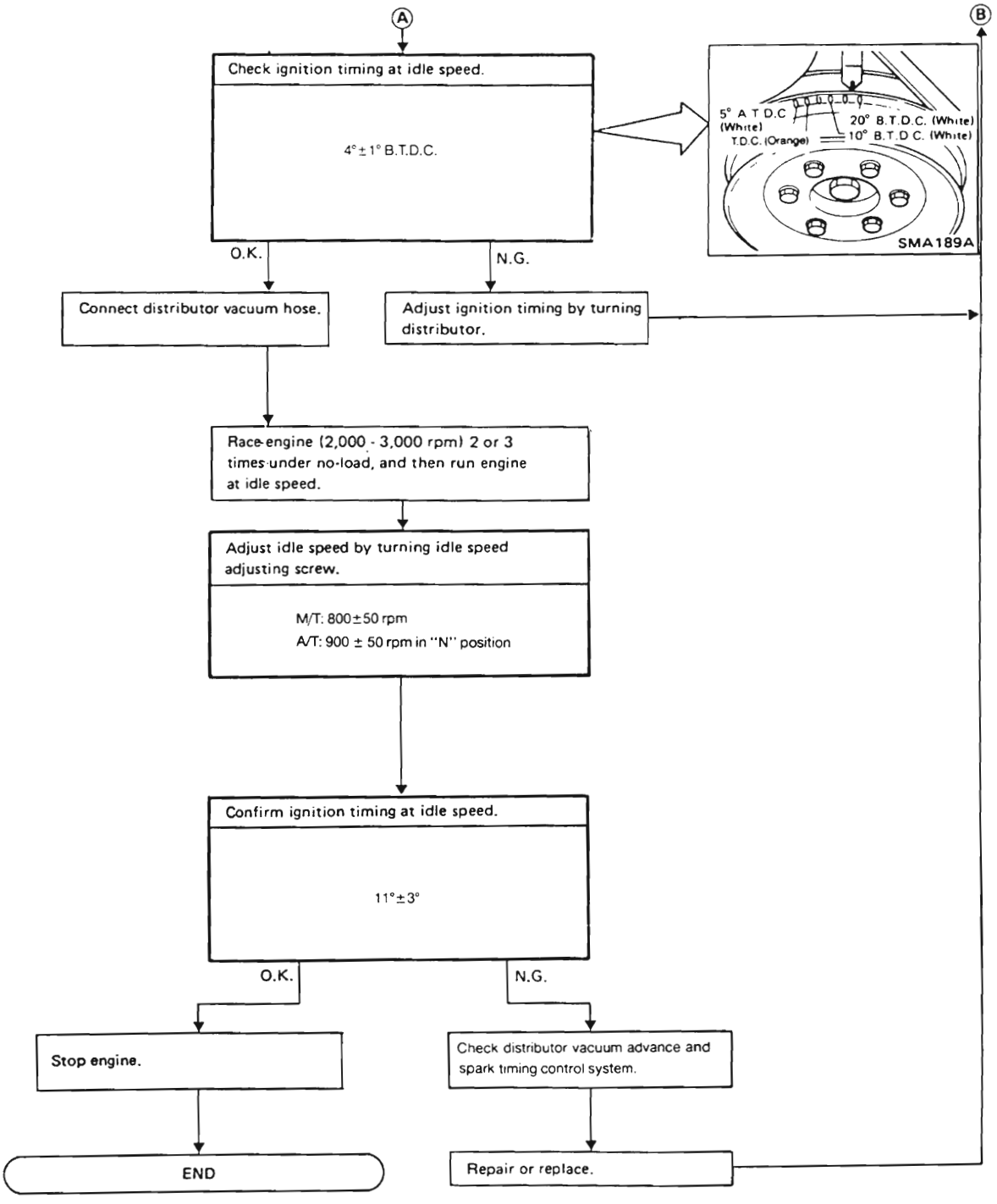
O.K.

N.G.

Adjust idle speed by turning idle speed adjusting screw.

Ⓐ

Ⓑ


A
B
Check ignition timing at idle speed.
4° ± 1° B.T.D.C.
5° A.T.D.C. (White)
T.D.C. (Orange)
20° B.T.D.C. (White)
10° B.T.D.C. (White)
SMA189A
O.K.
N.G.
Connect distributor vacuum hose.
Adjust ignition timing by turning distributor.
Race engine (2,000 - 3,000 rpm) 2 or 3 times under no-load, and then run engine at idle speed.
Adjust idle speed by turning idle speed adjusting screw.
M/T: 800±50 rpm
A/T: 900 ± 50 rpm in "N" position
Confirm ignition timing at idle speed.
11°±3°
O.K.
N.G.
Stop engine.
Check distributor vacuum advance and spark timing control system.
END
Repair or replace.

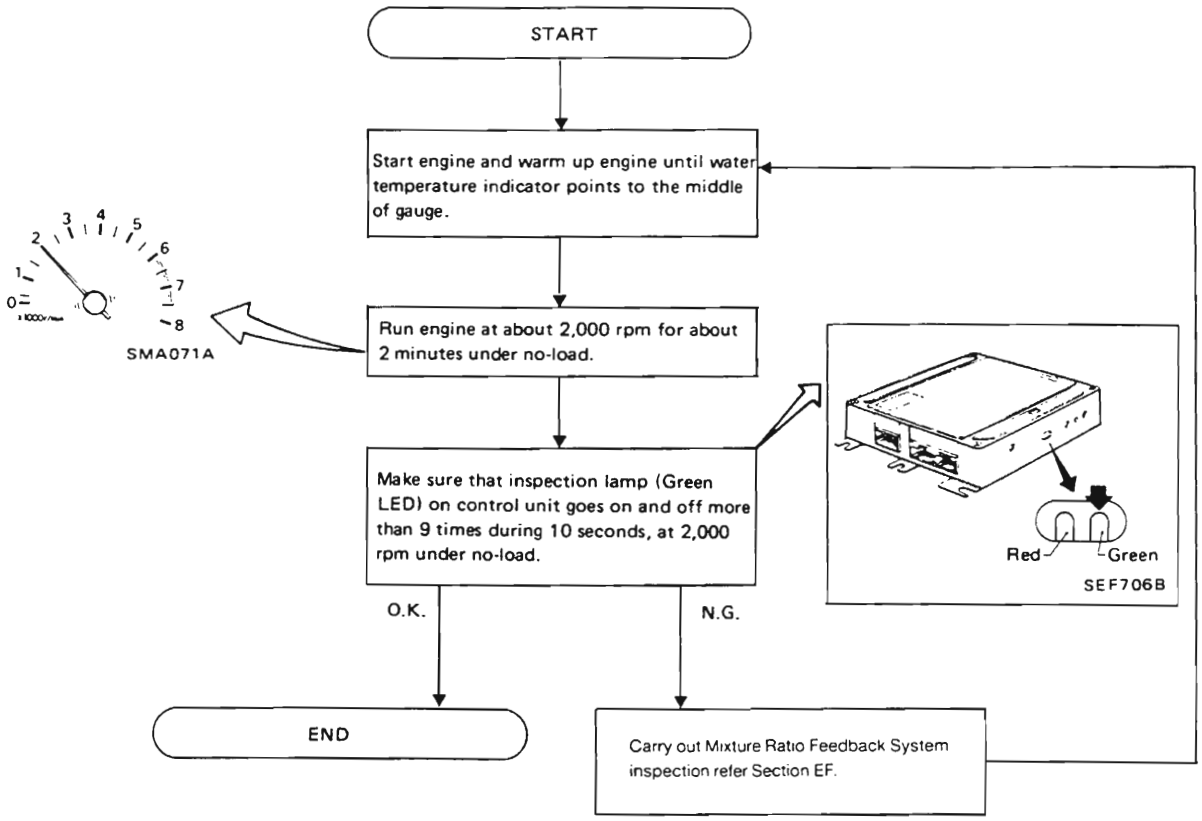
Checking Exhaust Gas Sensor

Preparation

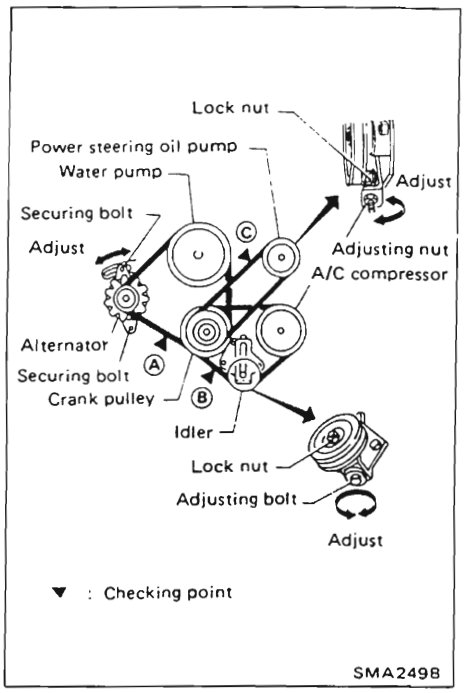
When checking exhaust gas sensor, make sure that the following are in good order.

- Battery
- Engine oil and coolant levels
- E.F.I. components
- E.F.I. harness and connectors
- Hoses
- Oil filer cap and oil level gauge

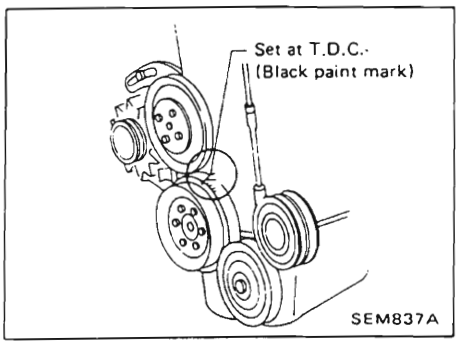
Checking procedure



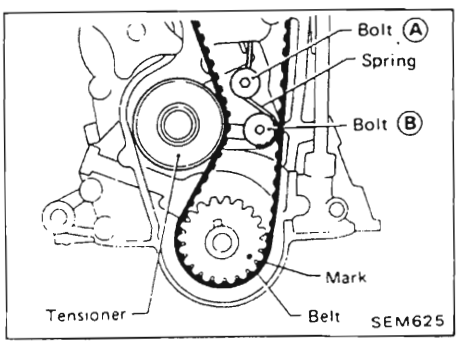
1. Remove radiator shroud, fan and pulleys. Refer to Cooling System – Radiator (Section LC).
2. Remove all spark plugs.



3. Remove the following belts.
- Power steering oil pump drive belt
- Compressor drive belt
- Alternator drive belt.

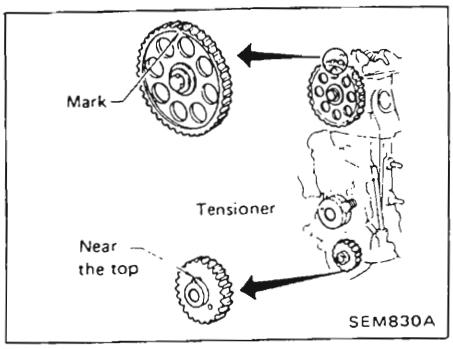


4. Set No. 1 cylinder at T.D.C. on its compression stroke.

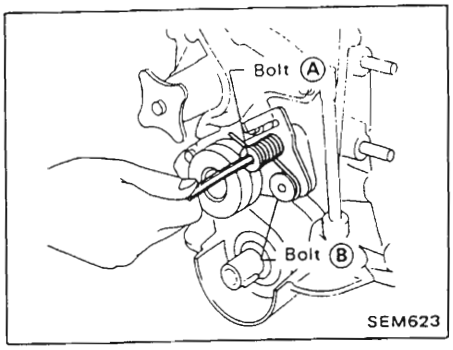


5. Remove front upper and lower belt covers.
6. Loosen timing belt tensioner bolts and remove return spring, then remove timing belt.

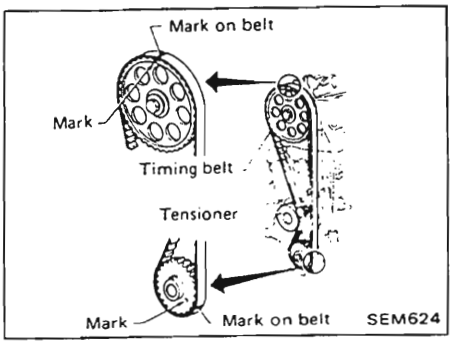
After removing timing belt, do not rotate crankshaft and camshaft separately because valves will hit piston head.



1. Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke.



2. Install tensioner and return spring.
- Temporarily tighten bolts so that tensioner can swing smoothly.



3. Set timing belt.

a. Ensure that timing belt and pulleys are clean and free of oil or water. Do not bend timing belt.

b. Align white lines on timing belt with punch mark on camshaft pulleys and crankshaft pulley.

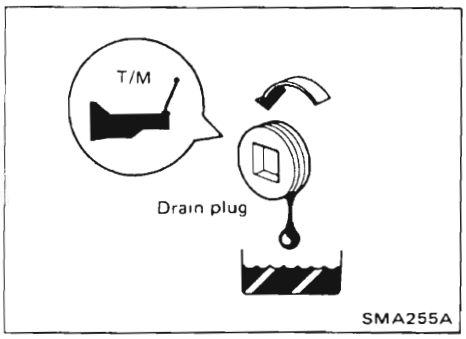
c. Have arrow on timing belt pointing toward front belt covers.

4. Tighten belt tensioner and assemble spring.

To set spring, first hook one end on bolt (B) side, then hook the other end on tensioner bracket pawl. After rotating crankshaft two turns clockwise, tighten bolt (B) and then bolt (A), and belt tension will automatically be the specified value.

: 15 - 20 N·m (1.5 - 2.0 kg-m, 11 - 14 ft-lb)

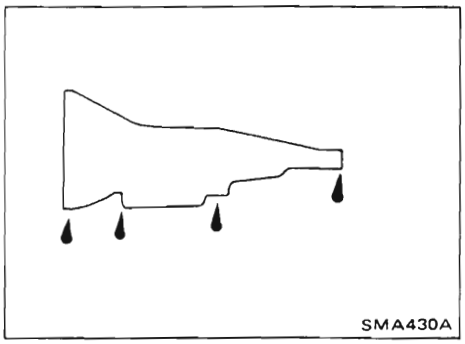
5. Install timing belt covers.



Checking M/T Oil

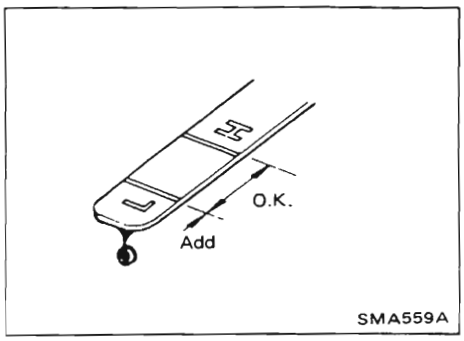
1. Check manual transmission for leakage.
2. Check oil level.

CAUTION:
Never start engine while checking oil level.



Checking A/T Fluid

1. Check automatic transmission for leakage.

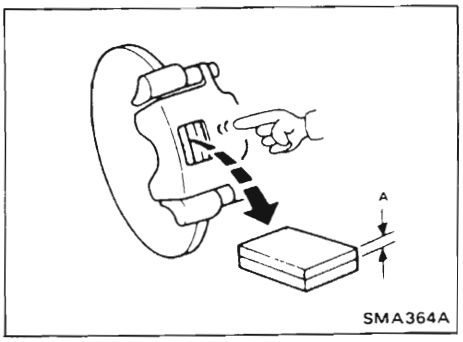


2. Check under following conditions.
(1) Place selector lever in "P" (PARK) position and idle engine.
(2) Maintain fluid temperature at 50 to 80°C (122 to 176°F).
(3) Add oil, if necessary.

Use recommended A/T fluid.

Checking Differential Gear Oil

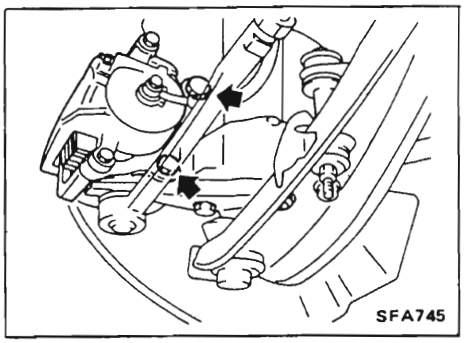
1. Use special tool No E3M5 to remove inspection plug.
   Note: Do not use screwdriver or other implement as damage to the plug will result.
2. Oil should be level with bottom of inspection hole.



Checking Disc Brake Pads

1. Remove road wheels.
2. Inspect rotor friction surface for wear or damage.
3. Visually check thickness of pads.

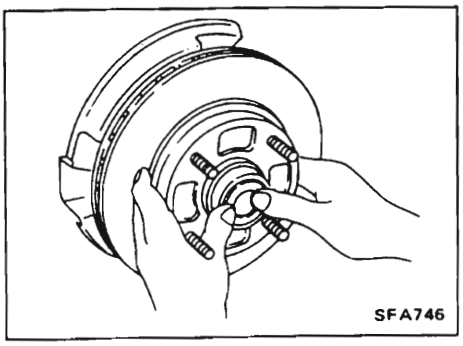
   Minimum thickness (Dim "A"): 3mm.



Repacking Front Wheel Bearings

- Remove brake caliper assembly.

Brake hose does not need to be disconnected from brake caliper.
Be careful not to depress brake pedal, or piston will pop out.
Make sure brake hose is not twisted.



- **Remove wheel hub and wheel bearing from spindle.**

Be careful not to drop outer bearing.

- Prise out grease seal and discard.
- Thoroughly clean inside of hub and knuckle spindle.

Inspection

WHEEL BEARING

Check wheel bearing to see that it rolls freely and is free from noise, cracks, pitting or wear. Replace if necessary.

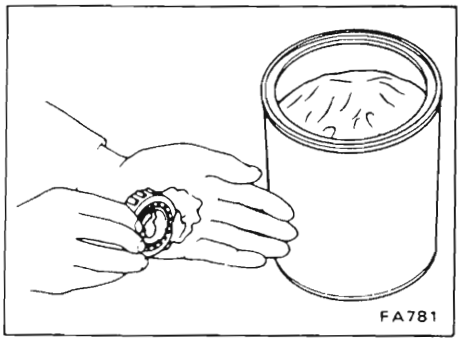
WHEEL HUB

Check wheel hub for cracks or damage and replace if necessary.

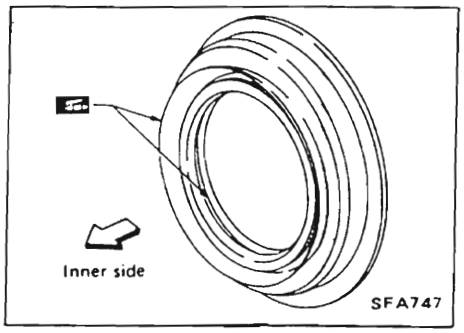
KNUCKLE SPINDLE

Check knuckle spindle for deformation or cracks and replace if damaged.

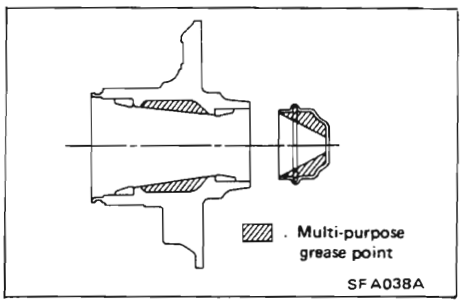
Repacking Front Wheel Bearings (cont'd)



- Pack each bearing cone with NLGI grease.

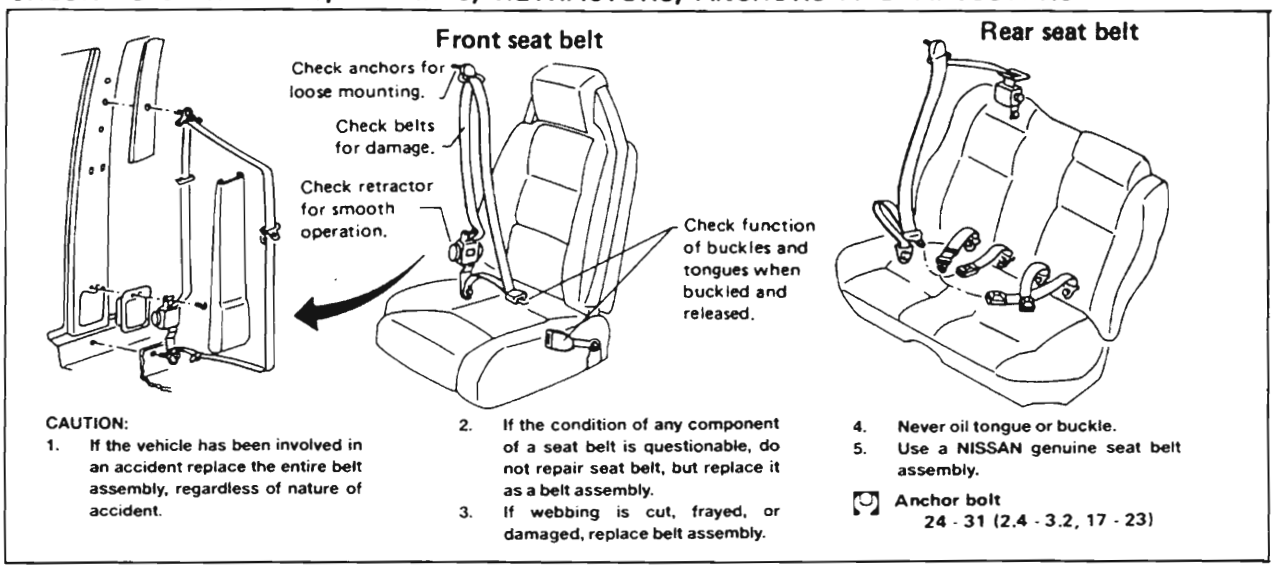


- Pack grease seal lip with NLGI grease, then install it into wheel hub with suitable drift.
- Always use new seal.



- Pack NLGI grease into hub and hub cap.

CHECKING SEAT BELTS, BUCKLES, RETRACTORS, ANCHORS AND ADJUSTERS



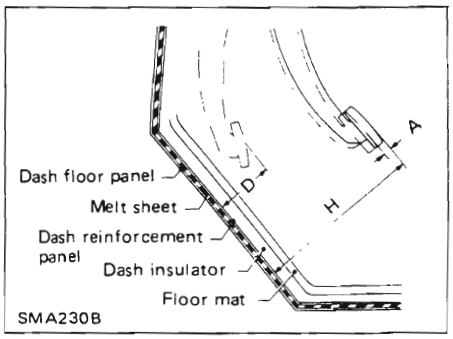
CAUTION:

1. If the vehicle has been involved in an accident replace the entire belt assembly, regardless of nature of accident.
2. If the condition of any component of a seat belt is questionable, do not repair seat belt, but replace it as a belt assembly.
3. If webbing is cut, frayed, or damaged, replace belt assembly.
4. Never oil tongue or buckle.
5. Use a NISSAN genuine seat belt assembly.

Anchor bolt
24 - 31 (2.4 - 3.2, 17 - 23)

Checking Inhibitor Switch Operation (A/T)

- Apply park brake firmly and place foot firmly on brake pedal.
- Shift automatic gear selector lever to each gear position and attempt to start engine.
- Ensure starter motor does not operate in positions 1, 2, D and R.
- Ensure starter motor does operate in positions P and N.

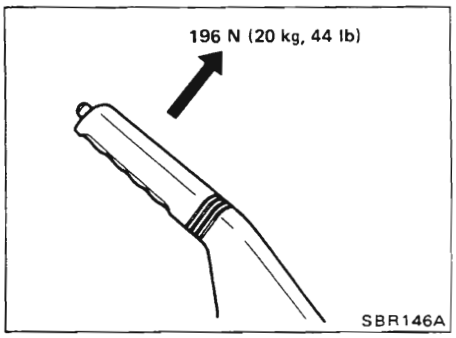


Checking Foot Brake Pedal Operation

H: **Free height**
Refer to S.D.S.

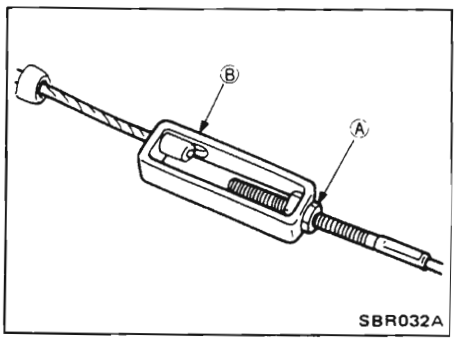
D: **Depressed height**
Under force of 490 N (50 kg, 110 lb) with engine running
Refer to S.D.S.

A: **Pedal free play**
1.0 - 3.0 mm (0.039 - 0.118 in)



Checking Parking Brake

1. Pull lever with specified amount of force.
   Check lever stroke and for smooth operation.
   Number of notches [At pulling force of 196 N (20 kg, 44 lb)] :
   Refer to S.D.S.



2. Use adjuster to adjust lever stroke.
(1) Loosen lock nut Ⓐ , rotate adjuster Ⓑ .
(2) Tighten lock nut Ⓐ .

Engine Maintenance—RB30E

INSPECTION AND ADJUSTMENT

Drive belt deflection

Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjusted deflection	
Alternator	7.5 (0.295)	4 - 6 (0.16 - 0.24)	3 - 5 (0.12 - 0.20)
Air conditioner compressor	12 (0.47)	7 - 9 (0.28 - 0.35)	6 - 8 (0.24 - 0.31)
Power steering oil pump	15 (0.59)	9 - 11 (0.35 - 0.43)	8 - 10 (0.31 - 0.39)
Applied pushing force	98 N (10 kg, 22 lb)		

Oil capacity (Refill capacity)

Unit: ℓ (Imp qt)

With oil filter change	4.4 (3-7/8)
Without oil filter change	4.0 (3-1/2)

Cooling system check

Unit: kPa (bar, kg/cm², psi)

Radiator cap relief pressure	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)

Coolant capacity

Unit: ℓ (Imp qt)

Refill capacity	9.0 (8)
Reservoir tank	0.6 (1/2)

Spark plug

Standard type	BCP6ES-11
Hot type	BCP5ES-11
Cold type	BCP7ES-11
Plug gap	1.0 - 1.1 mm (0.039 - 0.043 in)

Ignition timing and idle speed

	M/T	A/T (in "N" position)
Ignition timing B.T.D.C.	15°±2°	
Idle speed rpm	700±50	700±50

TIGHTENING TORQUE

Unit	N·m	kg-m	ft-lb
Alternator adjusting bar bolt	16-21	1.6-2.1	12-15
Idler pulley bolt (compressor)	31 - 42	3.2 - 4.3	23 - 31
P/S oil pump adjusting lock bolt	14 - 19	1.4 - 1.9	10 - 14
Oil pan drain plug	29 - 39	3.0 - 4.0	22 - 29
Spark plug	20 - 29	2.0 - 3.0	14 - 22
Exhaust tube nut	31 - 42	3.2 - 4.3	23 - 31

Engine Maintenance-CA20E

INSPECTION AND ADJUSTMENT

Valve clearance (Hot)

Unit: mm (in)

Intake	0.30 (0.012)
Exhaust	0.30 (0.012)

Drive belt defection

Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjusted deflection	
Alternator	13 (0.51)	7 - 10 (0.28 - 0.39)	6 - 8 (0.24 - 0.32)
Air conditioner compressor	7 (0.28)	3 - 5 (0.12 - 0.20)	3 - 5 (0.12 - 0.20)
Power steering oil pump	15 (0.59)	8 - 11 (0.31 - 0.43)	6-9 (0.35 - 0.43)
Applied pushing force	98 N (10 kg, 22 lb)		

Oil capacity (Refill capacity)

Unit: ℓ (Imp qt)

With oil filter change	3.4 (3)
Without oil filter change	2.6 (2¼)

Cooling system check

Unit: kPa (bar, kg/cm², psi)

Radiator cap relief pressure	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)

Coolant capacity

Unit: ℓ (Imp qt)

Refill capacity	7.8 (6¾)
Reservoir tank	0.6 (½)

Spark plug

Standard type	BCP6ES
Hot type	BCP5ES
Cold type	BCP7ES
Plug gap	1.0 - 1.1 mm (0.039 - 0.043 in)

Ignition timing and idle speed

Ignition timing* B.T.D.C.		4° ± 1°
Idle speed	rpm	
M/T		800 ± 50
A/T		900 ± 50

*Distributor vacuum hose disconnected and plugged

TIGHTENING TORQUE

Item	N·m	kg-m	ft-lb
Rocker cover screw	1 - 3	0.1 - 0.3	0.7 - 2.2
Air cleaner securing bolts	16 - 20	1.6 - 2.0	12 - 14
Cylinder head bolts	Refer Section EM		
Intake manifold nuts and bolts*	20 - 25	2.0 - 2.6	14 - 19
Exhaust manifold nuts*	20 - 29	2.0 - 3.0	14 - 22
Exhaust tube nuts*	26 - 36	2.7 - 3.7	20 - 27
Valve rocker adjusting nuts	18 - 22	1.8 - 2.2	13 - 16
Alternator adjuster lock bolt	14 - 17	1.4 - 1.7	10 - 12
Power steering pump adjusting bolt	14 - 17	1.4 - 1.7	10 - 12
Idler adjuster lock nut	14 - 17	1.4 - 1.7	10 - 12
Oil pan drain plug	29 - 39	3.0 - 4.0	22 - 29
Spark plug	20 - 29	2.0 - 3.0	14 - 22
Distributor securing bolt	5 - 6	0.5 - 0.6	3.6 - 4.3
P.C.V. valve	29 - 39	3.0 - 4.0	22 - 29

*: Cold condition [approximately 20°C (68°F)]

Chassis and Body Maintenance

INSPECTION AND ADJUSTMENT

Clutch

Unit: mm (in)

Pedal height "H"	194.5 - 204.5 (7.66 - 8.05)
Pedal free play "A"	1 - 3 (0.04 - 0.12)

Front axle and front suspension

Axial end play mm (in)	0 (0)
Wheel bearing preload (As measured at wheel hub bolt) N (kg, lb)	
With new grease seal	13.7 (1.4, 3.1) or less
With used grease seal	13.7 (1.4, 3.1) or less
Tie-rod length "L" (reference data) mm (in)	
PR25P	42.5 (1.673)
TRW	55 (2.16)
Front wheel turning angle Toe-out turns Inside/Outside degree	21°52'/20° Power Steering 21°46'/20° Manual Steering
Full turns Inside degree	41° - 45° Power Steering 37° - 41° Manual Steering
Outside degree	32° - 36° Power Steering 30° - 34° Manual Steering

Front wheel alignment (Unladen) *1

Camber		- 50' to 1°
Caster		3°45' - 5°15'
Kingpin inclination		11°45' to 13°35'
Toe-in	mm (in)	0 to 2 (0.00 to 0.08)
	*2	0 - 12'

*1: Tankfull of fuel, radiator coolant and engine oil full.
Spare tire, jack, hand tools, mats in designed position.
*2: Total toe-in

Brake

Unit: mm (in)

Disc brake Pad repair limit	2.0 (0.079)
Rotor thickness repair limit Front	20 (0.79)
Rear	9.4 (0.370)
Pedal free height	190.5 - 200.5 (7.50 - 7.89)
Pedal depressed height	90 (3.54) or more
Parking brake Number of notches	7 - 9

Wheel and tire

Tire inflation

Proper tire pressures are shown on the tire placard affixed into the glove box of vehicle.

Tire pressure should be checked when tires are COLD.

Mechanical average of right and left radial runout mm (in) Steel wheel	0.5 (0.020) or less
Wheel rim lateral runout and radial runout Aluminium wheel	0.3 (0.012) or less
Difference between right and left radial runout mm (in) Steel wheel	0.5 (0.020) or less
Aluminium wheel	0.2 (0.008) or less
Wheel balance Maximum allowable unbalance at rim flange g (oz)	10 (0.35)
Tire balancing weight g (oz)	5 - 60 (0.18 - 2.12) Spacing 5 (0.18)

TIGHTENING TORQUE

Unit	N·m	kg-m	ft-lb
Clutch			
Pedal stopper lock nut	16 - 22	1.6 - 2.2	12 - 16
Clutch switch lock nut	12 - 15	1.2 - 1.5	9 - 11
Master cylinder push rod lock nut	8 - 11	0.8 - 1.1	5.8 - 8.0
Manual transmission			
Drain and filter plugs	25 - 34	2.5 - 3.5	18 - 25
Front axle and front suspension			
Tie-rod lock nut	78 - 98	8.0 - 10.0	58 - 72
Brake			
Air bleeder valve	7 - 9	0.7 - 0.9	5.1 - 6.5
Stop lamp switch lock nut	12 - 15	1.2 - 1.5	9 - 11
Brake booster input rod lock nut	16 - 22	1.6 - 2.2	12 - 16
Wheel and tire			
Wheel nut	79 - 98	8 - 10	58 - 72

ENGINE MECHANICAL

EM

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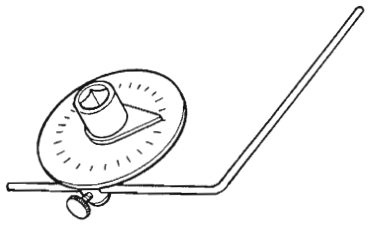
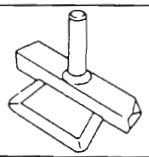
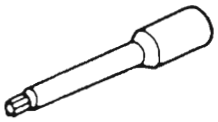
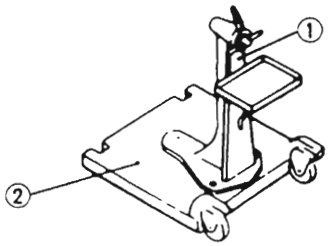
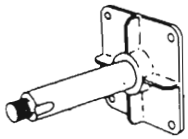
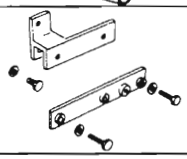
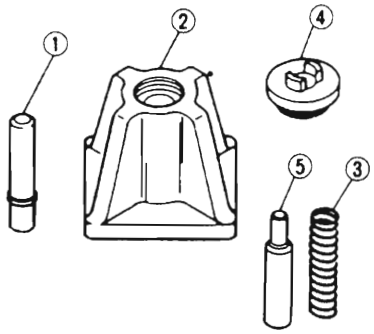
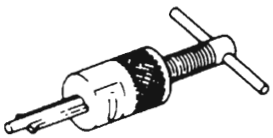
SPECIAL SERVICE TOOLS

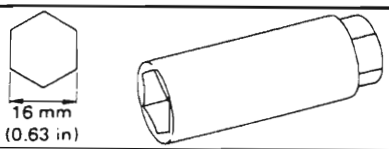
*. Special tool or commercial equivalent

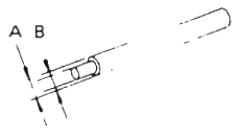
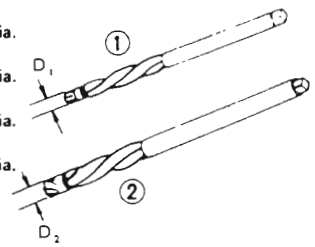
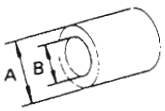
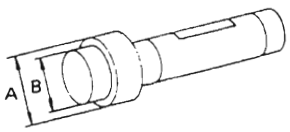
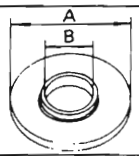
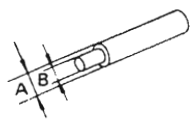
Tool number Tool name	Description	Engine application	
		CA	RB
E7106 Valve spring compressor		X	X
E7115 Angle gauge		X	X
E7112 Sump seal cutter (Litchfield)	 Removing oil pan	–	X
ST10120000* Cylinder head bolt wrench	 Loosening and tightening cylinder head bolt	–	X
KV10107501 Valve oil seal drift	 Installing valve oil seal	X	X
ST0501S000* Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	 Disassembling and assembling	X	X
KV10106500* Engine stand shaft		X	X

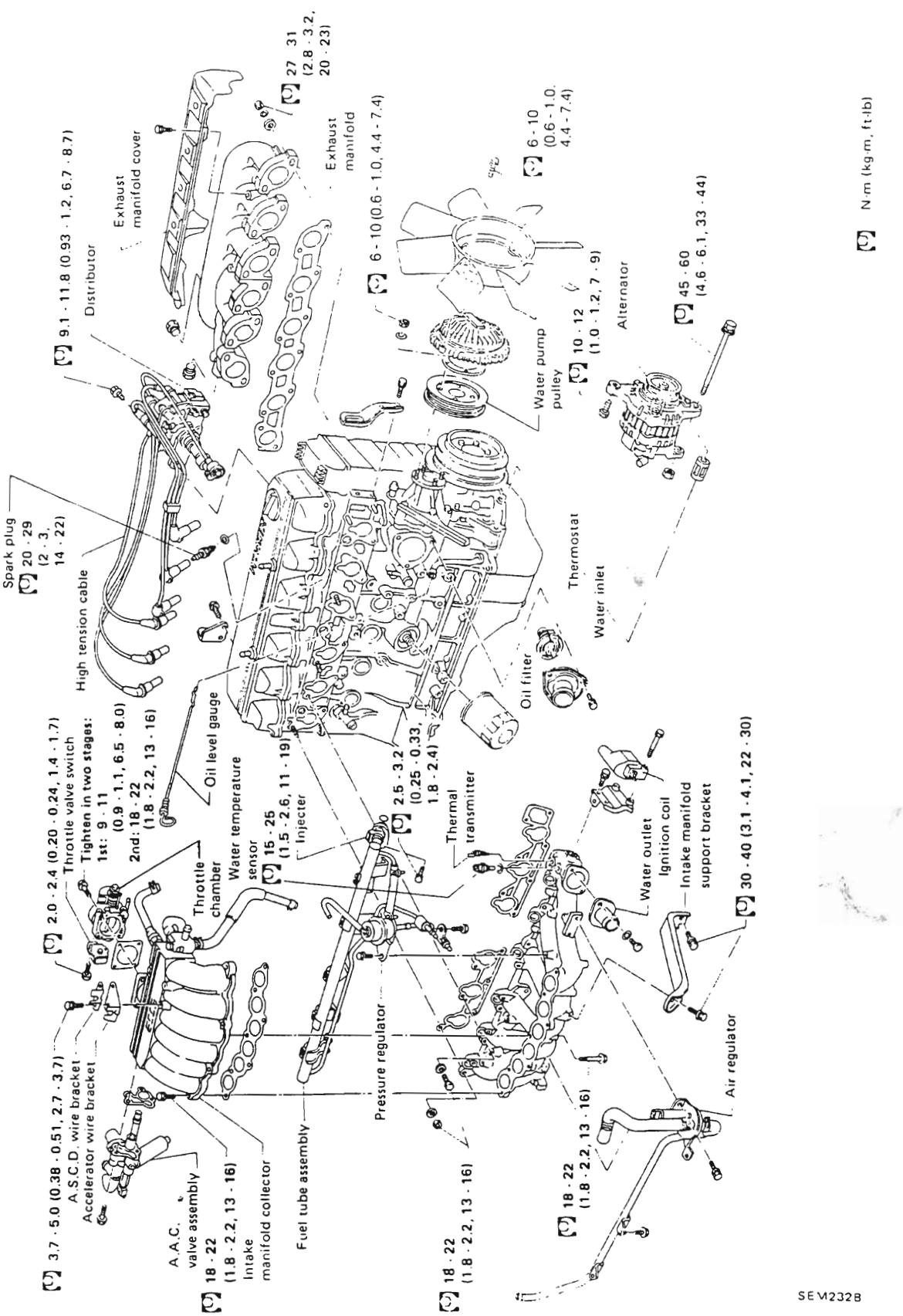
* Special tool or commercial equivalent

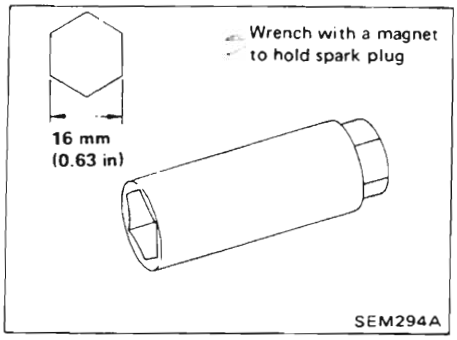
Tool number Tool name	Description	Engine application	
		CA	RB
KV10108101* Engine sub-attachment		X	–
KV10110700* Engine sub-attachment		–	X
KV101070S0 Piston pin press stand ① KV10107010 Center shaft ② ST13030020 Stand ③ ST13030030 Spring ④ KV10107020 Cap ⑤ ST13030051 Drift	 Disassembling and assembling piston with connecting rod	X	–
EM03470000* Piston ring compressor	 Installing piston assembly into cylinder bore	X	X
ST16610001* Pilot bushing puller	 Removing crankshaft pilot bushing	X	X

COMMERCIAL SERVICE TOOLS

Tool name	Description	Engine application	
		CA	RB
Spark plug wrench	 Removing and installing spark plug	X	X
Pulley holder	 Holding camshaft pulley while tightening or loosening camshaft bolt	X	X

Tool name	Description		Engine application	
			CA	RB
Valve guide drift	Intake: A = 10.5 mm (0.413 in) dia. B = 6.6 mm (0.260 in) dia. Exhaust: A = 11.5 mm (0.453 in) dia. B = 7.6 mm (0.299 in) dia. 	Removing and installing valve guide	–	X
Valve guide reamer	Intake: D_1 = 7.0 mm (0.276 in) dia. D_2 = 11.2 mm (0.441 in) dia. Exhaust: D_1 = 8.0 mm (0.315 in) dia. D_2 = 12.2 mm (0.480 in) dia. 	Reaming valve guide (①) or hole for oversize valve guide (②)	–	X
Valve seat cutter set		Finishing valve seat dimensions	X	X
Camshaft oil seal drift	A = 56 mm (2.20 in) dia. B = 44 mm (1.73 in) dia. 	Installing camshaft oil seal	–	X
Front oil seal drift	A = 56 mm (2.20 in) dia. B = 38 mm (1.50 in) dia. 	Installing front oil seal	–	X
Rear oil seal drift	A = 110 mm (4.33 in) dia. B = 46 mm (1.81 in) dia. 	Installing rear oil seal	–	X
Piston pin drift	A = 20.5 mm (0.807 in) dia. B = 11.5 mm (0.453 in) dia. 	Removing and installing piston pin	–	X
Piston ring expander		Removing and installing piston ring	X	X

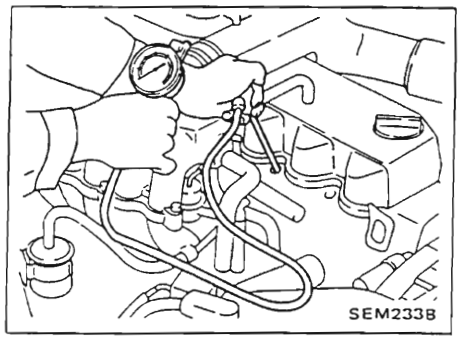

Spark plug
20 - 29 (2 - 3, 14 - 22)
9.1 - 11.8 (0.93 - 1.2, 6.7 - 8.7)
Distributor
Exhaust manifold cover
27 - 31 (2.8 - 3.2, 20 - 23)
Exhaust manifold
6 - 10 (0.6 - 1.0, 4.4 - 7.4)
6 - 10 (0.6 - 1.0, 4.4 - 7.4)
Water pump pulley
10 - 12 (1.0 - 1.2, 7 - 9)
Alternator
45 - 60 (4.6 - 6.1, 33 - 44)
High tension cable
Thermostat
Water inlet
Oil filter
Oil level gauge
2.0 - 2.4 (0.20 - 0.24, 1.4 - 1.7)
Throttle valve switch
Tighten in two stages:
1st: 9 - 11 (0.9 - 1.1, 6.5 - 8.0)
2nd: 18 - 22 (1.8 - 2.2, 13 - 16)
Throttle chamber
Water temperature sensor
15 - 25 (1.5 - 2.6, 11 - 19)
Injecter
2.5 - 3.2 (0.25 - 0.33, 1.8 - 2.4)
Thermal transmitter
Water outlet
Ignition coil
Intake manifold support bracket
30 - 40 (3.1 - 4.1, 22 - 30)
3.7 - 5.0 (0.38 - 0.51, 2.7 - 3.7)
A.S.C.D. wire bracket
Accelerator wire bracket
A.A.C. valve assembly
18 - 22 (1.8 - 2.2, 13 - 16)
Intake manifold collector
Fuel tube assembly
Pressure regulator
18 - 22 (1.8 - 2.2, 13 - 16)
18 - 22 (1.8 - 2.2, 13 - 16)
Air regulator
N·m (kg·m, ft·lb)
SEM232B



1. Warm up engine.
2. Remove all spark plugs.

Use a suitable plug wrench.

3. Disconnect distributor harness connector.



4. Attach a compression tester.
5. Depress accelerator pedal to fully open throttle.
6. Crank engine and read gauge indication of each cylinder.

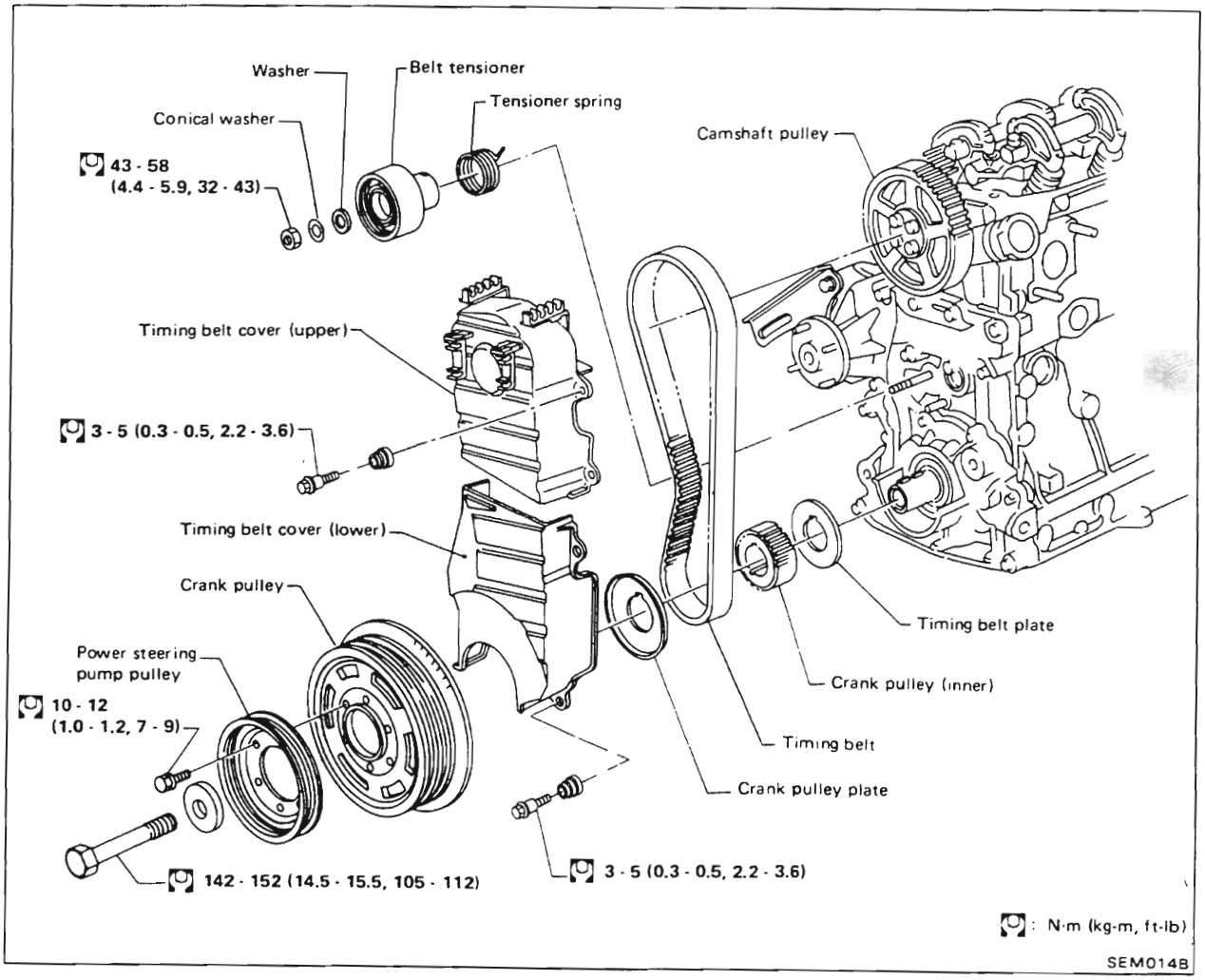
Compression pressure:
kPa (bar, kg/cm^2, psi):
Standard
1,196 (11.96, 12.2, 173) at 300 rpm
Minimum
883 (8.83, 9.0, 128)/300
Differential limit between cylinders:
kPa (bar, kg/cm^2, psi) at 300 rpm
98 (0.98, 1.0, 14)

7. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through the spark plug holes and retest compression.

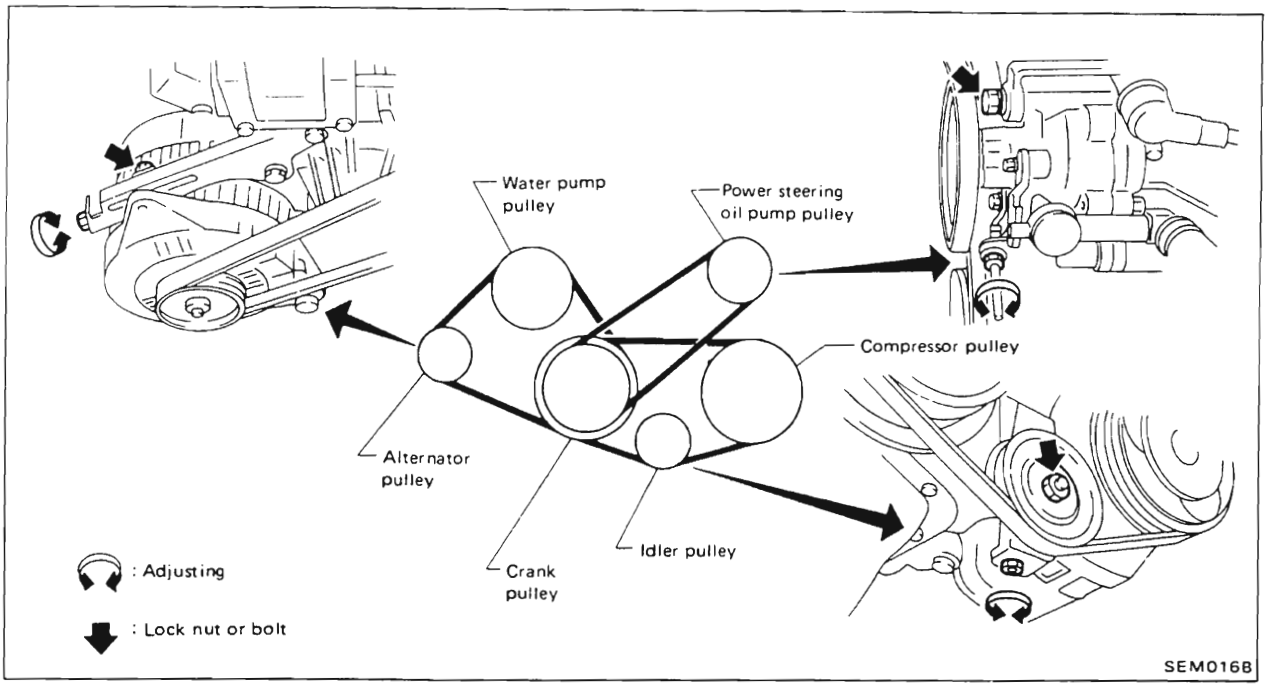
- If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
- If pressure stays low, valve may be sticking or seating improperly.
- If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasketed surface.

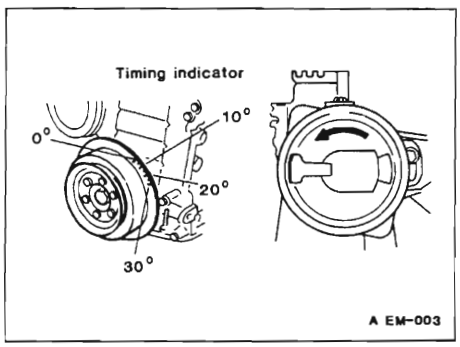
CAUTION:

a. Do not bend or twist timing belt too much.
b. After removing timing belt, do not rotate crankshaft and camshaft separately because valves will hit piston head.
c. Ensure timing belt, timing belt cam pulley, crank pulley (inner) and belt tensioner are clean and free from oil or water.
d. Before installing timing belt, confirm that No. 1 cylinder is set at T.D.C. on compression stroke.
e. Align arrow on timing belt forward.
f. Align white lines on timing belt with punch mark on cam pulley and crank pulley (inner).
g. Adjust belt tension with all spark plugs removed.

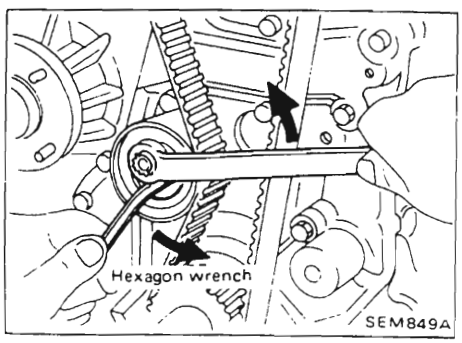


1. Remove radiator shroud, radiator, fan and pulley.
2. Remove all spark plugs.
3. Remove undercover.
4. Remove the following belts.
- Power steering drive belt
- Compressor drive belt
- Alternator drive belt





5. Set No. 6 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 1, No. 2 and No. 3 cylinders.
6. Set No. 1 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 4, No. 5 and No. 6 cylinders.
Check distributor rotor position 1-5 as shown in the figure.

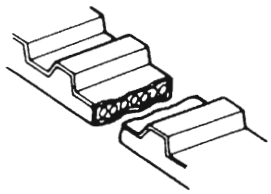
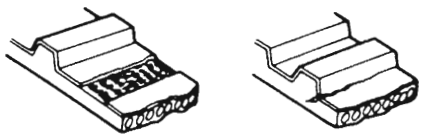
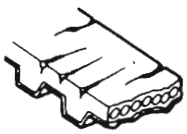


7. Remove crank pulley.
8. Remove front upper and lower belt covers.
9. Loosen tensioner lock nut and return spring, turn tensioner clockwise with hexagon wrench and temporarily tighten lock nut, then remove timing belt.

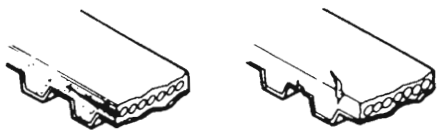
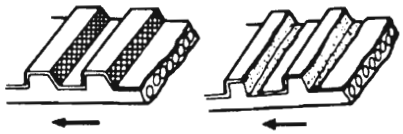
After removing timing belt, do not rotate crankshaft and camshaft separately, because valves will hit piston heads.

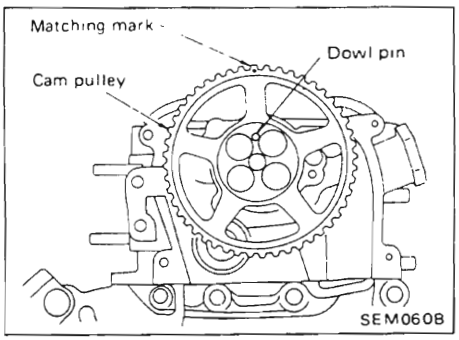
Inspection

Visually check the condition of the timing belt.
Replace if any abnormality is found.

Item to check	Problem	Cause
Belt is broken.	 SEM393A	• Improper handling • Poor belt cover sealing • Coolant leakage at water pump
Tooth is broken/ tooth root is cracked.	 SEM394A	• Camshaft jamming • Distributor jamming • Oil leakage at camshaft/crankshaft oil seal
Back surface is cracked/worn.	 SEM395A	• Tensioner jamming • Overheated engine • Interference with belt cover

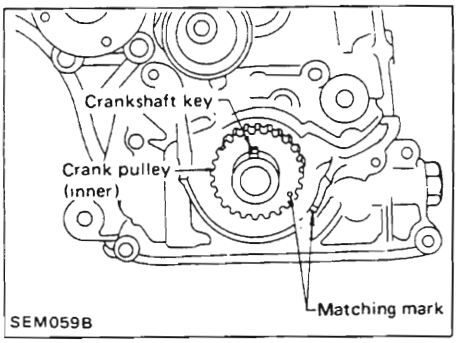
Inspection (Cont'd)

Item to check	Problem	Cause
Side surface is worn.	 • Side surface of belt is worn to such an extent as original trace of its cut is unclear. • Belt corners are worn and round. • Wicks are frayed and coming out. SEM396A	• Improper installation of belt • Malfunctioning crank pulley plate/timing belt plate
Teeth are worn.	 • Canvas on tooth face is worn down. • Canvas on tooth is fluffy, rubber layer is worn down and faded white, or canvas texture is unclear. SEM397A	• Poor belt cover sealing • Coolant leakage at water pump • Camshaft not functioning properly • Distributor not functioning properly • Excessive belt tension
Oil/Coolant or water is stuck to belt.		• Poor oil sealing of each oil seal • Coolant leakage at water pump • Poor belt cover sealing

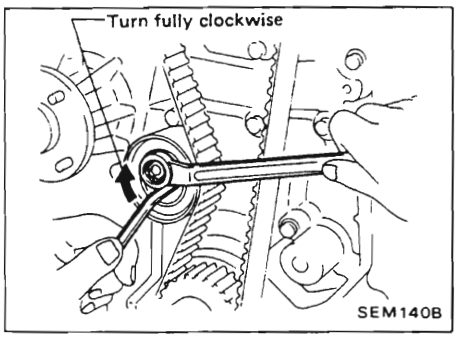


1. Confirm the No. 1 cylinder is set at T.D.C. on its compression stroke as follows.

(1) Confirm that camshaft dowel pin is at the top.

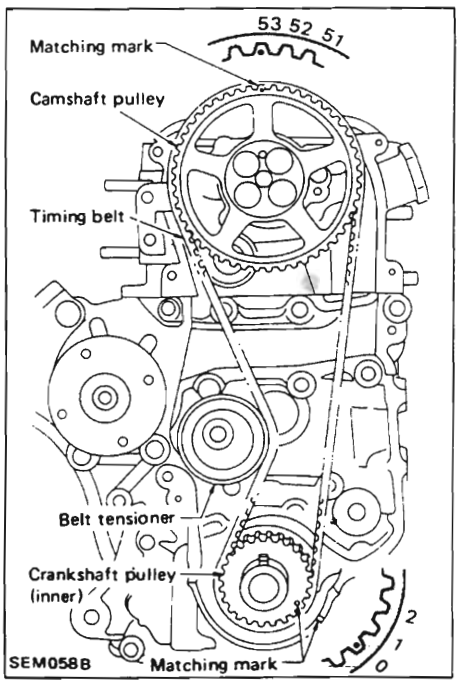


(2) Confirm that crankshaft key is at the top.



2. Turn tensioner fully clockwise with hexagon wrench and temporarily tighten lock nut.
3. Remove rocker cover and loosen all rocker shaft securing bolts.

Loosen all rocker shaft securing bolts thoroughly so that timing belt tension can be adjusted correctly. Otherwise, proper belt tension cannot be obtained.

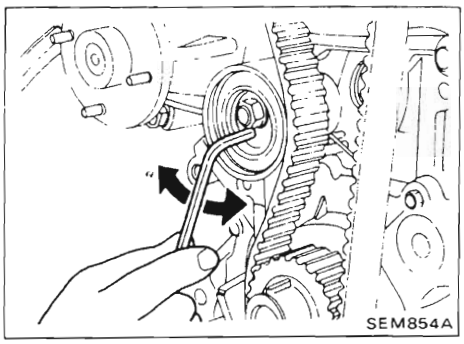


4. Set timing belt.

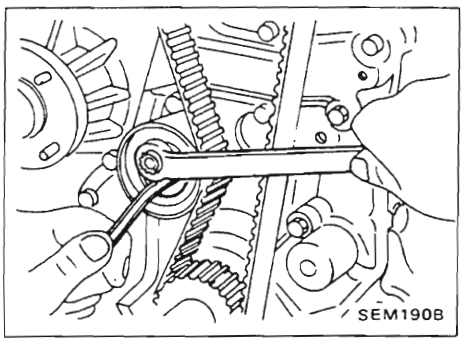
a. **Ensure timing belt and pulley are clean and free from oil or water. Do not bend.**

b. **Align white lines on timing belt with matching mark on cam pulley and crank pulley (inner).**

After setting timing belt, ensure there are 53 belt cogs between matching marks on cam pulley and crank pulley (inner).

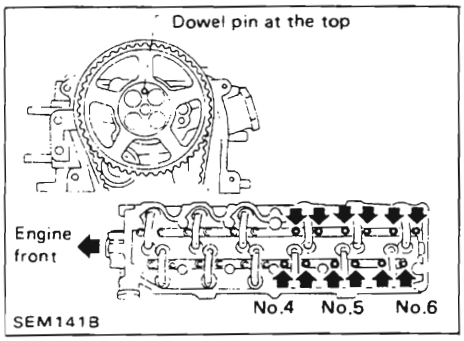


5. Adjust belt tension.
Slowly turn tensioner with hexagon wrench clockwise and counterclockwise two or three times.



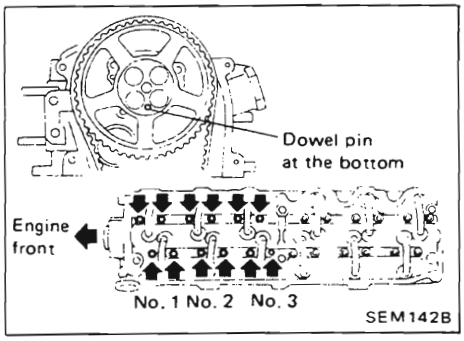
6. Tighten tensioner lock nut.
   ⟲ : **43 - 58 N·m**
   (4.4 - 5.9 kg-m, 32 - 43 ft-lb)

- **Hold hexagon wrench while tightening lock nut to prevent tensioner from moving. Otherwise, correct belt tension cannot be obtained.**

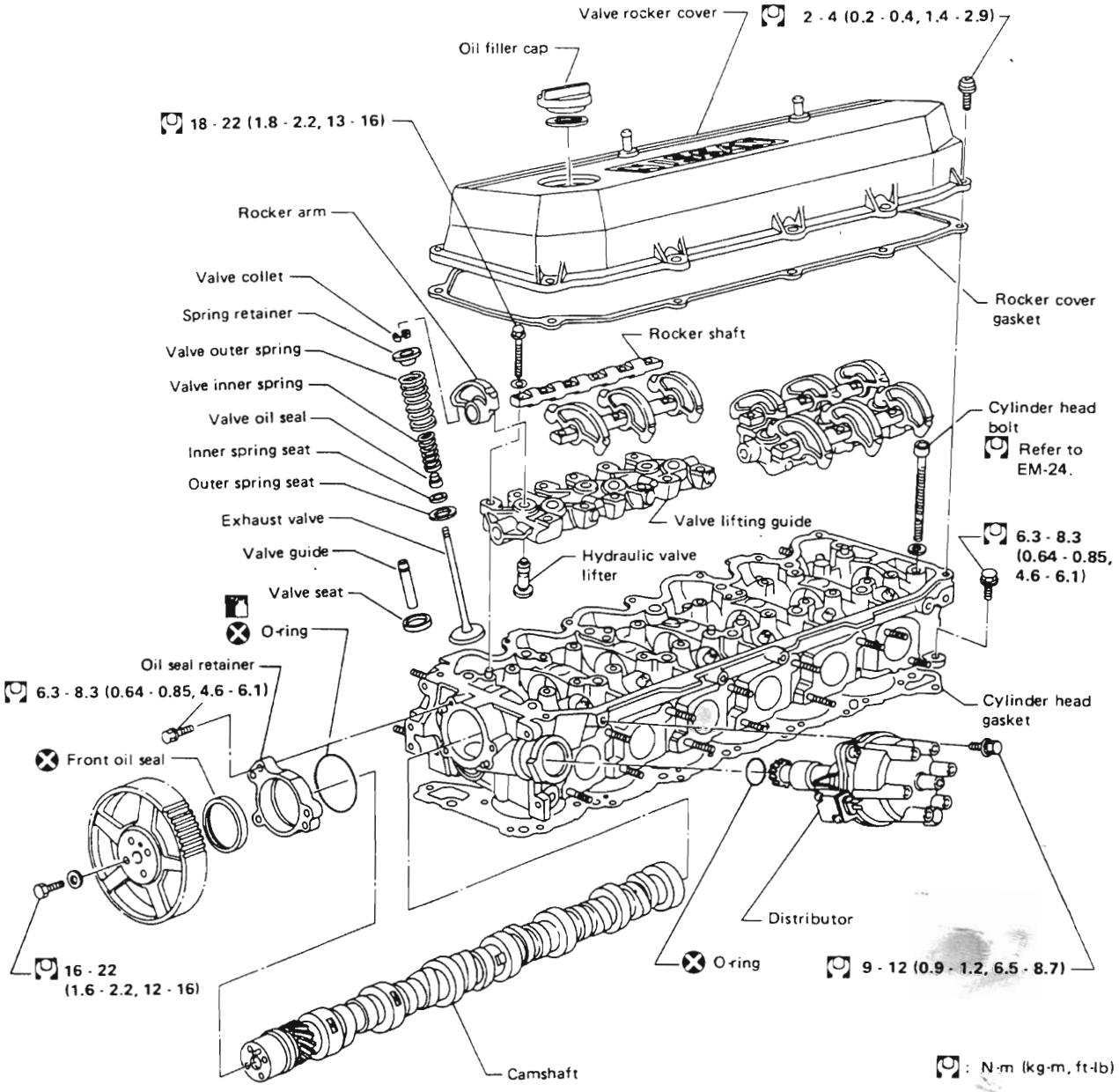


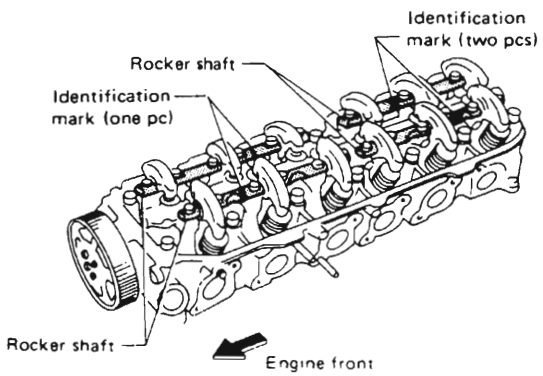
7. Tighten rocker shaft securing bolts in two or three stages.
   ⟲ : **18 - 22 N·m**
   (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

(1) Set No. 1 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 4, No. 5 and No. 6 cylinders.



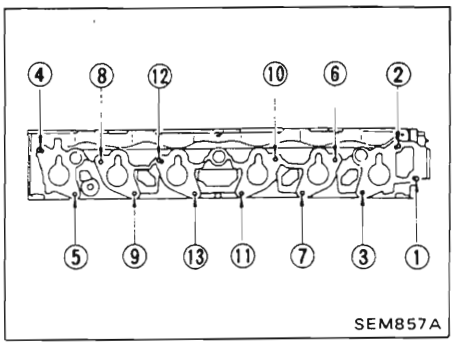
(2) Set No. 6 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 1, No. 2 and No. 3 cylinders.


Valve rocker cover
2 - 4 (0.2 - 0.4, 1.4 - 2.9)
Oil filler cap
18 - 22 (1.8 - 2.2, 13 - 16)
Rocker arm
Valve collet
Spring retainer
Valve outer spring
Valve inner spring
Valve oil seal
Inner spring seat
Outer spring seat
Exhaust valve
Valve guide
Valve seat
O-ring
Oil seal retainer
6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)
Front oil seal
16 - 22 (1.6 - 2.2, 12 - 16)
Rocker cover gasket
Rocker shaft
Cylinder head bolt
Refer to EM-24.
Valve lifting guide
Hydraulic valve lifter
6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)
Cylinder head gasket
Distributor
O-ring
9 - 12 (0.9 - 1.2, 6.5 - 8.7)
Camshaft
: N·m (kg-m, ft-lb)
SEM769A


Identification mark (two pcs)
Rocker shaft
Identification mark (one pc)
Rocker shaft
Engine front
SEM062B

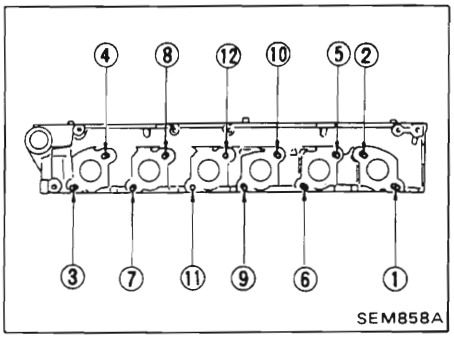
1. Remove timing belt.
   Set No. 1 cylinder at T.D.C. on its compression stroke. Refer to "TIMING BELT-Removal".

After removing timing belt, do not rotate crankshaft and camshaft separately, because valves will hit piston heads.

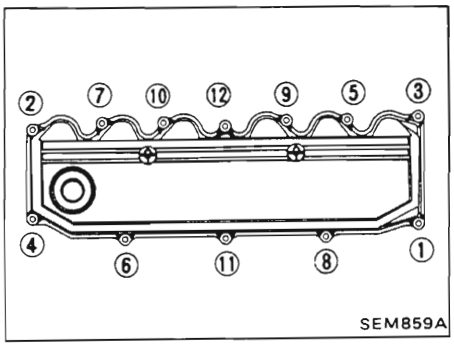


2. Remove air cleaner.
3. Disconnect vacuum hoses, water hoses and fuel hose.
4. Remove intake manifold.
   Remove intake manifold securing bolts/nuts in numerical order shown in figure.
   To install manifold, tighten bolts/nuts in reverse order of removal. Tighten in two or three stages.

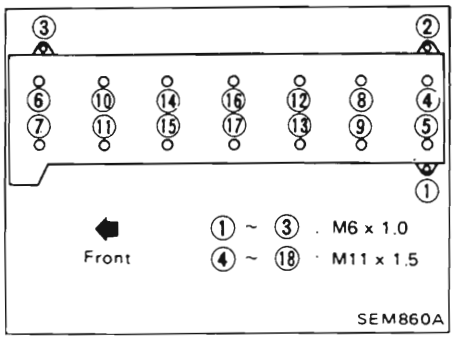
Before removing intake manifold, be sure to drain coolant by removing drain plug on cylinder block.



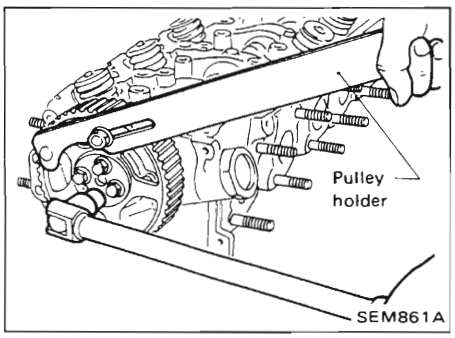
5. Remove exhaust manifold.
   Remove exhaust manifold securing bolts/nuts in numerical order shown in figure.
   To install manifold, tighten bolts/nuts in reverse order of removal. Tighten in two or three stages.



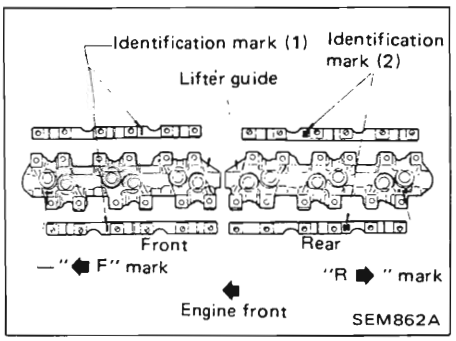
6. Remove rocker cover.
   Remove rocker cover securing bolts/nuts in numerical order shown in figure.
   To install rocker cover, tighten bolts/nuts in reverse order of removal. Tighten in two or three stages.



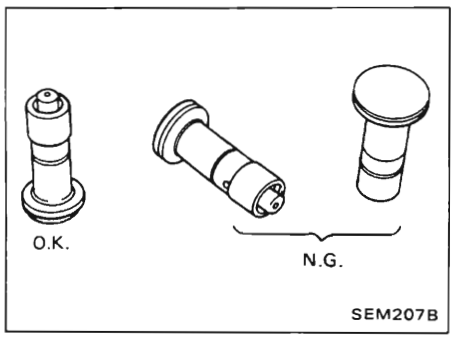
7. Remove cylinder head.
   Head warpage or cracking could result from removing in incorrect order.



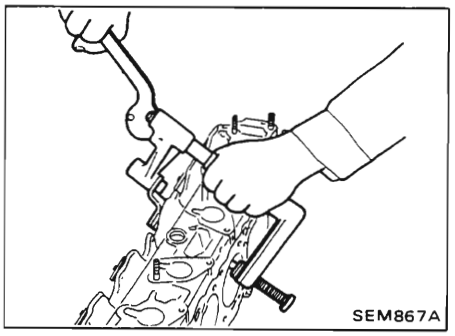
1. Remove camshaft pulley.



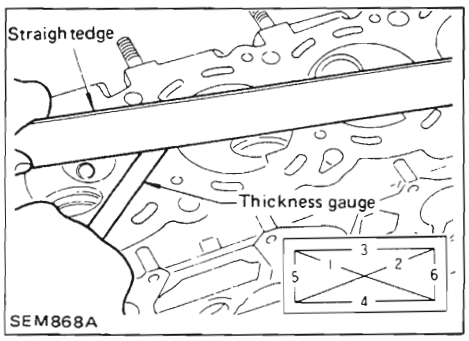
2. Remove rocker shafts with rocker arms.
The bolts should be loosened in two or three stages.



3. Remove hydraulic valve lifters and lifter guide.
   a. **Do not disassemble hydraulic valve lifter.**
   b. **Take care not to drop hydraulic valve lifters from lifter guides.**
   c. **Do not put hydraulic valve lifters upside down, otherwise air will enter valve lifter, causing it to make a noise.**
   d. **Attach tags to valve lifters so as not to mix them up.**
   e. **If valve lifters are to be left for a long time, submerge in engine oil to prevent air entering lifters.**
4. Loosen camshaft retainer bolts.
5. Remove camshaft with camshaft retainer and oil seal from front side.



6. Remove valve component parts.



CYLINDER HEAD DISTORTION

Warpage of surface

Less than 0.2 mm (0.008 in)

If beyond the specified limit, replace it or resurface it.

Resurfacing limit:

The resurfacing limit of cylinder head is determined by the cylinder block resurfacing in an engine.

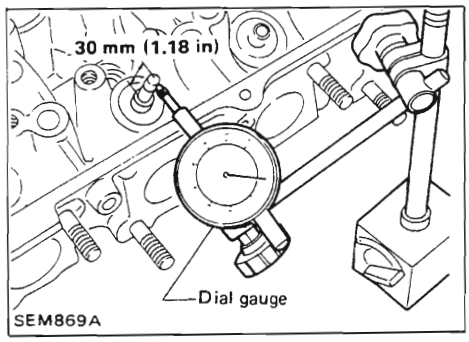
Amount of cylinder head resurfacing is "A"

Amount of cylinder block resurfacing is "B"

The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

After resurfacing the cylinder head, check that camshaft rotates freely by hand. If resistance is felt, the cylinder head must be replaced.



VALVE GUIDE CLEARANCE

- **Valve guide clearance should be measured parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)**

Stem to guide clearance:

Maximum limit

0.10 mm (0.0039 in)

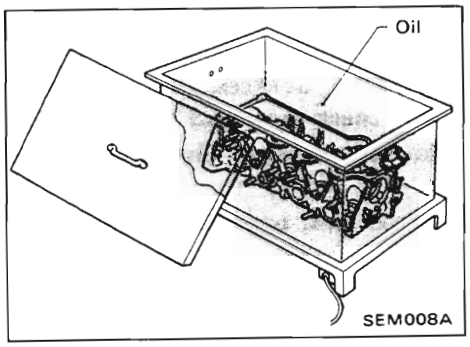
Maximum allowable deflection

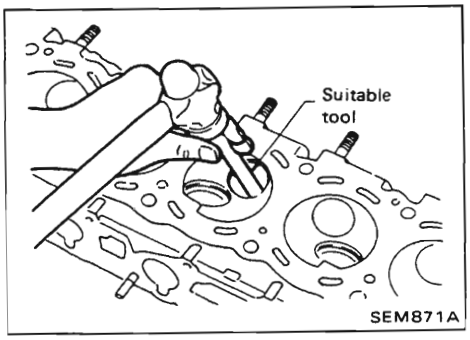
(Dial indicator reading)

0.2 mm (0.008 in)

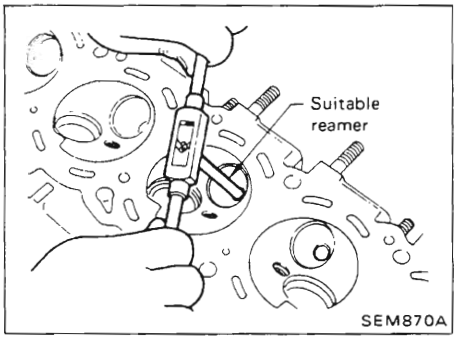
VALVE GUIDE REPLACEMENT

1. To remove valve guide, heat cylinder head to 150 to 160°C (302 to 320°F).

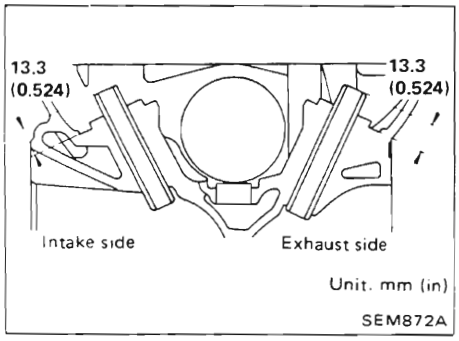




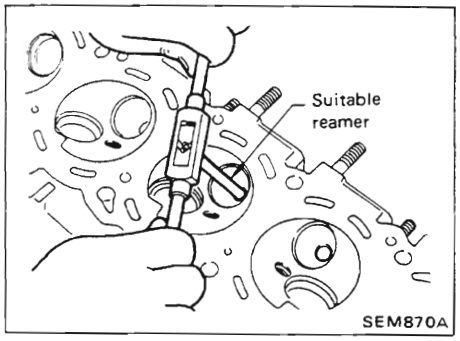
2. Remove valve guide with a press [under a 20 kN(2 t, 2.2 US ton, 2.0 Imp ton) pressure] or a hammer and suitable tool.



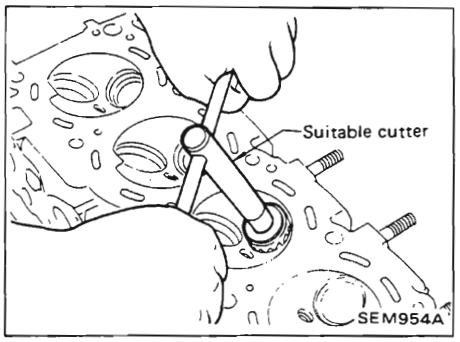
3. Ream cylinder head valve guide hole.
   Valve guide hole inner diameter
   [for 0.2 mm (0.008 in) oversize] :
   Intake:
   11.175 - 11.196 mm (0.4400 - 0.4408 in)
   Exhaust:
   12.175 - 12.196 mm (0.4793 - 0.4802 in)



4. Heat cylinder head to 150 to 160°C (302 to 320°F) and press service valve guide onto cylinder head.



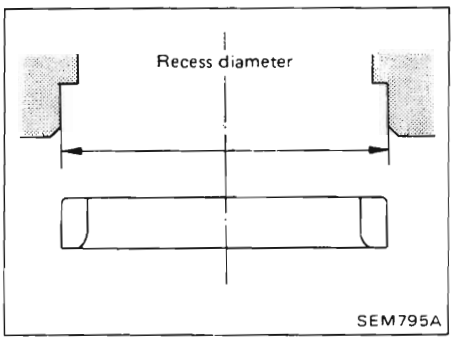
5. Ream valve guide.
   Finished size:
   Intake:
   7.000 - 7.018 mm (0.2756 - 0.2763 in)
   Exhaust:
   8.000 - 8.011 mm (0.3150 - 0.3154 in)



VALVE SEATS

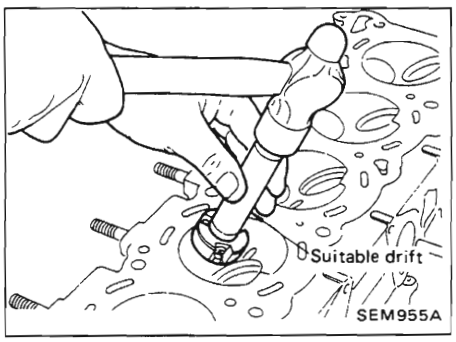
Check valve seats for any evidence of pitting at valve contact surface, and reseat or replace if worn excessively.

- When repairing valve seats, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.
- The cutting should be done with both hands for uniform cutting.

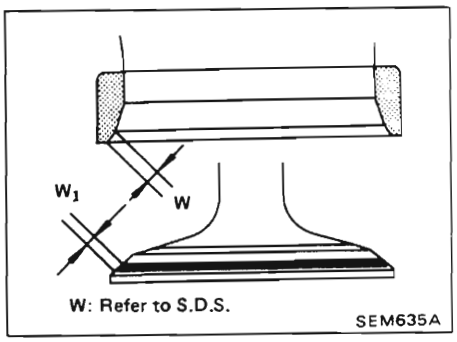


REPLACING VALVE SEAT FOR SERVICE PARTS

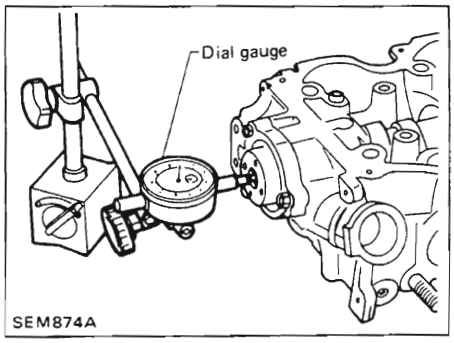
1. Bore out old seat until it collapses.
   The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream the cylinder head recess.
   Reaming bore for service valve seat (Oversize [0.5 mm (0.020 in)]):
   Intake:
   43.500 - 43.516 mm (1.7126 - 1.7132 in)
   Exhaust:
   37.500 - 37.516 mm (1.4764 - 1.4770 in)



3. Heat cylinder head to a temperature of 150 to 160°C (302 to 320°F) and press fit seat until it bottoms in the recess.



4. Cut or grind valve seat using suitable tool at the specified dimensions as shown in S.D.S.
5. After cutting, lap valve seat with a lapping compound.
6. Check contact condition of valve seat.



CAMSHAFT VISUAL CHECK

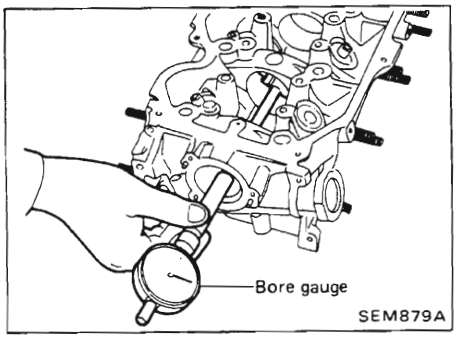
Check camshaft for scratches, seizure and wear.

CAMSHAFT END PLAY

1. Install camshaft and locate plate in cylinder head.
2. Measure camshaft end play.

Camshaft end play:

0.030 - 0.060 mm (0.0012 - 0.0024 in)

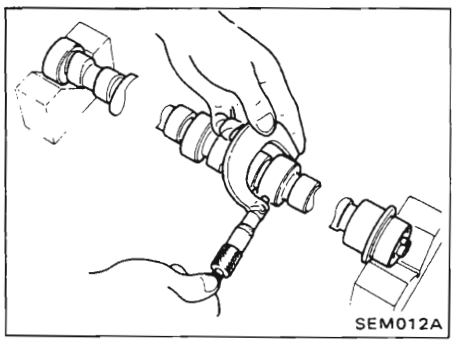


CAMSHAFT JOURNAL CLEARANCE

1. Measure the inner diameter of camshaft bearing.

Standard inner diameter:

No. 1 - No. 6	No. 7
47.000 - 47.025 mm (1.8504 1.8514 in)	46.500 - 46.525 mm (1.8307 - 1.8317 in)



2. Measure the outer diameter of camshaft journal.

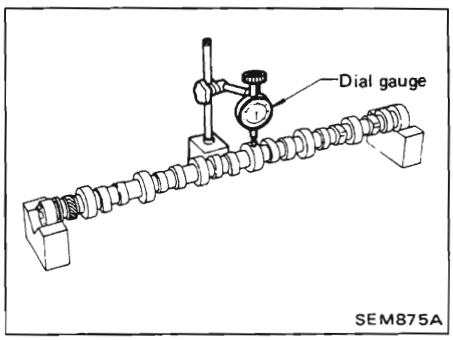
Standard outer diameter:

No. 1, 2, 3, 4, 5, 6	No. 7
46.935 - 46.955 mm (1.8478 - 1.8486 in)	46.415 - 46.435 mm (1.8274 - 1.8281 in)

If the clearance is greater than the maximum, replace camshaft and/or cylinder head.

Maximum clearance:

No. 1, 2, 3, 4, 5, 6	No. 7
0.090 mm (0.0035 in)	0.110 mm (0.0043 in)

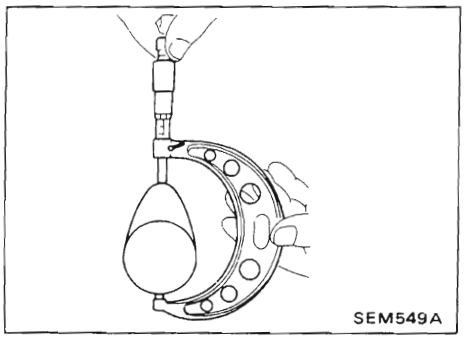


CAMSHAFT RUNOUT

Camshaft runout [T.I.R. (Total Indicator Reading)]

Limit 0.02 mm (0.0008 in)

If beyond the limit, replace.

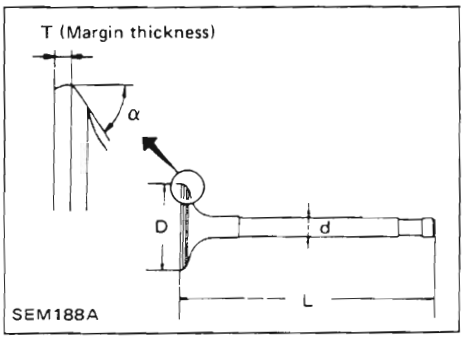

SEM549A

CAMSHAFT CAM HEIGHT

Standard cam height:
39.337 mm (1.5487 in)

Cam wear:
Limit 0.2 mm (0.008 in)

If wear is beyond the limit, replace.



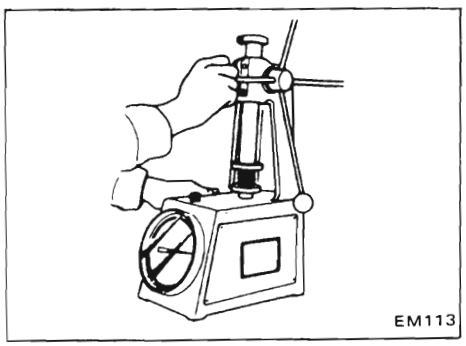
SEM188A

VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to S.D.S.

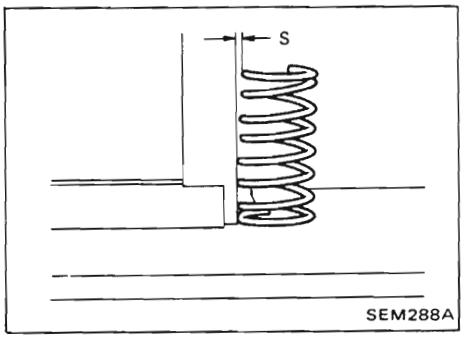
When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace the valve.

Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.


EM113

VALVE SPRING PRESSURE LOAD

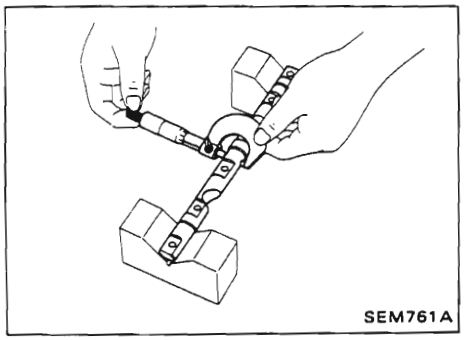
Refer to S.D.S.



SEM288A

VALVE SPRING SQUARENESS

Out of square:
Outer
Less than 2.2 mm (0.087 in)
Inner
Less than 1.9 mm (0.075 in)

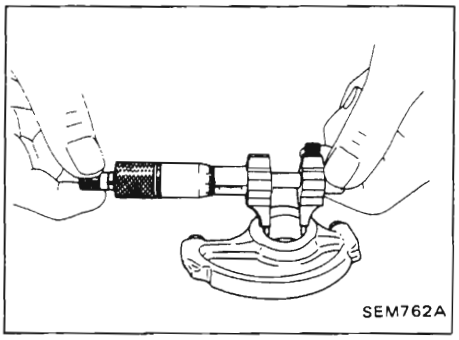

SEM761A

ROCKER SHAFT AND ROCKER ARM

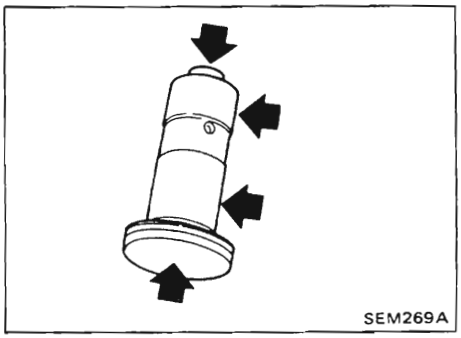
1. Check rocker shafts and rocker arms for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

Diameter:
17.979 - 18.000 mm (0.7078 - 0.7087 in)

Rocker arm to shaft clearance:
0.007 - 0.049 mm (0.0003 - 0.0019 in)

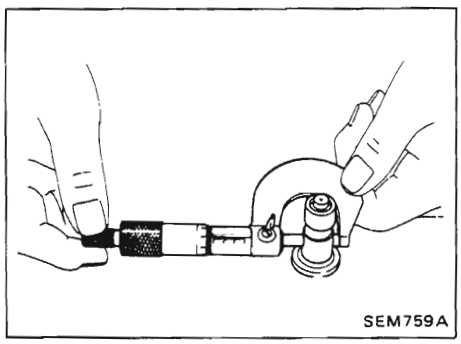

SEM762A

3. Check inner diameter of rocker arm.
   Diameter:
   18.007 - 18.028 mm (0.7089 - 0.7098 in)

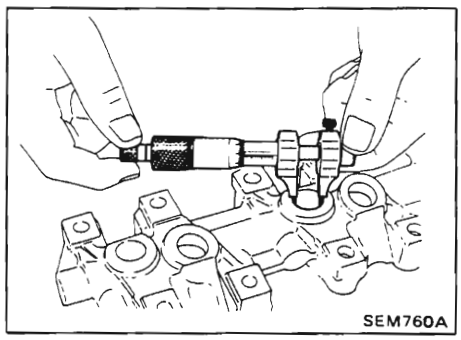

SEM269A

HYDRAULIC VALVE LIFTER

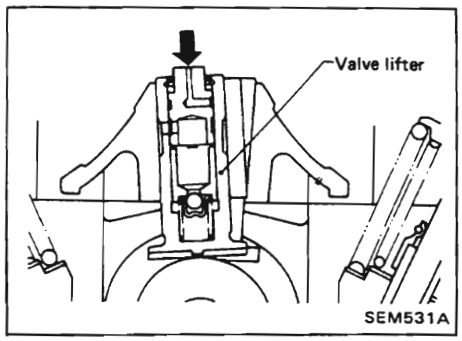
1. Check contact and sliding surfaces for wear or scratches.


SEM759A

2. Check diameter of a valve lifter.
   Outer diameter:
   15.947 - 15.957 mm (0.6278 - 0.6282 in)


SEM760A

3. Check valve lifter guide bore.
   Bore diameter:
   16.000 - 16.013 mm (0.6299 - 0.6304 in)
   Standard clearance:
   0.043 - 0.066 mm (0.0017 - 0.0026 in)



SEM531A

If valve lifters are noisy, check valve lifter.

(1) Depress plunger forcibly with your finger.

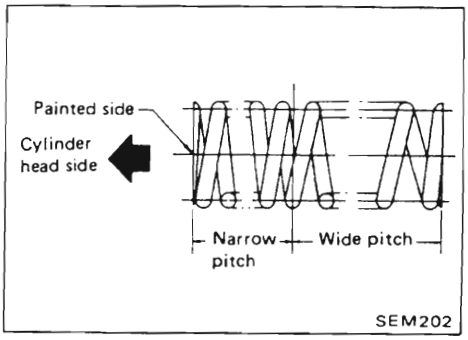
If it moves about 1 mm (0.04 in), it indicates air is inside valve lifter.

(2) Re-install rocker arm and rocker cover.

(3) Bleed air by running engine at 1,000 rpm under no-load for about 10 minutes.

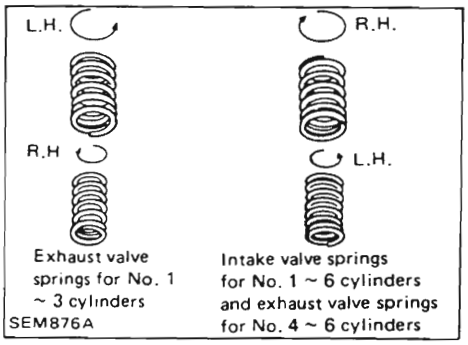
(4) Next, remove rocker cover and rocker arm and check to ensure all air is bled. (Refer to step (1) above.)

(5) If there is still air, replace valve lifter.



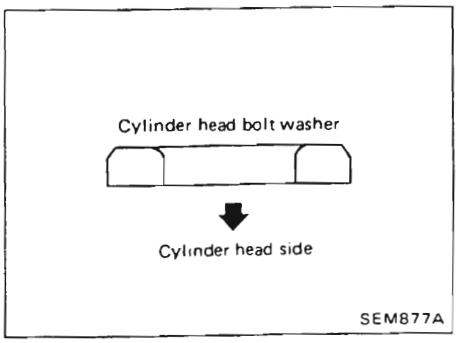
When installing valve component parts, observe the following:

- Always use new valve oil seal. (Refer to OIL SEAL REPLACEMENT.)
- Before installing valve oil seal, install inner valve spring seat.
- **Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.**



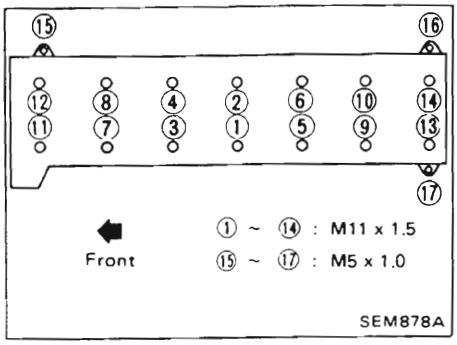
- Exhaust valve springs for No. 1, No. 2 and No. 3 cylinders differ from other springs in the "direction of winding", as indicated in the table below.

		Direction of winding	Identification color
Exhaust valve springs for No. 1 through 3 cylinders	Inner	R.H.	Pink
	Outer	L.H.	Green
Other	Inner	L.H.	Blue
	Outer	R.H.	White



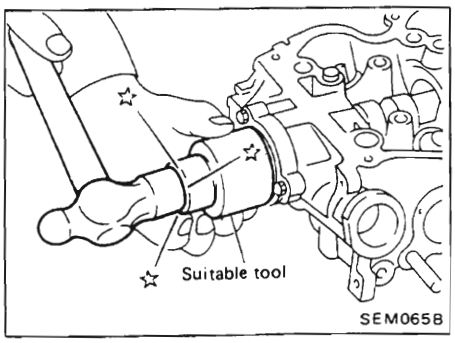
1. Install cylinder head with new gasket.
- **Be sure to install washers between bolts and head.**

Do not rotate crankshaft and camshaft separately, because valves will hit piston heads.

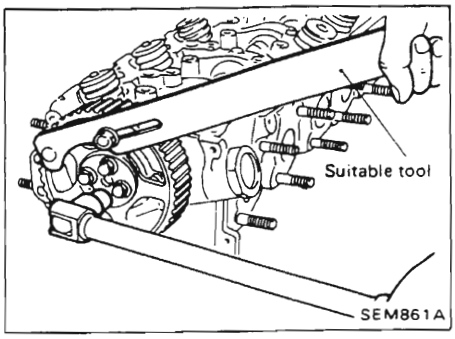


2. Apply oil to the thread portion and seat surface of bolts and tighten cylinder head bolts with washers.
- **Tightening procedure.**

1st **Tighten both 1-14 to 29 N-m (3.0 kg-m, 22 ft-lb).**
2nd **Tighten both 1-14 to 78 N-m (8.0 kg-m, 58 ft-lb).**
3rd **Loosen both 1-14 completely.**
4th **Tighten both 1-14 to 29 N-m (3.0 kg-m, 22 ft-lb).**
5th **Using an angle gauge turn bolts 1 - 14 100 to 105 deg. clockwise.**
6th **Tighten bolts 15-17 to 6.3-8.3 N-m (0.64-0.85 kg-m, 4.6-6.1 ft-lb).**

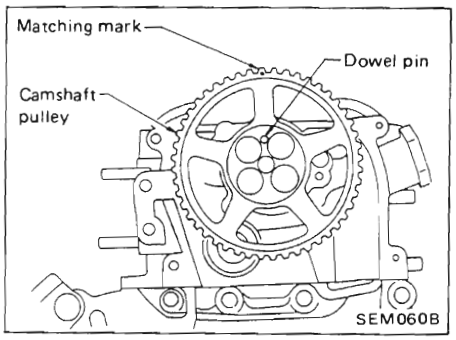


3. Install camshaft, camshaft retainer and camshaft front oil seal.
- Drive oil seal into place using a 41 mm diameter drift until it is flush with front surface of oil seal retainer.
  Be careful not to scratch or pinch periphery of oil seal.

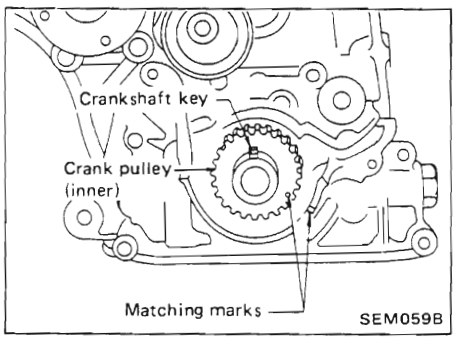


4. Install camshaft pulley.

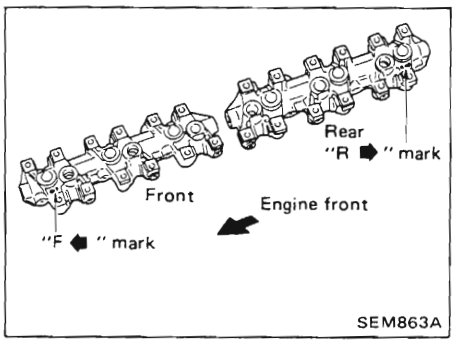
: **Camshaft pulley bolt:**
16 - 22 N·m
(1.6 - 2.2 kg-m, 12 - 16 ft-lb)
Camshaft retainer bolt:
7 - 8 N·m
(0.7 - 0.8 kg-m, 5.1 - 5.8 ft-lb)



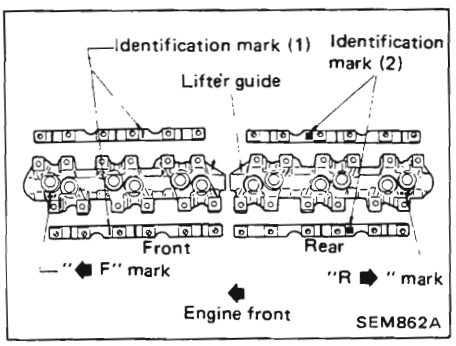
5. Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke as follows:
(1) Check camshaft dowel pin at the top.



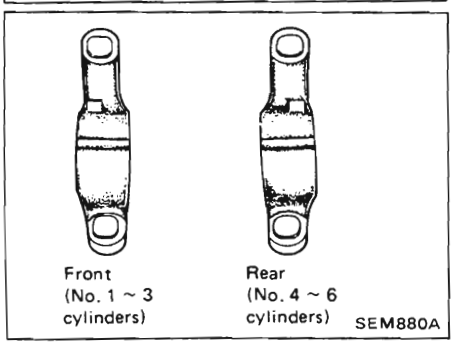
(2) Check crankshaft key at the top.

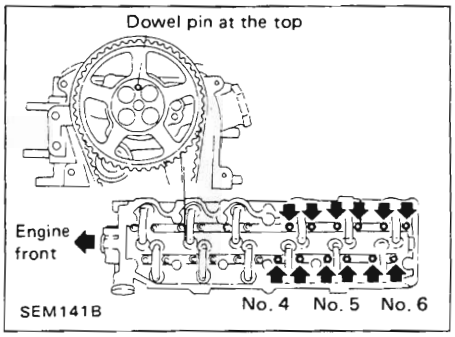


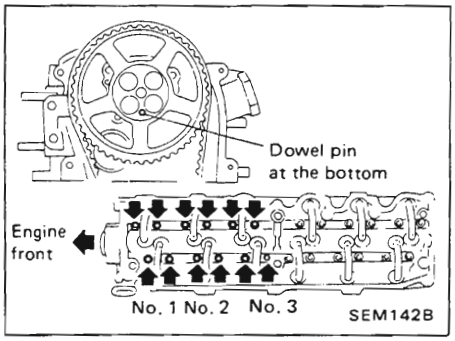
6. Install timing belt and adjust belt tension.
7. Install front upper and lower belt covers.
Refer to "TIMING BELT-Installation".
8. Install valve lifters and lifter guide.
Assemble valve lifters to their original position and take care not to drop lifters from lifter guide.



9. Install rocker shafts with rocker arms.







Tighten rocker shaft securing bolts in two or three stages.

[O] : 18 - 22 N·m
(1.8 - 2.2 kg-m, 13 - 16 ft-lb)

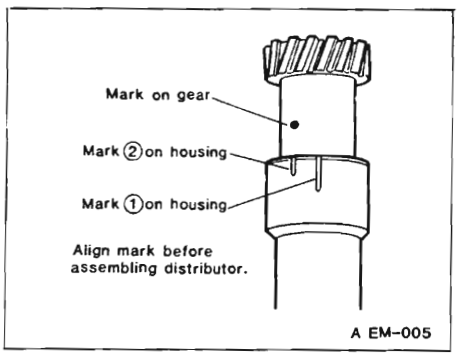
- When tightening, set camshaft lobe at the position where lobe is not lifted:

(1) Set No. 1 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 4, No. 5 and No. 6 cylinders.

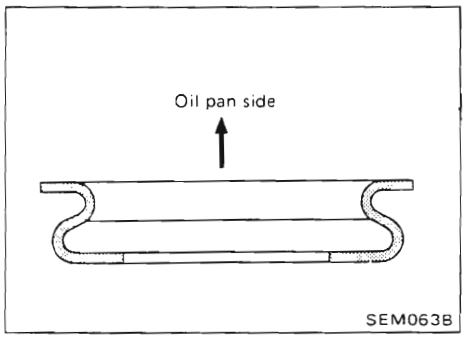
(2) Set No. 6 piston at T.D.C. on compression stroke and tighten rocker shaft bolts for No. 1, No. 2 and No. 3 cylinders.

10. Install intake and exhaust manifolds.
Refer to "Cylinder Head Removal" for tightening order of manifold bolts/nuts.

[O] : Intake manifold:
18 - 22 N·m
(1.8 - 2.2 kg-m, 13 - 16 ft-lb)
Exhaust manifold:
27 - 31 N·m
(2.8 - 3.2 kg-m, 20 - 23 ft-lb)



11. Install distributor.
Set the distributor gear position.
(Be sure mark (2) (⌴) on housing is aligned with mark on gear.)

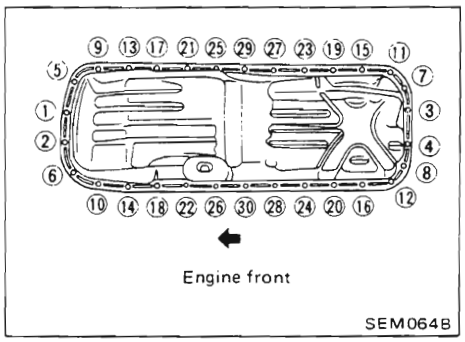


Removal

1. Drain engine oil.

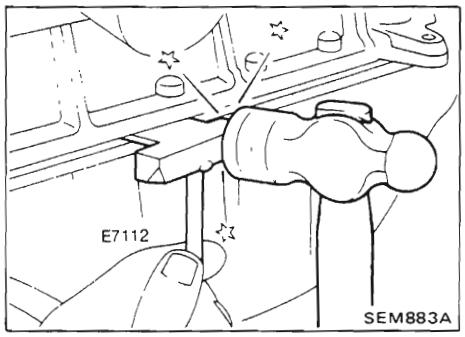
- Discard oil drain plug washer and install a new one.
- When installing drain plug washer, ensure it faces in correct direction.
- Drain plug tightening torque.

  29 - 39 N·m (3.0 - 4.0 kg-m, 22 - 29 ft-lb)



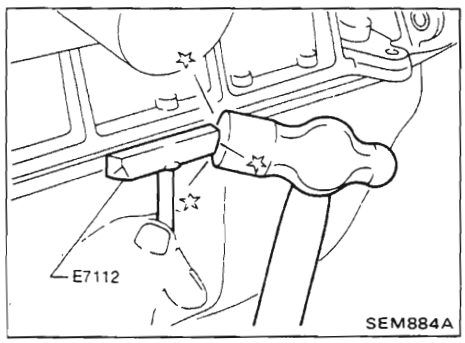
2. Remove engine gussets and oil pan.

- Remove bolts/nuts in numerical order shown in figure.
- Install bolts/nuts in reverse order of removal.

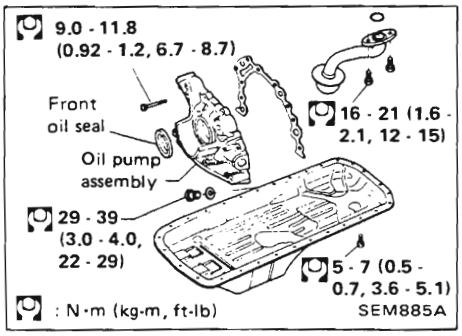


(1) Drive seal cutter (special tool) No into space between cylinder block and oil pan.

- **Do not drive seal cutter into oil pump or rear oil seal retainer portion, or aluminum mating face will be damaged.**
- **Do not use screwdriver, or oil pan flange will be deformed.**



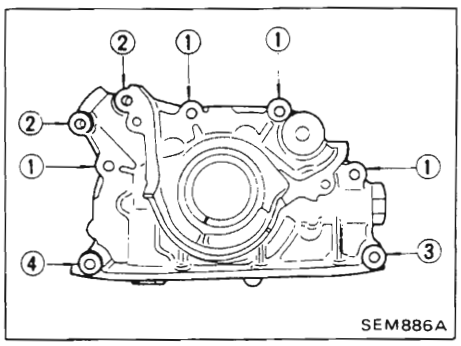
(2) Cut along seal by striking side of seal cutter until seal is broken and oil pan comes free.



3. Remove timing belt.
4. Remove oil pump assembly.

Inspection

Refer to section LC.



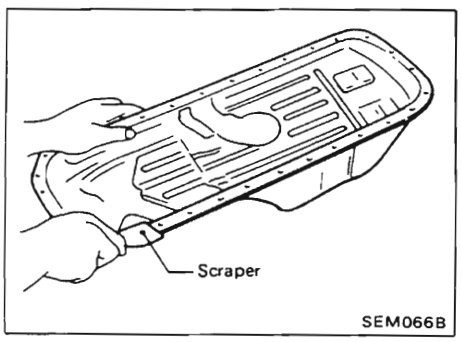
Installation

Always install with new oil seal.

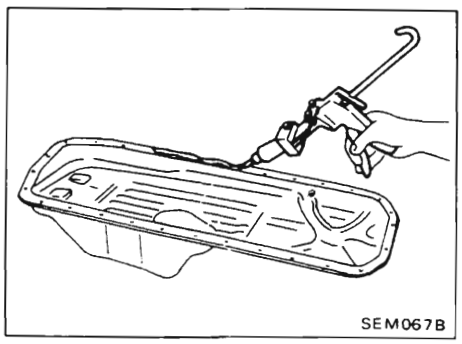
1. Install oil pump assembly.

Location	Bolt size	Length mm (in)
①	M6 x 1.0 (7T)	20 (0.79)
②	M6 x 1.0 (7T)	35 (1.38)
③	M6 x 1.0 (7T)	45 (1.77)
④	M6 x 1.0 (7T)	55 (2.17)

: 9.0 - 11.8 N·m (0.92 - 1.2 kg-m, 6.7 - 8.7 ft-lb)

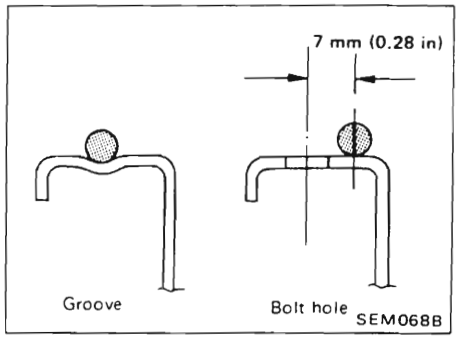


2. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper.
- Also remove traces of liquid gasket from mating surface of cylinder block.
- Check that oil pan flange is flat and matches mating surface of block.



3. Apply a continuous bead of liquid gasket to mating surface of oil pan.
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.

Installation (Cont'd)

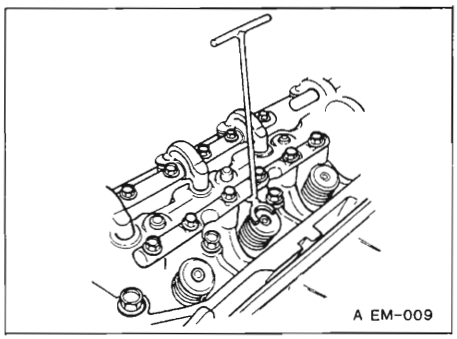


4. At each bolt hole apply liquid gasket to inner sealing surface of pan.

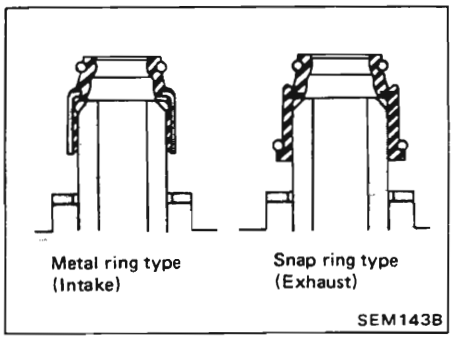
VALVE OIL SEAL

1. Remove rocker cover.
2. Remove rocker shaft assembly and valve lifters with valve lifter guide.
3. Remove spark plugs and install air hose adapter into spark plug hole and apply air pressure to hold valves in place [Apply pressure of 490 kPa (4.9 bar, 5 kg/cm^2, 71 psi)].

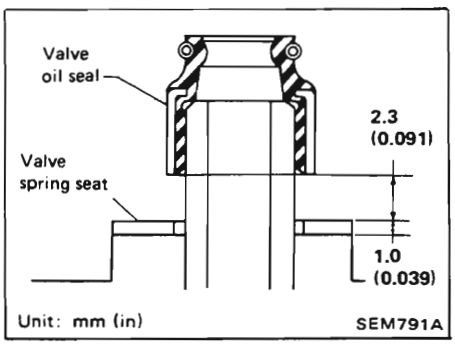
When performing this operation piston should be set at T.D.C.



4. Remove valve springs and valve oil seals.

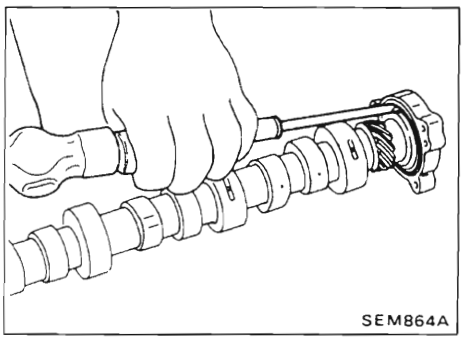


- Intake valve oil seals have metal ring, press-fit designs. Exhaust valve oil seals are snap ring retention type.



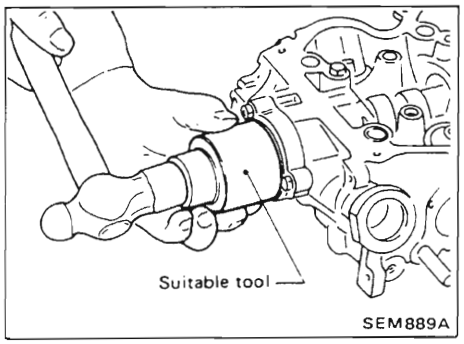
5. Apply engine oil to valve oil seal and install it in place.

- **Before installing valve oil seal, install inner valve spring seat.**
- **Use tool when installing intake valve oil seal (metal ring type).**
- **When installing exhaust valve oil seal, do not use tool. Push it by hand.**
- **Do not reuse valve oil seal.**


SEM864A

CAMSHAFT OIL SEAL

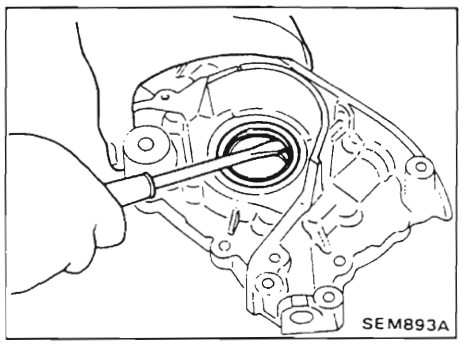
1. Remove timing belt.
2. Remove camshaft pulleys.
3. Remove camshaft.
4. Remove camshaft oil seal.



5. Apply engine oil to camshaft oil seal and install it in place. Using a 41 mm drift, drive oil seal until it is flush with oil seal retainer.

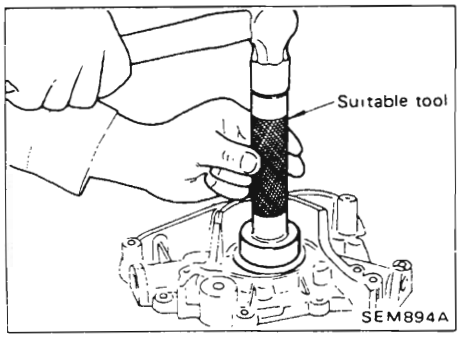
Do not drive oil seal in too far; otherwise it will block oil return hole in oil seal retainer.

6. Install camshaft pulley.
7. Install timing belt.

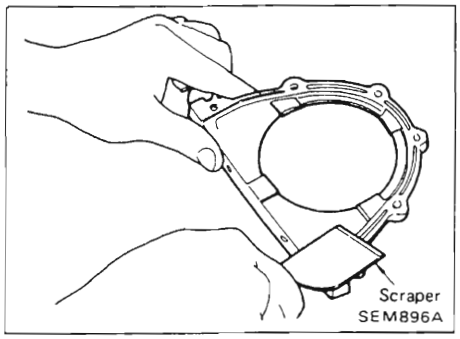

SEM893A

FRONT OIL SEAL

1. Remove oil pump assembly.
2. Remove front oil seal.

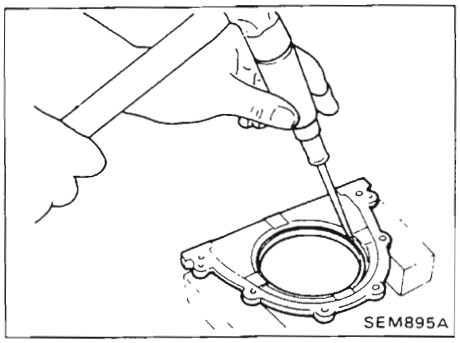


3. Apply engine oil to oil seal and install it in place.

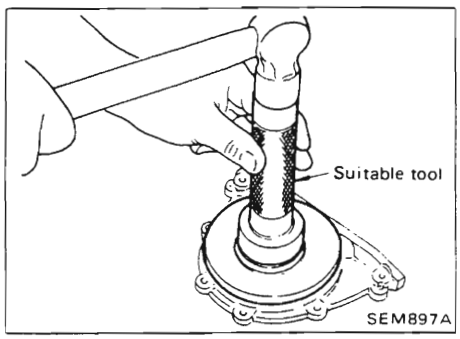


REAR OIL SEAL

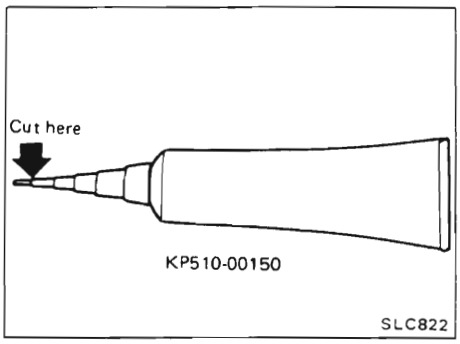
1. Remove flywheel and rear oil seal retainer.
2. Remove traces of liquid gasket using a scraper.



3. Remove rear oil seal from retainer.

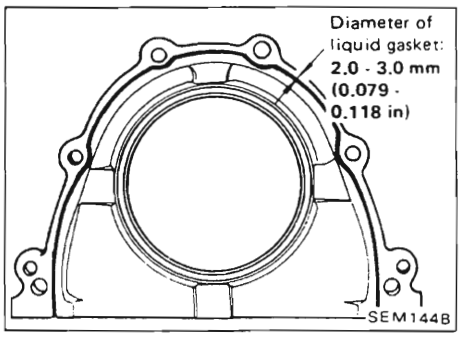


4. Apply engine oil to oil seal and install it in place.

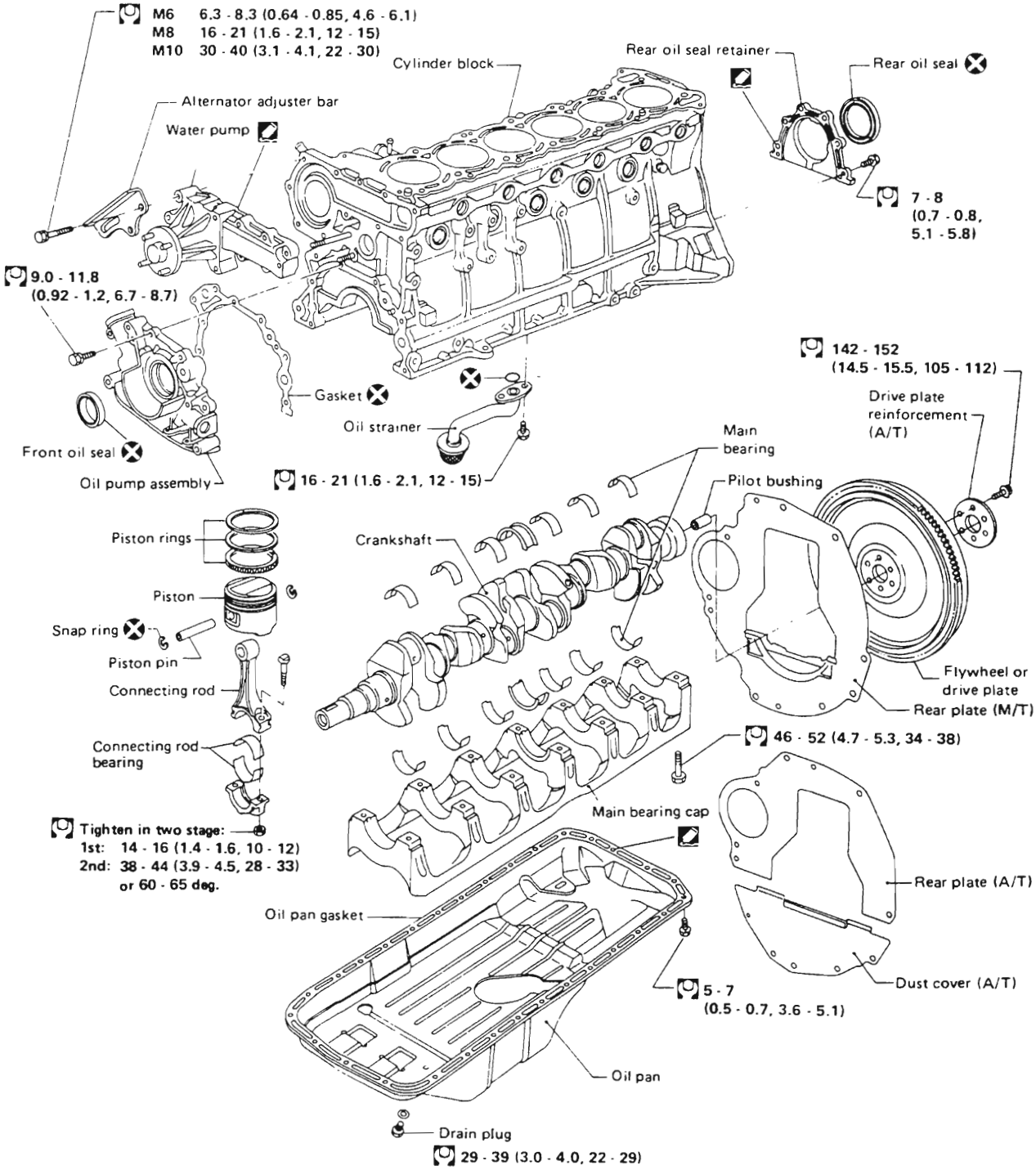


5. Apply a continuous bead of liquid gasket to rear oil seal retainer.

a. **Coat of liquid gasket should be maintained within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.**
b. **Attach oil seal retainer to cylinder block within five minutes after coating.**
c. **Wait at least 30 minutes before refilling engine oil or starting engine.**

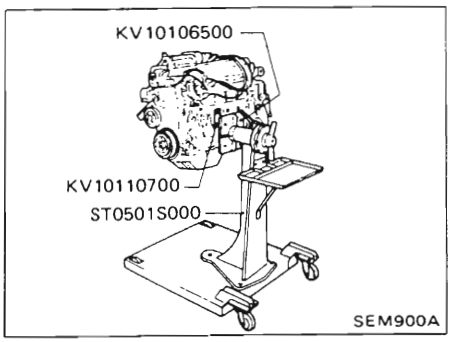


Cylinder Block, Crankshaft and Piston

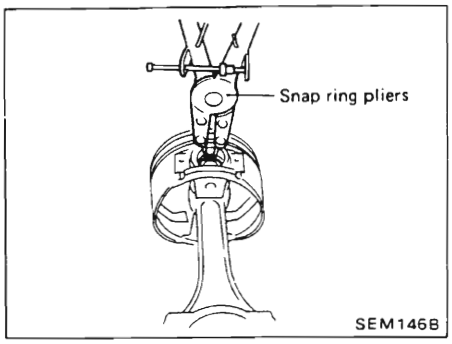


N·m (kg-m, ft-lb)

SEM145B

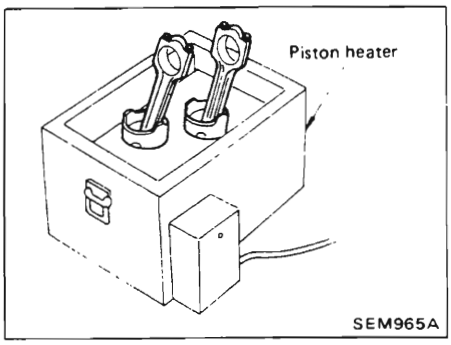


1. Place engine on work stand.
2. Remove timing belt.
3. Drain coolant and remove water pump.
4. Drain oil.
5. Remove oil pan and oil pump.
6. Remove cylinder head.
7. Remove pistons.
8. Remove bearing cap and crankshaft.

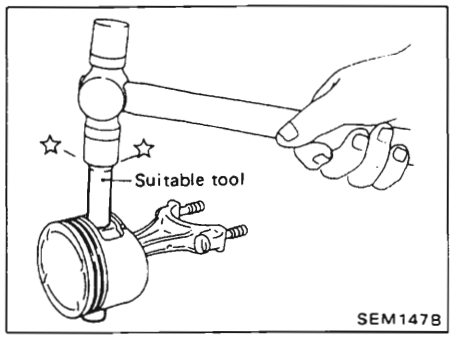


PISTON PIN

1. Remove snap ring.

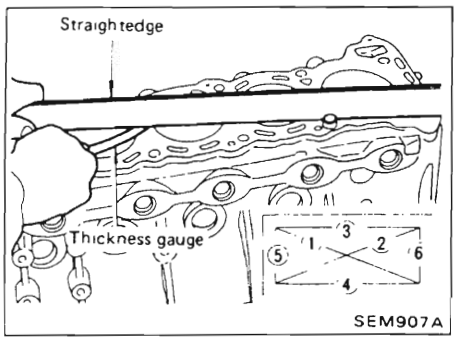


2. Heat piston to 60 to 70°C (140 to 158°F).



3. Push out piston pin by tapping lightly using suitable tool.

- **The piston and pin are a matched set.**
  Arrange pistons, pins, rings, connecting rods and bearings in correct order.



CYLINDER BLOCK DISTORTION

Clean upper face of cylinder block and measure the distortion.

Limit:

0.10 mm (0.0039 in)

If out of specification, resurface it.

The resurfacing limit of cylinder block is determined by the cylinder head resurfacing in an engine.

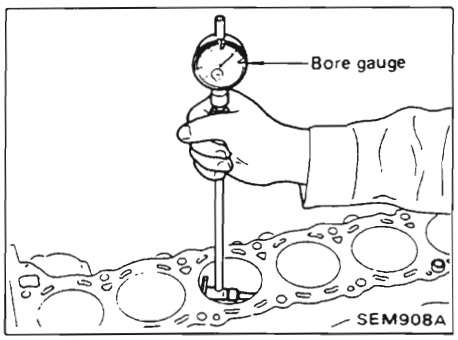
Amount of cylinder head resurfacing is "A"

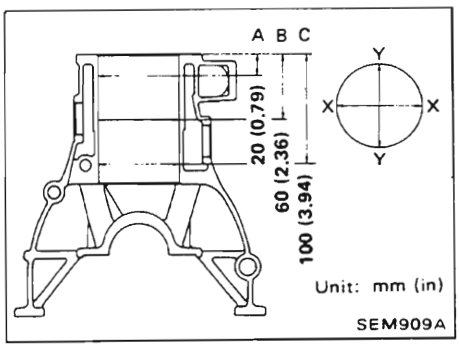
Amount of cylinder block resurfacing is "B"

The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

If necessary, replace cylinder block.





CYLINDER BORE

- Using a bore gauge, measure cylinder bore for wear, out-of-round or taper.

Standard inside diameter:

86.000 - 86.050 mm (3.3858 - 3.3878 in)

Refer to S.D.S.

Wear limit:

0.20 mm (0.0079 in)

Out-of-round (X-Y) limit:

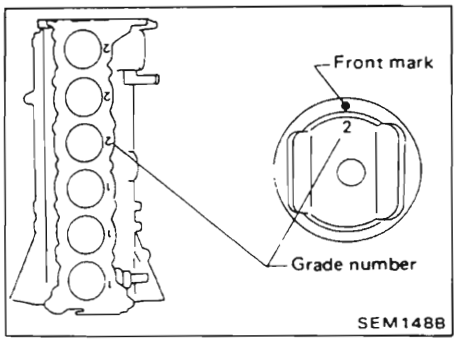
0.015 mm (0.0006 in)

Taper (A - B) limit:

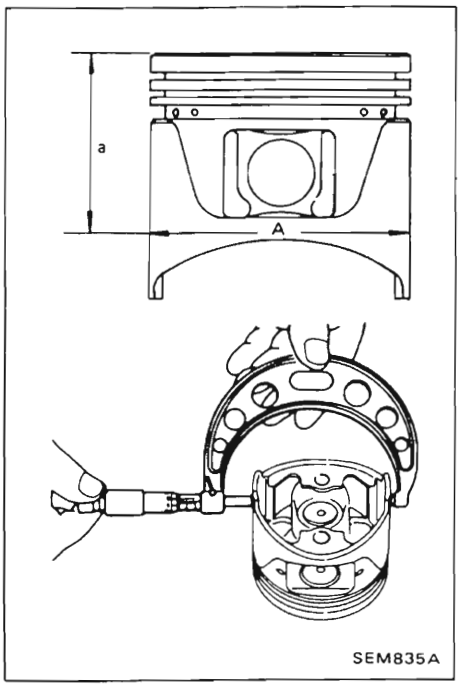
0.010 mm (0.0004 in)

If it exceeds the limit, rebore all six cylinders. Replace cylinder block if necessary.

- Check for damage to bores. If not repairable by honing, rebore all six cylinders.



- **If both cylinder block and piston are replaced with new ones, select the same piston as piston grade number punched on cylinder block upper surfaces.**



PISTON TO CYLINDER WALL CLEARANCE

1. Measure piston and cylinder bore diameter.
   Piston diameter "A":
   Refer to S.D.S.
   Measuring point "a" (Distance from the top):
   47 mm (1.85 in)
2. Check that piston clearance is within the specification.
   Piston clearance: [at 20°C (68°F)]
   0.015 - 0.035 mm (0.0006 - 0.0014 in)

CYLINDER BORING

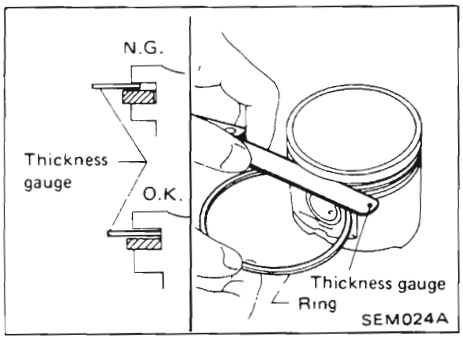
When any cylinder needs boring, all other cylinders must also be bored.

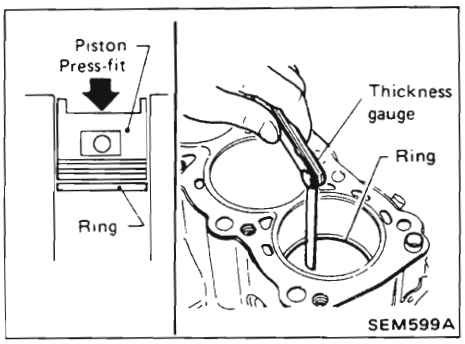
1. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service.
Refer to S.D.S.

2. The size to which cylinders must be honed is determined by adding piston-to-cylinder clearance to the piston skirt diameter "A".
   Measuring point "a" (Distance from the top):
   47 mm (1.85 in)
   Rebored diameter "D":
   D = (Skirt diameter as measured) + (Piston-to-wall clearance)
   = (Skirt diameter) + [0.015 - 0.035 (0.0006 - 0.0014)]

3. Install main bearing caps in place, and tighten to the specified torque to prevent distortion of the cylinder bores in final assembly.





PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.040 - 0.073 mm (0.0016 - 0.0029 in)

2nd ring

0.030 - 0.063 mm (0.0012 - 0.0025 in)

Max. limit of side clearance:

0.1 mm (0.004 in)

If out of specification, replace piston/piston pin assembly.

PISTON RING GAP

Standard ring gap:

Top ring:

0.24 - 0.31 mm (0.0094 - 0.0122 in)

2nd ring:

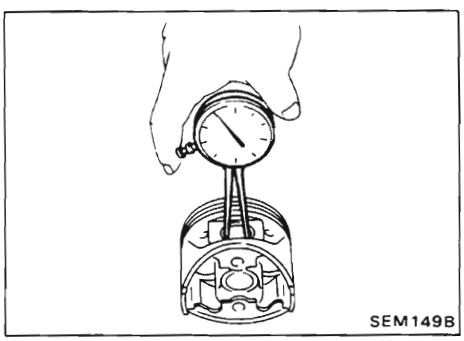
0.18 - 0.28 mm (0.0071 - 0.0110 in)

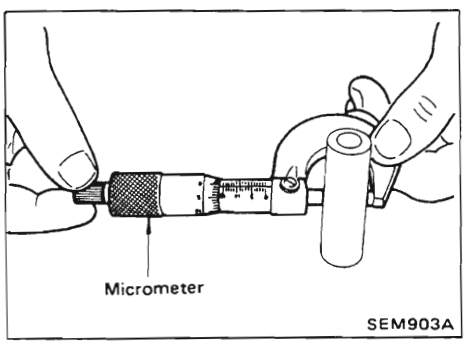
Max. limit of ring gap:

0.4 mm (0.016 in)

If out of specification, replace piston ring.

If gap still exceeds the limit even with a new ring, rebore the cylinder and use oversize piston/piston ring assembly.





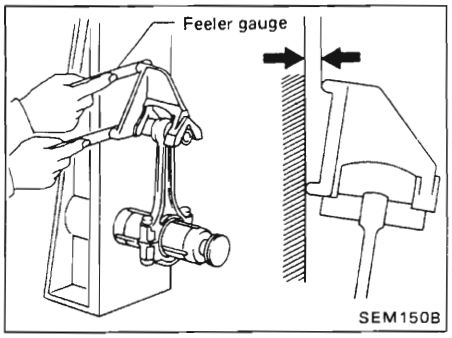
PISTON PIN AND PISTON PIN HOLE

1. Measure inside diameter of piston pin hole "dp".
2. Measure outside diameter of piston pin "Dp".
3. Calculate piston pin clearance.

dp - Dp = -0.004 to 0 mm (-0.0002 to 0 in)

[interference fit at 20°C (68°F)]

If it exceeds the limit, replace piston assembly with pin.

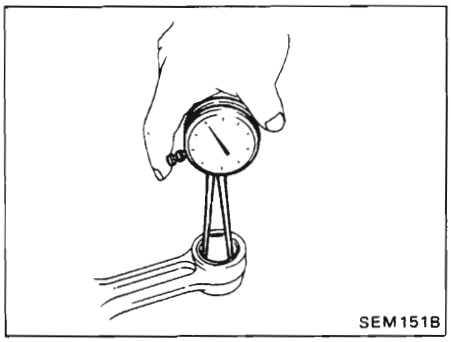


CONNECTING ROD BEND AND TORSION

Bend and torsion:

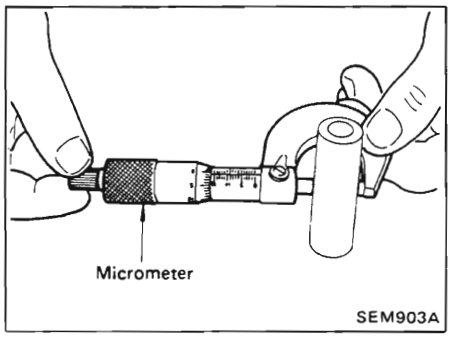
Limit 0.1 mm (0.004 in)
per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING (Small end)

1. Measure inside diameter "C" of bushing.

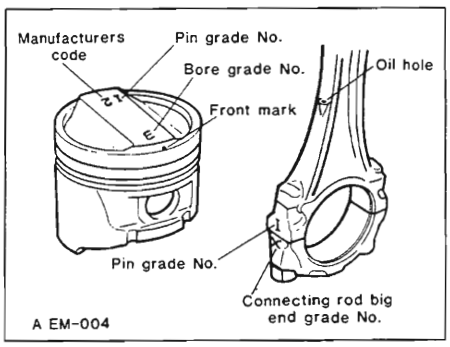


2. Measure outside diameter of piston pin "Dp".
3. Calculate connecting rod bushing clearance.

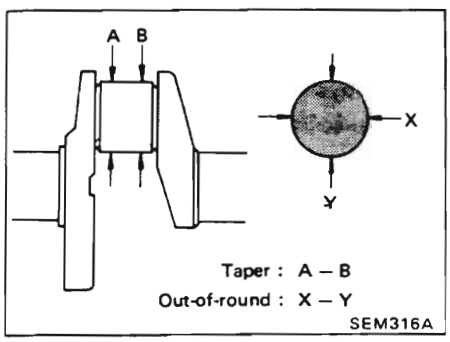
C - Dp = 0.005 - 0.017 mm (0.0002 - 0.0007 in)
[at 20°C (68°F)]

If it exceeds the limit, replace connecting rod assembly and/or piston set with pin.

Connecting rod bushing cannot be removed from connecting rod.



- **If both of connecting rod and piston set with pin are replaced with new one, select parts with the same grade number.**

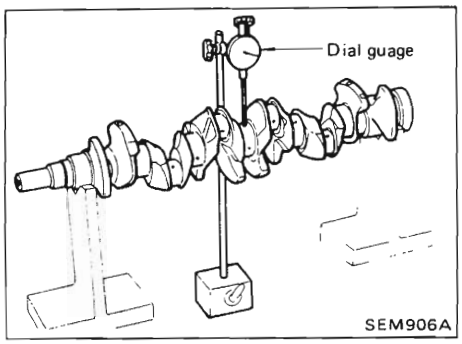


CRANKSHAFT

1. Check crankshaft journals and pins for score, bias, wear or cracks. If faults are minor, correct with fine emery cloth.
2. Check journals and pins with a micrometer for taper and out-of-round.

Out-of-round (X-Y):
Less than 0.005 mm (0.0002 in)
Taper (A-B):
Less than 0.005 mm (0.0002 in)

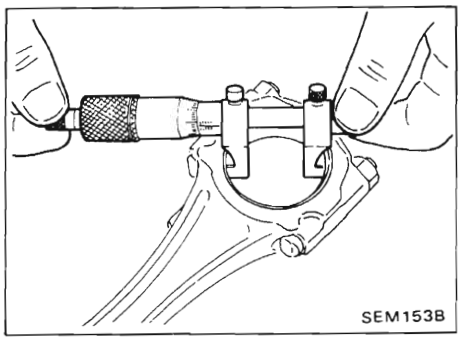
If it exceeds the limit, replace crankshaft.



3. Check crankshaft runout.

Runout [T.I.R. (Total Indicator Reading)]
Less than 0.05 mm (0.0020 in)

If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING (Big end) CLEARANCE

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

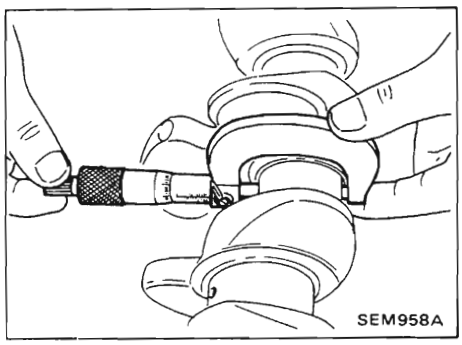
Apply oil to the thread portion of bolts and seating surface of nuts.

: 1st: 14 - 16 N·m
(1.4 - 1.6 kg-m, 10 - 12 ft-lb)
2nd: 38 - 44 N·m or 60 - 65 deg
(3.9 - 4.5 kg-m, 28 - 33 ft-lb)

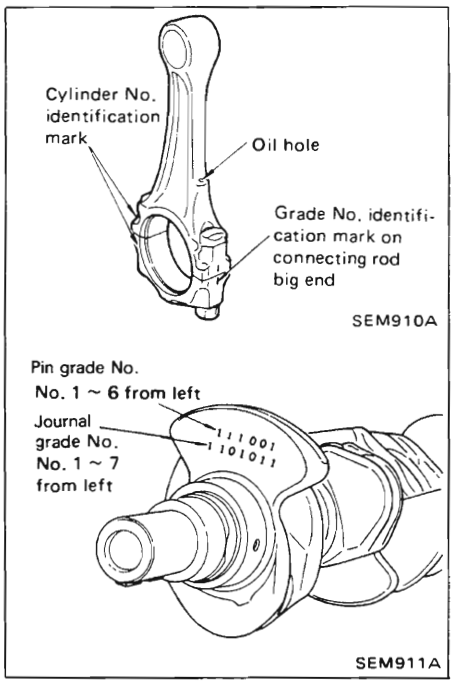
3. Measure inside diameter "C" of bearing.
4. Measure outside diameter "Dp" of pin journal in crankshaft.
5. Calculate connecting rod bearing clearance.

Connecting rod bearing clearance = C — Dp
Standard: 0.011 - 0.035 mm (0.0004 - 0.0014 in)
Limit: 0.090 mm (0.0035 in)

- If it exceeds the limit, replace the bearing.
- If it still exceeds the limit even with a new bearing, regrind crank pin and use undersized bearings.



- **Refer to S.D.S. for regrinding crankshaft and available service parts.**

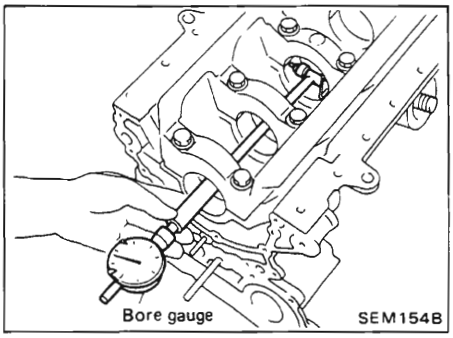


- If either bearing, crankshaft or connecting rod is replaced with new one, select connecting rod bearing according to the grade numbers of crank pin and connecting rod according to the following table.

		Connecting rod grade number	
		0	1
		Connecting rod bearing grade number	
Crank pin grade number	0	0	1
	1	1	2

Identification color:

Grade 0: No color
Grade 1: Brown
Grade 2: Green



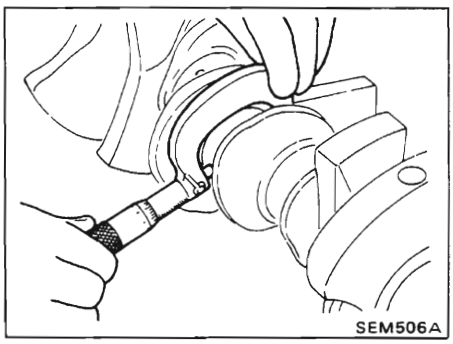
MAIN BEARING CLEARANCE

1. Install main bearings to cylinder block and main bearing cap.
2. Install main bearing cap to cylinder block.

Tighten all bolts in correct order and in two or three stages.

: 46 - 52 N·m (4.7 - 5.3 kg-m, 34 - 38 ft-lb)

3. Measure inside diameter "A" of main journal.

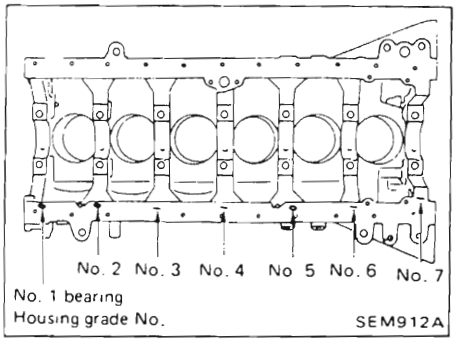


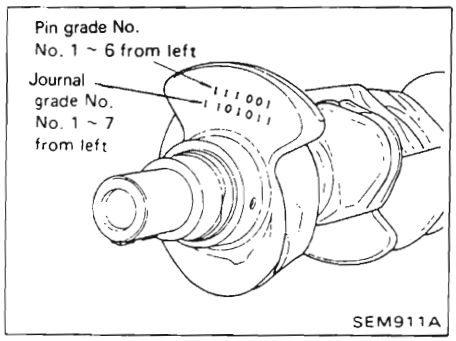
4. Measure outside diameter "Dm" of main journal in crankshaft.
5. Calculate main bearing clearance.

Main bearing clearance: A-Dm
Standard: 0.020 - 0.047 mm (0.0008 - 0.0019 in)
Limit: 0.090 mm (0.0035 in)

- If it exceeds the limit, replace the bearing.
- If it still exceeds the limit even with a new bearing, regrind crank pin and use undersized bearings.

- **Refer to S.D.S. for regrinding crankshaft and available service parts.**



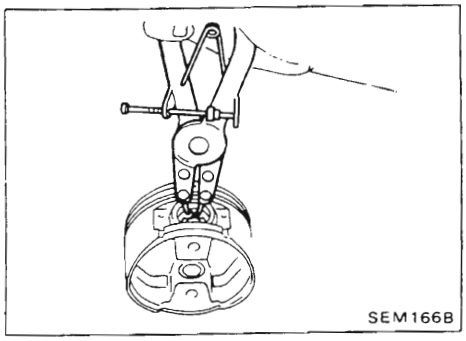


- If either bearing, crankshaft or cylinder block is replaced with new one, select main bearing according to the grade numbers of crank pin and cylinder block according to the following table.

		Main journal grade number		
		0	1	2
		Main bearing grade number		
Crankshaft journal grade number	0	0	1	2
	1	1	2	3
	2	2	3	4

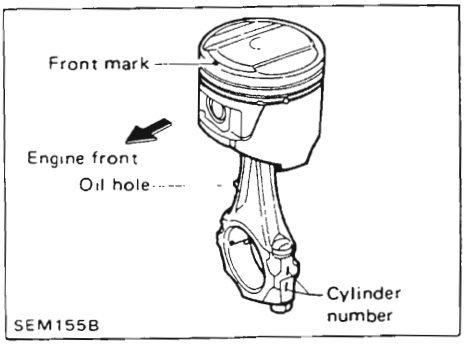
Identification color:

Grade 0: Black
Grade 1: Brown
Grade 2: Green
Grade 3: Yellow
Grade 4: Blue


SEM166B

PISTON

1. Install a new snap ring on one side of the piston pin hole.

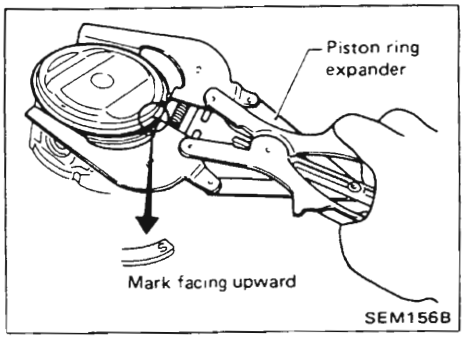


SEM155B

2. Heat the piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.

- **Check piston pin grade number. Refer to "Inspection" of this section.**
- **Align the direction of piston and connecting rod.**
- **Numbers are stamped on the connecting rod and cap corresponding to each cylinder. Care should be taken to avoid a wrong combination including bearing.**
- **When assembling, apply engine oil to pin and small end of connecting rod.**

3. Install piston rings.

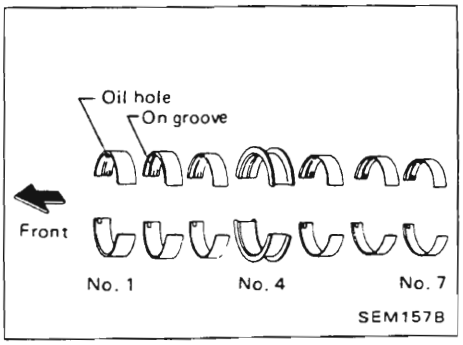


SEM156B

CRANKSHAFT

1. Set main bearings in the proper position on cylinder block and main bearing cap.

- **Confirm that the correct size of main bearings are used. Refer to "Inspection" of this section.**
- **Upper bearings (cylinder block side) have oil groove.**

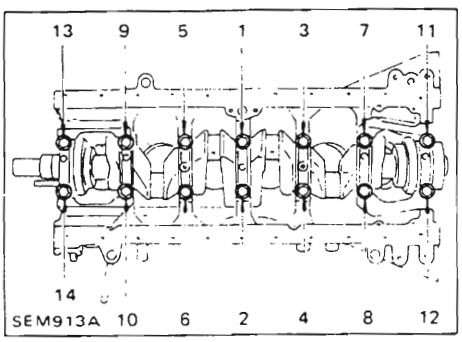


SEM157B

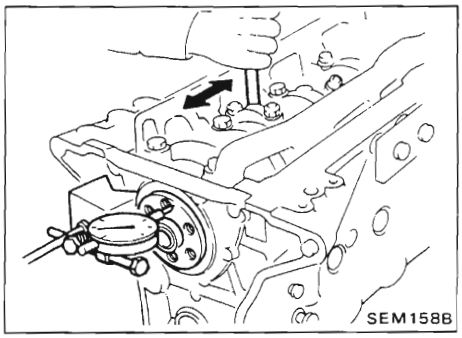
2. Apply engine oil to main bearing surfaces on both sides of cylinder block and cap.
3. Install crankshaft and main bearing caps and tighten bolts to the specified torque.

   : **46 - 52 N·m (4.7 - 5.3 kg-m, 34 - 38 ft-lb)**

- **Tighten in two or three stages.**
- **After securing bearing cap bolts, ascertain that crankshaft turns smoothly by hand.**



SEM913A



4. Measure crankshaft end play.

Crankshaft end play:

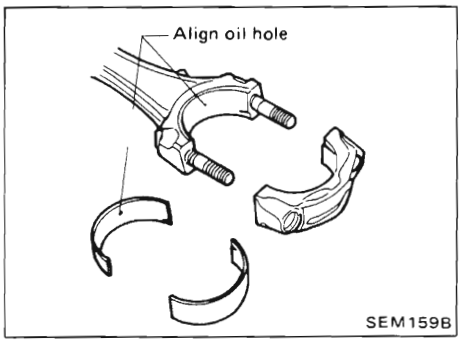
Standard

0.05 - 0.17 mm (0.0020 - 0.0067 in)

Limit

0.30 mm (0.0118 in)

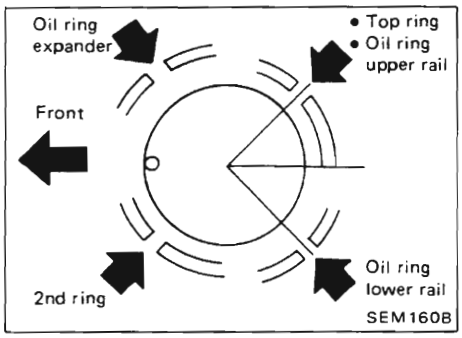
If beyond the limit, replace No. 4 main bearing.



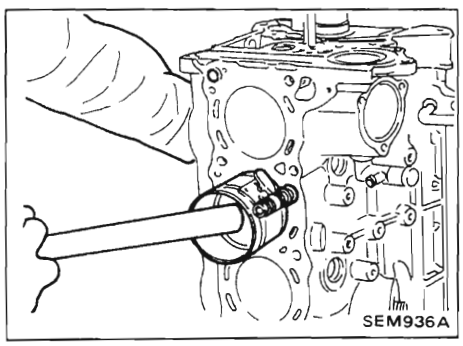
PISTON WITH CONNECTIONS ROD

1. Install connecting rod bearings in the connecting rods and connecting rod caps.

- Confirm that correct size of bearings are used. Refer to "Inspection" of this section.
- Install the bearings with the oil hole in the connecting rod.



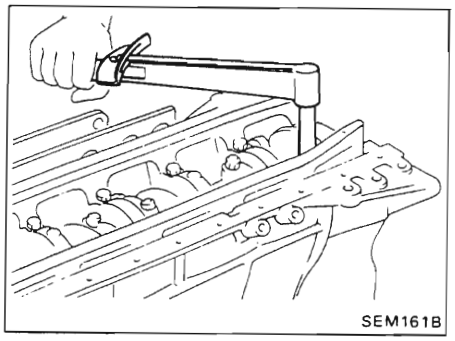
2. Set piston rings as shown.



3. Install pistons with connecting rods.

(1) Install them into corresponding cylinder using Tool.

- **Be careful not to scratch cylinder wall with connecting rod.**
- **Apply engine oil to cylinder wall, piston and bearing.**
- **Arrange so that the front mark on piston head faces to the front of engine.**

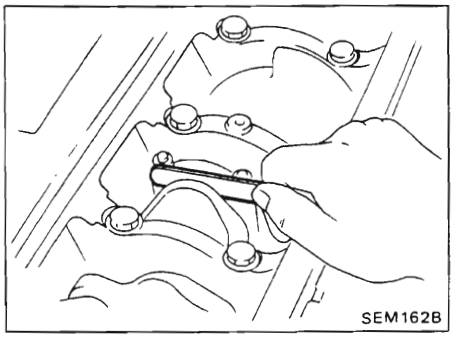

SEM161B

(2) Install connecting rod bearing caps.

: Tightening procedure

1st Tighten all bolts to 14 - 16 N·m (1.4 - 1.6 kg-m, 10 - 12 ft-lb)

2nd Tighten all bolts to 38 - 44 N·m (3.9 - 4.5 kg-m, 28 - 33 ft-lb)
or if you have an angle wrench, turn all bolts 60 - 65 degrees clockwise.


SEM162B

4. Measure connecting rod side clearance.

Connecting rod side clearance:

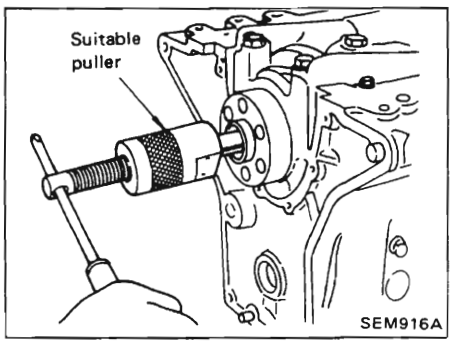
Standard

0.2 - 0.3 mm (0.008 - 0.012 in)

Limit

0.40 mm (0.0157 in)

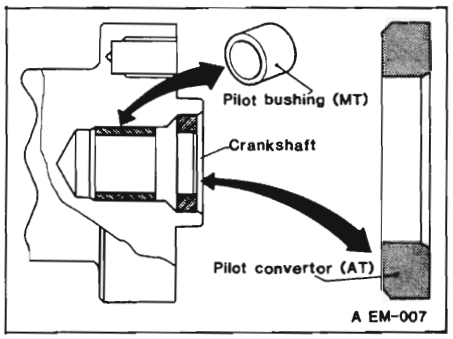
If beyond the limit, replace connecting rod and/or crankshaft.



SEM916A

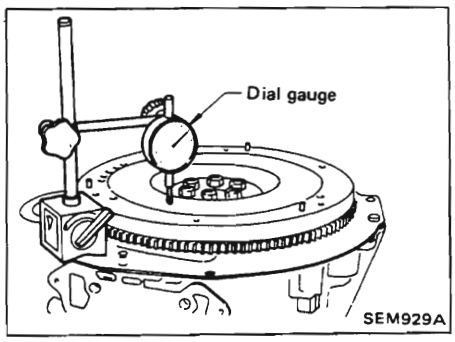
REPLACING PILOT BUSHING

1. Remove pilot bushing (M/T) or pilot convertor (A/T).



A EM-007

2. Install pilot bushing (M/T) or spigot (A/T) torque convertor.



SEM929A

FLYWHEEL RUNOUT

Runout: Less than 0.10 mm (0.0039 in)

If runout exceeds this limit, machine to correct.

General Specifications

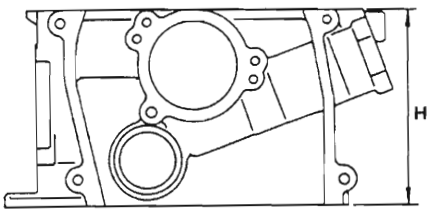
Cylinder arrangement		
Displacement	cm^3 (cu.in)	2,962 (180.74)
Bore and Stroke	mm (in)	86 x 85 (3.39 x 3.35)
Valve arrangement		O.H.C.
Firing order		1-5-3-6-2-4
Number of piston rings		
Compression		2
Oil		1
Number of main bearings		7
Compression ratio		9.0

Unit kPa (bar, kg/cm^2, psi)/rpm

Compression pressure	
Standard	1,196 (11.96, 12.2, 173)/300
Minimum	883 (8.83, 9.0, 128)/300
Differential limit between cylinders	98 (0.98, 1.0, 14)/300

Inspection and Adjustment

CYLINDER HEAD



SEM164B

Unit mm (in)

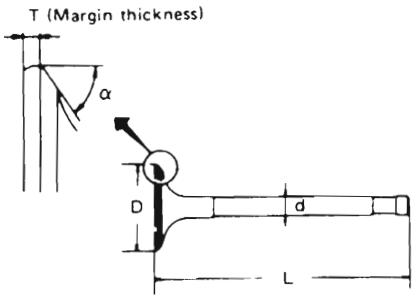
	Standard	Limit
Height (H)	106.3 - 106.7 (4.185 - 4.201)	0.2 (0.008)*
Surface distortion	–	0.2 (0.008)

* Total amount of cylinder head resurfacing and cylinder block resurfacing

Inspection and Adjustment (Cont'd)

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	
Intake	42.0 - 42.2 (1.654 - 1.661)
Exhaust	35.0 - 35.2 (1.378 - 1.386)
Valve length "L"	
Intake	125.3 - 125.9 (4.933 - 4.957)
Exhaust	124.2 - 124.8 (4.890 - 4.913)
Valve stem diameter "d"	
Intake	6.965 - 6.980 (0.2742 - 0.2748)
Exhaust	7.965 - 7.970 (0.3136 - 0.3138)
Valve seat angle "α"	
Intake Exhaust	45°15' - 45°45'
Valve margin "T"	
Intake	1.3 (0.051)
Exhaust	1.5 (0.059)
Valve margin "T" limit	More than 0.5 (0.020)
Valve stem end surface grinding limit	Less than 0.2 (0.008)
Valve clearance	
Intake	0 (0)
Exhaust	0 (0)

Valve spring

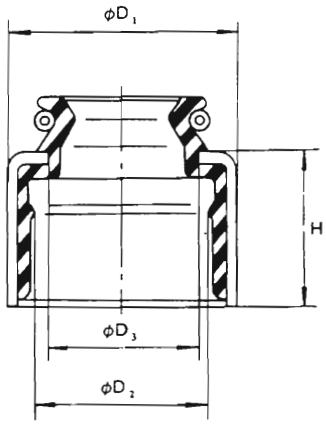
Free height mm (in)	Outer	51.2 (2.016)
	Inner	44.1 (1.736)
Pressure height mm/N (mm/kg, in/lb)	Outer	30.0/523.7 (30.0/53.4, 1.181/117.7)
	Inner	25.0/255.0 (25.0/26.0, 0.984/57.3)
Assembled height mm/N (mm/kg, in/lb)	Outer	40.0/250.1 (40.0/25.5, 1.575/56.2)
	Inner	35.0/107.9 (35.0/11.0, 1.378/24.3)
Out of square mm (in)	Outer	2.2 (0.087)
	Inner	1.9 (0.075)

Hydraulic valve lifter

Unit: mm (in)

Lifter outside diameter	15.947 - 15.957 (0.6278 - 0.6282)
Lifter guide inside diameter	16.000 - 16.013 (0.6299 - 0.6304)
Clearance between lifter and lifter guide	0.043 - 0.066 (0.0017 - 0.0026)

Valve oil seal (metal ring type)



SEM892A

	φD1	φD2	φD3	H
Intake side mm (in)	14 (0.55)	11 (0.43)	9.5 (0.374) max.	8.5 (0.335)
Exhaust side mm (in)	14.6 (0.575)	12 (0.47)	10.5 (0.413) max	8.5 (0.335)

Inspection and Adjustment (Cont'd)

Valve guide

Unit mm (in)

		Standard	Service
Valve guide Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 11.234 (0.4418 - 0.4423)
	Exhaust	12.023 - 12.034 (0.4733 - 0.4738)	12.223 12.234 (0.4812 - 0.4817)
Valve guide Inner diameter [Finished size]	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
	Exhaust	8.000 - 8.011 (0.3150 - 0.3154)	
Cylinder head valve guide hole diameter	Intake	10.975 10.996 (0.4321 0.4329)	11.175 - 11 196 (0.4400 - 0.4408)
	Exhaust	11.975 - 11.996 (0.4715 - 0.4723)	12.175 - 12.196 (0.4793 - 0.4802)
Interference fit of valve guide	Intake	0.027 - 0.059 (0.0011 - 0.0023)	
	Exhaust	0.027 - 0.059 (0.0011 - 0.0023)	

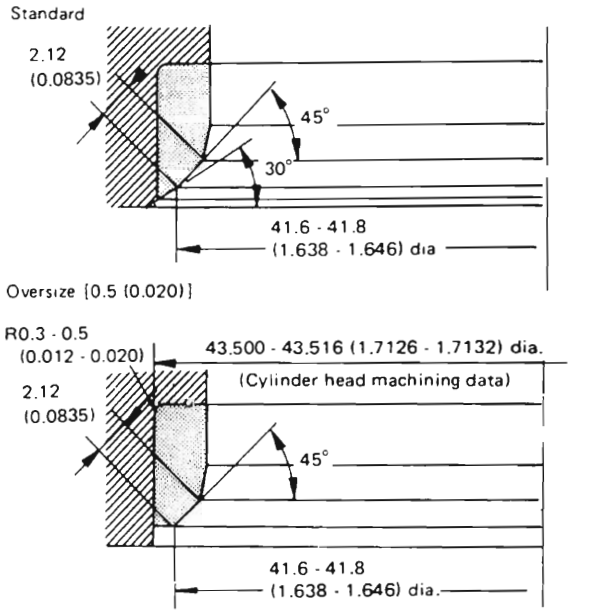
		Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.046 (0.0012 - 0.0018)	
Valve deflection limit		–	0.2 (0.008)

Rocker shaft and rocker arm

Unit mm (in)

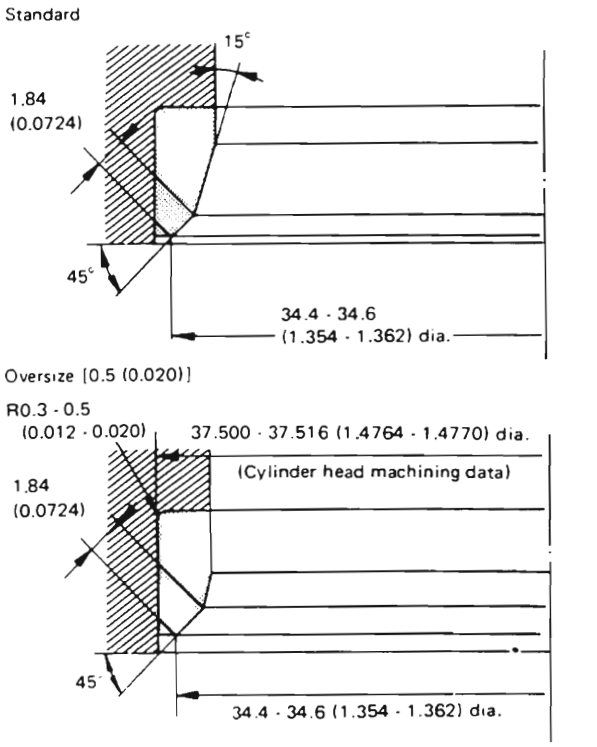
Rocker shaft Outer diameter	17.979 - 18.000 (0.7078 - 0.7087)
Rocker arm Inner diameter	18.007 - 18.028 (0.7089 - 0.7098)
Clearance between rocker arm and rocker shaft	0.007 - 0.049 (0.0003 - 0.0019)

Intake valve seat



Unit mm (in) SEM755A

Exhaust valve seat



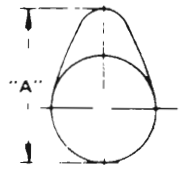
Unit mm (in) SEM756A

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

		Standard	Max. tolerance
Camshaft journal to bearing clearance	#1~#6	0.045 - 0.090 (0.0018 - 0.0035)	0.15 (0.0059)
	#7	0.065 - 0.110 (0.0026 - 0.0043)	
Inner diameter of camshaft bearing	#1~#6	47.00 - 47.025 (1.8504 - 1.8514)	–
	#7	46.50 - 46.525 (1.8307 - 1.8317)	
Outer diameter of camshaft journal	#1~#6	46.935 - 46.955 (1.8478 - 1.8486)	–
	#7	46.415 - 46.435 (1.8274 - 1.8281)	
Camshaft runout [T.I.R*]		Less than 0.02 (0.0008)	0.1 (0.004)
Camshaft end play		0.03 - 0.06 (0.0012 - 0.0024)	–

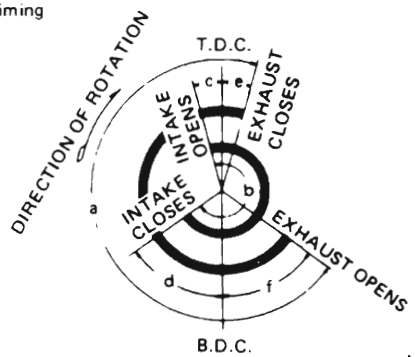


EM671

Cam height "A"	
Intake Exhaust	39.242 - 39.432 (1.5450 - 1.5524)
Wear limit of cam height	0.15 (0.0059)

*Total indicator reading

Valve timing



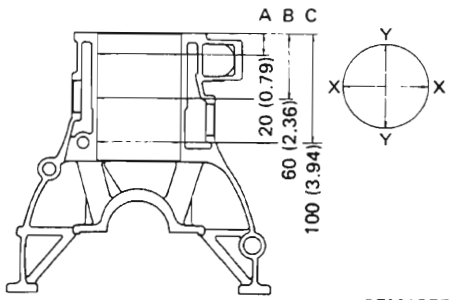
EM120

Unit: degree

a	b	c	d	e	f
248	248	10	58	16	52

CYLINDER BLOCK

Unit: mm (in)



SEM165B

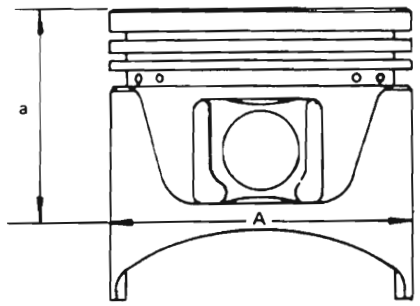
Surface flatness	
Standard	Less than 0.03 (0.0012)
Limit	0.10 (0.0039)
Cylinder bore	
Inner diameter	
Standard	
Grade No. 1	86.000 - 86.010 (3.3858 - 3.3862)
Grade No. 2	86.010 - 86.020 (3.3862 - 3.3866)
Grade No. 3	86.020 - 86.030 (3.3866 - 3.3870)
Grade No. 4	86.030 - 86.040 (3.3870 - 3.3874)
Grade No. 5	86.040 - 86.050 (3.3874 - 3.3878)
For oversize piston	
0.02 (0.0008)	86.020 - 86.070 (3.3866 - 3.3886)
0.50 (0.0197)	86.500 - 86.550 (3.4055 - 3.4075)
1.00	87.000 - 87.050 (3.4252 - 3.4272)
Wear limit	0.20 (0.0079)
Out-of-round (X-Y)	Less than 0.015 (0.0006)
Taper (A-B-C)	Less than 0.010 (0.0004)
Main journal inner diameter	
Grade No. 0	58.645 - 58.654 (2.3089 - 2.3092)
Grade No. 1	58.654 - 58.663 (2.3092 - 2.3096)
Grade No. 2	58.663 - 58.672 (2.3096 - 2.3099)
Difference in inner diameter between cylinders	
Standard	Less than 0.05 (0.0020)
Wear limit	0.20 (0.0079)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Available piston

Unit: mm (in)



SEM765A

Piston skirt diameter "A"	
Standard	
Grade No. 1	85.975 - 85.985 (3.3848 - 3.3852)
Grade No. 2	85.985 - 85.995 (3.3852 - 3.3856)
Grade No. 3	85.995 - 86.005 (3.3856 - 3.3860)
Grade No. 4	86.005 - 86.015 (3.3860 - 3.3864)
Grade No. 5	86.015 - 86.025 (3.3864 - 3.3868)
Oversize (service)	
0.02 (0.0008) (mark: "STD")	85.995 - 86.045 (3.3856 - 3.3876)
0.50 (0.0197) (mark: "50")	86.475 - 86.525 (3.4045 - 3.4065)
1.00 (0.0394) (mark: "100")	86.975 - 87.025 (3.4242 - 3.4262)
"a" dimension	47.0 (1.850)
Piston pin hole diameter	
Grade "0"	20.987 - 20.993 (0.8263 - 0.8265)
Grade "1"	20.993 - 20.999 (0.8265 - 0.8267)
Piston skirt clearance to cylinder block	0.015 - 0.035 (0.0006 - 0.0014)

*Values measured at ambient temperature of 20°C (68°F)

Piston ring

Unit: mm (in)

	Standard	Limit
Side clearance		
Top	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
2nd	0.030 - 0.063 (0.0012 - 0.0025)	
Ring gap [at master bore D = 86.000 (3.3858)]		
Top	0.24 - 0.31 (0.0094 - 0.0122)	0.4 (0.016)
2nd	0.18 - 0.28 (0.0071 - 0.0110)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	
Grade No. 0	20.989 - 20.995 (0.8263 - 0.8266)
Grade No. 1	20.995 - 21.001 (0.8266 - 0.8268)
Interference fit of piston pin to piston	-0.004 to 0 (-0.0002 to 0)
Piston pin to connecting rod bush clearance	0.005 - 0.017 (0.0002 - 0.0007)

*Values measured at ambient temperature of 20°C (68°F)

CONNECTING ROD

Unit: mm (in)

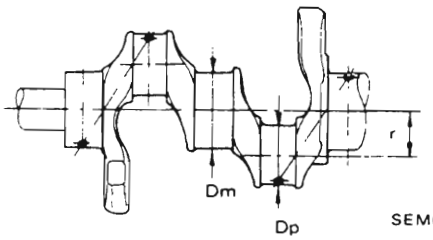
Center distance	152.40 - 152.50 (6.0000 - 6.0039)
Bend, torsion [per 100] Limit	± 0.025 (±0.0010)
Piston pin bushing inner diameter	
Grade No. 0	21.000 - 21.006 (0.8268 - 0.8270)
Grade No. 1	21.006 - 21.012 (0.8270 - 0.8272)
Connecting rod big end inner diameter	
Grade No. 0	53.000 - 53.007 (2.0866 - 2.0869)
Grade No. 1	53.007 - 53.013 (2.0869 - 2.0871)
Side clearance	
Standard	0.20 - 0.30 (0.0079 - 0.0118)
Limit	0.40 (0.0157)

Inspection and Adjustment (Cont'd)

CRANKSHAFT

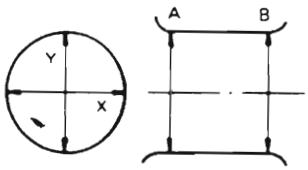
Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	54.967 - 54.975 (2.1641 - 2.1644)
Grade No. 1	54.959 - 54.967 (2.1637 - 2.1641)
Grade No. 2	54.951 - 54.959 (2.1634 - 2.1637)
Pin journal dia. "Dp"	
Grade No. 0	49.968 - 49.974 (1.9672 - 1.9675)
Grade No. 1	49.961 - 49.968 (1.9670 - 1.9672)
Center distance "r"	42.5 (1.673)
Out-of-round (X-Y)	
Standard	Less than 0.005 (0.0002)
Taper (A-B)	
Standard	Less than 0.005 (0.0002)
Runout [T.I.R.]	
Standard	Less than 0.10 (0.0039)
End play	
Standard	0.05 - 0.17 (0.0020 - 0.0067)
Limit	0.30 (0.0118)



SEM645

Out-of-round X-Y
Taper A-B



EM715

AVAILABLE MAIN BEARING

Standard

Grade number	Thickness "T" mm (in)	Identification color
0	1.821 - 1.825 (0.0717 - 0.0719)	Black
1	1.825 - 1.829 (0.0719 - 0.0720)	Brown
2	1.829 - 1.833 (0.0720 - 0.0722)	Green
3	1.833 - 1.837 (0.0722 - 0.0723)	Yellow
4	1.837 - 1.841 (0.0723 - 0.0725)	Blue

Undersize (service)

Unit: mm (in)

	Thickness "T"	Main journal diameter "Dm"
0.25 (0.0098)	1.952 - 1.960 (0.0769 - 0.0772)	Grind so that bearing clearance is the specified value.
0.50 (0.0197)	2.077 - 2.085 (0.0818 - 0.0821)	

AVAILABLE CONNECTING ROD BEARING

Standard

Grade number	Thickness "T" mm (in)	Identification color
0	1.502 - 1.506 (0.0591 - 0.0593)	–
1	1.506 - 1.510 (0.0593 - 0.0594)	Brown
2	1.510 - 1.514 (0.0594 - 0.0596)	Green

Undersize (service)

Unit: mm (in)

	Thickness "T"	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.540 - 1.548 (0.0606 - 0.0609)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.560 - 1.568 (0.0614 - 0.0617)	
0.25 (0.0098)	1.625 - 1.633 (0.0640 - 0.0643)	

Inspection and Adjustment (Cont'd)

MISCELLANEOUS COMPONENTS

	Unit: mm (in)
Flywheel	
Runout [T.I.R.]	Less than 0.1 (0.004)

Bearing clearance

	Unit: mm (in)
Main bearing clearance	
Standard	0.020 - 0.047 (0.0008 - 0.0019)
Limit	0.090 (0.0035)
Connecting rod bearing clearnace	
Standard	0.011 - 0.035 (0.0004 - 0.0014)
Limit	0.090 (0.0035)

Tightening Torque

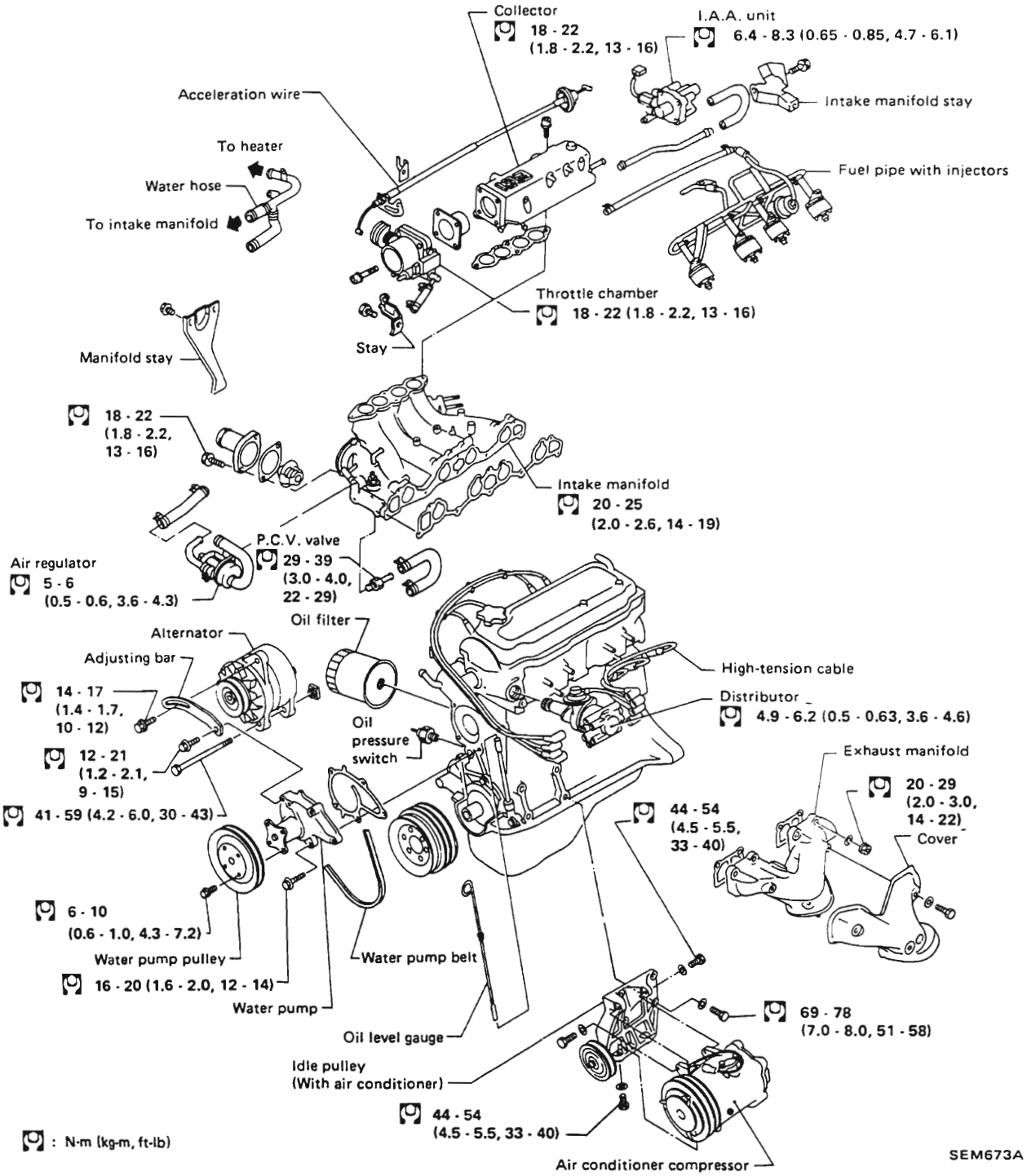
TIGHTENING TORQUE

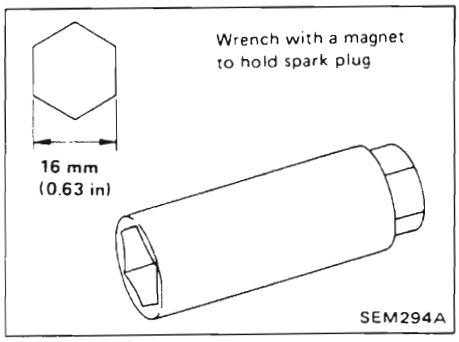
Engine outer parts

	N·m	kg-m	ft-lb
Intake manifold bolt Intake manifold nut	18 - 22	1.8 - 2.2	13 - 16
Exhaust manifold	27 - 31	2.8 - 3.2	20 - 23
Crankshaft pulley	142 - 152	14.5 - 15.5	105 - 112
Water inlet	16 - 21	1.6 - 2.1	12 - 15
Distributor bolt	9 - 12	0.9 - 1.2	6.5 - 8.7
Alternator adjusting bar bolt	16 - 21	1.6 - 2.1	12 - 15
Air bleeder plug (at intake manifold)	15 - 20	1.5 - 2.0	11 - 14

Engine parts

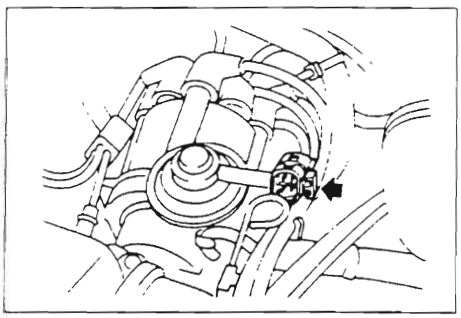
		N·m	kg-m	ft-lb
Rocker cover		2 - 4	0.2 - 0.4	1.4 - 2.9
Tensioner nut		43 - 58	4.4 - 5.9	32 - 43
Belt cover		3 - 5	0.3 - 0.5	2.2 - 3.6
Rocker shaft		18 - 22	1.8 - 2.2	13 - 16
Camshaft pulley		16 - 22	1.6 - 2.2	12 - 16
Cylinder head		Refer to page EM-24.		
Camshaft retainer		6.3 - 8.3	0.64 - 0.85	4.6 - 6.1
Water pump	M6	6.3 - 8.3	0.64 - 0.85	4.6 - 6.1
	M8	16 - 21	1.6 - 2.1	12 - 15
	M10	30 - 40	3.1 - 4.1	22 - 30
Oil pan		5 - 7	0.5 - 0.7	3.6 - 5.1
Drain plug		29 - 39	3.0 - 4.0	22 - 29
Oil pan		5 - 7	0.5 - 0.7	3.6 - 5.1
Oil pump regulator valve		39 - 69	4.0 - 7.0	29 - 51
Oil pump securing bolts		9.0 - 11.8	0.92 - 1.2	6.7 - 8.7
Oil strainer		16 - 21	1.6 - 2.1	12 - 15
Flywheel		142 - 152	14.5 - 15.5	105 - 112
Rear oil seal retainer		5.4 - 7.2	0.55 - 0.73	4.0 - 5.3
Connecting rod		Refer to EM-44.		
Main bearing cap		46 - 52	4.7 - 5.3	4 - 38
Water drain plug		34 - 44	3.5 - 4.5	25 - 33
Spark plug		20 - 29	2.0 - 3.0	14 - 22


Collector
18 - 22 (1.8 - 2.2, 13 - 16)
I.A.A. unit
6.4 - 8.3 (0.65 - 0.85, 4.7 - 6.1)
Acceleration wire
Intake manifold stay
To heater
Water hose
To intake manifold
Fuel pipe with injectors
Throttle chamber
18 - 22 (1.8 - 2.2, 13 - 16)
Stay
Manifold stay
18 - 22 (1.8 - 2.2, 13 - 16)
Intake manifold
20 - 25 (2.0 - 2.6, 14 - 19)
P.C.V. valve
29 - 39 (3.0 - 4.0, 22 - 29)
Air regulator
5 - 6 (0.5 - 0.6, 3.6 - 4.3)
Oil filter
Alternator
Adjusting bar
High-tension cable
14 - 17 (1.4 - 1.7, 10 - 12)
Distributor
4.9 - 6.2 (0.5 - 0.63, 3.6 - 4.6)
Oil pressure switch
12 - 21 (1.2 - 2.1, 9 - 15)
Exhaust manifold
20 - 29 (2.0 - 3.0, 14 - 22)
41 - 59 (4.2 - 6.0, 30 - 43)
44 - 54 (4.5 - 5.5, 33 - 40)
Cover
6 - 10 (0.6 - 1.0, 4.3 - 7.2)
Water pump pulley
Water pump belt
16 - 20 (1.6 - 2.0, 12 - 14)
Water pump
69 - 78 (7.0 - 8.0, 51 - 58)
Oil level gauge
Idle pulley (With air conditioner)
44 - 54 (4.5 - 5.5, 33 - 40)
: N·m (kg-m, ft-lb)
Air conditioner compressor
SEM673A

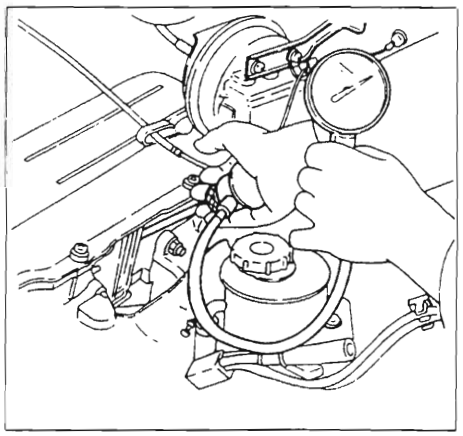


1. Warm up engine.
2. Remove one bank of spark plugs. (either intake or exhaust).

Use a suitable plug wrench.



3. Disconnect distributor harness connector.



4. Attach a suitable compression tester.
5. Depress accelerator pedal to fully open throttle.
6. Crank engine and read gauge indication of each cylinder.

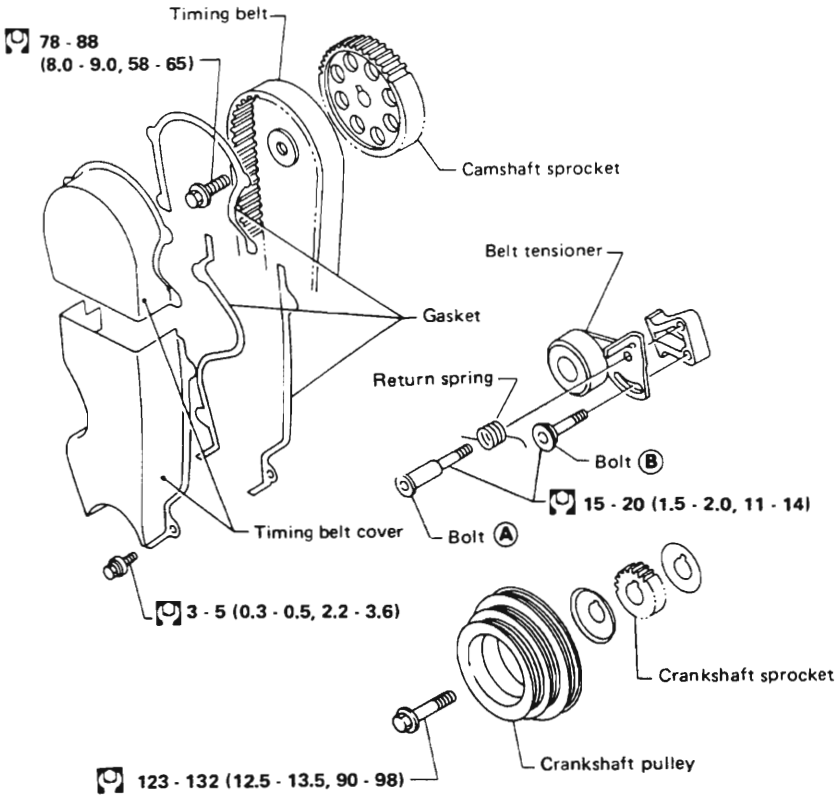
Compression pressure:
kPa (bar, kg/cm², psi) at 350 rpm
Standard
1,196 (11.96, 12.2, 173)
Minimum
902 (9.02, 9.2, 131)
Differential limit between cylinders:
kPa (bar, kg/cm², psi) at 350 rpm
98 (0.98, 1.0, 14)

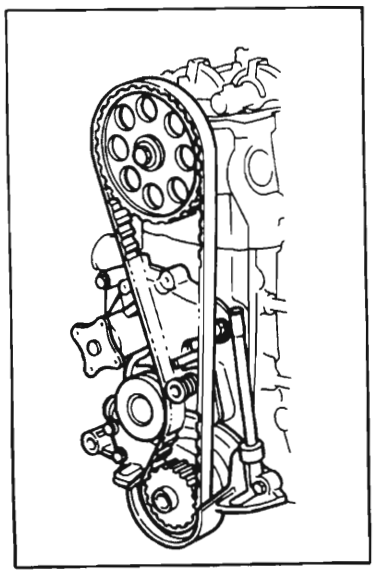
7. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through the spark plug holes and retest compression.

- If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
- If pressure stays low, valve may be sticking or seating improperly.
- If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasket surface.

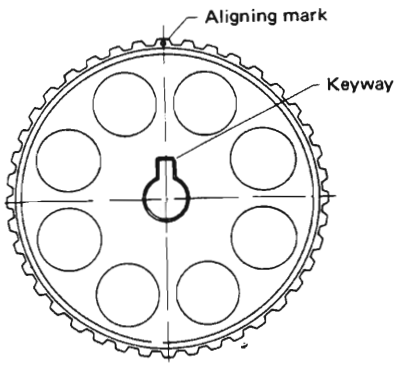
CAUTION:

a. Do not bend or twist timing belt too tightly.
b. After removing timing belt, do not rotate crankshaft and camshaft separately because valves will hit piston head.
c. Ensure timing belt, timing belt camshaft pulley, crankshaft timing pulley and belt tensioner are clean and free from oil or water.
d. Before installing timing belt, confirm that No. 1 cylinder is set at T.D.C. on compression stroke.
e. Align arrow on timing belt forward.
f. Align white lines on timing belt with punch mark on camshaft pulley and crankshaft pulley.
g. Adjust belt tension with all spark plugs removed.



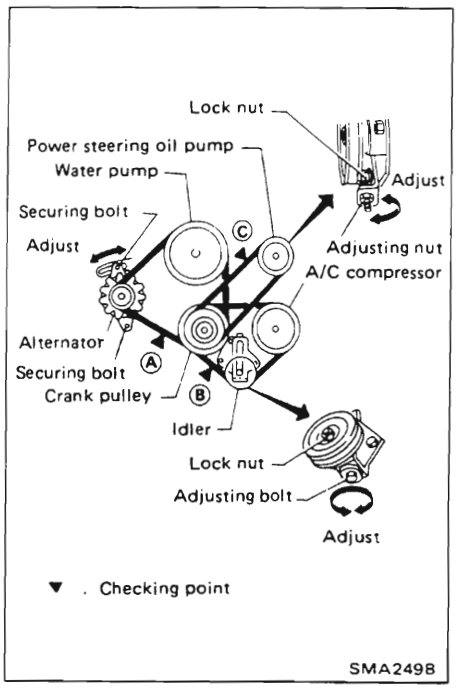


: N·m (kg-m, ft-lb)

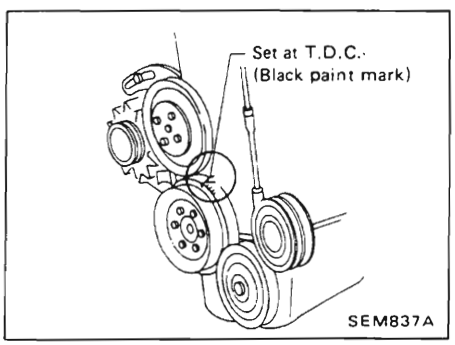


SEM044B

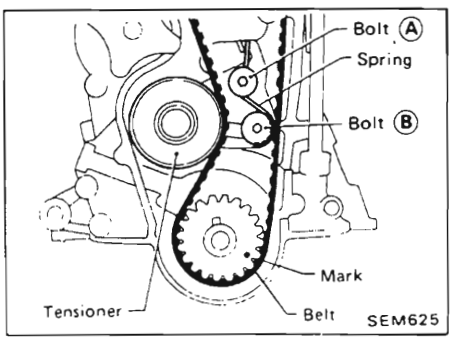
1. Remove radiator shroud, fan and pulleys.
2. Remove all spark plugs.



3. Remove the following belts.
- Power steering oil pump drive belt
- Compressor drive belt
- Alternator drive belt.



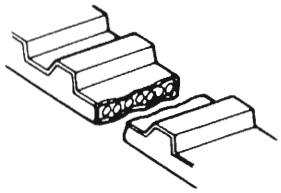
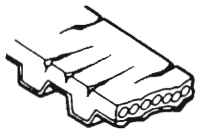
4. Set No. 1 cylinder at T.D.C. on its compression stroke.

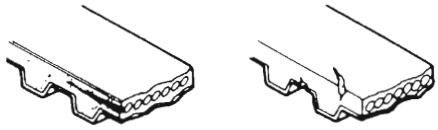
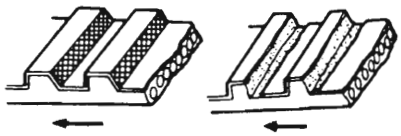


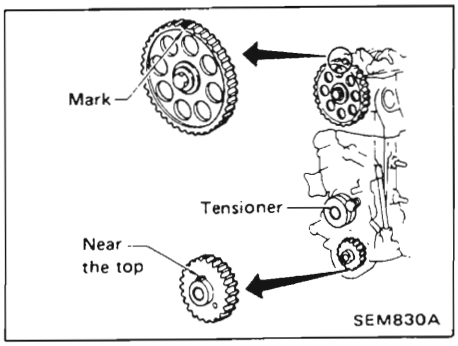
5. Remove front upper and lower belt covers.
6. Loosen timing belt tensioner bolts and remove return spring, then remove timing belt.

After removing timing belt, do not rotate crankshaft and camshaft separately because valves will hit piston head.

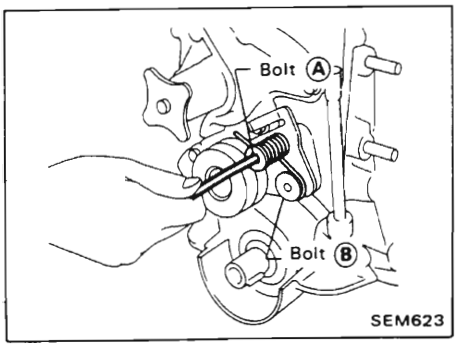
Visually check the condition of the timing belt.
Replace if any abnormality is found.

Item to check	Problem	Cause
Belt is broken.	 SEM393A	• Improper handling • Poor belt cover sealing • Coolant leakage at water pump
Tooth is broken/ tooth root is cracked.	 SEM394A	• Camshaft jamming • Distributor jamming • Oil leakage at camshaft/crankshaft oil seal
Back surface is cracked/worn.	 SEM395A	• Tensioner jamming • Overheated engine • Interference with belt cover

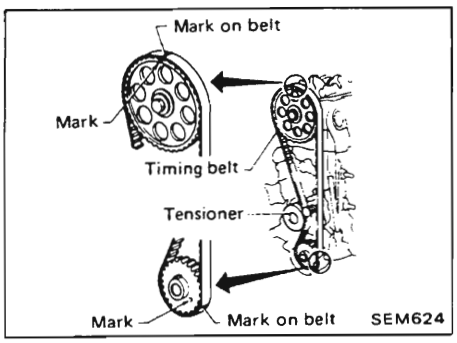
Item to check	Problem	Cause
Side surface is worn.	 • Side surface of belt is worn to such an extent that there is no trace of cutoff performed during manufacturing process. • Belt corners are worn and round. • Wicks are frayed and coming out. SEM396A	• Improper installation of belt • Malfunctioning crank pulley plate/timing belt plate
Teeth are worn.	 • Canvas on tooth face is worn down. • Canvas on tooth is fluffy, rubber layer is worn down and faded white, or canvas texture is unclear. SEM397A	• Poor belt cover sealing • Coolant leakage at water pump • Camshaft not functioning properly • Distributor not functioning properly • Excessive belt tension
Oil/Coolant or water is stuck to belt.		• Poor oil sealing of each oil seal • Coolant leakage at water pump • Poor belt cover sealing



1. Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke.



2. Install tensioner and return spring.
- **Temporarily tighten bolts so that tensioner can swing smoothly.**



3. Set timing belt.

a. **Ensure that timing belt and pulleys are clean and free of oil or water. Do not bend timing belt.**

b. **Align white lines on timing belt with punch mark on camshaft pulleys and crankshaft pulley.**

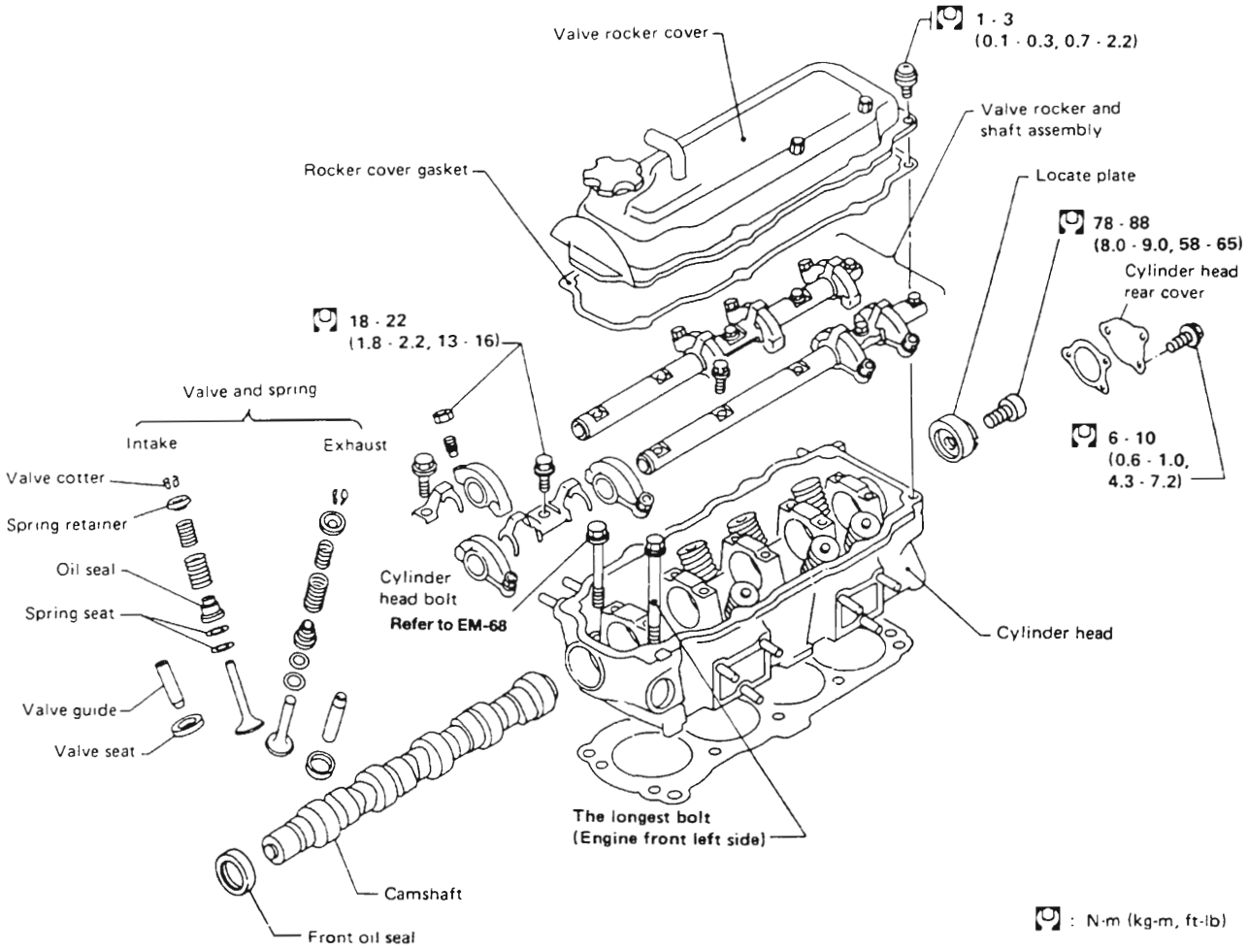
c. **Have arrow on timing belt pointing toward front belt covers.**

4. Tighten belt tensioner and assemble spring.

To set spring, first hook one end on bolt (B) side, then hook the other end on tensioner bracket pawl. After rotating crankshaft two turns clockwise, tighten bolt (B) and then bolt (A), and belt tension will automatically be the specified value.

: 15 - 20 N·m (1.5 - 2.0 kg-m, 11 - 14 ft-lb)

5. Install timing belt covers.

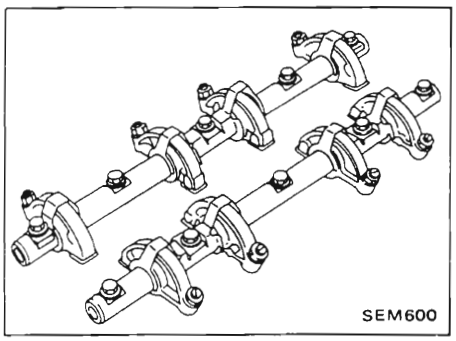


SEM783A

- When installing sliding parts such as rocker arms and camshaft, be sure to apply engine oil on the sliding surfaces.
- Use new gaskets and oil seals.
- When installing welch plug, apply sealant.

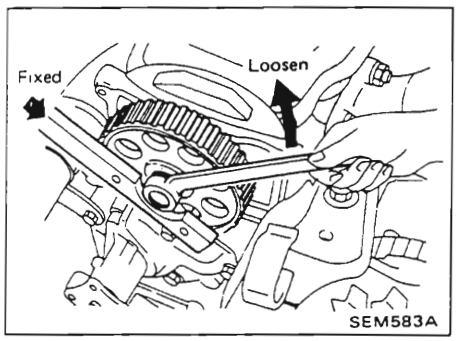
1. Remove timing belt.
   Set No. 1 cylinder at T.D.C. on its compression stroke.

After removing timing belt, do not rotate crankshaft and camshaft separately, because valves will hit piston heads.

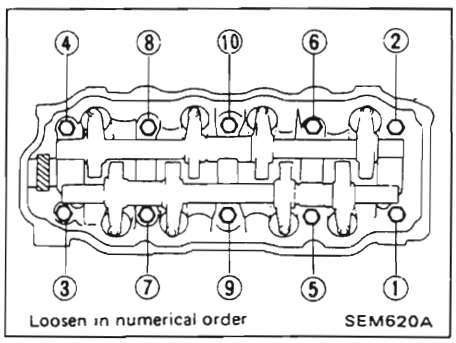


2. Remove rocker shafts with rocker arms and securing bolts.

Before removal, fully loosen valve clearance adjusting screws.
The bolts should be loosened in two or three stages.



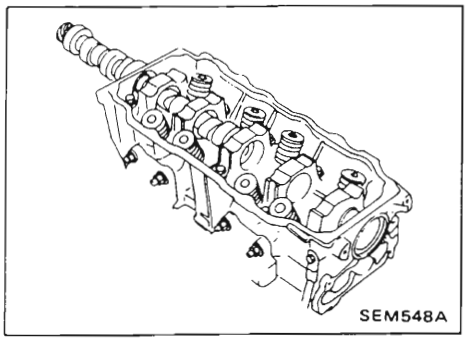
3. Remove camshaft sprocket.



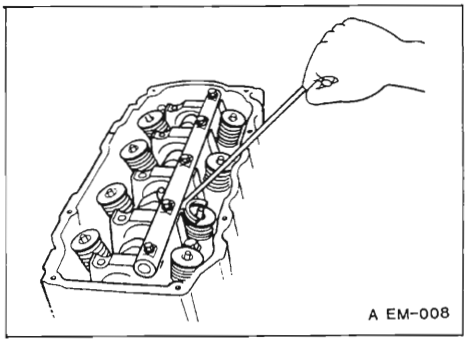
4. Remove cylinder head with manifolds.

Bolts should be loosened in two or three stages. Head warpage or cracking could result from removing in incorrect order.

5. Remove manifolds from cylinder head.

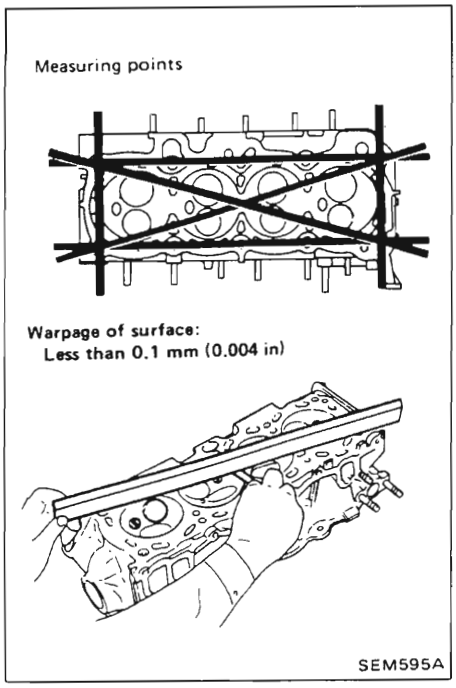


1. Remove camshaft locate plate.
2. Remove camshaft and camshaft oil seal.



3. Remove valve component parts.

4. Remove valve oil seals.



CYLINDER HEAD DISTORTION

Cylinder head distortion:

Less than 0.1 mm (0.004 in)

If beyond the specified limit, resurface it.

Nominal cylinder head height:

116.6 - 117.0 mm (4.591 - 4.606 in)

Resurfacing limit:

The resurfacing limit of cylinder head is determined by the cylinder block resurfacing in an engine.

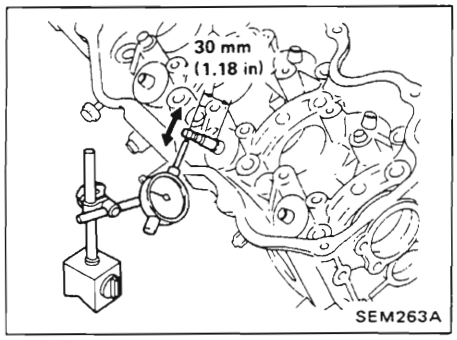
Amount of cylinder head resurfacing is "A"

Amount of cylinder block resurfacing is "B"

The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

After resurfacing the cylinder head, check that camshaft rotates freely by hand. If resistance is felt, the cylinder head must be replaced.



VALVE GUIDE CLEARANCE

- Valve guide clearance should be measured parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)

  Stem to guide clearance:

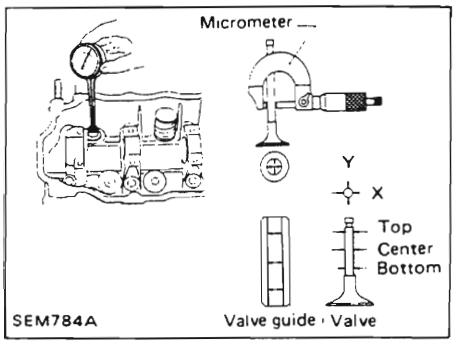
  Maximum limit

  0.10 mm (0.0039 in)

  Maximum allowable deflection

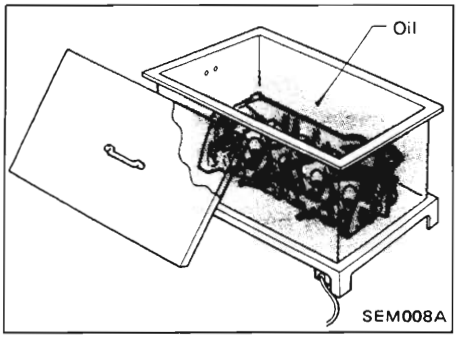
  (Dial indicator reading)

  0.2 mm (0.008 in)



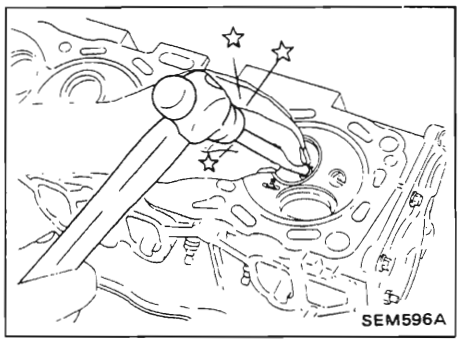
- To determine the correct replacement part, measure valve stem diameter and valve guide bore.

  For dimensions, refer to S.D.S.

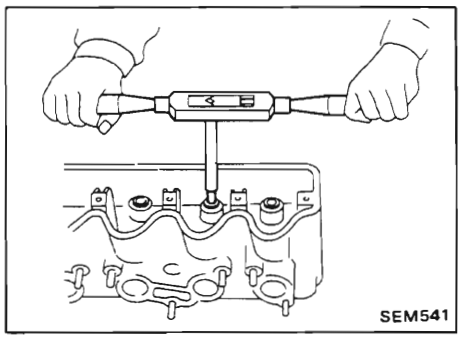


VALVE GUIDE REPLACEMENT

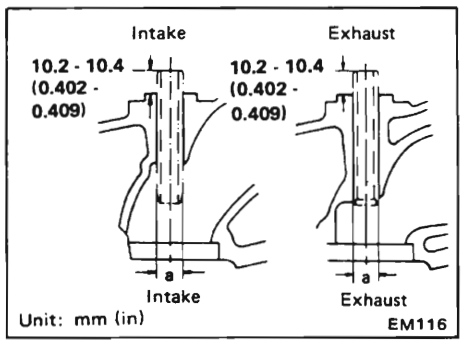
1. To remove valve guide heat cylinder head to 150 to 160°C (302 to 320°F).



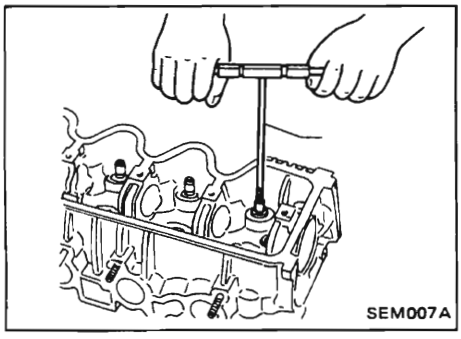
2. Drive out valve guide with a press [under a 20 kN (2t, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.



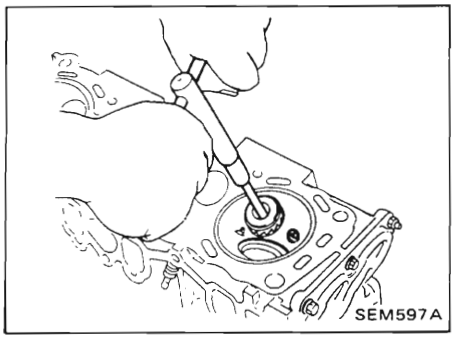
3. Ream cylinder head valve guide hole.
   Cylinder head valve guide hole diameter "a"
   (For service parts): mm (in)
   11.185 - 11.196 (0.4404 - 0.4408)



4. Heat cylinder head to 150 to 160°C (302 to 320°F) and press service valve guide into cylinder head.



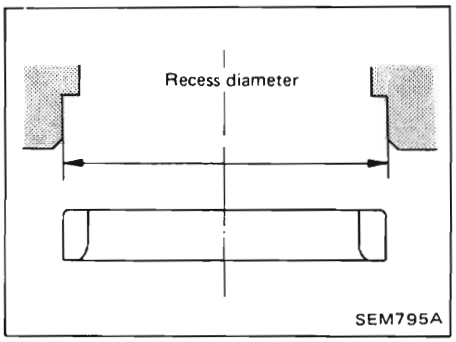
5. Ream valve guide.
   Finished size: mm (in)
   7.000 - 7.018 (0.2756 - 0.2763)


SEM597A

VALVE SEATS

Check valve seats for any evidence of pitting at valve contact surface, and reseat or replace if excessively worn.

- **When repairing valve seats, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.**
- **The cutting should be done with both hands for uniform cutting.**



SEM795A

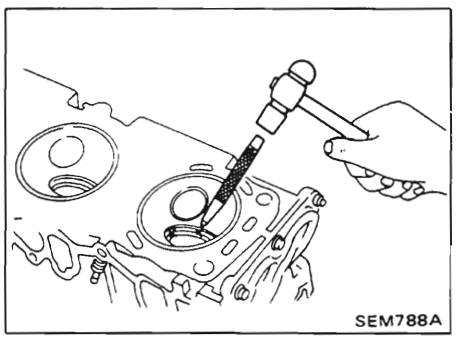
REPLACING VALVE SEAT FOR SERVICE PARTS

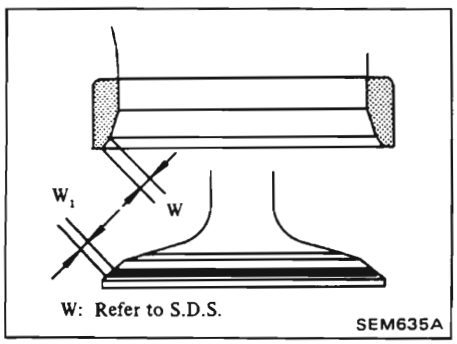
1. Bore out old seat until it collapses.
   The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream the cylinder head recess.

Reaming bore for service valve seat (Oversize [0.5 mm (0.020 in)]):

Intake:
43.500 - 43.516 mm (1.7126 - 1.7132 in) dia.
Exhaust:
37.500 - 37.516 mm (1.4764 - 1.4770 in) dia.

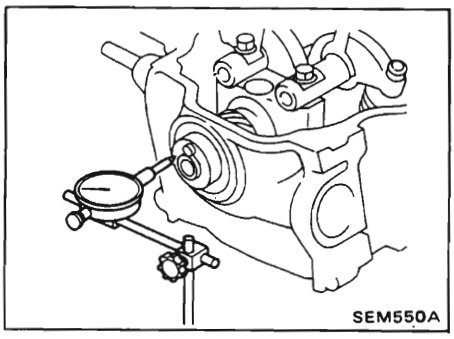
3. Heat cylinder head to a temperature of 150 to 160°C (302 to 320°F).
4. Press fit seal until it seats on the bottom, and peen more than 4 points.


SEM788A



SEM635A

5. Cut or grind valve seat using suitable tool at the specified dimensions as shown in S.D.S.
6. After cutting, lap valve seat with a lapping compound.
7. Check contact condition of valve seat.


SEM550A

CAMSHAFT VISUAL CHECK

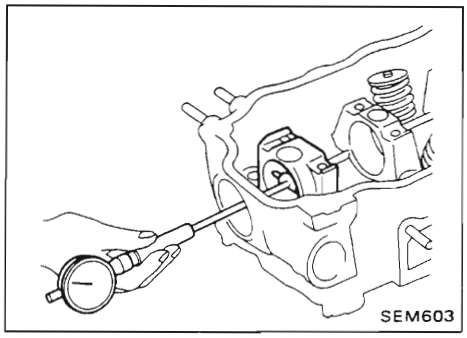
Check camshaft for scratches, seizure and wear.

CAMSHAFT END PLAY

1. Install camshaft and locate plate in cylinder head.
2. Measure camshaft end play.

Camshaft end play:

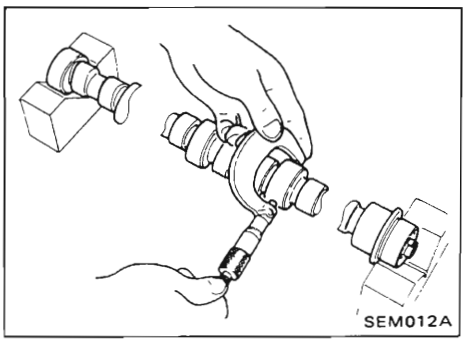
Standard	**0.07 - 0.14 mm (0.0028 - 0.0055 in)**
Limit	**0.2 mm (0.008 in)**


SEM603

CAMSHAFT JOURNAL CLEARANCE

1. Measure the inner diameter of camshaft bearing.

Standard inner diameter:
46.000 - 46.016 mm (1.8110 - 1.8116 in)


SEM012A

2. Measure the outer diameter of camshaft journal.

Standard outer diameter
#1 - #4 journal:
45.935 - 45.955 mm (1.8085 - 1.8092 in)
#5 journal:
45.915 - 45.935 mm (1.8077 - 1.8085 in)

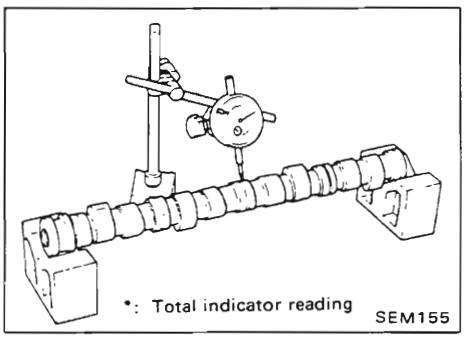
If the clearance is greater than the maximum, replace camshaft and/or cylinder head.

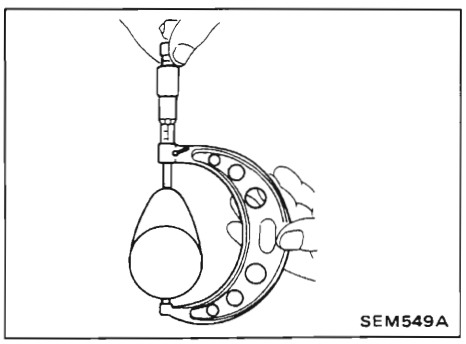
Maximum clearance:
0.10 mm (0.0039 in)

CAMSHAFT RUNOUT

Camshaft Runout [T.I.R. (Total Indicator Reading)]
Limit 0.05 mm (0.0020 in)

If beyond the limit, replace.

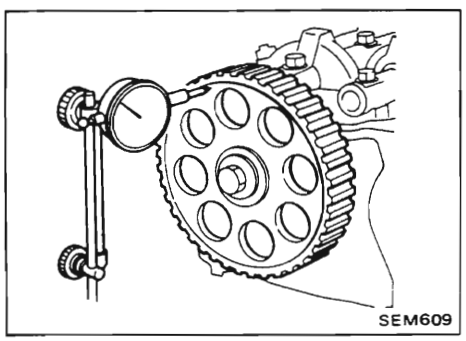

*: Total indicator reading
SEM155


SEM549A

CAMSHAFT CAM HEIGHT

Standard cam height:
38.834 - 38.884 mm (1.5289 - 1.5309 in)
Cam wear:
Limit 0.2 mm (0.008 in)

If wear is beyond the limit, replace.

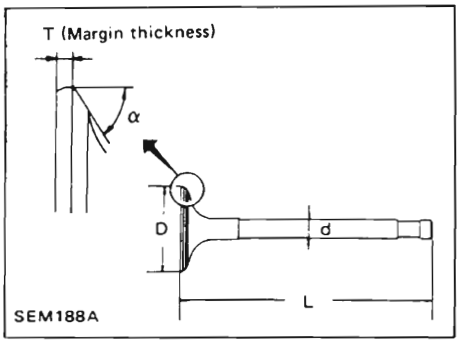

SEM609

CAMSHAFT SPROCKET RUNOUT

Install sprocket on camshaft and check for runout.

If runout exceeds the specified limit, replace camshaft sprocket.

Runout:
(Total indicator reading)
Limit 0.1 mm (0.004 in)

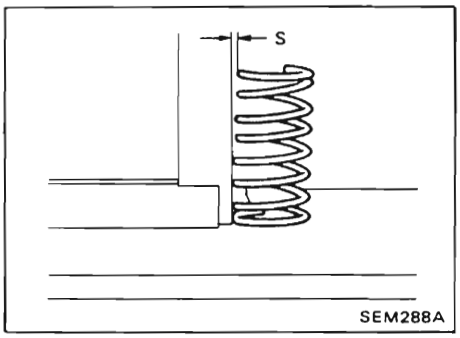


VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to S.D.S.

When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace the valve.

Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.



VALVE SPRING SQUARENESS

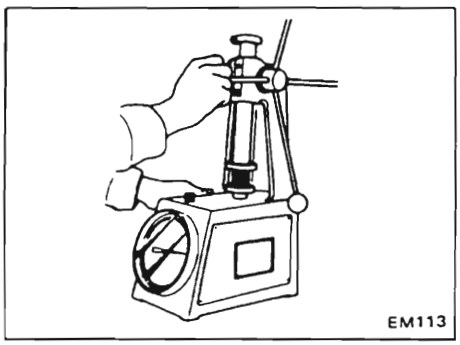
Out of square:

Outer

Less than 2.2 mm (0.087 in)

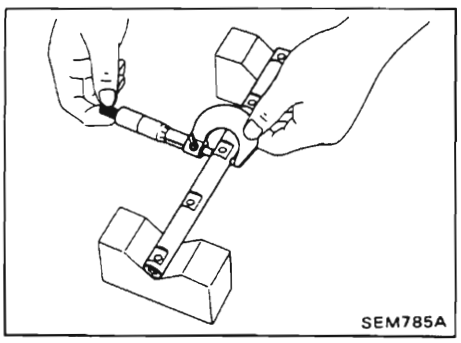
Inner

Less than 1.9 mm (0.075 in)



VALVE SPRING PRESSURE LOAD

Refer to S.D.S.

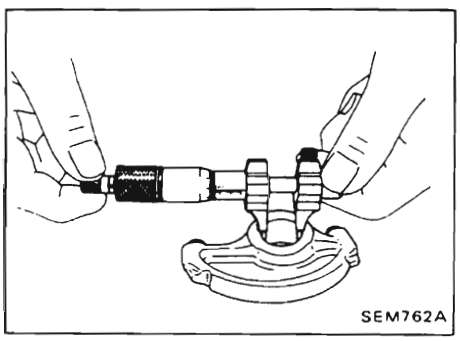


ROCKER SHAFT AND ROCKER ARM

1. Check rocker shafts and rocker arms for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

Diameter mm (in):

19.979 - 20.000 (0.7866 - 0.7874)



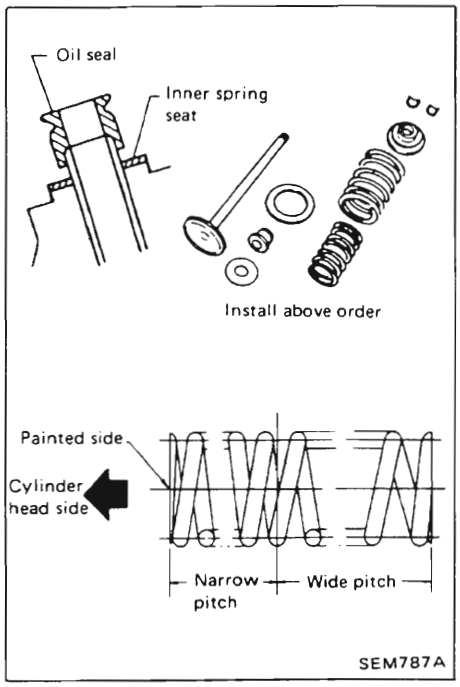
3. Check inner diameter of rocker arm.

Diameter mm (in):

20.007 - 20.028 (0.7877 - 0.7885)

Rocker arm to shaft clearance:

0.007 - 0.049 (0.0003 - 0.0019)



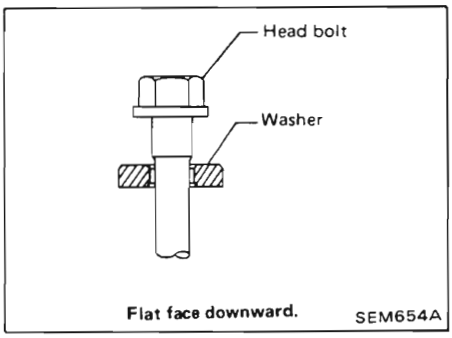
1. Install valve component parts.
- Always use new valve oil seal. **(Refer to EM-73)**
- Before installing valve oil seal, install inner valve spring seat.
- Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.

2. Install camshaft.
3. Install camshaft locate plate.

: **Locate plate bolt**
78 - 88 N·m
(8.0 - 9.0 kg-m, 58 - 65 ft-lb)

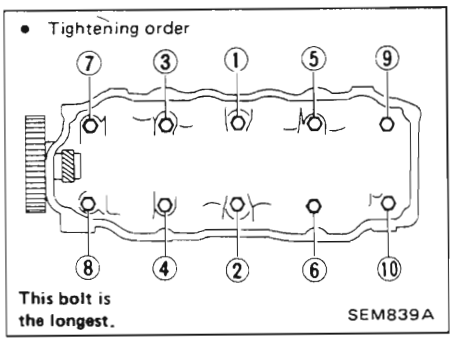
4. Apply engine oil to camshaft oil seal and install it in place.

Always use new camshaft oil seal.



1. Install cylinder head with new gasket.
- **Be sure to install washers between bolts and head.**

Do not rotate crankshaft and camshaft separately, because valves will hit piston heads.

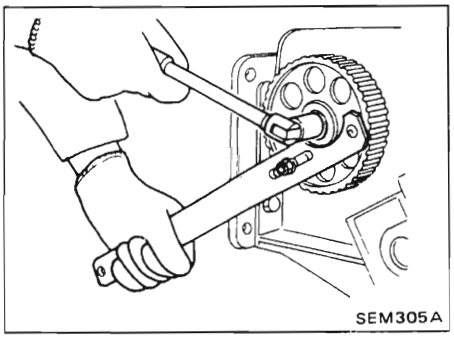


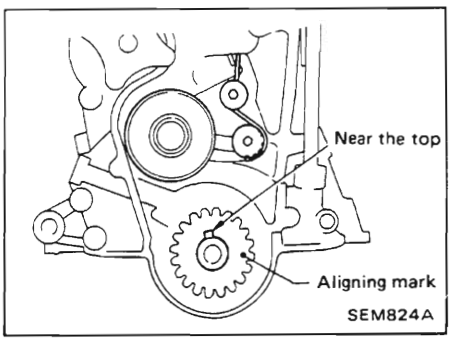
2. Apply oil to the thread portion and seat surface of bolts and tighten cylinder head bolts.
- **Tightening procedure.**

1st **Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).**
2nd **Tighten all bolts to 78 N·m (8.0 kg-m, 58 ft-lb).**
3rd **Loosen all bolts completely.**
4th **Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).**
5th **Using an angle wrench, turn bolt ⑧ 83 to 88 degrees and the other bolts 75 to 80 degrees clockwise.**

3. Install camshaft, locating plate, rear cover and camshaft pulley.

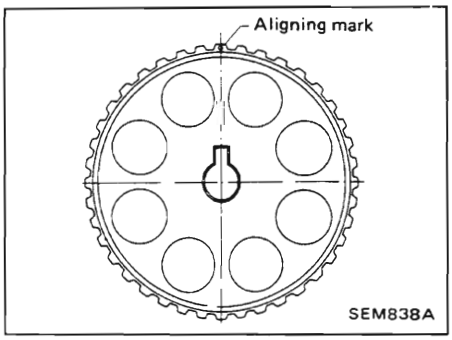
: **Camshaft pulley:**
78 - 88 N·m (8.0 - 9.0 kg-m, 58 - 65 ft-lb)
Locating plate bolt:
78 - 88 N·m (8.0 - 9.0 kg-m, 58 - 65 ft-lb)



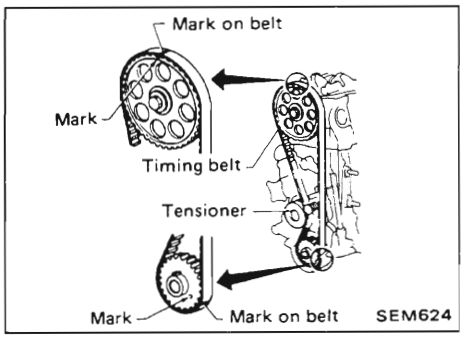


4. Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke as follows:

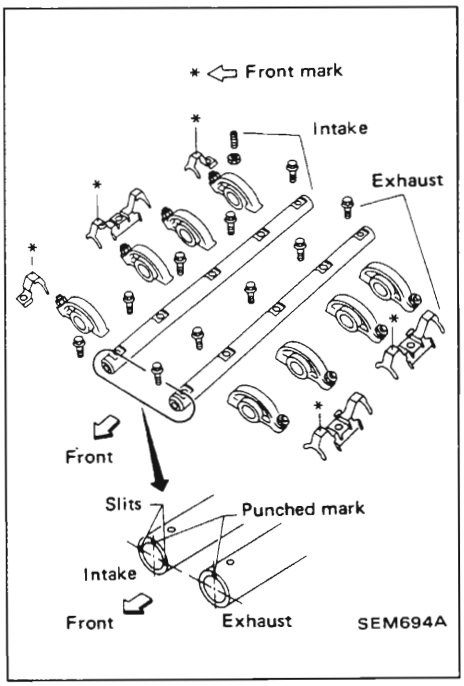
(1) Check crankshaft key near to the top.



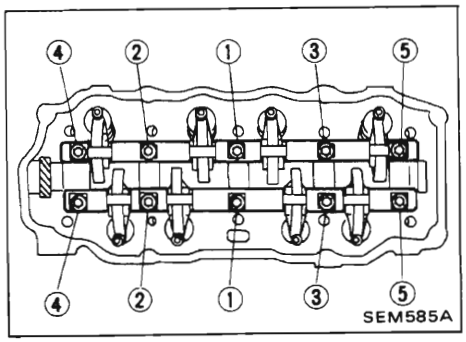
(2) Check camshaft pulley aligning mark at the top.



5. Install timing belt and adjust belt tension.
Refer to "TIMING BELT-Installation".

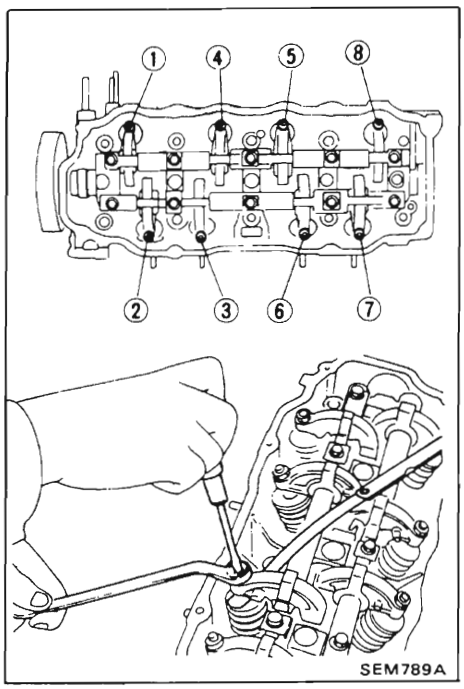


6. Install rocker shaft with rocker arms.
To prevent rocker shaft springs from slipping out of rocker shafts, insert bracket bolts into shaft.



7. Tighten rocker shaft bolts.
- **Tighten bolts gradually, in two or three stages in the sequence shown in the figure.**
- **Make sure that valve clearance adjusting screws are fully loosened.**

Rocker shaft bolts:
: 18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)



8. Adjust valve clearance.
(1) Set No. 1 cylinder in top dead center on its compression stroke, and adjust valve clearance ①, ②, ④ and ⑥.
(2) Set No. 4 cylinder in top dead center on its compression stroke, and adjust valve clearance ③, ⑤, ⑦ and ⑧.

Valve clearance

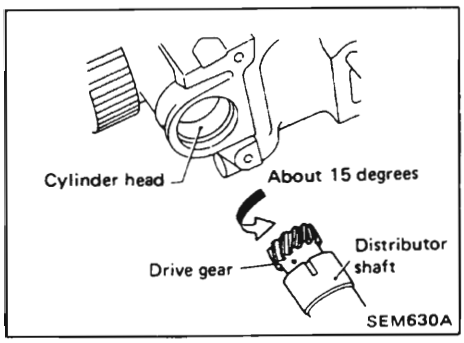
Unit: mm (in)

	COLD*	HOT
Intake	0.21 (0.008)	0.30 (0.012)
Exhaust	0.23 (0.009)	0.30 (0.012)

*: At temperature 20°C (68°F)

Adjusting screw lock nuts:
: 18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

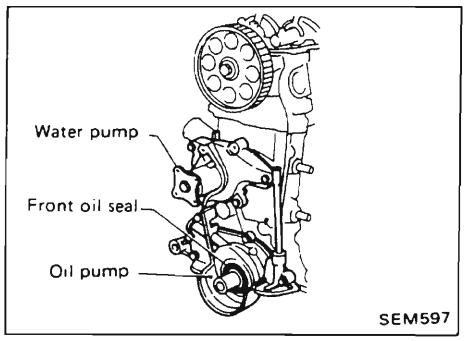
9. Install intake and exhaust manifolds.
: Intake manifold:
20 - 25 N·m (2.0 - 2.6 kg-m, 14 - 19 ft-lb)
Exhaust manifold:
20 - 29 N·m (2.0 - 3.0 kg-m, 14 - 22 ft-lb)



10. Install distributor.
Set the distributor gear position.
- **Align distributor gear mark advanced by one tooth with the mark on the shaft.**

Removal

1. Drain engine oil and remove oil pan.
2. Remove timing belt.



3. Remove oil pump assembly.

Inspection

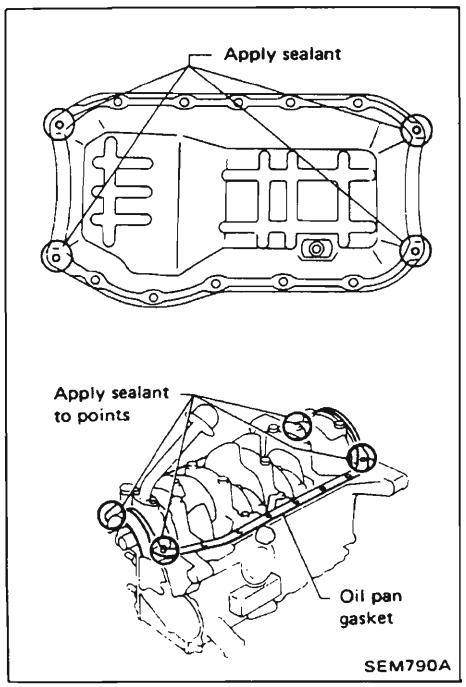
Refer to LC section.

Installation

Always install with new oil seal.

1. Install oil pump assembly.

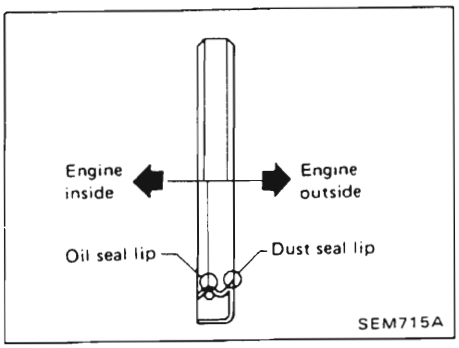
   : **12 - 16 N·m (1.2 - 1.6 kg-m, 9 - 12 ft-lb)**



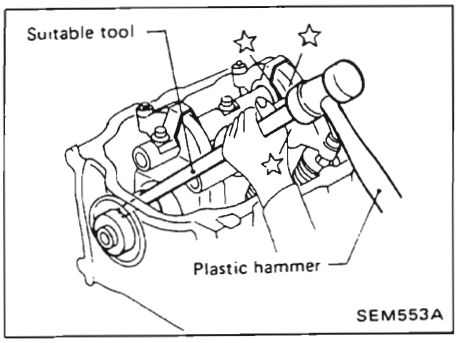
2. Apply sealant to oil pan and oil pan gasket.
3. Install gasket and oil pan.

   : **Oil pan:**
   5 - 7 N-m
   (0.5 - 0.7 kg-m, 3.6 - 5.1 ft-lb)

   : **Drain plug:**
   29 - 39 N·m
   (3.0 - 4.0 kg-m, 22 - 29 ft-lb)



OIL SEAL INSTALLING DIRECTION

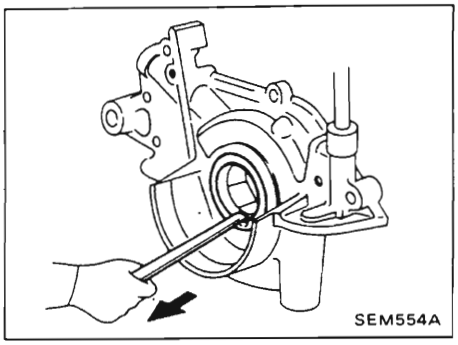


CAMSHAFT OIL SEAL

1. Remove timing belt and camshaft sprocket.
2. Remove camshaft oil seal.

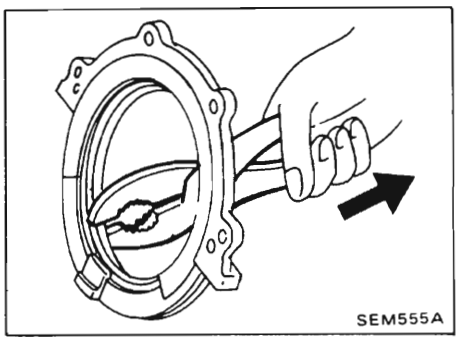
Be careful not to scratch camshaft.

3. Apply engine oil to camshaft oil seal and install it in place.



FRONT OIL SEAL

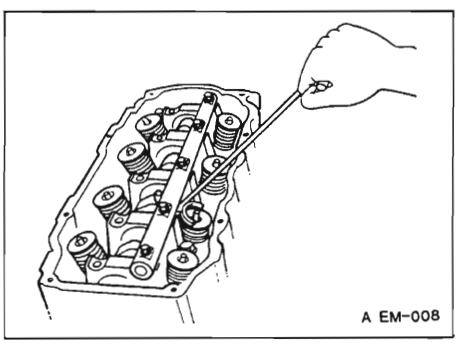
1. Remove oil pump assembly.
2. Remove crankshaft oil seal.
3. Apply engine oil to oil seal and install it in place.



REAR OIL SEAL

1. Remove flywheel and rear oil seal retainer.
2. Remove rear oil seal from the retainer.
3. Apply engine oil to oil seal and install it in place.
4. Install rear oil seal retainer with gasket.

: 4 - 6 N·m (0.4 - 0.6 kg-m, 2.9 - 4.3 ft-lb)

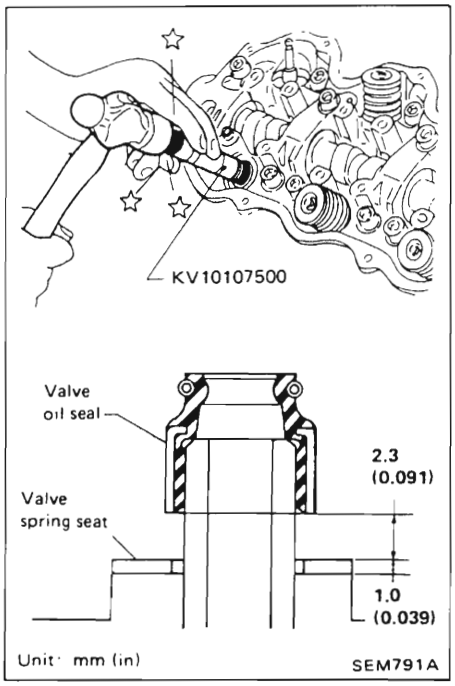


VALVE OIL SEAL

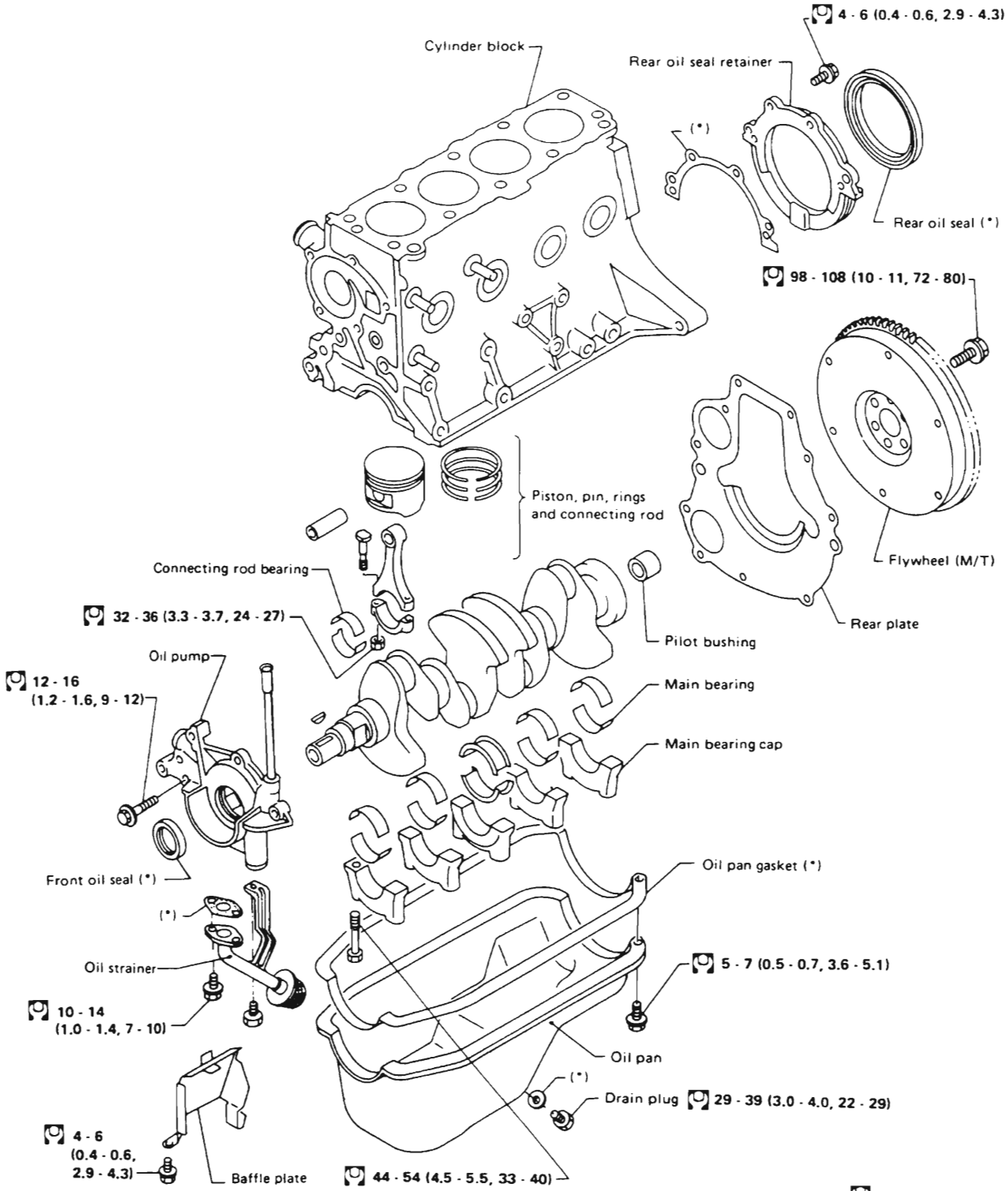
1. Remove rocker cover.
2. Remove rocker shaft assembly.
3. Remove one spark plug.
4. Install air hose adapter into spark plug hole and apply air pressure to hold valves in place [Apply pressure of 490 kPa (4.9 bar, 5 kg/cm², 71 psi)].

When performing this operation piston should be set at T.D.C.

5. Remove valve spring and valve oil seal.



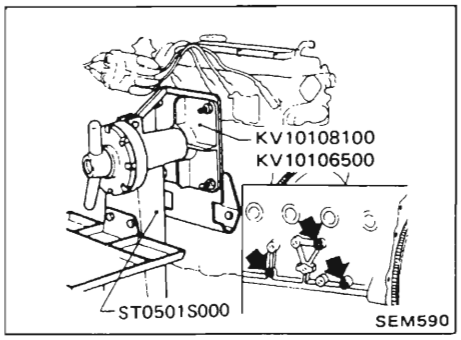
6. Apply engine oil to valve oil seal and install it in place.
Before installing valve oil seal, install inner valve spring seat.



N·m (kg-m, ft-lb)

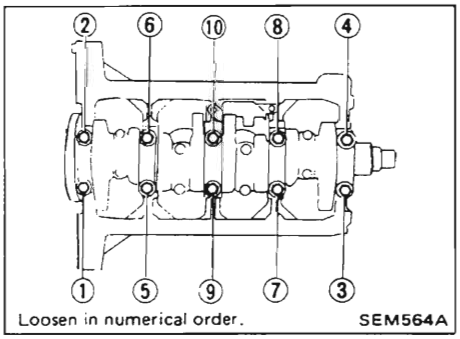
- **When installing sliding parts such as bearings, be sure to apply engine oil on the sliding surfaces.**
- (*) Always use new gaskets, oil seals and sealing washers.

SEM539A



PISTON AND CRANKSHAFT

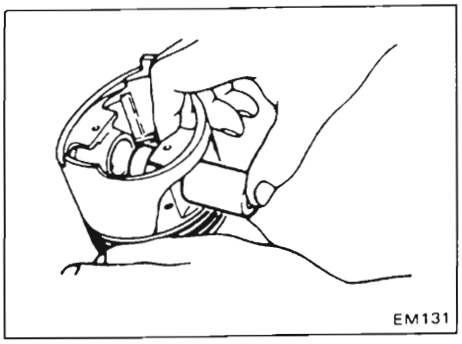
1. Place engine on work stand.
2. Remove timing belt.
3. Drain coolant and oil.
4. Remove water pump.
5. Remove oil pan and oil pump.
6. Remove cylinder head.
7. Remove pistons.



8. Remove bearing cap and crankshaft.

Place the bearings and caps in their proper order.

Upper bearings (Cylinder block side) have oil groove.

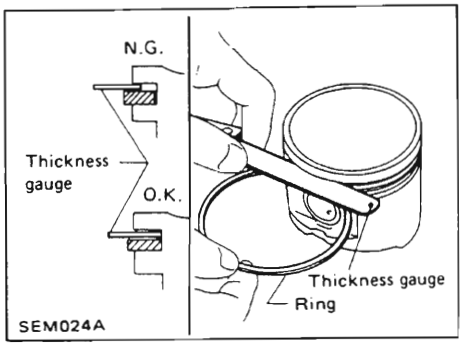

EM131

PISTON AND PISTON PIN CLEARANCE

- Confirm piston pin is a smooth push fit by hand at room temperature.

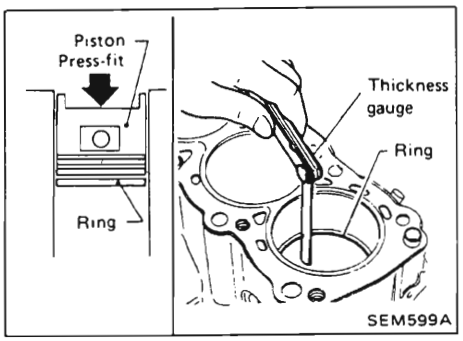
Piston pin to piston clearance:
0.008 - 0.012 mm (0.0003 - 0.0005 in)

Apply engine oil to piston pin.



PISTON RING SIDE CLEARANCE

Side clearance:
Top ring
0.040 - 0.073 mm (0.0016 - 0.0029 in)
2nd ring
0.030 - 0.063 mm (0.0012 - 0.0025 in)
Max. limit of side clearance (Top and 2nd rings):
0.1 mm (0.004 in)

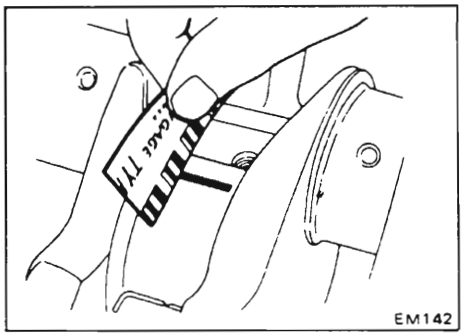


PISTON RING GAP

Standard ring gap mm (in):
Top ring
0.25 - 0.51 (0.0098 - 0.0201)
2nd ring
0.15 - 0.31 (0.0059 - 0.0122)
Oil ring (Rail ring)
0.20 - 0.76 (0.0079 - 0.0299)
Max. limit of ring gap:
1.0 mm (0.039 in)

BEARING CLEARANCE

Bearing clearance:
Main bearing
0.020 - 0.047 mm (0.0008 - 0.0019 in)
Limit 0.1 mm (0.004 in)
Connecting rod bearing
0.010 - 0.044 mm (0.0004 - 0.0017 in)
Limit 0.1 mm (0.004 in)


EM142

Method A (Using plastigage)

CAUTION:

- Do not turn crankshaft or connecting rod while the plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. However, if excessive bearing clearance still exists, use thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.

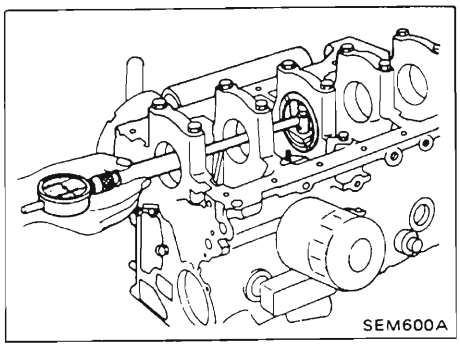
Method B (Using dial gauge & micrometer)

MAIN BEARING

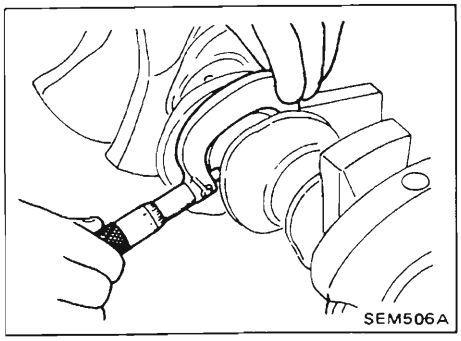
1. Install main bearings to cylinder block and main bearing cap.
2. Install main bearing cap to cylinder block.

Tighten all bolts in correct order and in two or three stages.

: 44 - 54 N·m (4.5 - 5.5 kg-m, 33 - 40 ft-lb)


SEM600A

3. Measure inside diameter "A" of main journal.


SEM506A

4. Measure outside diameter "Dm" of main journal in crankshaft.

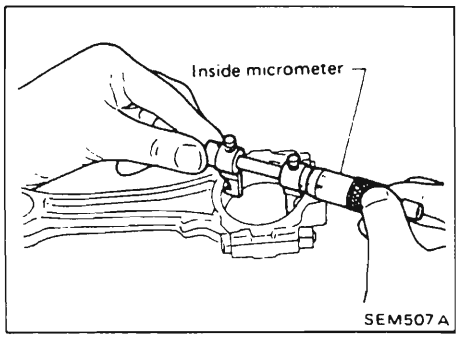
5. Calculate main bearing clearance.
   Main bearing clearance = A – Dm

CONNECTING ROD BEARING

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

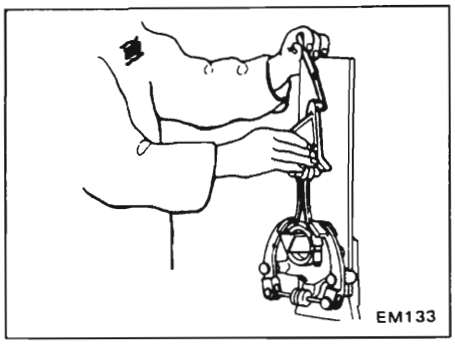
Apply oil to the thread portion of bolts and seating surface of nuts.

: 32 - 36 N·m (3.3 - 3.7 kg-m, 24 - 27 ft-lb)



SEM507A

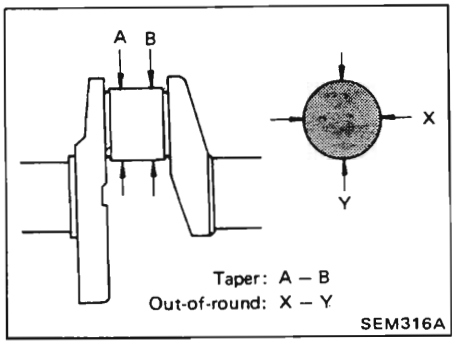
3. Measure inside diameter "C" of bearing.
4. Measure outside diameter "Dp" of crankshaft pin journal.
5. Calculate connecting rod bearing clearance.
   Connecting rod bearing clearance = C – Dp


EM133

CONNECTING ROD BEND AND TORSION

Bend and torsion:

Limit 0.1 mm (0.004 in) per 100 mm (3.94 in) length



SEM316A

CRANKSHAFT

1. Check crankshaft journals for score, bias, wear or cracks.

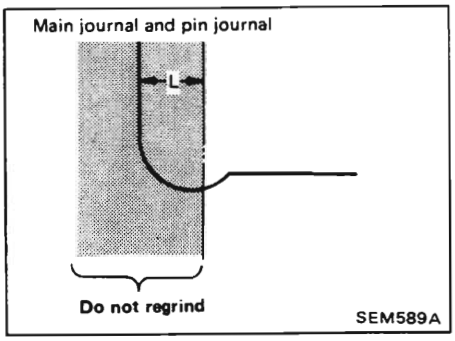
2. Check journals with a micrometer for taper and out-of-round.

Out-of-round (X – Y):

Less than 0.03 mm (0.0012 in)

Taper (A – B):

Less than 0.03 mm (0.0012 in)



SEM589A

a. **Fillet roll should not be reground.**

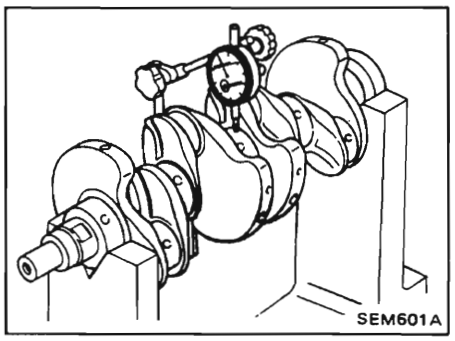
L: Pin journal

2.5 mm (0.098 in)

Main journal

2.0 mm (0.079 in)

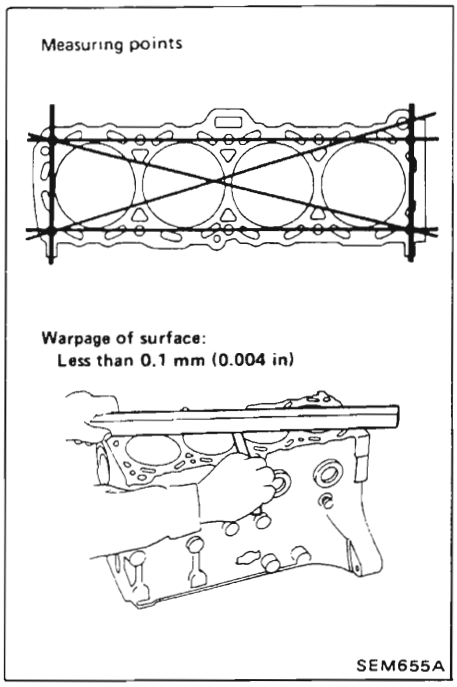
b. **Refer to S.D.S. for regrinding crankshaft and available service parts.**


SEM601A

3. Check crankshaft runout.

Runout [T.I.R. (Total Indicator Reading)]:

Less than 0.05 mm (0.0020 in)



CYLINDER BLOCK DISTORTION AND WEAR

1. If beyond the specified limit, resurface it.

Nominal cylinder block height:
223.25 - 223.35 mm (8.7894 - 8.7933 in)

Resurfacing limit:

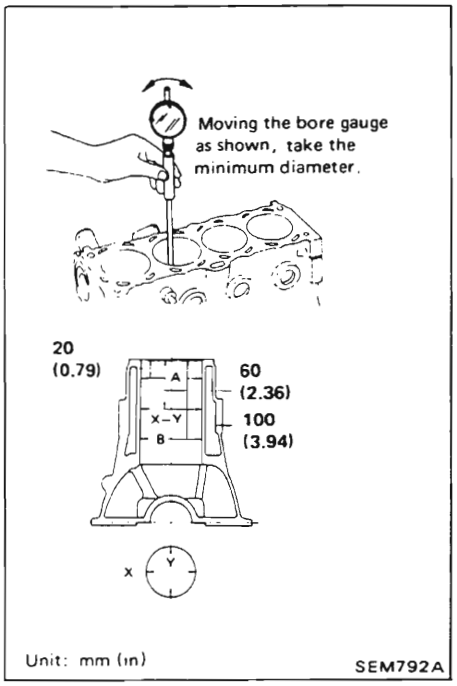
The resurfacing limit of cylinder block is determined by the cylinder head resurfacing in an engine.

Amount of cylinder head resurfacing is "A"

Amount of cylinder block resurfacing is "B"

The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)



2. Using a bore gauge, measure cylinder bore for wear, out-of-round or taper.

Standard inside diameter:
84.50 - 84.55 mm (3.3268 - 3.3287 in)
Refer to S.D.S.

Wear limit:
0.20 mm (0.0079 in)

Out-of-round (X-Y) limit:
0.02 mm (0.0008 in)

Taper (A-B) limit:
0.02 mm (0.0008 in)

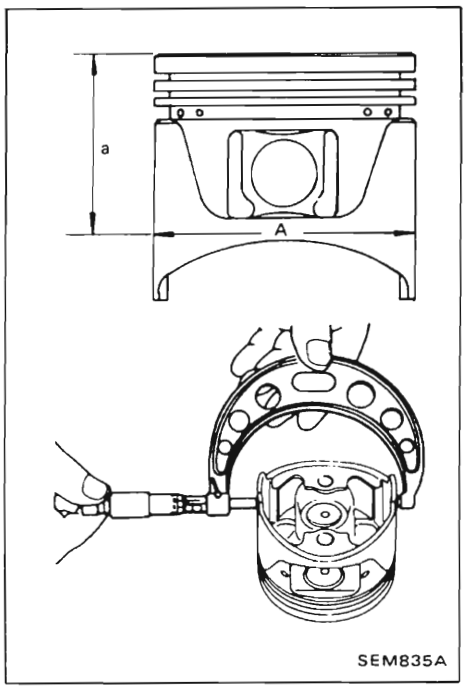
3. Check for scratches or seizure. If seizure is found, hone it.

CYLINDER BORING

When any cylinder needs boring, all other cylinders must also be bored at the same time.

1. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service. Refer to S.D.S.



2. The size to which cylinders must be honed is, determined by adding piston-to-cylinder clearance to the piston skirt diameter "A".

Dimension "a":
45.0 mm (1.772 in)

Rebored size calculation

D = A + B – C = A + [0.005 to 0.025 mm (0.0002 to 0.0010 in)]

where,

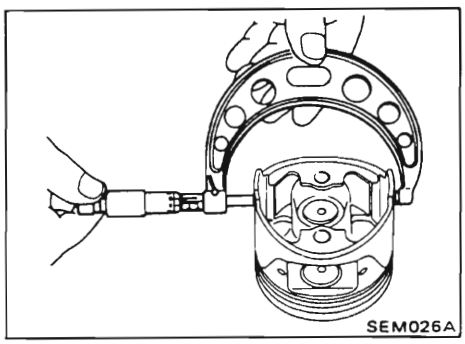
- **D : Honed diameter**
- **A : Skirt diameter as measured**
- **B : Piston-to-wall clearance**
- **C : Machining allowance**
  0.02 mm (0.0008 in)

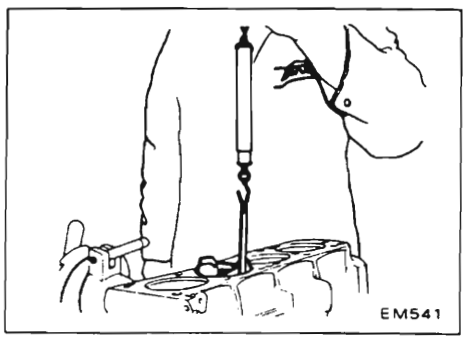
3. Install main bearing caps in place, and tighten to the specified torque to prevent distortion of the cylinder bores in final assembly.
4. Cut cylinder bores in the order of 2-4-1-3.

- **Do not cut too much out of the cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**

5. Hone the cylinders to the required size referring to S.D.S.
6. Measure the finished cylinder bore for out-of-round and taper.

- **Measurement of a just machined cylinder bore requires utmost care since it is expanded by cutting heat.**





PISTON TO CYLINDER WALL CLEARANCE

Using micrometer

1. Measure piston and cylinder bore diameter.

Piston diameter "A":
Refer to S.D.S.
Measuring point "a" (Distance from the bottom):
45.0 mm (1.772 in)

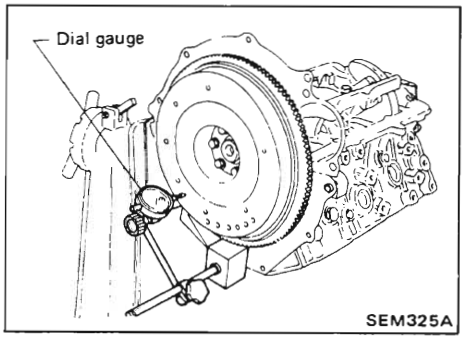
2. Check that piston clearance is within the specification.

Piston clearance:
0.025 - 0.045 mm (0.0010 - 0.0018 in)

Using feeler gauge

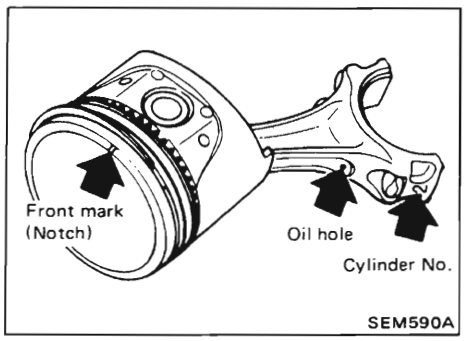
Measure the extracting force by pulling feeler gauge straight upward.

Feeler gauge thickness:
0.04 mm (0.0016 in)
Extracting force:
2.0 - 14.7 N (0.2 - 1.5 kg, 0.4 - 3.3 lb)



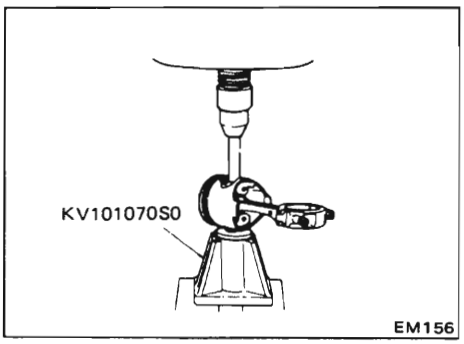
FLYWHEEL RUNOUT

Runout (Total indicator reading):
Less than 0.15 mm (0.0059 in)

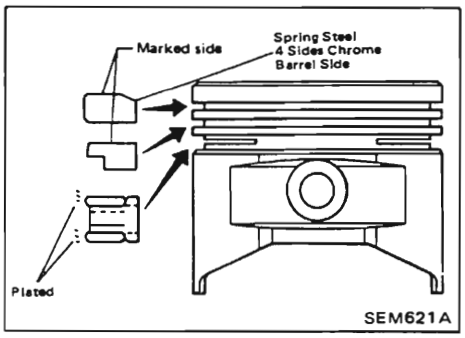


PISTON

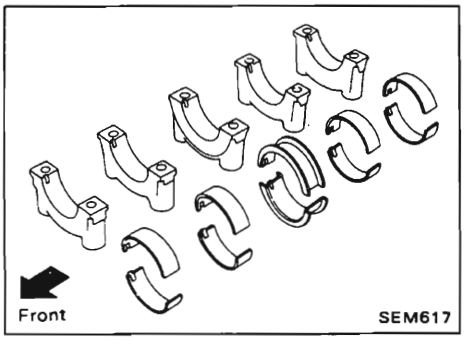
a. Numbers stamped on the connecting rod and cap correspond to each cylinder. Care should be taken to avoid a wrong combination including bearing.



b. When pressing piston pin in connecting rod, apply engine oil to pin and small end of connecting rod.
c. After assembling, ascertain that piston swings smoothly.



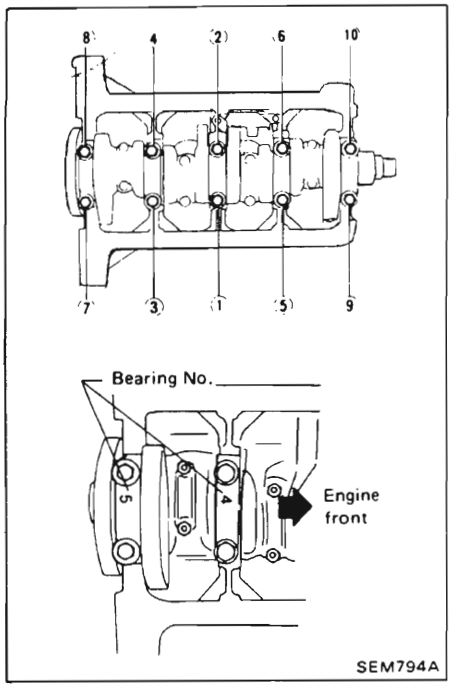
1. Install piston rings.



CRANKSHAFT

1. Set main bearings in the proper position on cylinder block.

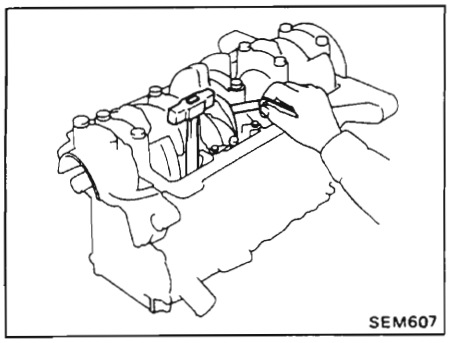
If either crankshaft, cylinder block or main bearing is reused it is necessary to measure main bearing clearance.
Upper bearings (Cylinder block side) have oil groove.



2. Apply engine oil to main bearing surfaces on both sides of cylinder block and cap.
3. Install crankshaft and main bearing caps and tighten bolts to specified torque.

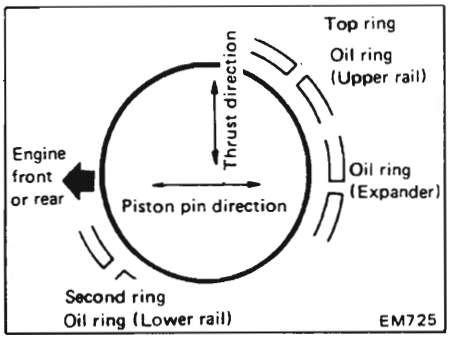
   : Main bearing cap bolt
   44 - 54 N·m
   (4.5 - 5.5 kg-m, 33 - 40 ft-lb)

- Arrange the parts so that the indicated number on bearing cap is in a row from the front of engine.
- Prior to tightening bearing cap bolts, place bearing cap in proper position by shifting crankshaft in the axial direction.
- **Tighten bearing cap bolts gradually in two or three stages in the sequence shown.**
- After securing bearing cap bolts, make sure that crankshaft turn smoothly.

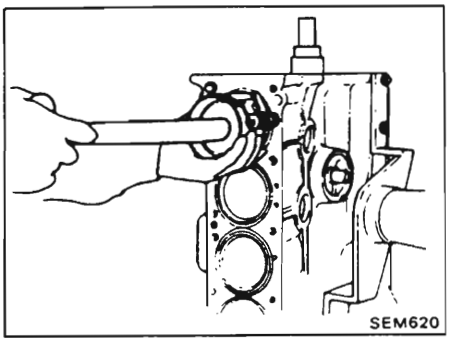


4. Measure crankshaft end play at center bearing.

   Crankshaft end play:
   Limit
   0.30 mm (0.0118 in)



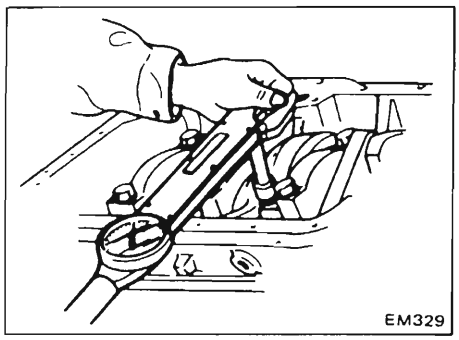
- **Set piston ring as shown.**



5. Install pistons with connecting rods.

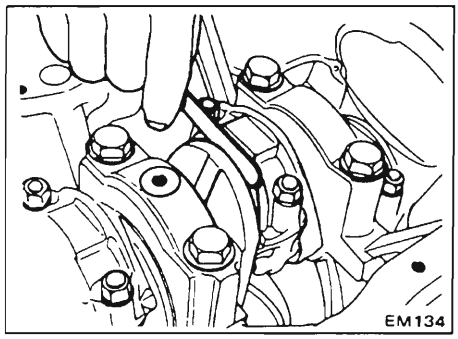
(1) Install them into corresponding cylinder using Tool.

- **Be careful not to scratch cylinder wall with connecting rod.**
- **Apply engine oil to cylinder wall, piston and bearing.**
- **Arrange so that the front mark on piston head faces to the front of engine.**



(2) Install connecting rod bearing caps.

[O] : **Connecting rod bearing nut**
32 - 36 N·m
(3.3 - 3.7 kg-m, 24 - 27 ft-lb)



6. Measure connecting rod side clearance.
Connecting rod side clearance:
Limit 0.30 mm (0.0118 in)

General Specifications

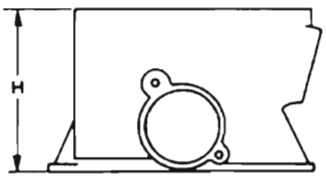
Engine model	CA20
Cylinder arrangement	4, in-line
Displacement cm^3 (cu in)	1,974 (120.45)
Bore x stroke mm (in)	84.5 x 88.0 (3.327 x 3.465)
Valve arrangement	O.H.C.
Firing order	1-3-4-2
Number of piston rings	
Compression	2
Oil	1
Number of main bearings	5
Compression ratio	8.5

Unit kPa (bar, kg/cm^2, psi)/rpm

Compression pressure	
Standard	1,196 (11.96, 12.2, 173)/350
Minimum	902 (9.02, 9.2, 131)/350
Differential limit between cylinders	98 (0.98, 1.0, 14)/350

Inspection and Adjustment

CYLINDER HEAD



SEM529A

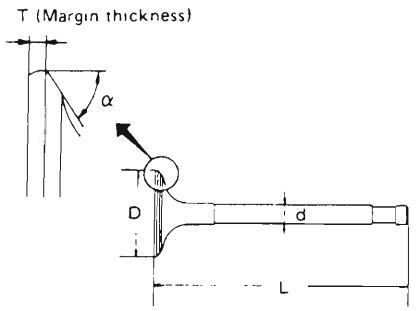
Unit: mm (in)

	Standard	Limit
Height (H)	116.6 - 117.0 (4.591 - 4.606)	0.2 (0.008)*
Surface distortion	0.03 (0.0012)	0.1 (0.004)

*: Total amount of cylinder head resurfacing and cylinder block resurfacing

Inspection and Adjustment (Cont'd)

VALVE



SEM188A

Unit mm (in)

Engine model	CA20	Limit
Valve head diameter (D) In.	40.0 - 40.2 (1.575 - 1.583)	–
Ex.	35.0 - 35.2 (1.378 - 1.386)	–
Valve length (L) In	105.25 - 105.55 (4.1437 - 4.1555)	–
Ex.	107.79 - 108.21 (4.2437 - 4.2602)	–
Valve stem diameter (d) In.	6.965 - 6.980 (0.2742 - 0.2748)	–
Ex.	6.945 - 6.960 (0.2734 - 0.2740)	
Valve face angle (α) In.	45°15' - 45°45'	–
Ex.		
Valve head margin (T) In.	1.15 - 1.45 (0.0453 - 0.0571)	0.5 (0.020)
Ex.	1.35 - 1.65 (0.0531 - 0.0650)	
Valve stem end surface grinding limit	–	0.2 (0.008)

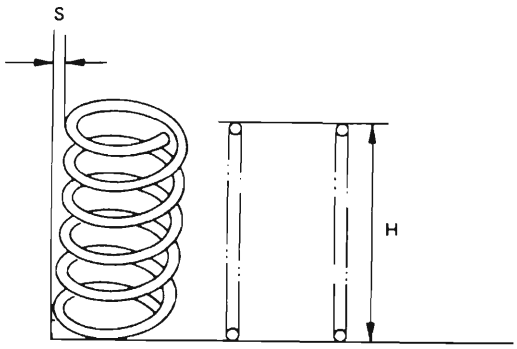
VALVE CLEARANCE

Unit: mm (in)

	COLD*	HOT
Intake	0.21 (0.008)	0.30 (0.012)
Exhaust	0.23 (0.009)	0.30 (0.012)

* At temperature 20°C (68°F)

VALVE SPRING



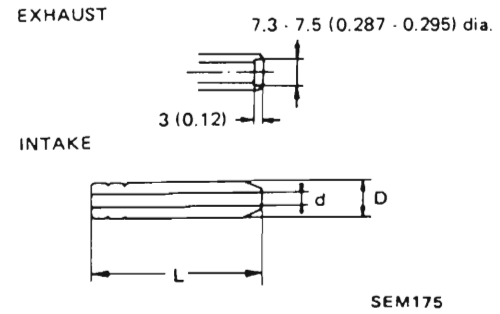
SEM567A

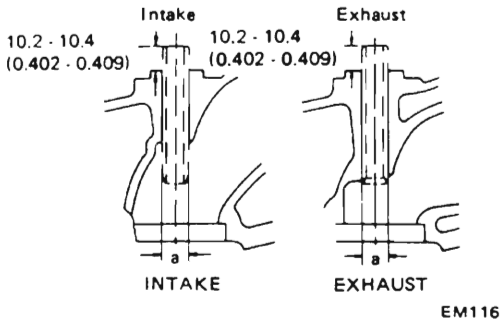
Unit: mm (in)

	Standard	Limit
Free height (H) Outer	49.98 (1.9677)	–
Inner	44.1 (1.736)	–
Pressure height mm/N (mm/kg, in/lb) Outer	29.5/480.5 (29.5/49.0, 1.161/108.0)	–
Inner	25.0/255.0 (25.0/26.0, 0.984/57.3)	–
Assembled height mm/N (mm/kg, in/lb) Outer	40.0/208.9 (40.0/21.3, 1.575/47.0)	–
Inner	35.0/107.9 (35.0/11.0, 1.378/24.3)	–
Out of square (S) Outer	–	2.2 (0.087)
Inner	–	1.9 (0.075)

Inspection and Adjustment (Cont'd)

VALVE GUIDE





Unit: mm (in)

		Standard	Service
Length (L)		45.0 (1.772)	45.0 (1.772)
Outer diameter (D)		11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
Inner diameter (d) [Finished size]		7.000 - 7.018 (0.2756 - 0.2763)	
Cylinder head hole diameter (a)		10.975 - 10.996 (0.4321 - 0.4329)	11.185 - 11.196 (0.4404 - 0.4408)
Interference fit		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit
Stem to guide clearance	In.	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Ex.	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection		–	0.2 (0.008)

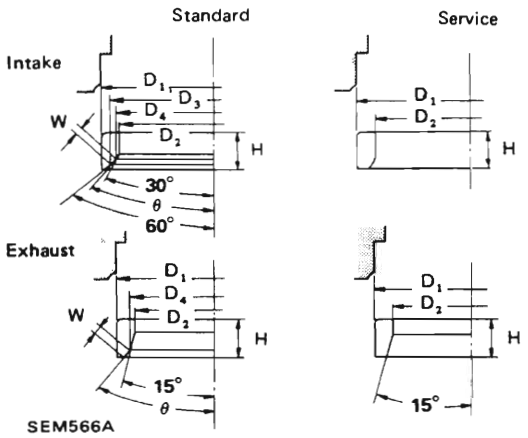
ROCKER SHAFT AND ROCKER ARM

Unit mm (in)

	Standard
Rocker shaft Outer diameter	19.979 - 20.000 (0.7866 - 0.7874)
Rocker arm Inner diameter	20.007 - 20.028 (0.7877 - 0.7885)
Clearance between rocker arm and rocker shaft	0.007 - 0.049 (0.0003 - 0.0019)

Inspection and Adjustment (Cont'd)

VALVE SEAT



Unit: mm (in)

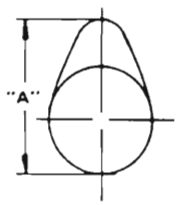
		Standard	Service*
Cylinder head seat recess diameter (D_1)	In.	43.000 - 43.016 (1.6929 - 1.6935)	43.500 - 43.516 (1.7126 - 1.7132)
	Ex.	37.000 - 37.016 (1.4567 - 1.4573)	37.500 - 37.516 (1.4764 - 1.4770)
Valve seat interference fit	In.	0.081 - 0.113 (0.0032 - 0.0044)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (D_1)	In.	43.097 - 43.113 (1.6967 - 1.6974)	43.597 - 43.613 (1.7164 - 1.7170)
	Ex.	37.080 - 37.096 (1.4598 - 1.4605)	37.580 - 37.596 (1.4795 - 1.4802)
Valve seat inner diameter (D_2)	In.	36.85 - 37.15 (1.4508 - 1.4626)	
	Ex.	29.85 - 30.15 (1.1752 - 1.1870)	
Height (H)	In.	7.6 - 7.7 (0.299 - 0.303)	7.0 - 7.1 (0.276 - 0.280)
	Ex.	7.4 - 7.5 (0.291 - 0.295)	
Face angle (θ)	In.	45°	
	Ex.	45°	
Contacting width (W)	In.	1.8 - 2.1 (0.071 - 0.083)	
	Ex.	1.4 - 1.8 (0.055 - 0.071)	
Face inner diameter (D_4)	In.	37.8 (1.488)	*: Valve seat surface must be corrected into specified value.
	Ex.	34.4 - 34.6 (1.354 - 1.362)	
Face outer diameter (D_3)	In.	40.6 - 40.8 (1.598 - 1.606)	

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Max. tolerance
Camshaft journal to bearing clearance	–	0.1 (0.004)
Inner diameter of camshaft bearing	46.000 - 46.016 (1.8110 - 1.8116)	–
Outer diameter of camshaft journal	#1 - #4 45.935 - 45.955 (1.8085 - 1.8092) #5 45.915 - 45.935 (1.8077 - 1.8085)	–
Camshaft runout [T.I.R.*]	–	0.05 (0.0020)
Camshaft end play	0.07 - 0.14 (0.0028 - 0.0055)	0.2 (0.008)

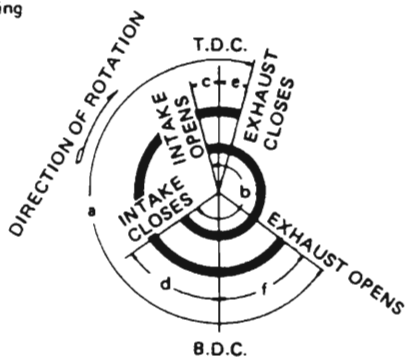


EM671

Cam height "A" Intake Exhaust	38.834 - 38.884 (1.5289 - 1.5309)
Wear limit of cam height	0.2 (0.008)

*Total indicator reading

Valve timing

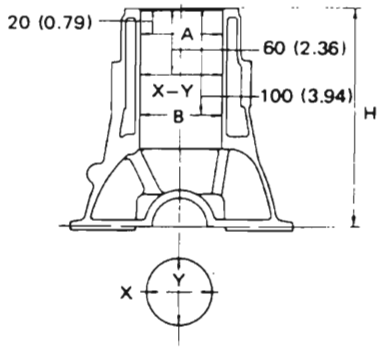


EM120

Unit: degree

a	b	c	d	e	f
240	240	12	48	14	54

CYLINDER BLOCK



SEM528A

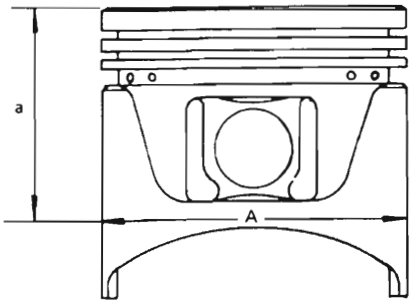
Unit: mm (in)

	Standard	Limit (*: Wear limit)
Engine model	CA20	
Height (H)	223.25 - 223.35 (8.7894 - 8.7933)	0.2 (0.008)*
Surface flatness	0.03 (0.0012)	0.1 (0.004)
Cylinder bore Inner diameter Standard Grade No. 1	84.50 - 84.51 (3.3268 - 3.3272)	0.2 (0.008)*
Grade No. 2	84.51 - 84.52 (3.3272 - 3.3276)	
Grade No. 3	84.52 - 84.53 (3.3276 - 3.3279)	
Grade No. 4	84.53 - 84.54 (3.3279 - 3.3283)	
Grade No. 5	84.54 - 84.55 (3.3283 - 3.3287)	
For oversize piston 0.02 (0.0008) (Standard for service)	84.52 - 84.57 (3.3276 - 3.3295)	
0.5 (0.020)	85.00 - 85.05 (3.3465 - 3.3484)	
1.0 (0.039)	85.50 - 86.00 (3.3661 - 3.3858)	
Out-of-round (X-Y)	Less than 0.015 (0.0006)	0.02 (0.0008)
Taper (A-B)	Less than 0.01 (0.0004)	0.02 (0.0008)
Difference in inner diameter between cylinders	Less than 0.05 (0.0020)	0.2 (0.008)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Piston



SEM765A

Unit mm (in)

Engine model	CA20
Piston skirt diameter (A) Standard Grade No. 1	84.465 - 84.475 (3.3254 - 3.3258)
Grade No. 2	84.475 - 84.485 (3.3258 3.3262)
Grade No. 3	84.485 - 84.495 (3.3262 - 3.3266)
Grade No. 4	84.495 - 84.505 (3.3266 - 3.3270)
Grade No. 5	84.505 - 84.515 (3.3270 - 3.3274)
Service (Oversize) 0.02 (0.001) (Standard for service)	84.485 - 84.535 (3.3262 - 3.3281)
0.5 (0.020)	84.965 - 85.015 (3.3451 - 3.3470)
1.0 (0.039)	85.465 - 85.515 (3.3648 - 3.3667)
Dimension (a)	45.0 (1.772)
Piston pin hole diameter	20.003 - 20.012 (0.7875 - 0.7879)
Piston skirt to cylinder bore clearance	0.025 - 0.045 (0.0010 - 0.0018)
Feeler gauge extraction force with gauge thickness 0.04 mm (0.0016 in) N (kg, lb)	2.0 - 14.7 (0.2 - 1.5, 0.4 - 3.3)

Piston ring

Unit mm (in)

	Standard	Limit
Engine model	CA20	
Side clearance Top	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
2nd	0.030 - 0.063 (0.0012 0.0025)	
Ring gap Top	0.25 - 0.51 (0.0098 - 0.0201)	1.0 (0.039)
2nd	0.15 - 0.31 (0.0059 - 0.0122)	
Oil (Rail)	0.20 - 0.76 (0.0079 - 0.0299)	

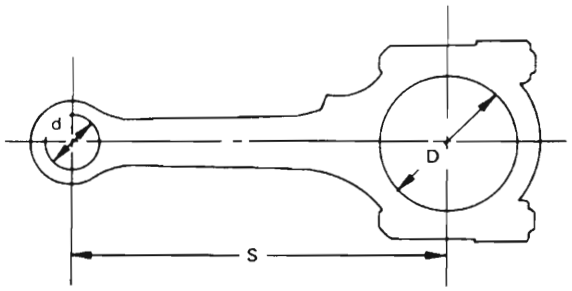
Piston pin

Unit mm (in)

	CA20
Piston pin outer diameter	19.995 - 20.000 (0.7872 - 0.7874)
Piston pin to piston pin bore clearance	0.003 - 0.017 (0.0001 - 0.0007)
Interference fit of piston pin to connecting rod	0.017 - 0.038 (0.0007 - 0.0015)

Inspection and Adjustment (Cont'd)

CONNECTING ROD

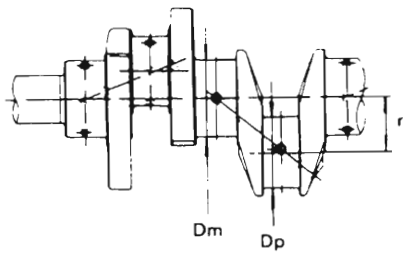


SEM570A

Unit: mm (in)

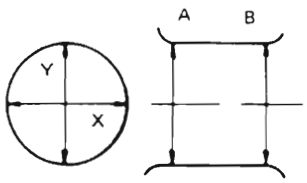
	Standard	Limit
Engine model	CA20	
Center distance (S)	149.25 - 149.35 (5.8760 - 5.8799)	–
Bend [per 100 mm (3.94 in)]	Less than 0.05 (0.0020)	0.10 (0.0039)
Torsion [per 100 mm (3.94 in)]	Less than 0.05 (0.0020)	0.10 (0.0039)
Piston pin bore diameter (d)	19.965 - 19.978 (0.7860 - 0.7865)	–
Crank pin bore diameter (D)	48.000 - 48.013 (1.8898 - 1.8903)	–
Big end play	0.2 - 0.3 (0.008 - 0.012)	0.3 (0.012)

CRANKSHAFT



EM737

Out-of-round X – Y
Taper A – B



EM715

Unit: mm (in)

Engine model	CA20
Main journal diameter (Dm)	52.951 - 52.964 (2.0847 - 2.0852)
Pin journal diameter (Dp)	44.961 - 44.974 (1.7701 - 1.7706)
Center distance (r)	43.97 - 44.03 (1.7311 - 1.7335)
	Limit
Taper of journal and pin (A – B)	0.03 (0.0012)
Out-of-round of journal and pin (X – Y)	0.03 (0.0012)
Bend	0.05 (0.0020)
Free play	0.3 (0.012)
Runout [T.I.R.]	0.05 (0.0020)

Inspection and Adjustment (Cont'd)

BEARING

Bearing clearance

Unit: mm (in)

	Standard	Limit
Main bearing clearance	0.020 - 0.047 (0.0008 - 0.0019)	0.1 (0.004)
Connecting rod bearing clearance	0.010 - 0.044 (0.0004 - 0.0017)	0.1 (0.004)

Main bearing undersize

Unit: mm (in)

	Crankshaft journal diameter
Standard	52.951 - 52.964 (2.0847 - 2.0852)
0.25 (0.0098) Undersize	52.701 - 52.714 (2.0748 - 2.0754)
0.50 (0.0197) Undersize	52.451 - 52.464 (2.0650 - 2.0655)

Connecting rod bearing undersize

Unit: mm (in)

	Crankshaft pin diameter
Engine model	CA20
Standard	44.961 - 44.974 (1.7701 - 1.7706)
0.08 (0.0031) Undersize	44.881 - 44.894 (1.7670 - 1.7675)
0.12 (0.0047) Undersize	44.841 - 44.854 (1.7654 - 1.7659)
0.25 (0.0098) Undersize	44.711 - 44.724 (1.7603 - 1.7608)
0.50 (0.0197) Undersize	44.461 - 44.474 (1.7504 - 1.7509)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket runout [T.I.R.]	Less than 0.1 (0.004)
Flywheel runout [T.I.R.]	Less than 0.15 (0.0059)

Tightening Torque

Unit	N·m	kg-m	ft-lb
Engine front side			
Alternator adjusting bar	14 17	1.4 1.7	10 12
Belt tensioner bolt	15 20	1.5 2.0	11 - 14
Crank pulley damper bolt	123 - 132	12.5 13.5	90 - 98
Crank pulley to damper bolt	12 14	1.2 1.4	9 10
Front cover bolt	3 - 5	0.3 - 0.5	2.2 - 3.6
Water pump bolt	16 - 20	1.6 2.0	12 - 14
Water pump pulley bolt	6 - 10	0.6 - 1.0	4.3 - 7.2
Engine right side			
Alternator bolt	41 59	4.2 - 6.0	30 - 43
Throttle chamber bolts	18 - 22	1.8 - 22	13 - 16
Intake manifold bolts and nuts	20 - 25	2.0 - 2.6	14 - 19
P C V valve	29 - 39	3.0 - 4.0	22 - 29
Water outlet	18 - 22	1.8 - 2.2	13 - 16
Engine left side			
Distributor securing bolt	5 - 6	0.5 - 0.6	3.6 - 4.3
Air conditioner compressor bracket	69 - 78	7.0 - 8.0	51 - 58
Air conditioner compressor to bracket	44 - 54	4.5 - 5.5	33 - 40
Exhaust manifold	20 - 29	2.0 - 3.0	14 - 22
Exhaust tube	26 - 36	2.7 - 3.7	20 - 27
Manifold cover	4 - 5	0.4 - 0.5	2.9 - 3.6

Unit	N·m	kg-m	ft-lb
Engine top side			
Camshaft sprocket	78 - 88	8.0 - 9.0	58 - 65
Cylinder head bolt	Refer to page EM-68.		
Rocker shaft	18 - 22	1.8 - 2.2	13 - 16
Valve clearance adjusting screw lock nut	18 - 22	1.8 - 2.2	13 - 16
Rocker cover	1 - 3	0.1 - 0.3	0.7 - 2.2
Spark plug	20 - 29	2.0 - 3.0	14 - 22
Engine bottom side			
Connecting rod cap	32 36	3.3 - 3.7	24 - 27
Main bearing cap	44 - 54	4.5 - 5.5	33 - 40
Oil pump	12 - 16	1.2 - 1.6	9 - 12
Oil strainer	10 - 14	1.0 - 1.4	7 - 10
Oil pan	5 - 7	0.5 - 0.7	3.6 - 5.1
Oil pan drain plug	29 - 39	3.0 - 4.0	22 - 29
Engine rear side			
Camshaft locate plate	78 - 88	8.0 - 9.0	58 - 65
Cylinder head rear cover	6 - 10	0.6 - 1.0	4.3 - 7.2
Clutch cover	18 - 22	1.8 - 2.2	13 - 16
Flywheel	98 - 108	10.0 - 11.0	72 - 80
Rear oil seal retainer	4 - 6	0.4 - 0.6	2.9 - 4.3
Starter motor	29 - 39	3.0 - 4.0	22 - 29

ENGINE LUBRICATION & COOLING SYSTEMS

LC

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RB30E

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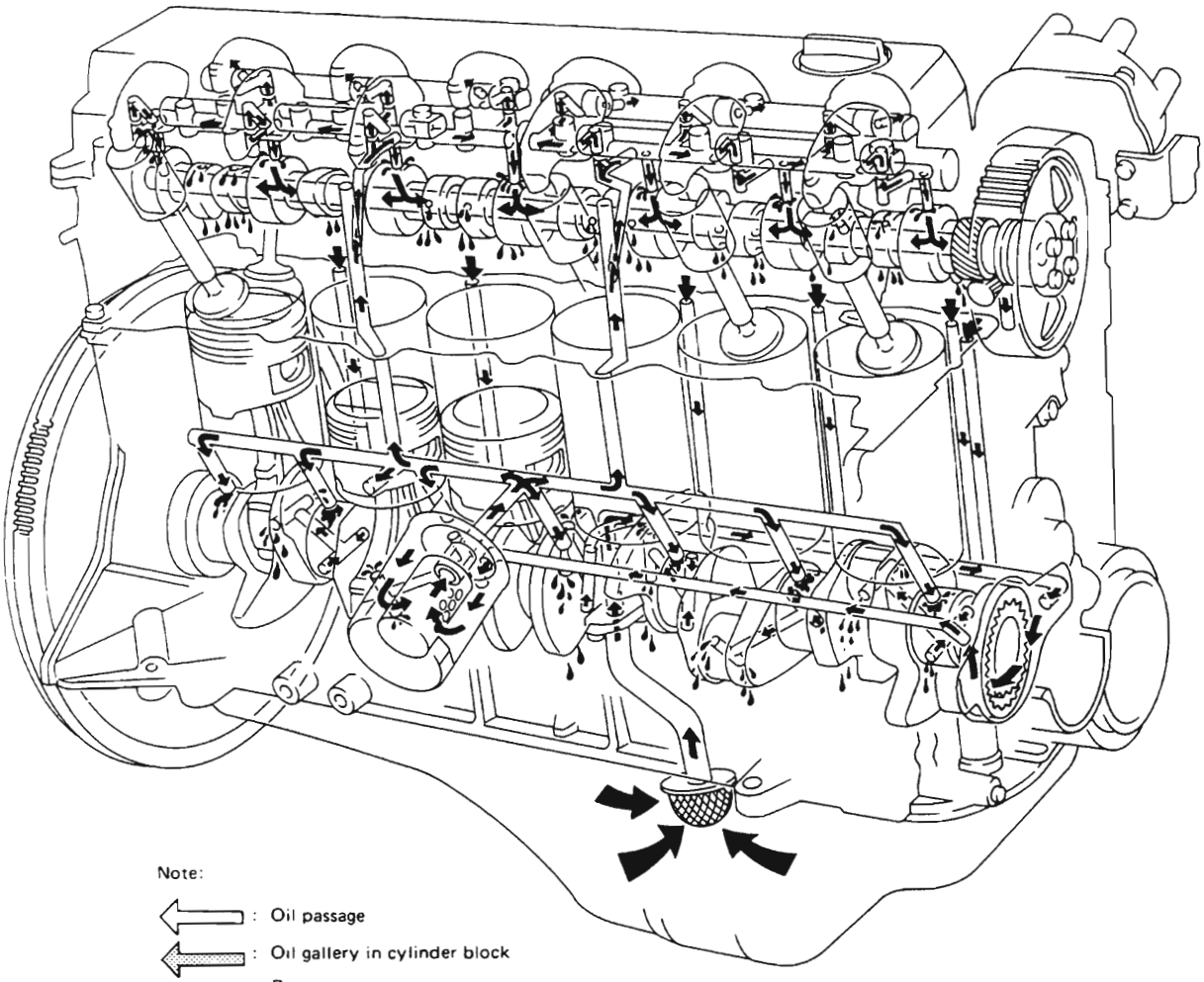
Lubricating Circuit

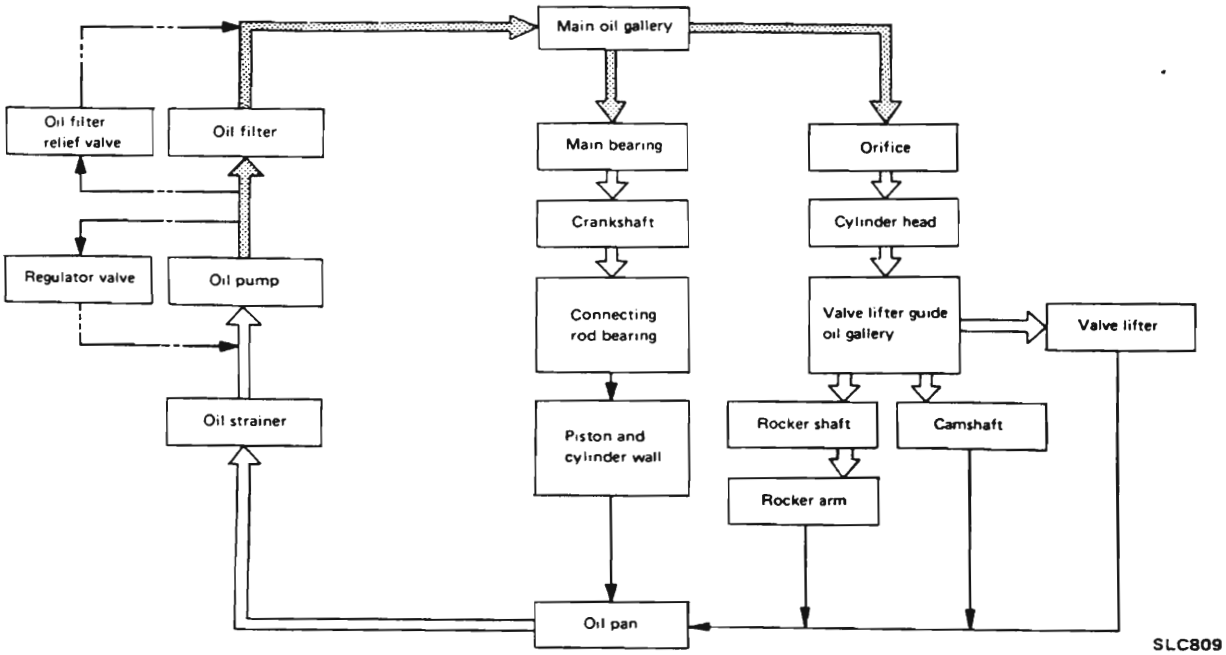


Note:

: Oil passage

: Oil gallery in cylinder block

: By-pass passage



On-vehicle Service—Oil Pressure Check

WARNING:

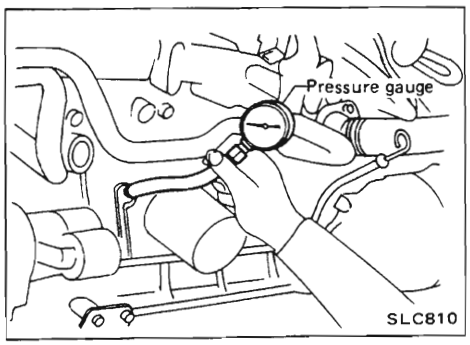
- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.

CAUTION:

- **The following data is tested using the correct viscosity oil with the engine at normal operating temperature. Slight differences will be found because of oil viscosity or oil temperature.**
  If difference is extreme, check oil passage and oil pump for oil leaks.

1. Warm up engine.
2. Stop engine and remove oil pressure switch.

Oil pressure switch:
: 10 - 16 N·m
(1.0 - 1.6 kg-m, 7 - 12 ft-lb)

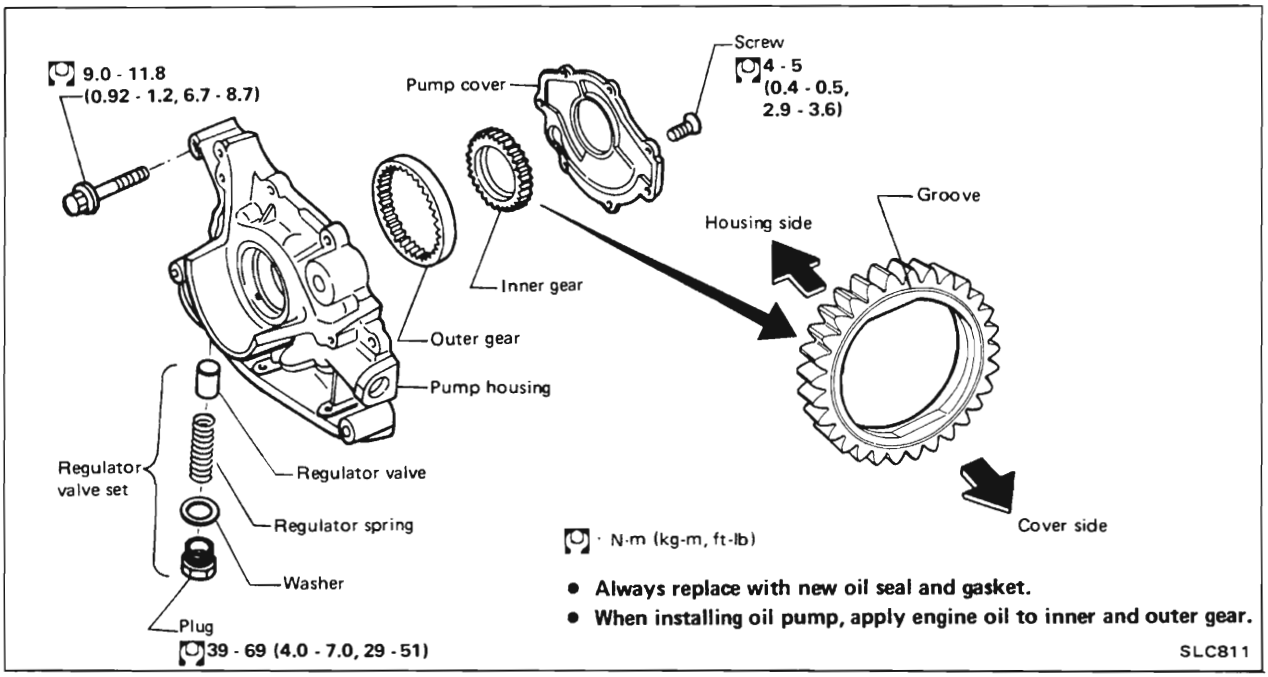


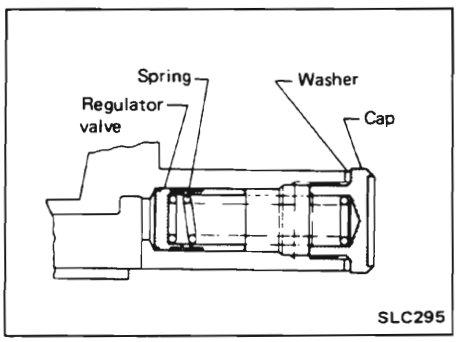
3. Install pressure gauge.
4. Start engine and check oil pressure with engine running under no-load.

Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
600	98 (0.98, 1.0, 14)
2,000	294 (2.94, 3.0, 43)
6,000	392 (3.92, 4.0, 57)

If difference is extreme, check oil passage and oil pump for oil leaks.

Oil Pump

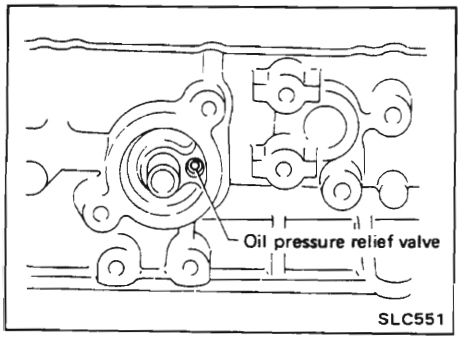




REGULATOR VALVE INSPECTION

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil and check that it slides smoothly in the valve bore.

If damaged, replace regulator valve set or oil pump assembly.



OIL PRESSURE RELIEF VALVE INSPECTION

Inspect oil pressure relief valve for damage or wear. If replacement is necessary, remove valve by prying it out with a screwdriver. Install a new valve in place using a hammer and suitable tool.

Oil Pump (Cont'd)

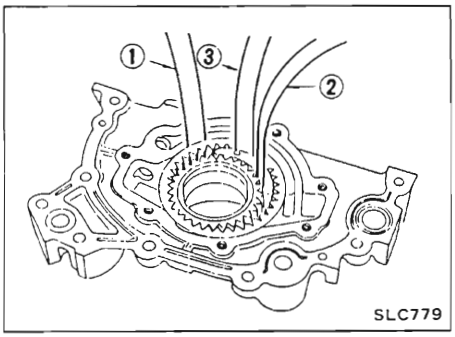
OIL PUMP INSPECTION

Using a feeler gauge, check the following clearance.

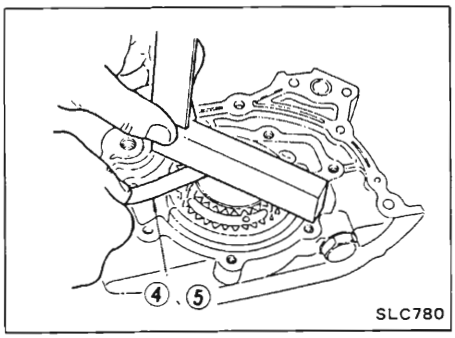
Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.22 - 0.33 (0.0087 - 0.0130)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
Inner gear to brazed portion of housing clearance ⑥	0.106 - 0.152 (0.0042 - 0.0060)

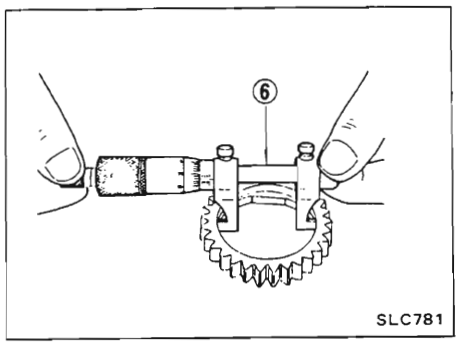
If it exceeds the limit, replace gear set or entire oil pump assembly.



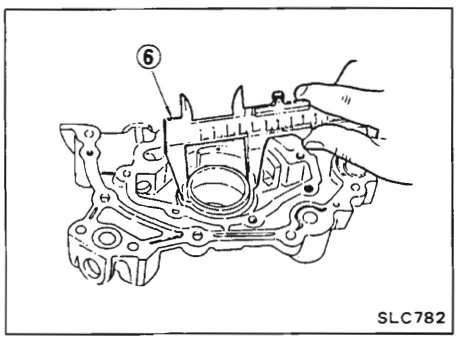
SLC779



SLC780

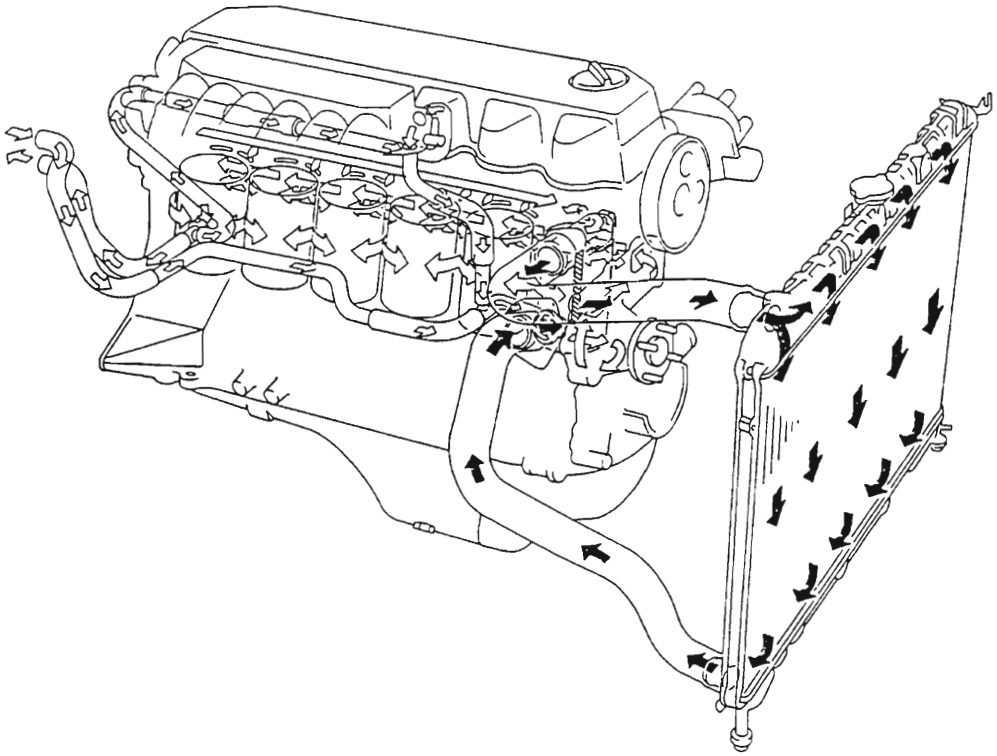


SLC781



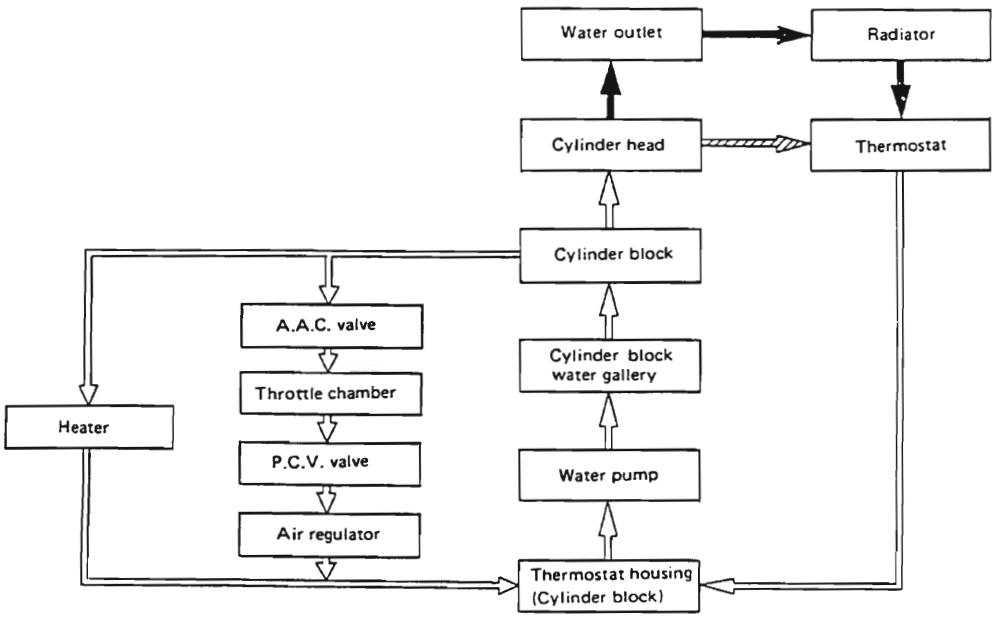
SLC782

Cooling Circuit



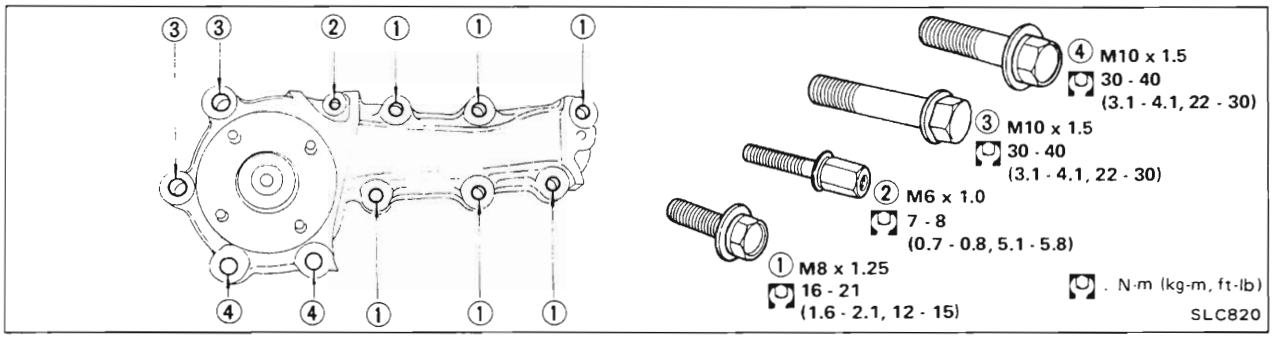
Thermostat: Open

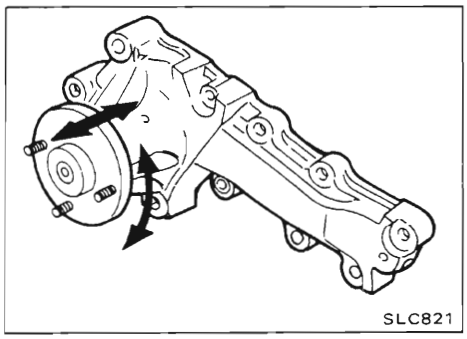
Thermostat: Closed



SLC860

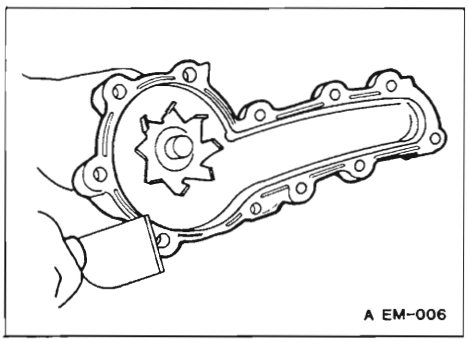
Water Pump





INSPECTION

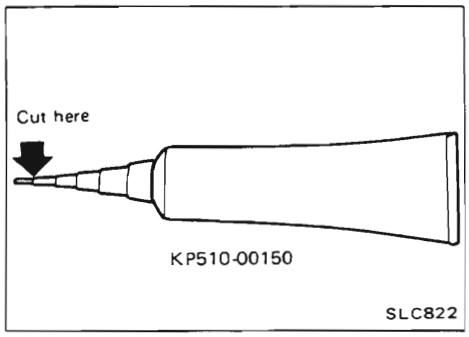
Check for excessive end play and rough operation.



INSTALLATION

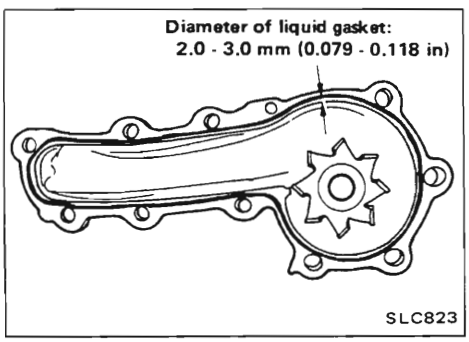
- Remove liquid gasket from mating surface of pump housing using a scraper.

  Be sure liquid gasket in grooves is also removed.
- Remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white spirit.



- Cut off tip of nozzle of liquid gasket tube at point shown in figure.

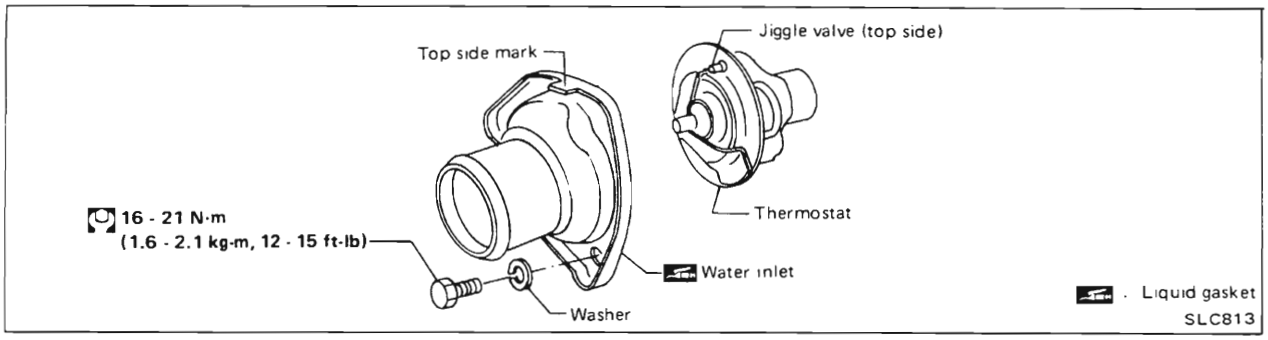
Note: use only genuine Nissan liquid gasket (Part No. KP510-00150).

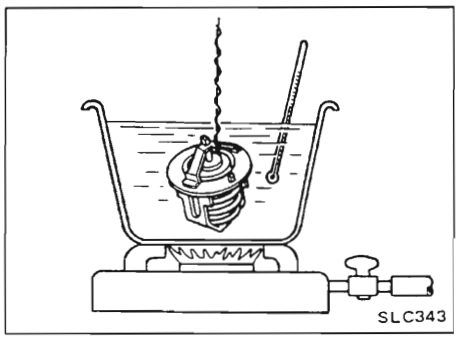


- Apply a continuous bead of liquid gasket to mating surface of pump housing as shown.

a. **Be sure diameter of liquid gasket is within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.**
b. **Attach pump housing to cylinder block within five minutes of applying liquid gasket.**
c. **After installing pump housing, wait least 30 minutes before filling cooling system.**

Thermostat



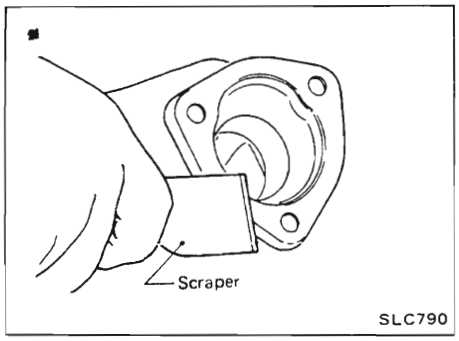


INSPECTION

1. Check valve seating condition at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.

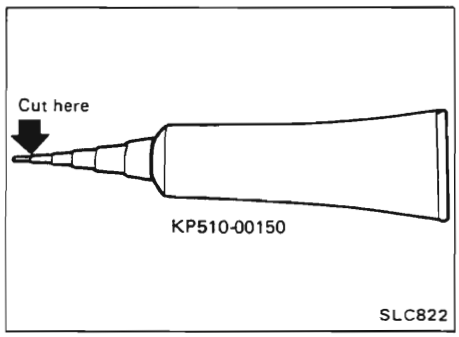
Valve opening temperature °C (°F)	76.5 (170)
Maximum valve lift mm/°C (in/°F)	10/90 (0.39/194)

3. Then check if valve closes at 5°C (9°F) below valve opening temperature.



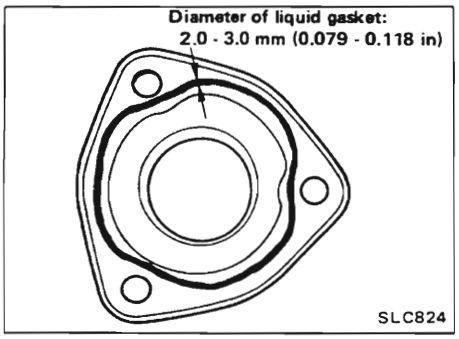
INSTALLATION

- Remove liquid gasket from mating surface of thermostat using a scraper.
- Similarly, remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white gasoline.



- Cut off tip of nozzle of liquid gasket tube at point shown in figure.

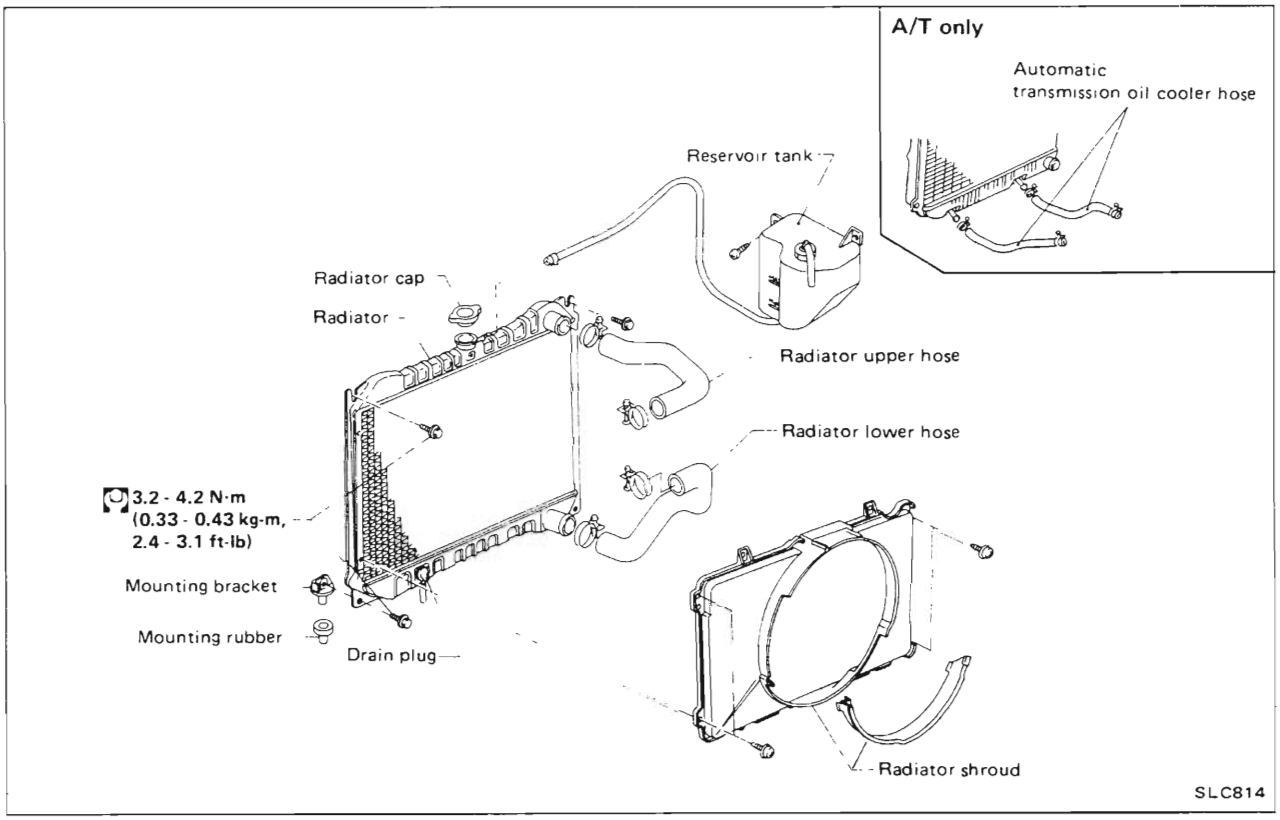
Note: use only genuine Nissan liquid gasket (Part No. KP510-00150).



- Apply a continuous bead of liquid gasket to mating surface of water inlet.

a. **Be sure diameter of liquid gasket is within 2.0 to 3.0 mm (0.079 to 0.118 in).**
b. **Attach water inlet to cylinder block within five minutes after applying liquid gasket.**
c. **After installing water inlet, wait at least 30 minutes before refilling coolant and starting engine.**

Radiator

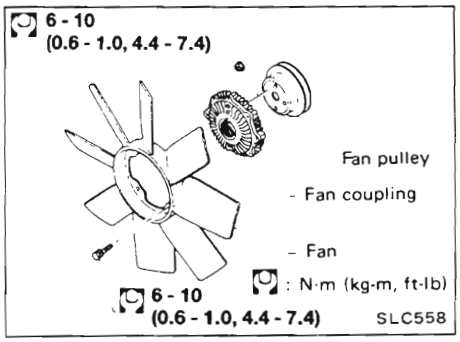


Radiator Minor Repair Procedure

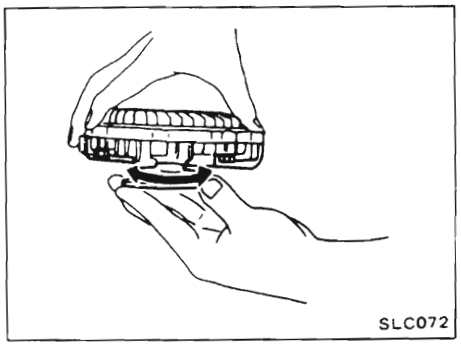
(Using Agent Part No. 21411-J7025)

Minor radiator repairs are defined as damage to tubes in the form of holes no greater in size than approximately 1mm.

1. Remove radiator.
2. If necessary, carefully cut away or bend fins to expose affected area. Do not cut away what is not necessary and do not remove more than 25mm (total) finning from the radiator.
3. Dry affected tube and area with an air drier.
4. Lightly surface damaged area with suitable scraper and wipe clean with petrol.
5. Mix contents of bottle well and apply repair agent to affected area with a suitable clean, dry applicator (cut down wooden stirrer).
6. Apply repair agent sparingly.
7. Repair agent must be allowed to dry in ambient conditions for a minimum of 3 hours before re-fitting the radiator in vehicle. Do not use heat to promote drying.
8. Refit radiator and refill cooling system (refer Section MA).



Cooling Fan



INSPECTION

Check fan coupling for oil leakage or bent bimetal.

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm², psi)
600	98 (0.98, 1.0, 14)
2,000	294 (2.94, 3.0, 43)
6,000	392 (3.92, 4.0, 57)

Oil pump

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.22 - 0.33 (0.0087 - 0.0130)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
Inner gear to brazed portion of housing clearance ⑥	0.106 - 0.152 (0.0042 - 0.0060)

Oil pressure regulator valve

Opening pressure kPa (bar, kg/cm², psi)/rpm	373 - 412 (3.73 - 4.12, 3.8 - 4.2, 54 - 60)/2,000 rpm

Tightening torque

Unit	N·m	kg-m	ft-lb
Oil pump securing bolt	9.0 - 11.8	0.92 - 1.2	6.7 - 8.7
Oil pump cover screw	4 - 5	0.4 - 0.5	2.9 - 3.6
Regulator valve cap bolt	39 - 69	4.0 - 7.0	29 - 51
Oil strainer bolt	16 - 21	1.6 - 2.1	12 - 15
Oil pressure switch	10 - 16	1.0 - 1.6	7 - 12

Engine Cooling System

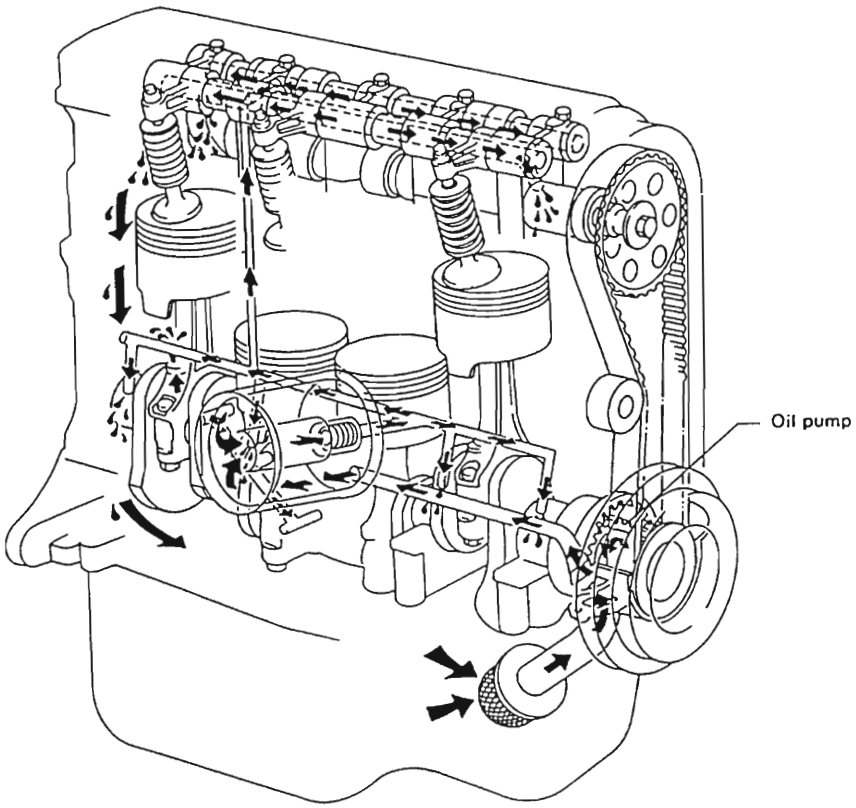
Thermostat

Valve opening temperature	°C (°F)	76.5 (170)
Maximum valve lift	mm/°C (in/°F)	10/90 (0.39/194)

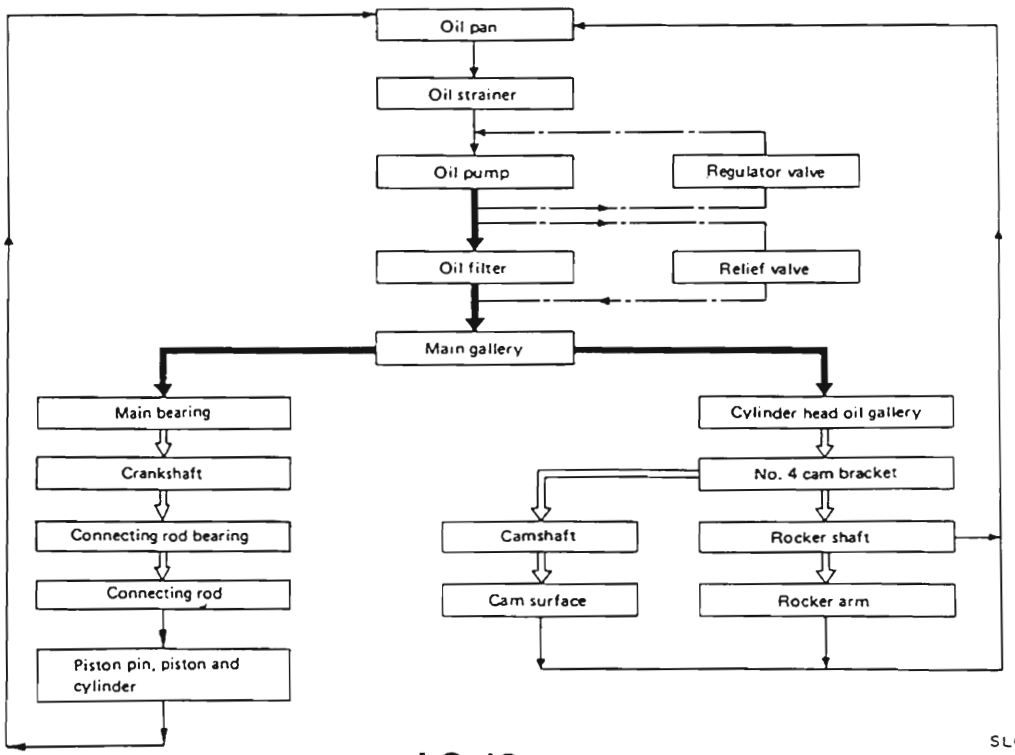
Tightening torque

Unit	N·m	kg-m	ft-lb
Water pump securing bolt			
M6	7 - 8	0.7 - 0.8	5.1 - 5.8
M8	16 - 21	1.6 - 2.1	12 - 15
M10	30 - 40	3.1 - 4.1	22 - 30
Water inlet	16 - 21	1.6 - 2.1	12 - 15
Radiator securing bolt	3.2 - 4.2	0.33 - 0.43	2.4 - 3.1
Fan coupling securing bolt	6 - 10	0.6 - 1.0	4.4 - 7.4
Fan securing bolt	6 - 10	0.6 - 1.0	4.4 - 7.4

Lubrication Circuit



Note: : Oil gallery in cylinder block
: Oil passage
: By-pass passage



SLC740

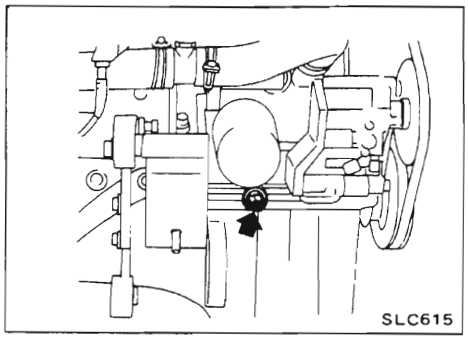
On-vehicle Service—Oil Pressure Check

WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.

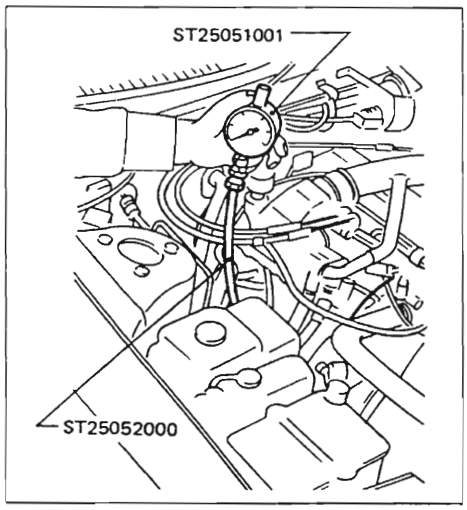
CAUTION:

- **The following data is tested using the correct viscosity oil with the engine at normal operating temperature. Slight difference will be found because of oil viscosity or oil temperature. If difference is extreme, check oil passage and oil pump for oil leaks.**



1. Warm up engine.
2. Stop engine and remove oil pressure switch.

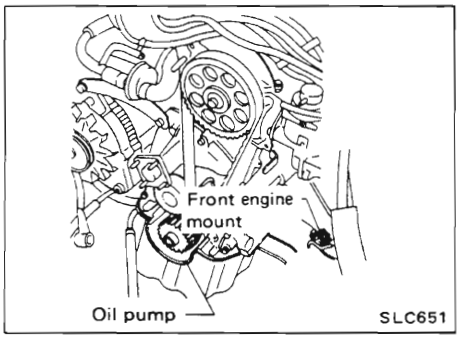
   : Oil pressure switch
   10 - 16 N·m
   (1.0 - 1.6 kg-m, 7 - 12 ft-lb)



3. Install pressure gauge.
4. Start engine and check oil pressure with engine running under no-load.

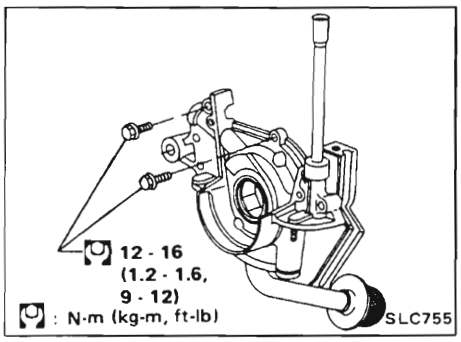
Engine rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 98 (1.0, 1, 14)
2,000	294 (2.9, 3, 43)
4,000	392 (3.9, 4, 57)

Oil Pump



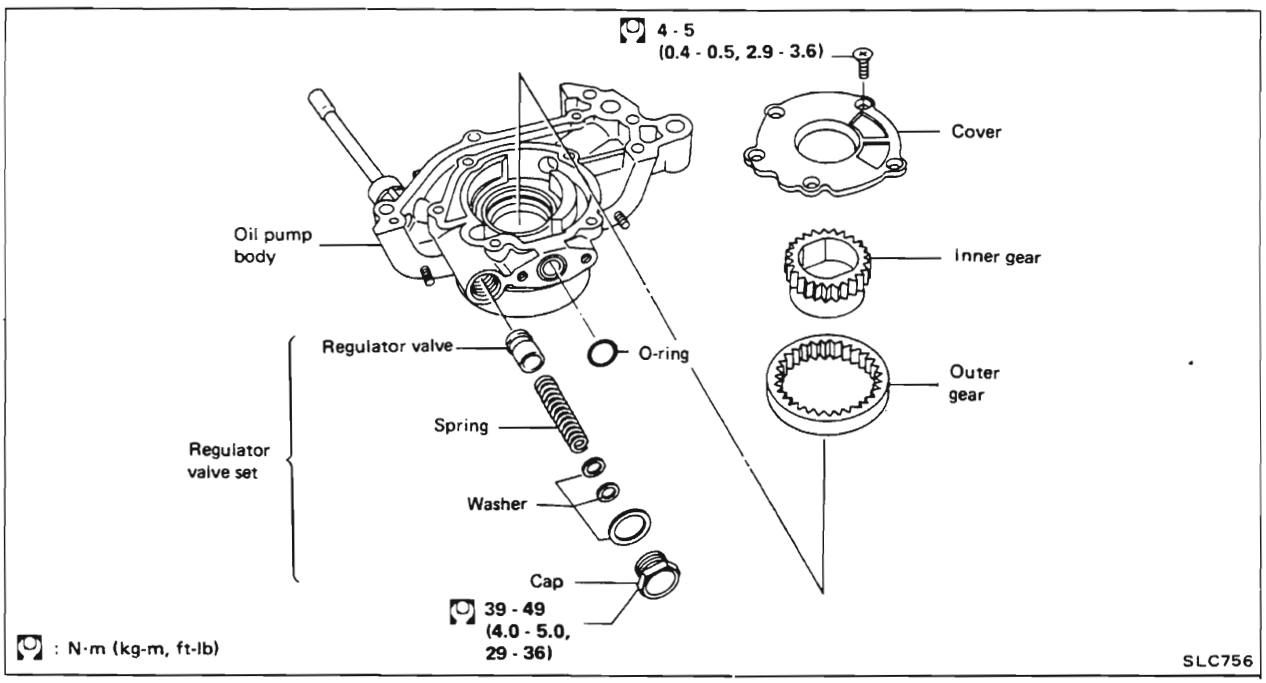
REMOVAL

1. Remove drive belts and alternator.
2. Remove timing belt covers and timing belt.
3. Remove oil pan.



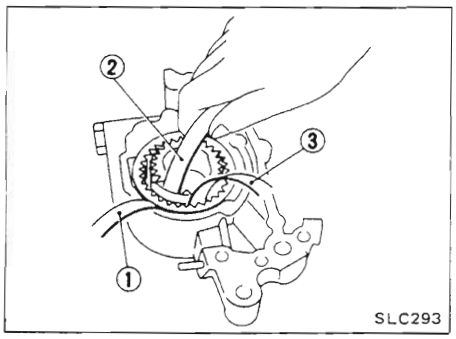
4. Remove oil pump assembly with oil strainer.

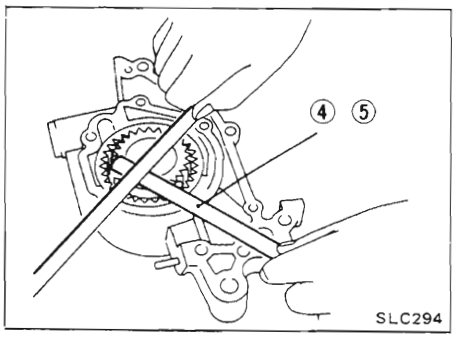
DISASSEMBLY AND ASSEMBLY



- **Always replace with new oil seal and gasket.**
- **When installing oil pump, apply engine oil to inner and outer gear.**
- **Be sure that O-ring is properly fitted.**

Oil Pump (Cont'd)





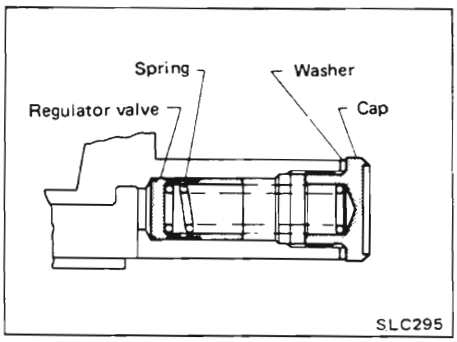
INSPECTION

Using a feeler gauge, check the following clearances.

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

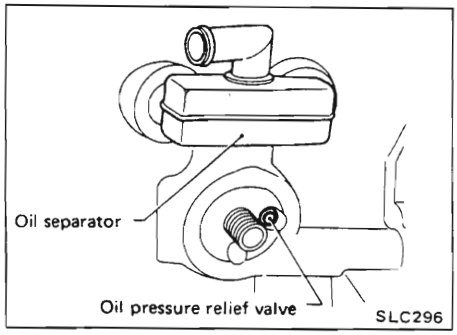
If it exceeds the limit, replace gear set or entire oil pump assembly.



REGULATOR VALVE INSPECTION

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil and check that it slides smoothly in the valve bore.

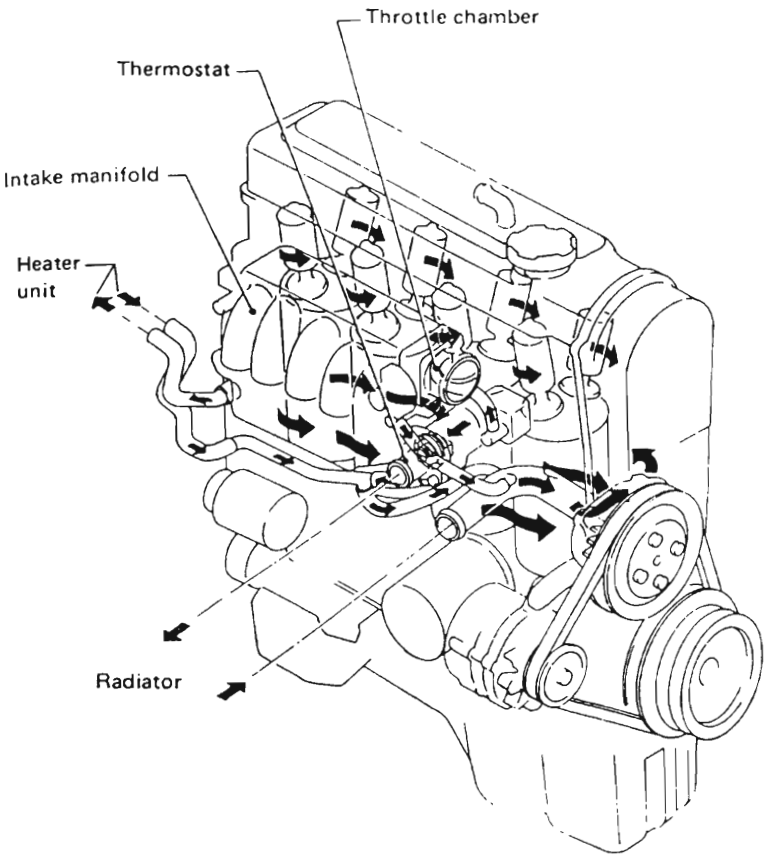
If damaged, replace regulator valve set or oil pump assembly.

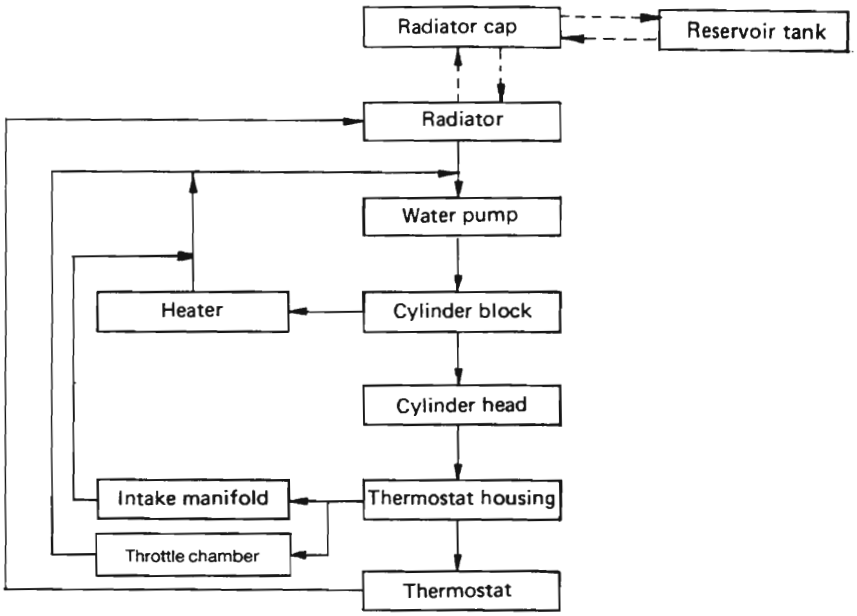


OIL PRESSURE RELIEF VALVE INSPECTION

Inspect oil pressure relief valve for damage or wear. If replacement is necessary, remove valve by prying it out with a screwdriver. Install a new valve in place using a hammer and suitable tool.

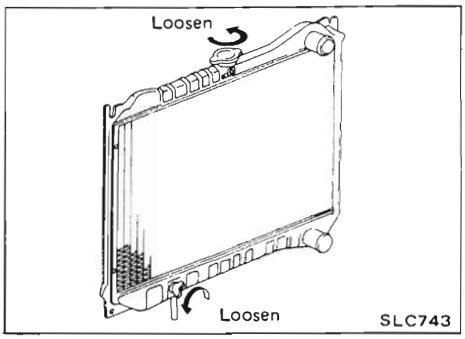
Cooling Circuit





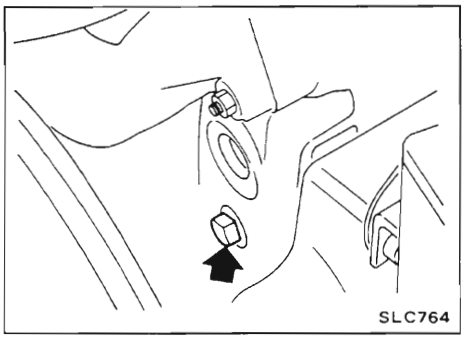
SLC742

Water Pump

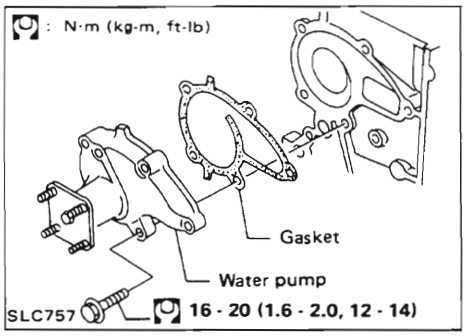


REMOVAL AND INSTALLATION

1. Drain coolant from radiator.

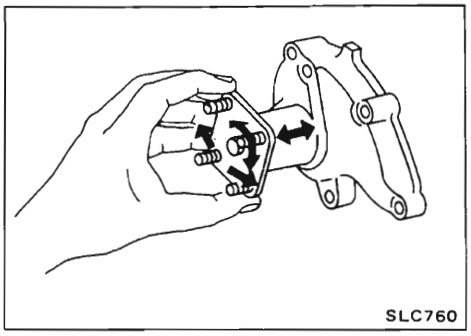


2. Remove cylinder block drain plug located at left rear of cylinder block and drain coolant.



CAUTION:

- **When removing water pump assembly, be careful not to get coolant on timing belt.**
- **Water pump cannot be disassembled and should be replaced as a unit.**
- **Always replace with new gasket.**
- **To avoid deforming timing cover, make sure there is adequate clearance between cover and hose clamp.**
- **After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.**

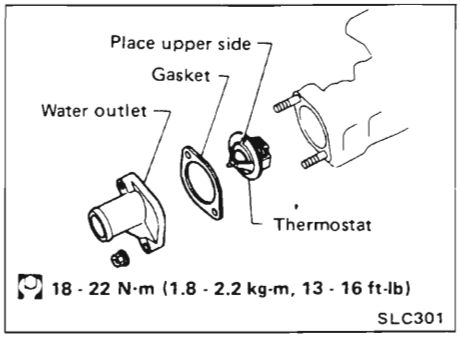


INSPECTION

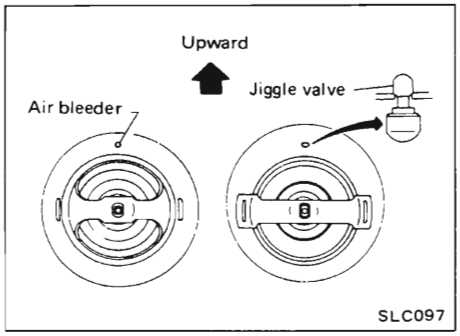
1. Check for badly rusted or corroded body assembly and vane.
2. Check for rough operation due to excessive end play.

Thermostat

REMOVAL AND INSTALLATION

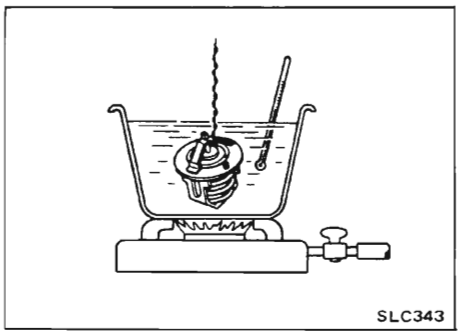


1. Drain engine coolant.
2. Disconnect upper hose from water outlet, then remove thermostat.



3. Install thermostat with jiggle valve facing upward.

- **After installation, run engine for a few minutes, and check for leaks.**
- **Always replace with new gasket.**



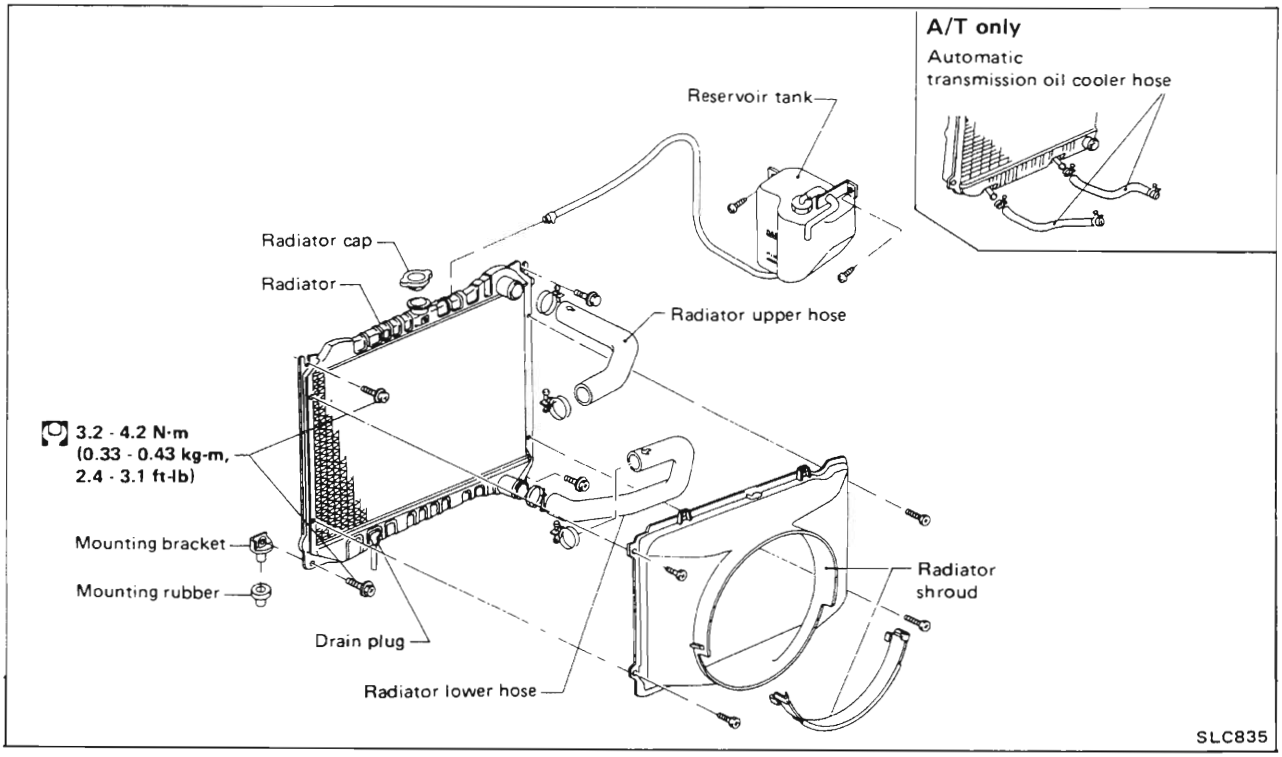
INSPECTION

1. Check for valve seating condition at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.

Valve opening temperature °C (°F)	82 (180)
Max. valve lift mm/°C (in/°F)	8/95 (0.31/203)

3. Then check if valve closes at 5°C (9°F) below valve opening temperature.

Radiator

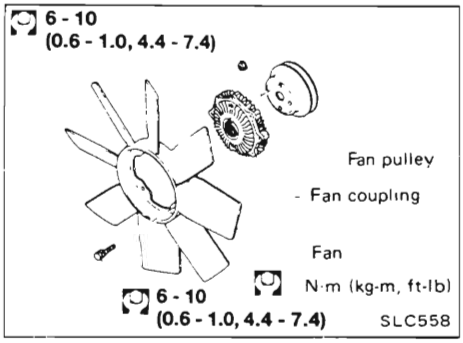


Radiator Minor Repair Procedure

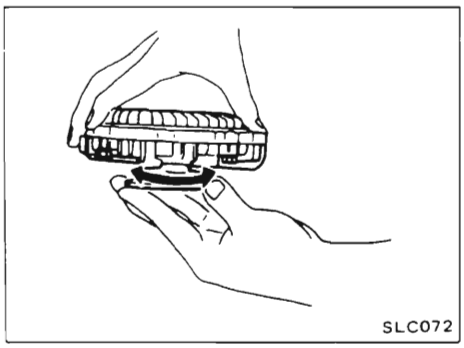
(Using Agent Part No. 21411-J7025)

Minor radiator repairs are defined as damage to tubes in the form of holes no greater in size than approximately 1mm.

1. Remove radiator.
2. If necessary, carefully cut away or bend fins to expose affected area. Do not cut away what is not necessary and do not remove more than 25mm (total) finning from the radiator.
3. Dry affected tube and area with an air drier.
4. Lightly surface damaged area with suitable scraper and wipe clean with petrol.
5. Mix contents of bottle well and apply repair agent to affected area with a suitable clean, dry applicator (cut down wooden stirrer).
6. Apply repair agent sparingly.
7. Repair agent must be allowed to dry in ambient conditions for a minimum of 3 hours before re-fitting the radiator in vehicle. Do not use heat to promote drying.
8. Refit radiator and refill cooling system (refer Section MA).



Cooling Fan



INSPECTION

Check fan coupling for oil leakage or bent bimetal.

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm², psi)
Idle speed	More than 98 (1.0, 1, 14)
2,000	294 (2.9, 3, 43)
4,000	392 (3.9, 4, 57)

Oil pressure regulator valve

	kPa (bar, kg/cm², psi)/rpm
Regulator valve opening pressure	373 - 412 (3.73 - 4.12, 3.8 - 4.2, 54 - 60)/2,000

Oil pump inspection

Unit: mm (in)

Body to outer gear clearance	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent clearance	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance	0.05 - 0.11 (0.0020 - 0.0043)

Tightening torque

Unit	N·m	kg-m	ft-lb
Oil pump securing bolt	12 - 16	1.2 - 1.6	9 - 12
Oil pump cover screw	4 - 5	0.4 - 0.5	2.9 - 3.6
Oil pressure regulator valve cap	39 - 49	4.0 - 5.0	29 - 36
Oil strainer bolt	10 - 14	1.0 - 1.4	7 - 10
Oil pressure switch	10 - 16	1.0 - 1.6	7 - 12

Engine Cooling System

Thermostat

Valve opening temperature °C (°F)	82 (180)
Max. valve lift mm/°C (in/°F)	8/95 (0.31/203)

Tightening torque

Unit	N·m	kg-m	ft-lb
Water pump securing bolt	16 - 20	1.6 - 2.0	12 - 14
Water outlet securing bolt	18 - 22	1.8 - 2.2	13 - 16
Radiator securing bolt	3.2 - 4.2	0.33 - 0.43	2.4 - 3.1
Fan securing bolt	6 - 10	0.6 - 1.0	4.3 - 7.2

ENGINE FUEL

EF

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	CA20E	RB30E
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MIXTURE RATIO FEEDBACK SYSTEM INSPECTION	EF-45	EF-108
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- Handle air flow meter carefully to avoid damage.
- Do not disassemble air flow meter.
- Do not clean air flow meter with any type of detergent.
- Even a slight leak in the air intake system can cause serious problems.

- Do not shock or jar the crank angle sensor.

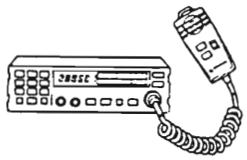
- Do not apply battery power directly to injectors.

- Do not disassemble auxiliary air control valve (RB30E engine).

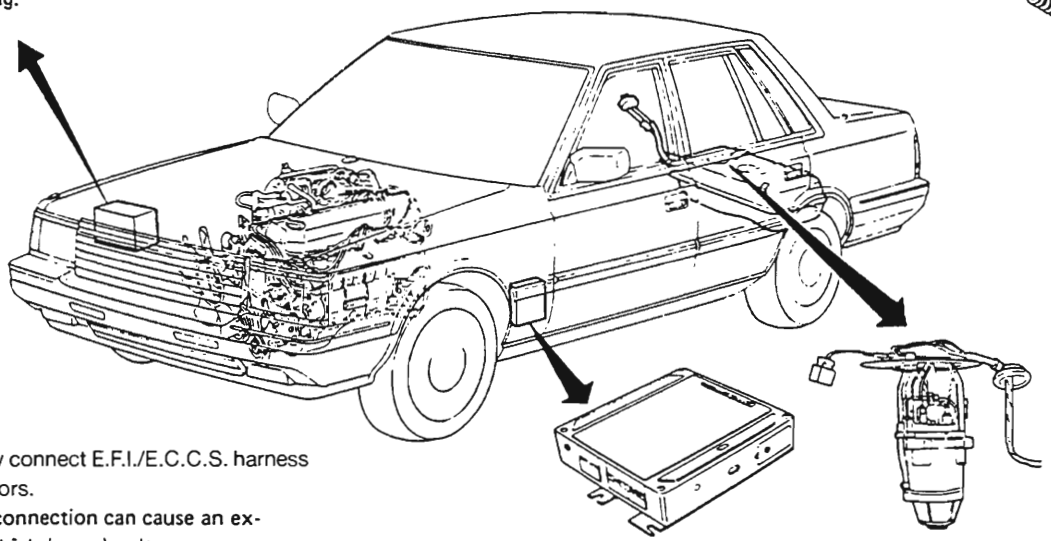
- Do not depress accelerator pedal when starting.
- Immediately after starting, do not rev up engine unnecessarily.
- Do not rev up engine just prior to shutdown.

- When installing C.B. ham radio or a mobile phone, be sure to observe the following as it may adversely affect electronic control systems depending on its installation location.

1) Keep the antenna as far as possible away from the electronic control units.
2) Also keep the antenna feeder line more than 20 cm (7.9 in) away from the harness of electronic controls.
   Do not let them run parallel for a long distance.
3) Adjust the antenna and feeder line so that the standing-wave ratio is low.
4) Connect the ground wire from the radio chassis to the body.



- Always use 12 volt batteries as power source.
- Do not attempt to disconnect battery cables while engine is operating.

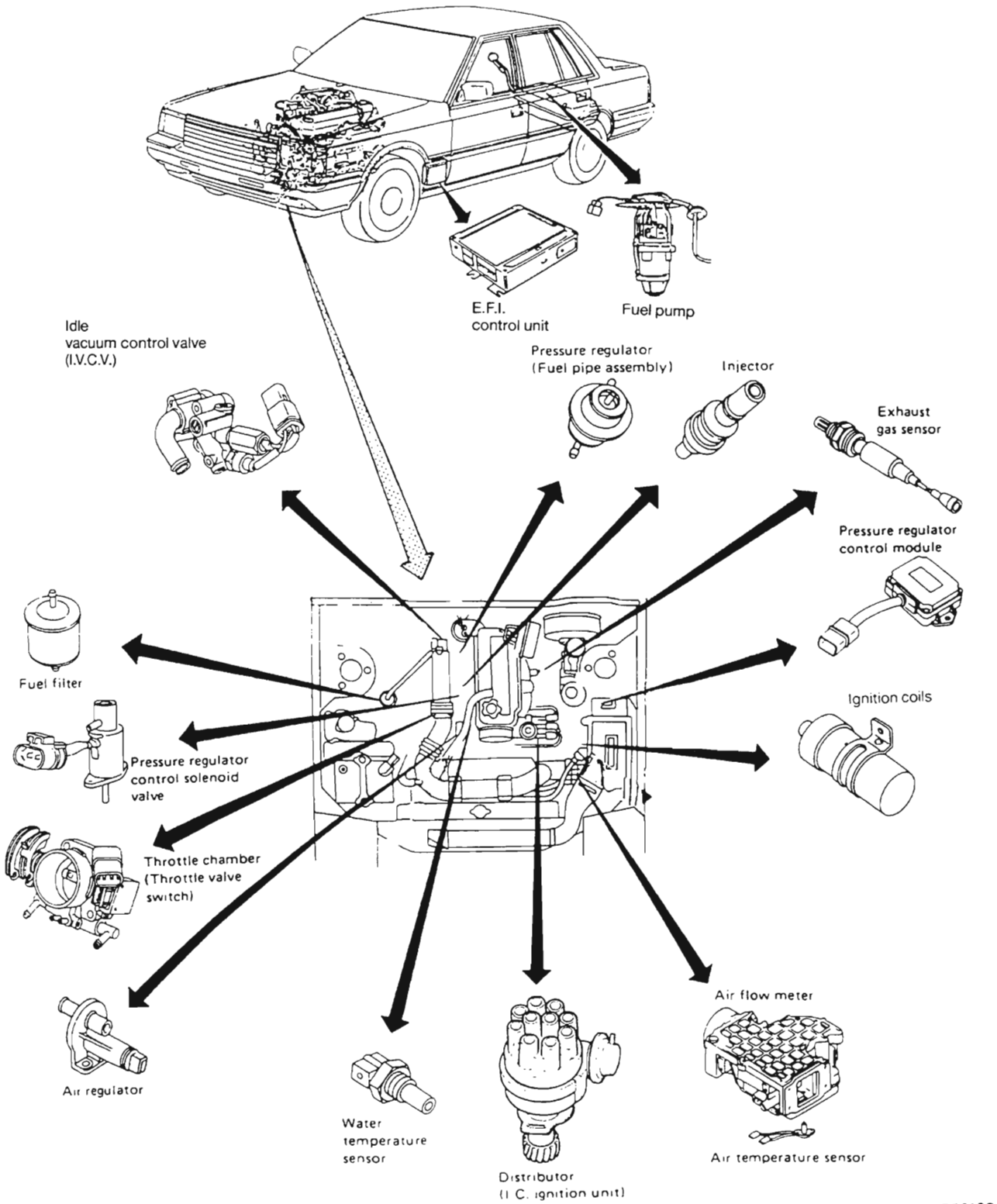


- Securely connect E.F.I./E.C.C.S. harness connectors.
  A poor connection can cause an extremely high (surge) voltage to develop in coil and condenser, thus resulting in damage to IC circuit.
- Keep E.F.I./E.C.C.S. harness at least 10 cm (3.9 in) away from adjacent harnesses, to prevent an E.F.I./E.C.C.S. system malfunction due to reception of external noise, degraded operation of IC circuit, etc.
- Keep E.F.I./E.C.C.S. parts and harnesses dry.
- Before removing parts, turn off ignition switch and then disconnect battery ground cable.

- Do not disassemble E.F.I./E.C.C.S. control unit.
- Do not turn diagnosis mode selector forcibly.

- Do not operate fuel pump when the fuel lines are empty.
- Do not reuse fuel hose clamps.
- Tighten fuel hose clamps to specified torque.

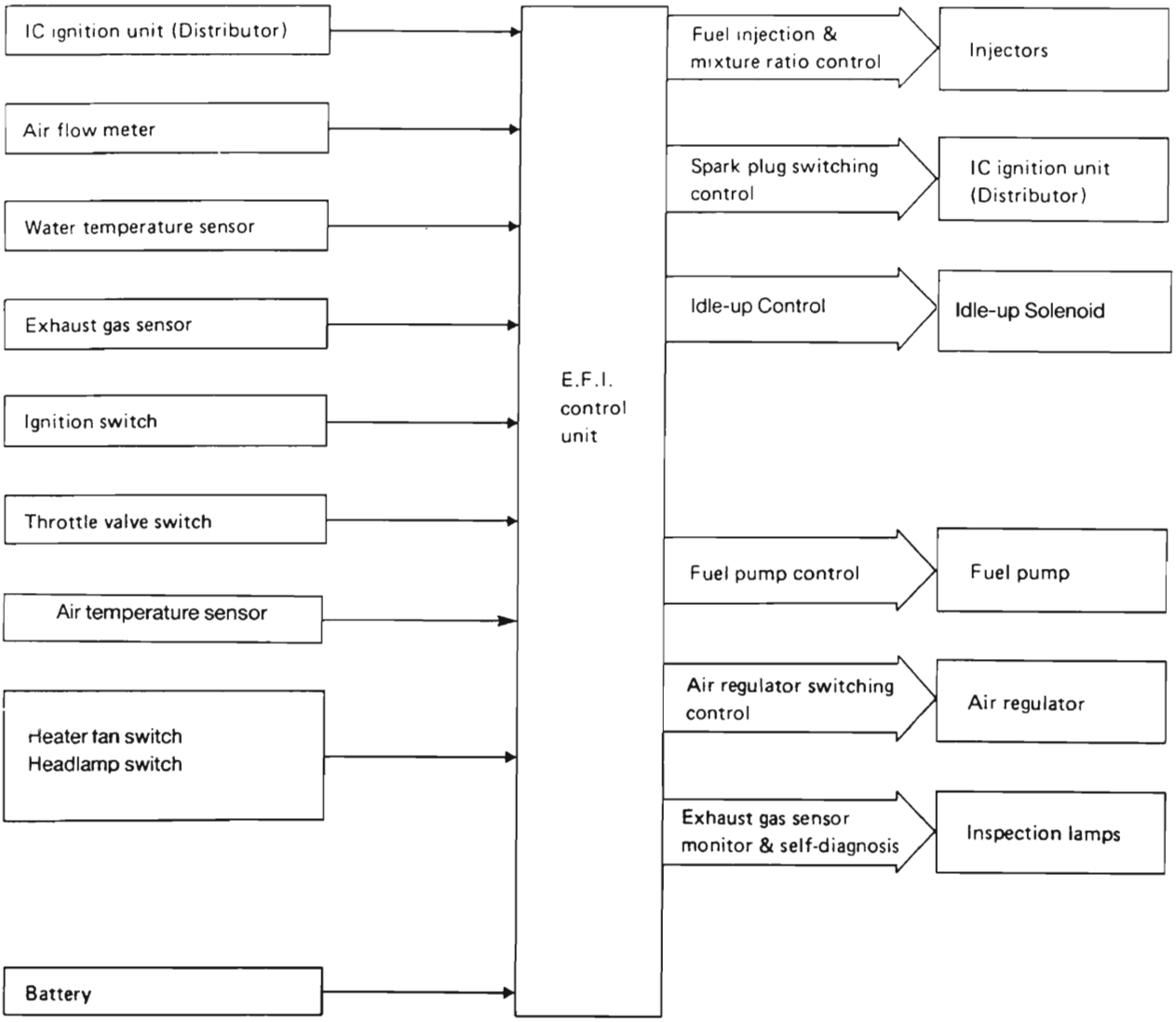
SEF601D


E.F.I.
control unit
Fuel pump
Idle
vacuum control valve
(I.V.C.V.)
Pressure regulator
(Fuel pipe assembly)
Injector
Exhaust
gas sensor
Pressure regulator
control module
Fuel filter
Ignition coils
Pressure regulator
control solenoid
valve
Throttle chamber
(Throttle valve
switch)
Air flow meter
Air regulator
Water
temperature
sensor
Distributor
(I.C. ignition unit)
Air temperature sensor

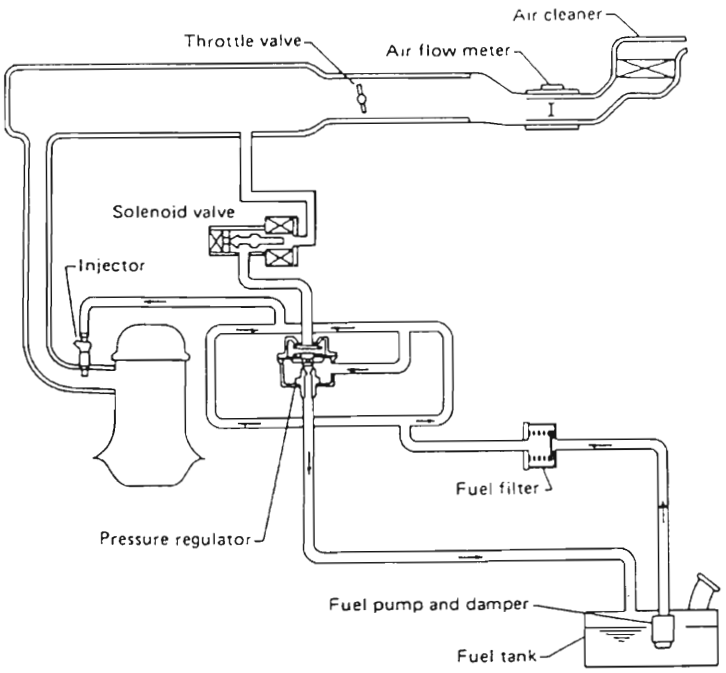
SEF610C

E.F.I. CHART

CA20E

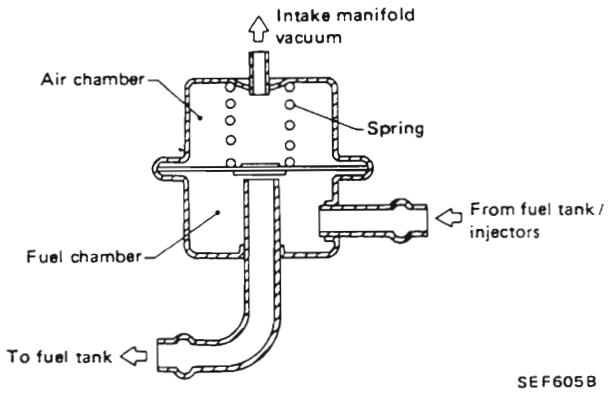


FUEL FLOW SYSTEM DESCRIPTION

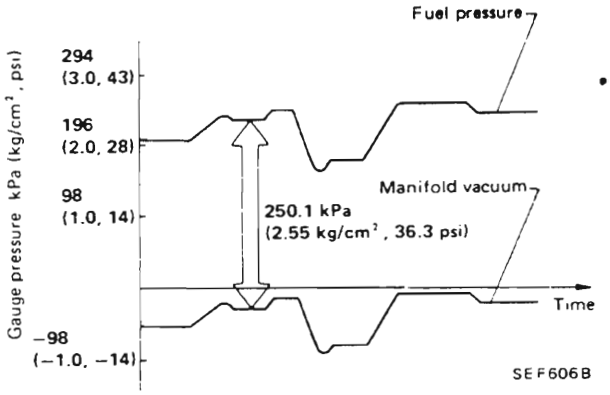


SEF594C

The amount of fuel to be injected is determined by the injection pulse duration as well as by a pressure difference between fuel pressure and intake manifold vacuum pressure. The E.F.I. control unit controls only the injection pulse duration. For this reason, the pressure difference between the fuel pressure and intake manifold vacuum pressure should be maintained at a constant level. Since the intake manifold vacuum pressure varies with engine operating conditions, a pressure regulator is placed in the fuel line to regulate the fuel pressure in response to changes in the intake manifold vacuum pressure.



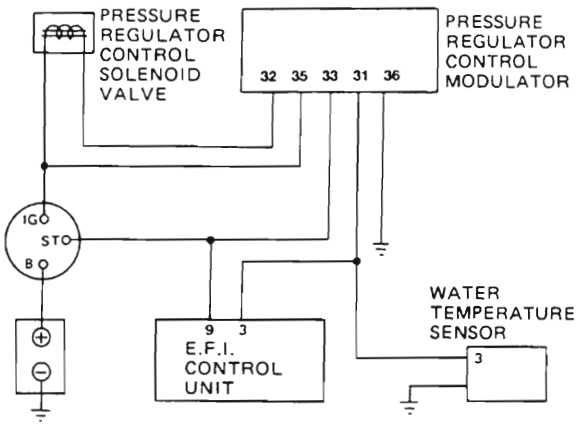
SEF605B



SEF606B

FUEL FLOW SYSTEM DESCRIPTION

Pressure Regulator Control System



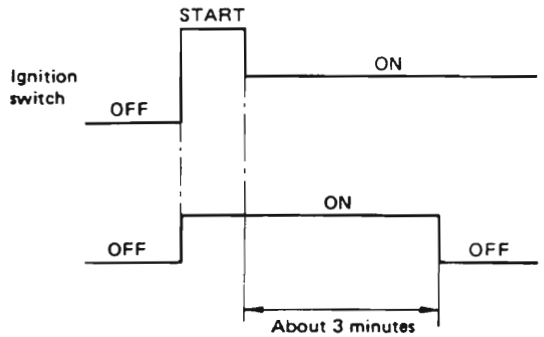
SEF616C

The pressure regulator control improves the starting of a hot engine by cutting off the intake manifold vacuum pressure thus increasing the fuel pressure.

OPERATION

This system operates when starting and 3 minutes after start, when all of the following conditions are met.

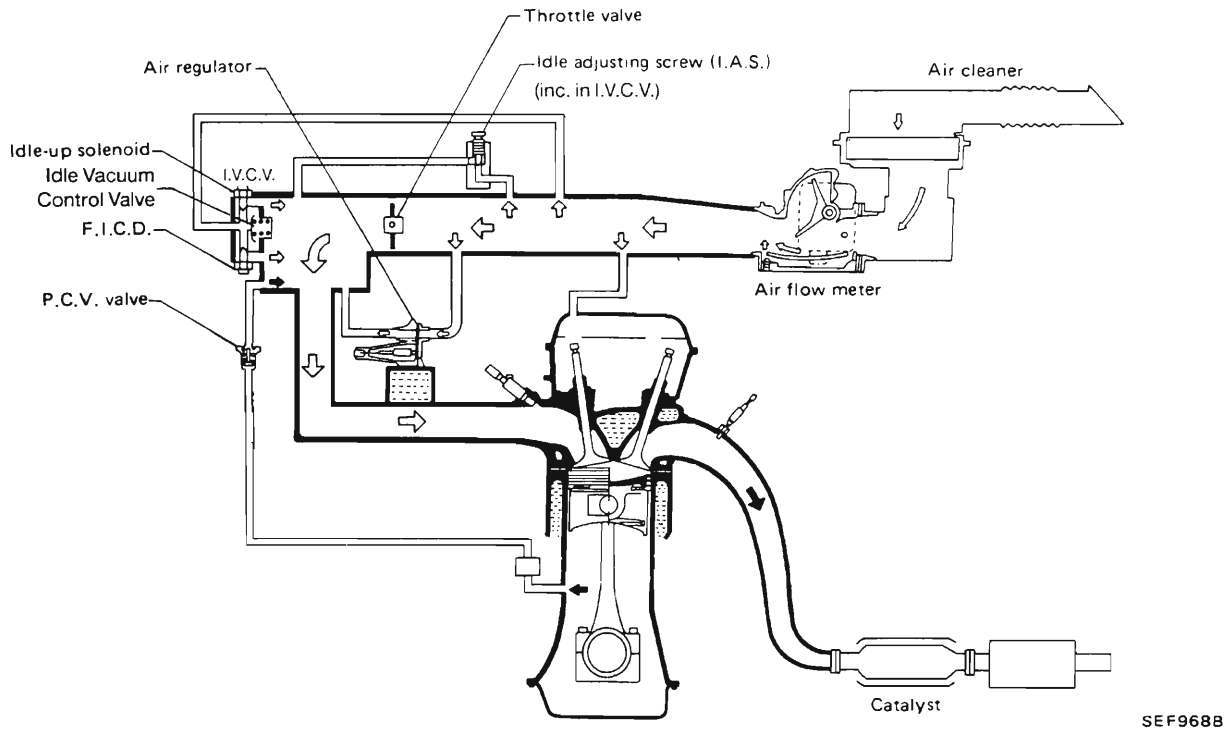
- Water temperature is above 95°C.



SEF741B

AIR FLOW SYSTEM DESCRIPTION

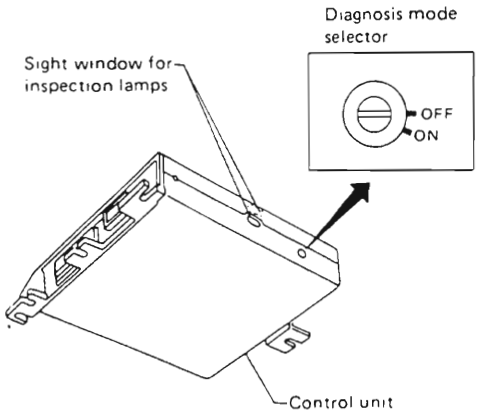
CA20E



Components

CONTROL UNIT

The control unit consists of a micro-computer, connectors for signal input and output and power supply, inspection lamps and diagnostic mode selector. The control unit controls the amount of fuel that is injected, fuel pump operation, idle-up control, feedback of the mixture ratio, air regulator control and spark plug switching.



AIR FLOW METER

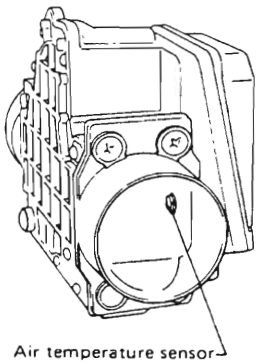
The air flow meter measures the quantity of intake air, and sends a signal to the control unit. The air flow meter is provided with a flap in the air passage.

During idling operation when the amount of intake air is extremely small, the air flows parallel with the flap through the by-pass port so that the specified intake air flow can be provided correctly.

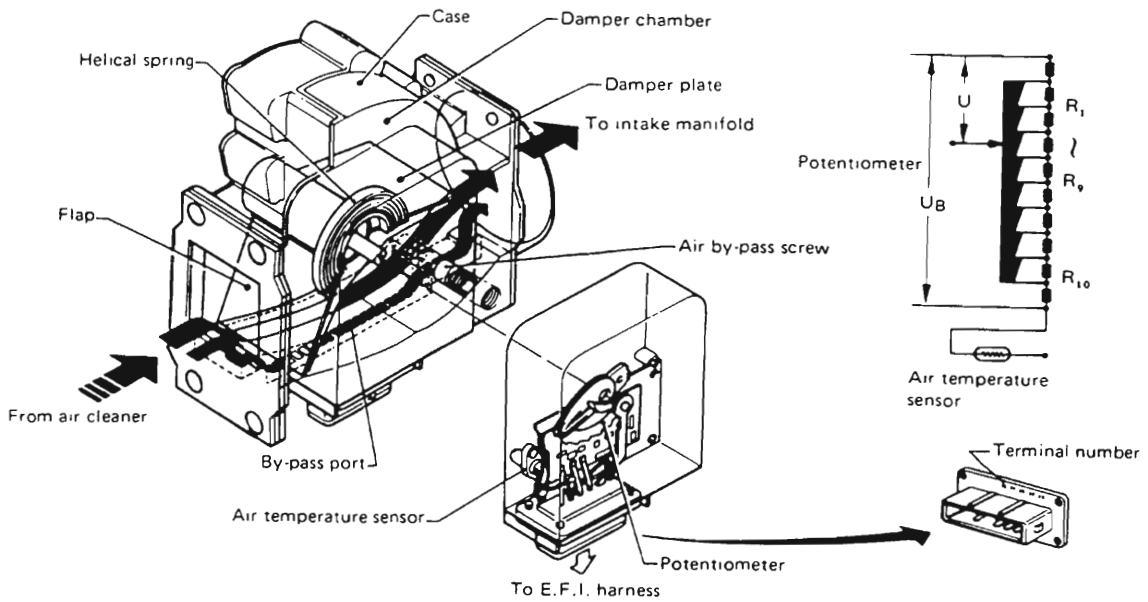
An air temperature sensor is installed in the air passage.

The by-pass port has the air by-pass screw which regulates the idle mixture ratio. The air by-pass screw is preset and sealed at the factory.

Air temperature sensor



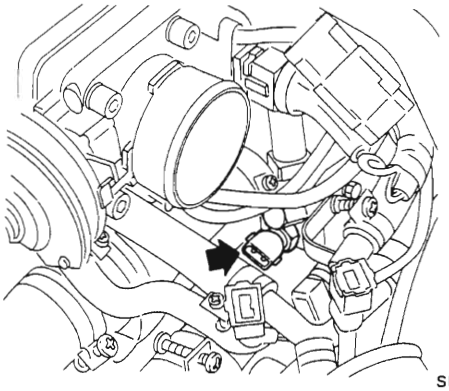
SEF971B



SEF118A

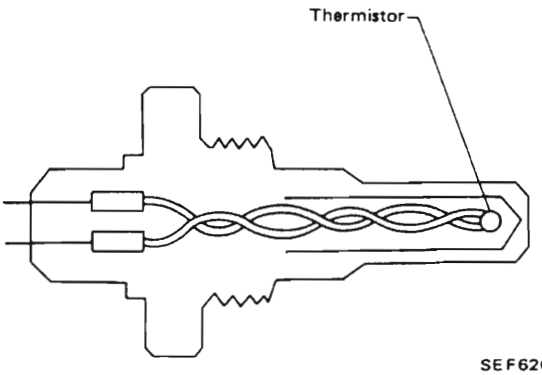
Components (Cont'd)

WATER TEMPERATURE SENSOR



SEF972B

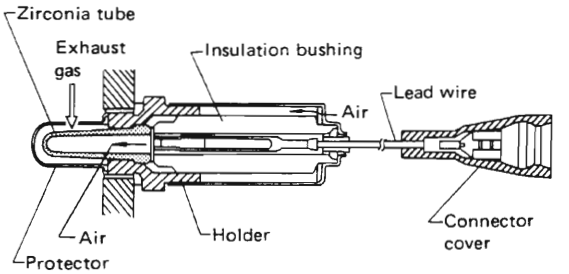
The water temperature sensor, mounted in the engine water outlet, monitors changes in coolant temperature and transmits a signal to the E.F.I. control unit. The temperature sensing unit employs a thermistor which is sensitive to the change in temperature. Electrical resistance of the thermistor decreases in response to the temperature rise.



SEF620B

EXHAUST GAS SENSOR

The exhuast gas sensor, which is located in the exhaust manifold, monitors the density of oxygen in the exhaust gas. It consists of a closed-end tube made of ceramic zirconia and other components. Porous platinum electrodes cover the tubes inner and outer surfaces. The closed-end of the tube is exposed to the exhaust gas in the exhaust manifold. The outer surface of the tube contacts the exhaust gas while the inner surface contacts the air.

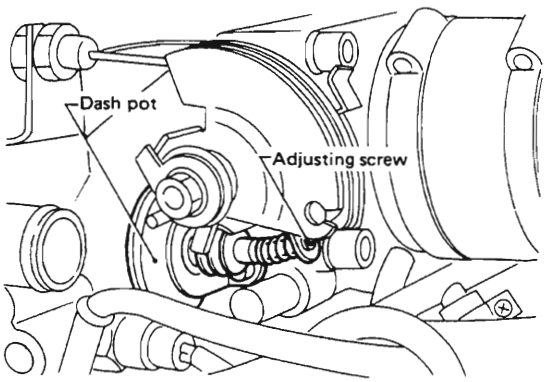


SEF016B

Dash pot

To decrease the intake air gradually when throttle valve is closed, a dash pot is installed on the throttle chamber.

Dash pot touch speed:
2,000 rpm ..... M/T
3,000 rpm ..... A/T



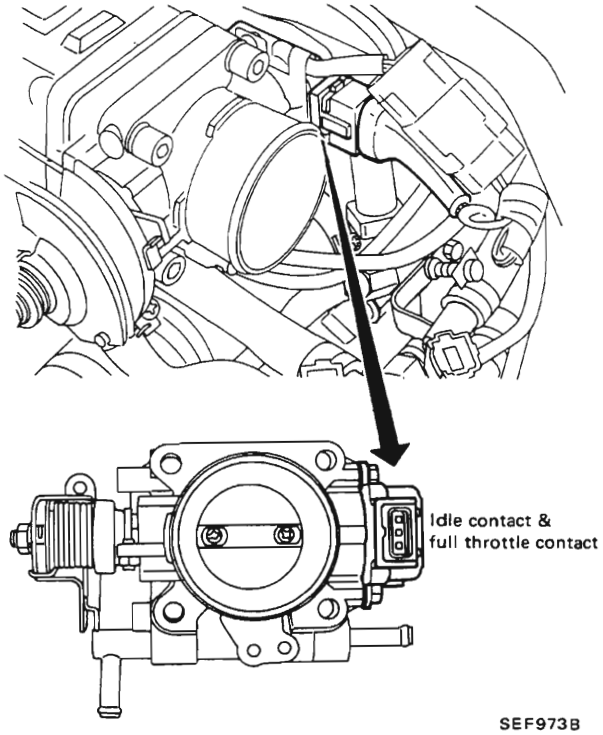
SEF050C

Components (Cont'd)

THROTTLE VALVE SWITCH

The throttle valve switch is attached to the throttle chamber and actuates in response to accelerator pedal movement.

This switch has idle contact and full throttle contact. The idle contact closes when the throttle valve is positioned at idle and opens when it is at any other position.



SEF973B

Throttle valve switch adjustment

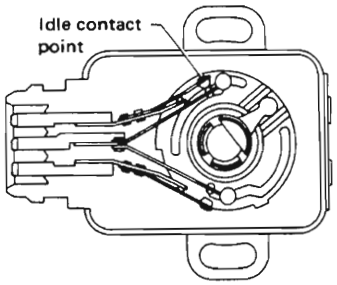
1. Check idle speed.

   M/T **800±50 rpm**
   A/T **900±50 rpm (in "N" position)**

2. Adjust throttle valve switch.

   Idle contact point: OFF → ON
   M/T **Idle speed +250±150 rpm**
   A/T **Idle speed (in "N" position) +250±150 rpm**

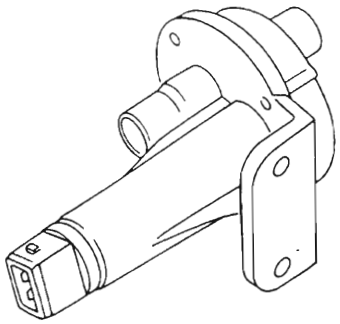
3. Check that throttle valve switch closes at idle.



SEF869B

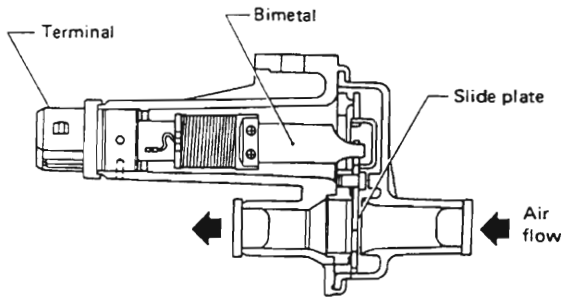
AIR REGULATOR

Air regulator gives an air by-pass when the engine is cold for the purpose of a fast idle during warm-up.



SEF936B

A bimetal, heater and rotary shutter are built into the air regulator. When the bimetal temperature is low, the air by-pass port is open. As the engine starts and electric current flows through a heater, the bimetal begins to rotate the shutter to close off the by-pass port. The air passage remains closed until the engine is stopped and the bimetal temperature drops.

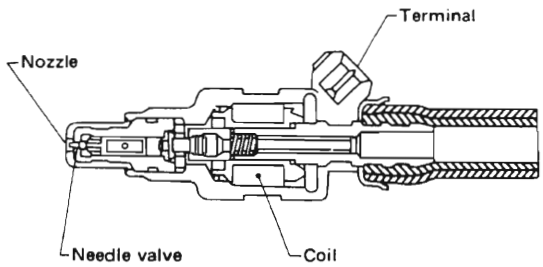


SEF937B

Components (Cont'd)

FUEL INJECTOR

The fuel injector is a small, precision solenoid valve. As the E.F.I. control unit outputs an injection signal to each fuel injector, the coil built into the injector pulls the needle valve back, and fuel is injected through the nozzle to intake manifold. The amount of fuel injected is controlled by the E.F.I. control unit as an injection pulse duration.

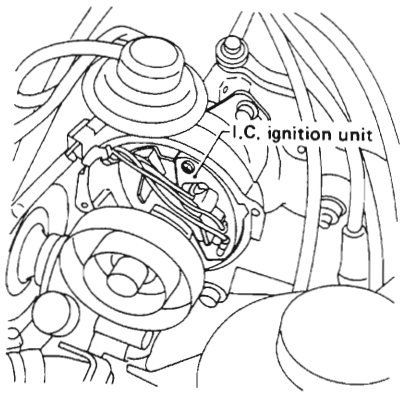


SEF627B

IC IGNITION UNIT

The ignition signal is sent to the E.F.I. control unit to control the injected fuel digitally by monitoring the engine revolution.

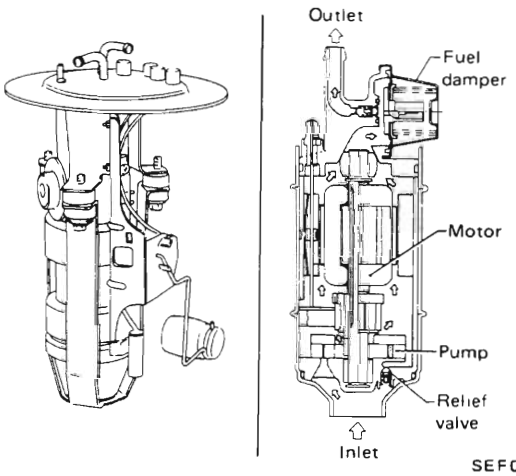
Refer to SPARK PLUG SWITCHING CONTROL SYSTEM (EF-14)



SEF976B

FUEL PUMP

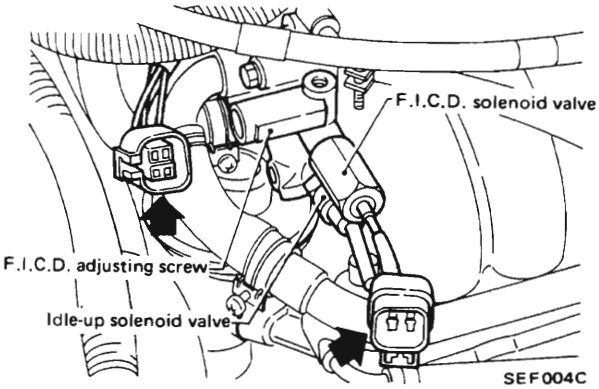
The fuel pump, which is located in the fuel tank, is a wet type pump where the vane rollers are directly coupled to a motor which is filled with fuel.



SEF043C

IDLE-UP SOLENOID VALVE

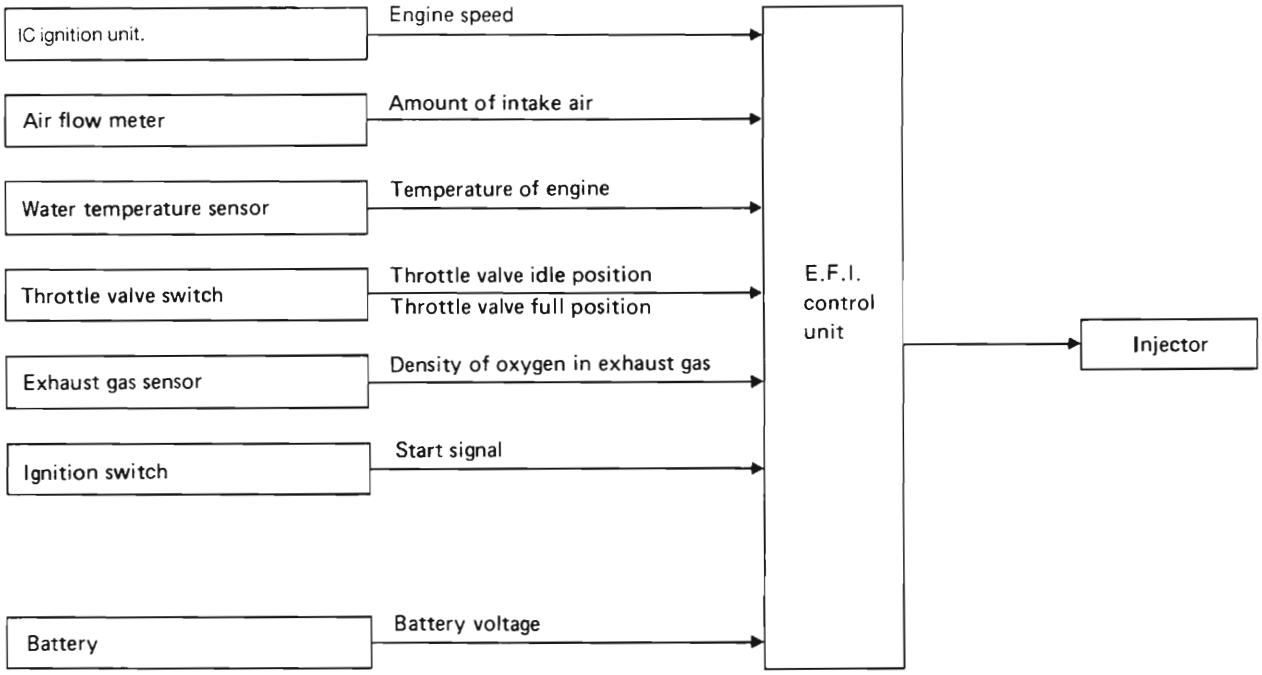
The idle-up solenoid valve is attached to the intake manifold. The solenoid valve actuates to stabilize idle speed when engine electrical load is introduced. By activating the Heater Fan or light switch.



SEF004C

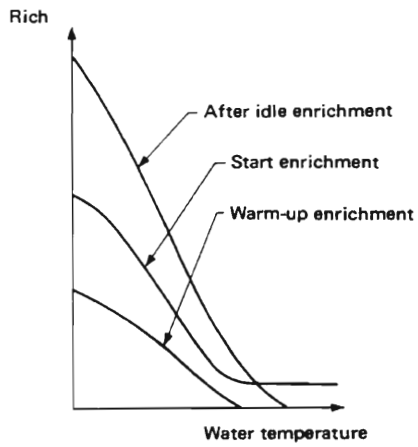
CA20E

Fuel Injection Control



The E.F.I. control unit calculates basic injection pulse width by processing signals from IC ignition unit and air flow meter. Receiving signals from each sensor which detects various engine conditions, the control unit adds various enrichments, which are pre-programmed in the control unit, to the basic injection amount. Thus, the optimum amount of fuel is injected through the injectors.

1) Fuel enrichment
   In the following each conditions, fuel is enriched.
- During warm-up
- When starting
- After idle
- With heavy load
- Full throttle



SEF872B

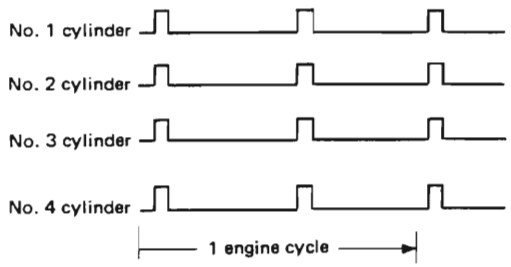
Enrichment rates for "with heavy load" are pre-programmed for engine speed and basic injection pulse width.

Fuel Injection Control (Cont'd)

2) Fuel Shut-off (During deceleration). Fuel shut-off occurs under certain conditions defined by throttle position, water temperature and engine speed.

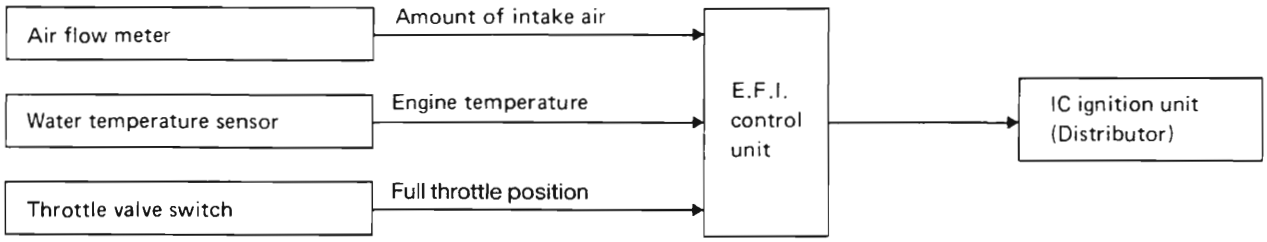
3) Simultaneous injection
The fuel is injected into all four cylinders simultaneously twice each engine cycle.

- Simultaneous injection



CA20E

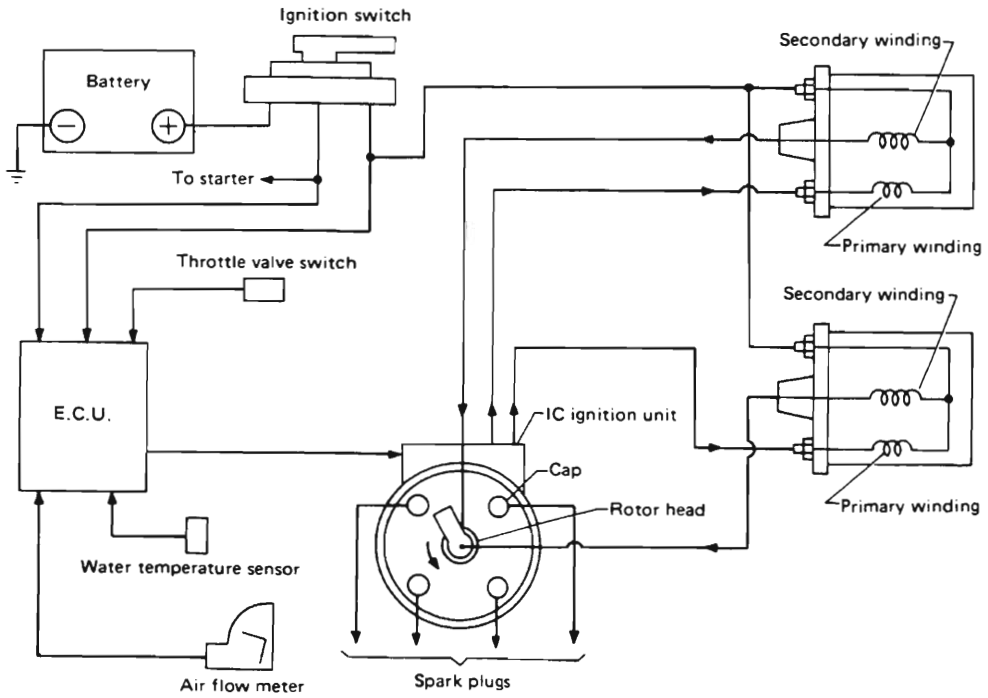
Spark Plug Switching Control



The spark plug switching control system is designed to change the ignition system from 2-plug ignition to 1-plug ignition during heavy load driving in order to reduce engine noise.

Operation

Water temperature	Engine operation condition		Ignition control
	Load		Spark control
Above 15°C (59°F)	Cranking		2-spark plug system
	Light load	Idle	2-spark plug system
		Drive	2-spark plug system
	Heavy load	Drive	1-spark plug system
Below 15°C (59°F)	All		2-spark plug system

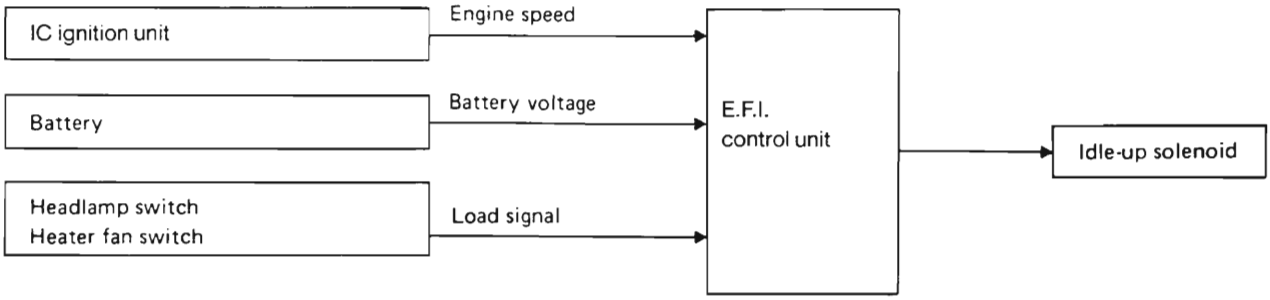


SEF581C

E.F.I. DESCRIPTION

CA20E

Idle-up Control

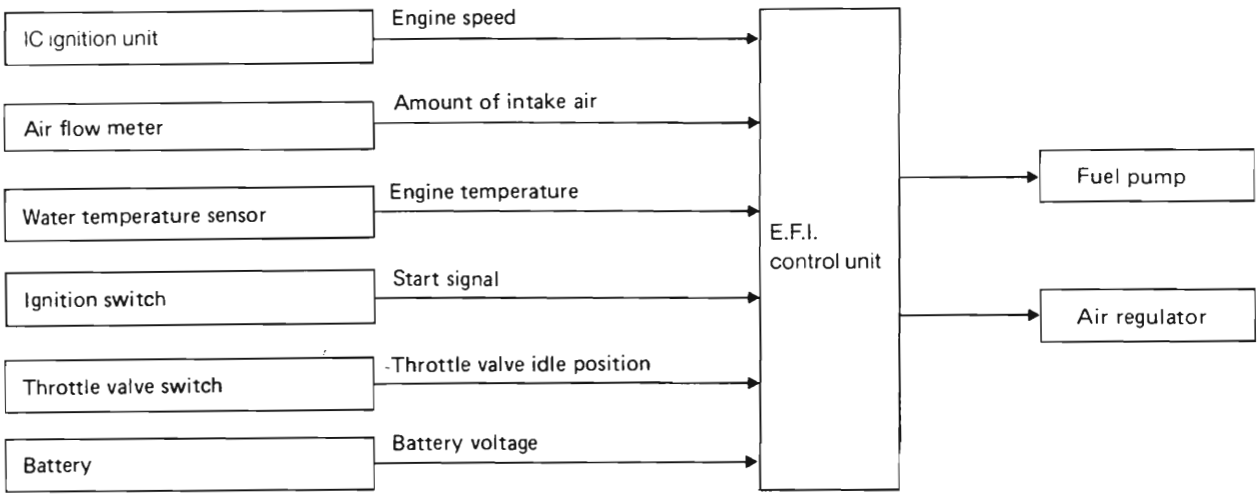


The idle speed is compensated by the E.F.I. control unit to prevent rough idle when any of the following conditions are met.
The control unit is signalled by headlamp or fan switch and activates ON/OFF signal. The signal from control unit is transmitted to the idle-up solenoid valve to stabilize idle speed.

Condition	Idle-up solenoid operation
• Battery voltage is below 12V • Load signal is ON when engine speed is less than 1,500 rpm • When air flow meter is malfunctioning	ON
Except above	OFF

CA20E

Fuel Pump and Air Regulator Control



Air regulator control

The air regulator is controlled by the E.F.I. control unit at the same time the fuel pump ON-OFF is controlled.

Fuel pump voltage control

The fuel pump is controlled by the E.F.I. control unit adjusting the voltage supplied to the fuel pump.

Conditions		Voltage
• 16.7 seconds after ignition switch is turned to ON with engine running. • Engine cranking • Engine speed is more than 3,000 rpm • Engine is under heavy load • Engine temp. above 100°C • Engine temp. below 10°C		Approximately 13.1 [V]
Except above	Idle switch ON	9.95 [V]
	Idle switch OFF	13.1 [V]

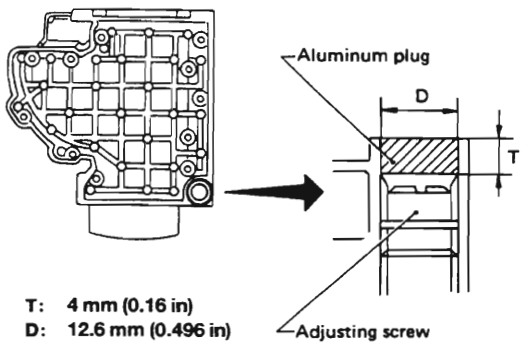
Fuel pump and air regulator ON-OFF control

Ignition switch position	Engine condition	Fuel pump/ Air regulator operation
ON	Stopped	Operates for 5 seconds
	Running	Operates
	After stall	Stops in 1 second
START	Starting	Operates

Caution

a. Before connecting or disconnecting E.F.I. harness connector to or from any E.F.I. unit, be sure to turn the ignition switch to the "OFF" position and disconnect the negative battery terminal.
   Otherwise, there may be damage to control unit.
b. Do not attempt to disassemble any E.F.I. component parts. To conduct electrical checks on these component parts, closely follow the steps outlined under "ELECTRONIC CONTROL SYSTEM INSPECTION" on pages EF-30 through EF-40.
c. When conducting self-diagnosing, follow the steps outlined under "SELF-DIAGNOSIS" on pages EF-23 through EF-29 in order to obtain accurate diagnosing results. After self-diagnosing has been completed, erase the memory properly.
d. Always turn the diagnosis mode selector carefully using a screwdriver. If it is turned forcibly, it may be damaged, resulting in the inability to perform the self-diagnosing or to monitor the mixture ratio.
e. Before troubleshooting, ensure that all harness connectors are secure.
f. While performing the CO% adjustment, be certain of the following to prevent possible damage to the air flow meter.

CA20E engine



T: 4 mm (0.16 in)
D: 12.6 mm (0.496 in)

SEF190C

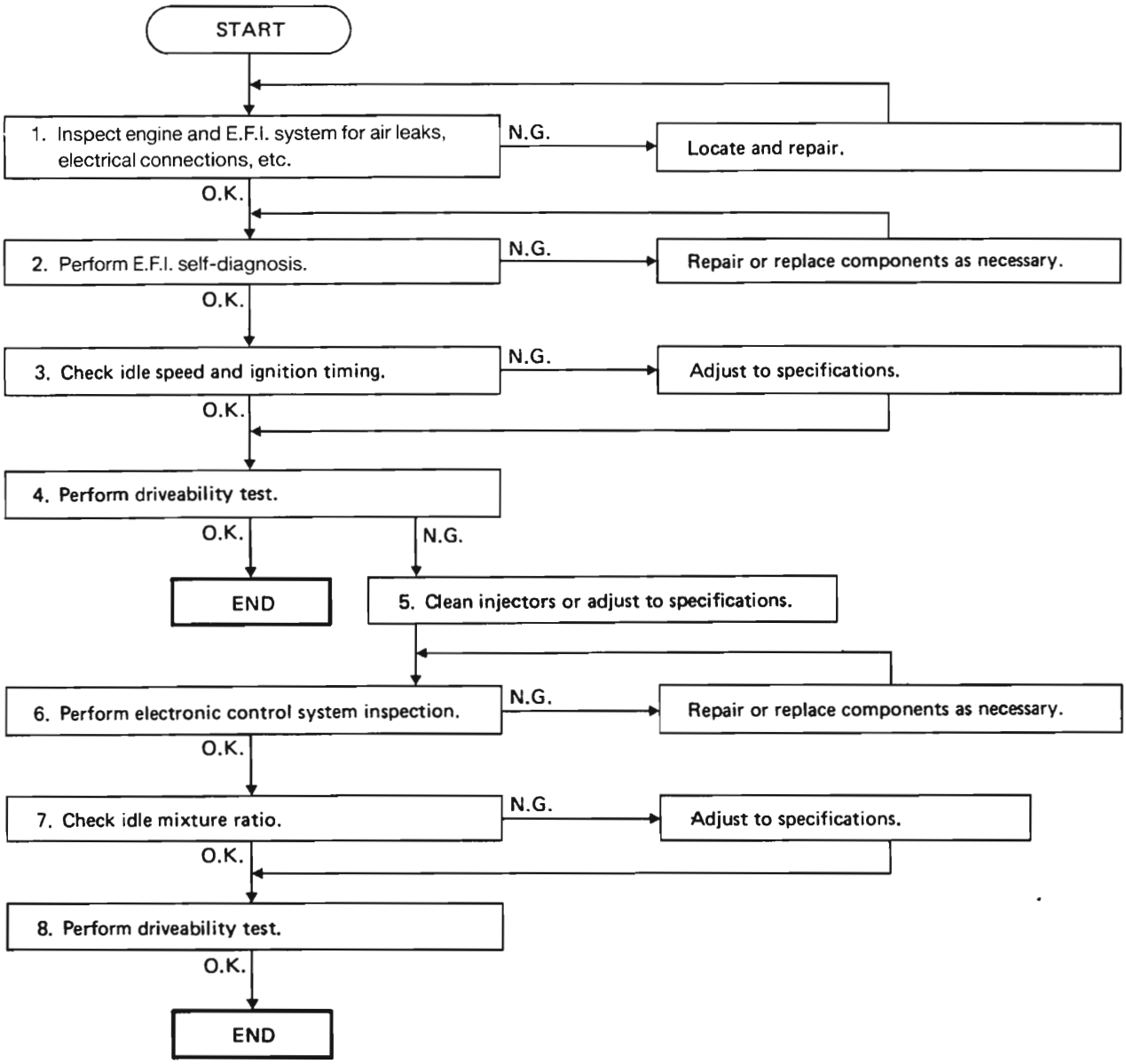
g. To remove plug, drill small diameter hole through centre of plug. Use a length of hollow tube around drill bit to limit penetration to 5mm maximum. Screw a suitably sized self-tapping screw into the hole. With pliers (or equivalent) carefully lever under both sides of screw head to prise out plug.
h. After mixture adjustment new plug **MUST** be fitted to ensure ADR Compliance.

   Plug Part No. — B2681-09POO

DIAGNOSTIC PROCEDURE

CA20E

Driveability



1. Inspect engine and E.F.I. system for air leaks, proper electrical connections, etc.
1) Check all hoses and ducts for air leaks.
2) Check air cleaner for clogging.
3) Check harness connectors for proper connections.
4) Check ignition wiring.
5) Check gaskets for leaks at all air intake components.
6) Check air regulator operation.

2. Perform E.F.I. self-diagnosis.
Follow the procedure in E.F.I. SELF-DIAGNOSIS (Pages EF-23 to EF-29).

3. Check idle speed and ignition timing.

a. **Prepare the following conditions:**
- **Battery is in good order.**
- **Headlamp switch: OFF**
- **Heater blower: OFF**

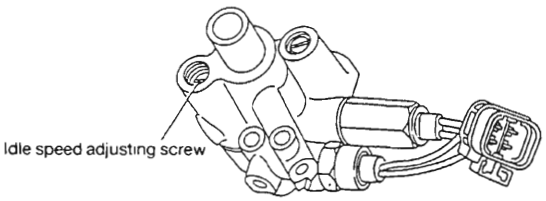
b. **Warm engine to operating temperature.**

Check and adjust as follows:
1) Race engine two or three times under no-load, then run engine at idle speed.
2) Check idle speed.

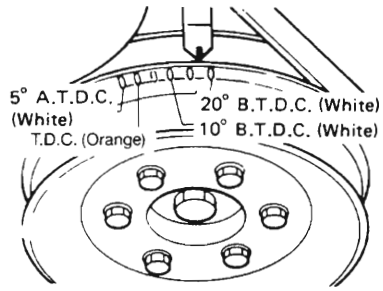
Idle speed: rpm

	M/T	A/T (in "N" position)
CA20E	800±50	900±50

If necessary, adjust to the specified speed by turning the idle speed adjusting screw.



3) Check ignition timing with a timing light. (Disconnect and Plug Vacuum Advance line at Distributor).



SMA189A

(Without vacuum advance):
M/T 4°±1° B.T.D.C.
A/T 4°±1° B.T.D.C.

If necessary, adjust ignition timing by turning distributor.

4) Check throttle valve switch (Idle contact), and adjust if necessary. (Refer to page EF-10).

OFF → ON:
M/T Idle speed +250±150 rpm
A/T Idle speed (in "N" position) +250±150 rpm

4. Perform driveability test.
Evaluate effectiveness of adjustments by driving vehicle. If unsatisfactory, proceed to step 5.

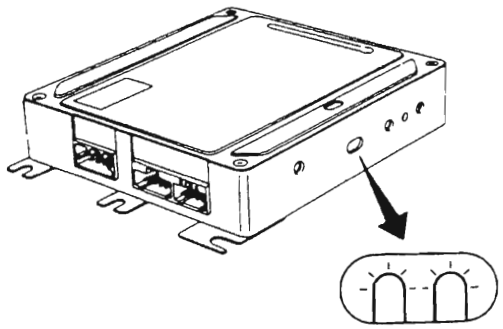
5. Clean injectors or adjust to specifications. Check injectors or try replacement injectors.
6. Perform electronic control system inspection. Check the following using circuit tester.

- Injector circuits
- Air regulator circuit
- Exhaust gas sensor circuit

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Pages EF-30 — EF-40)

7. Check idle mixture ratio.

1) Warm up engine to operating temperature.
2) Verify that the diagnosis mode selector is turned "OFF".
3) Verify that engine is still at operating temperature.
4) Race engine two or three times under no-load, then run engine at idle speed.
5) Disconnect throttle switch harness connector.
6) Look at inspection lamps (red and green).



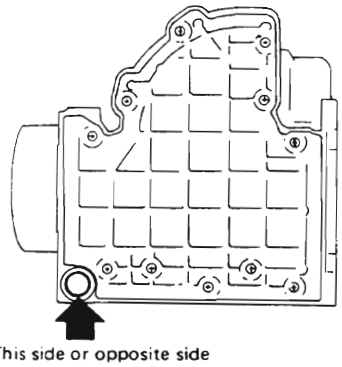
SEF648B

When both inspection lamps blink, it indicates that the idle mixture ratio is correct.

7) If N.G., adjust idle mixture ratio by turning air by-pass screw on air flow meter so that inspection lamps blink simultaneously.

Refer to CAUTION (f & g) on page EF-17

CA20E engine



SEC325A

8. Check mixture ratio at engine speed.

1) Verify that inspection lamps on control unit blink simultaneously at idle.
2) Race engine two or three times under no-load, then run engine at idle speed.
3) Gradually increase engine speed and check for operating (blinking) of the inspection lamps at different engine rpms (up to approximately 2,000 rpm).

- If both inspection lamps continue to blink during idle to 2,000 rpm range, it indicates that the idle mixture ratio is correct.

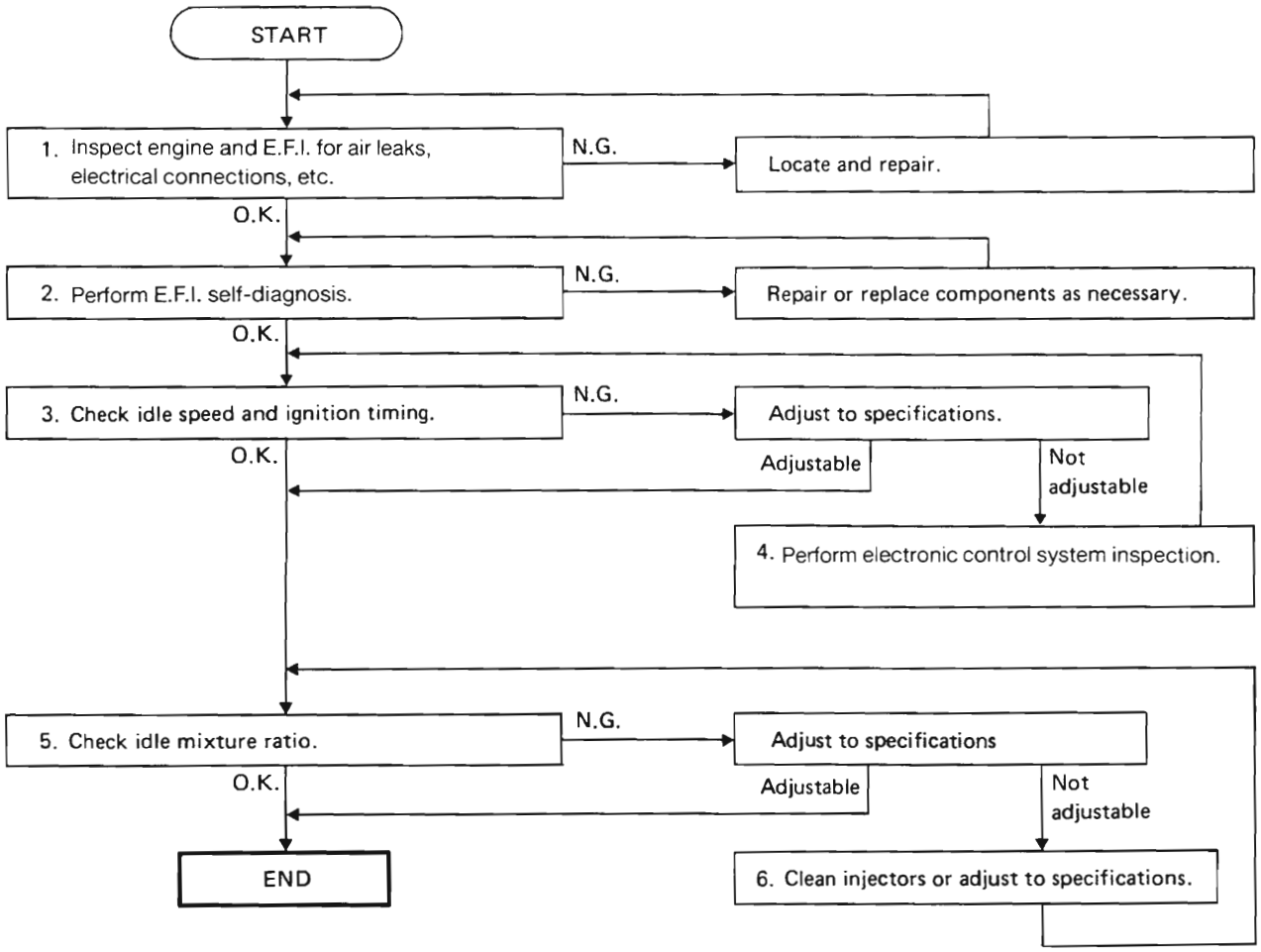
4) If N.G., replace air flow meter and adjust idle mixture ratio as per step 7.

9. Perform driveability test.
Re-evaluate vehicle performance.

DIAGNOSTIC PROCEDURE

CA20E

Improper Idling and Stall



1. Inspect engine and E.F.I. for air leaks, electric connections, etc.
   Refer to DRIVEABILITY.
2.
1) Perform E.F.I. self-diagnosis.
   Follow the procedure in SELF-DIAGNOSIS (Pages EF-23 to EF-29).
2) Confirm throttle valve switch operation.
   Refer to DRIVEABILITY.
3. Check idle speed and ignition timing.
   Refer to DRIVEABILITY.
4. Perform electronic control system inspection.

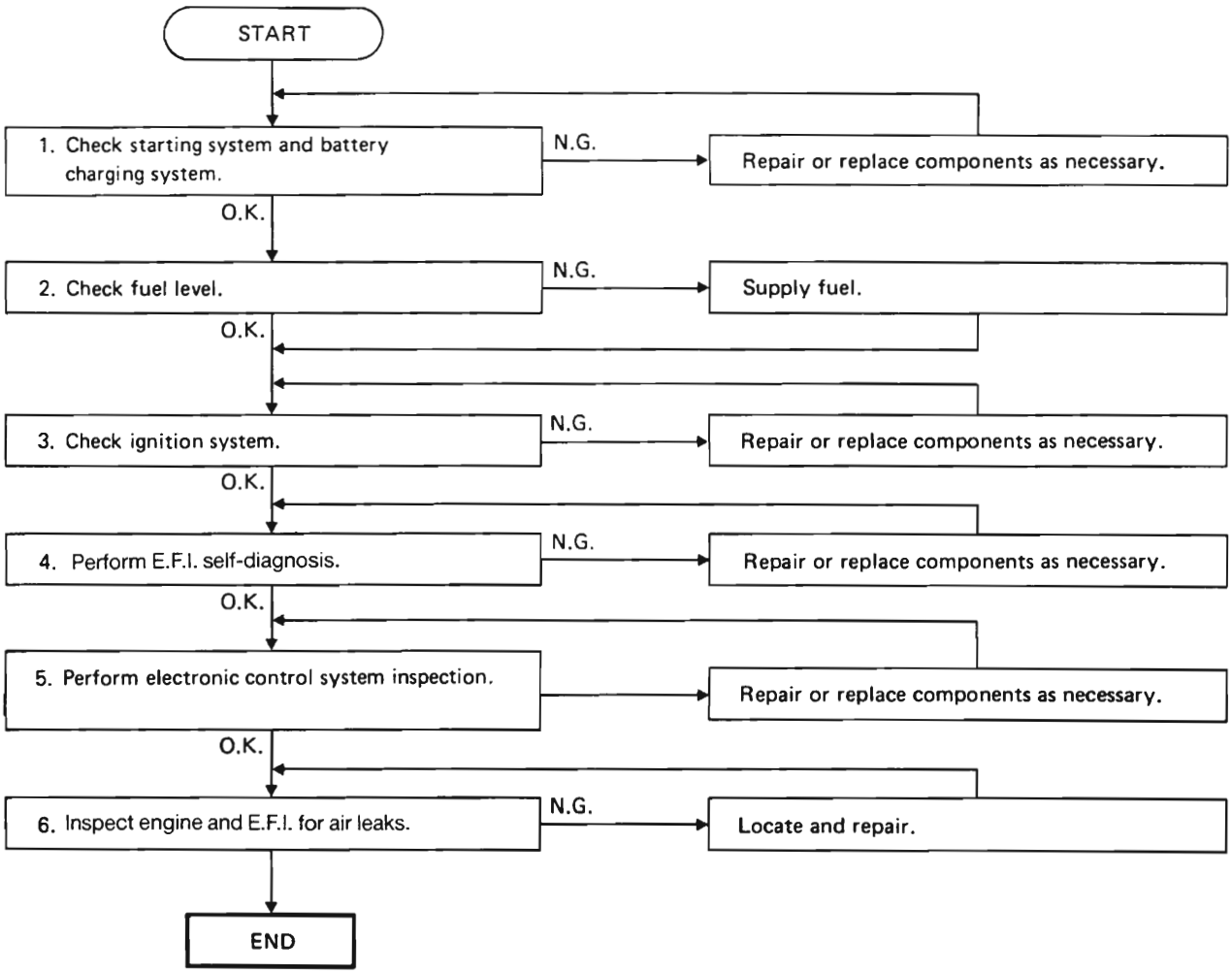
   Check the following using circuit tester.
- Injector circuit
- Air regulator circuit
- Idle-up solenoid valve

   Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Pages EF-30 to EF-40).
5. Check idle mixture ratio.
   Refer to DRIVEABILITY.
6. Check injectors and replace if necessary.

DIAGNOSTIC PROCEDURE

CA20E

Engine Startability



1. **Check starting system and battery charging system.**
1) **Check starter operation.**
2) **Check battery voltage.**
Repair or replace as necessary.
2. **Check fuel level.**
If fuel level is low or empty, add fuel.
3. **Check ignition system.**
1) **Check ignition wiring.**
2) **Check distributor rotor head.**
3) Check spark plugs.
4. Perform E.F.I. self-diagnosis. Follow the procedure in E.F.I. SELF-DIAGNOSIS (Pages EF-23 to EF-29).
5. Perform electronic control system inspection.

Check the following using circuit tester.
- **Injector circuit**
- **Air regulator circuit**

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Pages EF-30 to EF-40).
6. Inspect engine and E.F.I. for air leaks. Refer to DRIVEABILITY.

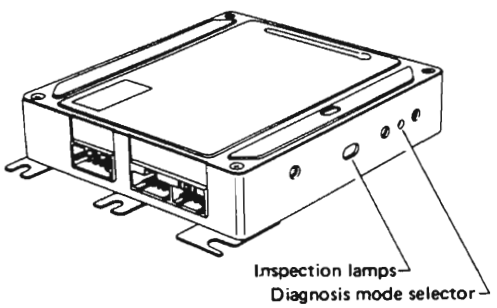
SELF-DIAGNOSIS

CA20E

Self-diagnostic System

The self-diagnostic system determines malfunctions of signal systems such as sensors, actuators, and wire harnesses based on the status of the input signals received by the E.F.I. control unit. A malfunction is displayed by both the red and green L.E.D.s (Light Emitting Diodes).
Basically, self-diagnosis is always performed when the power is furnished to the E.F.I. control unit. The self-diagnosis results are retained in the memory chip of the E.F.I. control unit and are displayed only when the diagnosis mode selector (located on the side of the control unit) is turned "ON".
The self-diagnostic system is provided with functions which display malfunctions being checked as well as those which are stored in the memory. In this sense, it is very effective in determining an "intermittent" malfunction. The results which are stored in the memory can be erased by following the steps specified.

A malfunctioning area is determined by the number of blinks of both the red and green L.E.D.s. First, the red L.E.D. blinks and the green follows. The red L.E.D. refers to the tenth digit while the green one refers to the unit digit. For example, when the red L.E.D. blinks three times and the green L.E.D. blinks twice, this implies number "32". In this way, all problems are classified by code numbers.



SEF650B

ITEMS DISPLAYED ALL THE TIME

Codes for some items will be displayed even though they are not malfunctioning. It is necessary to enter a signal manually to cancel these codes.

The codes are:-
1) Throttle valve switch
2) Start signal
3) Load signal (from fan switch and head lamp switch)

See page EF-25 for correct procedure.

ITEMS RETAINED IN MEMORY

The following items will be retained in the memory from the time of detection until erased.

Judging

Air flow meter circuit
- When the air flow meter produces an abnormally high output voltage with the engine off.
- When the air flow meter produces an abnormally low output voltage with the engine running.

Water temperature sensor circuit
When the circuit is shorted or open.

Ignition signal
When an ignition signal is not produced on the primary winding of the ignition coil.

Fuel pump circuit
When current flowing through the control unit to drive the fuel pump is too small or too large while the engine is operating.

Air temperature sensor circuit.
When the circuit is shorted or open.

Self-diagnostic System (Cont'd)

CAUTION:

a. Always turn the diagnosis mode selector carefully using a screwdriver. Do not press hard to turn. Otherwise, the selector may be damaged.

b. When the engine fails to start, crank the engine more than two seconds before starting the self-diagnosing.

c. **Before starting the self-diagnosing, DO NOT ERASE THE STORED MEMORY. Doing so will reduce the self-diagnosis function considerably.**

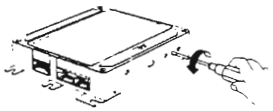
d. After a malfunctioning area has been corrected, be sure to erase the memory.

e. The self-diagnosed results are retained in the memory by a small current flow from the battery. Disconnecting the battery cable or the control unit's connector erases the memory stored. Always perform the self-diagnosing regarding "intermittent" checks before disconnecting.

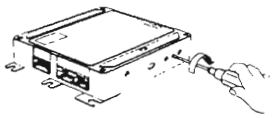
f. **If you make a fuel filter change when disconnecting fuel pump connector, the control unit memorizes number 22 in the self-diagnosis.**

CA20E

Self-diagnostic Procedure



SEF651B



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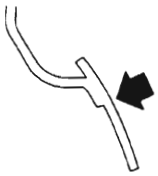


SEF653B

START

Verify that diagnosis mode selector is turned "OFF".

Turn ignition switch to "ON" position.

Make sure that inspection lamps on control unit stay "ON". (Bulb check)

N.G. → Check harness for battery source. (Refer to page EF-39) If battery is O.K. replace control unit.

O.K.

Turn diagnosis mode selector "ON"

Make sure that inspection lamps on control unit are displaying code No. 23, No. 24 (M/T), No.31 and No.32.

N.G. → Write down the malfunctioning code.

O.K.

Fully depress accelerator pedal, then release.

Transmission Type

M/T

A/T

Code 24
Early model control units (identified by Part No. 22611-66S00) were manufactured with a code 24 function. This however, was not utilized on the R31 series.
Consequently, when performing self diagnosis, it will be necessary to bridge control unit terminals 5 and 14 to clear code 24.
Late model control units (identified by Part No. 22611-66S01 and 22611-J7000) are manufactured without the code 24 function. However, the control unit diagnostic sticker does still list a code 24 function. This should be ignored.

Make sure that inspection lamps on control unit are displaying code No. 31 and No. 32.

N.G. → Write down the malfunctioning code.

O.K.

Start engine.

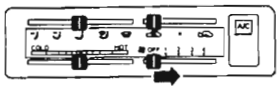
Make sure that inspection lamps on control unit are displaying code No. 31.

N.G. → Write down the malfunctioning code.

O.K.

Ⓐ

Self-diagnostic Procedure (Cont'd)



SEF877B

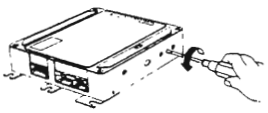
Ⓐ

Turn fan switch
OFF → ON → OFF →

Make sure that inspection lamps on control unit are displaying code No. 44.

N.G. → Write down the malfunctioning code.

O.K.



SEF651B

Turn diagnosis mode selector "OFF"

Turn off engine.

See decoding chart (Pages EF-27 -29).

Check malfunctioning area
(Pages EF-30 -40).

Erase the memory of self-diagnosis results.

Procedure for memory erasure

Turn ignition switch to "OFF" position.

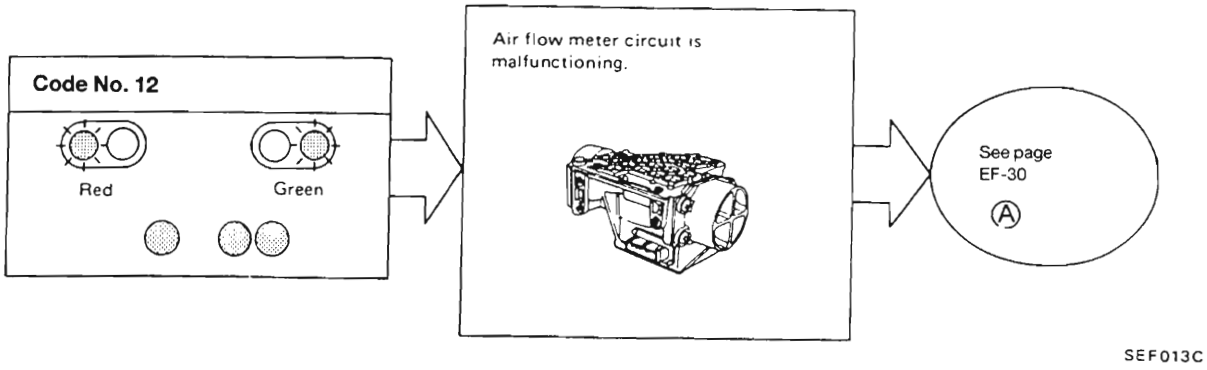
Turn self-diagnosis mode selector to "OFF" position.

Disconnect the battery cable. Keep it off for more than 15 seconds.

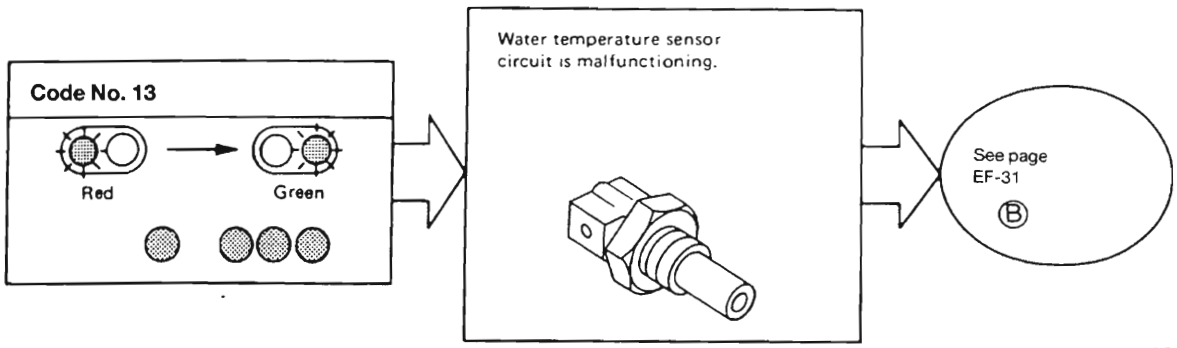
Reconnect the battery cable.

END

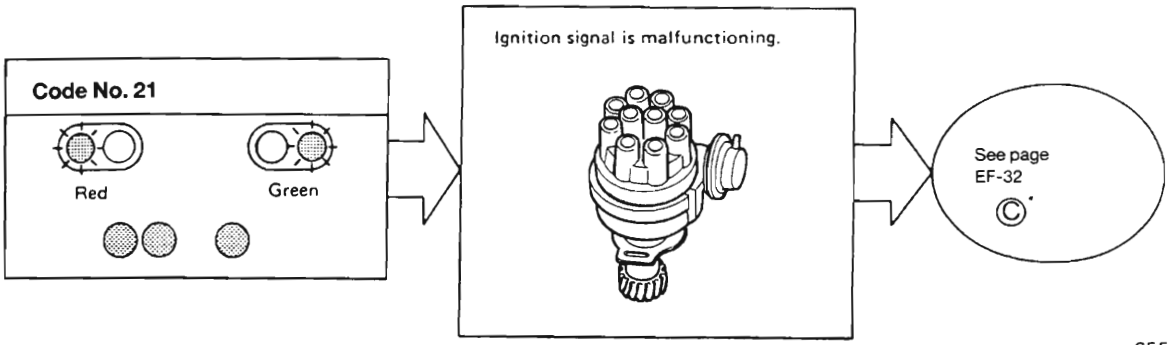
Decoding Chart



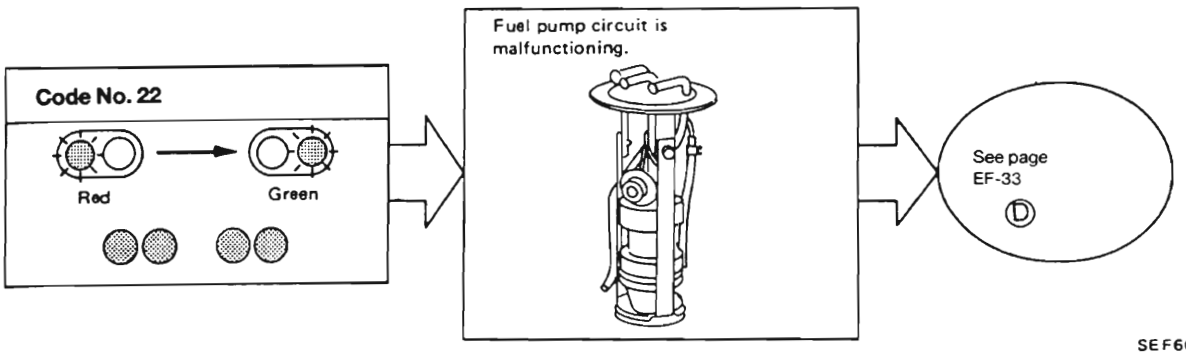
SEF013C



SEF659B



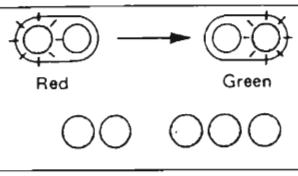
SEF014C



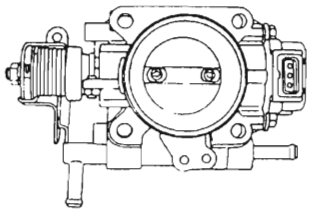
SEF662B

Decoding Chart (Cont'd)

Code No. 23



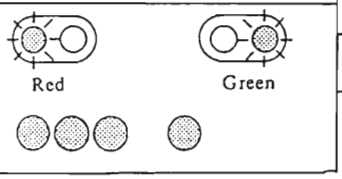
Throttle valve switch (Idle switch) circuit is malfunctioning.

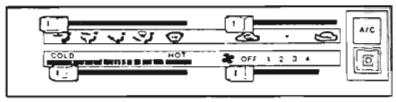


See page EF-34 Ⓔ

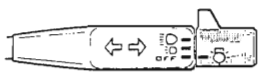
SEF878B

Code No. 31



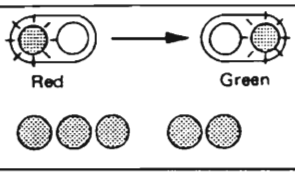


Idle control system is malfunctioning. (Lighting switch or fan switch.)

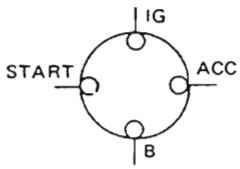


See page EF-35 Ⓕ

Code No. 32



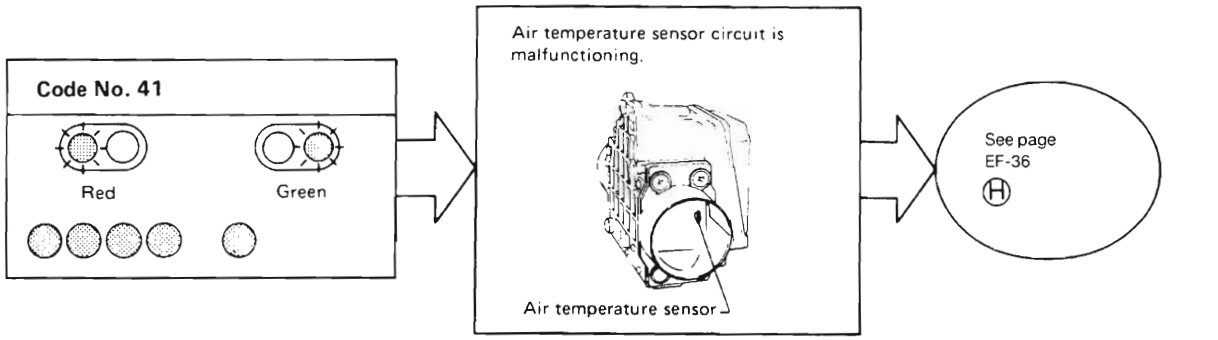
Starter signal is malfunctioning.



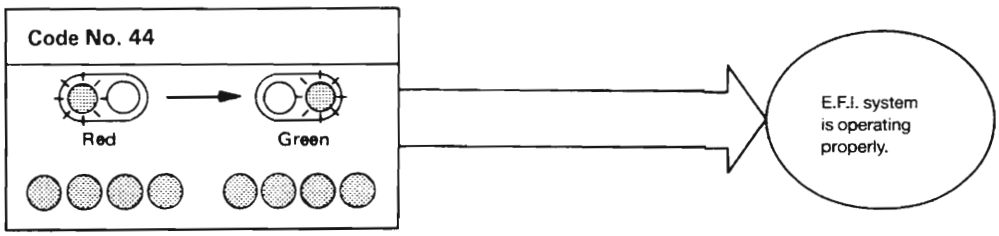
See page EF-35 Ⓖ

SEF666B

Decoding Chart (Cont'd)



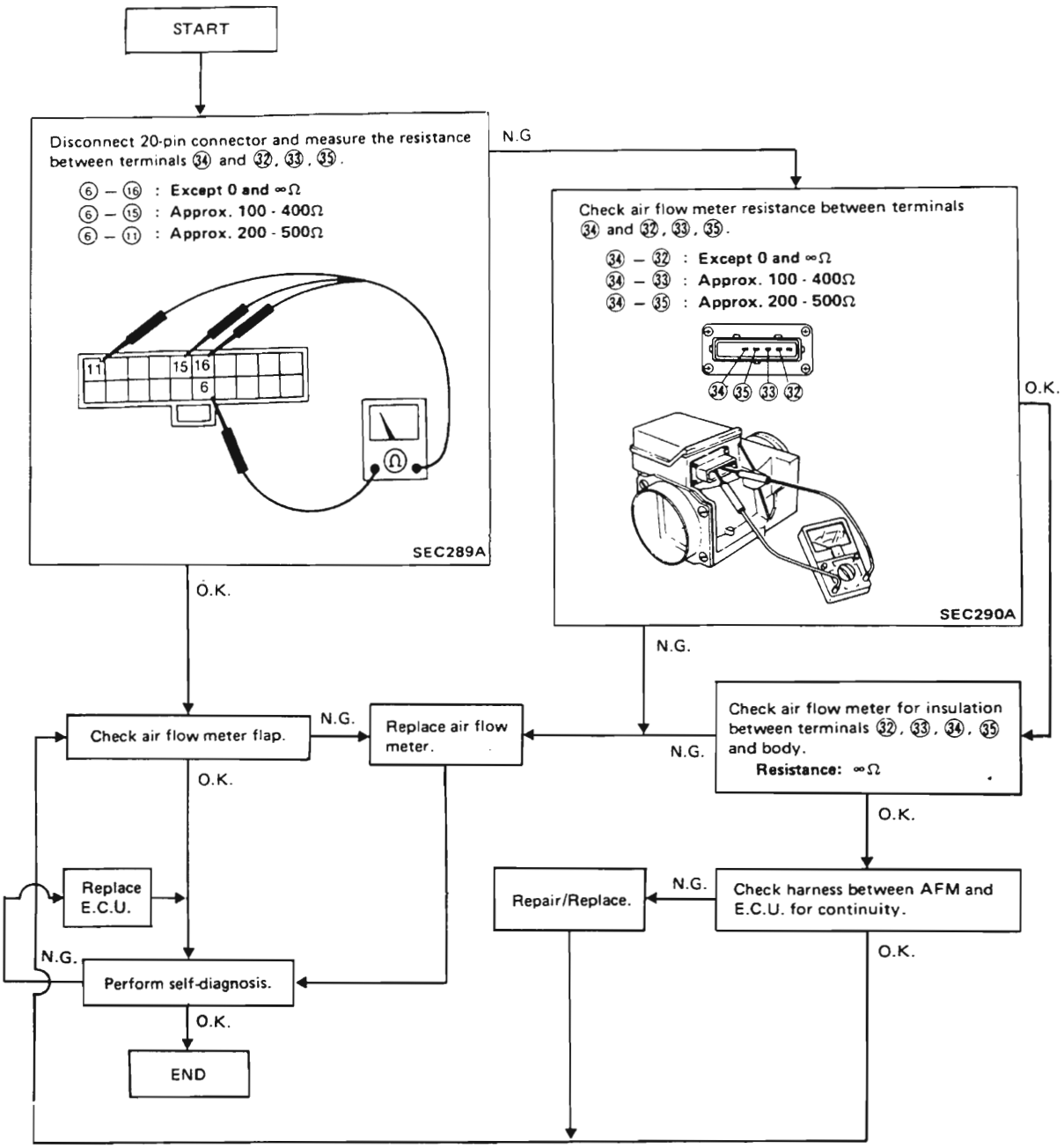
SEC314A



SEF669B

Before checking the following items, ensure that each connector is securely connected.

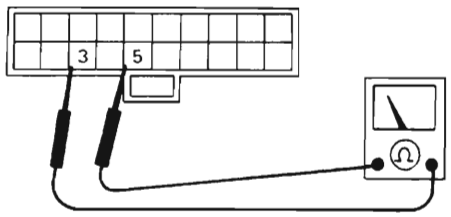
Ⓐ Air flow meter (Code No. 12)



Ⓑ **Water temperature sensor (Code No. 13)**

START

Disconnect 20-pin connector and measure the resistance between terminal ③ and ground ⑤.

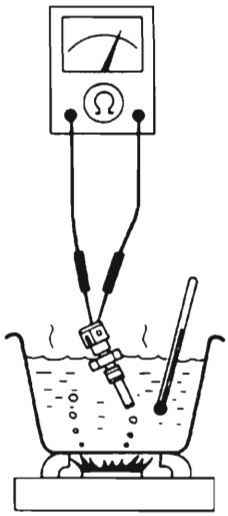


SEC293A

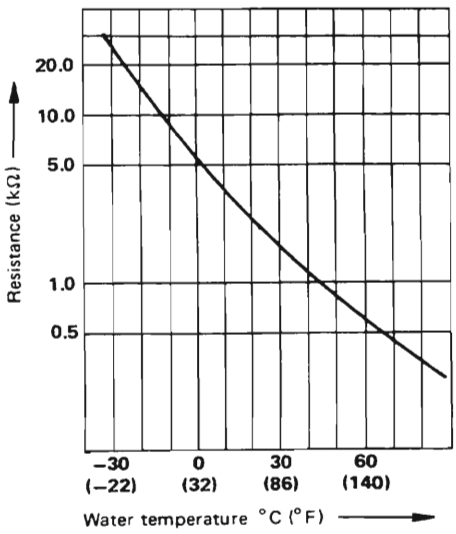
Water temperature	Resistance
Above 20°C (68°F)	Below 2.7 kΩ
Below 20°C (68°F)	Above 2.3 kΩ

N.G.

Dip the sensor into the water maintained at a temperature of 20°C (68°F), 80°C (176°F), etc., and read its resistance.



CHARACTERISTIC CURVE



SEC300A

O.K.

O.K.

Check harness between E.C.U. and water temp. sensor.

N.G.

Repair/Replace.

N.G.

Replace water temp. sensor.

Replace E.C.U.

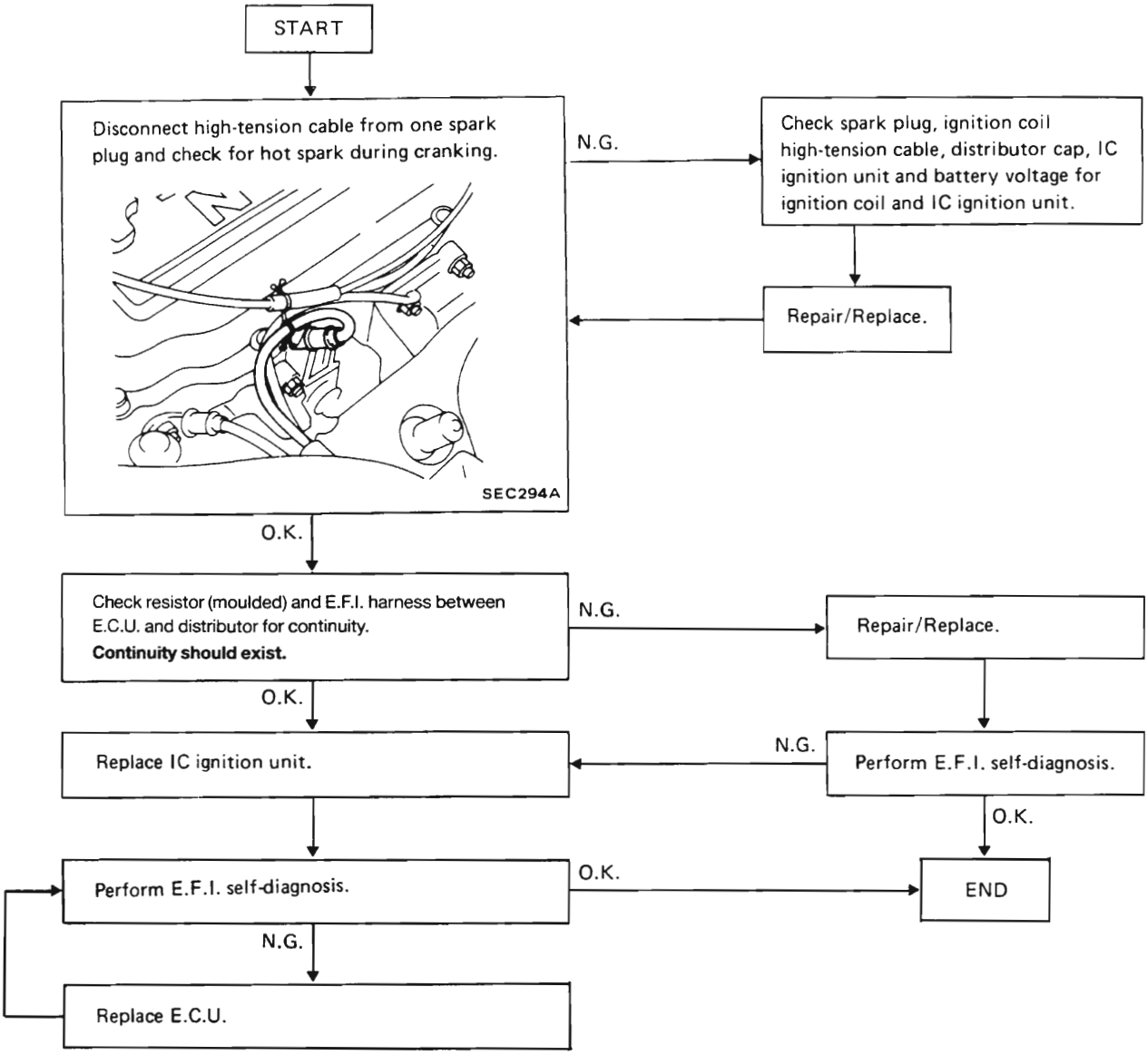
Perform E.F.I. self-diagnosis.

N.G.

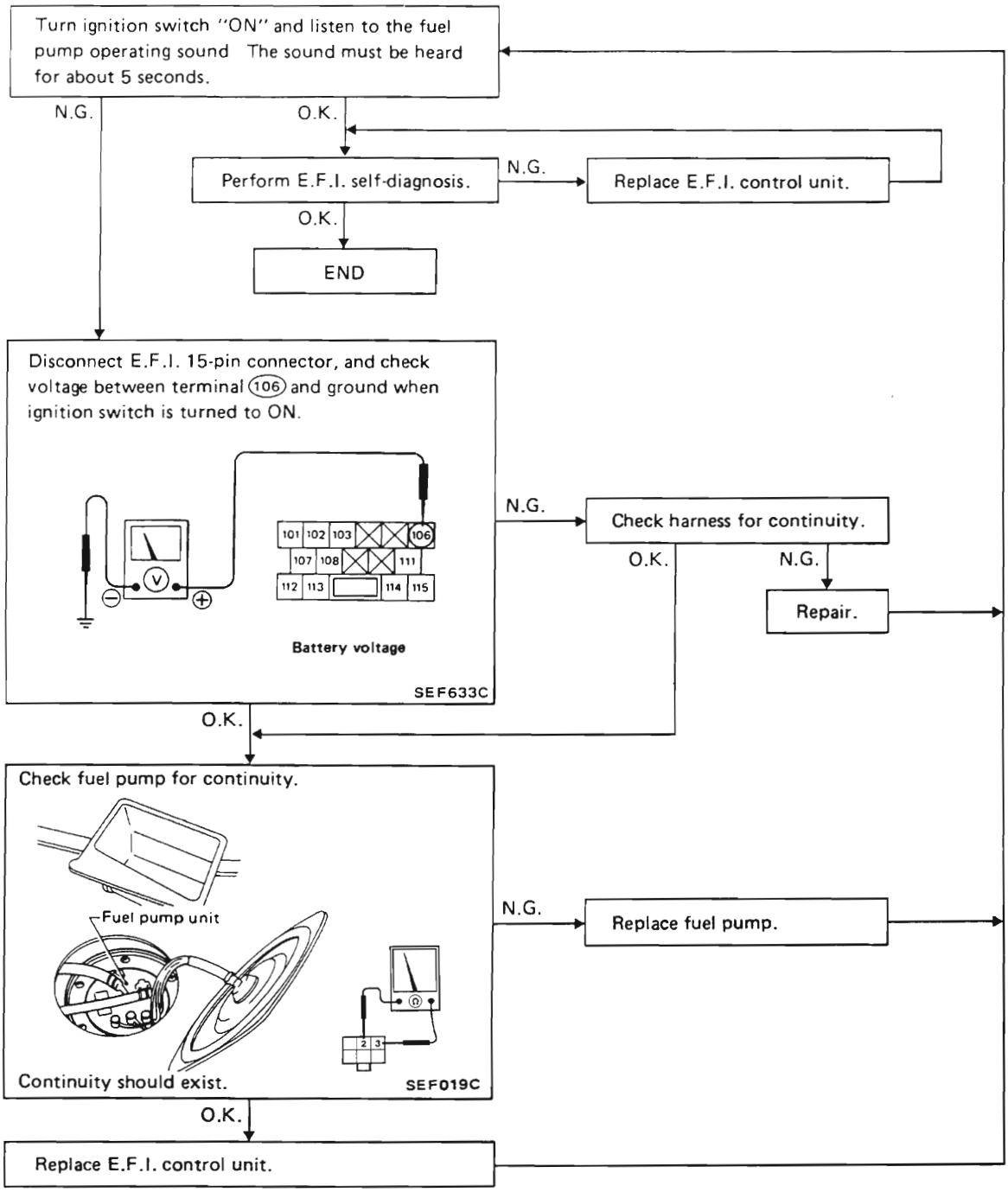
O.K.

END

© IGN. (Ignition system) (Code No. 21)



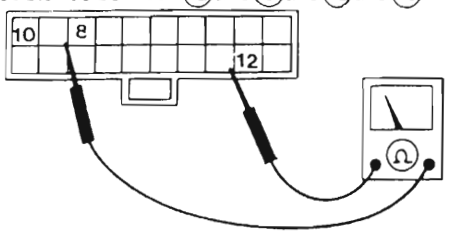
Ⓓ Fuel pump (Code No. 22)



Ⓔ Throttle valve switch (Code No. 23)

START

Disconnect 20-pin connector and measure the resistance between (12) and (8) and (12) and (10).



Throttle	12 and 8	12 and 10
released	0Ω	∞Ω
Fully depressed	∞Ω	0Ω

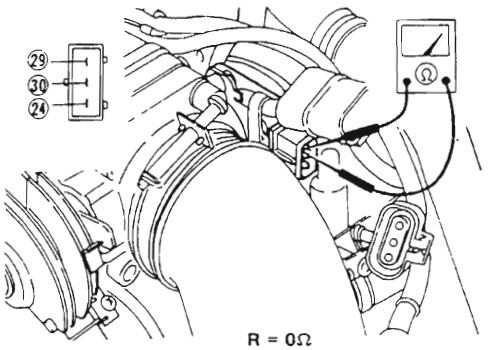
SEC296A

O.K → Perform E.F.I. self-diagnosis. → O.K. → END

N.G. → Replace E.C.U. → Perform E.F.I. self-diagnosis.

N.G

Measure the resistance between (29) and (30) Throttle closed. (24) and (30) Throttle wide open.



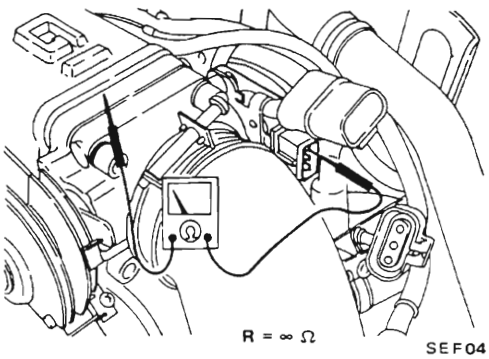
SEF040C

N.G. → 29 and 30 / 24 and 30 → Adjust idle contact see S.D.S. for contact speed

N.G. → 29 and 30 / 24 and 30 → Replace throttle valve switch.

O.K.

Measure the resistance between (29), (30), (24) and body ground.

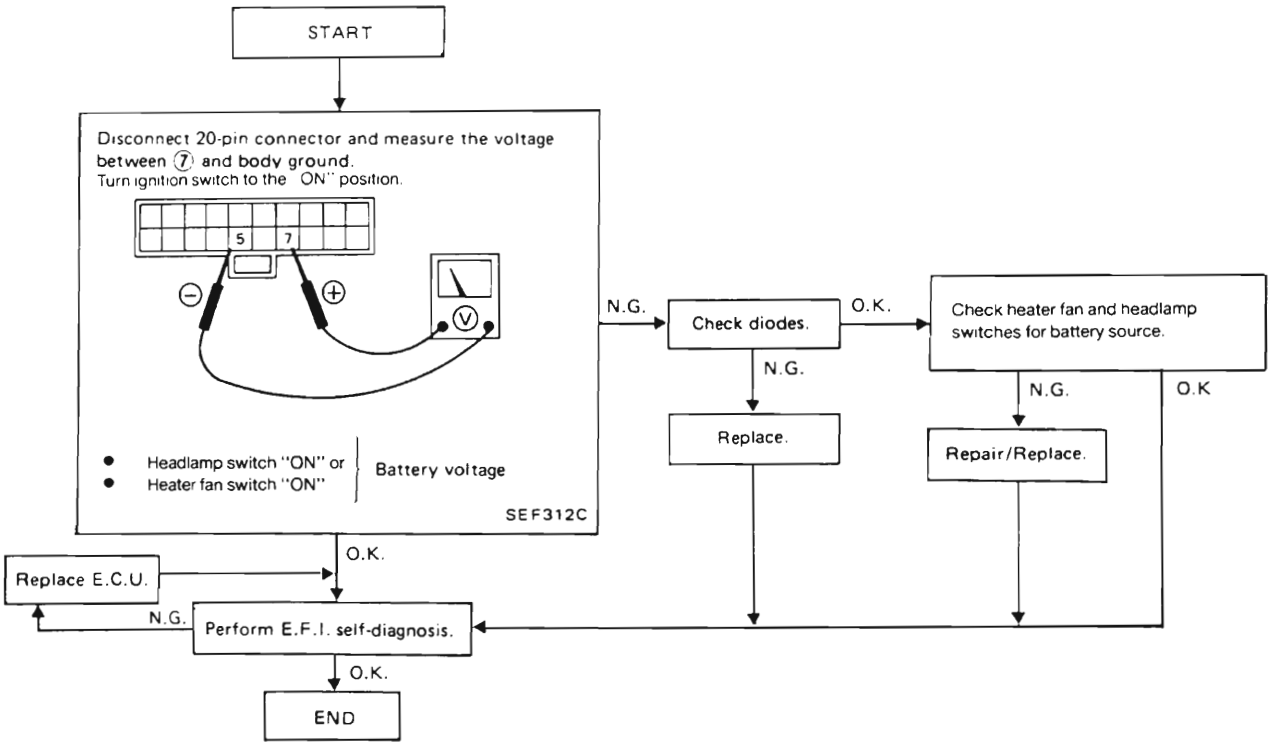


SEF041C

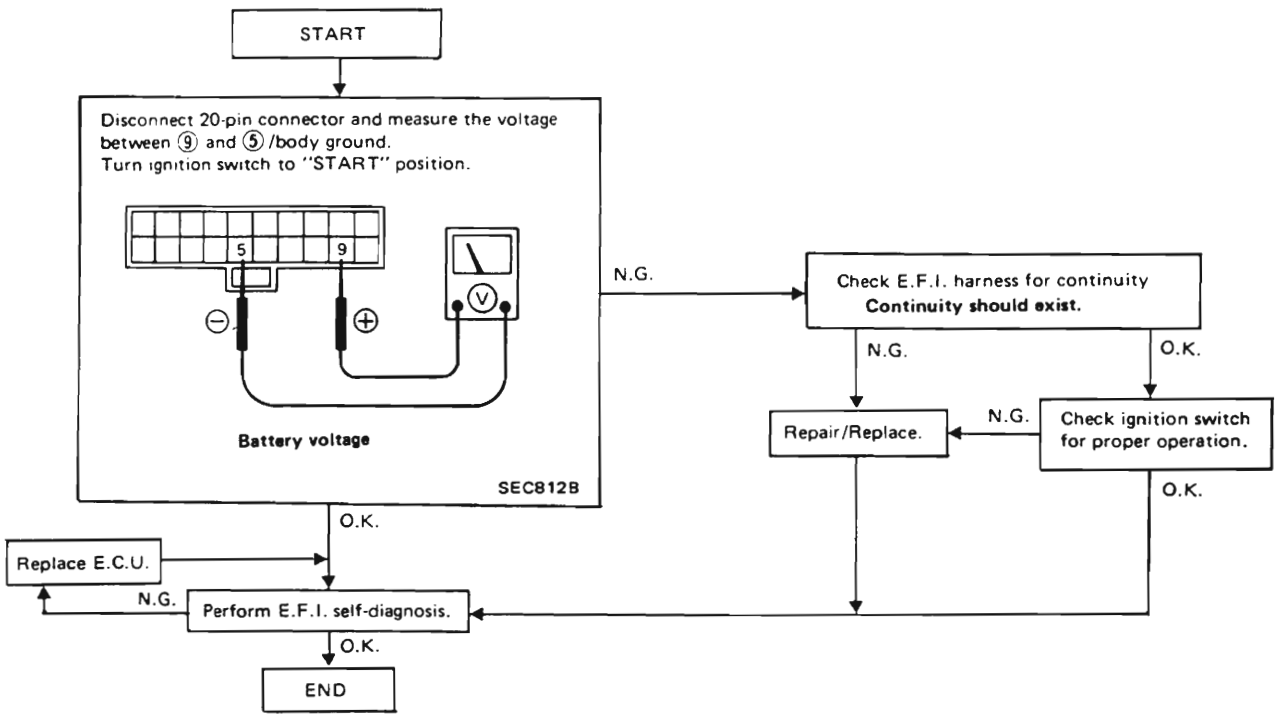
N.G. → Replace throttle valve switch.

O.K. → Check E.F.I. harness between E.C.U. and throttle valve switch for continuity. **Continuity should exist.** → Repair/Replace.

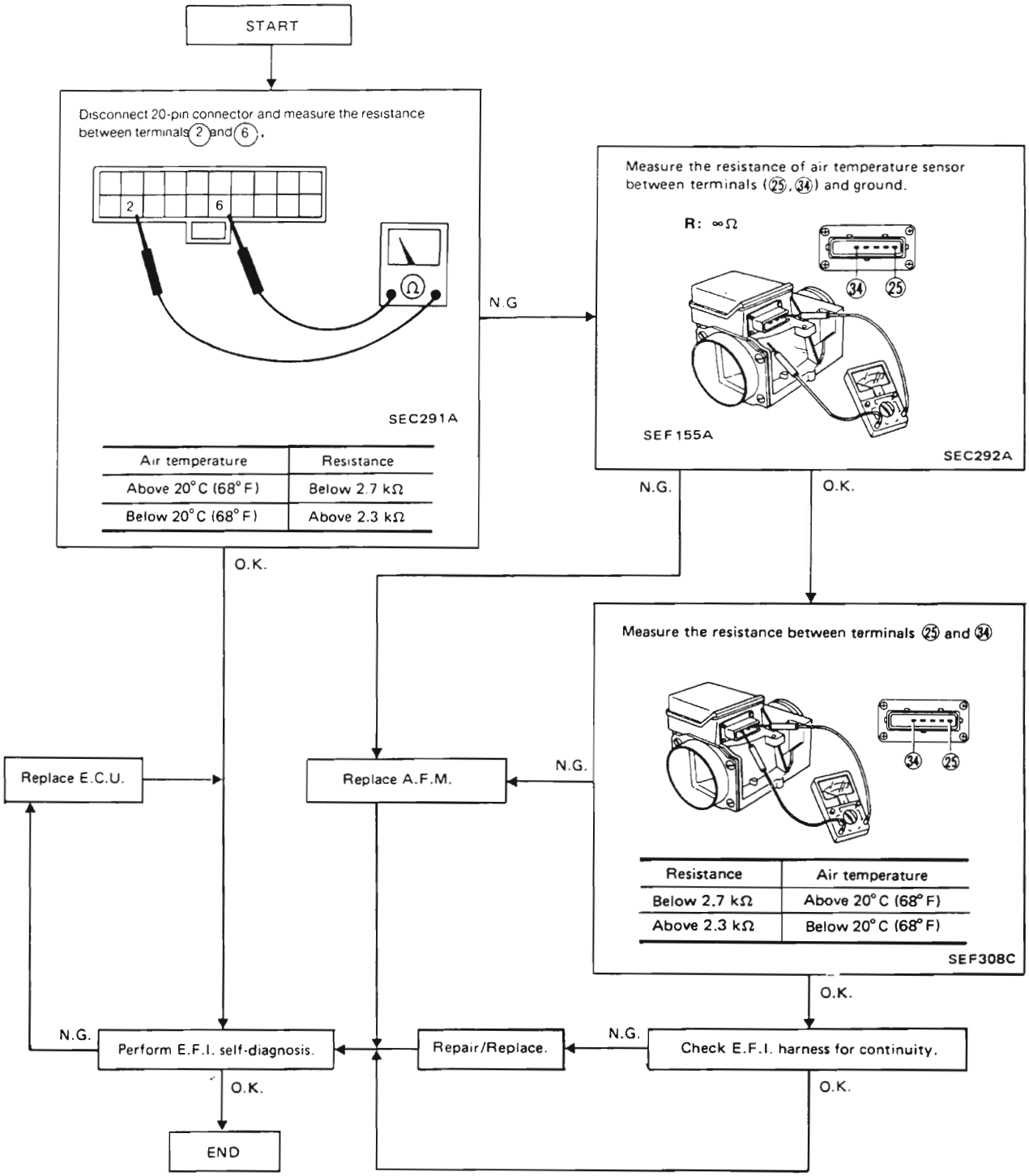
Ⓕ Load signal (Code No. 31)



Ⓖ Starter switch (Code No. 32)



Ⓗ Air temperature sensor (Code No. 41)



Air temperature	Resistance
Above 20°C (68°F)	Below 2.7 kΩ
Below 20°C (68°F)	Above 2.3 kΩ

Resistance	Air temperature
Below 2.7 kΩ	Above 20°C (68°F)
Above 2.3 kΩ	Below 20°C (68°F)

Ⓙ Air regulator

START

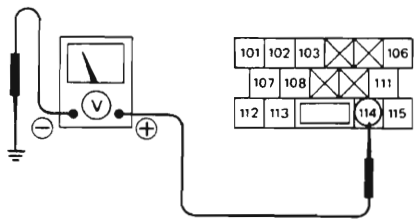
a. Check air regulator operation.
   - When engine is cold ... Open
   - After warm-up ... Closed

b. Check air regulator shutter for smooth operation.

O.K. → END

N.G.

Disconnect E.F.I. 15-pin connector, and check voltage between (114) and ground when ignition switch is turned to ON.



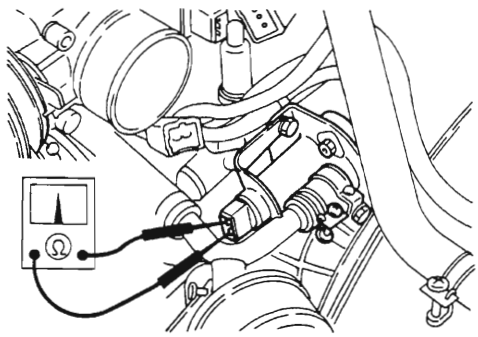
Battery voltage

SEF596C

O.K. → Replace E.C.U.

N.G.

Check air regulator for continuity.



Resistance: Approximately 70Ω

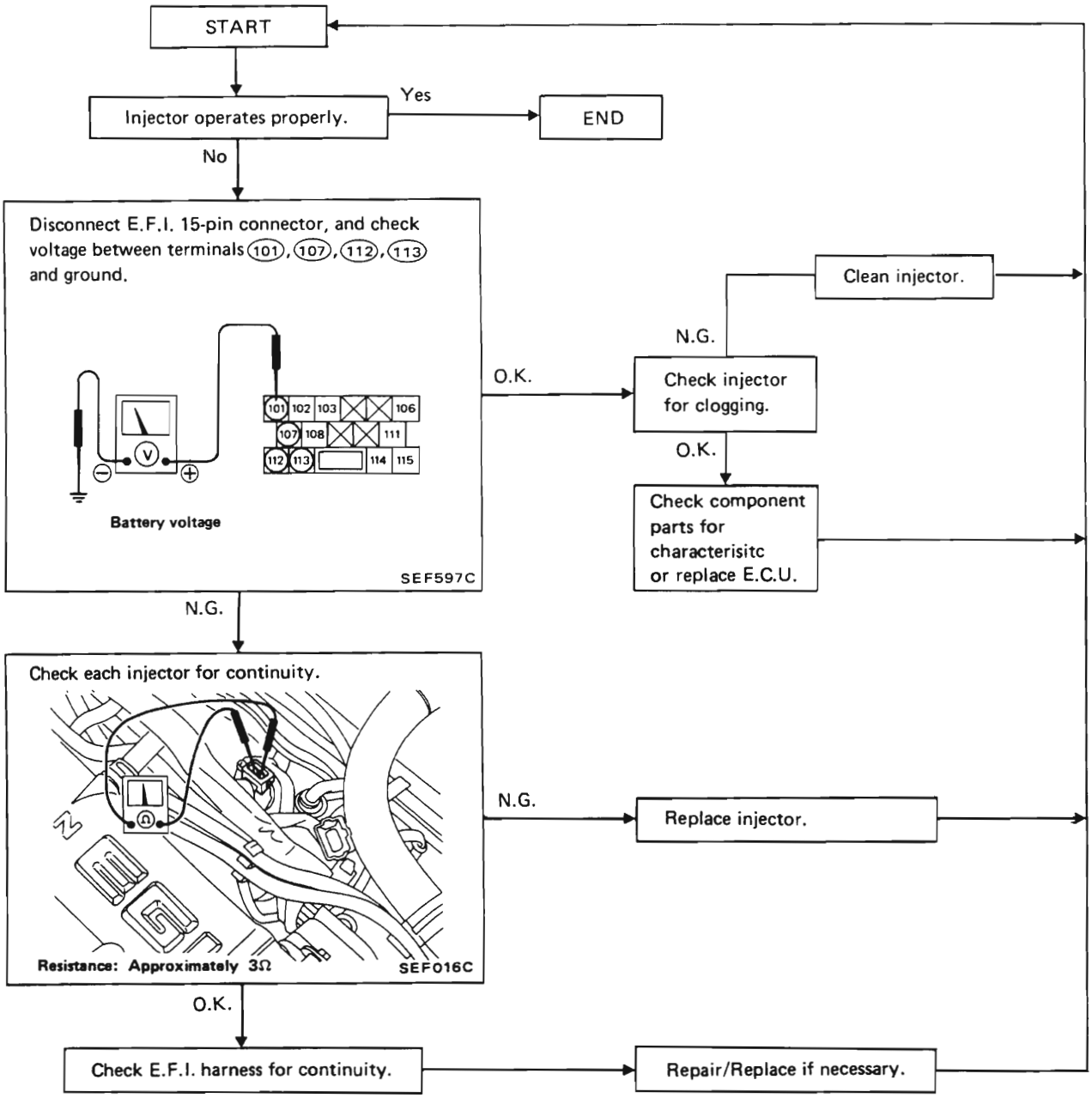
SEF012C

N.G. → Replace air regulator.

O.K.

Check E.F.I. harness for continuity. → Repair/Replace if necessary.

Ⓚ Injector


START
Injector operates properly.
Yes
END
No
Disconnect E.F.I. 15-pin connector, and check voltage between terminals (101), (107), (112), (113) and ground.
Battery voltage
SEF597C
O.K.
Check injector for clogging.
N.G.
Clean injector.
O.K.
Check component parts for characterisitc or replace E.C.U.
N.G.
Check each injector for continuity.
Resistance: Approximately 3Ω
SEF016C
N.G.
Replace injector.
O.K.
Check E.F.I. harness for continuity.
Repair/Replace if necessary.

Ⓛ Battery source and ground

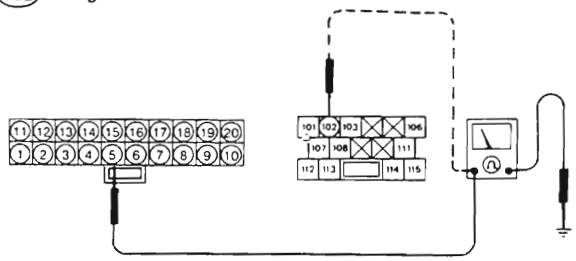
START

Engine operates normally.

Yes → END

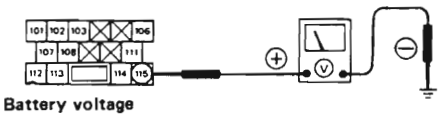
No

Disconnect E.F.I. 15-pin and 20-pin connectors, and check continuity between terminals ⑤, (102) and ground.



Continuity should exist.

Check voltage between terminal (115) and ground.



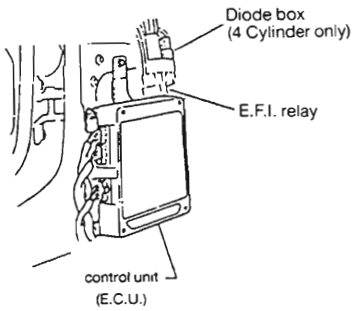
Battery voltage

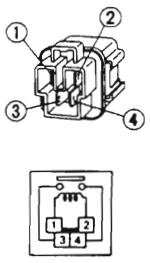
SEF598C

O.K. → Check component parts for characteristic or replace E.C.U.

N.G.

Check E.F.I. relay for proper operation.





SEF625C

Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

N.G. → Replace E.F.I. relay.

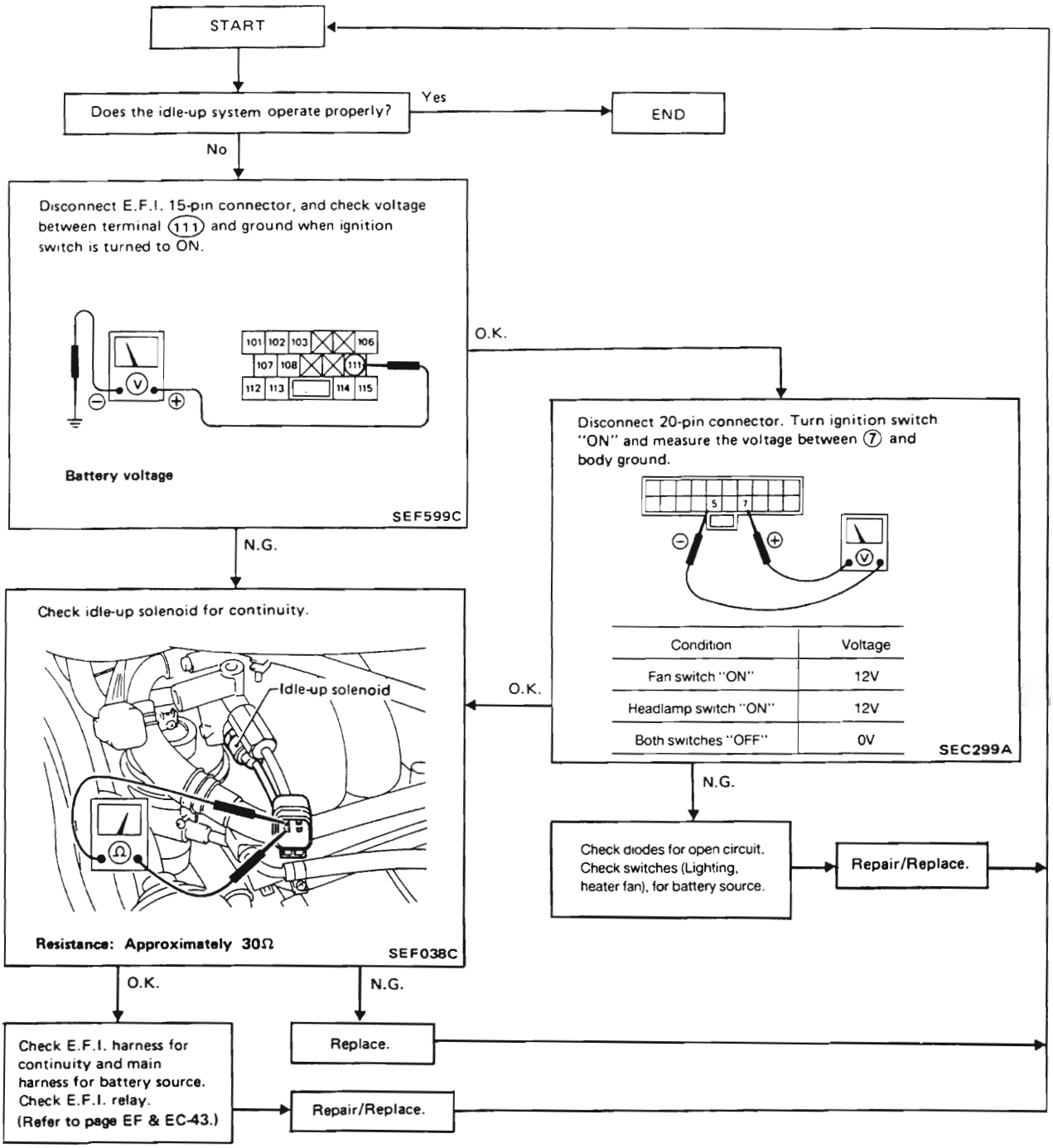
O.K.

Check E.F.I. harness for continuity and main harness for battery source. → Repair/Replace if necessary.

Ⓜ Exhaust gas sensor

Refer to MIXTURE RATIO FEEDBACK SYSTEM INSPECTION.

Ⓝ* Idle-up solenoid valve



FUEL SYSTEM INSPECTION

CA20E

Releasing Fuel Pressure

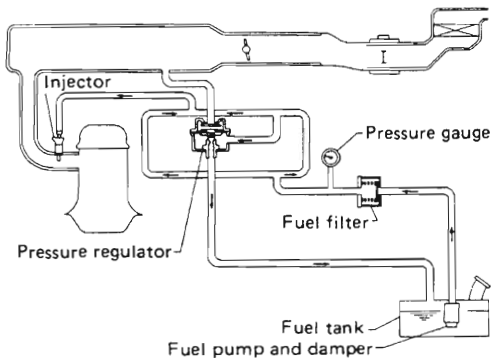
Before disconnecting fuel line, release fuel pressure from fuel line to eliminate danger.

(1) Start engine.
(2) Disconnect the harness connector of fuel pump.
(3) After engine stall, crank the engine two or three times.
(4) Turn the ignition switch "OFF".
(5) Reconnect the harness connector of fuel pump.

Erase the memory (Code 22) of the self-diagnosis in the control unit. Refer page EF-26.

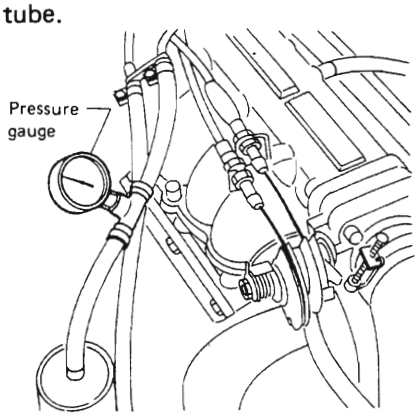
Fuel Pressure Check

Use Pressure Gauge to check fuel pressure.
Before carrying out test, make sure water temperature is below 95°C.



SEF595C

1. Release fuel pressure to zero.
2. Disconnect fuel hose between fuel filter and fuel tube (engine side).
3. Install pressure gauge between fuel filter and fuel tube.



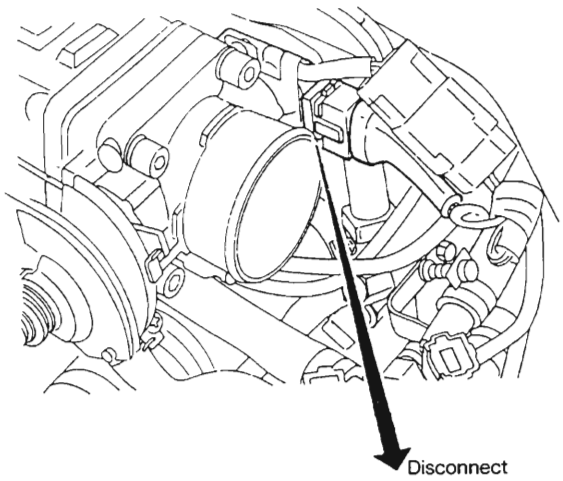
SEF052C

4. Start engine and check for fuel leakage.
5. Read the indication of fuel pressure gauge.

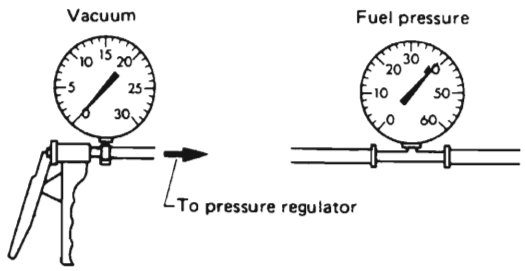
At idling:
Approximately 206 kPa (2.1 kg/cm², 30 psi)
The moment accelerator pedal is fully depressed:
Approximately 255 kPa (2.6 kg/cm², 37 psi)

Fuel Pressure Check (Cont'd)

6. Stop engine and disconnect fuel pressure regulator vacuum hose from intake collector.
7. Plug intake collector with a rubber cap.
8. Connect variable vacuum source to fuel pressure regulator.



9. Disconnect throttle switch plug. Ensure engine is at operating temperature.
10. Read the indication of fuel pressure gauge as vacuum is changed.



SEF718B

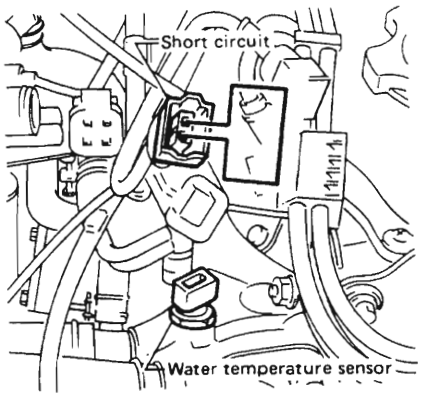
Vacuum kPa (mmHg, inHg)	Fuel pressure kPa (kg/cm^2, psi)
0 (0, 0)	248.1 - 255.0 (2.53 - 2.60, 36.0 - 37.0)
16.9 (127, 5.00)	227.5 - 241.3 (2.32 - 2.46, 33.0 - 35.0)
33.9 (254, 10.00)	213.8 - 220.7 (2.18 - 2.25, 31.0 - 32.0)
50.8 (381, 15.00)	200.1 - 206.9 (2.04 - 2.11, 29.0 - 30.0)
67.7 (508, 20.00)	179.5 - 193.2 (1.83 - 1.97, 26.0 - 28.0)

Fuel pressure should decrease as vacuum increases. If results are unsatisfactory, replace fuel pressure regulator.

If results are unsatisfactory but test in step 5 shows incorrect pressures, check operation of pressure regulator control system.

Pressure Regulator Control System Inspection

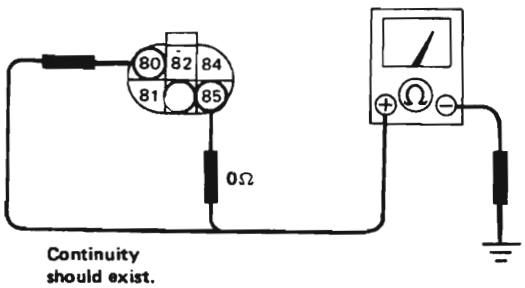
1. Disconnect water temperature sensor harness connector and jump terminals of harness connector with a lead wire.



SEF227C

2. Disconnect a vacuum hose between pressure regulator and solenoid valve.
3. Start engine and make sure that the vacuum does not exist for three minutes.
4. If vacuum exists, disconnect pressure regulator control modulator harness connector and check the circuit and solenoid valve.

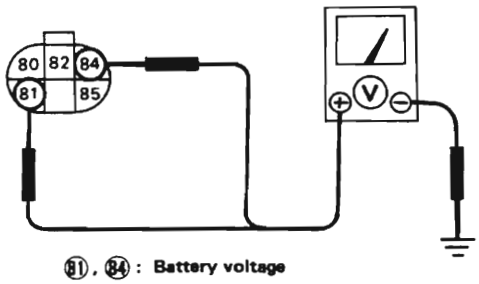
a. Confirm that ignition switch is in "OFF" position and check for continuity between ⑧⓪ ⑧⑤ and ground.



Continuity should exist.

SEF634C

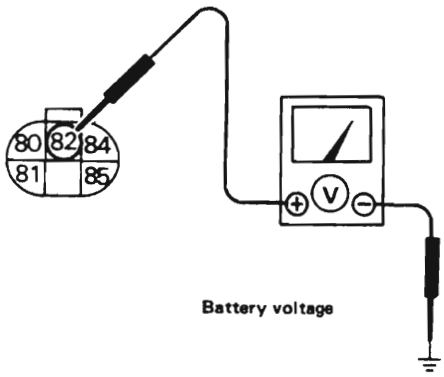
b. Turn ignition switch "ON" and measure voltage between ⑧①, ⑧④ and ground.



⑧①, ⑧④ : Battery voltage

SEF635C

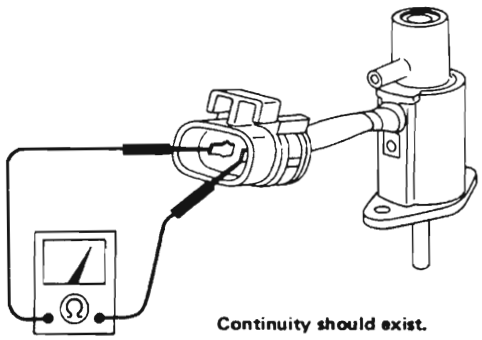
c. Disconnect starter motor "S" terminal.
Turn ignition switch to "START" position and measure voltage between ⑧② and ground.



Battery voltage

SEF746B

d. Check solenoid valve for continuity between terminals of solenoid valve.



Continuity should exist.

SEF698B

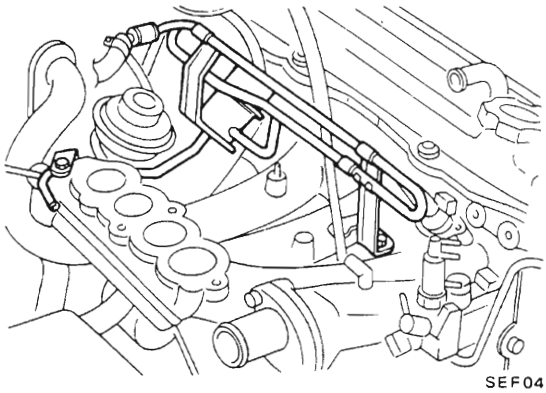
FUEL SYSTEM INSPECTION

CA20E

Injector Removal and Installation

1. Release fuel pressure to zero.
2. Remove or disconnect the following:

- Drain engine coolant
- E.F.I. harness
- Ignition wire
- Hoses
- Collector with throttle chamber

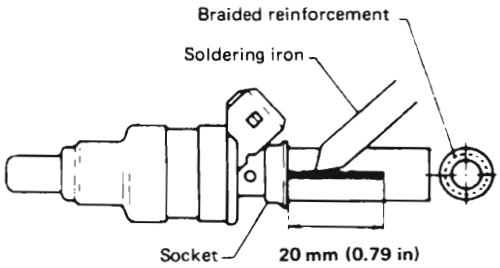


SEF048C

3. Disconnect fuel hoses and pressure regulator vacuum hose.
4. Remove injectors with fuel tube assembly.
5. Remove injector from fuel tube.
6. Remove fuel hose.

1) Heat soldering iron (150 watt) for 15 minutes. Cut hose into braided reinforcement from mark to socket end.

Do not allow soldering iron to cut all the way through the hose and touch injector tail piece.



EF551

2) Then pull rubber hose out with hand.

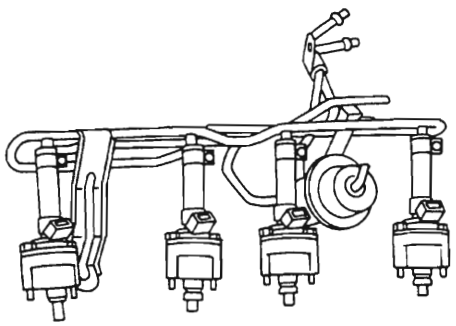
a. **Be careful not to damage socket plastic connector, etc. with soldering iron.**
b. **Never place injector in a vise when disconnecting rubber hose.**

7. Install fuel hose as follows:

1) Clean exterior of injector tail piece.
2) Wet inside of new rubber hose with fuel.
3) Push end of rubber hose with hose sockets onto injector tail piece by hand as far as they will go.

CAUTION:
After properly connecting fuel hose to injector and fuel tube, check connection for fuel leakage.

8. Assemble injections with fuel pipe.



SEF939B

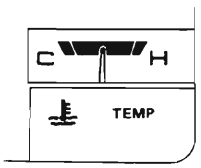
MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

CA20E

PREPARATION

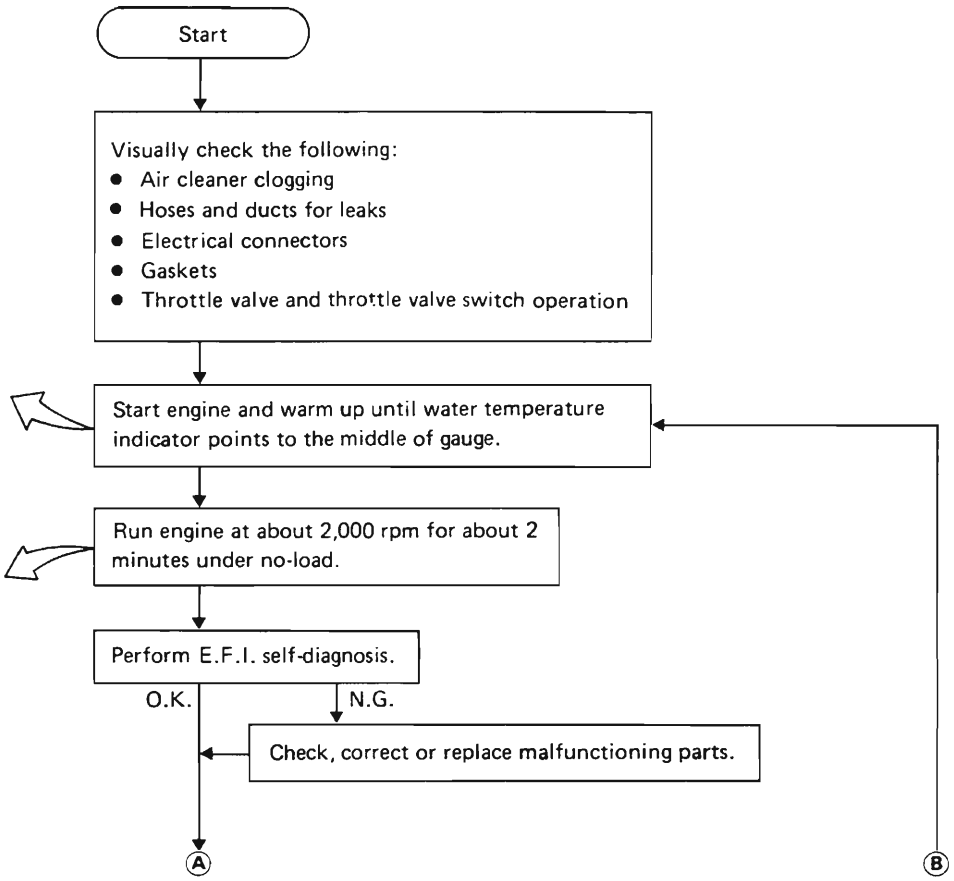
1. Make sure that the following parts are in good order.
- Battery
- Ignition system
- Engine oil and coolant levels
- Fuses
- E.F.I. harness connectors
- Vacuum hoses
- Air intake system
  (oil filler cap, oil level gauge, etc.)
- Valve clearance, engine compression
- Throttle valve and throttle valve switch operation

2. Heater fan and headlamp switches must be turned to the "OFF" position.
3. Make sure that diagnosis mode selector is in "OFF" position.

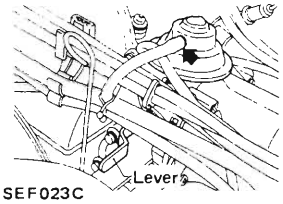


SMA937A

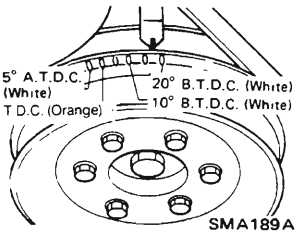
SEF477B



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

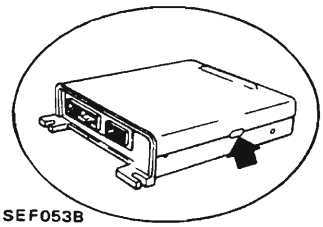


SEF023C



SMA189A

SEF477B


SEF053B

Ⓐ

Does engine run smoothly?

O.K. / N.G.

Check and clean injectors, and replace injectors if necessary.

Disconnect distributor vacuum hose from distributor vacuum controller and plug hose with proper cap.

Run engine at about 2,000 rpm for about 2 minutes under no-load.
Run engine at idle speed and ensure that engine speed is below 1,000 rpm.

Race engine two or three times under no-load and run engine for about one minute at idle speed.

Check ignition timing with timing light.

M/T: 4±1° B.T.D.C. A/T:4±1° B.T.D.C.

O.K. / N.G.

Adjust ignition timing to the specified valve by turning distributor after loosening distributor securing bolt.

Connect distributor vacuum hose to distributor vacuum controller.

Run engine at about 2,000 rpm for about 2 minutes under no-load.

Make sure that even if inspection lamp (Red) on control unit goes on, the green lamp goes on and off more than 9 times during 10 seconds at 2,000 rpm.

O.K. / N.G.

Ⓒ Ⓓ Ⓑ

MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

CA20E

Ⓒ

Disconnect throttle valve switch harness connector.

Race engine two or three times under no-load, then run engine at idle speed.

Check inspection lamps (Red and Green) on control unit blinks.
They should blink simultaneously.

No

Yes

Reconnect throttle valve switch harness connector.

Race engine two or three times under no-load, then run engine at idle speed.

Check idle speed.

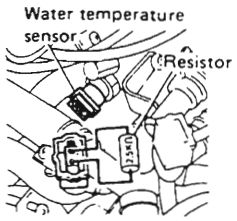
Idle speed:
Manual transmission models
800±50 rpm
Automatic transmission models
900±50 rpm (in "N" position)

O.K.

N.G.

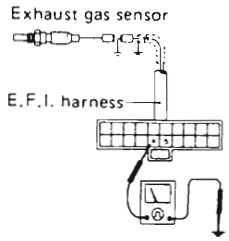
END

Adjust idle speed by turning idle speed adjusting screw.



SEF025C

Ⓓ



SEF024C

Check exhaust gas sensor harness:
1) Turn off engine and disconnect battery ground cable.
2) Disconnect 20-pin connector from Control Unit.
3) Disconnect exhaust gas sensor harness connector and connect terminal for exhaust gas sensor harness connector to ground with a jumping wire.
4) Check for continuity between terminal No. 4 of 20-pin connector and ground metal on vehicle body.

Continuity exists ..... O.K.
Continuity does not exist ..... N.G.

O.K.

N.G.

Repair or replace E.F.I. harness and connect battery ground cable.

Connect E.F.I. 20-pin connector to control unit. Connect battery ground cable and disconnect jumping wire.

- Disconnect water temperature sensor harness connector.
- Connect a resistor (2.5 kΩ) between terminals of water temperature sensor harness connector.

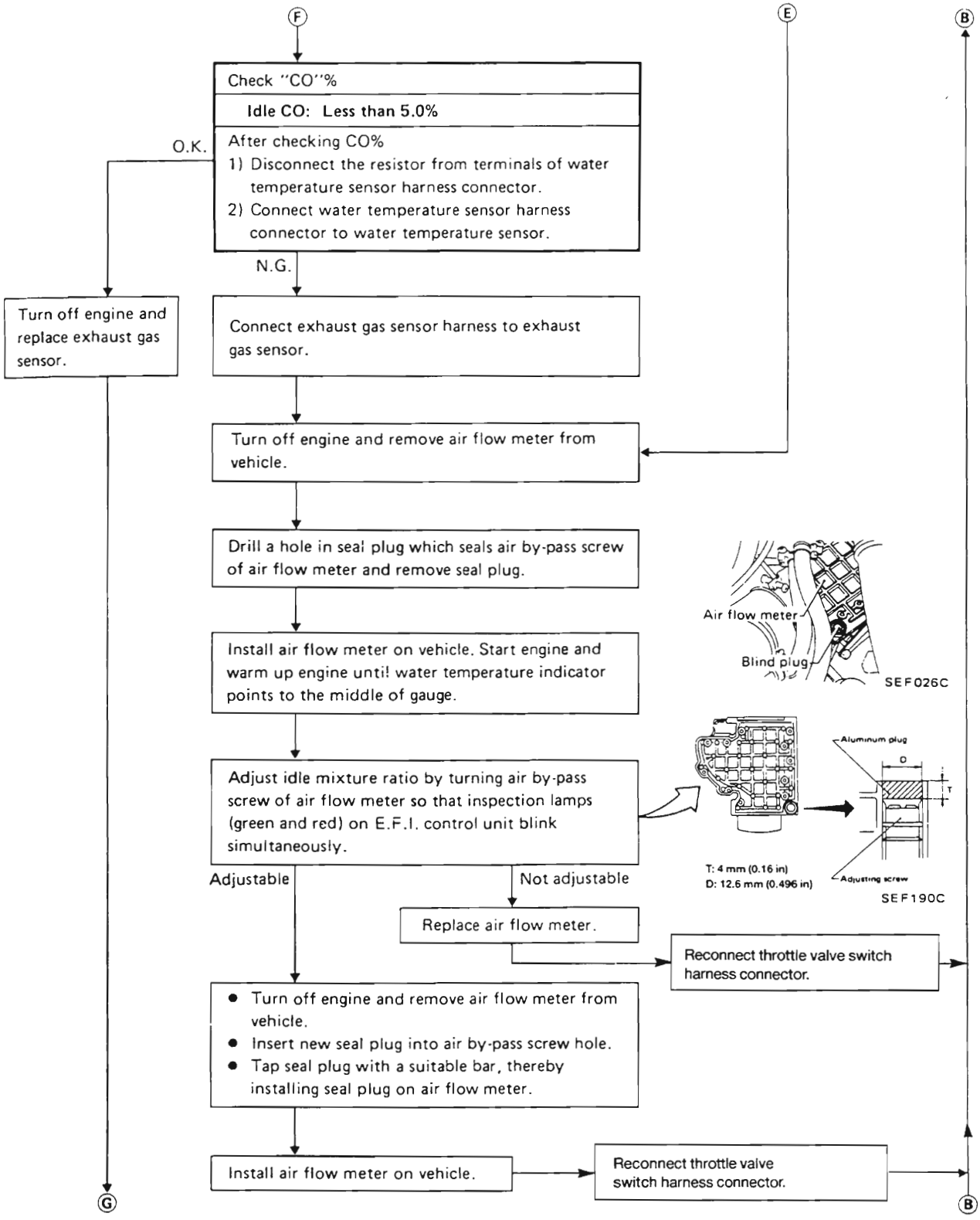
Start engine and warm up engine until water temperature indicator points to the middle of gauge.

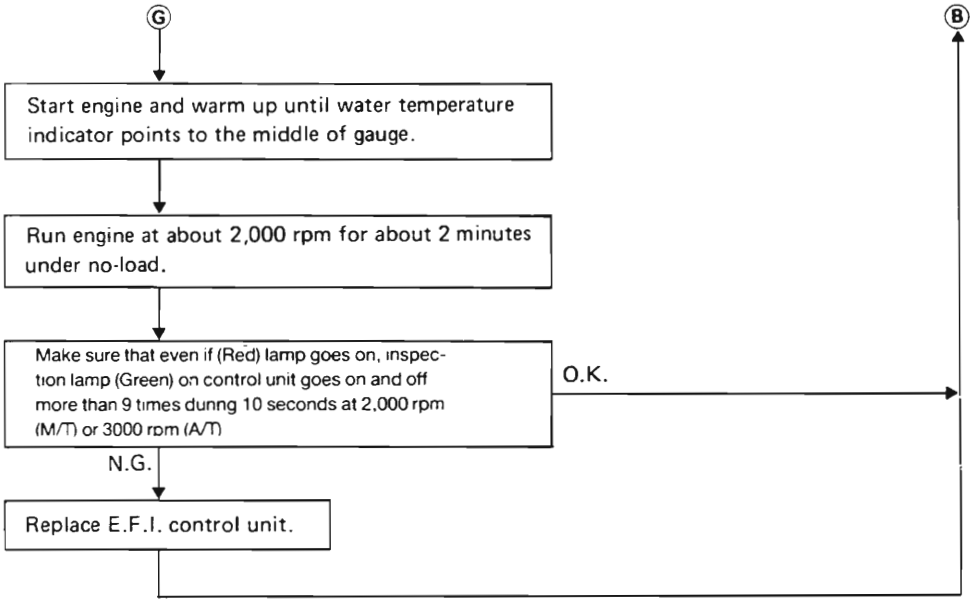
Race engine two or three times under no-load then run engine at idle speed.

Ⓔ Ⓕ Ⓑ

MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

CA20E




G
B
Start engine and warm up until water temperature indicator points to the middle of gauge.
Run engine at about 2,000 rpm for about 2 minutes under no-load.
Make sure that even if (Red) lamp goes on, inspection lamp (Green) on control unit goes on and off more than 9 times during 10 seconds at 2,000 rpm (M/T) or 3000 rpm (A/T)
O.K.
N.G.
Replace E.F.I. control unit.

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

General Specifications

FUEL PUMP Cut-off discharge pressure kPa (kg/cm², psi)	294 - 441 (3.0 - 4.5, 43 - 64)
Design current A	4.7
Fuel flow with 12V ℓ (US gal, Imp gal)/hr	95 (25-1/8, 20-7/8)
PRESSURE REGULATOR Regulated pressure kPa (kg/cm², psi)	250.1 (2.55, 36.3)
AIR REGULATOR Air flow quantity [at 20°C (68°F)] m³ (cu ft)/hr	14.0 (494)
Throttle chamber Bore diameter mm (in)	50 (1.97)
VACUUM CONTROL VALVE Set pressure	600 - 640 mm Hg

THROTTLE VALVE SWITCH Engine speed when idle switch is changed from "OFF" to "ON" rpm	M/T Idle speed +250±150 rpm A/T Idle speed (in "N" position) +250±150 rpm
FUEL PRESSURE (Measuring point: between fuel filter and fuel pipe) At idling kPa (kg/cm², psi)	Approximately 206 (2.1, 30)
The moment accelerator pedal is fully depressed kPa (kg/cm², psi)	Approximately 255 (2.6, 37)
FUEL INJECTOR Coil resistance Ω	2.0 - 3.0
AIR REGULATOR Circuit resistance Ω	Approximately 65

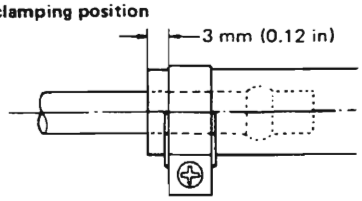
Inspection and Adjustment

AIR FLOW METER Potentiometer resistance between terminals ㉝ and ㉞	Ω	100 - 400
between terminals ㉞ and ㉟	Ω	200 - 500
between terminals ㉜ and ㉞	Ω	Except 0 and ∞
AIR TEMPERATURE SENSOR Thermistor resistance at −10°C (14°F)	kΩ	8.0 - 10.0
at 20°C (68°F)	kΩ	2.3 - 2.7
at 50°C (122°F)	kΩ	0.7 - 0.9
WATER TEMPERATURE SENSOR Thermistor resistance at −10°C (14°F)	kΩ	8.5 - 9.5
at 20°C (68°F)	kΩ	2.3 - 2.7
at 50°C (122°F)	kΩ	0.77 - 0.87
at 80°C (176°F)	kΩ	0.30 - 0.33

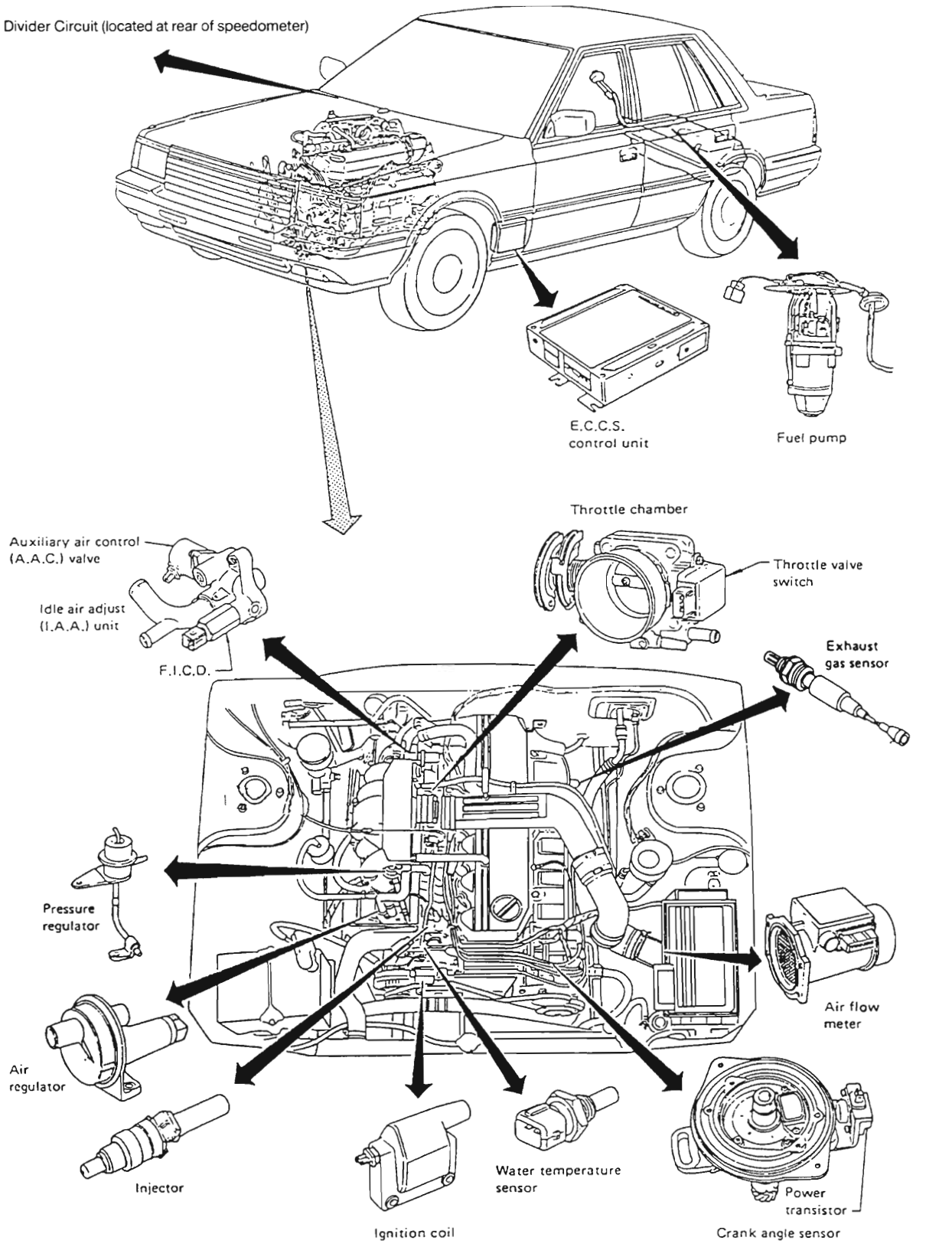
Tightening Torque

Unit	N·m	kg-m	ft-lb
Catalytic converter bolt	31 - 42	3.2 - 4.3	23 - 31
Water temperature sensor	15 - 20	1.5 - 2.0	11 - 14
Throttle valve switch	2.0 - 2.4	0.20 - 0.24	1.4 - 1.7
Air regulator	5 - 6	0.5 - 0.6	3.6 - 4.3
Injector	2.5 - 3.2	0.25 - 0.33	1.8 - 2.4
Throttle chamber securing screw	18 - 22	1.8 - 2.2	13 - 16
Exhaust gas sensor	25 - 34	2.5 - 3.5	18 - 25
Fuel hose clamp	1.0 - 1.5	0.10 - 0.15	0.7 - 1.1

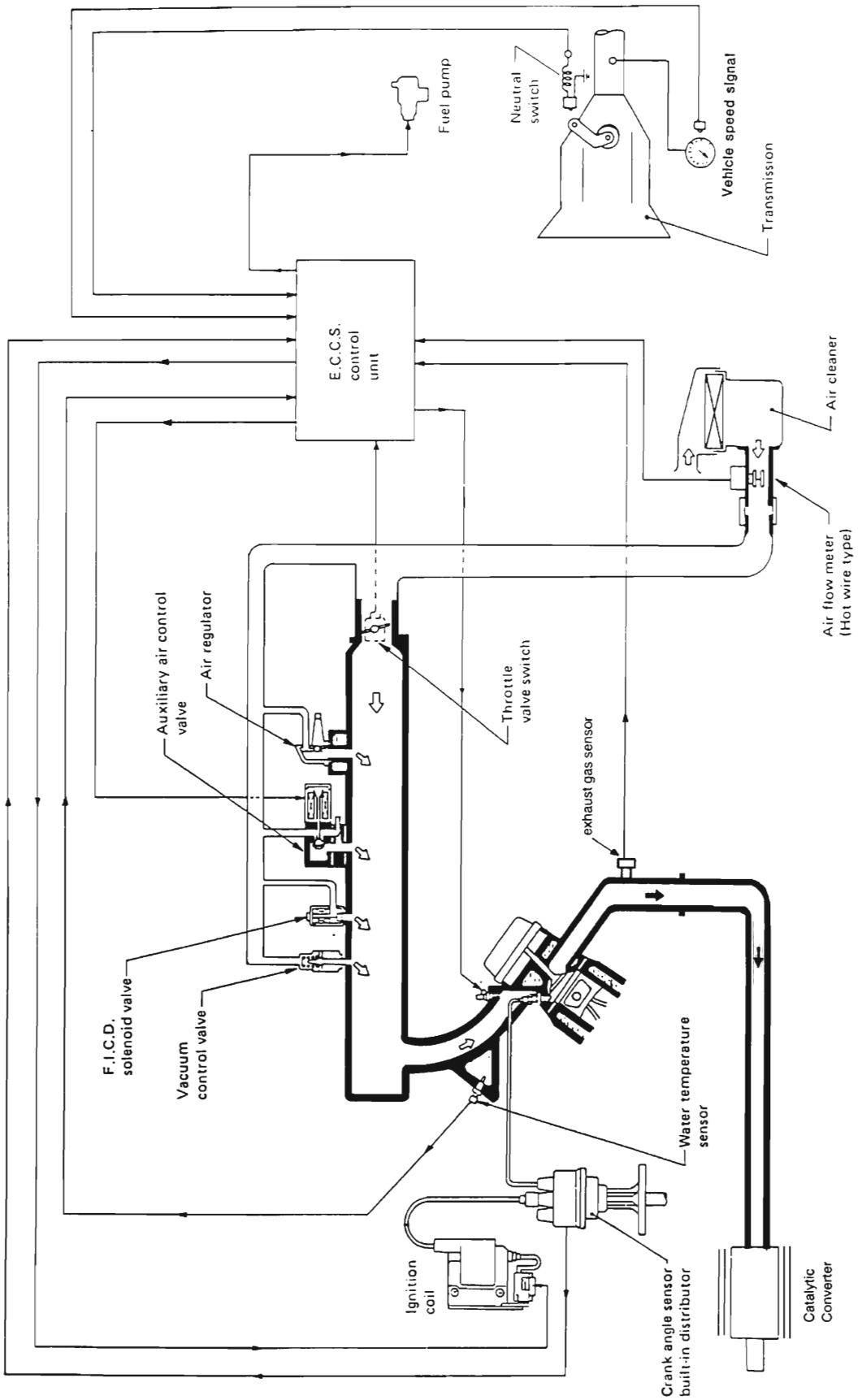
Fuel hose clamping position

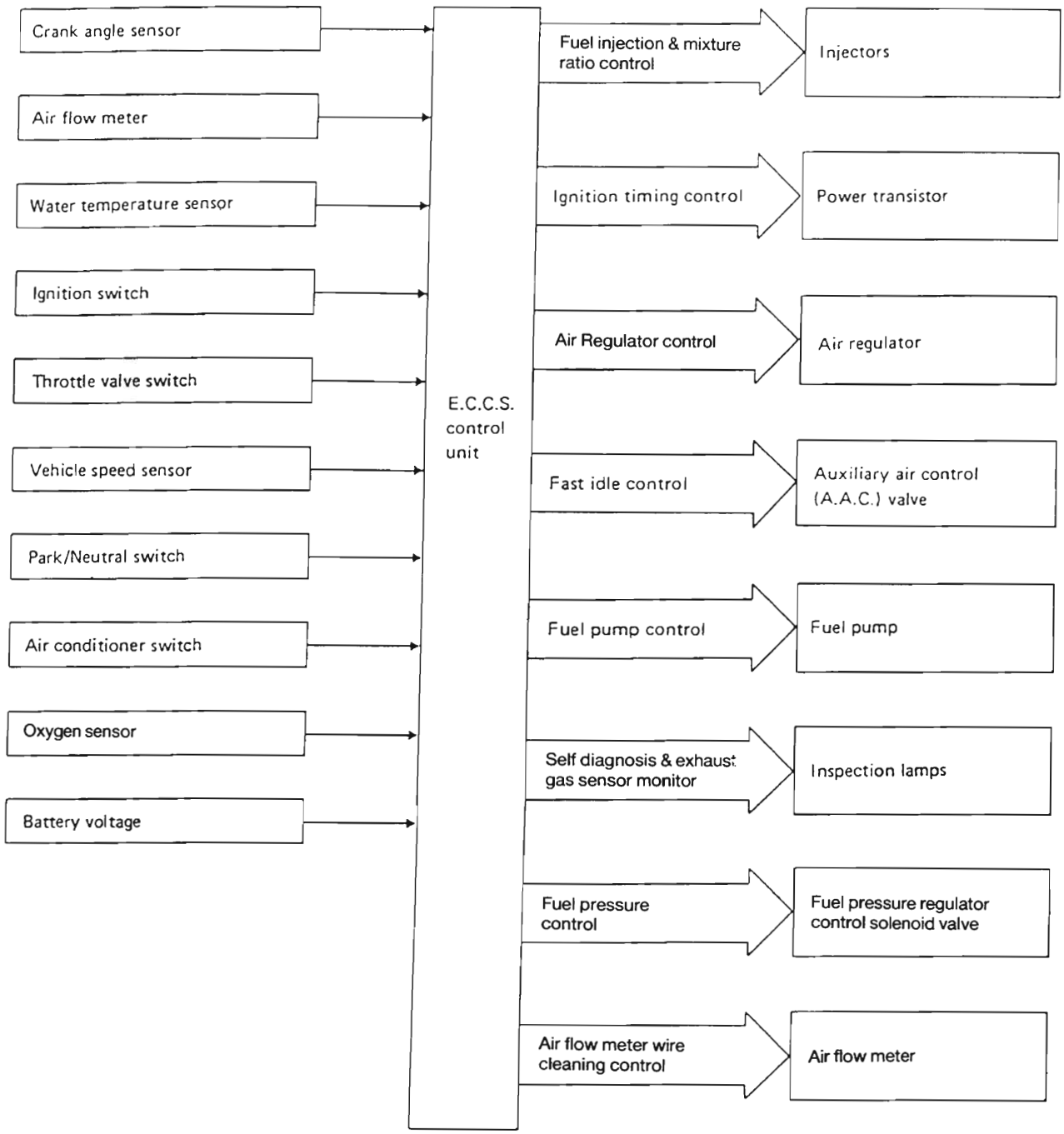


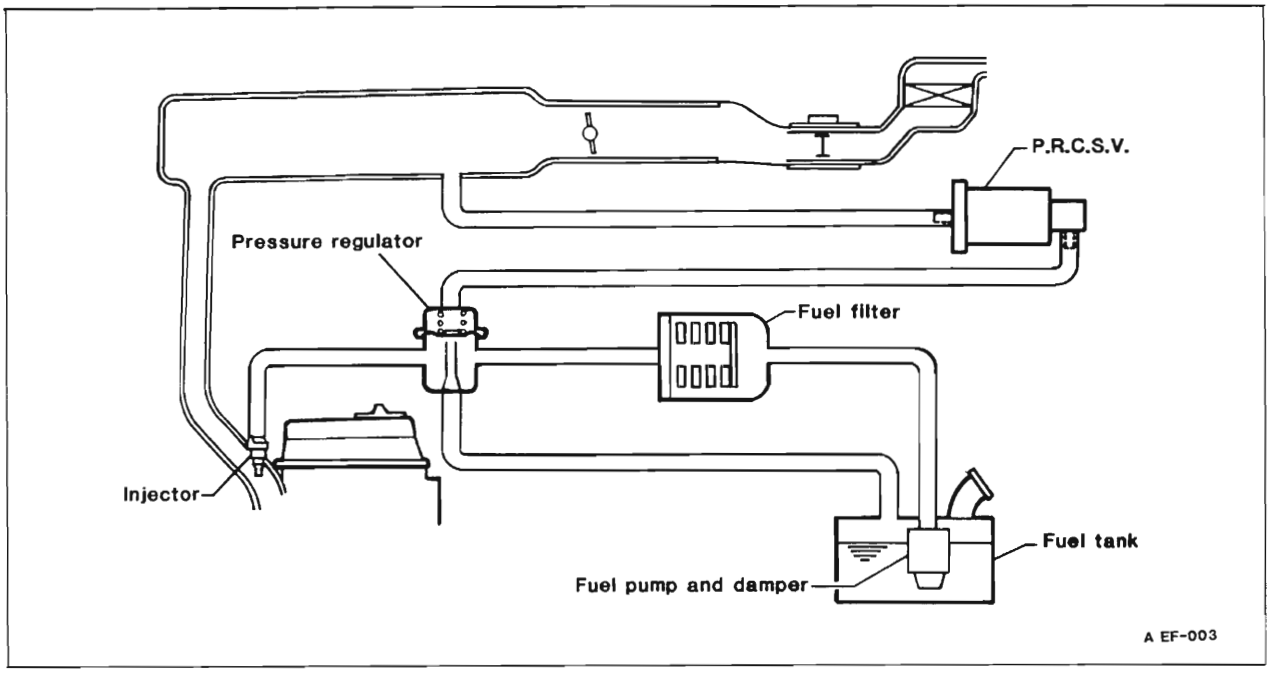
EF336A

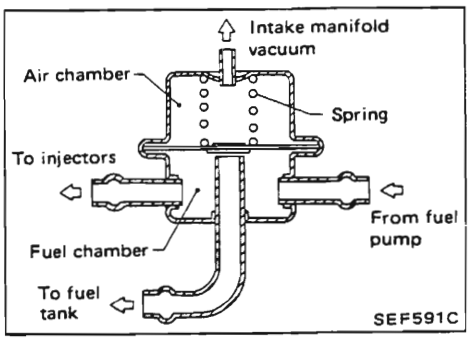

Divider Circuit (located at rear of speedometer)
E.C.C.S. control unit
Fuel pump
Throttle chamber
Auxiliary air control (A.A.C.) valve
Idle air adjust (I.A.A.) unit
F.I.C.D.
Throttle valve switch
Exhaust gas sensor
Pressure regulator
Air flow meter
Air regulator
Injector
Ignition coil
Water temperature sensor
Power transistor
Crank angle sensor

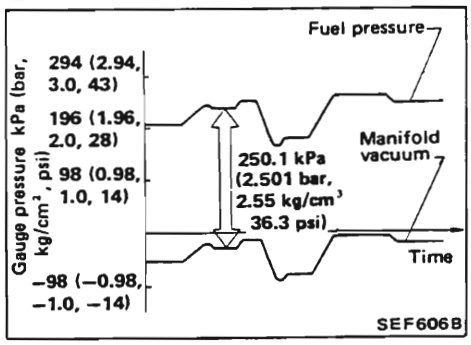
SEF602D


Fuel pump
Neutral switch
Vehicle speed signal
Transmission
E.C.C.S. control unit
Air cleaner
Air flow meter (Hot wire type)
Auxiliary air control valve
Air regulator
Throttle valve switch
exhaust gas sensor
F.I.C.D. solenoid valve
Vacuum control valve
Water temperature sensor
Ignition coil
Crank angle sensor built-in distributor
Catalytic Converter


Crank angle sensor
Air flow meter
Water temperature sensor
Ignition switch
Throttle valve switch
Vehicle speed sensor
Park/Neutral switch
Air conditioner switch
Oxygen sensor
Battery voltage
E.C.C.S. control unit
Fuel injection & mixture ratio control
Injectors
Ignition timing control
Power transistor
Air Regulator control
Air regulator
Fast idle control
Auxiliary air control (A.A.C.) valve
Fuel pump control
Fuel pump
Self diagnosis & exhaust gas sensor monitor
Inspection lamps
Fuel pressure control
Fuel pressure regulator control solenoid valve
Air flow meter wire cleaning control
Air flow meter

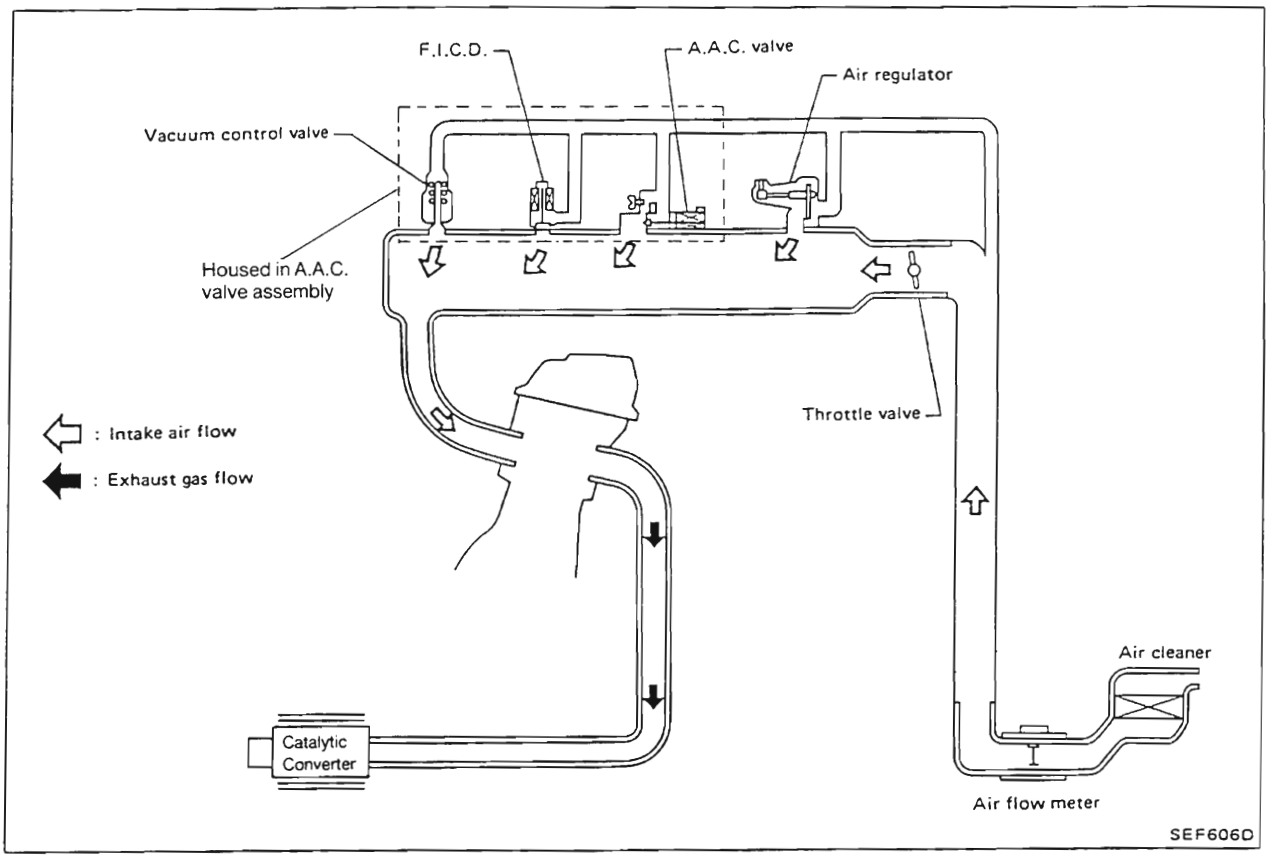


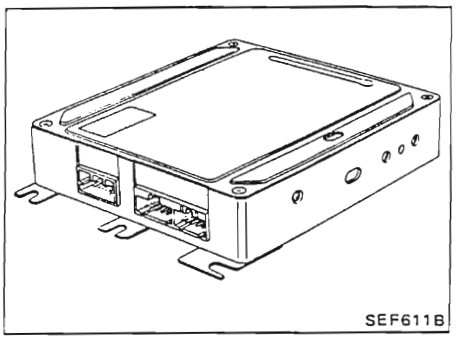




The amount of fuel to be injected is determined by the injection pulse duration as well as by a pressure difference between fuel pressure and intake manifold vacuum pressure. The E.C.C.S. control unit controls only the injection pulse duration. For this reason, the pressure difference between the fuel pressure and intake manifold vacuum pressure should be maintained at a constant level. Since the intake manifold vacuum pressure varies with engine operating conditions, a pressure regulator is placed in the fuel line to regulate the fuel pressure in response to changes in the intake manifold vacuum pressure.

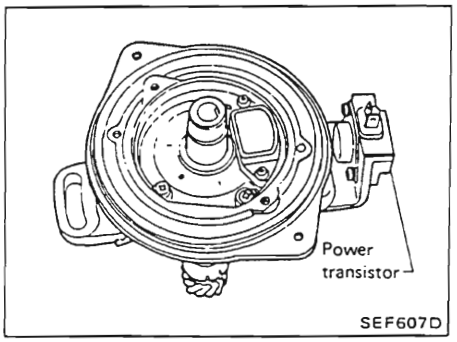
A pressure regulator control system is incorporated in the E.C.C.S. system to cut the manifold pressure supply to the pressure regulator under certain conditions when starting and for up to 3 minutes after starting. For operating details refer to page EF-58.


F.I.C.D.
A.A.C. valve
Air regulator
Vacuum control valve
Housed in A.A.C.
valve assembly
: Intake air flow
: Exhaust gas flow
Throttle valve
Air cleaner
Catalytic
Converter
Air flow meter
SEF606D


SEF611B

E.C.C.S. CONTROL UNIT

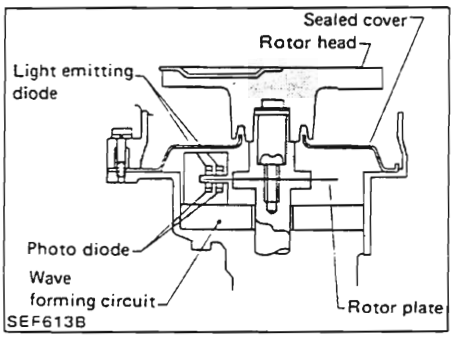
The E.C.C.S. control unit consists of a microcomputer, connectors for signal input and output and power supply, inspection lamps and diagnostic mode selector. The control unit controls the amount of fuel that is injected, ignition timing, idle speed and fuel pump operation.



SEF607D

CRANK ANGLE SENSOR

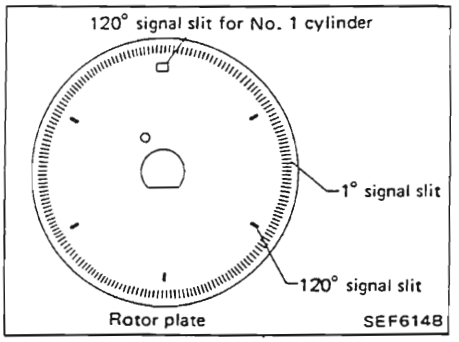
Crank angle sensor is a basic signal sensor for the entire E.C.C.S. It monitors engine speed and piston position, and it sends signals to the E.C.C.S. control unit for control of fuel injection, ignition timing, idle speed and fuel pump operation.



SEF613B

Crank angle sensor has rotor plate and wave forming circuit. Rotor plate has 360 slits for 1° signal (engine speed signal) and 6 slits for 120° signal (crank angle signal). Light Emitting Diodes (L.E.D.) and Photo Diodes are built into wave forming circuit.

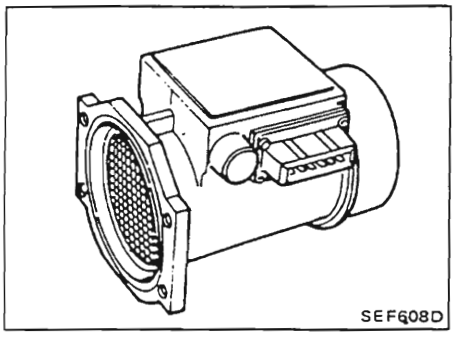
When signal rotor plate passes the space between the L.E.D. and Photo Diode, the slit of the signal rotor plate alternately cuts the light which is sent to the photo diode from the L.E.D. This causes an alternative voltage and it is then converted into an on-off pulse by the wave forming circuit, which is sent to the control unit.

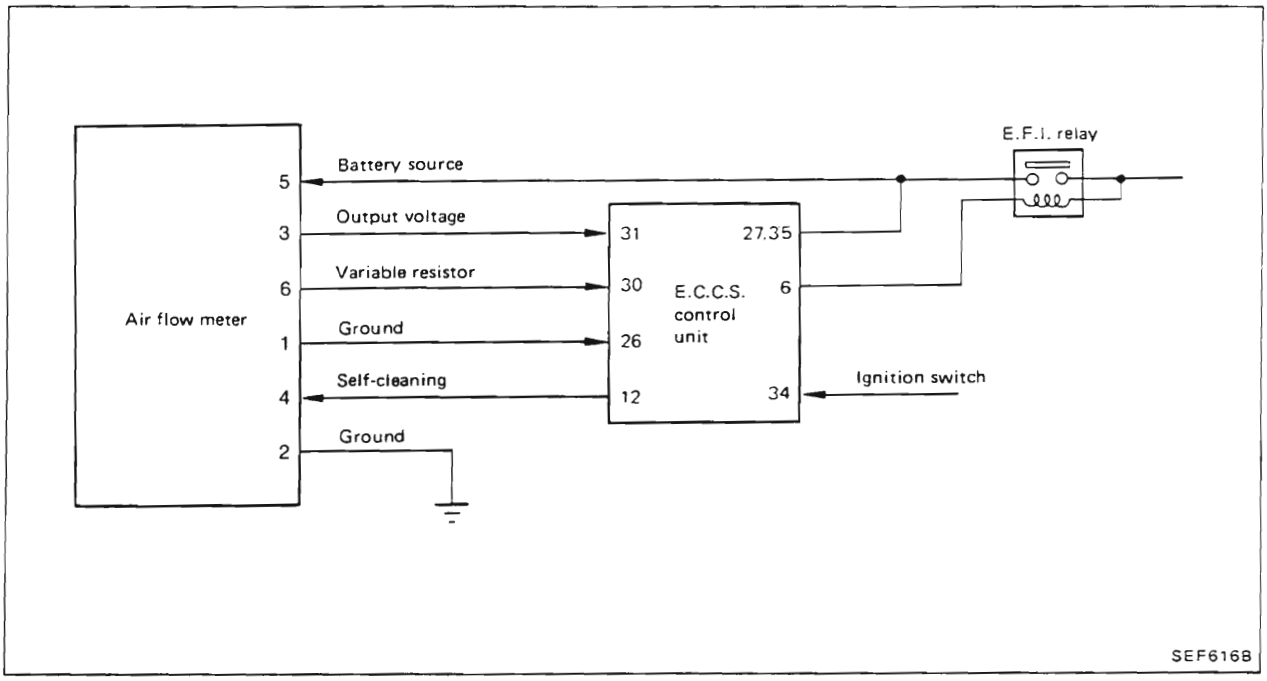


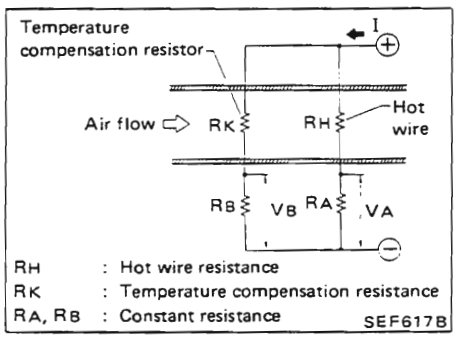
SEF614B

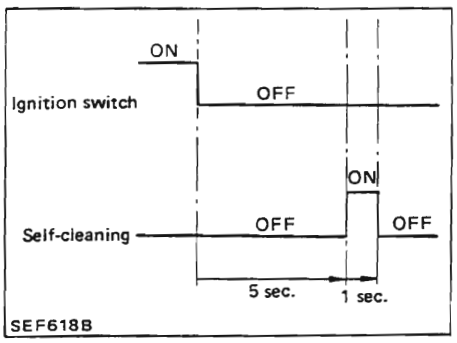
AIR FLOW METER

The air flow meter measures the mass flowrate of intake air. Measurements are made in such a manner that the control circuit emits an electrical output signal in relation to the amount of heat dissipated from the hot wire placed in the stream of intake air.


SEF608D







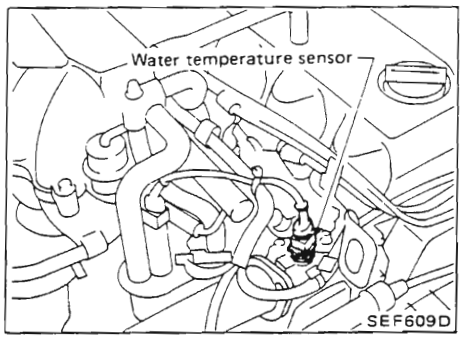
The air flowing around the hot wire removes the heat from the hot wire. The temperature of the hot wire is very sensitive to the mass flowrate of the air. The higher the temperature of the hot wire, the higher its resistance value. This change in the temperature (or: resistance) is determined by the mass flowrate of the air. The control circuit accurately regulates current (I) in relation to the varying resistance value (R_H) so that V_A always equals V_B. The air flow meter transmits an output for voltage V_A to the control unit where the output is converted into an intake air signal.

Self-cleaning

After engine is stopped, the E.C.C.S. control unit heats up the hot wire to approximately 1,000°C (1,832°F) to burn out dust which adhered to the hot wire.

Self-cleaning operation

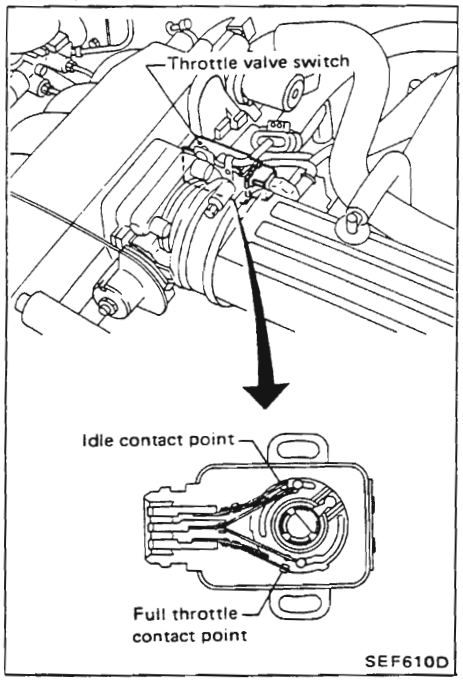
Condition	Operation
After running engine at above 1,500 rpm After driving vehicle at above 20 km/h Water temperature is less than 115°C (239°F)	Operates
Except above	Does not operate



WATER TEMPERATURE SENSOR

The water temperature sensor monitors changes in cooling water temperature and transmits a signal to the E.C.C.S. control unit.

The temperature sensing unit employs a thermistor which is sensitive to the change in temperature. Electrical resistance of the thermistor decreases in response to the temperature rise.



THROTTLE VALVE SWITCH

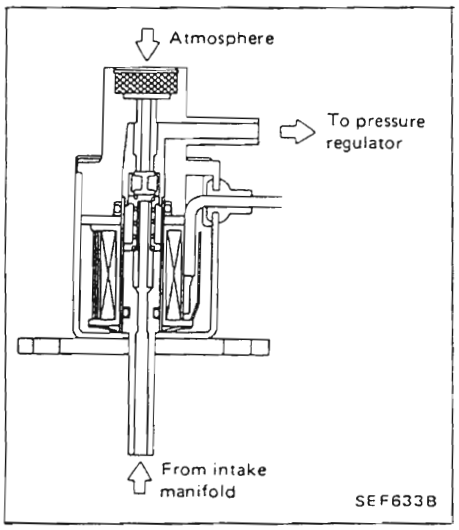
The throttle valve switch is attached to the throttle chamber and actuates in response to accelerator pedal movement.

This switch has idle contact and full throttle contact. The idle contact closes when the throttle valve is positioned at idle and opens when it is at any other position.

The full throttle contact is used only for the electronic controlled automatic transmission.

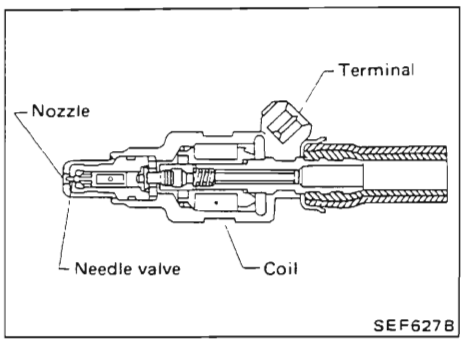
VEHICLE SPEED SENSOR

The vehicle speed sensor provides a vehicle speed signal to the E.C.C.S. control unit via a divider circuit located in the speedometer circuit.



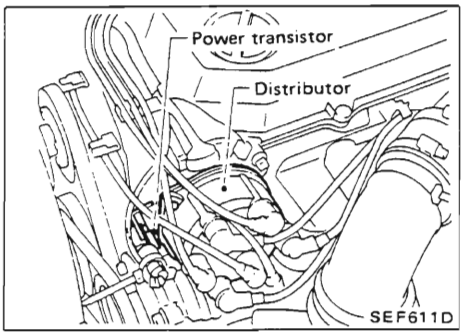
PRESSURE REGULATOR CONTROL SOLENOID VALVE

The pressure regulator control solenoid valve cuts the intake manifold vacuum signal for pressure regulator control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When it is off, a vacuum signal from the intake manifold is fed into the pressure regulator. As the control unit outputs an ON signal, the coil pulls the plunger downward, and cuts the vacuum signal.



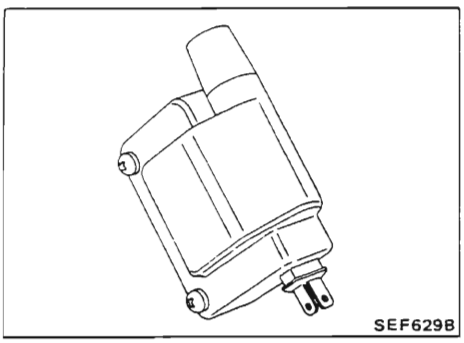
FUEL INJECTOR

The fuel injector is a small, precision solenoid valve. As the E.C.C.S. control unit outputs an injection signal to each fuel injector, the coil built into the injector pulls the needle valve back, and fuel is injected through the nozzle to intake manifold. The amount of fuel injected is controlled by the E.C.C.S. control unit as an injection pulse duration.



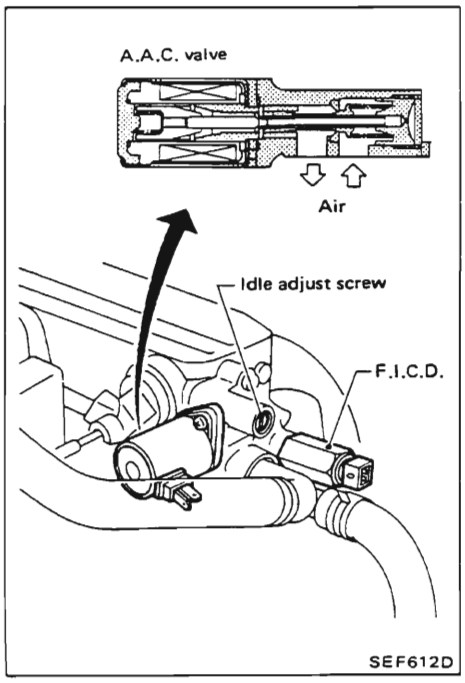
POWER TRANSISTOR

The ignition signal from the E.C.C.S. control unit is amplified by the power transistor, which connects and disconnects the coil primary circuit to induce the proper high voltage in the secondary circuit.



IGNITION COIL

The ignition coil is a moulded type.



IDLE AIR ADJUST (I.A.A.) UNIT

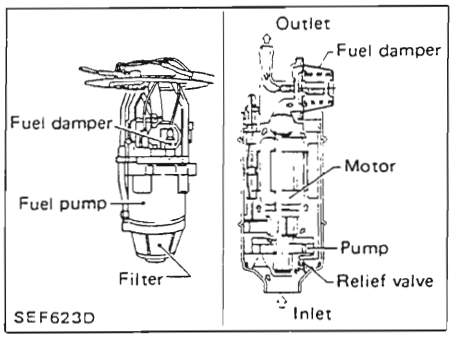
Auxiliary air control (A.A.C.) valve

The A.A.C. valve is attached to the intake collector. The E.C.C.S. control unit actuates A.A.C. valve by a variable ON/OFF pulse of approximately 160 Hz. The longer the ON pulse the larger the amount of air flow through the A.A.C. valve.

F.I.C.D.

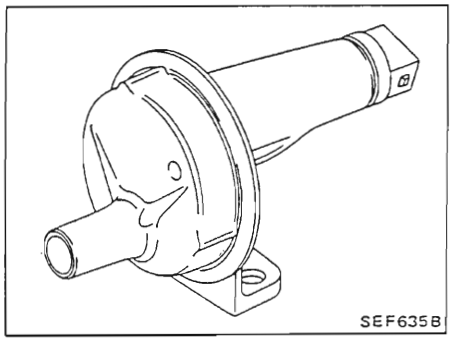
The F.I.C.D. is attached to the intake collector.

The solenoid valve opens an auxiliary air passage when air conditioner switch is turned "ON", to raise the idle speed.



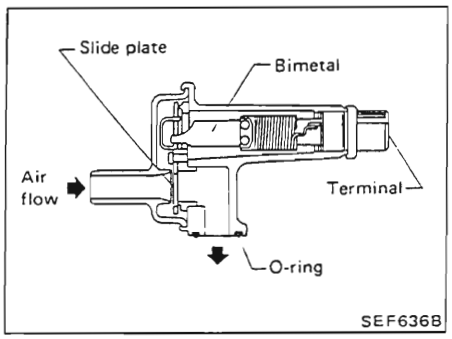
FUEL PUMP

The fuel pump, which is located in the fuel tank, is a wet type pump where the vane rollers are directly coupled to a motor which is filled with fuel.

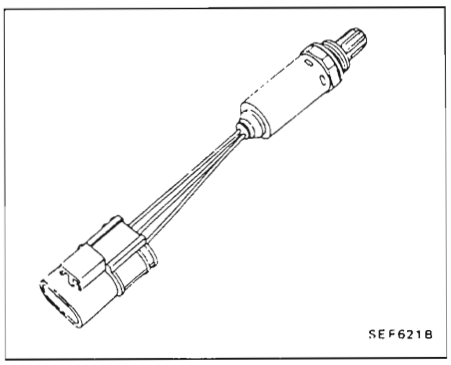


AIR REGULATOR

Air regulator gives an air by-pass when the engine is cold for the purpose of a fast idle during warm-up.



A bimetal, heater and rotary shutter are built into the air regulator. When the bimetal temperature is low, the air by-pass port is open. As the engine starts and electric current flows through a heater, the bimetal begins to rotate the shutter to close off the by-pass port. The air passage remains closed until the engine is stopped and the bimetal temperature drops.



EXHAUST GAS SENSOR

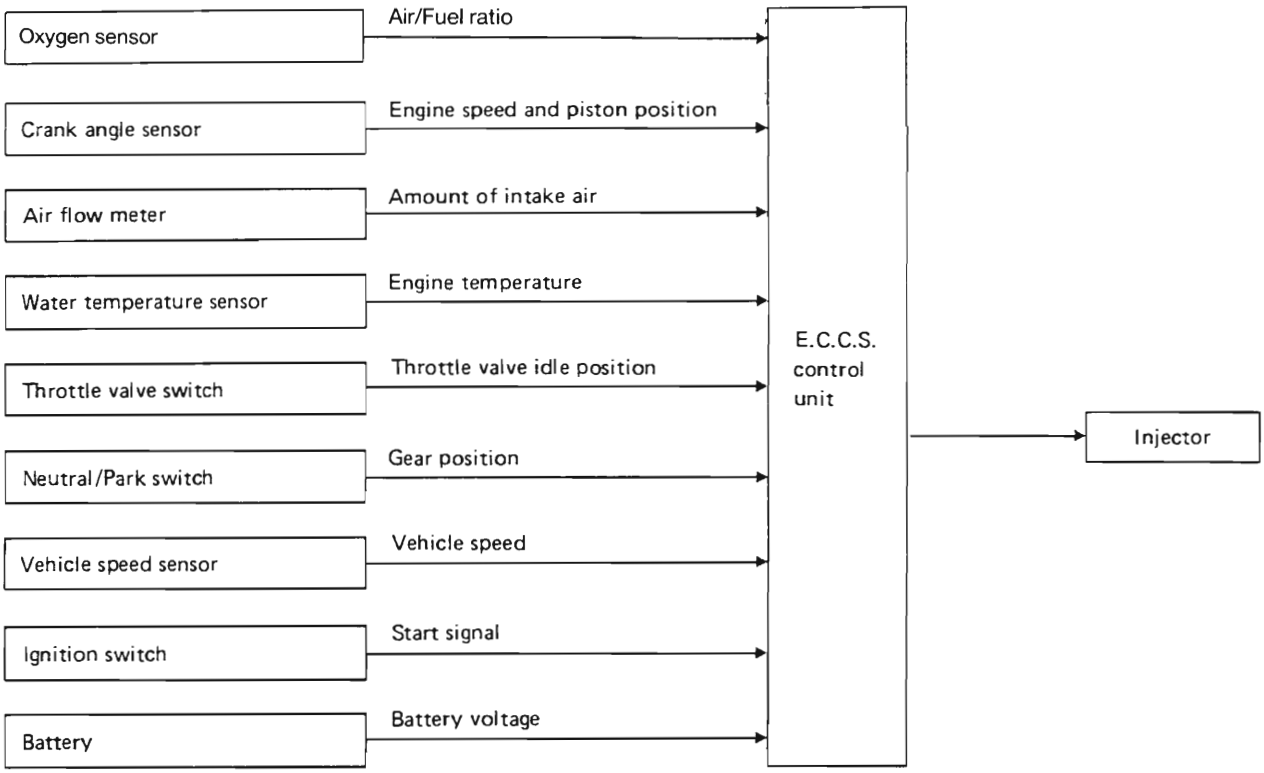
The exhaust gas sensor, which is built into the exhaust manifold, monitors the density of oxygen in the exhaust gases.

It consists of ceramic titania (major sensor), ceramic alumina and other components. The ceramic alumina which contains the ceramic titania is exposed to the exhaust gas in the exhaust manifold.

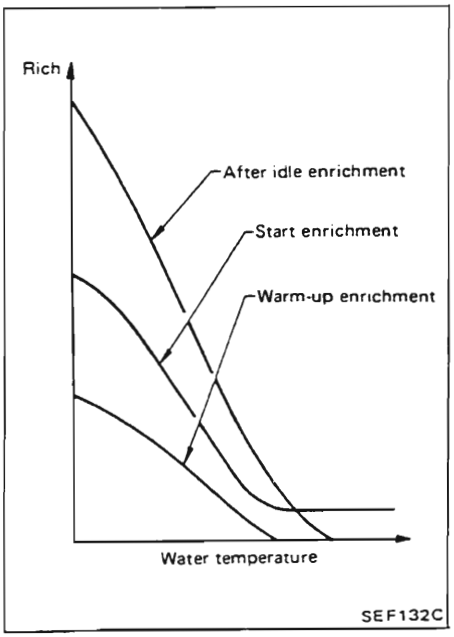
In order to ensure the stable performance of the exhaust gas sensor, a heater is employed in the ceramic alumina.

NEUTRAL/PARK SWITCH

A neutral switch (mounted on the manual transmission selector housing) and inhibitor switch (automatic transmission) signal the E.C.C.S. control unit when the transmission is shifted to the Neutral position (automatic and manual transmission) or Park position (automatic transmission), for fuel injection and idle speed control.



The E.C.C.S. control unit calculates basic injection pulse width by processing signals from crank angle sensor and air flow meter. Receiving signals from each sensor which detects various engine conditions, E.C.C.S. control unit adds various enrichments, which are pre-programmed in the control unit, to the basic injection amount. Thus, the optimum amount of fuel is injected through the injectors.



FUEL ENRICHMENT

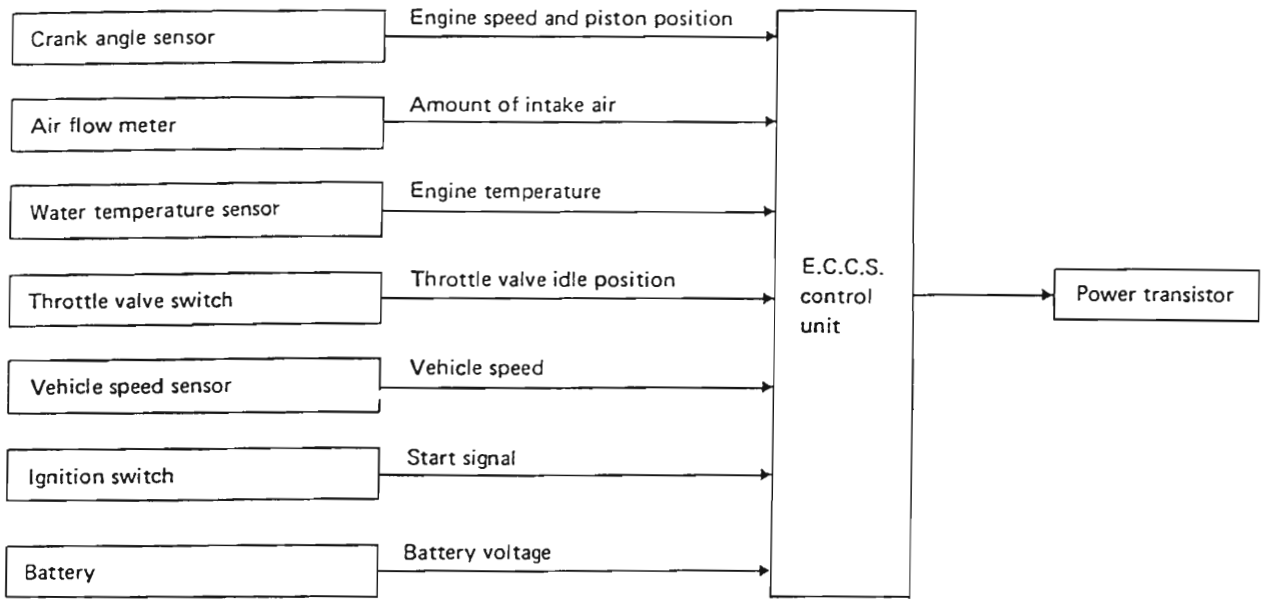
In each of the following conditions, fuel is enriched.

- During warm-up
- When starting
- After idle
- When accelerating
- With heavy load
- When water temperature is high.

Enrichment rates for "when accelerating" and "with heavy load" are pre-programmed for engine speed and basic injection pulse width.

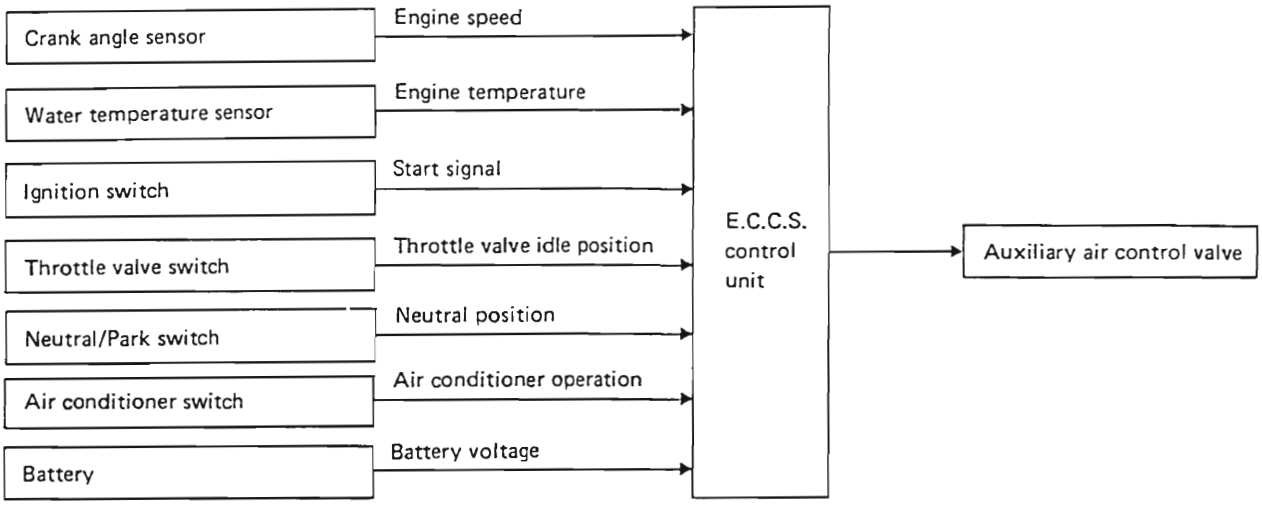
FUEL SHUT-OFF

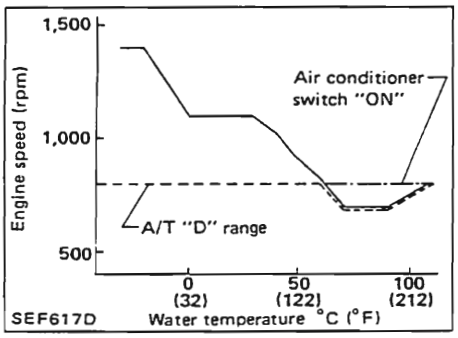
Fuel shut-off is accomplished under certain conditions: defined by throttle position, gear position, water temperature, engine speed and vehicle speed.



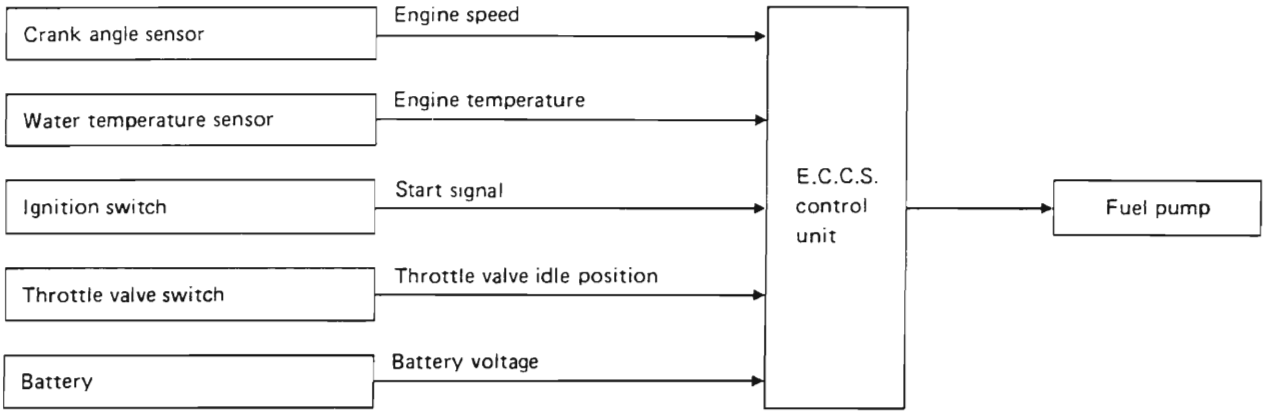
Ignition timing is controlled, corresponding to the engine operating conditions, by the E.C.C.S. control unit: that is, as the optimum ignition timing in each driving condition has been preprogrammed in the control unit, the ignition timing is determined by electrical signals processed in the unit.

The signal from E.C.C.S. control unit is transmitted to power transistor, and controls ignition timing.





The idle speed is controlled by the E.C.C.S. control unit, corresponding to the engine operating conditions. The E.C.C.S. control unit senses the engine condition and determines the best idle speed at each water temperature and gear position. The control unit then sends an electronic signal, corresponding to the difference between the best idle speed and the actual idle speed, to the A.A.C. valve.



The fuel pump is controlled by the E.C.C.S. control unit adjusting the output voltage supplied to the fuel pump.

Fuel pump ON-OFF control

Fuel pump operates under the following conditions.

- 5 seconds after ignition switch is turned to ON.
- While engine is running.
- 1 second after stall.

Fuel pump voltage control

Conditions	Voltage
5 seconds after ignition switch is turned to ON Engine cranking 30 seconds after engine start [above 50°C (122°F)] Engine temp. above 90°C (194°F) Engine temp. below 10°C (50°F)	Approximately 13.4 [V]
Except above	9.4 ~ 13.4 [V]

CAUTION:

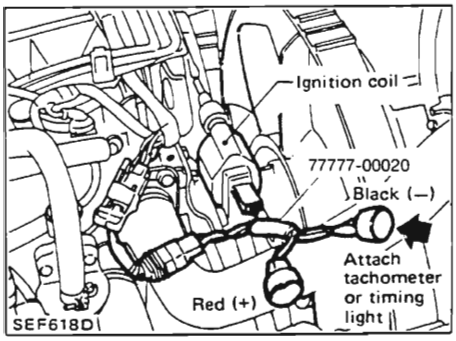
a. Before connecting or disconnecting E.C.C.S. harness connector to or from any E.C.C.S. unit, be sure to turn the ignition switch to the "OFF" position and disconnect the negative battery terminal.
   Otherwise, there may be damage to control unit.

b. **Do not attempt to disassemble any E.C.C.S. component parts. To conduct electrical checks on these component parts, closely follow the steps outlined under "ELECTRONIC CONTROL SYSTEM INSPECTION" on pages EF-79 through EF-107.**

c. **When conducting self-diagnosis, follow the steps outlined under "SELF-DIAGNOSIS" on pages EF-73 through EF-78 in order to obtain accurate diagnosing results. After self-diagnosis has been completed, erase the memory properly.**

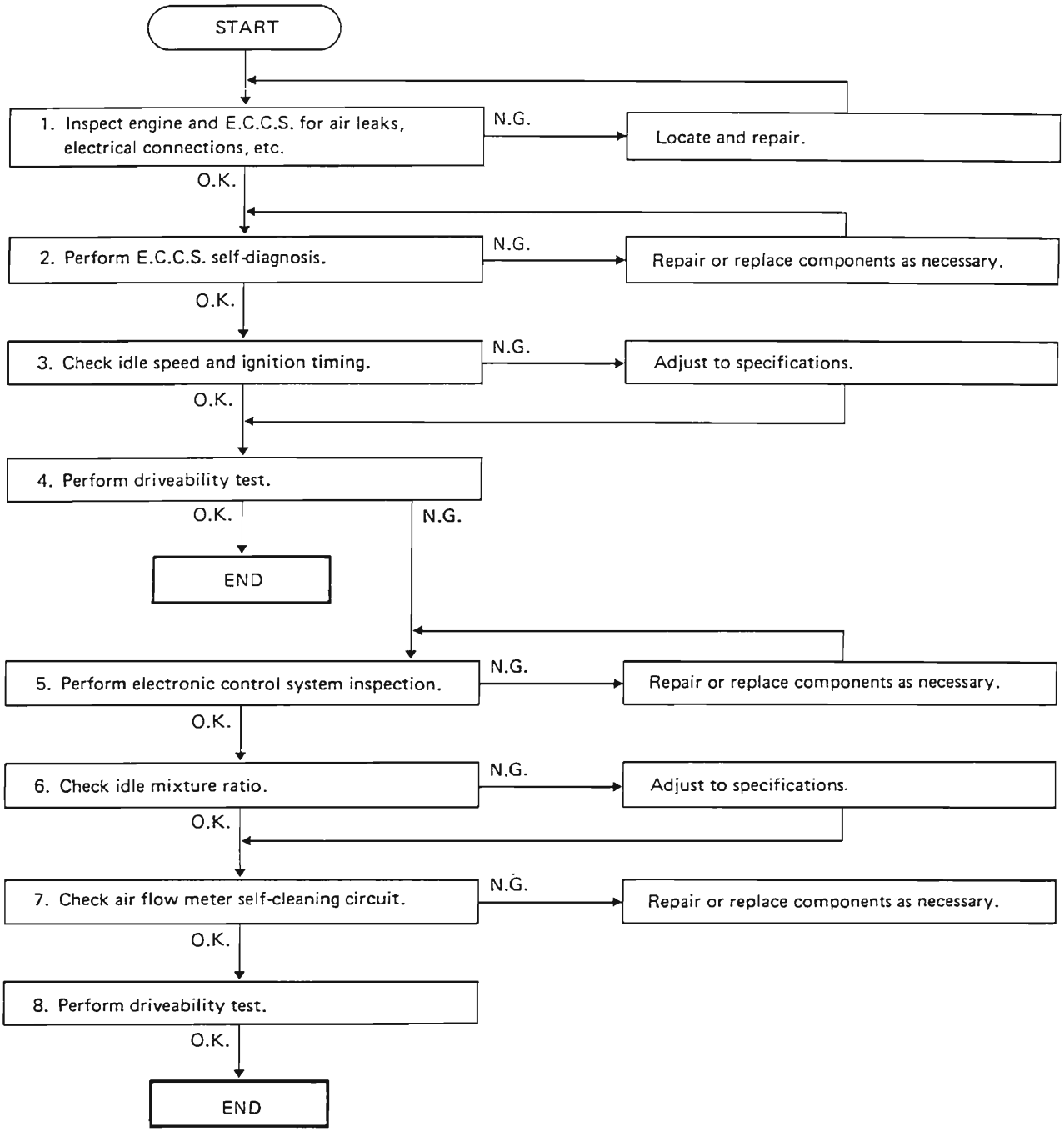
d. Always turn the diagnosis mode selector carefully using a screwdriver. If it is turned forcibly, it may be damaged, resulting in the inability to perform the self-diagnosis.

e. Before troubleshooting, ensure that all harness connectors are secure.



Preparation

When measuring idle speed and ignition timing, use adapter harness between ignition coil and ignition coil harness connector.


START
1. Inspect engine and E.C.C.S. for air leaks, electrical connections, etc.
N.G.
Locate and repair.
O.K.
2. Perform E.C.C.S. self-diagnosis.
N.G.
Repair or replace components as necessary.
O.K.
3. Check idle speed and ignition timing.
N.G.
Adjust to specifications.
O.K.
4. Perform driveability test.
O.K.
N.G.
END
5. Perform electronic control system inspection.
N.G.
Repair or replace components as necessary.
O.K.
6. Check idle mixture ratio.
N.G.
Adjust to specifications.
O.K.
7. Check air flow meter self-cleaning circuit.
N.G.
Repair or replace components as necessary.
O.K.
8. Perform driveability test.
O.K.
END

1. Inspect engine and E.C.C.S. for air leaks, proper electrical connections, etc.

1) Check all hoses and ducts for air leaks.
2) Check air cleaner for clogging.
3) Check harness connectors for proper connections.
4) Check ignition wiring.
5) Check gaskets for leaks at all air intake components.
6) Check air regulator operation.

2. Perform E.C.C.S. self-diagnosis.

Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF-29).

3. Check idle speed and ignition timing.

a. **Prepare the following conditions:**
- **Headlamp switch: OFF**
- **Heater blower: OFF**
- **Rear window defogger: OFF**
- **Air conditioner switch: OFF (if fitted)**

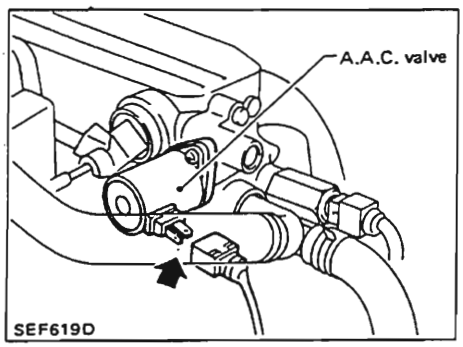
b. **Warm engine to operating temperature.**

Check and adjust as follows:

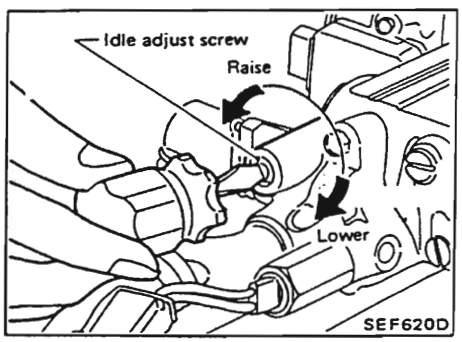
1) Race engine two or three times under no-load, then run engine at idle speed.
2) Check idle speed.

700±50 rpm (in "N" position)

If out of specification, adjust as follows:



a. Stop engine and disconnect A.A.C. valve harness connector.

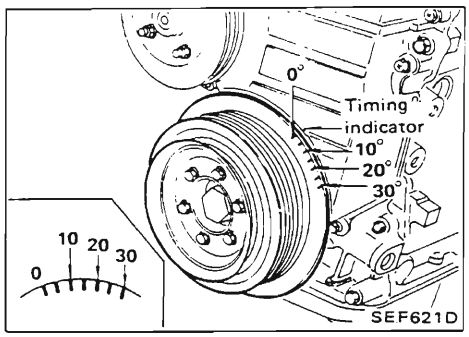


b. Start engine and adjust engine speed by turning idle speed adjusting screw.

650 rpm (in "N" position)

c. Stop engine and connect A.A.C. valve harness connector. Then start engine.
d. Make sure that idle speed is in the specified range.

700±50 rpm



3) Check ignition timing with a timing light.
   15° ±2° B.T.D.C.
   If necessary, adjust ignition timing by turning distributor.

4. Perform driveability test.

Evaluate effectiveness of adjustments by driving vehicle. If unsatisfactory, proceed to step 5.

5. Perform electronic control system inspection.

Check the following using circuit tester.

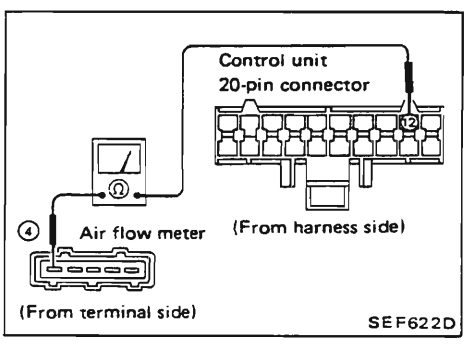
- Injector circuits
- Air regulator circuit

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF-79).

6. Check idle mixture ratio.

7. Check air flow meter self-cleaning circuit.

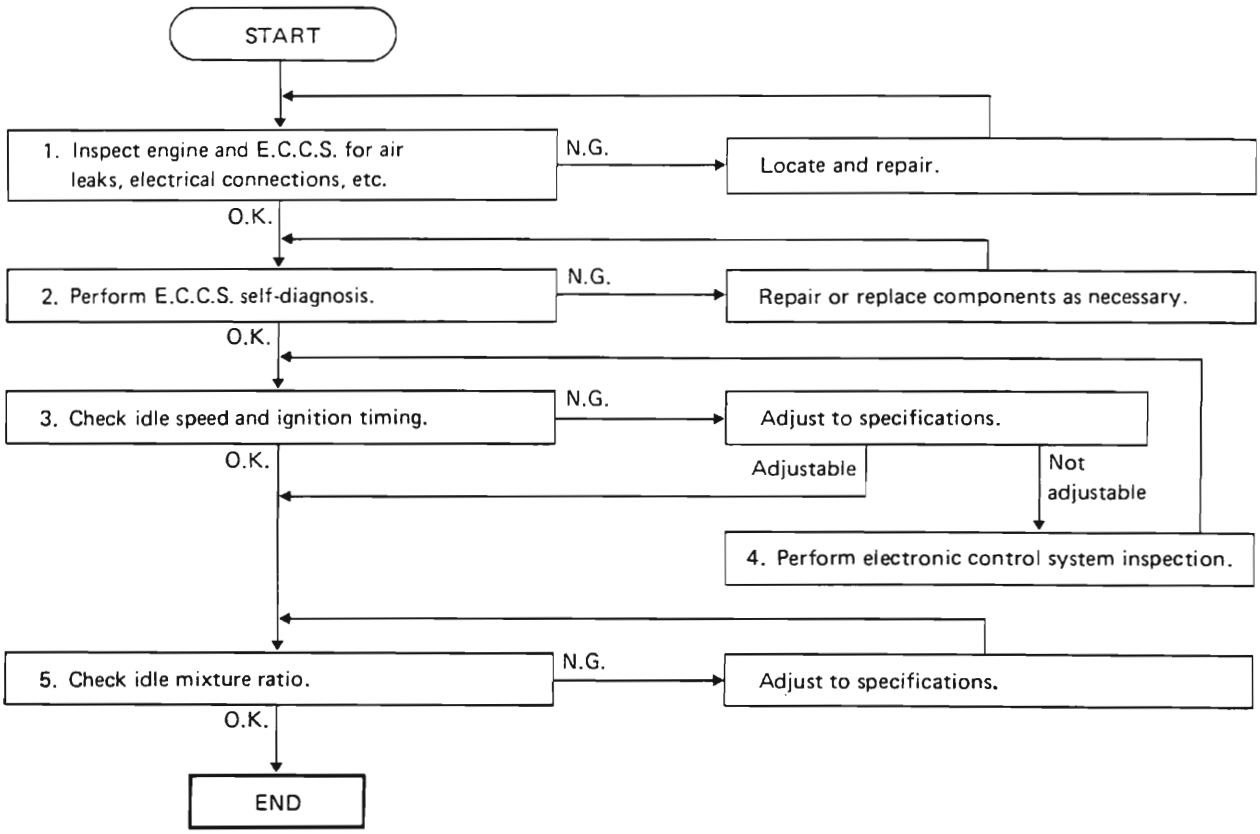
1) Start engine and race engine to above 1,500 rpm.
2) Drive vehicle at above 20 km/h then run engine at idle.
3) Remove air duct from air flow meter (air cleaner side) while engine is idling.
4) Using a mirror, ensure that hot wire heats up to a red glow for one second after the ignition switch has been turned off for 5 seconds.



5) If N.G., check harness for continuity.
   Check for continuity between terminal ⑫ of 20-pin connector and terminal ④ of air flow meter harness connector.
   Continuity should exist.
6) If continuity does not exist, repair or replace harness.
   If harness is O.K. replace air flow meter.

8. Perform driveability test.

Re-evaluate vehicle performance.



1. Inspect engine and E.C.C.S. for air leaks, electric connections, etc.

Refer to DRIVEABILITY.

2. Perform E.C.C.S. self-diagnosis.

Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF-73).

3. Check idle speed and ignition timing.

Refer to DRIVEABILITY.

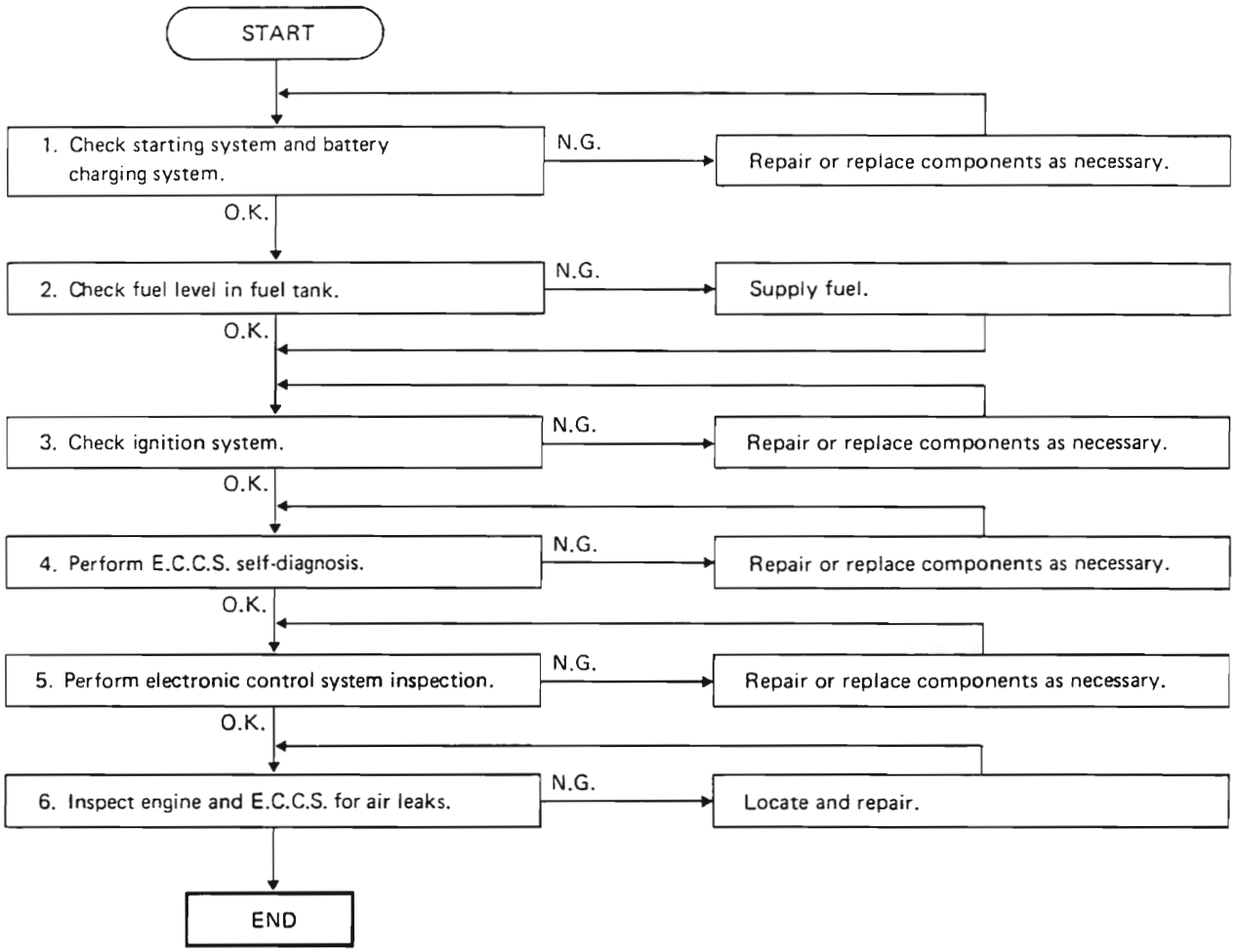
4. Perform electronic control system inspection.

Check the following using circuit tester.

- Injector circuit
- Air regulator circuit
- A.A.C. valve

Follow the procedure in ELECTRONIC CONTROL SYSTEM INJECTION (Page EF-35).

5. Check idle mixture ratio.



1. Check starting system and battery charging system.

1) Check starter operation.
2) Check battery voltage.
   Repair or replace as necessary.

2. Check fuel level.

If fuel level is low or empty, add fuel.

3. Check ignition system.

1) Check ignition wiring.
2) Check distributor rotor head.
3) Check spark plug.

4. Perform E.C.C.S. self-diagnosis.

Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF-73).

5. Perform electronic control system inspection.

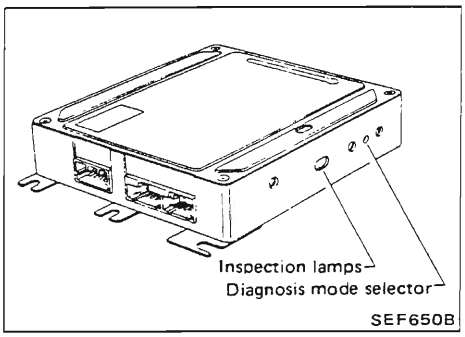
Check the following using circuit tester.

- Injector circuit
- Air regulator circuit

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF-79).

6. Inspect engine and E.C.C.S. for air leaks.

Refer to DRIVEABILITY.



DESCRIPTION

The self-diagnostic system determines malfunctions of signals which provide data to the E.C.U. The malfunctions may not be only E.C.C.S. component malfunctions but may also be poor contact of the connectors, shorted or open circuit of the harness and malfunctions of transit relays and diodes. Some of the malfunctions are stored in the E.C.U. and others are not. A malfunction is displayed by the red and green L.E.D.s (Light Emitting Diodes) which are located in the control unit. Self-diagnosis is performed when the self-diagnosis selector is turned on.

DISPLAYS OF MALFUNCTIONING CODES

A malfunctioning area is displayed by the number of both the red and green L.E.D.s. First, the red L.E.D. flashes and the green follows.

The red L.E.D. refers to the tenth digit while the green one refers to the unit digit. For example, when the red L.E.D. flashes three times and the green L.E.D. flashes twice, this implies number "32". In this way, malfunctioning areas are classified by code numbers.

DISPLAYED CODE

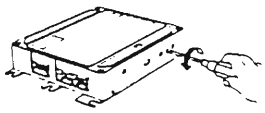
CODE	L.E.D. display (Red → Green)	Malfunctioning area	Items retained in memory
11	⊗ → ⊗	Crank angle sensor circuit	X
12	⊗ → ⊗⊗	Air flow meter circuit	X
13	⊗ → ⊗⊗⊗	Water temperature sensor circuit	X
14	⊗ → ⊗⊗⊗⊗	Vehicle speed signal	–
21	⊗⊗ → ⊗	Ignition signal missing in primary coil	X
22	⊗⊗ → ⊗⊗	Fuel pump circuit	X
23	⊗⊗ → ⊗⊗⊗	Throttle valve switch (Idle switch) circuit	–
24	⊗⊗ → ⊗⊗⊗⊗	Neutral/Park switch	–
31	⊗⊗⊗ → ⊗	Heater/air conditioner switch	–
32	⊗⊗⊗ → ⊗⊗	Starter signal circuit	–
44	⊗⊗⊗⊗ → ⊗⊗⊗⊗	No malfunctioning in the above circuit (Check other electrical systems.)	–

X: Yes –: No

CAUTION:

a. Always turn the diagnosis mode selector carefully using a screwdriver. Do not press hard to turn. Otherwise, the selector may be damaged.
b. When the engine fails to start, crank the engine more than two seconds before starting the self-diagnosis.
c. Before starting the self-diagnosis, do not erase the stored memory. Doing so will reduce the self-diagnosis function considerably.
d. After a malfunctioning area has been corrected, be sure to erase the memory.
e. The self-diagnosed results are retained in the memory by a small current flow from the battery. Disconnecting the battery cable or the E.C.C.S.'s 15-pin connector erases the memory stored.
f. The crank angle sensor signal plays an important role in the E.C.C.S. A malfunctioning of air flow meter is sometimes accompanied by a malfunctioning of the crank angle sensor. So when the crank angle sensor and the air flow meter are both malfunctioning, always start by checking the crank angle sensor first.
g. Start the self-diagnosis 10 seconds after the ignition switch is turned to "OFF" because the air flow meter self-cleaning system is working.

INSPECTION START


SEF651B

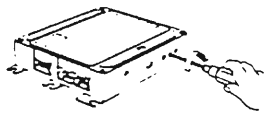
Verify that diagnosis mode selector is turned fully counterclockwise.

Turn ignition switch to "ON" position.

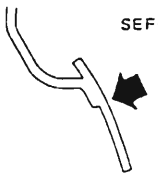
Make sure that inspection lamps on control unit stay "ON". (Bulb check)

N.G. → Check harness for battery source. (Refer to page EF-99.) If battery is O.K., replace control unit.

O.K.


SEF652B

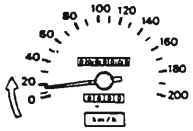
Turn diagnosis mode selector fully clockwise.


SEF653B

Depress accelerator pedal, then release.

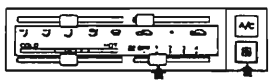
Shift transmission control lever.
Neutral → Others → Neutral

Start engine.
Apply brakes and shift to "D" position (A/T models).


SEF623D

Drive vehicle at more than 10 km/h

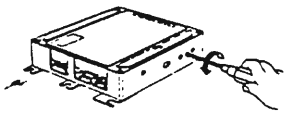
Turn air conditioner switch (if fitted) and heater fan switch.
OFF → ON → OFF


SEF624D

Make sure that inspection lamps on control unit are displaying code No. 44. (A/c fitted) or No. 31. (A/c not fitted)

N.G. → Write down the malfunctioning code.

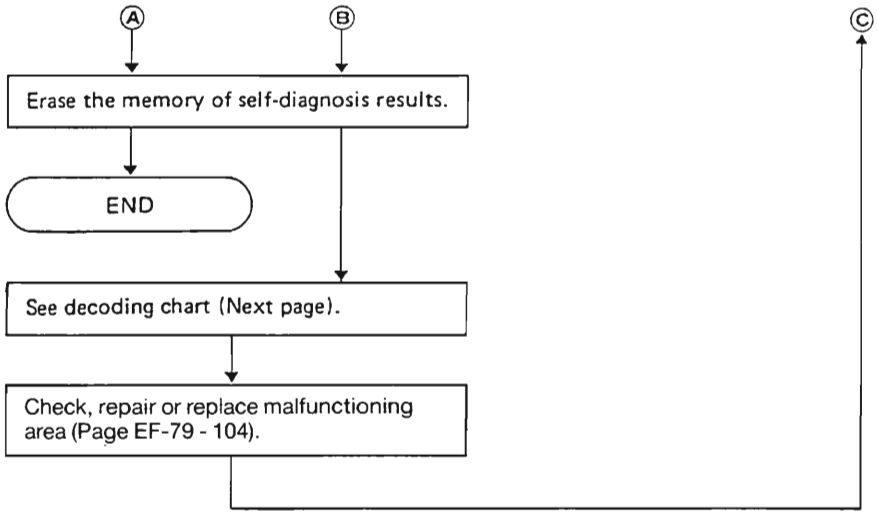
O.K.


SEF651B

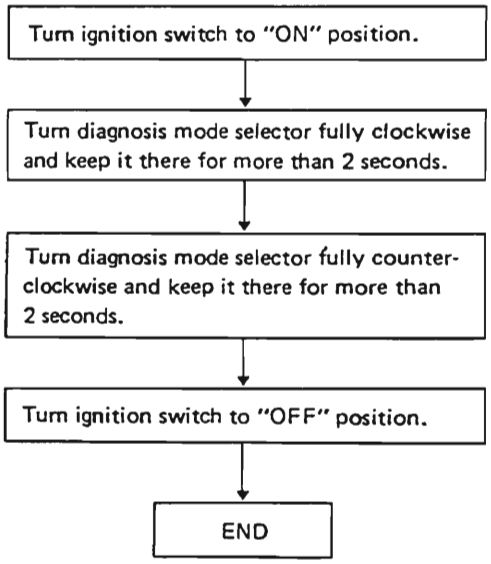
Turn diagnosis mode selector fully counterclockwise.

Turn off engine.

Ⓐ Ⓑ Ⓒ



Procedure for memory erasure



Code No.	Diagnosis	Inspection	Reference page
11	• 1° or 120° signal is not entered for one second while engine is running. • 120° signal is not entered for one second during engine cranking. • Either 1° or 120° signal is not entered often enough while the engine speed is higher than 600 rpm.	• Crank angle sensor harness and connectors • Starting system • Crank angle sensor • E.C.U.	EF-79
12	• An abnormally high output voltage is entered while engine is off. • An abnormally low output voltage is entered while the engine speed is higher than 600 rpm.	• Air flow meter harness and connectors • Air flow meter • Air flow meter self-cleaning system • E.C.U.	EF-81
13	• The water temperature sensor circuit is open or shorted. (An abnormally high or low output is entered)	• Water temperature sensor harness and connectors • Water temperature sensor	EF-84
14	• The vehicle speed signal is not entered while the vehicle is running.	• Vehicle speed sensor harness and connectors • Vehicle speed sensor	EF-86
21	• The ignition signal in the primary coil is not entered more than 10 times.	• Harness between E.C.U. and ignition coil. • Power transistor • Ignition coil • High tension cables • Spark plugs • Distributor • E.C.U.	EF-87
22	• The electric current for fuel pump is extremely low or high.	• Fuel pump harness and connectors • Fuel pump • E.C.U.	EF-90
23	• The ON-OFF signal from idle switch is not entered after ignition switch is turned to "ON".	• Throttle valve switch harness and connectors • Throttle valve switch • Idle switch improper adjustment	EF-91
24	• The ON-OFF signal from neutral/park switch is not entered after ignition switch is turned to "ON".	• Neutral/Park switch harness and connectors • Neutral/Park switch	EF-93

Code No.	Diagnosis	Inspection	Reference page
31	• An ON-OFF signal from the air conditioner system is not entered after the ignition switch is turned to "ON".	• Air conditioner system	EF-94
32	• The start signal from the ignition switch is not entered after the engine has started.	• Ignition switch • Ignition system harness and connectors	EF-95
44	• The systems which are diagnosed by E.C.U. are working normally.	• Inspect other electric control systems.	–

Crank Angle Sensor

INSPECTION START

Perform self-diagnosis. (Refer to page EF-75.)

Code No. 11 Displayed?

No → Does the engine run normally?

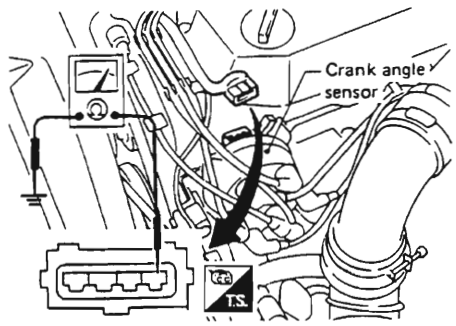
No → Check other systems.
- Ignition timing
- Fuel supply system
- Air flow meter

Yes → INSPECTION END

Yes

Check the battery voltage

1. Disconnect the crank angle sensor harness connector.
2. Measure the resistance for ground.

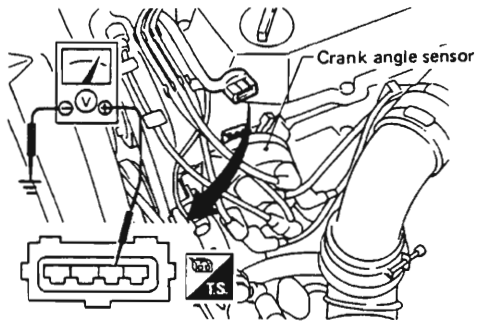


Resistance: 0Ω

SEF625D

N.G. → Repair/Replace the harness.

3. Turn ignition switch "ON" and measure the voltage.



Voltage: Battery voltage

SEF626D

N.G. → Check E.C.C.S. relay and harness related battery source.

→ Repair/Replace.

O.K. → Ⓐ

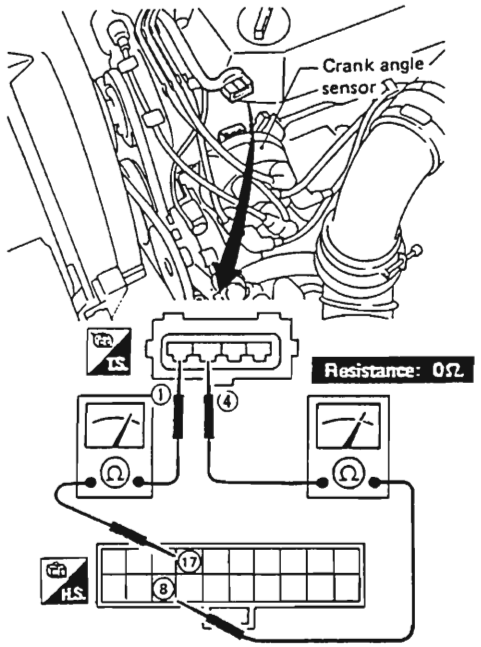
Ⓑ

Crank Angle Sensor (Cont'd)

Ⓐ

Check harness between the crank angle sensor and E.C.U.

1. Turn ignition switch "OFF".
2. Disconnect E.C.U. 20-pin connector and crank angle sensor connector.
3. Check continuity between terminals ① - ⑰, ④ - ⑧.



N.G. → Repair/Replace the harness. → Ⓑ

O.K.

Visually check
Check the crank angle sensor for any damage.

Replace the crank angle sensor.

Perform self-diagnosis. (Refer to page EF-75.)

Code No. 11 Displayed?

Yes → Replace E.C.U. → Perform self-diagnosis. (Refer to page EF-75.)

No → INSPECTION END

Air Flow Meter

INSPECTION START

Refer to page EF-104 for checking self-cleaning system.

Perform self-diagnosis. (Refer to page EF-75.)

CAUTION:
*If Code No. 11 and Code No. 12 are both displayed, first check the crank angle sensor.

Code No. 12 Displayed?

No → Does the engine run normally?

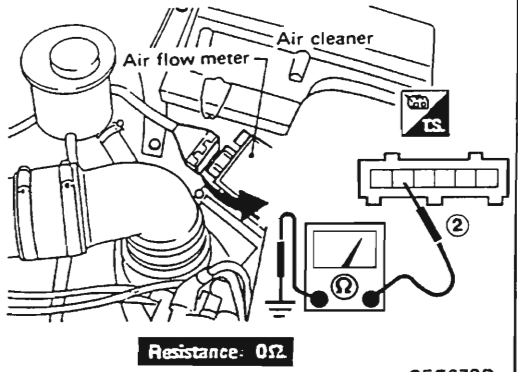
No → Check other systems.
- Fuel system
- Ignition timing
- Crank angle sensor

Yes → END

Yes

Check the battery voltage

1. Disconnect air flow meter harness connector.
2. Measure the resistance of ground circuit.

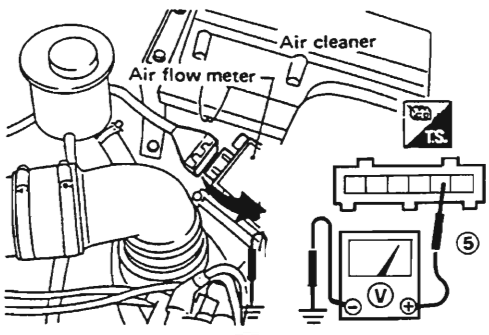


Resistance: 0Ω

SEF679D

N.G. → Repair/Replace the harness.

3. Turn ignition switch "ON" and measure the voltage at ⑤



Voltage: Battery voltage

SEF680D

N.G. → Check E.F.I. relay and harness related battery source. → Repair/Replace.

O.K. → Ⓐ

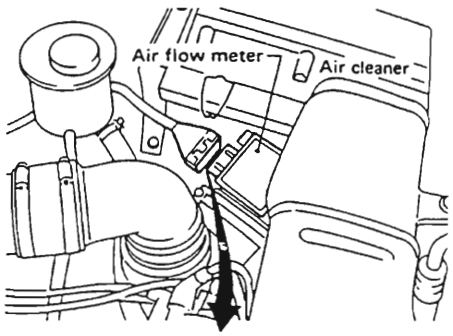
Ⓑ → Perform self-diagnosis. (Refer to page EF-75.)

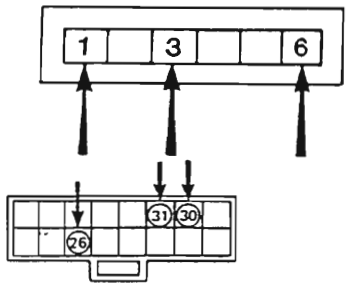
Air Flow Meter (Cont'd)

Ⓐ

Check harness between the air flow meter and E.C.U.

1. Turn ignition switch "OFF".
2. Disconnect E.C.U. 16-pin connector and air flow meter harness connector.
3. Check continuity between terminals ⑥ - ㉚, ③ - ㉛, ① - ㉖.





E.C.U. 16-pin harness connector

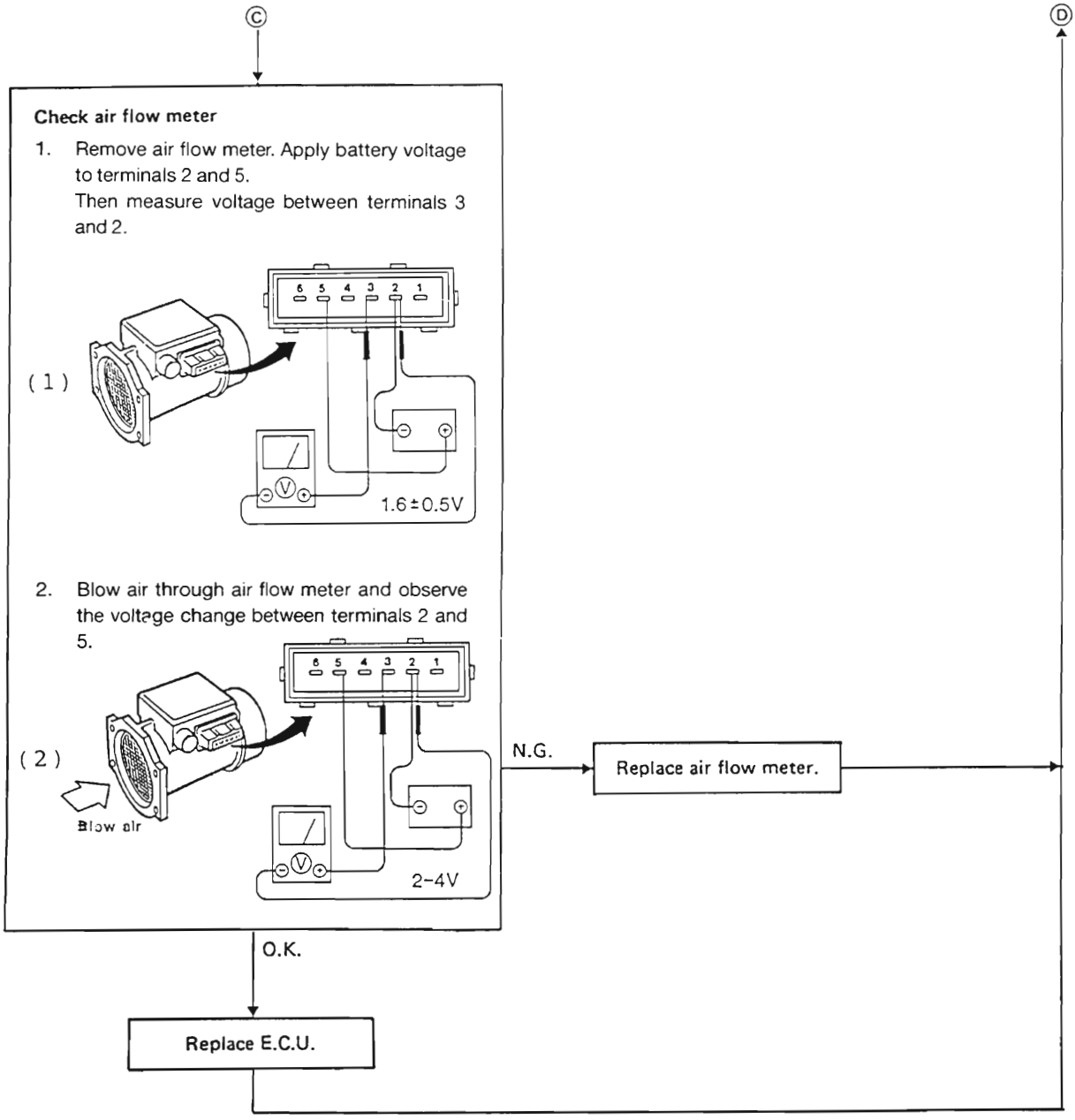
SEF628D

N.G. → Repair/Replace the harness. → Ⓑ

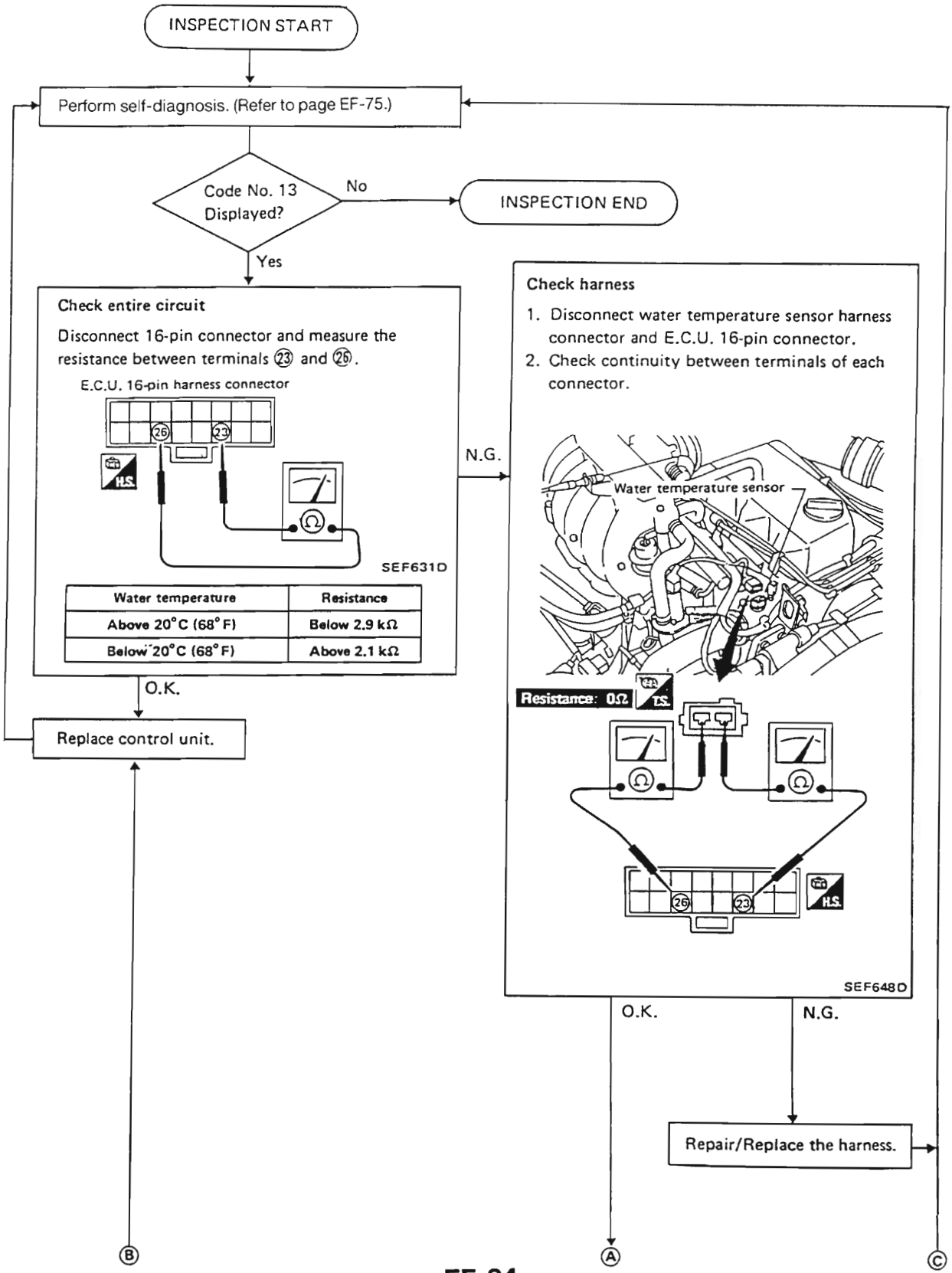
O.K. → Ⓒ

Ⓓ

Air Flow Meter (Cont'd)



Water Temperature Sensor

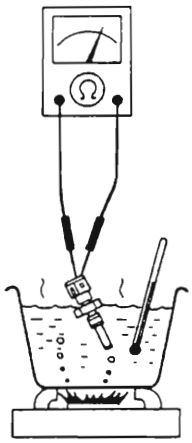


Water Temperature Sensor (Cont'd)

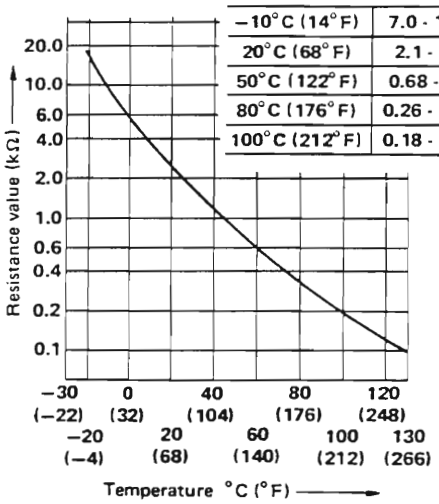
Ⓑ Ⓐ Ⓒ

Check water temperature sensor

Dip the sensor into water maintained at a temperature of 20°C (68°F), 80°C (176°F), etc., and read its resistance.



−10°C (14°F)	7.0 - 11.4 kΩ
20°C (68°F)	2.1 - 2.9 kΩ
50°C (122°F)	0.68 - 1.0 kΩ
80°C (176°F)	0.26 - 0.39 kΩ
100°C (212°F)	0.18 - 0.20 kΩ



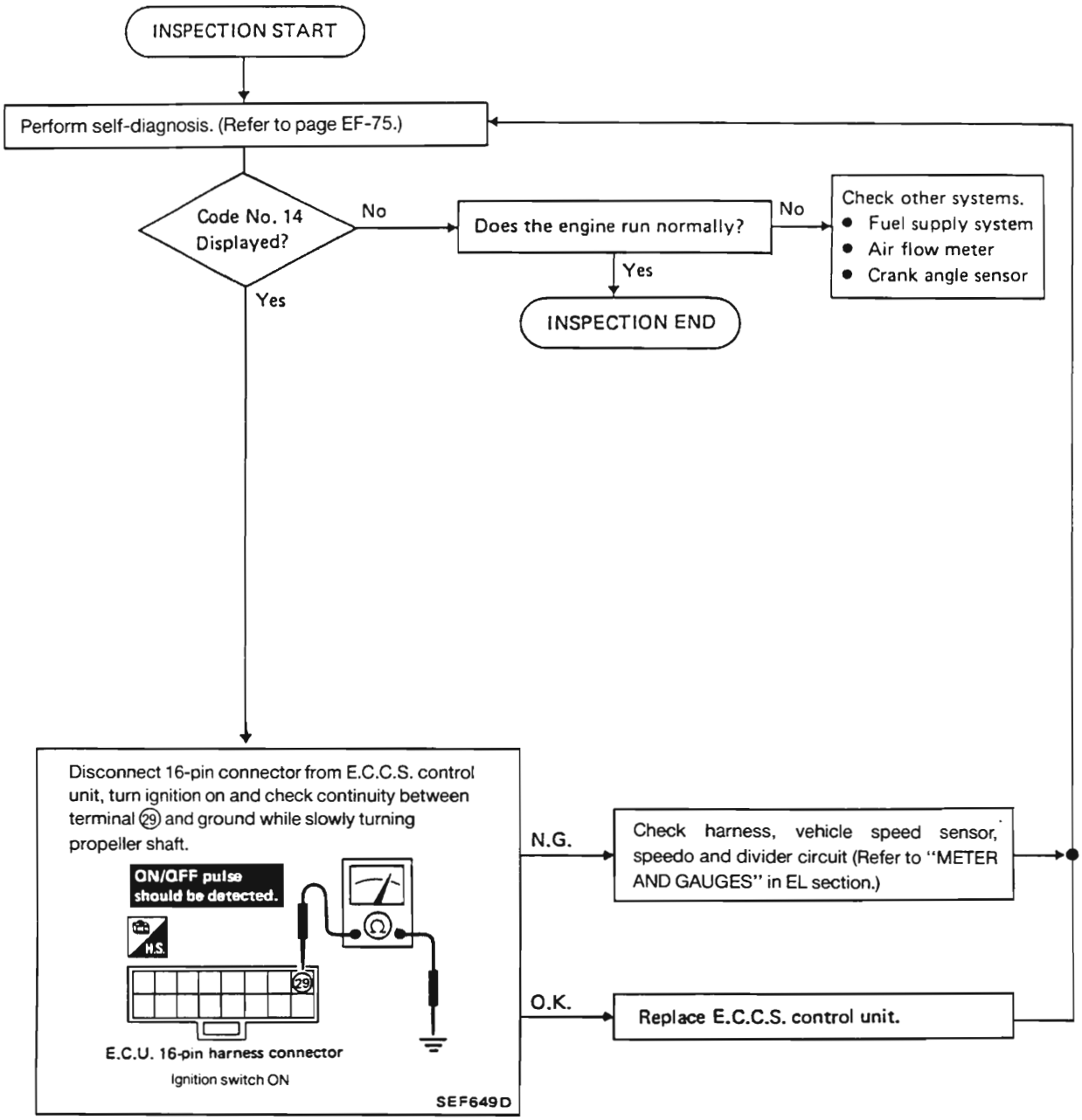
SEF677B

O.K.

N.G.

Replace water temperature sensor.

Vehicle Speed Sensor



Ignition Signal

INSPECTION START

Perform self-diagnosis. (Refer to page EF-75.)

Code No. 21 Displayed? — No → Does the engine run normally? — No → Check other systems.
- Fuel supply system
- Air flow meter
- Crank angle sensor

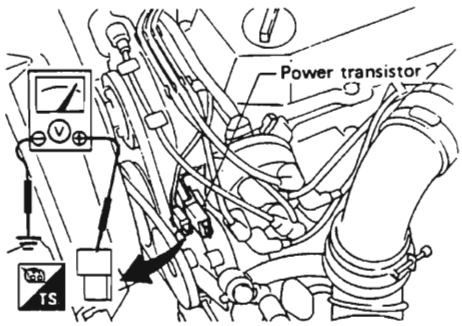
Does the engine run normally? — Yes → INSPECTION END

Code No. 21 Displayed? — Yes → Check spark plugs, ignition wires, distributor cap and distributor rotor.

If abnormality is found, repair or replace.

Check battery voltage at power transistor

1. Disconnect the harness connector at power transistor.
2. Turn ignition switch "ON" and measure the voltage.



Voltage: Battery voltage

SEF650D

3. Turn ignition switch "OFF".

N.G. → Repair/Replace the harness. → Ⓒ → Ⓑ

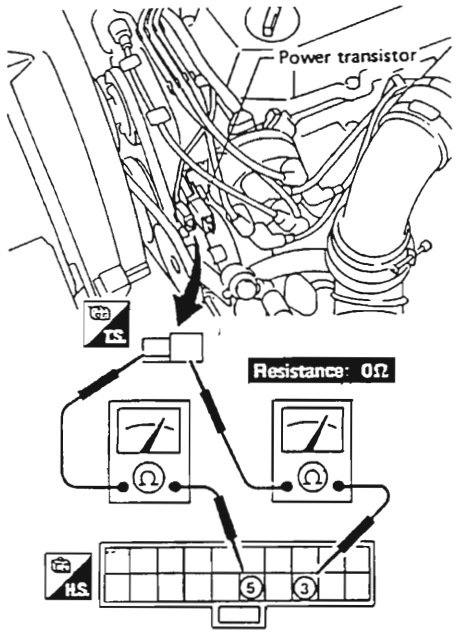
O.K. → Ⓐ

Ignition Signal (Cont'd)

Ⓐ

Check harness between E.C.U. and power transistor

1. Disconnect E.C.U. 20-pin connector and power transistor harness connector.
2. Check continuity between terminals of each connector.



SEF651D

N.G. → Ⓒ

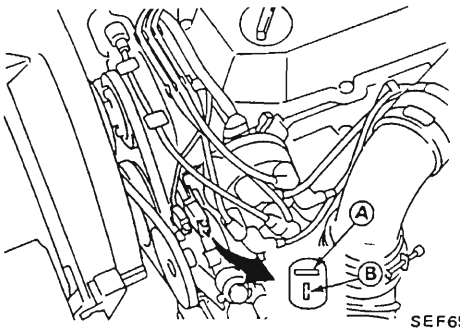
O.K. → Ⓓ

Ⓑ → Ⓔ

Ignition Signal (Cont'd)

Ⓓ

Check power transistor.



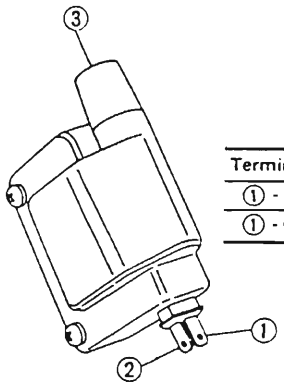
SEF652D

Ohmmeter leads to pins (+)	Ohmmeter leads to pins (−)	Should read
⏚	A	0Ω
A	⏚	∞Ω
A	B	∞Ω
B	A	0Ω
⏚	B	0Ω
B	⏚	0Ω

O.K. →

Check ignition coil with harness

Check for continuity.



Terminals	Resistance
① - ②	1Ω
① - ③	10 kΩ

SEF956C

N.G. ↑ Replace the ignition coil. → Ⓔ

O.K. ↓ Replace E.C.U. → Ⓔ

N.G. ↓ Replace power transistor. → Ⓔ

Fuel Pump

INSPECTION START

Check the fuse.

Perform self-diagnosis. (Refer to page EF-75.)

Code No. 22 Displayed?

No → Check fuel pressure. → INSPECTION END

Yes

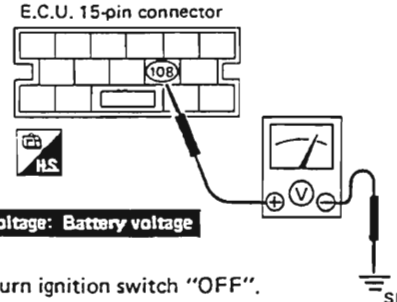
Turn ignition switch "ON" and listen to the fuel pump operating sound. The sound must be heard for about 5 seconds.

N.G. → Check harness

O.K.

Check battery voltage

1. Disconnect E.C.C.S. 15-pin connector, and check voltage between terminal (108) and ground when ignition switch is turned to "ON".

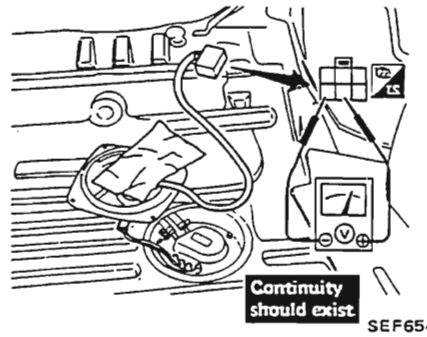


2. Turn ignition switch "OFF".

O.K.

Check fuel pump

1. Check fuel pump for continuity.



2. Check fuel pump for insulation.

N.G. → Replace fuel pump.

O.K.

Replace E.C.U.

Check harness

1. Check harness between E.C.U. and fuel pump.
2. Check harness between fuel pump and fuse block.

O.K. → (to fuel pump checks)

N.G. → Repair/Replace.

Throttle Valve Switch

INSPECTION START

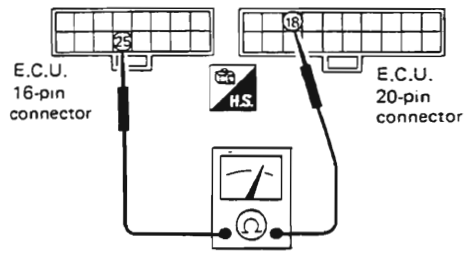
Adjust accelerator wire.

Perform self-diagnosis. (Refer to page EF-75.)

Code No. 23 Displayed? — No / Yes

Check signal for E.C.U.

1. Disconnect E.C.U. 20-pin and 16-pin connectors.
2. Check for continuity between ⑱ and ㉕.



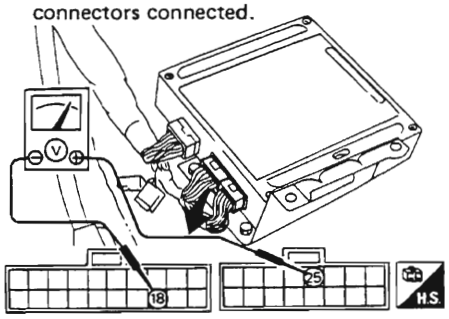
SEF655D

Accelerator pedal	Resistance (Ω)
Free	0
Depressed	∞

N.G. O.K.

Confirm idle switch operation

1. Start engine.
2. Check voltage between ⑱ and ㉕ with connectors connected.



SEF657D

Make sure the voltage changes to 0V from 12V as the engine speed drops below 900 r.p.m.

3. Stop engine.

INSPECTION END

Replace E.C.U.

Adjust throttle valve switch (Idle switch)

1) Start engine and raise engine speed to about 1,500 rpm.
2) Decrease engine speed and confirm that idle switch turns on at the engine speed as shown below.

OFF → ON:
950±50 rpm (in "N" position)

If out of specification, adjust as follows.

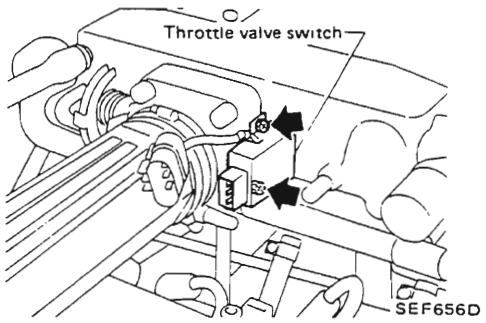
3) Disconnect A.A.C. valve harness connector and confirm idle speed.

650±50 rpm (in "N" position)

If out of specification, adjust by turning idle adjust screw. (Refer to section MA.)

4) Raise engine speed to about 1,500 rpm.
5) Decrease engine speed and adjust idle switch so that switch turns on at the engine speed shown below.

OFF → ON:
950±50 rpm (in "N" position)



SEF656D

6) Connect A.A.C. valve connector and confirm idle speed.

700±50 rpm (in "N" position)

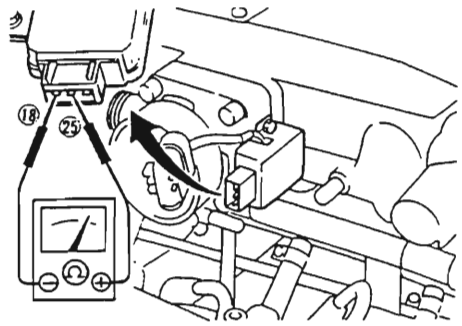
Ⓐ Ⓒ Ⓑ

Throttle Valve Switch (Cont'd)

Ⓐ

Check throttle valve switch

1. Disconnect throttle valve switch harness connector.
2. Check the throttle valve switch for continuity between ㉕ and ⑱.



SEF658D

Throttle valve	Continuity
Idle position	Yes (0Ω)
Slightly opened position	No (∞Ω)

N.G.

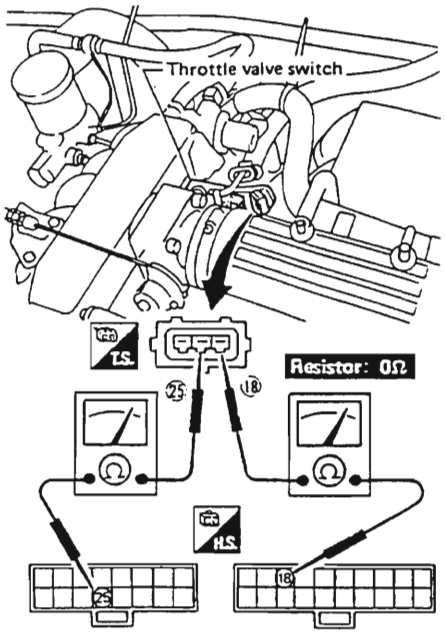
Replace throttle valve switch.

O.K.

Ⓒ

Check harness for continuity

1. Disconnect E.C.U. 20-pin and 16-pin connectors and throttle valve switch harness connector.
2. Check continuity between terminals of each connector.



SEF659D

N.G.

Repair/Replace harness.

Ⓑ

Neutral Switch

INSPECTION START

Perform self-diagnosis. (Refer to page EF-75.)

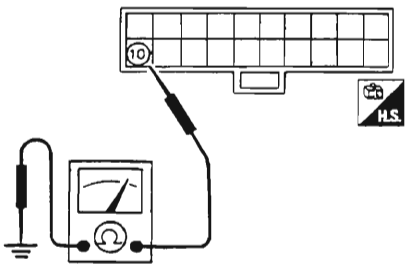
Code No. 24 Displayed?

No → INSPECTION END

Yes

Check neutral/park switch harness.

1. Disconnect 20-pin connector.
2. Turn ignition switch "ON" and measure resistance between terminal ⑩ and ground.



SEF660D

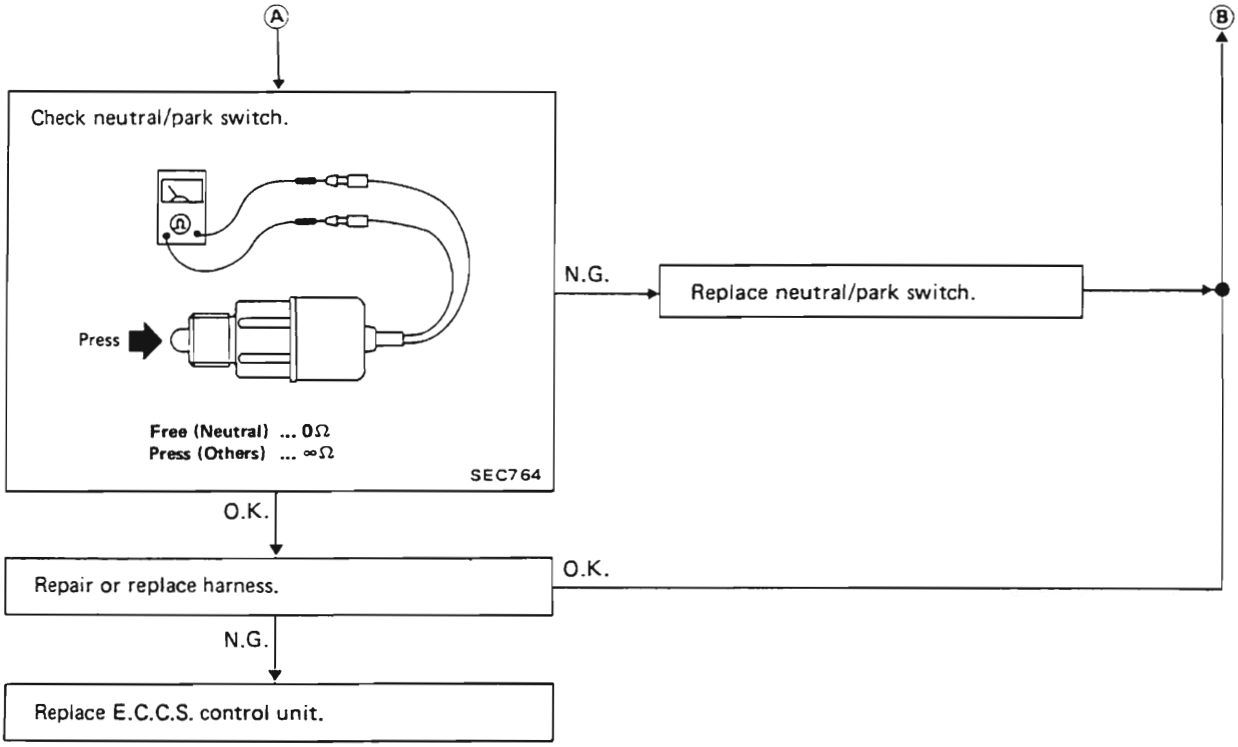
Gear position	Continuity
Except neutral/park	∞Ω
Neutral/park	0Ω

SEF512D

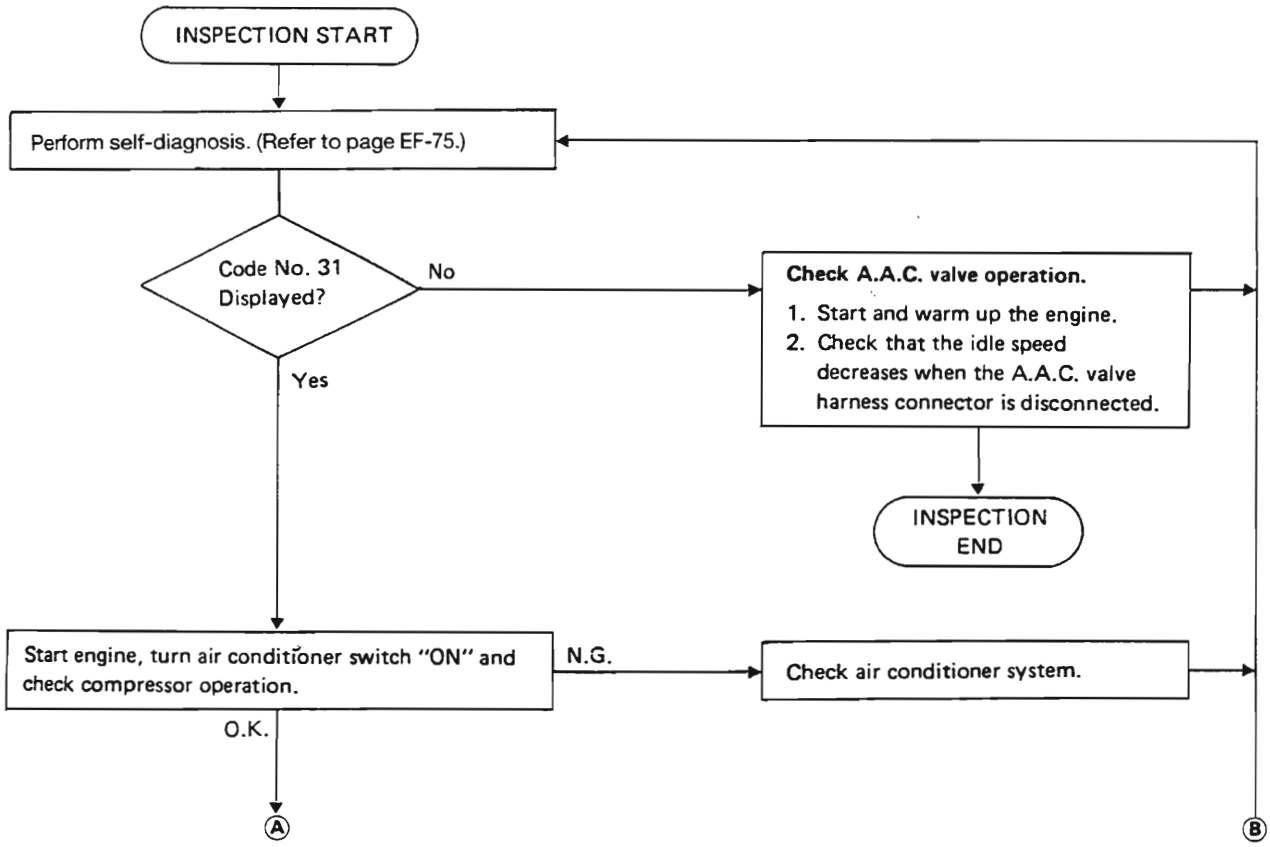
Ⓐ

Ⓑ

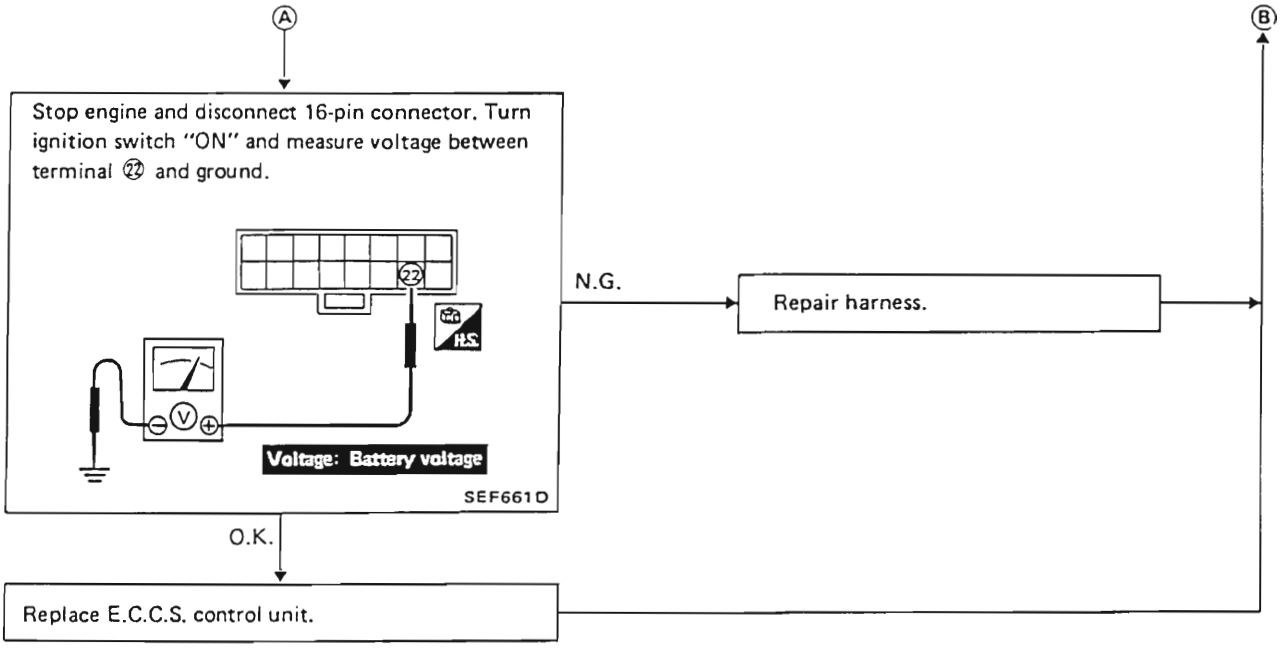
Neutral Switch (Cont'd)



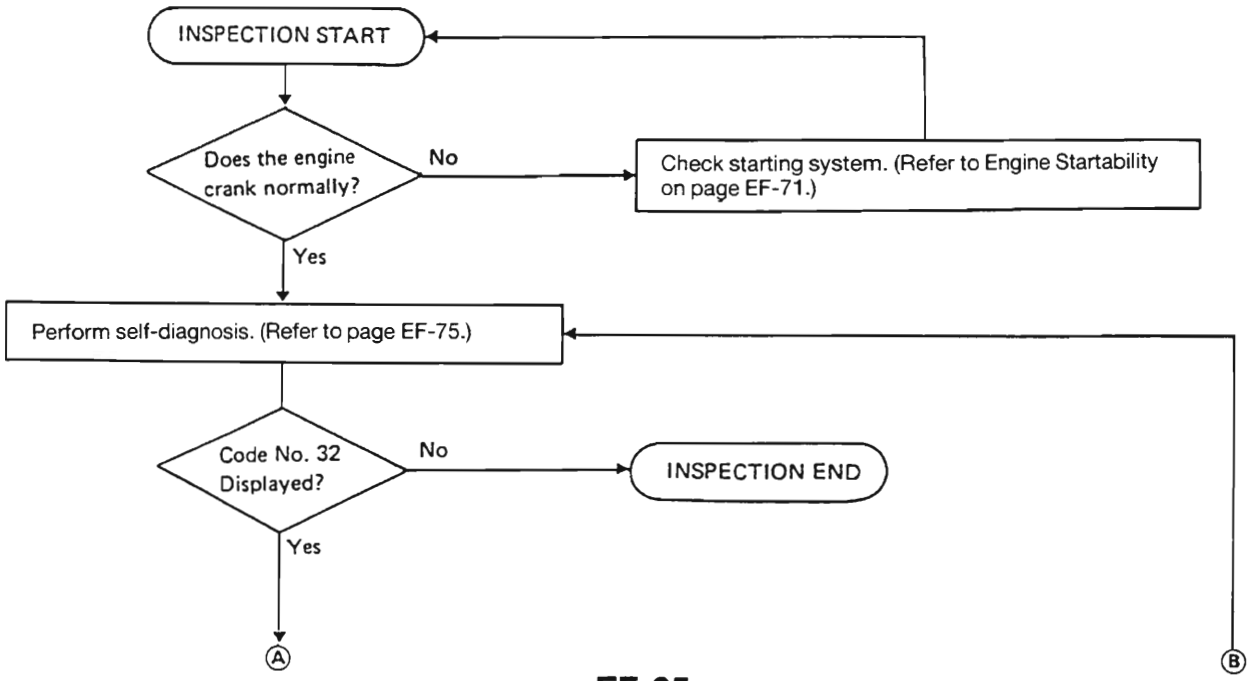
Air Conditioner Signal



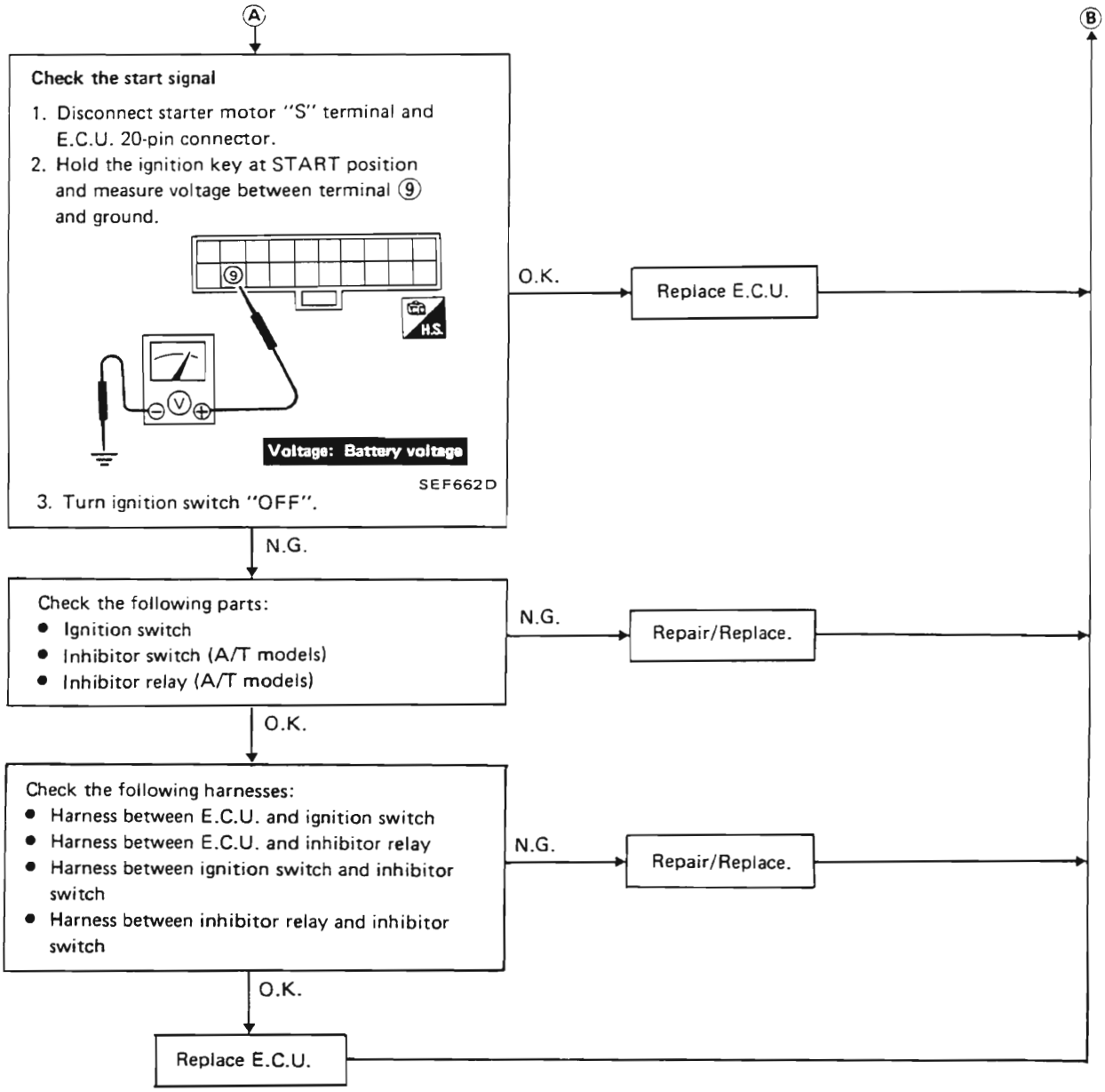
Air Conditioner Signal (Cont'd)



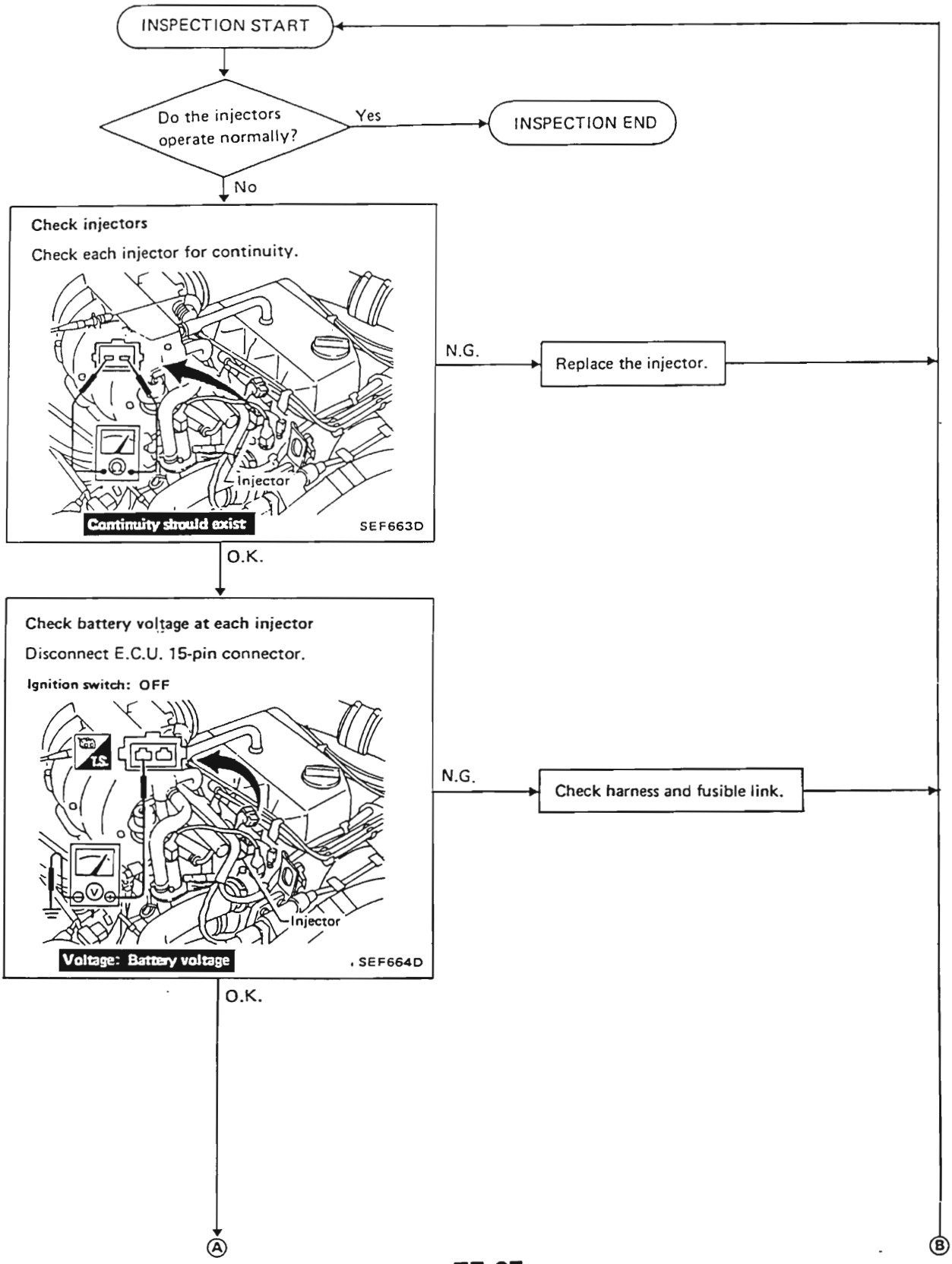
Start Signal



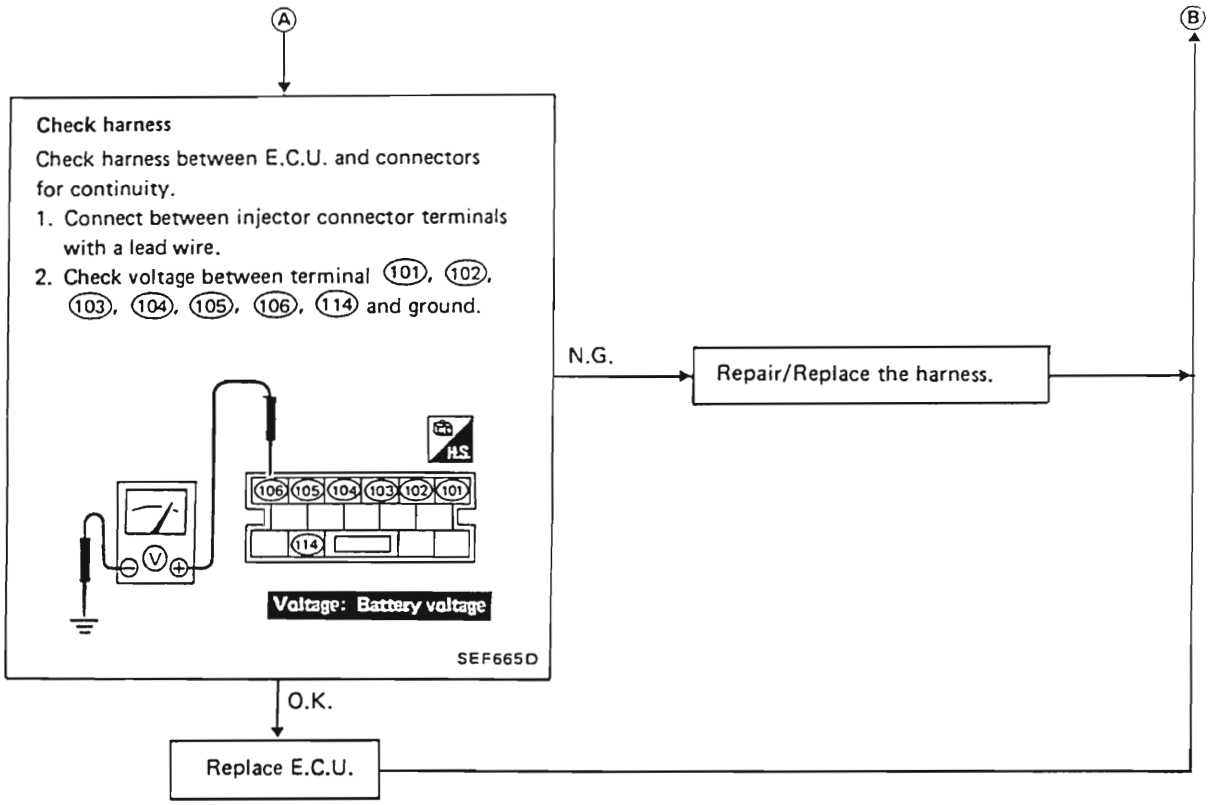
Start Signal (Cont'd)



Injector


INSPECTION START
Do the injectors operate normally?
Yes
INSPECTION END
No
Check injectors
Check each injector for continuity.
Injector
Continuity should exist
SEF663D
N.G.
Replace the injector.
O.K.
Check battery voltage at each injector
Disconnect E.C.U. 15-pin connector.
Ignition switch: OFF
Injector
Voltage: Battery voltage
SEF664D
N.G.
Check harness and fusible link.
O.K.
Ⓐ
Ⓑ

Injector (Cont'd)

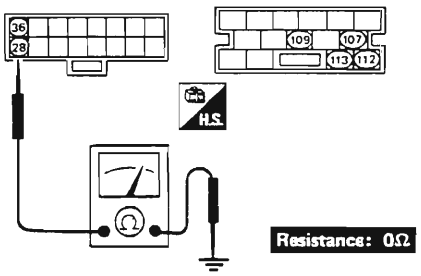


Battery Voltage and Ground Test

INSPECTION START

Check ground terminals

1. Disconnect E.C.U. 15-pin and 16-pin connectors.
2. Check for continuity at ㉘, ㊱, ⑩⑦, ⑩⑨, ⑪② and ⑪③.



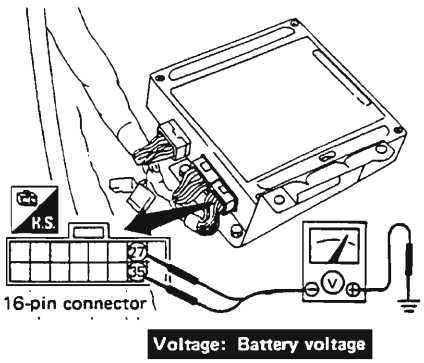
SEF666D

N.G. → Check that the ground terminal is securely mounted.
- O.K. → Repair/Replace ground harnesses.
- N.G. → Securely mount.

O.K.

Check battery voltage

1. Securely connect E.C.U. 15-pin and 16-pin connectors.
2. Turn ignition switch "ON" and measure the voltage at ㉗ and ㉟.



SEF667D

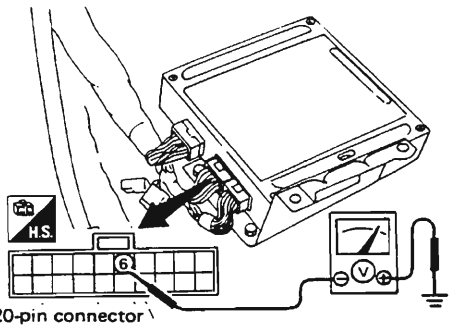
O.K.

INSPECTION END

N.G.

Check E.C.C.S. relay control

Measure the voltage at ⑥ for 6 seconds when ignition switch is turned to "OFF" from "ON" position.



Ignition	Voltage
OFF	12 V
ON	0 V

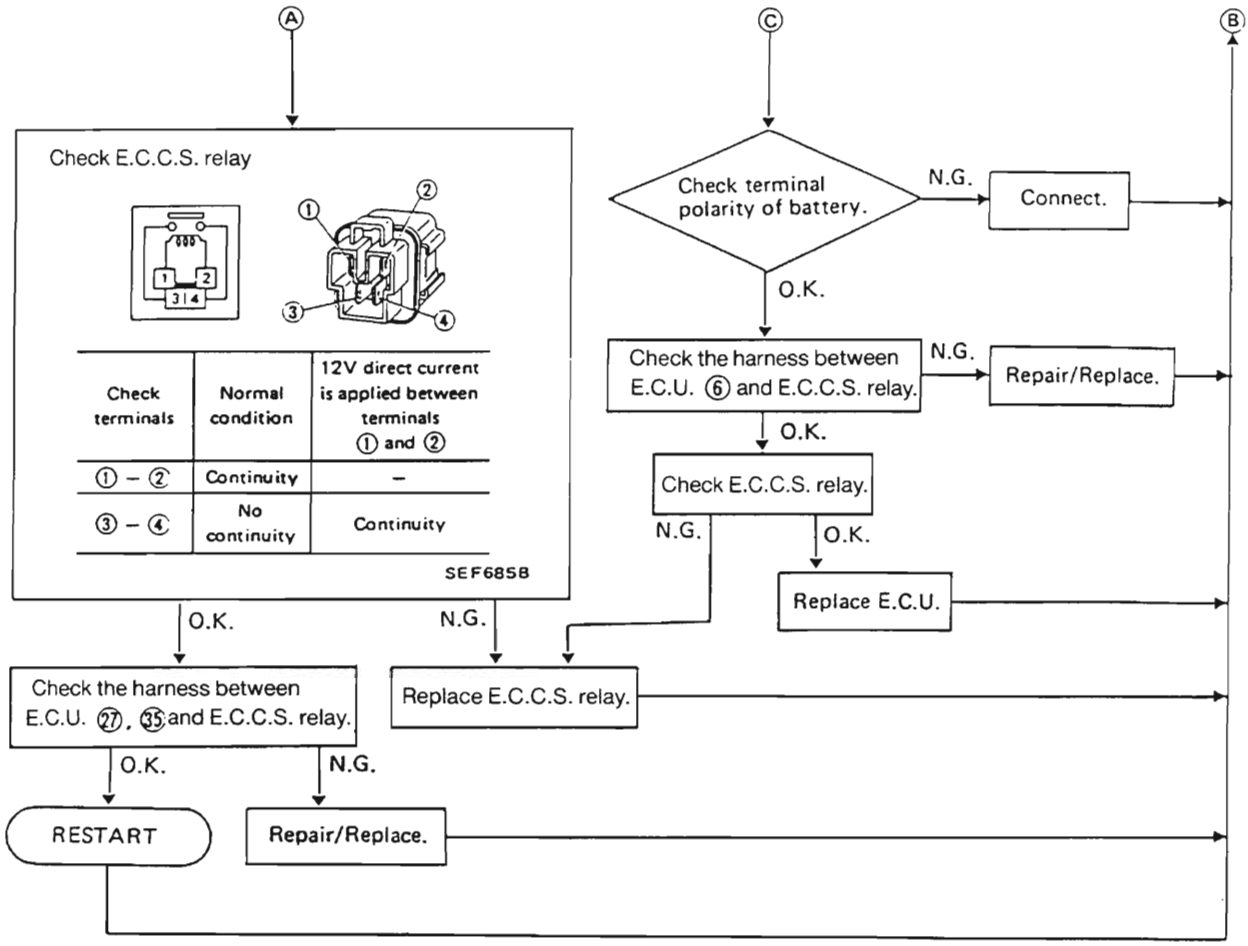
SEF668D

O.K. → Ⓐ

N.G. → Ⓒ

Ⓑ → INSPECTION START

Battery Voltage and Ground Test (Cont'd)



Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

Air Regulator

INSPECTION START

Visually check air regulator shutter for operation

Condition	Shutter position
In cold condition [Before starting at 20°C (68°F)]	1/2 open
After warm-up	Fully open

O.K. → Check air regulator shutter closing time.

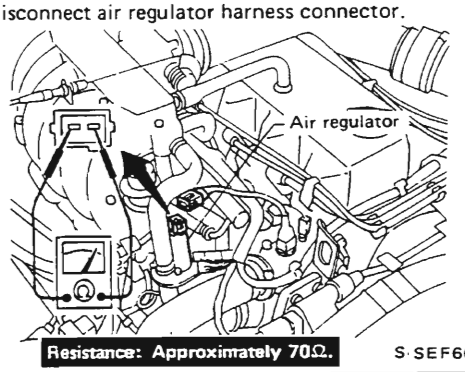
Reasonable? Yes → INSPECTION END

No → Check air regulator shutter for smooth operation.

N.G. → Replace air regulator.

Check air regulator for continuity

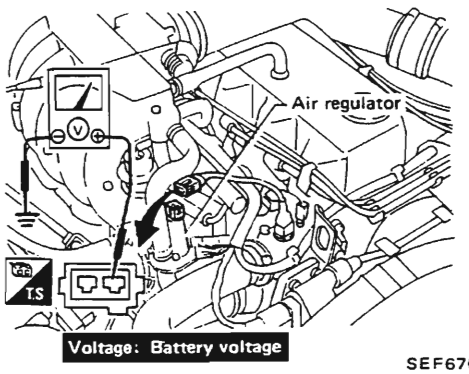
Disconnect air regulator harness connector.



O.K.

Check battery voltage

1. Turn ignition switch "ON" and measure the voltage at connector.



2. Turn ignition switch "OFF".

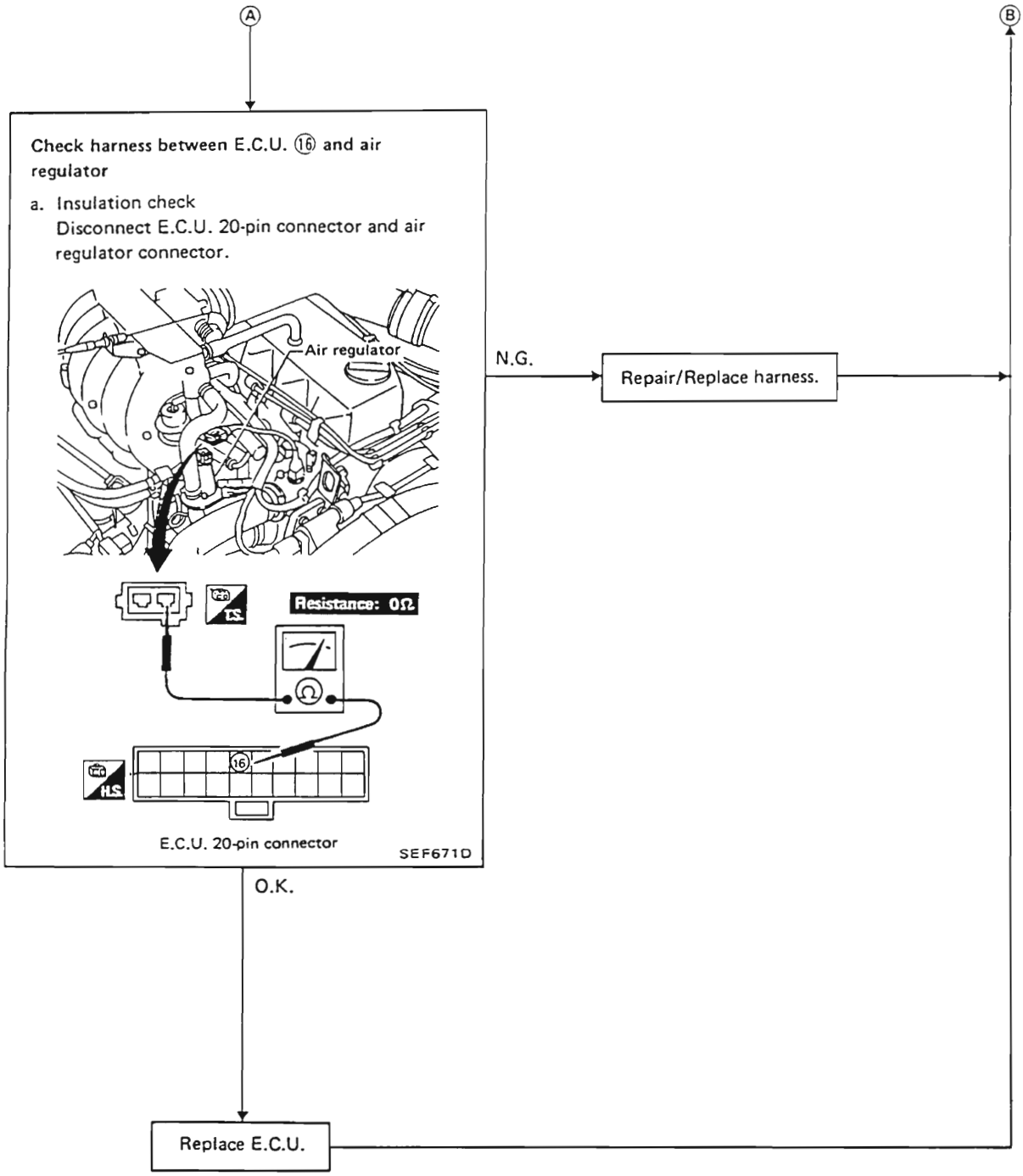
N.G. → Check the following:
- Ignition switch
- Harness between ignition switch and air regulator
- Battery

O.K.

Ⓐ

Ⓑ

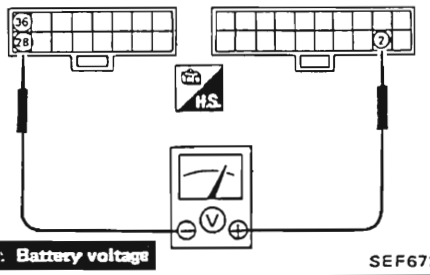
Air Regulator (Cont'd)



Auxiliary Air Control (A.A.C.) Valve or Idle-up Solenoid Valve

Check voltage between terminals ② and ㉘, ㊱ with 16-pin and 20-pin connectors connected to the control unit.

Ignition switch: ON



Voltage: Battery voltage

SEF672D

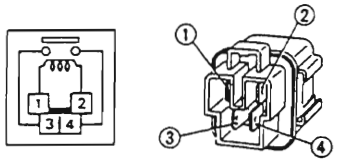
O.K. → END

N.G. → Check harness for continuity.

Check harness for continuity. N.G. → Repair harness.

O.K. →

Check E.F.I. relay.



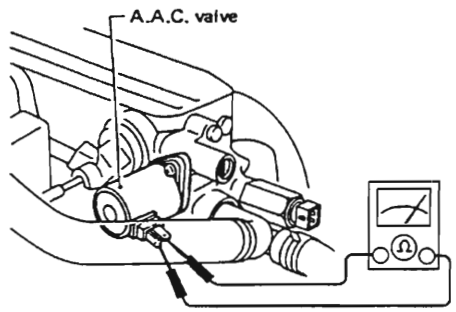
Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

SEF685B

N.G. → Replace E.C.C.S. relay.

O.K. →

Check A.A.C. valve.



Continuity should exist

SEF673D

N.G. → Replace A.A.C. valve or idle-up solenoid valve.

Self-cleaning Hot Wire

INSPECTION START

Start engine and race engine to above 2,500 rpm.

Drive vehicle at above 20 km/h.
then run engine at idle.

Remove air duct from air flow meter (air cleaner side) while engine is idling.

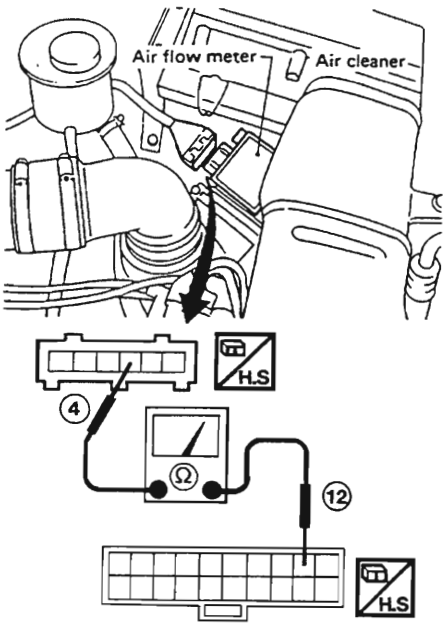
Using a mirror, ensure that hot wire heats up to a red glow for one second after the ignition switch has been turned off for five seconds.

O.K. → INSPECTION END

N.G.

Check harness for continuity.

Check for continuity between terminal ⑫ of 20-pin connector and terminal ④ of air flow meter harness connector.



N.G. → Repair/replace harness.

O.K.

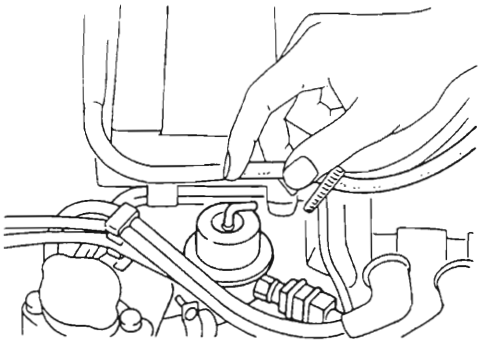
Replace air flow meter.

Pressure Regulator Control Solenoid Valve

INSPECTION START

Check the system operation

1. Disconnect water temperature sensor harness connector and bridge across terminals of connector with a lead wire.
2. Disconnect a vacuum hose between pressure regulator and solenoid valve.
3. Start engine.
4. There should be no vacuum in the hose for 3 minutes.



SEF727D

5. Stop the engine.

O.K. → Check water temperature sensor. → INSPECTION END

N.G. → Ⓐ

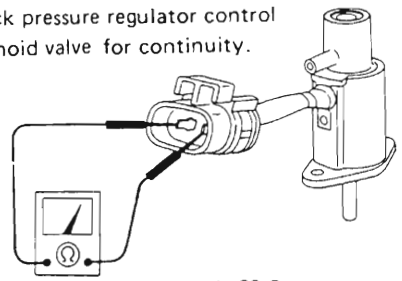
Ⓑ → INSPECTION START

Pressure Regulator Control Solenoid Valve (Cont'd)

Ⓐ

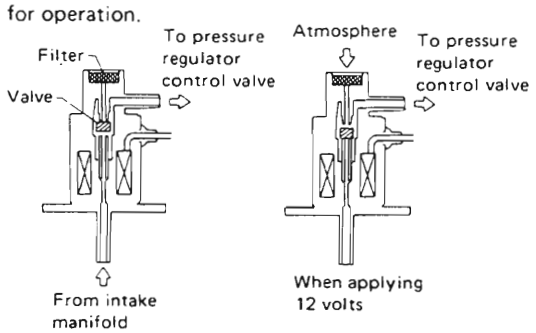
Check the solenoid valve

Check pressure regulator control solenoid valve for continuity.



Resistance: Approximately 30 Ω. SEF698B

Check pressure regulator control solenoid valve for operation.



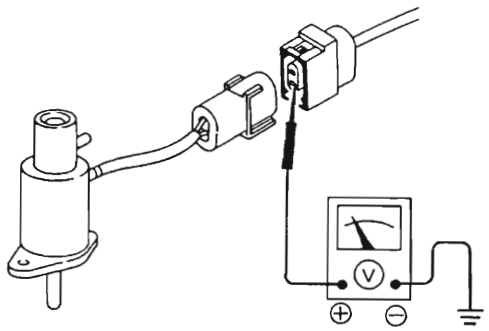
SEF792B

N.G. → Replace pressure regulator control valve. → Ⓑ

O.K.

Check battery source

1. Check battery voltage at the solenoid valve by turning on ignition switch.



Ignition switch: ON
Voltage: Battery voltage

SEF515D

N.G. → Check the following systems:
- Battery source and ground → Ⓑ

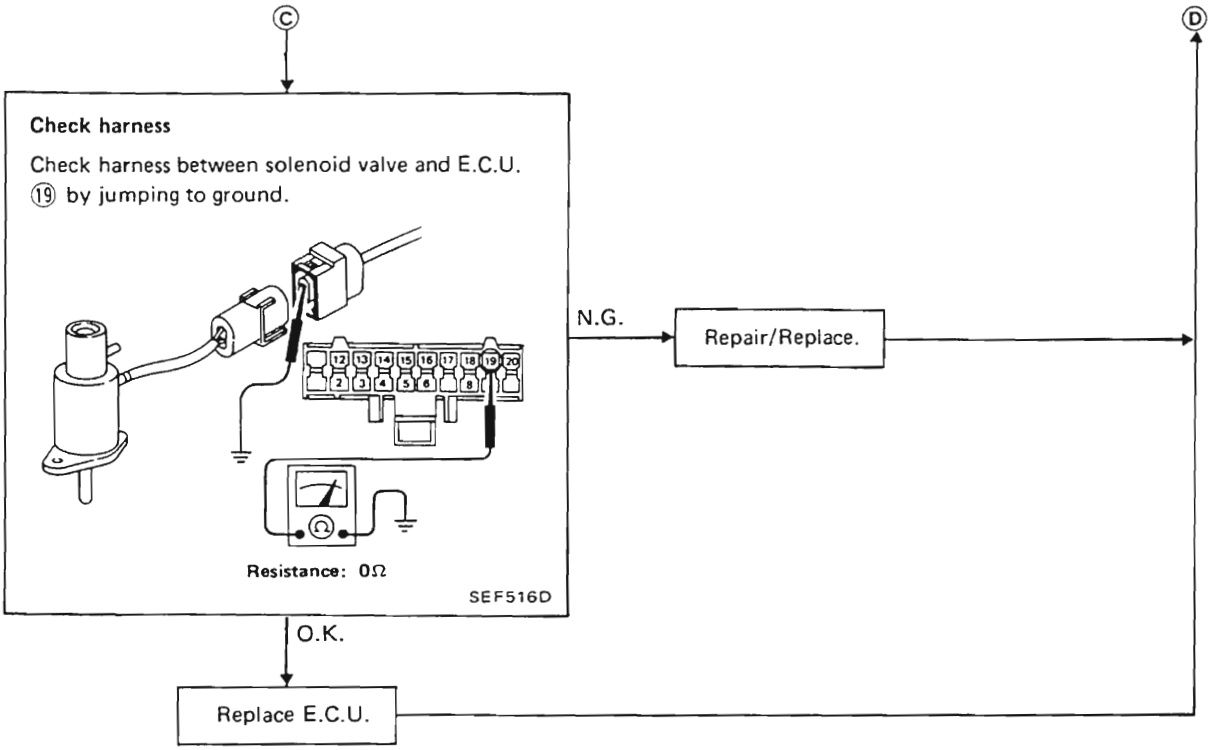
2. Turn ignition switch "OFF".

O.K. → Ⓒ

Ⓓ

RB30E

Pressure Regulator Control Solenoid Valve (Cont'd)



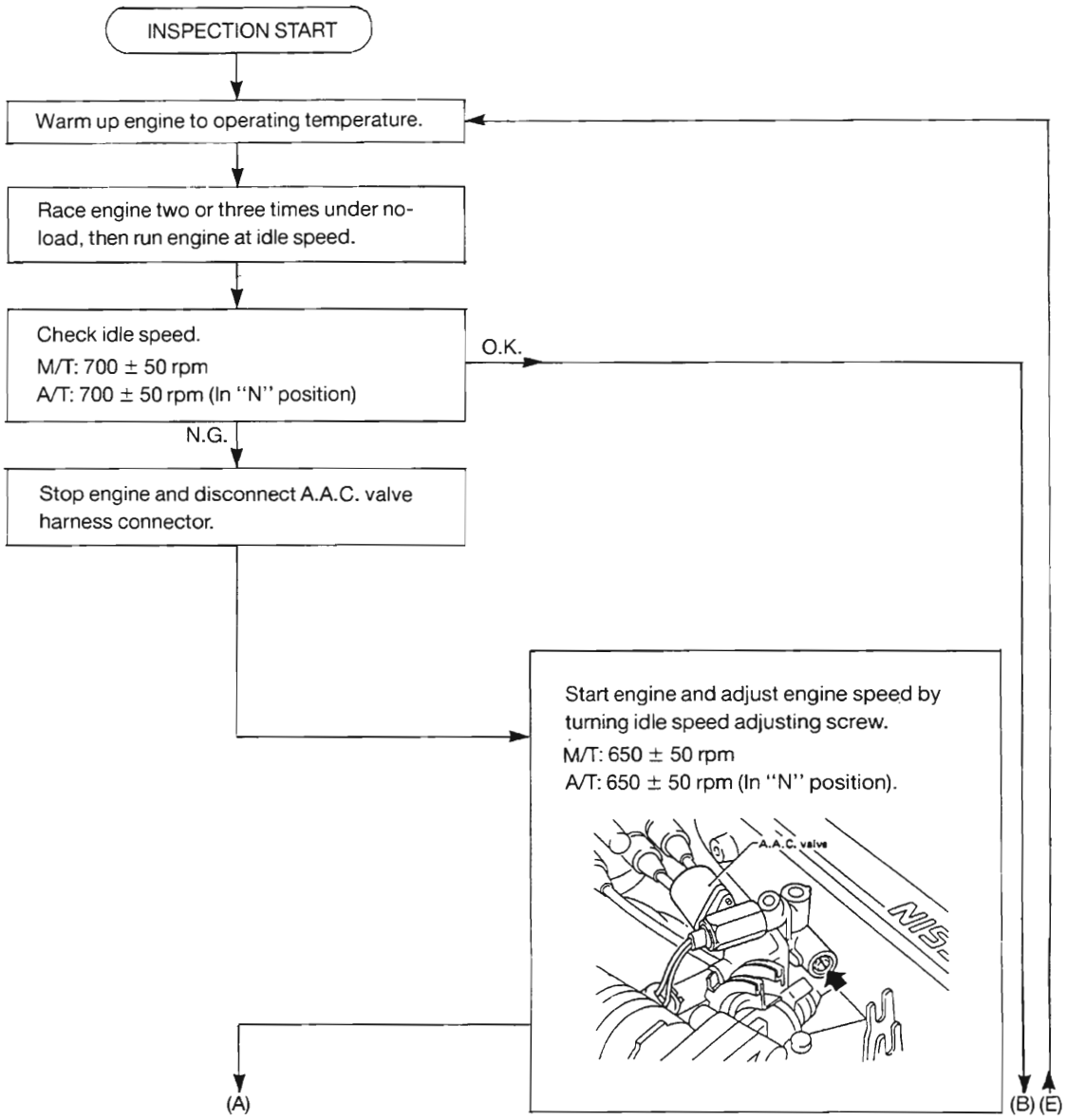
MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

RB30E

PREPARATION

1. Make sure that the following parts are in good order.
- Battery
- Ignition system
- Engine oil and coolant levels
- Fuses
- E.C.C.S. harness connectors
- Vacuum hoses
- Air intake system
  (oil filler cap, oil level gauge, etc.)
- Engine compression
- Throttle valve and throttle valve switch operation

2. On air conditioner equipped models, checks should be carried out while the air conditioner is "OFF".



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

RB30E

(A)

Stop engine and reconnect A.A.C. valve harness connector. Then start engine.

Make sure that idle speed is in the specified range.
M/T: 700±50 rpm
A/T: 700±50 rpm (In "N" position).

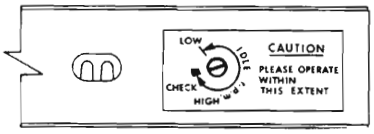
O.K.

N.G.

Engine Idle Speed Slow

Engine Idle Speed Fast

Turn diagnostic mode selector in a clockwise direction **only between the counter-clockwise and mid position** until the correct idle speed is attained.



Note: The diagnostic mode selector must be adjusted between the counter-clockwise and mid positions to enable the O_2 sensor check function to operate for periodic maintenance checks.

O.K.

N.G.

Check A.A.C. valve as per the test procedure in the Service Manual.

(B)

(E)

Check ignition timing with a timing light.
15°±2° B.T.D.C.

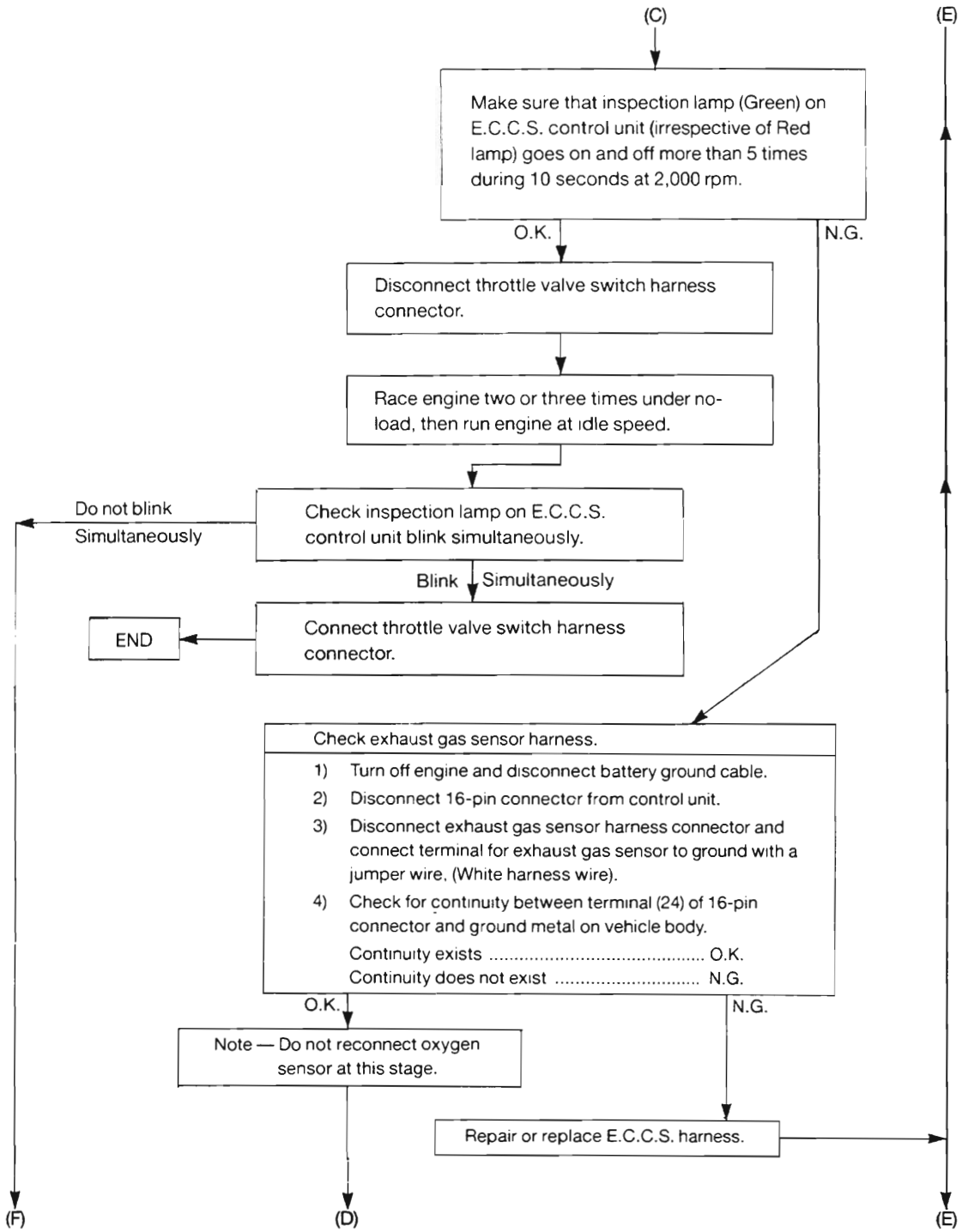
N.G.

If necessary, adjust ignition timing by turning distributor.

Run engine at about 2,000 rpm for about 2 minutes under no-load.

C

(E)


(C)
(E)
Make sure that inspection lamp (Green) on E.C.C.S. control unit (irrespective of Red lamp) goes on and off more than 5 times during 10 seconds at 2,000 rpm.
O.K.
N.G.
Disconnect throttle valve switch harness connector.
Race engine two or three times under no-load, then run engine at idle speed.
Do not blink Simultaneously
Check inspection lamp on E.C.C.S. control unit blink simultaneously.
Blink Simultaneously
END
Connect throttle valve switch harness connector.
Check exhaust gas sensor harness.
1) Turn off engine and disconnect battery ground cable.
2) Disconnect 16-pin connector from control unit.
3) Disconnect exhaust gas sensor harness connector and connect terminal for exhaust gas sensor to ground with a jumper wire. (White harness wire).
4) Check for continuity between terminal (24) of 16-pin connector and ground metal on vehicle body.
Continuity exists ..... O.K.
Continuity does not exist ..... N.G.
O.K.
N.G.
Note — Do not reconnect oxygen sensor at this stage.
Repair or replace E.C.C.S. harness.
(F)
(D)
(E)

MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

(F) (D) (E)

Check exhaust gas sensor heater harness.

1) Reconnect 16-pin connector to control unit.
2) Reconnect battery ground cable.

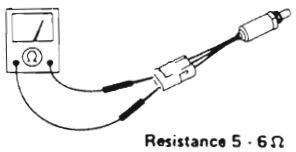
With ignition "ON", ensure battery voltage is present at Blue Wire and ground continuity (zero Ohms) exists on Black Wire to the exhaust gas sensor *harness* plug.

O.K. N.G.

Rectify wiring

Check exhaust gas sensor heater.

Measure the resistance of exhaust gas sensor heater.



Resistance 5 - 6 Ω

O.K. N.G.

Renew exhaust gas sensor

NOTE — Do not reconnect exhaust gas sensor at this stage.

Disconnect water temperature sensor harness connector.

Connect a resistor (2.5KΩ) between terminals of water temperature sensor harness connector.

Start engine and warm up engine until water temperature indicator points to the middle of gauge.

Race engine two or three times under no-load, then run engine at idle speed.

Check CO%

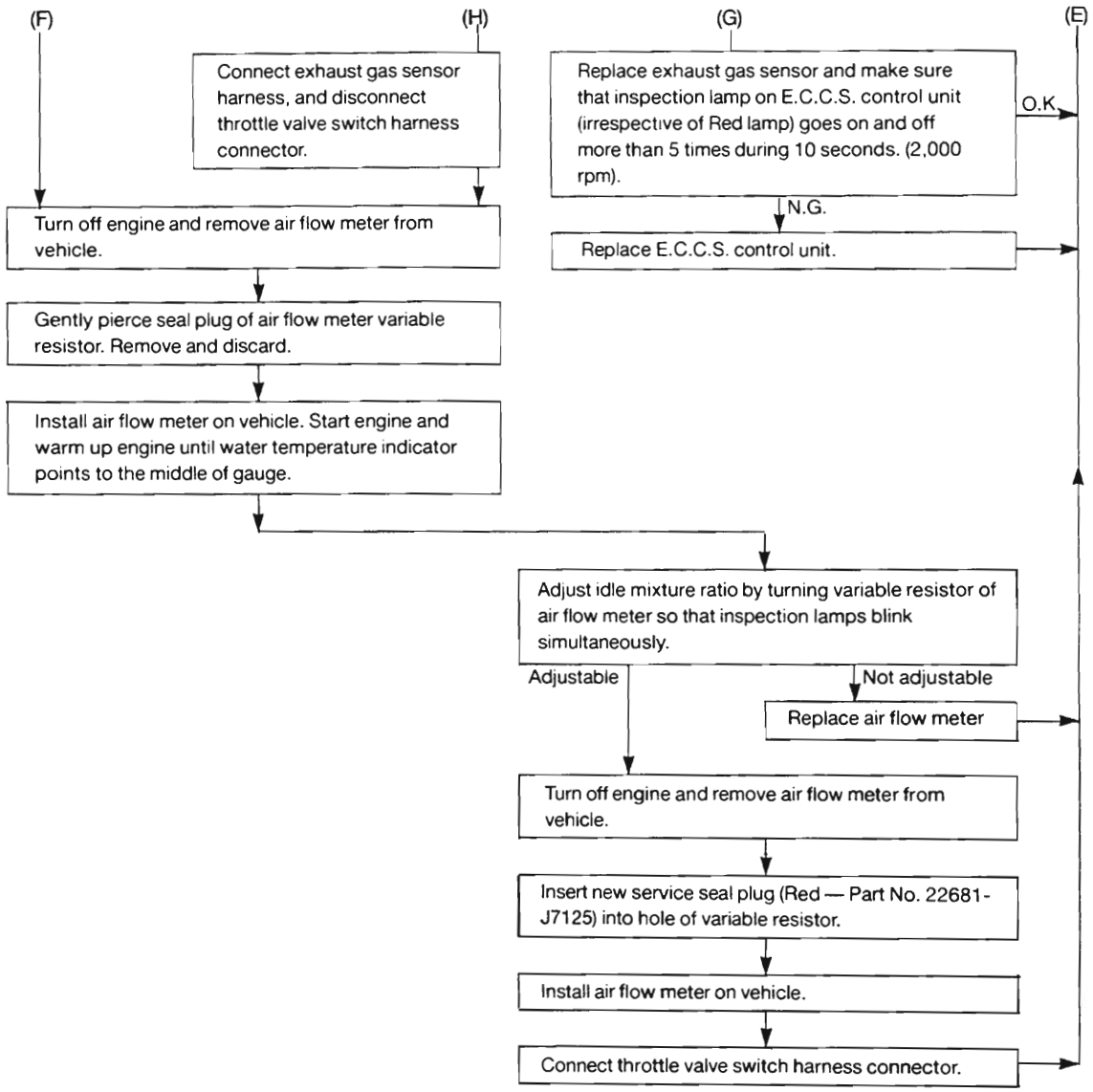
Idle CO: 0.2 — 4.0%

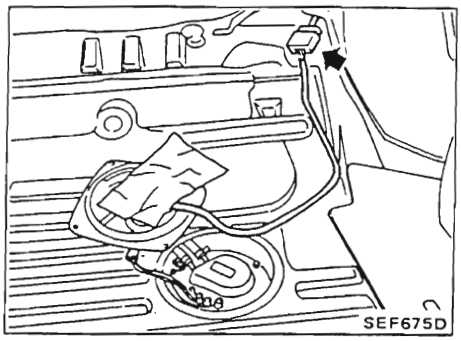
After checking CO%,

1) Disconnect the resistor from terminals of water temperature sensor.
2) Connect water temperature sensor harness connector to water temperature sensor.

N.G. O.K.

(F) (H) (G) (E)

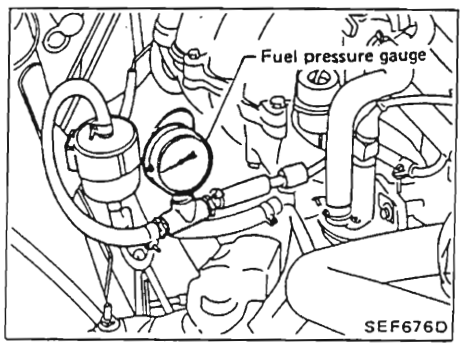

(F)
(H)
(G)
(E)
Connect exhaust gas sensor harness, and disconnect throttle valve switch harness connector.
Replace exhaust gas sensor and make sure that inspection lamp on E.C.C.S. control unit (irrespective of Red lamp) goes on and off more than 5 times during 10 seconds. (2,000 rpm).
O.K.
N.G.
Replace E.C.C.S. control unit.
Turn off engine and remove air flow meter from vehicle.
Gently pierce seal plug of air flow meter variable resistor. Remove and discard.
Install air flow meter on vehicle. Start engine and warm up engine until water temperature indicator points to the middle of gauge.
Adjust idle mixture ratio by turning variable resistor of air flow meter so that inspection lamps blink simultaneously.
Adjustable
Not adjustable
Replace air flow meter
Turn off engine and remove air flow meter from vehicle.
Insert new service seal plug (Red — Part No. 22681-J7125) into hole of variable resistor.
Install air flow meter on vehicle.
Connect throttle valve switch harness connector.



Releasing Fuel Pressure

Before disconnecting fuel line, release fuel pressure from fuel line to eliminate danger.

1. Start engine.
2. Remove luggage floor mat.
3. Disconnect fuel pump connector with engine running.
4. After engine stalls, crank engine two or three times to make sure that pressure is released.
5. Turn ignition switch off and connect fuel pump connector.

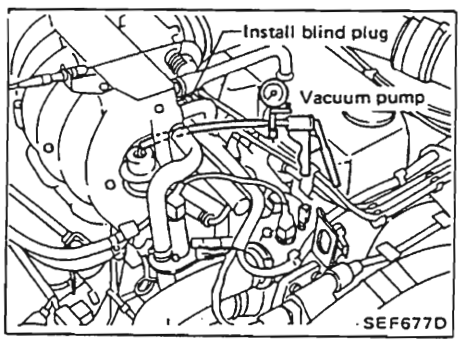


Fuel Pressure Check

a. When reconnecting fuel line, always use new clamps and be sure to position them correctly.
b. Use a torque driver to tighten clamps.
c. Use Pressure Gauge to check fuel pressure.

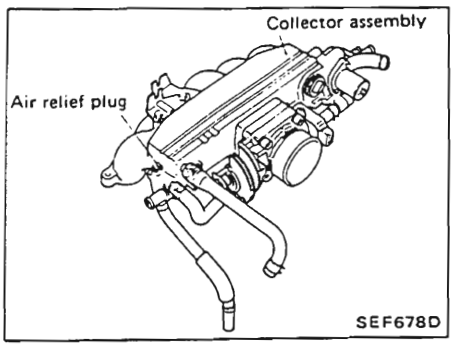
1. Release fuel pressure to zero.
2. Disconnect fuel hose between fuel filter and fuel tube (engine side).
3. Install pressure gauge between fuel filter and fuel tube.
4. Start engine and check for fuel leakage.
5. Read the indication of fuel pressure gauge.

At idling:
Approximately 206 kPa
(2.06 bar, 2.1 kg/cm^2, 30 psi)
The moment accelerator pedal is fully depressed:
Approximately 255 kPa
(2.55 bar, 2.6 kg/cm^2, 37 psi)



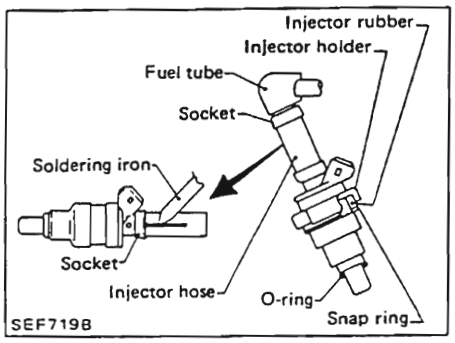
6. Stop engine and disconnect fuel pressure regulator vacuum hose from intake collector.
7. Plug intake collector with a rubber cap.
8. Connect a vacuum handy pump to fuel pressure regulator.
9. Start engine and read the indication of fuel pressure gauge as vacuum is changed.

Fuel pressure should decrease as vacuum increases. If results are unsatisfactory, replace fuel pressure regulator.



Injector Removal and Installation

1. Release fuel pressure to zero.
2. Remove air relief plug on intake collector and drain about 0.5 liter (7/8 Imp pt) of coolant.
3. Remove intake collector assembly.
4. Remove fuel tube and injectors as an assembly.



5. Remove fuel hose.

1) Heat soldering iron (150 watt) for 15 minutes. Cut hose into braided reinforcement from mark to socket end and fuel tube end.

Do not feed soldering iron until it touches injector tail piece.

2) Then pull rubber hose out with hand.

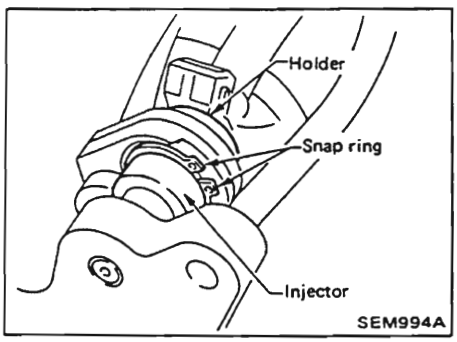
a. **Be careful not to damage socket plastic connector, etc. with soldering iron.**

b. **Never place injector in a vise when disconnecting rubber hose.**

6. Install fuel hose as follows:

1) Clean exterior of injector tail piece and fuel tube end.
2) Wet inside of new rubber hose with fuel.
3) Push end of rubber hose with hose sockets onto injector tail piece and fuel tube end by band as far as they will go.

Clamp is not necessary at the connections.



CAUTION:

- **When installing injector on intake manifold, do not allow holder to catch ends of snap ring.**
- **After properly connecting fuel hose to injector and fuel tube, check connection for fuel leakage.**

General Specifications

Fuel pump	
Cut-off discharge pressure kPa (bar, kg/cm², psi)	297 - 441 (2.97 - 4.41, 3.0 - 4.5, 43 - 64)
Pressure regulator	
Regulated pressure kPa (bar, kg/cm², psi)	250.1 (2.501, 2.55, 36.3)
Air regulator	
Air flow amount [at 20°C (68°F)] m³ (cu ft)/hr	14.5 (512)

Inspection and Adjustment

Fuel pressure	
At idle kPa (bar, kg/cm², psi)	Approximately 206 (2.06, 2.1, 30)
The moment accelerator pedal is fully depressed kPa (bar, kg/cm², psi)	Approximately 255 (2.55, 2.6, 37)
Air flow meter	
Voltage between terminals 3 and 2	1.6±0.5V
Water temperature sensor and fuel temperature sensor	
Thermistor resistance	
at –10°C (14°F)	7.0 - 11.4 kΩ
at 20°C (68°F)	2.1 - 2.9 kΩ
at 50°C (122°F)	0.68 - 1.0 kΩ
Throttle valve switch	
Engine speed when idle switch is turned from "ON" to "OFF"	950±50 rpm

Tightening Torque

Unit	N·m	kg-m	ft-lb
Throttle chamber securing bolt	18 - 22	1.8 - 2.2	13 - 16
Water temperature sensor	15 - 20	1.5 - 2.0	11 - 14
Fuel hose clamp	1.0 - 1.5	0.10 - 0.15	0.7 - 1.1

EMISSION CONTROL SYSTEM

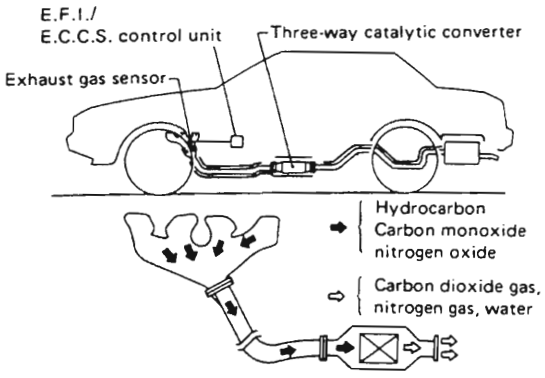
CONTENTS

CATALYTIC CONVERTER	EC-2
INTAKE MANIFOLD VACUUM CONTROL	EC-2
SPARK TIMING CONTROL SYSTEM	EC-3
CRANKCASE EMISSION CONTROL	EC-4
EVAPORATIVE EMISSION CONTROL	EC-5

EXHAUST EMISSION CONTROL SYSTEM

Catalytic Converter

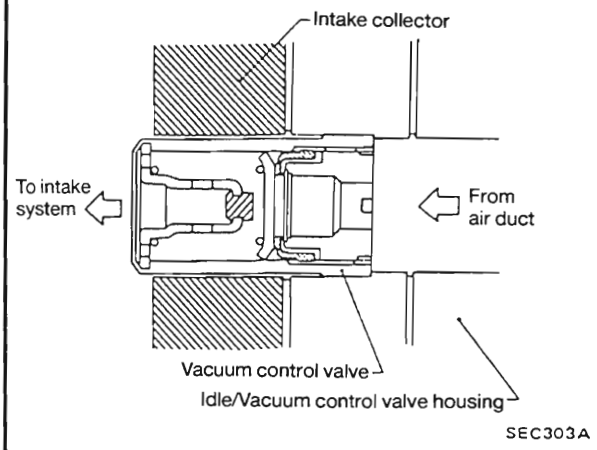
The exhaust gas contains unburned, harmful gases. While the mixture ratio is maintained to the stoichiometric point by the mixture ratio feedback system, the three-way catalytic converter activates to oxidize and reduce harmful gases (HC, CO and NOx) into harmless gases (CO_2, H_2O and N_2). In this way, the catalytic converter cleans the exhaust gas and emits CO_2, H_2O and N_2 into the atmosphere.



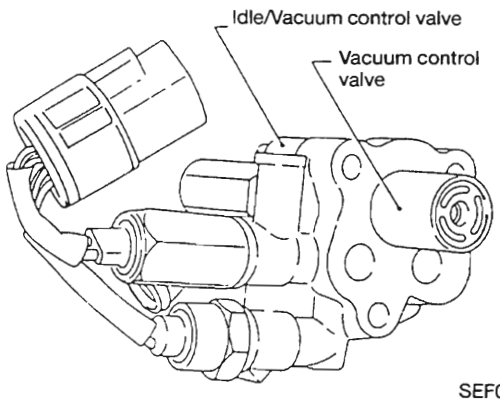
SEF034C

Intake Manifold Vacuum Control

Mounted in the idle/vacuum control valve assembly, the vacuum control valve reduces the possibility of engine lubricating oil entering the combustion chamber when manifold negative pressure is high during deceleration. When manifold negative pressure exceeds the preset value, the valve opens allowing atmospheric pressure to enter the intake manifold.



SEC303A



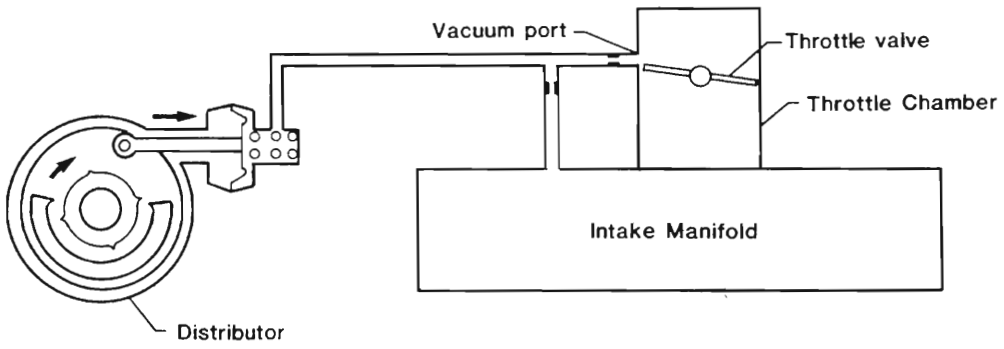
SEF033C

EXHAUST EMISSION CONTROL SYSTEM

Spark Timing Control System (CA20E engine)

DESCRIPTION

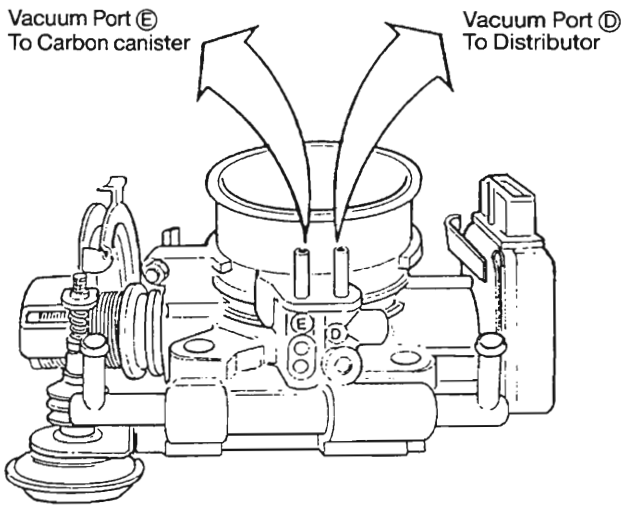
The spark timing control system controls the amount of vacuum advance under varying driving conditions. The proportion of manifold vacuum available to the distributor advance module is varied with respect to throttle position.



A EC-002

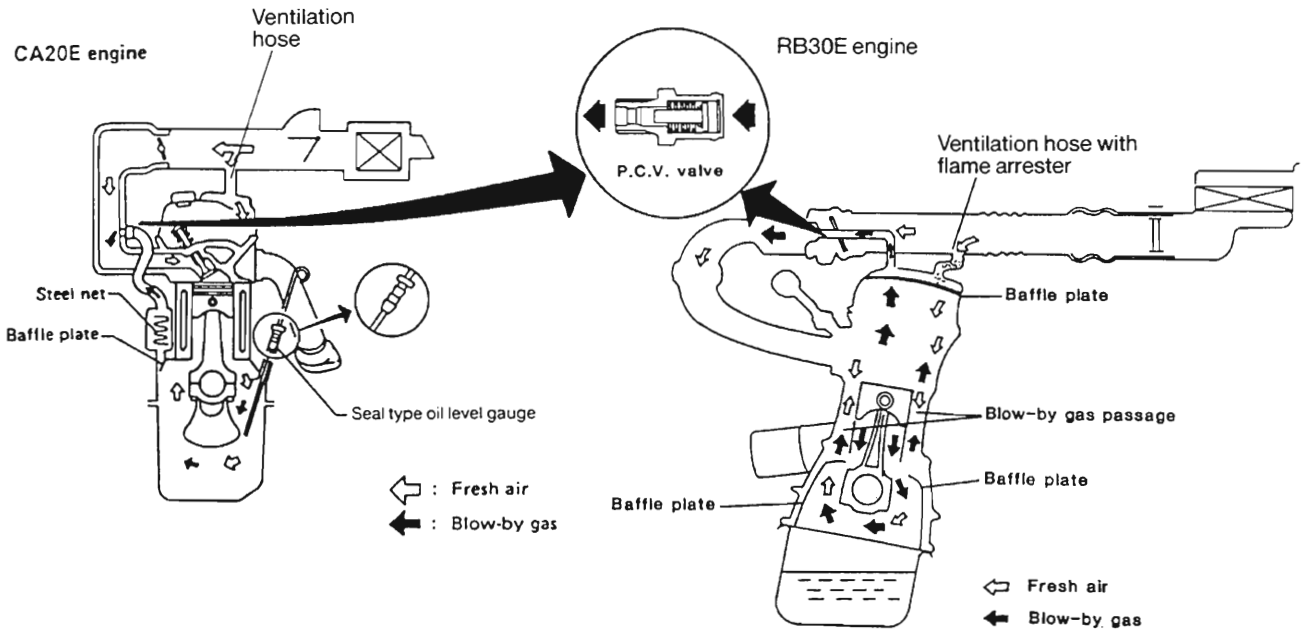
Throttle Chamber Vacuum Hose Connections (CA20E engine)

Check throttle chamber for correct connection of vacuum hoses.



View from underneath throttle chamber.

CRANKCASE EMISSION CONTROL SYSTEM

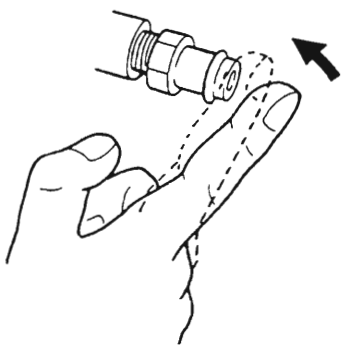


The positive crankcase ventilation (PCV) valve is provided to allow blow-by gas to flow to the intake manifold. Fresh air enters the crankcase via the ventilation hose.

Inspection

P.C.V. VALVE

With engine running at idle, remove ventilation hose from P.C.V. valve; if valve is working properly, a hissing noise will be heard as air passes through it and a strong vacuum should be felt immediately when a finger is placed over valve inlet.



SEC137A

VENTILATION HOSE

1. Check hoses and hose connections for leaks.
2. Disconnect all hoses and clean with compressed air. If any hose cannot be freed of obstructions, replace.

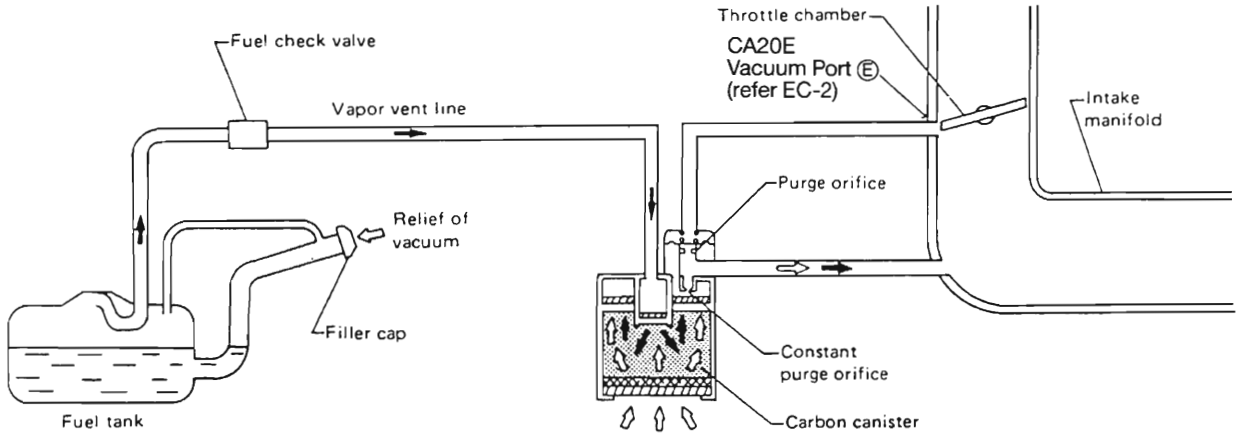
EVAPORATIVE EMISSION CONTROL SYSTEM

Operation

The fuel vapor from the sealed fuel tank is led into the canister which contains activated carbon and the vapor is stored there when the engine is not running.

The canister retains the fuel vapor until the canister is purged by the air drawn through the purge line to the intake manifold when the engine is running. When the engine runs at idle, the purge control valve is closed.

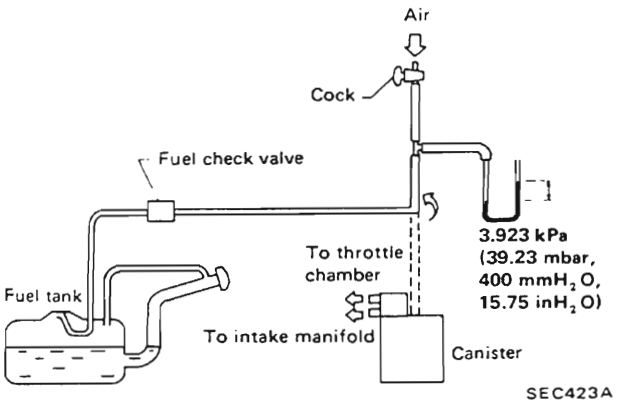
Only a small amount of purge air flows into the intake manifold through the constant purge orifice. As the engine speed increases, and the throttle vacuum rises higher, the purge control valve opens and the vapor is sucked into the intake manifold through both the fixed orifice and the constant purge orifice.



SEC422A

Inspection

VAPOR VENT LINE



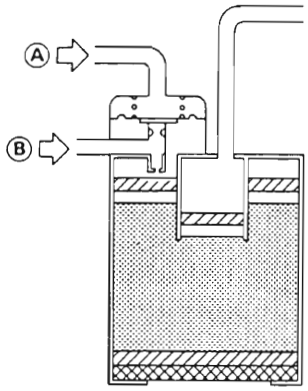
SEC423A

1. Check hoses and fuel tank filler cap.
2. Disconnect the vapor vent line connecting carbon canister to fuel tank.
3. Connect a 3-way connector, a manometer and a cock (or an equivalent 3-way charge cock) to the end of the vent line.
4. Supply fresh air into the vapor vent line through the cock little by little until pressure becomes 3.923 kPa (39.23 mbar, 400 mmH_2O, 15.75 inH_2O).
5. Shut the cock completely and leave it unattended.
6. After 2.5 minutes, measure the height of the liquid in the manometer.
7. Variation in height should remain at 0.245 kPa (2.45 mbar, 25 mmH_2O, 0.98 inH_2O).
8. When filler cap does not close completely, the height should drop to zero in a short time.
9. If the height does not drop to zero in a short time when filler cap is removed, the cause is a restricted or blocked vapor vent line.

Inspection (Cont'd)

CARBON CANISTER

Check carbon canister as follows:



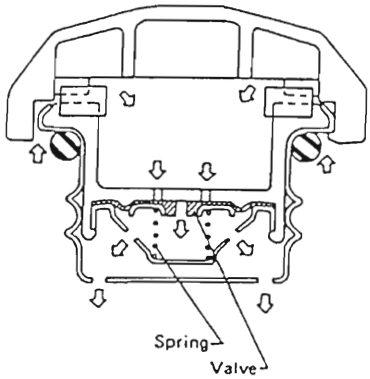
1. With a vacuum pump connected to connection Ⓐ apply a negative pressure and ensure there is no leakage.
2. With a vacuum pump connected to connection Ⓑ apply a negative pressure and ensure there is no blockage.

If malfunctioning, replace faulty part.

FUEL TANK VACUUM RELIEF VALVE

Check the valve for flow resistance with a radiator cap tester or the like.

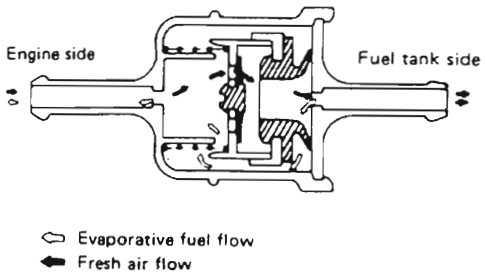
Air flow direction	Air flow quantity	Air flow
To outside	Any	No
To inside	Large	
	Small	Yes



SEC308A

FUEL CHECK VALVE

1. Apply low pressure air through connector on fuel tank side.
   Considerable resistance should be felt and some air should flow through the valve.
2. Apply low pressure air through connector on engine side. Air flow should be smoothly directed toward the fuel tank side.
3. If fuel check valve does not function properly in steps 1 and 2, replace.

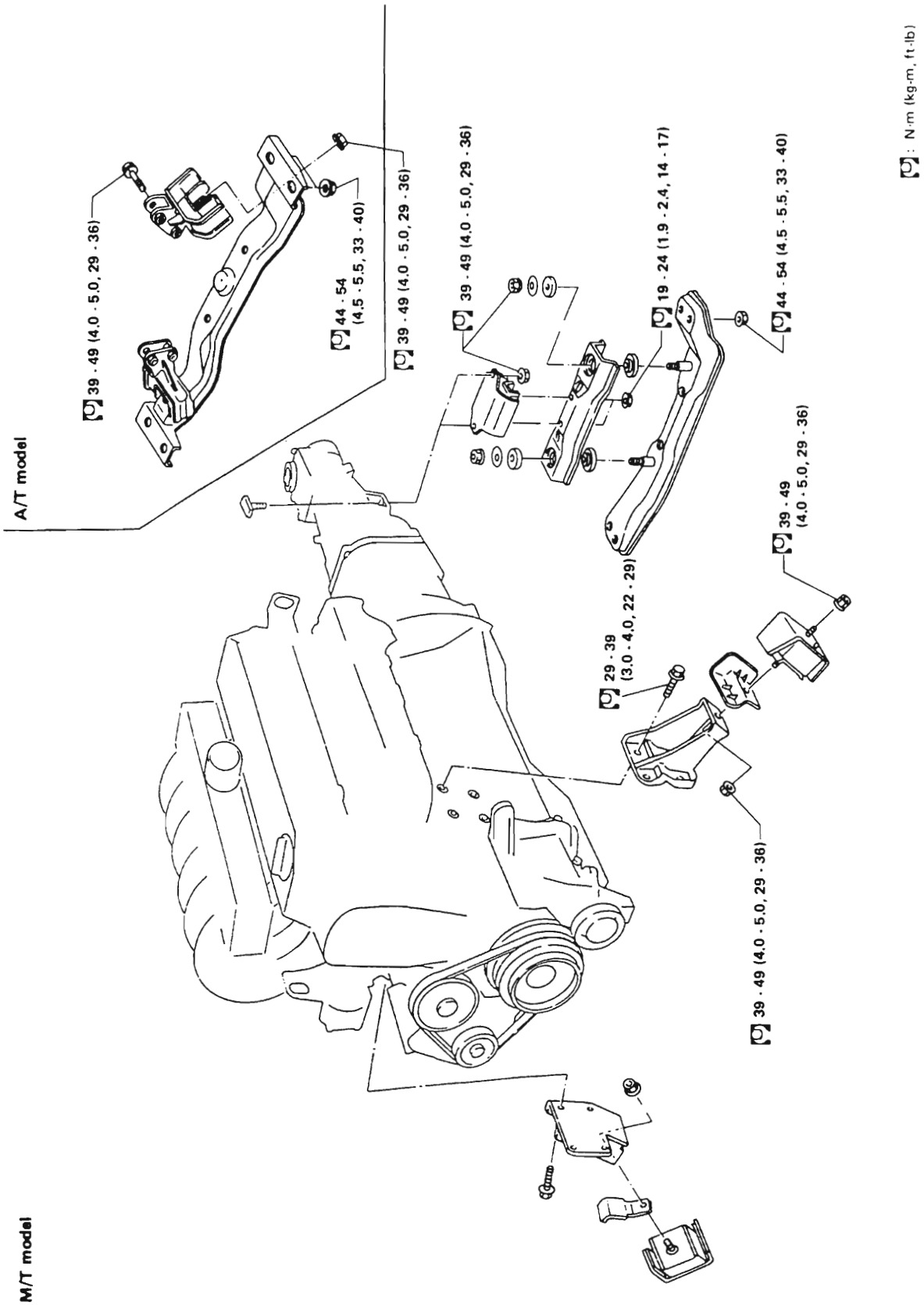


EC090A

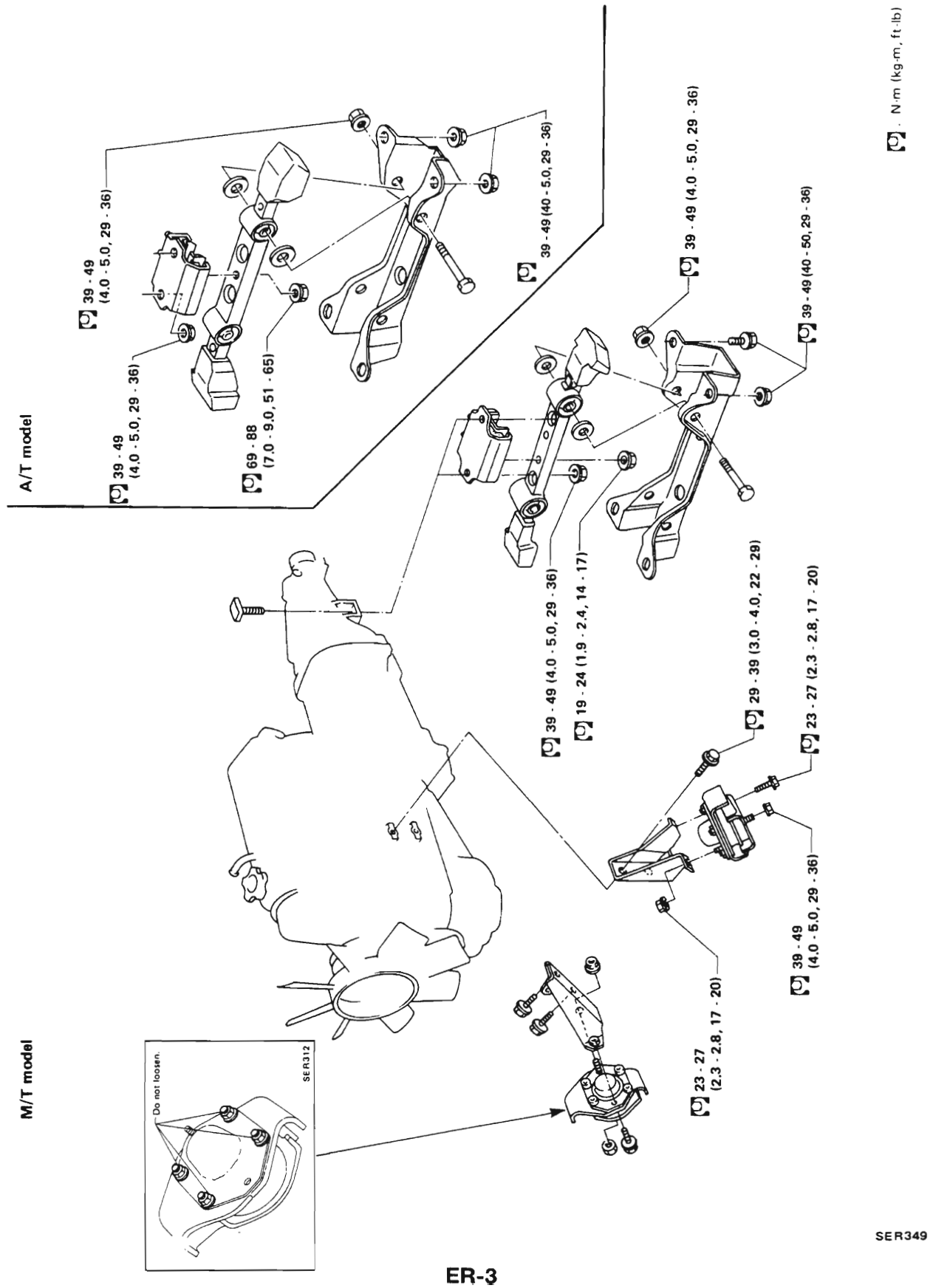
ENGINE REMOVAL & INSTALLATION

CONTENTS

ENGINE REMOVAL — RB30E ER-2
ENGINE REMOVAL — CA20E ER-3


A/T model
M/T model
39 - 49 (4.0 - 5.0, 29 - 36)
44 - 54 (4.5 - 5.5, 33 - 40)
39 - 49 (4.0 - 5.0, 29 - 36)
39 - 49 (4.0 - 5.0, 29 - 36)
19 - 24 (1.9 - 2.4, 14 - 17)
44 - 54 (4.5 - 5.5, 33 - 40)
39 - 49 (4.0 - 5.0, 29 - 36)
29 - 39 (3.0 - 4.0, 22 - 29)
39 - 49 (4.0 - 5.0, 29 - 36)
: N·m (kg-m, ft-lb)

SEM017B


A/T model
39 - 49 (4.0 - 5.0, 29 - 36)
39 - 49 (4.0 - 5.0, 29 - 36)
69 - 88 (7.0 - 9.0, 51 - 65)
39 - 49 (40 - 50, 29 - 36)
39 - 49 (4.0 - 5.0, 29 - 36)
39 - 49 (4.0 - 5.0, 29 - 36)
39 - 49 (40 - 50, 29 - 36)
19 - 24 (1.9 - 2.4, 14 - 17)
29 - 39 (3.0 - 4.0, 22 - 29)
23 - 27 (2.3 - 2.8, 17 - 20)
39 - 49 (4.0 - 5.0, 29 - 36)
23 - 27 (2.3 - 2.8, 17 - 20)
M/T model
Do not loosen.
SER312
: N·m (kg-m, ft-lb)
SER349

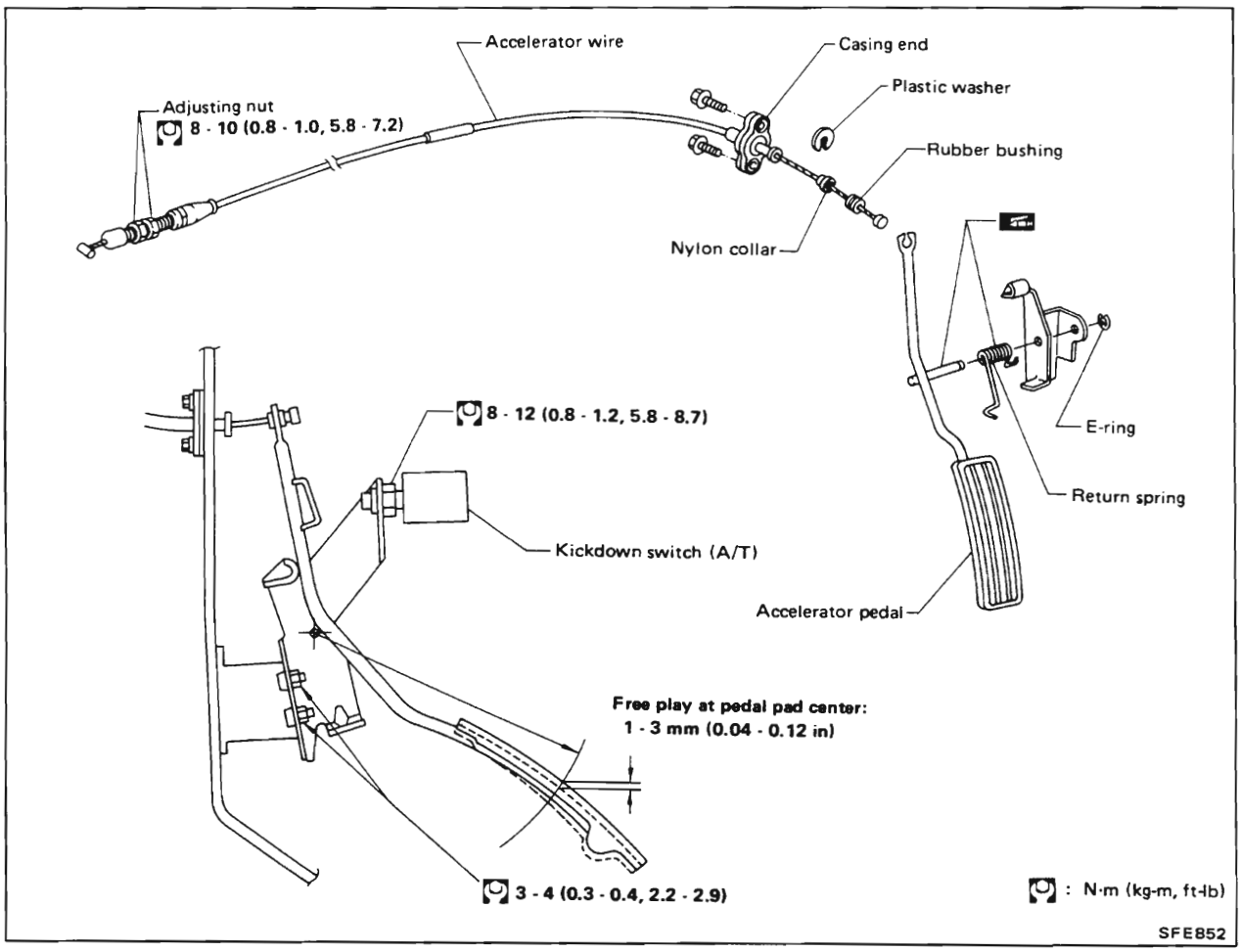
ENGINE CONTROL, FUEL & EXHAUST SYSTEMS

CONTENTS

ENGINE CONTROL SYSTEM FE-2
FUEL SYSTEM FE-3
EXHAUST SYSTEM FE-4

Accelerator Control System

a. Check to see if throttle valve fully opens when accelerator pedal is fully depressed and if it returns to idle when released.
b. Adjust accelerator pedal free play by turning adjusting nut.
c. On automatic transmission models, make sure kickdown switch rod is fully pushed in when accelerator pedal is depressed completely.
d. Check accelerator control parts for improper contact with any adjacent parts.
e. When connecting accelerator wire, be careful not to twist or scratch its inner wire.
f. Apply a light coat of recommended multi-purpose grease to all sliding or friction surfaces. Do not apply grease to wire.



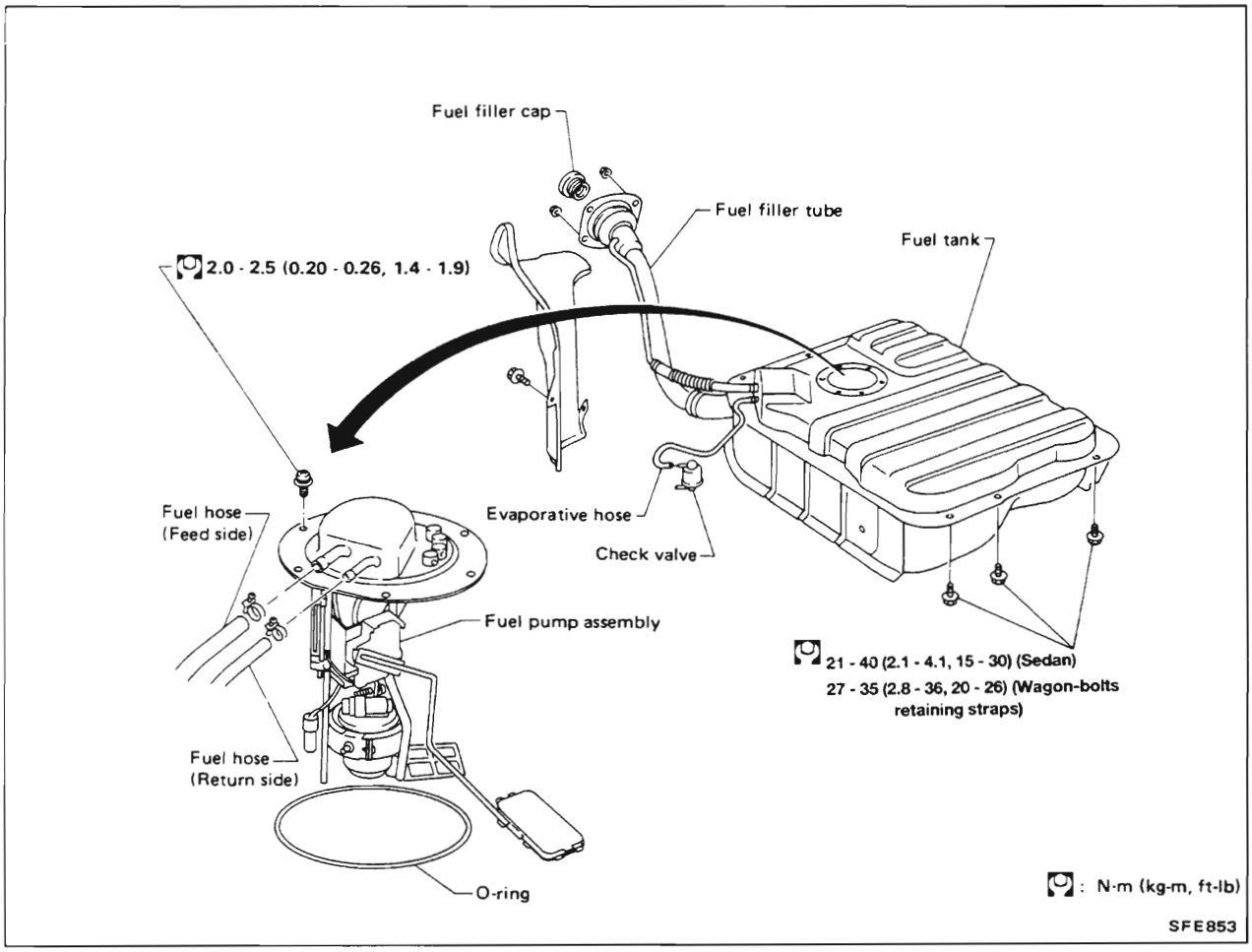
WARNING:

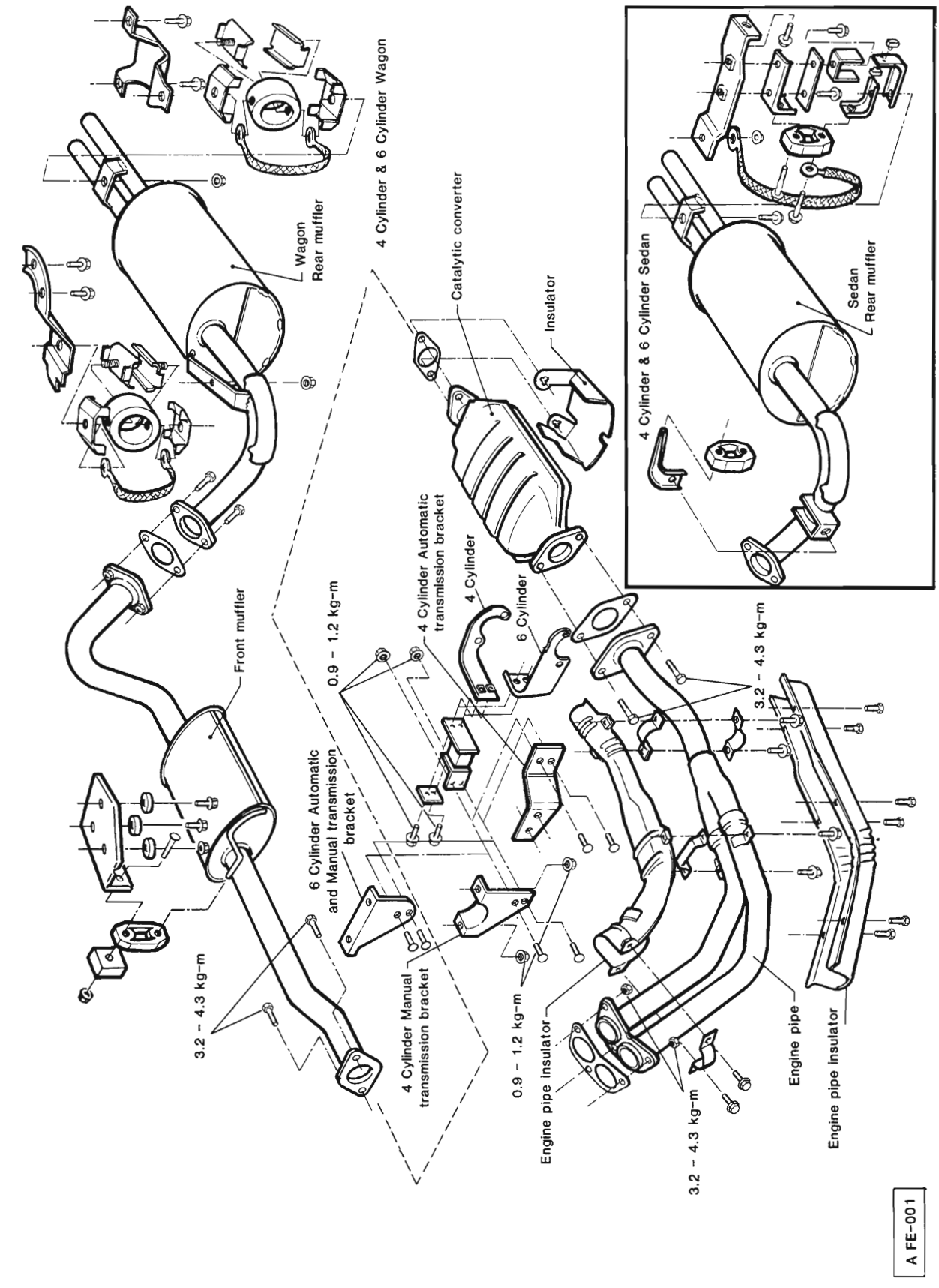
When replacing fuel line parts, be sure to observe the following:

a. Put a "CAUTION: INFLAMMABLE" sign in workshop.
b. Be sure to furnish the workshop with a CO_2 fire extinguisher.
c. Be sure to disconnect battery ground cable before conducting operations.
d. Put drained fuel in an explosion-proof container and put lid on securely.

CAUTION:

a. Do not disconnect any fuel line unless absolutely necessary.
b. Plug hose and pipe openings to prevent entry of dust or dirt.
c. Always replace O-ring and clamps with new ones.
d. Do not kink or twist hose and tube when they are installed.
e. Do not tighten hose clamps excessively to avoid damaging hoses.
f. When installing fuel check valve, be careful of its designated direction (Refer to section EC).
g. Run the engine and check for leaks at connections.

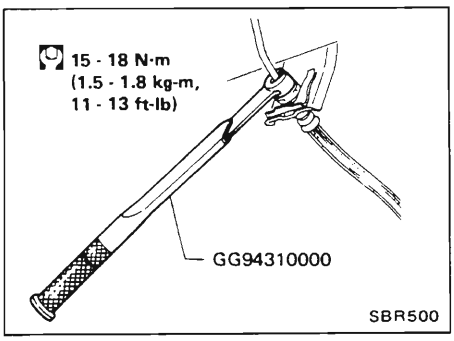



4 Cylinder & 6 Cylinder Wagon
Wagon
Rear muffler
Front muffler
3.2 – 4.3 kg-m
6 Cylinder Automatic
and Manual transmission
bracket
0.9 – 1.2 kg-m
4 Cylinder Automatic
transmission bracket
4 Cylinder
6 Cylinder
Catalytic converter
Insulator
4 Cylinder Manual
transmission bracket
0.9 – 1.2 kg-m
Engine pipe insulator
3.2 – 4.3 kg-m
3.2 – 4.3 kg-m
Engine pipe
Engine pipe insulator
4 Cylinder & 6 Cylinder Sedan
Sedan
Rear muffler
A FE-001

CLUTCH

CONTENTS

PRECAUTION CL-2
PREPARATION CL-3
CLUTCH SYSTEM CL-4
INSPECTION AND ADJUSTMENT CL-5
HYDRAULIC CLUTCH CONTROL CL-6
CLUTCH RELEASE MECHANISM CL-9
CLUTCH DISC AND CLUTCH COVER CL-11
SERVICE DATA AND SPECIFICATIONS CL-13



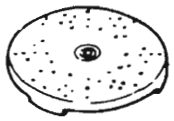
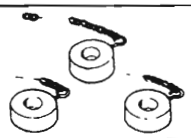
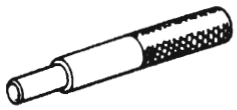
- **Recommended fluid is brake fluid is as specified on brake master cylinder.**
- Do not reuse drained brake fluid.
- Be careful not to splash brake fluid on painted areas.
- When removing and installing clutch piping, use Tool.
- To clean or wash all parts of master cylinder, operating cylinder and clutch damper, use clean brake fluid.
- Never use mineral oils such as gasoline or kerosene. It will ruin the rubber parts of the hydraulic system.

WARNING:

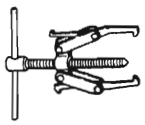
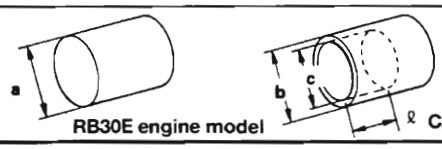
Remove all dust from clutch disc with a dust collector after cleaning with waste cloth.

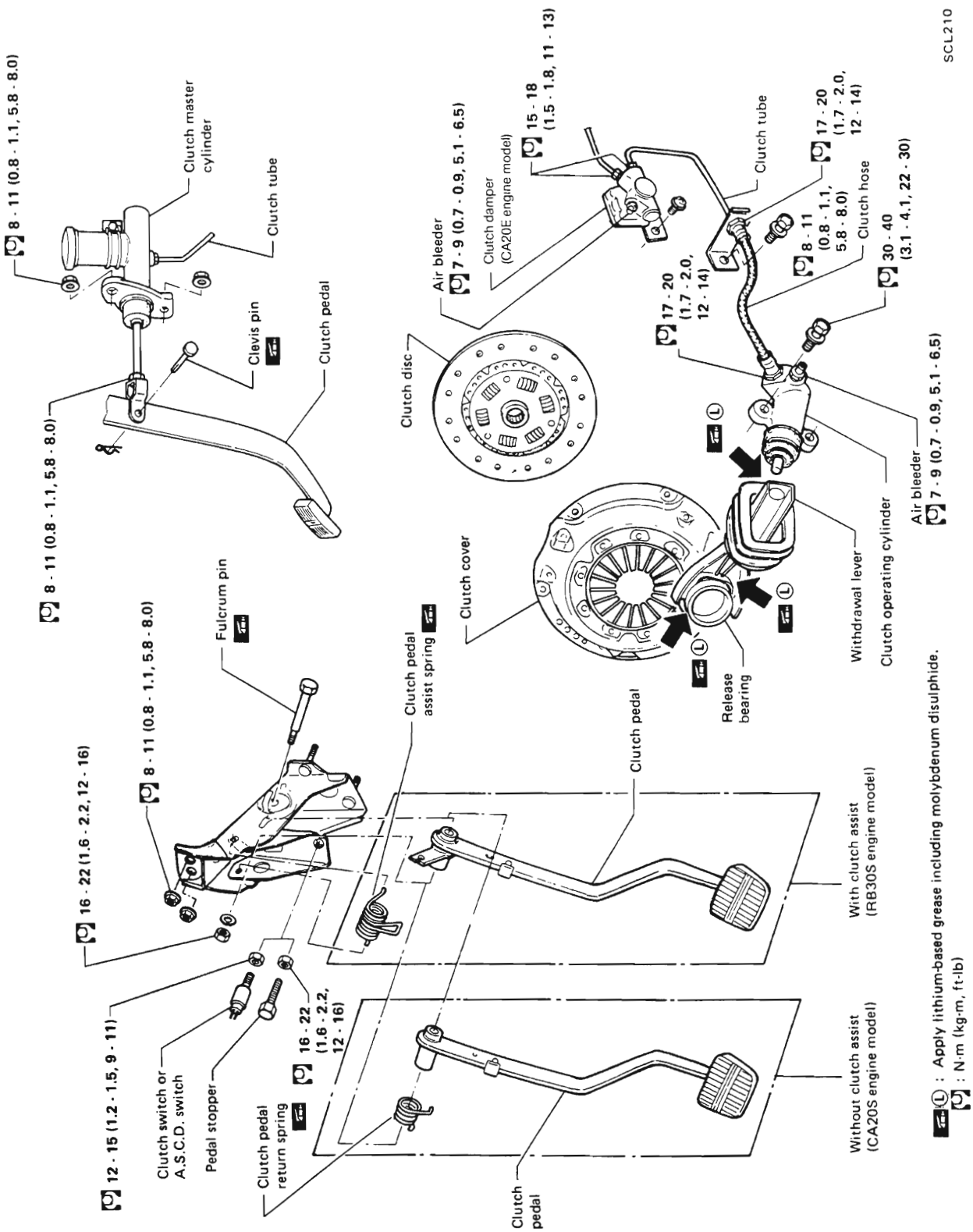
SPECIAL SERVICE TOOLS

*: Special tools or commercial equivalent

Tool number Tool name	Description	
ST20050010 Base plate		Inspecting diaphragm spring of clutch cover
ST20050100 Distance piece		
GG94310000 Flare nut torque wrench		Removing and installing each clutch piping
ST20600000* (KV30100100) Clutch aligning bar		Installing clutch cover and clutch disc
ST20050240* Diaphragm spring adjusting wrench		Adjusting unevenness of diaphragm spring of clutch cover

COMMERCIAL SERVICE TOOLS

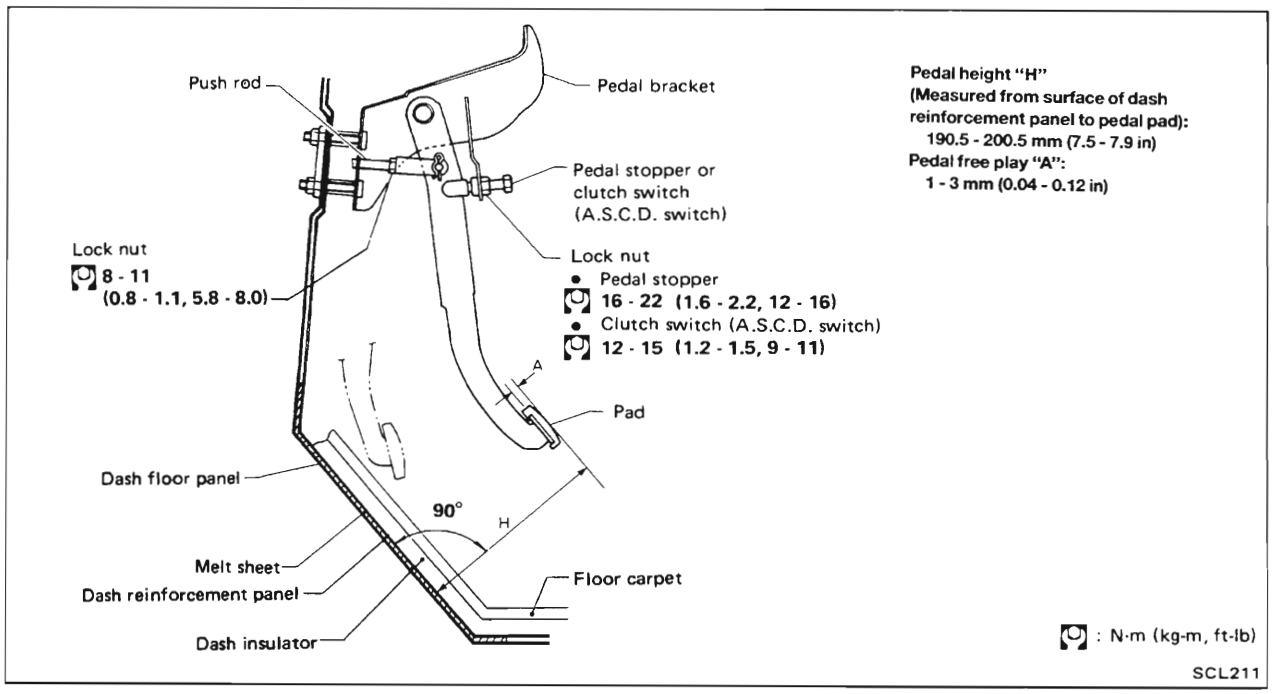
Tool name	Description	
Puller		Removing relase bearing
Drift		Installing release bearing **a = 50 (1.97) dia.** **b = 51.5 (2.028) dia.** **c = 44 (1.73) dia.** **ℓ = 20 (0.79)** Unit: mm (in)

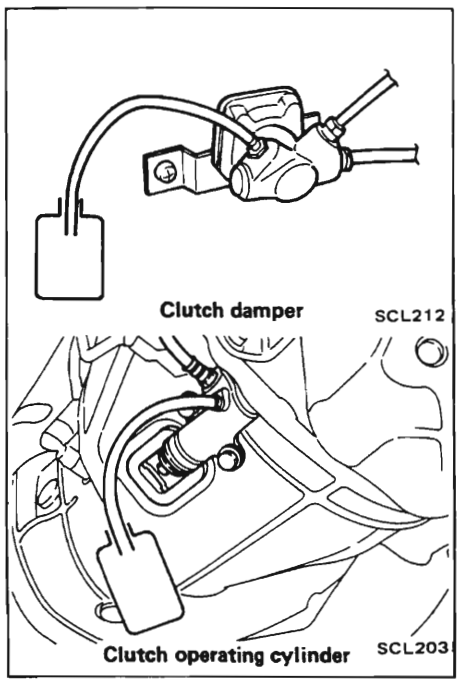


Ⓛ : Apply lithium-based grease including molybdenum disulphide.
: N·m (kg-m, ft-lb)

Adjusting Clutch Pedal

1. Adjust pedal height with pedal stopper or clutch switch.
2. Adjust pedal free play with push rod.





Bleeding Procedure

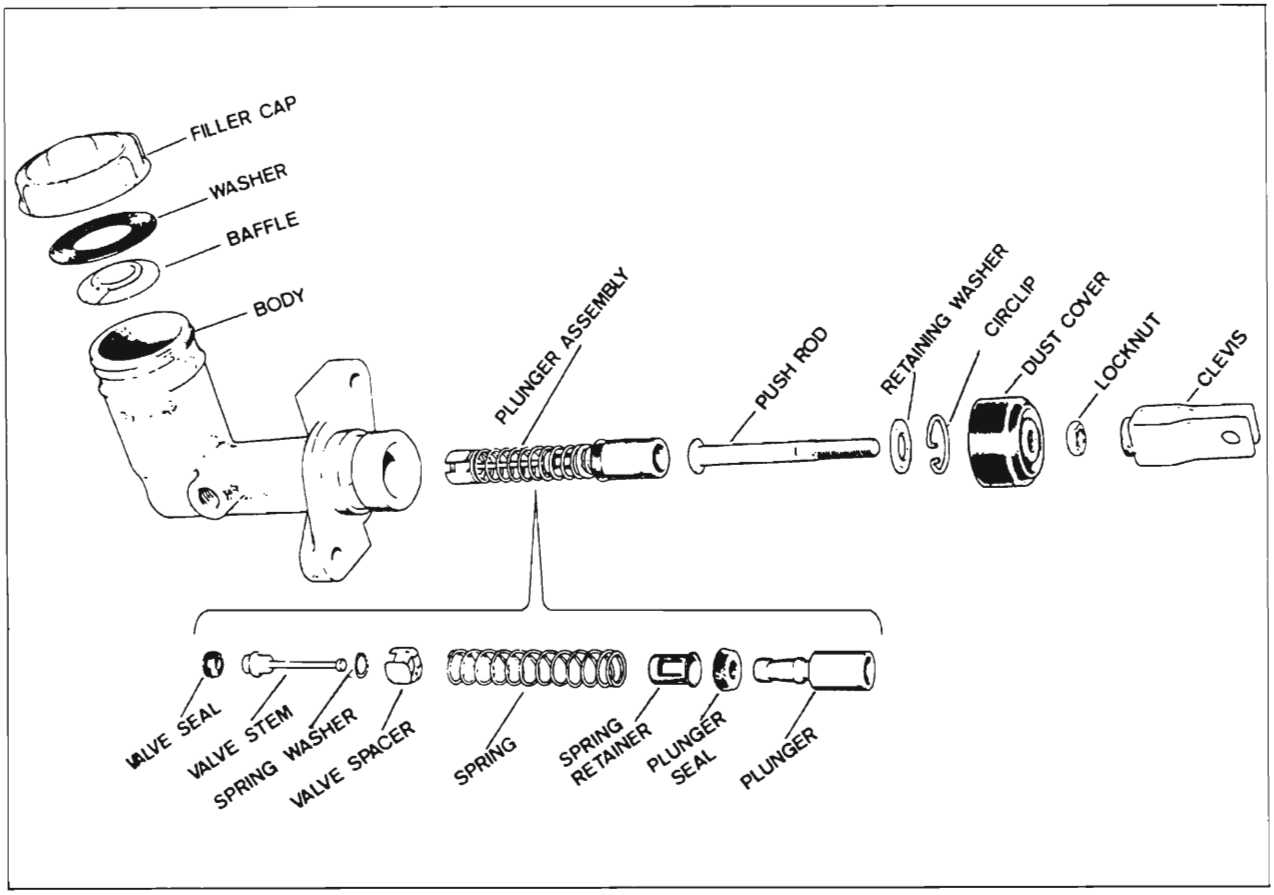
Bleed air according to the following procedure (models equipped with clutch damper)

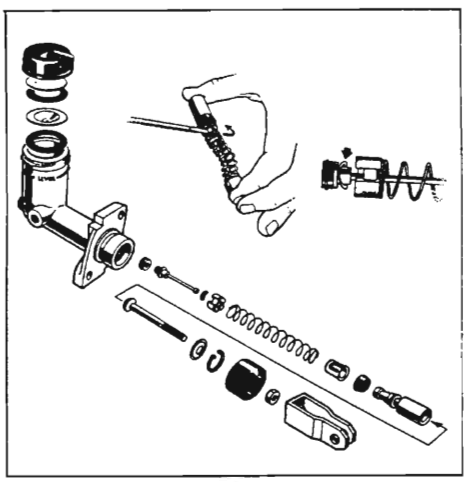
Clutch damper → Clutch operating cylinder

- **Carefully monitor fluid level at master cylinder during bleeding operation.**

1. Top up reservoir with recommended brake fluid.
2. Connect a transparent vinyl tube to air bleeder valve.
3. Fully depress clutch pedal several times.
4. With clutch pedal depressed, open bleeder valve to release air.
5. Close bleeder valve.
6. Repeat steps 3 through 5 above until brake fluid comes out of air bleeder valve without air bubbles.

Clutch Master Cylinder





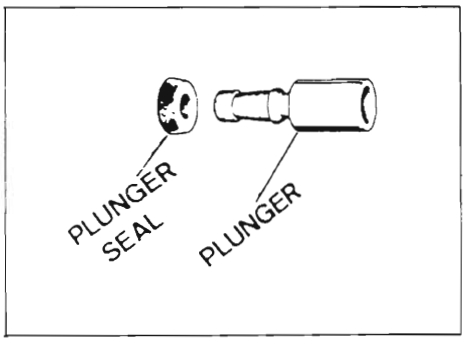
DISASSEMBLY

1. Lift rubber dust cover off cylinder end and remove circlip.
2. Remove plunger assembly by shaking assembly out of cylinder or by applying a short blast of compressed air through the fluid outlet.
3. Lift the leaf of the spring retainer and remove the spring assembly from the plunger. Compress the spring to remove the valve stem from the keyhole of the spring retainer, thus releasing the tension of the spring.
4. Remove the spring, valve spacer and spring washer from the valve stem.
5. Remove the valve seal from the valve head.

Clutch Master Cylinder (Cont'd)

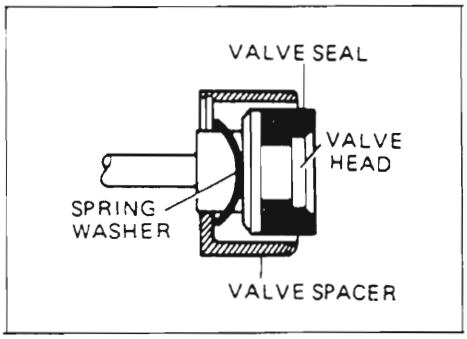
INSPECTION

1. Check fit and appearance of seals. If loose on plunger or appear oversize, they are possibly contaminated. Discard them.
2. Clean all parts with clean brake fluid or methylated spirits.
3. Examine plunger and bore surfaces for scores, ridges, and corrosion. If any doubt exists regarding condition of parts, discard and fit new components.

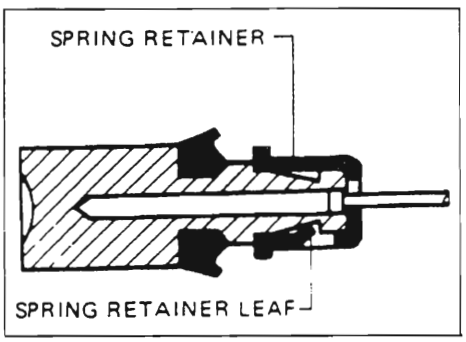


REASSEMBLY

1. Lubricate all parts with clean unused brake fluid.
2. Fit plunger seal to plunger — lip towards tapered end.



3. Install valve seal, smallest diameter leading, on to valve stem head.
4. Position spring washer on valve stem so that it cups away from the valve stem shoulder. Follow with valve spacer — legs first — and spring.



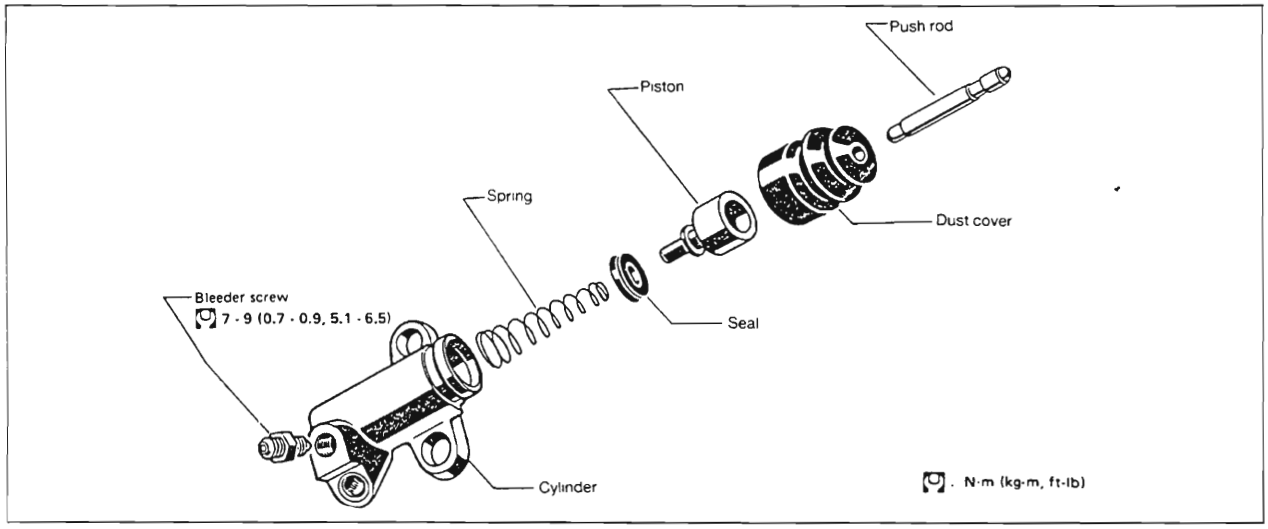
5. Fit the spring retainer to the spring, compress the spring until the valve stem passes through the keyhole in the spring retainer and engages in its centre. Fit the spring sub-assembly immediately to the plunger and push the leaf of the retainer home to lock in position.
6. Ensure that cylinder and plunger are adequately lubricated with clean unused brake fluid and insert the plunger assembly into the cylinder, being careful to ease the seal lip into the bore.
7. Position the push rod and retaining washer, press down into housing and lock in place with circlip. Smear sealing areas of rubber dust cover with rubber grease and instal on cylinder body. Refit clevis to push rod.

CAUTION — To prevent any foreign matter entering the cylinder when unit is being refitted, temporarily replace reservoir cap and cover any openings. When push rod is connected to pedal it is important that there is a clearance of 0.8 mm (1/32") approximately between push rod and plunger in fully released position.

Operating Cylinder

INSPECTION

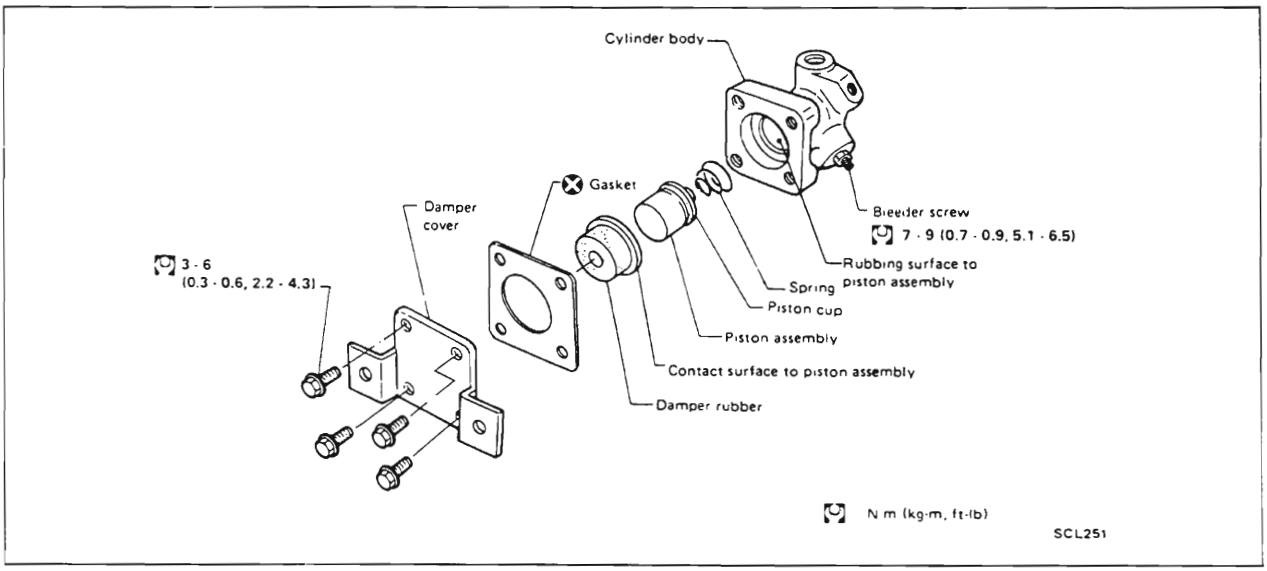
- Check rubbing surface of cylinder for wear, rust or damage. Replace if necessary.
- Check piston with piston cup for wear or damage. Replace if necessary.
- Check piston spring for wear or damage. Replace if necessary.
- Check dust cover for cracks, deformation or damage. Replace if necessary.

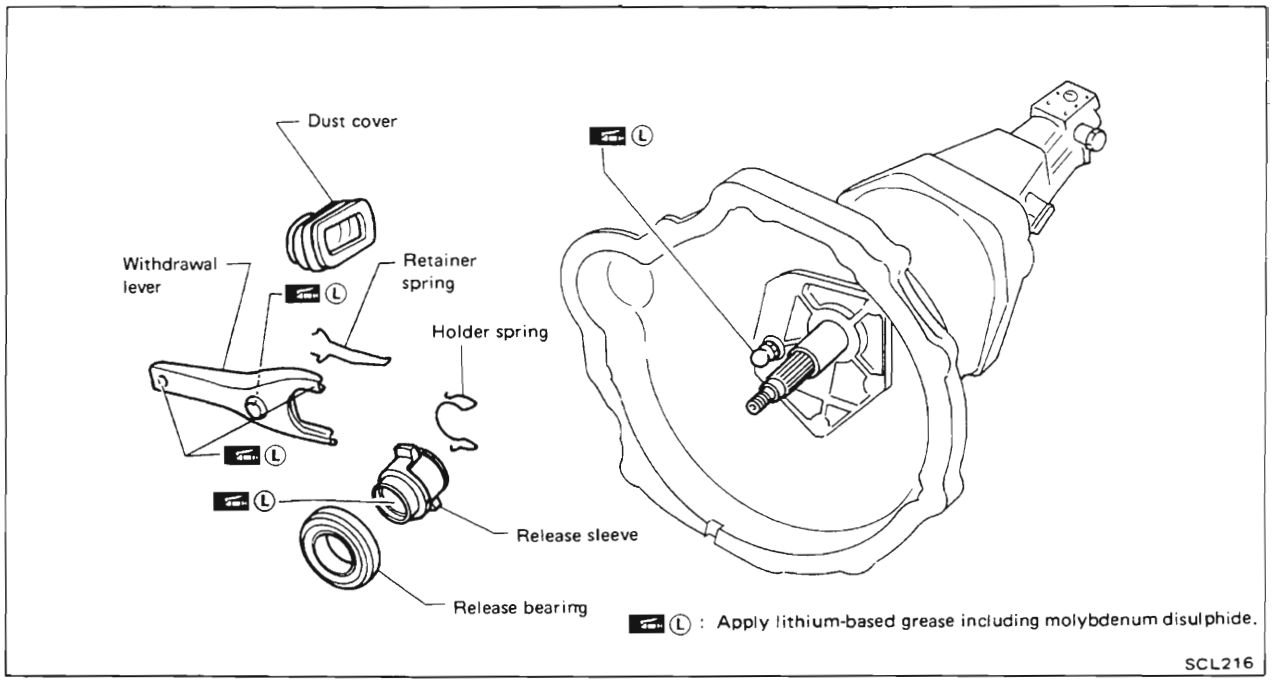


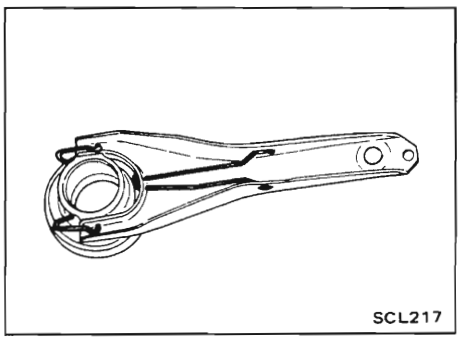
Clutch Damper — CA20E

INSPECTION

- Check cylinder and piston rubbing surface for uneven wear, rust or damage. Replace if necessary.
- Check damper rubber and piston cup for cracks, deformation or damage. Replace if necessary.

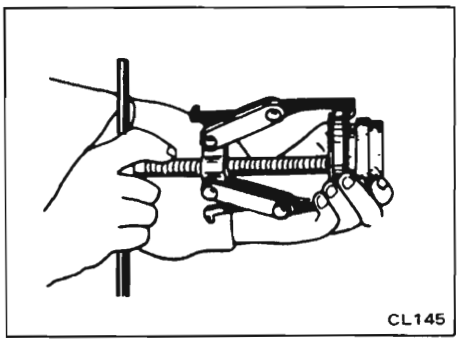




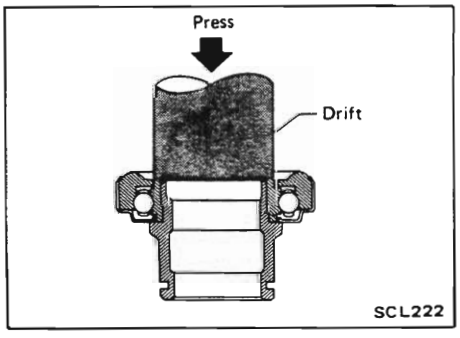


REMOVAL AND INSTALLATION

- Install retainer spring and holder spring.

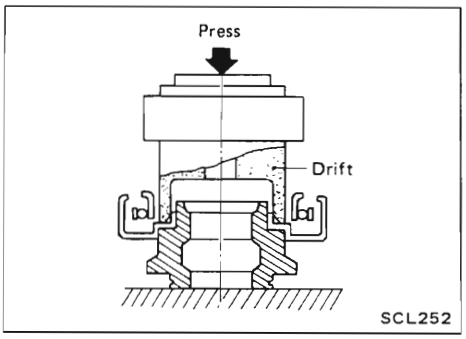


- Remove release bearing.



- Install release bearing with suitable drift.

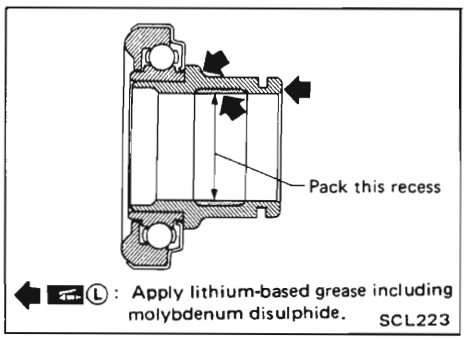
— RB30E engine model —



— CA20E engine model —

INSPECTION

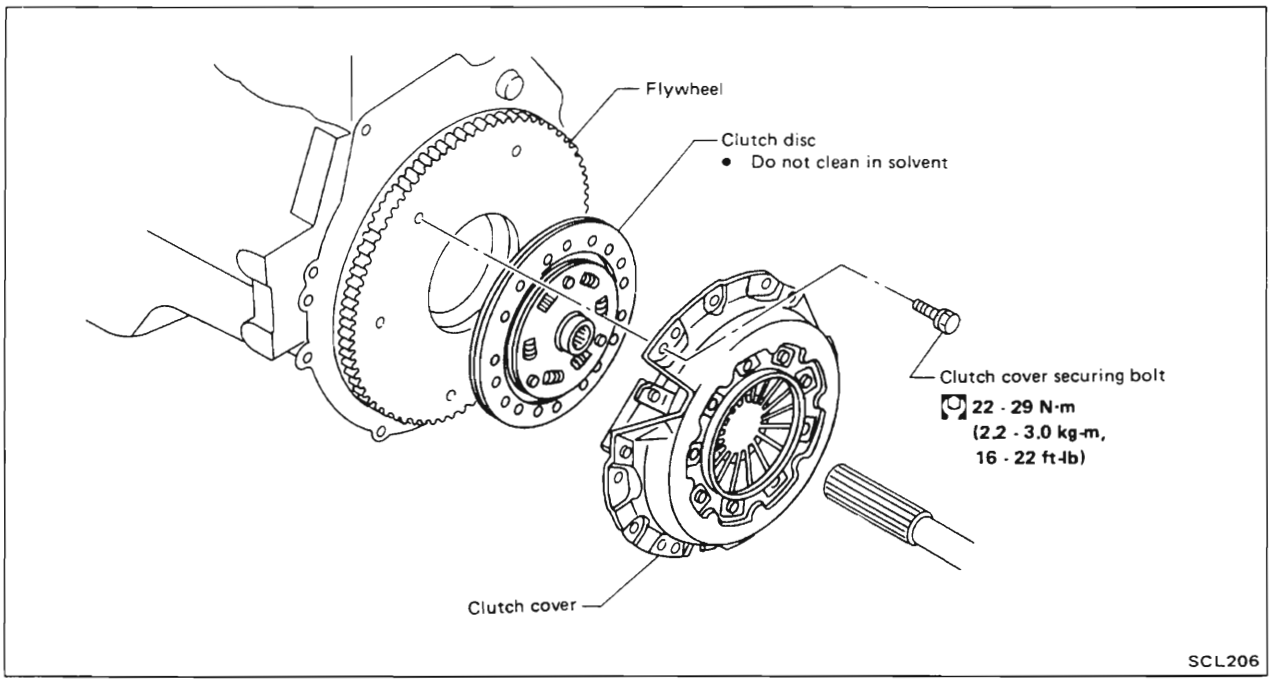
- Check release bearing to see that it rolls freely and is free from noise, crack, pitting or wear. Replace if necessary.
- Check release sleeve and withdrawal lever rubbing surface for wear, rust or damage. Replace if necessary.

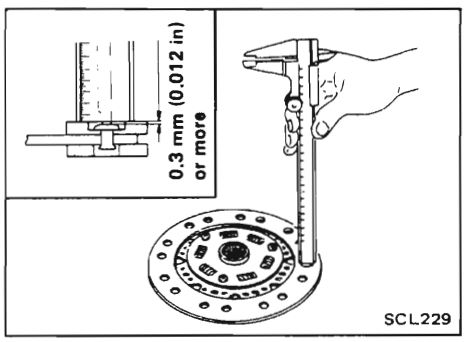


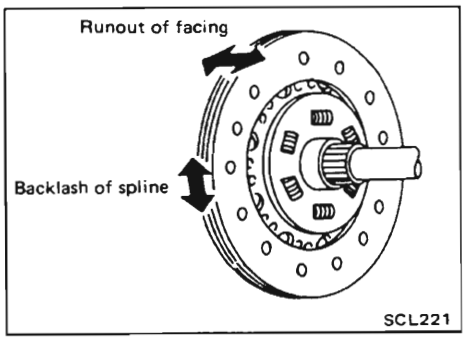
LUBRICATION

- Apply recommended grease to contact surface and rubbing surface.

Too much lubricant might cause clutch disc facing damage.







Clutch Disc and Flywheel

INSPECTION

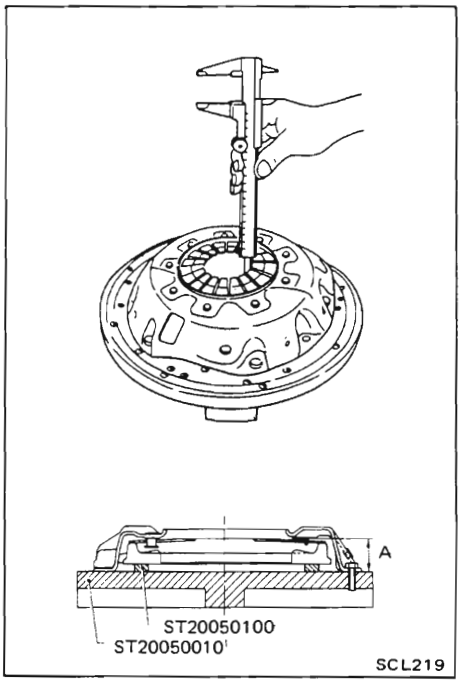
Check clutch disc for wear of facing.

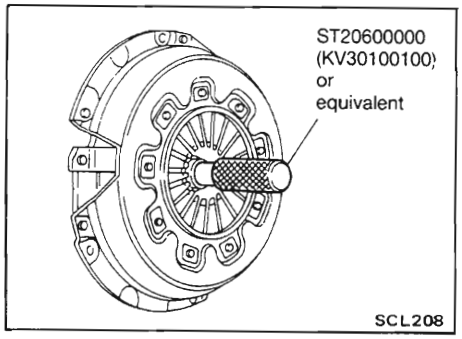
Wear limit of facing surface to rivet head:
0.3 mm (0.012 in)

- Check clutch disc for backlash of spline and runout of facing.

  Maximum backlash of spline (at outer edge of disc):
  225DS: 0.4 mm (0.016 in)
  240TBL: 1.0 mm (0.039 in)
  Runout limit:
  0.5 mm (0.020 in)
  Distance of runout check point (from hub center)
  225DS: 107.5 mm (4.23 in)
  240TBL: 115 mm (4.53 in)

- Check clutch disc for burns, discoloration or oil or grease leakage. Replace if necessary.
- Check contact surface of flywheel for slight burns or discoloration.
  Repair flywheel with emery paper.





Clutch Cover

INSPECTION

- Check unevenness of diaphragm spring.

  Uneven limit: (at throw out bearing diameter)
  0.5 mm (0.020 in)

- Set Tool and check height and unevenness of diaphragm spring.

Set 0.2 mm (0.008 in) feeler gauges on distance pieces (ST20050100) when checking C240S.

Diaphragm spring height "A":
225DS: 35 - 37 mm (1.38 - 1.46 in)
C240S: 37.5 - 39.5 mm (1.476 - 1.555 in)

- Check pivot rings for wear or damage by shaking cover assembly up and down to listen for chattering noise, or lightly hammering on rivets for a slight cracking noise. Replace clutch cover assembly if necessary.
- Check pressure plate and clutch disc contact surface for slight burns or discoloration. Repair pressure plate with emery paper.
- Check pressure plate and clutch disc contact surface for deformation or damage. Replace if necessary.

INSTALLATION

- Insert Tool into clutch disc hub when installing clutch cover and disc.

General Specifications

CLUTCH MASTER CYLINDER

Inner diameter	mm (in)	15.87 (5/8)

CLUTCH OPERATING CYLINDER

Inner diameter	mm (in)	19.05 (3/4)

CLUTCH DAMPER

Inner diameter	mm (in)	19.05 (3/4)

CLUTCH DISC

Model	225DS	240TBL
Engine	CA20E	RB30E
Facing size mm (in) (Outer dia. x Inner dia. x thickness)	225 × 156 × 3.6 (8.86 × 5.91 × 0.138) × 6.14 × 0.142	240 x 160 x 3.5 (9.45 x 6.30 x 0.138
Thickness of disc assembly With load mm (in)	7.6 - 8.0 (0.299 - 0.31 5) with 4,510 N (460 kg, 1,017 lb)	7.9 - 8.3 (0.311 - 0.327) with 5,884 N (600 kg, 1,323 lb)

CLUTCH COVER

Model	225DS	C240S
Engine	CA20E	RB30E
Full load N (kg, lb)	4,510 (460, 1,017)	4,904 (500, 1,103)

Inspection and Adjustment

CLUTCH PEDAL

mm (in)

Pedal height "H*"	190.5 - 200.5 (7.5 - 7.9)
Pedal free play	1 - 3 (0.04 - 0.12)

*: Measured from surface of dash reinforcement panel to pedal pad

CLUTCH DISC

mm (in)

Model	225DS	240TBL
Wear limit of facing surface to rivet head	0.3 (0.012)	
Runout limit of facing	1.0 (0.039)	
Distance of runout check point (from the hub center)	107.5 (4.23)	115 (4.53)
Maximum backlash of spline (at outer edge of disc)	0.4 (0.016)	1.0 (0.039)

CLUTCH COVER

mm (in)

Model	225DS	C240S
Diaphragm spring height	35 - 37 (1.38 - 1.46)	37.5 - 39.5 (1.476 - 1.555)
Uneven limit of diaphragm spring toe height	0.5 (0.020)	

Tightening Torque

Unit	N·m	kg-m	ft-lb
Pedal stopper lock nut	16 - 22	1.6 - 2.2	12 - 16
Clutch switch lock nut	12 - 15	1.2 - 1.5	9 - 11
Fulcrum pin securing nut	16 - 22	1.6 - 2.2	12 - 16
Clutch pedal bracket securing nut	8 - 11	0.8 - 1.1	5.8 - 8.0
Master cylinder push rod lock nut	8 - 11	0.8 - 1.1	5.8 - 8.0
Master cylinder securing nut	8 - 11	0.8 - 1.1	5.8 - 8.0
Valve stopper	2.5 - 3.9	0.25 - 0.4	1.8 - 2.9
Reservoir band	2.5 - 3.9	0.25 - 0.4	1.8 - 2.9
Operating cylinder securing nut	30 - 40	3.1 - 4.1	22 - 30
Clutch tube flare nut	15 - 18	1.5 - 1.8	11 - 13
Bleeder screw	7 - 9	0.7 - 0.9	5.1 - 6.5
Clutch hose to operating cylinder or clutch tube	17 - 20	1.7 - 2.0	12 - 14
Clutch hose cramp to body	8 - 11	0.8 - 1.1	5.8 - 8.0
Damper cover to cylinder body	3 - 6	0.3 - 0.6	2.2 - 4.3
Clutch cover securing bolt	22 - 29	2.2 - 3.0	16 - 22

MANUAL TRANSMISSION

CONTENTS

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REMOVAL AND INSTALLATION ..... MT- 5
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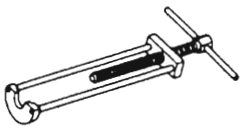
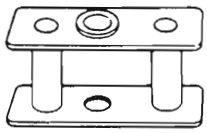
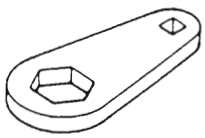
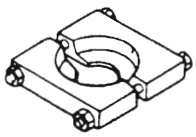
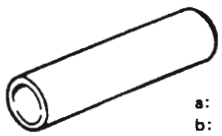
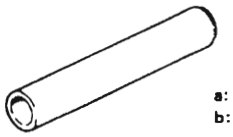
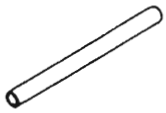
ASSEMBLY MT-20
SERVICE DATA AND SPECIFICATIONS MT-23

SPECIAL SERVICE TOOLS

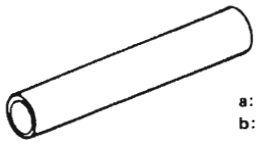
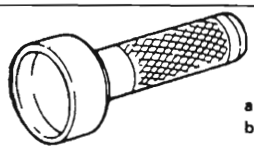
*: Special tools or commercial equivalent

Tool number Tool name Tool supplier	Description	
ST23810001 Adapter setting plate		Fixing adapter plate with gear assembly
E7127 Puller Litchfield		Removing overdrive mainshaft bearing
KV31100401 Transmission press stand		Pressing counter gear and mainshaft
E7122 Wrench Litchfield		Tightening mainshaft lock nut
ST23540000* (KV31100300*) Pin punch		Removing and installing fork rod retaining pin
ST30031000* Puller		Removing and installing 1st gear bushing
ST23860000* Drift	 **a: 38 mm (1.50 in) dia.** **b: 33 mm (1.30 in) dia.**	Installing counter drive gear
ST22360002* Drift	 **a: 29 mm (1.14 in) dia.** **b: 23 mm (0.91 in) dia.**	Installing counter gear front and rear end bearings
ST22350000* Drift	 **a: 34 mm (1.34 in) dia.** **b: 28 mm (1.10 in) dia.**	Installing O.D. gear bushing

a: Outer diameter of drift
b: Inner diameter of drift

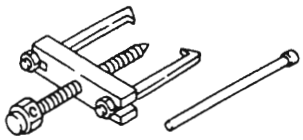
PREPARATION

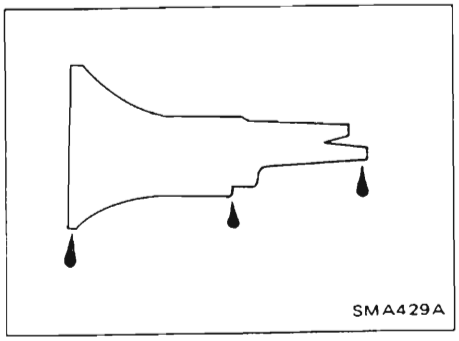
*. Special tools or commercial equivalent

Tool number Tool name Tool supplier	Description	
ST23800000* Drift	 a: 44 mm (1.73 in) dia. b: 31 mm (1.22 in) dia.	Installing front cover oil seal
ST33400001* Drift	 a: 60 mm (2.36 in) dia. b: 47 mm (1.85 in) dia.	Installing rear oil seal
E7128 Puller Litchfield		Removing rear oil seal

a: Outer diameter of drift
b: Inner diameter of drift

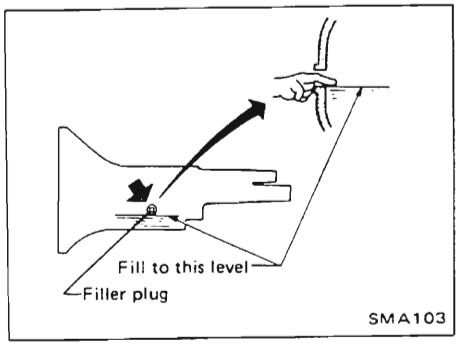
COMMERCIAL SERVICE TOOL

Tool name	Description	
Puller		Removing counter bearings, counter drive and O.D. gears


SMA429A

Checking M/T Oil

- Check manual transmission for leakage.



SMA103

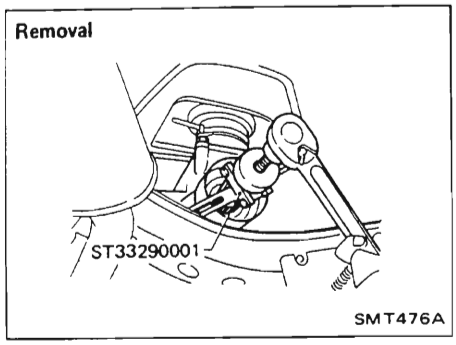
- Check oil level.

Replacing Rear Oil Seal

Whilst replacing rear oil seal take note of the following.

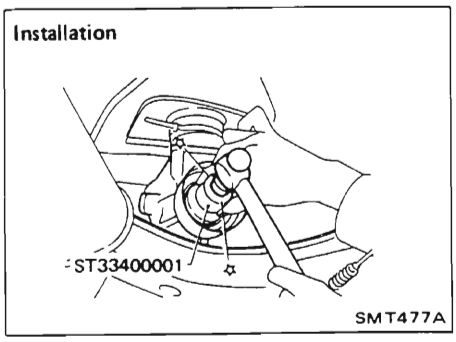
- Prior to removing tailshaft, mark all flanges so that it can be re-installed in the same position.
- Upon completion of the repair, check gear oil level.

Removal



SMT476A

Installation

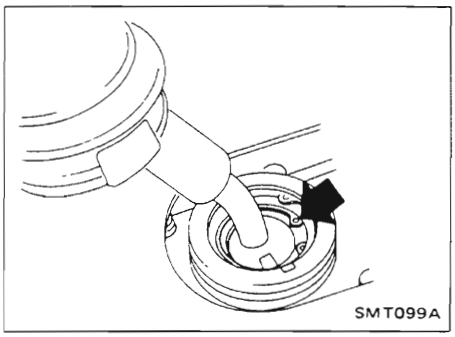


SMT477A

Removal

- Remove propeller shaft.
  Refer to PD section.
- **Insert plug into rear oil seal after removing propeller shaft.**

CAUTION:
Be careful not to damage spline, sleeve yoke and rear oil seal, when removing propeller shaft.


SMT099A

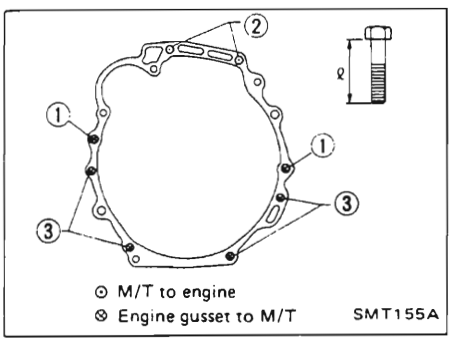
Remove shift lever.

- Support engine by placing a jack under oil pan.
  Use wooden block or similar to prevent damage.

CAUTION:
Do not place jack under the oil pan drain plug.
WARNING:
Support Manual Transmission, while removing it.

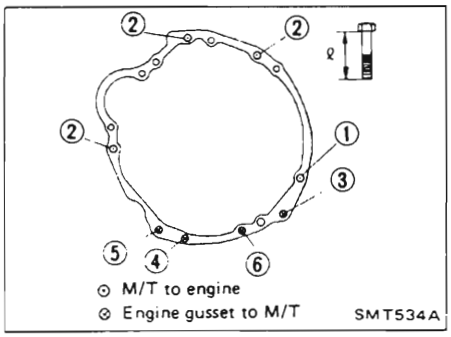
Installation

- Tighten bolt securing transmission.



- **CA20E engine model**

Bolt No.	Tightening torque N·m (kg-m, ft-lb)	ℓ mm (in)
1	39 - 49 (4.0 - 5.0, 29 - 36)	75 (2.95)
2	39 - 49 (4.0 - 5.0, 29 - 36)	65 (2.56)
3	29 - 39 (3.0 - 4.0, 22 - 29)	25 (0.98)

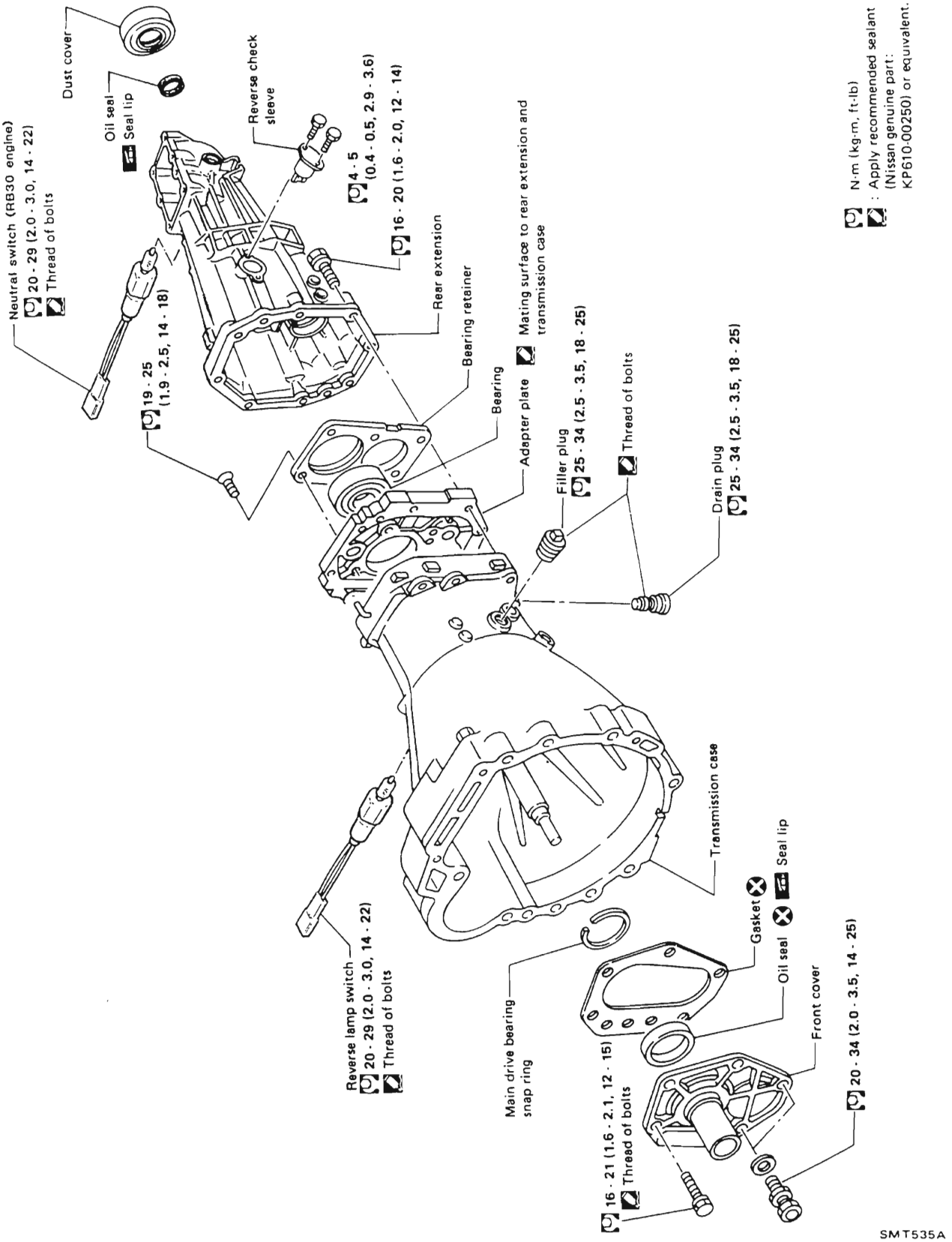


- **RB30E engine model**

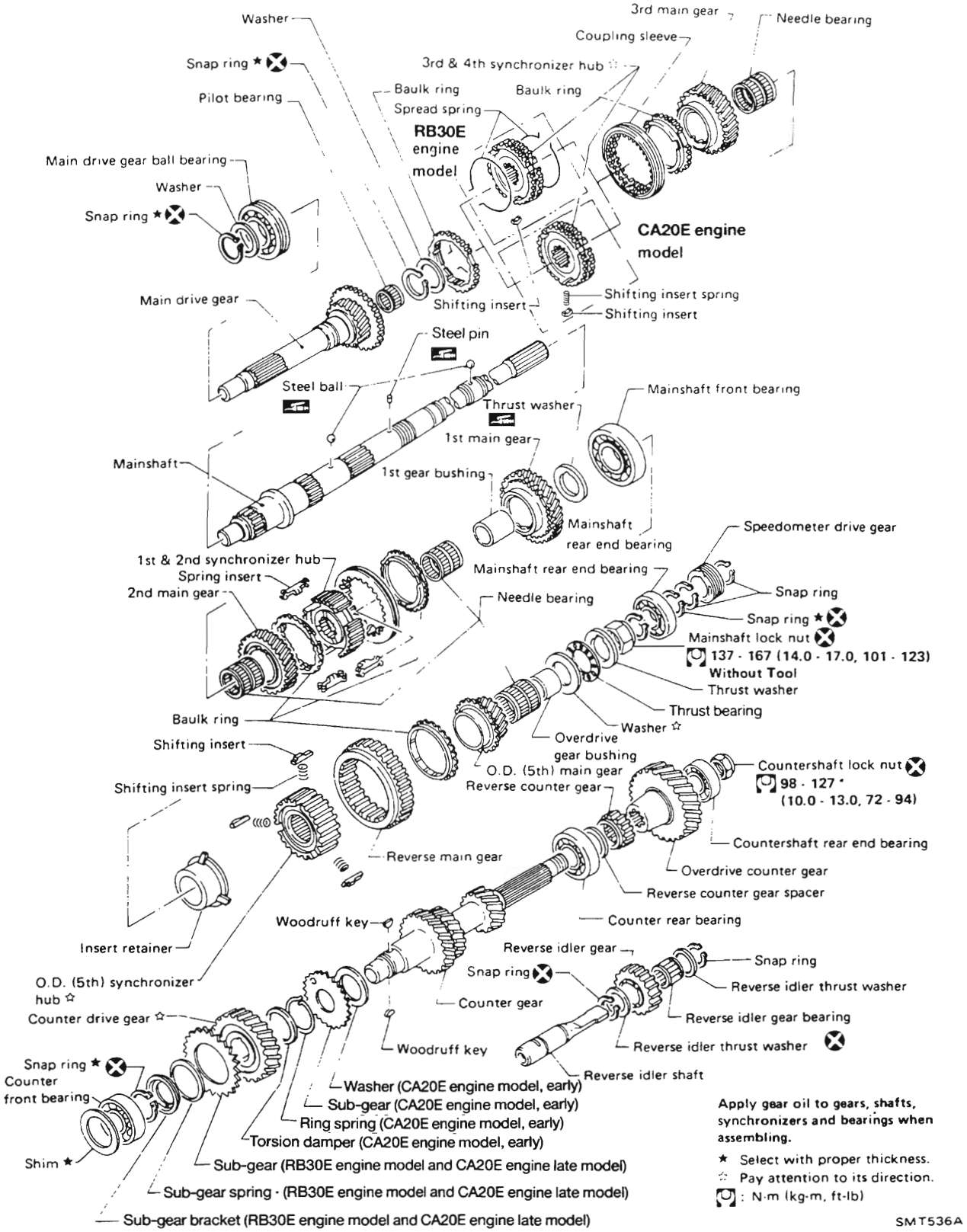
Bolt No.	Tightening torque N·m (kg-m, ft-lb)	ℓ mm (in)
1	44 - 49 (4.5 - 5.0, 33 - 36)	65 (2.56)
2	39 - 49 (4.0 - 5.0, 29 - 36)	60 (2.36)
3*	34 - 44 (3.5 - 4.5, 25 - 33)	60 (2.36)
4*	29 - 39 (3.0 - 4.0, 22 - 29)	40 (1.57)
5*	29 - 39 (3.0 - 4.0, 22 - 29)	30 (1.18)
6	29 - 39 (3.0 - 4.0, 22 - 29)	25 (0.98)

*: With nut

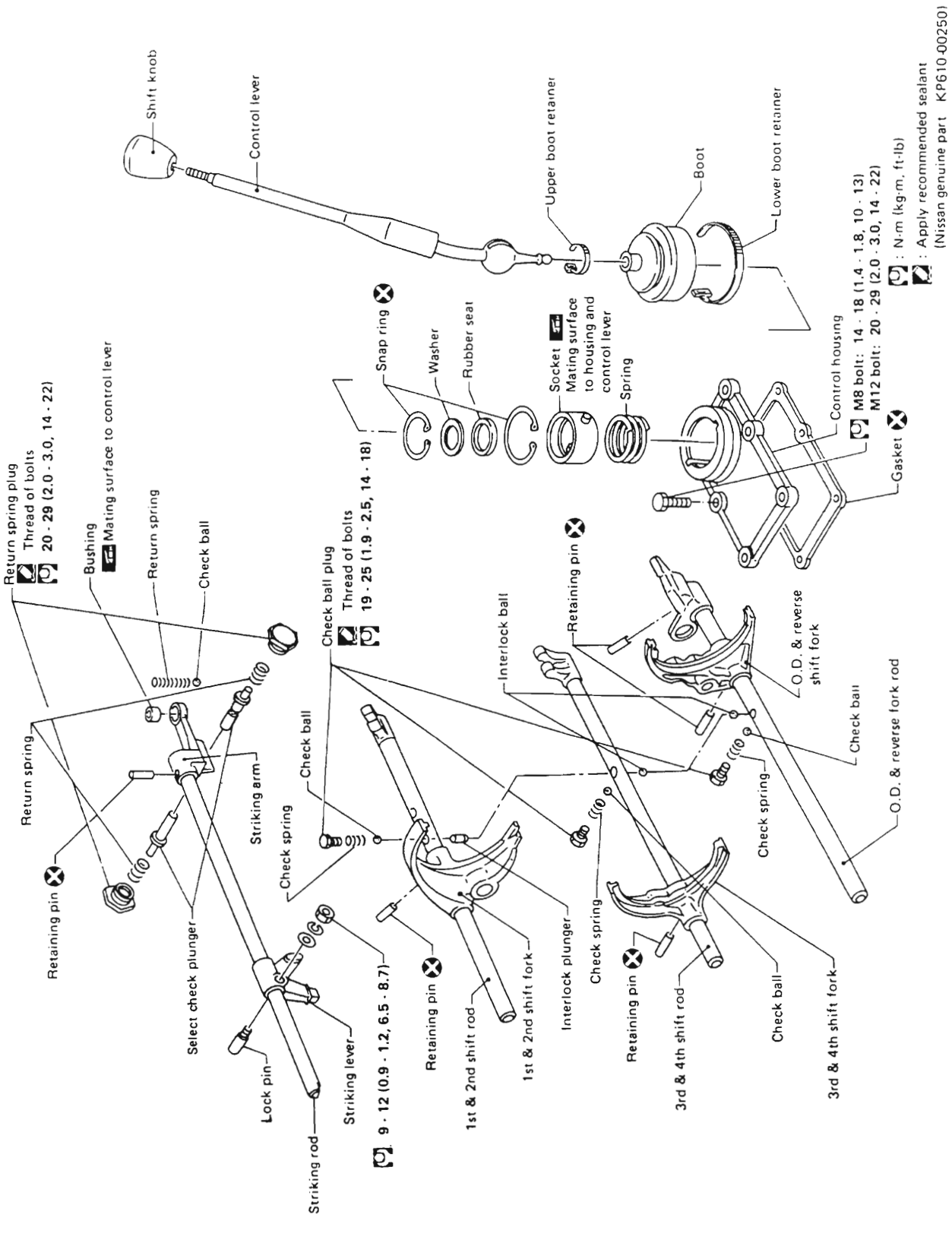
Case Components



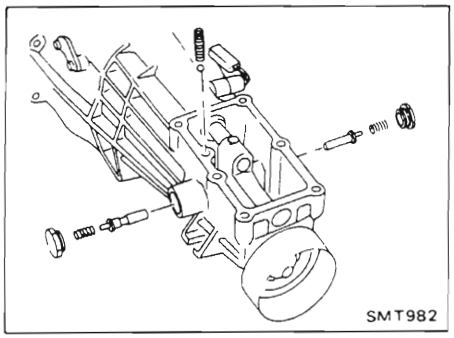
Gear Components



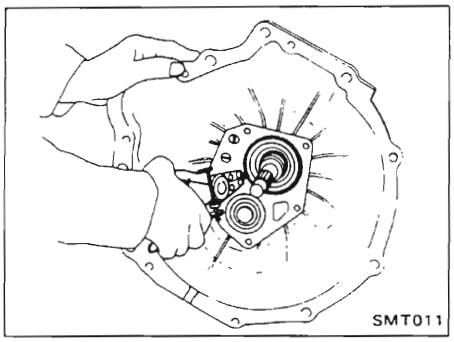
Shift Control Components



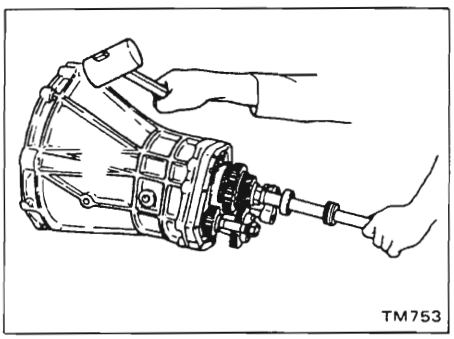
SMT172A



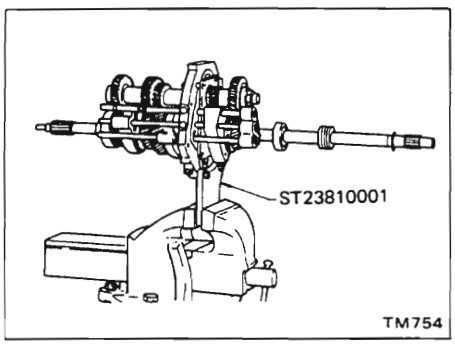
1. Remove rear extension.
(1) Remove control housing, check ball, return spring plugs, select check plungers and return springs.
(2) Remove neutral switch (RB30E).
(3) Remove rear extension by lightly tapping it.



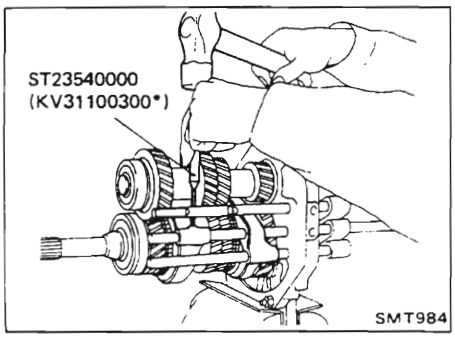
2(f) Remove front cover, gasket, countershaft front bearing shim, and main drive bearing outer snap ring (Large).
(2) Remove reverse lamp switch.



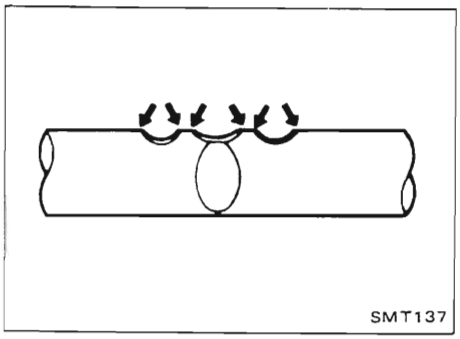
3. Separate transmission case from adapter plate.



4. Set up Tool on adapter plate.
5. Remove check ball plugs, check springs, and check balls.



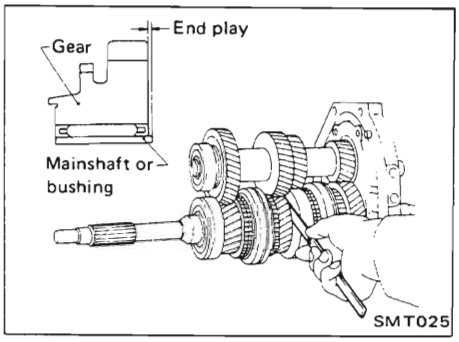
6. Drive out retaining pins. Then drive out fork rods and remove interlock balls.


SMT137

Forks and Fork Rods

INSPECTION

- Check for wear, scratches, projection or other damage.



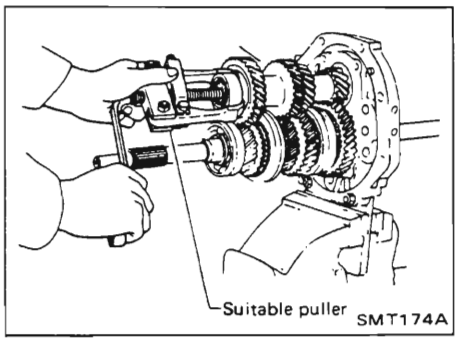
SMT025

Gears and Shafts

DISASSEMBLY

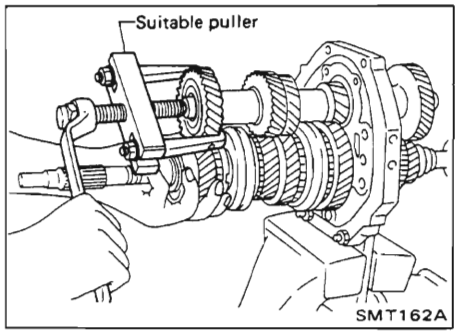
1. Before disassembly, measure each gear end play.
- If end play is not within the specified limit, disassemble and check the parts.
- Replace any part which is worn or damaged.

Gear	End play mm (in)
1st	0.31 - 0.41 (0.0122 - 0.0161)
2nd	0.11 - 0.21 (0.0043 - 0.0083)
3rd	0.11 - 0.21 (0.0043 - 0.0083)
O.D.	0.32 - 0.39 (0.0126 - 0.0154)
Reverse idler	0.05 - 0.50 (0.0020 - 0.0197)



SMT174A

2. Mesh 2nd and reverse gear, then draw out counter front bearing with suitable puller.
3. Remove snap ring of counter drive gear.



SMT162A

4. Remove sub-gear components and counter drive gear.

— CA20E engine model —

(1) Pull out counter drive gear with main drive gear assembly with suitable puller.
(2) Remove sub-gear, washer, torsion damper and ring spring.

— RB30E engine model —

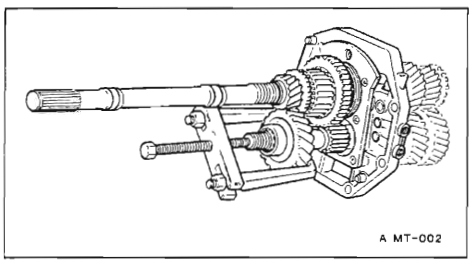
(1) Remove sub-gear bracket, sub-gear spring and sub-gear.
(2) Pull out counter drive gear with main drive gear assembly with suitable puller.

5. Remove snap ring and draw out 3rd & 4th synchronizer and 3rd main gear.

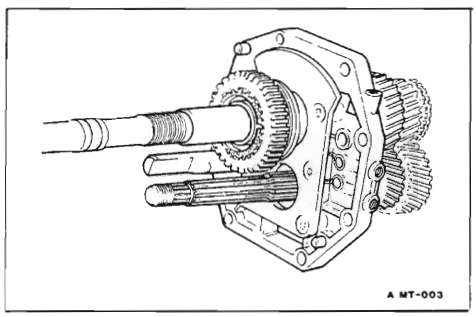
Gears and Shafts (Cont'd)

Dismantle parts at rear of adapter plate as follows:

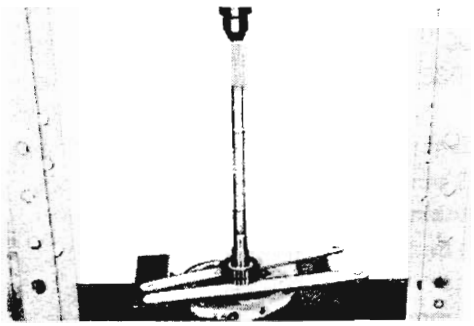
(1) Remove snap rings, steel ball and speedometer gear from mainshaft.
(2) Remove snap ring and overdrive mainshaft bearing.
(3) Release staking on countershaft nut and mainshaft nut by drilling, and remove nuts.
Ensure staking is clear of threads.
Mainshaft nut left hand thread.



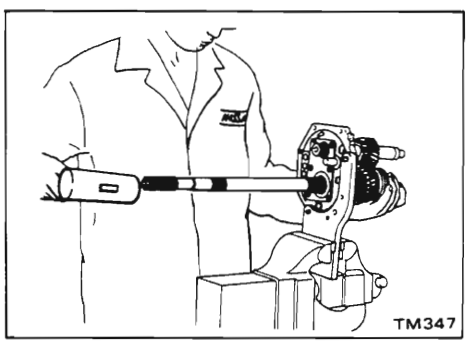
(4) Remove thrust washer, steel peg and thrust bearing from mainshaft.
(5) Pull out O.D. counter gear and bearing with suitable puller.
(6) Draw out reverse counter gear and spacer.



(7) Remove snap rings from reverse idler shaft and draw out reverse idler gear, thrust washers and needle bearing.
(8) Remove O.D. main gear, needle and baulk ring.



(9) Press out O.D. gear bushing, insert retainer and O.D. synchronizer.

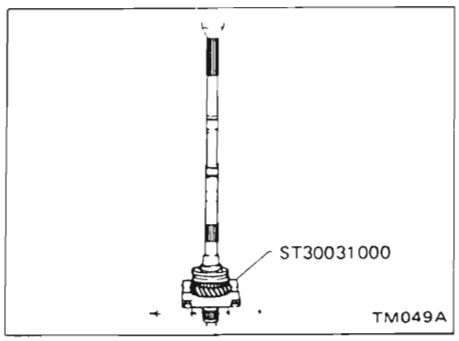


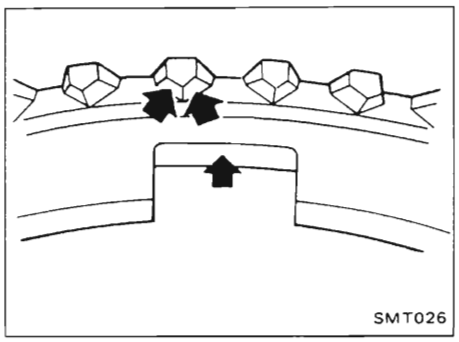
(7) Draw out mainshaft assembly together with counter gear, by tapping rear end of mainshaft and counter gear.
(8) Remove thrust washer, steel ball, 1st main gear and needle bearing.

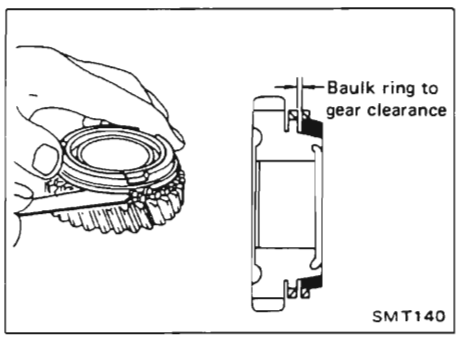
Be careful not to lose steel ball.

Gears and Shafts (Cont'd)

9. Press out 1st gear mainshaft bushing together with 2nd main gear with Tool.
10. Remove 2nd gear needle bearing.







INSPECTION

- Check all gears for excessive wear, chips or cracks; replace as required.
- Check shaft for bending, cracks or wear; if necessary, replace.

Baulk rings

- If found to be deformed, cracked or other damaged excessively, replace baulk ring.
- Place baulk ring in position on gear cone. While holding baulk ring against gear as far as it will go, measure gap between baulk ring and gear.
  If the clearance is smaller than the wear limit, replace baulk ring.

Baulk ring to gear clearance:

Standard

1st & 2nd gear
1.00 - 1.60 mm
(0.0394 - 0.0630 in)

3rd & main drive gear
1.20 - 1.60 mm
(0.0472 - 0.0630 in)

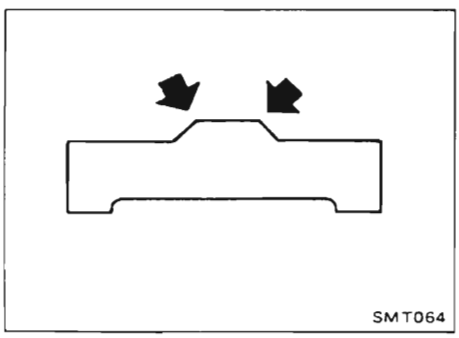
O.D. gear
1.00 - 1.40 mm
(0.0394 - 0.0551 in)

Wear limit

1st & 2nd gear
0.8 mm (0.031 in)

3rd & main drive gear
0.8 mm (0.031 in)

O.D. gear
0.5 mm (0.020 in)



Shifting inserts and springs

If worn excessively, worn unevenly, deformed or damaged, replace.

Gears and Shafts (Cont'd)

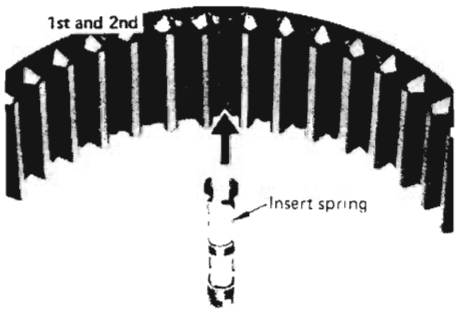
ASSEMBLY

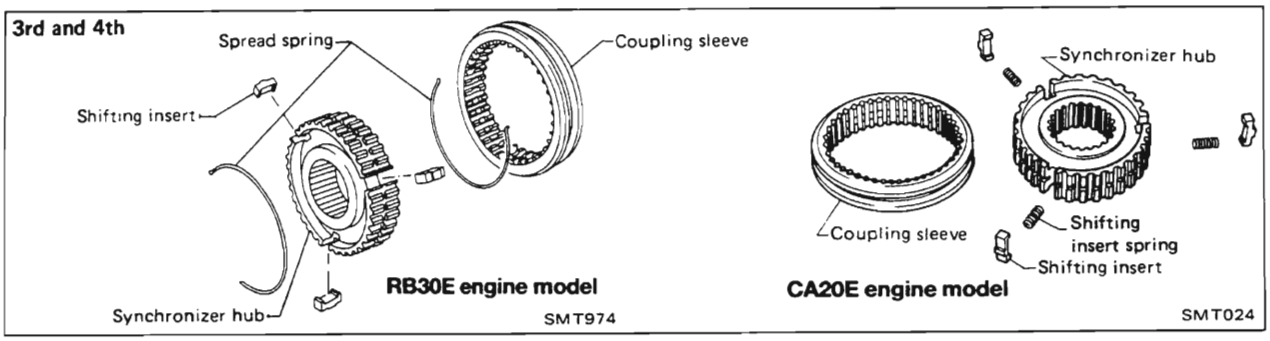
Note:

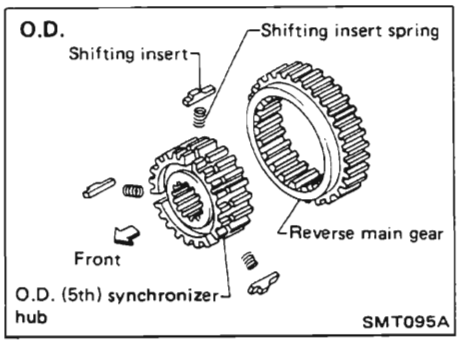
Apply gear oil to each part.

- Needle bearings
- Baulk rings
- Shafts
- Gears
- Oil seals

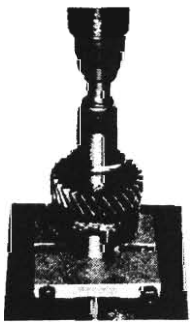
1. Assemble synchronizers.



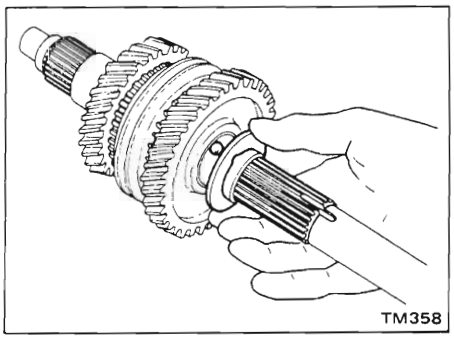




2. Assemble 2nd main gear, needle bearing and 1st & 2nd synchronizer assembly, then press 1st gear bushing on mainshaft.



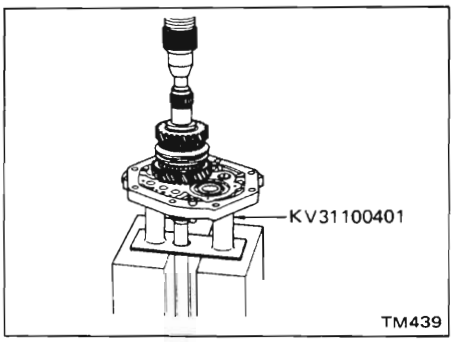
Gears and Shafts (Cont'd)


TM358

3. Assemble 1st main gear, steel ball, and thrust washer on mainshaft.

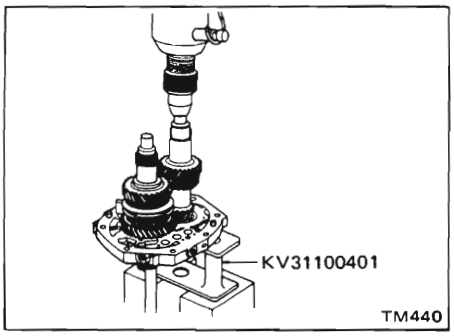
Before installing steel ball and thrust washer, apply grease to them.

4. Install counter rear bearing to adapter plate.



TM439

5. Press mainshaft assembly to adapter plate with Tool.



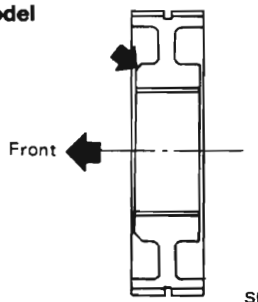
TM440

6. Press counter gear into adapter plate with Tool.

7. Install 3rd main gear and 3rd & 4th synchronizer assembly.

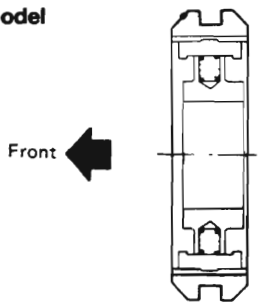
Pay attention to direction of synchronizer.

RB30E engine model

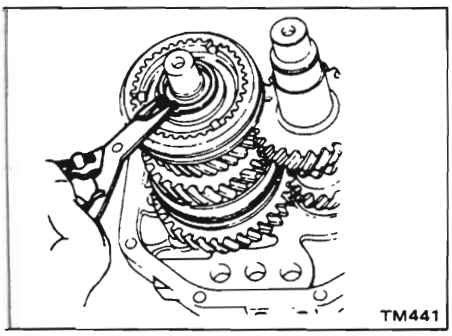


SMT008A

CA20E engine model



SMT031


TM441

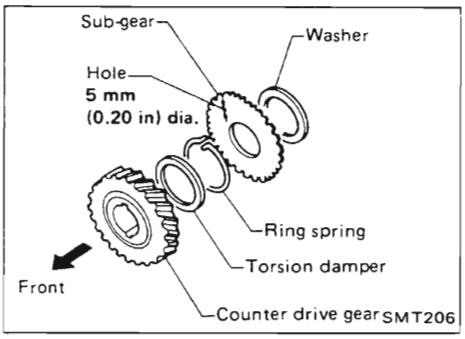
8. Install thrust washer on mainshaft and secure it with mainshaft front snap ring.

Select proper snap ring that will minimize clearance of groove in mainshaft.

Allowable clearance of groove 0-0.18 mm (0-0.0071 in).

9. Apply gear oil to mainshaft pilot bearing and install it on mainshaft.

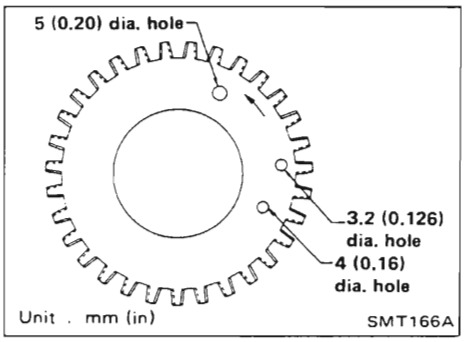
Gears and Shafts (Cont'd)



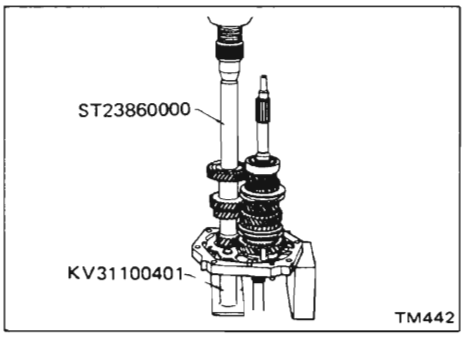
10. Assemble counter drive gear and sub-gear components.

— CA20E engine model, early type —

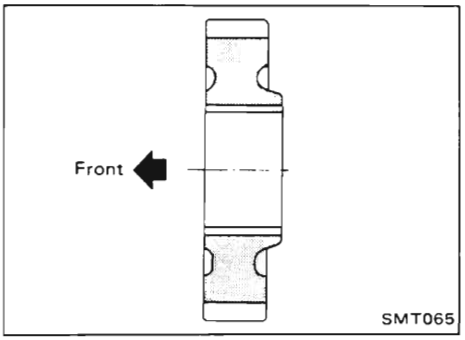
(1) Install torsion damper on counter drive gear, then install ring spring and sub-gear. First insert one end of ring spring into 5 mm (0.20 in) diameter hole on sub-gear, then insert the other end of ring spring into 5 mm (0.20 in) diameter hole on counter drive gear.



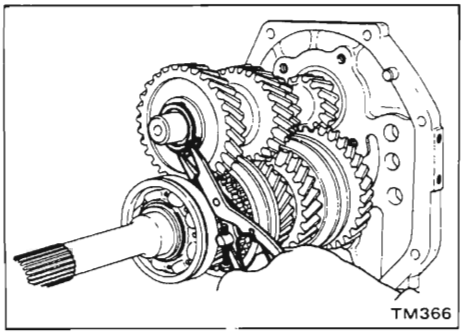
(2) Set counter drive gear with main drive gear on countershaft while rotating sub-gear 2 pitches in direction of arrow and engage with main drive gear.



(3) Press on counter drive gear with main drive gear using Tool.



Pay attention to direction of counter drive gear.



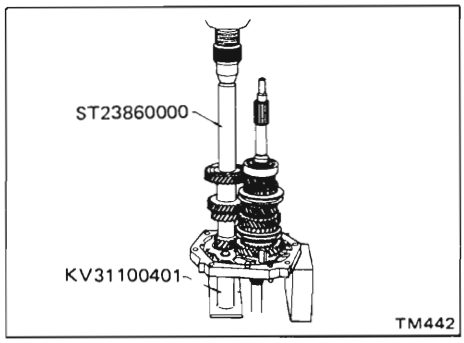
(4) Secure counter drive gear with snap ring.

Select proper snap ring that will minimize clearance of groove in countershaft.

Allowable clearance of groove:
0 - 0.18 mm (0 - 0.0071 in)

Part number	Thickness mm (in)
32215-E9000	1.4 (0.055)
32215-E9001	1.5 (0.059)
32215-E9002	1.6 (0.063)

Gears and Shafts (Cont'd)



— RB30E engine model and CA20E engine model late type —

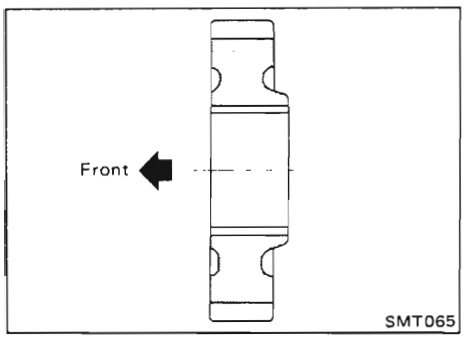
(1) Press counter drive gear and main drive gear with Tool.

(2) Install sub-gear bracket on counter drive gear and then select proper snap ring that will minimize clearance of groove in counter gear.

Allowable clearance of groove:
0 - 0.18 mm (0 - 0.0071 in)

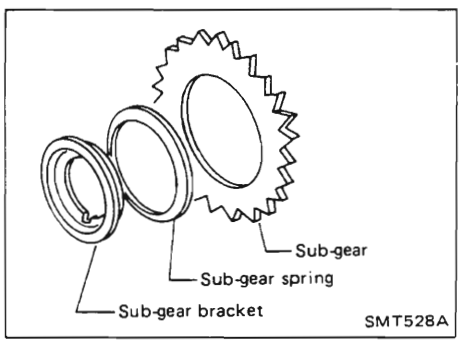
Counter drive gear snap ring:

Part number	Thickness mm (in)
32215-E9000	1.4 (0.055)
32215-E9001	1.5 (0.059)
32215-E9002	1.6 (0.063)

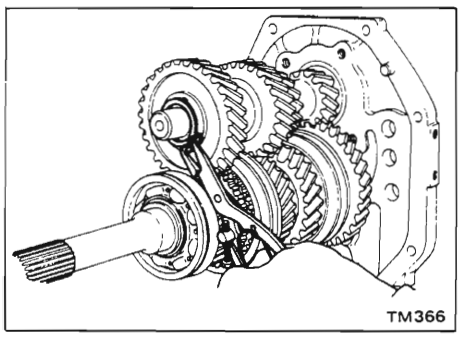


(3) Remove snap ring and sub-gear bracket from counter gear.

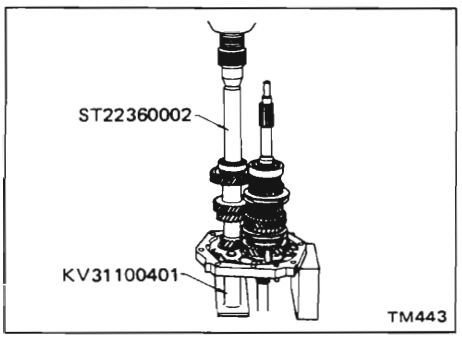
(4) Install sub-gear, sub-gear spring and sub-gear bracket.



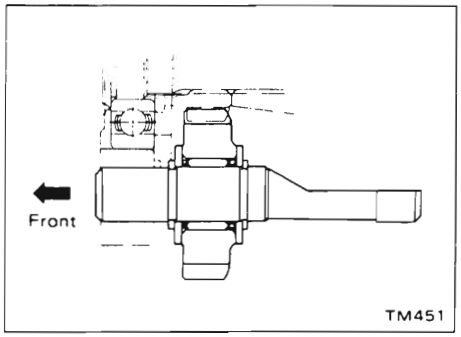
(5) Install selected counter drive gear snap ring.



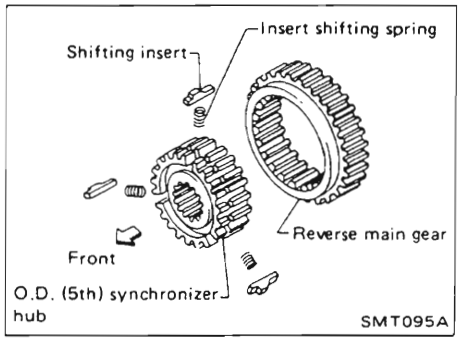
11. Press counter gear front bearing onto counter gear.



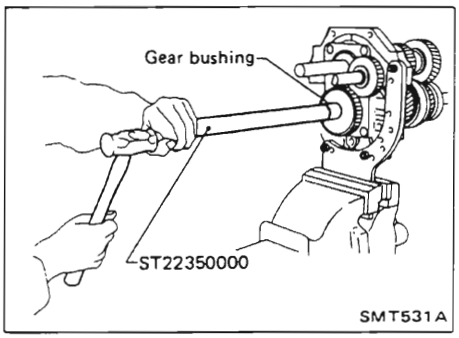
Gears and Shafts (Cont'd)



12. Assemble parts at rear of adapter plate as follows:
(1) Install reverse idler gear to reverse idler shaft with spacers, snap rings and needle bearing.

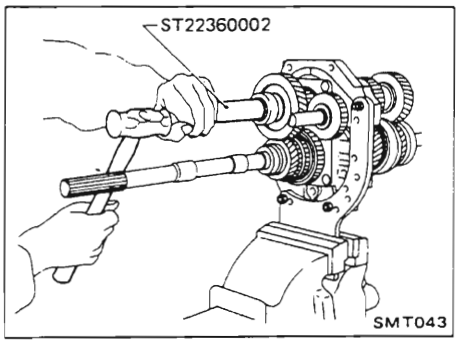


(2) Install insert retainer and O.D. synchronizer to mainshaft.
Pay attention to direction of hub.

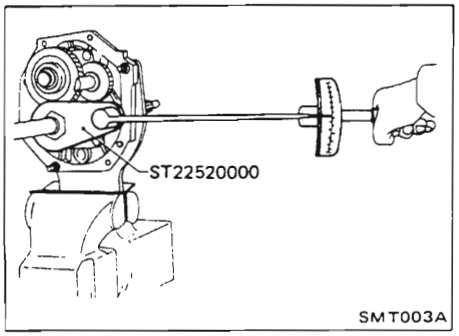


(3) Install O.D. gear bushing with Tool.
(4) Install O.D. main gear, needle bearing and baulk ring.
Do not install thrust bearing or washer at this stage.

(5) Install spacer, reverse counter gear and O.D. counter gear.
O.D. main gear and O.D. counter gear should be handled as a matched set.



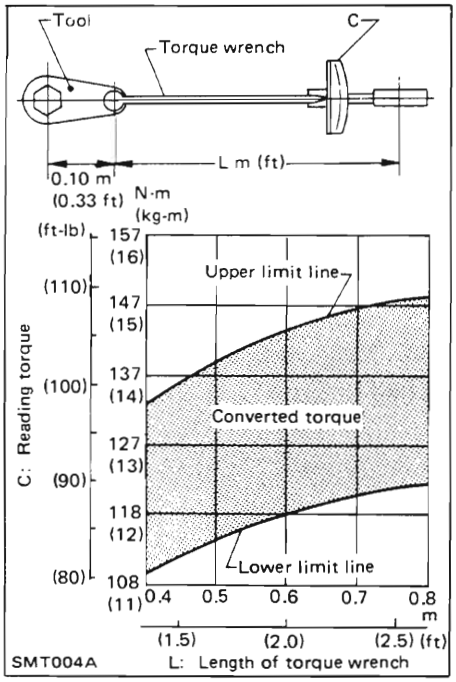
(6) Install washer, thrust bearing, steel pin and thrust washer. Instal (new) main shaft nut finger tight.
(7) Install countershaft rear end bearing with tool.



13. Mesh 2nd and reverse gears and tighten mainshaft lock nut with Tool.

Always use new lock nut.

Gears and Shafts (Cont'd)



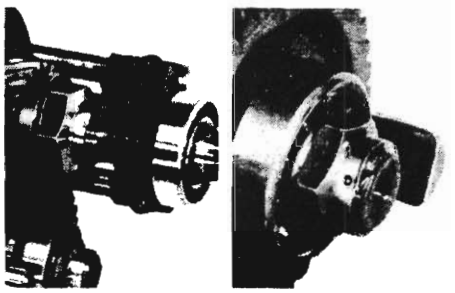
The chart on the left shows the required torque wrench reading when using service tool ST22520000 to tension the mainshaft nut to between 137 and 167 Nm.

The horizontal axis shows torque wrench length and the vertical axis shows torque wrench reading.

For a given torque wrench length the torque wrench reading must be within the shaded area.

14. Tighten countershaft lock nut.
Always use new lock nut.
15. Measure gear end play. For the description, refer to Disassembly of Gears and Shafts.
16. If end plays are within specification, stake mainshaft and countershaft lock nuts using a punch.

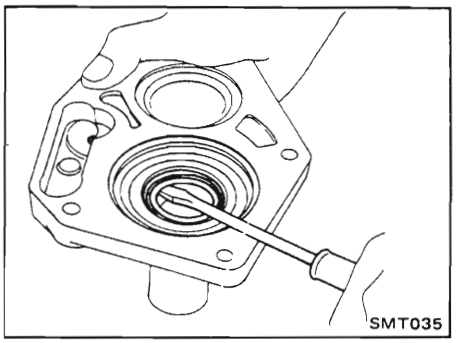
Mainshaft **Countershaft**



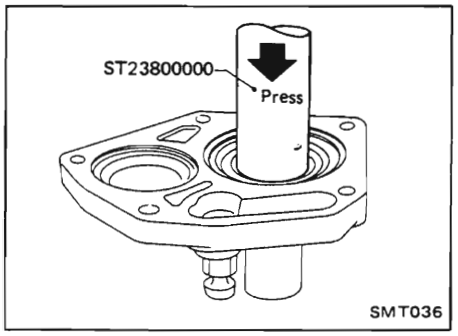
Oil Seals

REPLACING FRONT COVER OIL SEAL

Be careful not to damage mating surface of front cover.

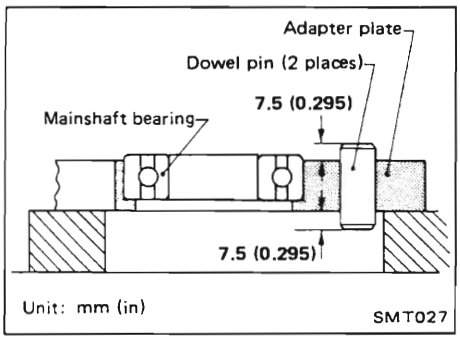


Press new oil seal onto front cover with Tool.



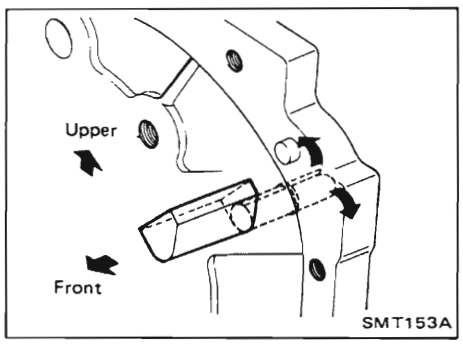
Adapter Plate

- When replacing adapter plate parts, use the following procedures.



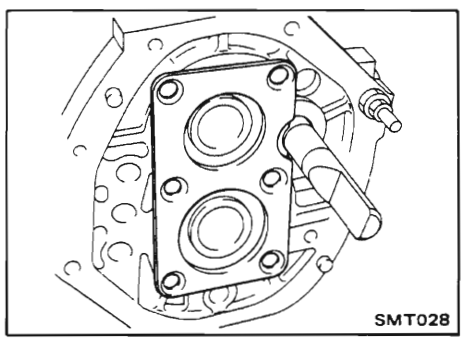
DOWEL PIN

- Set dowel pin.



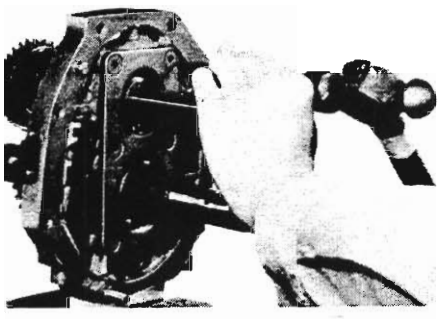
OIL GUTTER

Install oil gutter on adapter plate and expand on rear side.

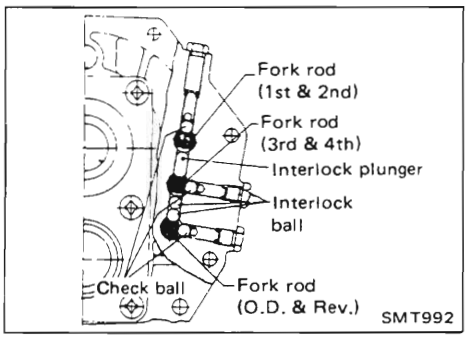


BEARING RETAINER

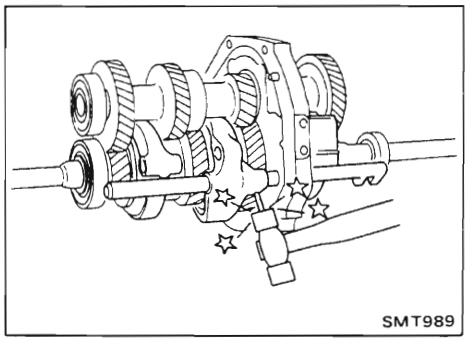
1. Insert reverse shaft, then install bearing retainer.



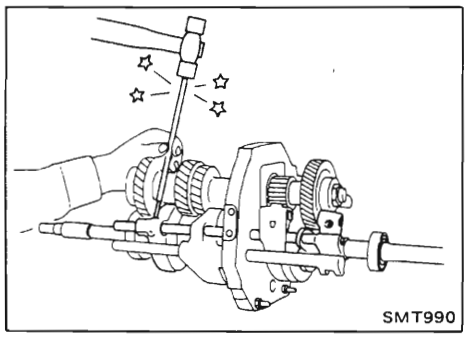
2. Tighten each screw, then stake it at two points.



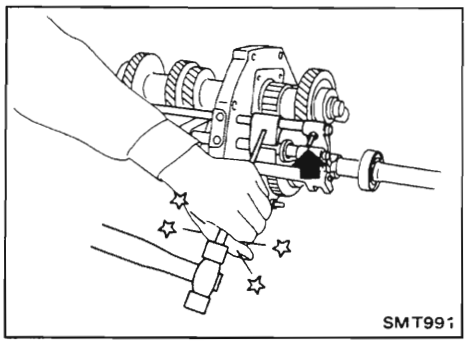
1. Instal shift rods, interlock plunger, interlock balls and check balls.



(1) 1st-2nd shift fork

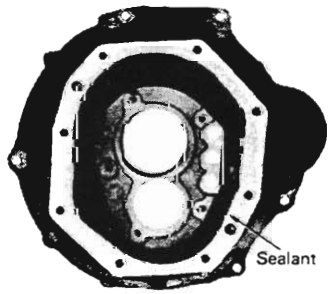


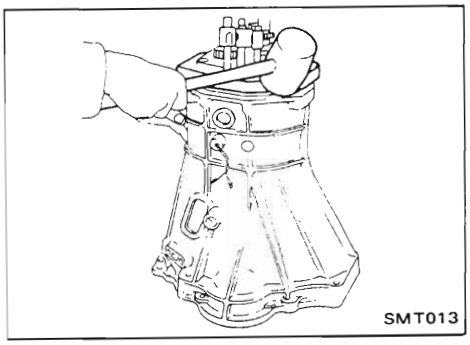
(2) 3rd-4th shift fork



(3) O.D.-Reverse shift fork

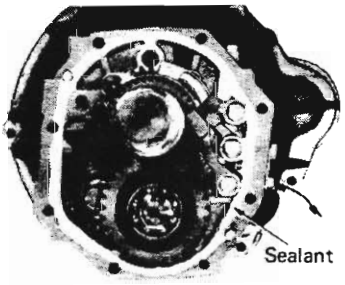
2. Apply sealant to mating surface of transmission case.



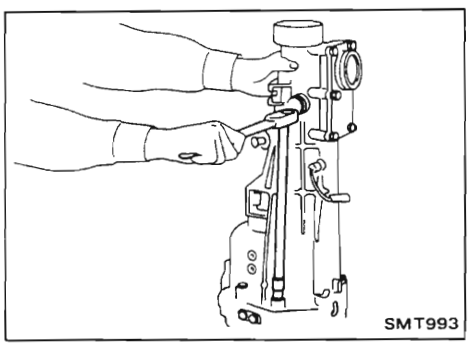

SMT013

3(1) Slide gear assembly into transmission case by lightly tapping with a soft hammer.

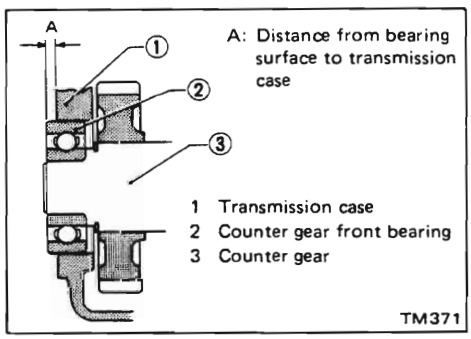
(2) Fit reverse lamp switch.



4. Apply sealant to mating surface of adapter plate.


SMT993

5. Install rear extension.
6. Fit main drive bearing snap ring.



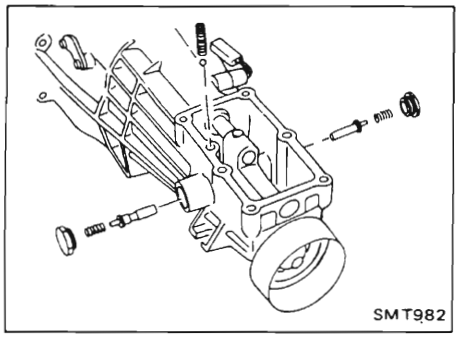
TM371

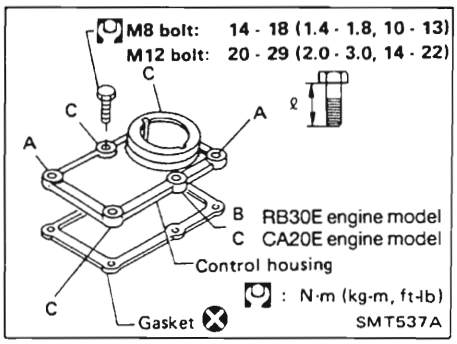
7. Select counter front bearing shim.

Unit: mm (in)

"A"	Thickness of shim	Part number
4.52 - 4.71 (0.1780 - 0.1854)	Not necessary	
4.42 - 4.51 (0.1740 - 0.1776)	0.1 (0.004)	32218-V5000
4.32 - 4.41 (0.1701 - 0.1736)	0.2 (0.008)	32218-V5001
4.22 - 4.31 (0.1661 - 0.1697)	0.3 (0.012)	32218-V5002
4.12 - 4.21 (0.1622 - 0.1657)	0.4 (0.016)	32218-V5003
4.02 - 4.11 (0.1583 - 0.1618)	0.5 (0.020)	32218-V5004
3.92 - 4.01 (0.1543 - 0.1579)	0.6 (0.024)	32218-V5005

8. Install gasket and front cover.


SMT982



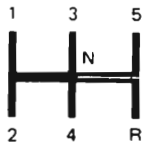
9. Install return spring plugs, check ball, return springs and select check plunger.
10. Install control housing.
11. Install neutral switch (RB30E).

12. Tighten control housing bolts.

	A	B	C
CA20E	2	0	4
RB30E	2	1	3

A : M8, ℓ = 30 mm (1.18 in)
B : M12, ℓ = 27 mm (1.06 in)
C : M8, ℓ = 25 mm (0.98 in)

General Specifications

Transmission model	FS5W71C	
Engine	CA20E	RB30E
No. of speeds	5	
Shift pattern		
Synchromesh type	Warner	
Gear ratio		
1st	3.321	
2nd	1.902	
3rd	1.308	
4th	1.000	
O.D.	0.838	
Reverse	3.382	
No. of teeth		
Mainshaft		
Drive	22	
1st	33	
2nd	27	
3rd	26	
O.D.	22	
Reverse	36	
Countershaft		
Drive	31	
1st	14	
2nd	20	
3rd	28	
O.D.	37	
Reverse	15	
Reverse idler gear	21	
Oil capacity ℓ (Imp pt)	2.0 (3½)	

Inspection and Adjustment

GEAR END PLAY

Unit: mm (in)

1st gear	0.31 - 0.41 (0.0122 - 0.0161)
2nd gear	0.11 - 0.21 (0.0043 - 0.0083)
3rd gear	0.11 - 0.21 (0.0043 - 0.0083)
O.D. gear	0.32 - 0.39 (0.0126 - 0.0154)
Reverse idler gear	0.05 - 0.50 (0.0020 - 0.0197)

CLEARANCE BETWEEN BAULK RING AND GEAR

Unit: mm (in)

Standard	
1st & 2nd	1.00 - 1.60 (0.0394 - 0.0630)
3rd & main drive	1.20 - 1.60 (0.0472 - 0.0630)
O.D.	1.00 - 1.40 (0.0394 - 0.0551)
Wear limit	
1st & 2nd	0.80 (0.0315)
3rd & main drive	0.80 (0.0315)
O.D.	0.50 (0.0197)

AVAILABLE SNAP RINGS

Main drive gear bearing

Allowable clearance	0 - 0.13 mm (0 - 0.0051 in)
Thickness mm (in)	Part number
1.73 (0.0681)	32204 - 78005
1.80 (0.0709)	32204 - 78000
1.87 (0.0736)	32204 - 78001
1.94 (0.0764)	32204 - 78002
2.01 (0.0791)	32204 - 78003
2.08 (0.0819)	32204 - 78004

Mainshaft front

Allowable clearance	0 - 0.18 mm (0 - 0.071 in)
Thickness mm (in)	Part number
2.4 (0.094)	32263 - V5200
2.5 (0.098)	32263 - V5201
2.6 (0.102)	32263 - V5202

Mainshaft rear end bearing

Allowable clearance	0 - 0.14 mm (0 - 0.0055 in)
Thickness mm (in)	Part number
1.1 (0.043)	32228 - 20100
1.2 (0.047)	32228 - 20101
1.3 (0.051)	32228 - 20102
1.4 (0.055)	32228 - 20103

Counter drive gear

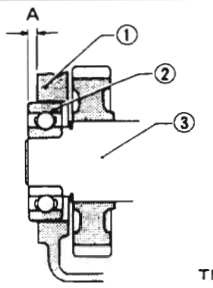
Allowable clearance	0 - 0.18 mm (0 - 0.0071 in)
Thickness mm (in)	Part number
1.4 (0.055)	32215 - E9000
1.5 (0.059)	32215 - E9001
1.6 (0.063)	32215 - E9002

Inspection and Adjustment (Cont'd)

AVAILABLE SHIMS

Counter front bearing

Unit: mm (in)



TM371

A: Distance from bearing surface to transmission case

1 Transmission case
2 Counter gear front bearing
3 Counter gear

"A"	Thickness of shim	Part number
4.52 - 4.71 (0.1780 - 0.1854)	Not necessary	
4.42 - 4.51 (0.1740 - 0.1776)	0.1 (0.004)	32218 - V5000
4.32 - 4.41 (0.1701 - 0.1736)	0.2 (0.008)	32218 - V5001
4.22 - 4.31 (0.1661 - 0.1697)	0.3 (0.012)	32218 - V5002
4.12 - 4.21 (0.1622 - 0.1657)	0.4 (0.016)	32218 - V5003
4.02 - 4.11 (0.1583 - 0.1618)	0.5 (0.020)	32218 - V5004
3.92 - 4.01 (0.1543 - 0.1579)	0.6 (0.024)	32218 - V5005

Tightening Torque

Unit	N·m	kg-m	ft-lb
Clutch operating cylinder	30-40	3.1-4.1	22-30
Transmission securing bolt	Refer page MT-5		
Engine gusset to engine	29-39	3.0-4.0	22-29
Crossmember to body			
RB30E	44-54	4.5-5.5	32-40
CA20E	39-49	4.0-5.0	29-36
Rear mounting insulator to rear extension	39-49	4.0-5.0	29-36
Starter motor fixing bolt	30-40	3.1-4.1	22-30

GEAR ASSEMBLY

Unit	N·m	kg-m	ft-lb
Rear extension to transmission case	16 - 20	1.6 - 2.0	12 - 14
Front cover to transmission case	16 - 21	1.6 - 2.1	12 - 15
Control housing to rear extension			
M8 bolt	14 - 18	1.4 - 1.8	10 - 13
M12 bolt	20 - 29	2.0 - 3.0	14 - 22
Ball pin	20 - 34	2.0 - 3.5	14 - 25
Filler plug	25 - 34	2.5 - 3.5	18 - 25
Drain plug	25 - 34	2.5 - 3.5	18 - 25
Speedometer pinion sleeve retainer bolt	4 - 5	0.4 - 0.5	2.9 - 3.6
Return spring plug	20 - 29	2.0 - 3.0	14 - 22
Reverse check sleeve to transmission case	4 - 5	0.4 - 0.5	2.9 - 3.6
Reverse lamp switch	20 - 29	2.0 - 3.0	14 - 22
Check ball plug	19 - 25	1.9 - 2.5	14 - 18
Mainshaft lock nut	Refer page MT-18		
Countershaft lock nut	98 - 127	10.0 - 13.0	72 - 94
Striking lever lock nut	9 - 12	0.9 - 1.2	6.5 - 8.7
Bearing retainer to adapter plate	19 - 25	1.9 - 2.5	14 - 18

AUTOMATIC TRANSMISSION

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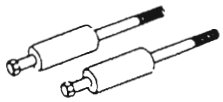
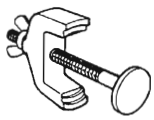
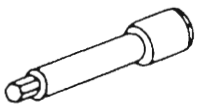
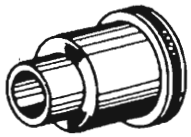
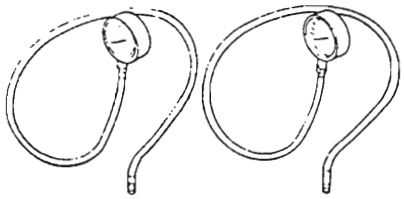
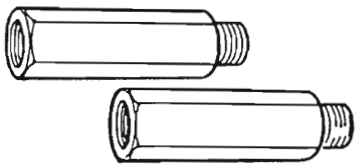
SPECIAL SERVICE TOOLS

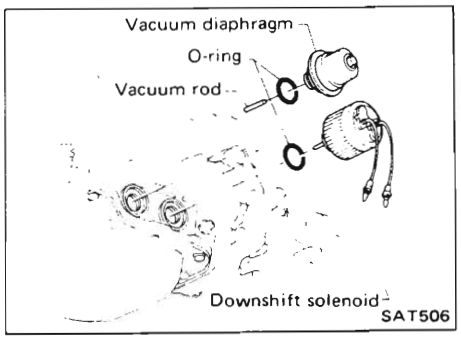
Tool number Tool name Tool supplier	Description	
E7289 Sliding hammer Litchfield		Removing oil pump assembly
E7129 Clutch spring compressor Litchfield		Removing and installing clutch springs
E7288 Hex head extension Litchfield		Removing and installing one-way clutch inner race
E7130 Oil pump assembling gauge Litchfield		Installing oil pump
E1344A Oil pressure gauge set Litchfield		
E7123 Pressure gauge set adaptor kit Litchfield		
E7128 Extension oil seal puller Litchfield		Removing extension oil seal

Service Notice

- Before proceeding with disassembly, thoroughly clean the outside of the transmission. It is important to prevent the internal parts of the transmission from becoming contaminated by dirt or other foreign matter.
- Disassembly should be done in a clean work area.
- Use a nylon cloth or paper towel for wiping parts clean. Common shop rags can leave lint that might interfere with the transmission's operation.
- When disassembling parts, be sure to place them in order in parts rack so they can be put back in the unit in their proper positions.
- All parts should be carefully cleaned with a general purpose, non-flammable solvent before inspection or reassembly.
- Gaskets, seals, and O-rings should be replaced. It is also very important to perform functional tests whenever it is designated.
- The valve body contains many precision parts and requires extreme care when parts are removed and serviced. Place removed parts on a parts rack so they can be put back in the valve body in the same positions and sequences. Care will also prevent springs and small parts from becoming scattered or lost.
- Before assembly, apply a coat of recommended A.T.F. to all parts. Vaseline may be applied to O-rings and seals. Do not use any grease.
- Care should be taken to avoid damaging O-rings, seals and gaskets when assembling.
- After overhaul, refill the transmission with new A.T.F.

Abbreviations used throughout this section stand for the following:

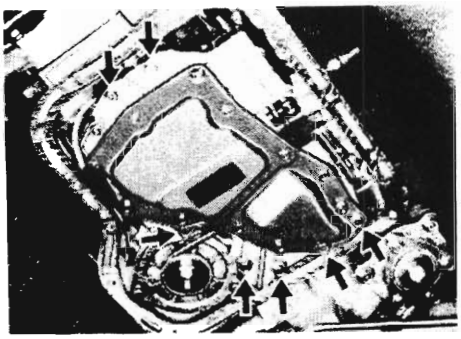
- A.T.F. ..... Automatic transmission fluid
- D_1 ..... Drive range 1st gear
- D_2 ..... Drive range 2nd gear
- D_3 ..... Drive range 3rd gear
- D_4 ..... Drive range 4th gear
- O.D. ..... Overdrive
- 1_2 ..... 1 range 2nd gear
- 1_1 ..... 1 range 1st gear



Control valve

1. Drain fluid by removing oil pan.
2. Remove kickdown solenoid and vacuum diaphragm & rod.

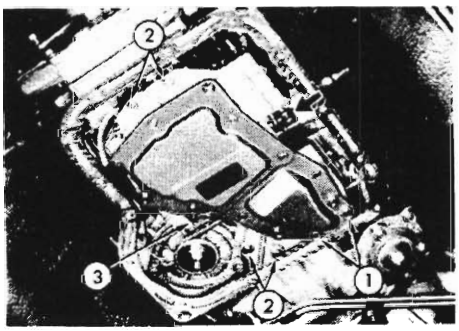
Be careful not to lose vacuum rod.



3. Remove control valve assembly.

Be careful not to drop manual valve out of valve body.

4. Disassemble, inspect and assemble control valve assembly. Refer to Control Valve Body.



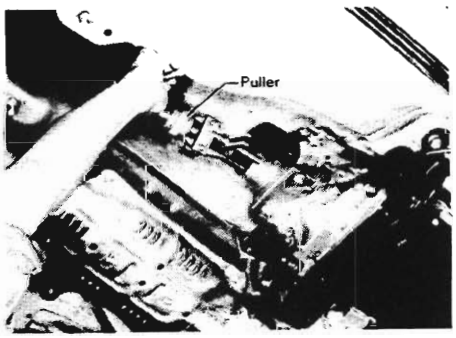
1 40 mm (1.57 in)
2 35 mm (1.38 in)
3 25 mm (0.98 in)

5. Install control valve assembly.

- **Set manual shaft at Neutral, then align manual plate with groove in manual valve of control valve assembly.**
- **Securing bolts come in 3 different lengths.**
- **After installing control valve to transmission case, make sure that control lever can be moved to all positions.**

6. Install kickdown solenoid and vacuum diaphragm & rod.

Make sure that vacuum diaphragm rod does not interfere with side plate of control valve.



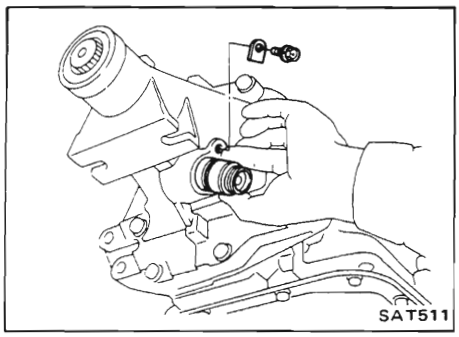
Extension Oil Seal Replacement

1. Remove oil seal.

Extension Oil Seal Replacement (Cont'd)

2. Apply coat of A.T.F. to oil seal surface, then drive new seal into place.
3. Coat sealing lips with vaseline, then install propeller shaft.

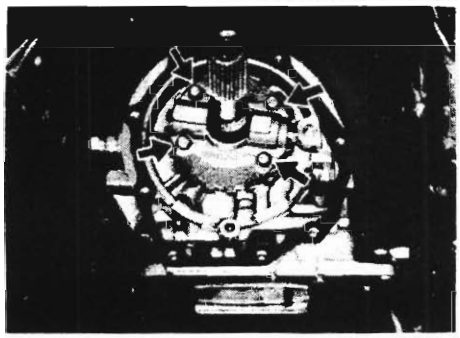
Parking Component



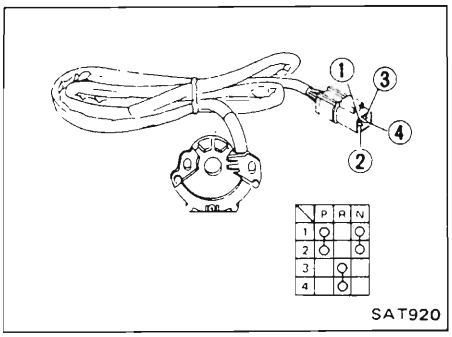
1. Remove oil pan.
2. Remove propeller shaft.
3. Remove speedometer pinion.
4. Support transmission with a jack, then remove rear mounting bolts.

5. Remove rear extension bolts, then draw out rear extension with rear mounting.
6. Remove control valve assembly.
7. Inspect and repair parking components. Check component parts for wear or damage.

Governor Valve Assembly



1. Drain oil by removing oil pan.
2. Remove rear extension with rear mounting.
3. Remove governor valve assembly.
4. Inspect and repair governor valve assembly. Refer to Governor for inspection.



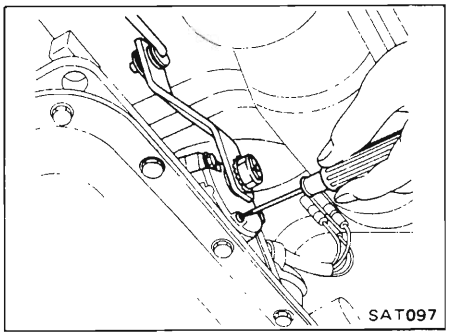
Inhibitor Switch Adjustment

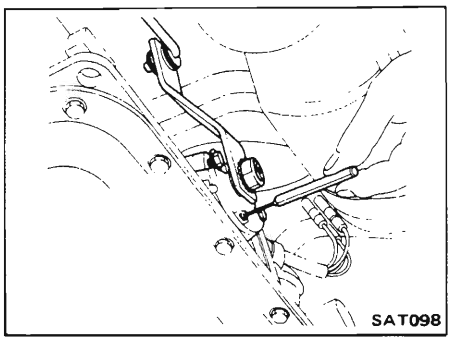
Disconnect harness at connector, then remove inhibitor switch.

- Check continuity at "N", "P" and "R" ranges.
- With selector lever held in "Neutral", turn manual lever an equal amount in both directions to see if current flow ranges are nearly the same. (Current normally begins to flow before manual lever reaches an angle of 1.5° in either direction.)
  If current flows outside normal range, or if normal flow range is out of specifications, properly adjust inhibitor switch.

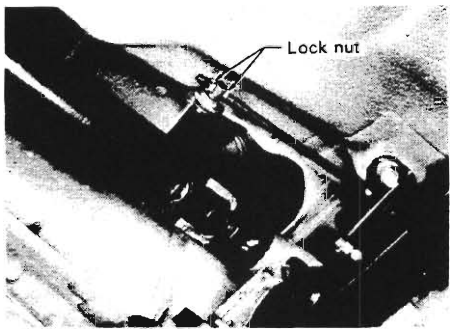
Adjust inhibitor switch as follows:

1. Place the manual valve in Neutral (vertical position).
2. Remove the screw.





3. Loosen the attaching bolts.
4. With an aligning pin [2.0 mm (0.079 in) dia.], move the switch until the pin falls into the hole in the rotor.
5. Tighten the attaching bolts equally.
6. Recheck for continuity. If necessary, replace the switch.

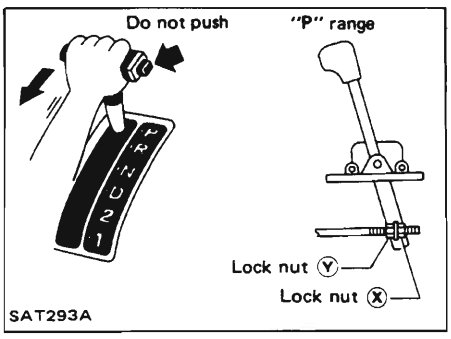


Manual Linkage Adjustment

Move the shift lever from the "P" range to "1" range. You should be able to feel the detents in each range.

If the detents cannot be felt or the pointer indicating the range is improperly aligned, the linkage needs adjustment.

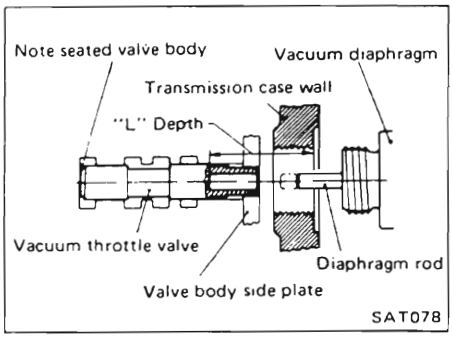
1. Place selector lever in "P" range.
2. Loosen lock nuts.



3. Tighten lock nut Ⓧ until it touches trunnion pulling selector lever toward "R" range side without pushing button.
4. Back off lock nut Ⓧ one turn and tighten lock nut Ⓨ to the specified torque.

   ☐ : **Lock nut Ⓨ**

   8 - 11 N·m (0.8 - 1.1 kg-m, 5.8 - 8.0 ft-lb)
5. Move selector lever from "P" range to "1" range. Make sure that selector lever can move smoothly.



Vacuum Diaphragm Rod Adjustment

1. Remove diaphragm from transmission case.
2. With a depth gauge, measure depth "L". Be sure vacuum throttle valve is pushed into valve body as far as possible.
3. Check "L" depth with chart below and select proper length rod.

Vacuum diaphragm rod selection

Measured depth "L" mm (in)	Rod length mm (in)	Part number
Under 25.55 (1.0059)	29.0 (1.142)	31932-X0103
25.65 - 26.05 (1.0098 - 1.0256)	29.5 (1.161)	31932-X0104
26.15 - 26.55 (1.0295 - 1.0453)	30.0 (1.181)	31932-X0100
26.65 - 27.05 (1.0492 - 1.0650)	30.5 (1.201)	31932-X0102
Over 27.15 (1.0689)	31.0 (1.220)	31932-X0101

Downshift Solenoid, O.D. Cancel Solenoid and Lock-up Solenoid (RB30E)

Refer to ELECTRICAL SYSTEM.

Kickdown Switch Adjustment

Refer to ELECTRICAL SYSTEM.

Preliminary Checks

FLUID LEAKAGE

To detect a fluid leak:

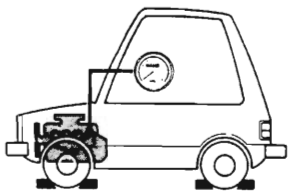
1) Raise vehicle.
2) Clean area suspected of leaking.
3) Start engine, apply foot brake, place selector lever in "D" range, and wait a few minutes.
4) Stop engine.
5) Check for fresh leakage.

FLUID CONDITION

1) Dark or Black Fluid:
   With a burned odor
   — Worn friction material.
2) Milky Pink Fluid: Water Contamination
   — Road water entering through filler tube or breather.
3) Varnished Fluid, light to dark brown and tacky: Oxidation
   — Over or Underfilling.
   — Overheating.

If these conditions exist, check operation of A/T as specified in Road Testing. Especially if the condition as described in 2) exists, it will be necessary to wash all parts in A/T or replace A/T assembly with new one.

Road Testing



SAT596

- Before starting road tests, install vacuum gauge.
- Perform road tests, using "Symptom" chart, as follows:

"P" RANGE

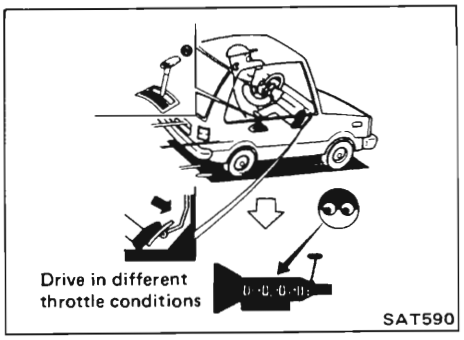
1. Place selector lever in "P" range and start the engine. Stop the engine and repeat the procedure in all other ranges and neutral.
2. Stop vehicle on a slight upgrade and place control lever in "P" range. Release parking brake to make sure vehicle remains locked.

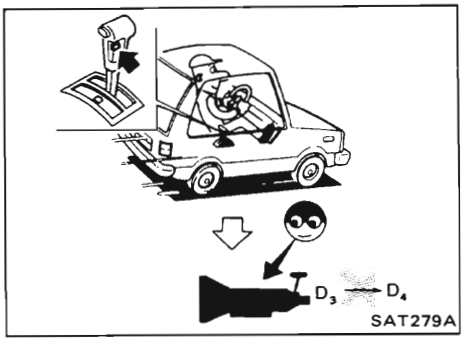
"R" RANGE

1. Shift selector lever from "P" to "R", and note shift quality.
2. Drive the vehicle in reverse long enough to detect slippage or other abnormalities.

"N" RANGE

1. Shift selector lever from "R" and "D" to "N" and note quality.
2. Release parking brake with control lever in "N" range. Lightly depress accelerator pedal to make sure vehicle does not move. (When vehicle is new or soon after clutches have been replaced, vehicle may move slightly. This is not a problem.)





Road Testing (Cont'd)

"D" RANGE

1. Manually shift selector lever from "N" to "D" range, and note shift quality.
2. Using the shift schedule as a reference, drive vehicle in "D" range. Record, on symptom chart, respective vehicle speeds at which upshifting and downshifting occur. Check that there is not a considerable jolt when shifting gears. Also determine the timing at which shocks are encountered during shifting and which clutches are engaged.
3. Check to determine if shifting to overdrive gear cannot be made while O.D. Control/powershift switch is in the "CANCEL"/"OFF" position.
4. When vehicle is being driven in the 65 to 85 km/h in "D_3" range at half to light throttle position, fully depress accelerator pedal to make sure it downshifts from 3rd to 2nd gear.
5. When vehicle is being driven in the 25 to 35 km/h ("D_2" range) at half to light throttle position, fully depress accelerator pedal to make sure it downshifts from 2nd to 1st gear.

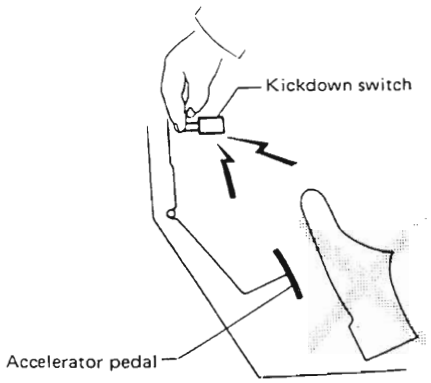
"2" RANGE

1. While vehicle is being driven in "2" range, make sure that it does not shift into 1st or 3rd gear, despite speed.changes.
2. Shift control lever to "D" range and allow vehicle to operate at 40 to 50 km/h. Then, shift to "2" range to make sure it downshifts to 2nd gear.

"1" RANGE

1. Shift selector lever to "1" range and allow vehicle to run. Ensure that it does not upshift from 1st to 2nd gear although vehicle speed increases.
2. While vehicle is being driven in "1" range, release accelerator pedal to make sure that engine compression acts as a brake.
3. Shift selector lever to "D" or "2" range and allow vehicle to run at 20 to 30 km/h. Then, shift selector lever to "1" range to make sure the downshift to 1st gear is made.

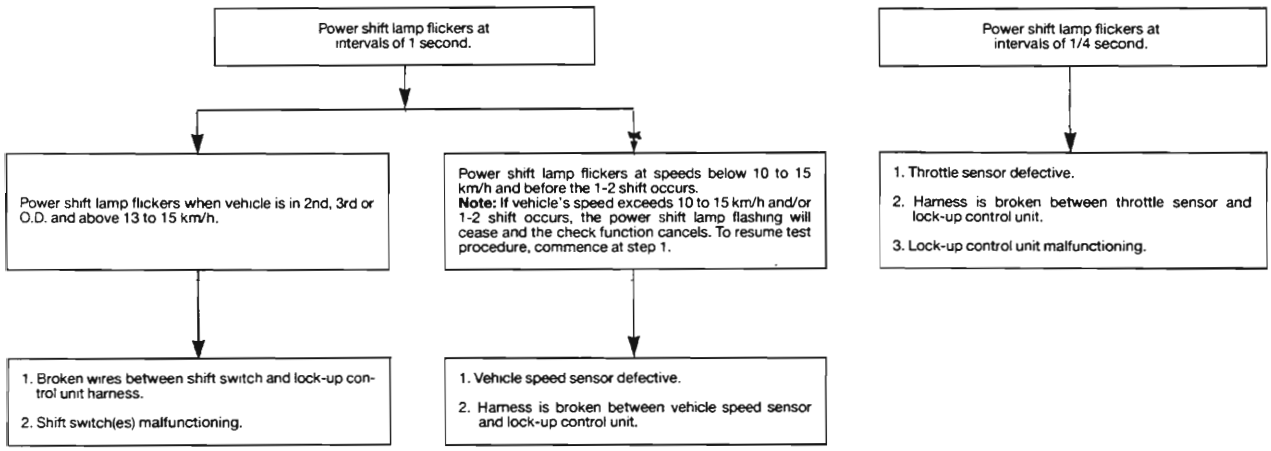
Troubles Detected by Self-diagnosing and Their Indication



Procedure

Before trouble-shooting the lock-up control unit, operate the self-diagnosis function as follows:–

1. Turn power shift switch to the "OFF" position.
2. Turn the ignition switch to "ON".
   Do not start the engine.
3. Operate kickdown switch by hand for at least one second.
   Do not use the accelerator pedal.
   If light flickers at this stage, refer chart below.
   If light does not flicker, continue.
4. Start the engine and run the vehicle about 20 km/h and check to see whether or not an abnormal condition exists. (The power shift lamp will blink if a problem exists.)
   Turning the ignition switch to "OFF" or "ACC" cancels the self-diagnosis function. If cancelled, repeat steps over again.
5. If an abnormal condition is indicated, track down the cause of the problem in accordance with the chart as shown below.



Inspection procedure 1. — Defective vehicle speed signal.

1. Connect tester to connector terminals, Nos. 11 and 22, of control unit.
2. Check voltage variation by running vehicle over 1 m (3 ft) at very slow speed.
   Proper indication:
   Voltage must vary from 0V to over 5V.

   If voltage does not vary correctly, refer to checking procedure for Speedo Sensor **AND** Speedo Divider Circuit and Wiring (page EL-37).

Inspection procedure 2. — Defective throttle sensor signal.

1. Connect tester to connector terminals, Nos. 4 and 22, of control units.
2. Measure voltage while operating accelerator pedal.
   Proper indication:
   Accelerator pedal in full-close throttle position: 0.4V
   Accelerator pedal in full-open throttle position: 4V

If voltage does not vary correctly, but voltages at pins 3 and 5 of control unit are correct, proceed as follows:

1. Back probe harness side of throttle sensor connector plug (ignition on, engine not running).
2. Check voltage between L. green/red wire and ground while opening and closing throttle. Voltage should vary between 0.4V and 4V.

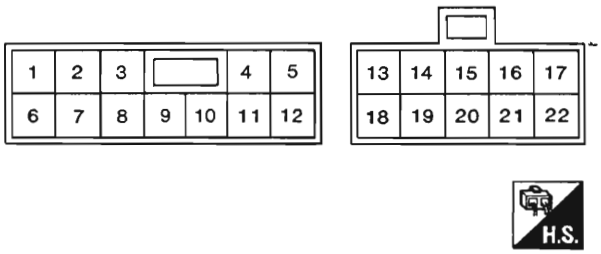
3a. If OK check continuity of LG/R wire between harness plug and control unit connector pin 4.

3b. If N.G. disconnect switch from harness and check for 5V between LG/R wire and ground and for continuity between LG wire and ground.
If N.G. check wiring.
If OK replace throttle sensor/switch.

Inspection of Lock-up Control Unit

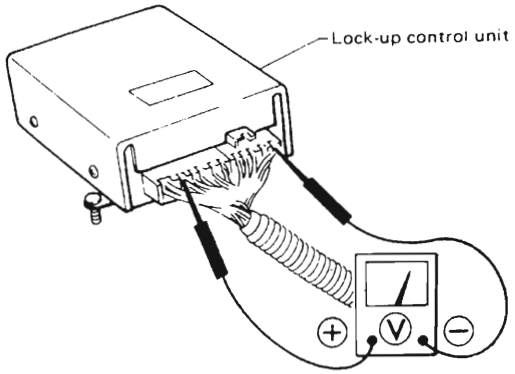
RB30E

Note: When inspecting control unit, be aware that faults can be caused by previous water damage which may not be immediately apparent at the time of testing.



Check voltage between No. 22 terminal (Ground) and each terminal in the following table using tester.

Note: Terminals (14) and (20) are not used as inputs for the lock-up control unit. Early production vehicles have a wire terminated at pin (14), however it is not necessary to check this wiring when performing control unit inspection.



Terminal No.	Wire Colour	Component signal	Test method	Required result
1	PU/W	Downshift solenoid	Depress and release accelerator pedal	0V — pedal depressed 12V — pedal released
2	GR/R	Lock-up solenoid	Drive vehicle in "D" and "2" at constant speeds with less than half throttle	Above 75 kph in "D" — 0V Below 75 kph in "D" — 12V Above 60 kph in "2" — 0V Below 60 kph in "2" — 12V
3	R	Throttle sensor (power source)	Depress and release accelerator pedal	5V at all times
4	LG/R	Throttle sensor	Operate accelerator pedal with engine stopped, ignition on	Full throttle 0.4V Throttle closed 4V
5	G	Throttle sensor (ground)	Use Ω meter	Check continuity to ground
6	L/R	O.D. cancel solenoid	Operate power shift switch	Powershift on — 0V Powershift off — 12V

RB30E

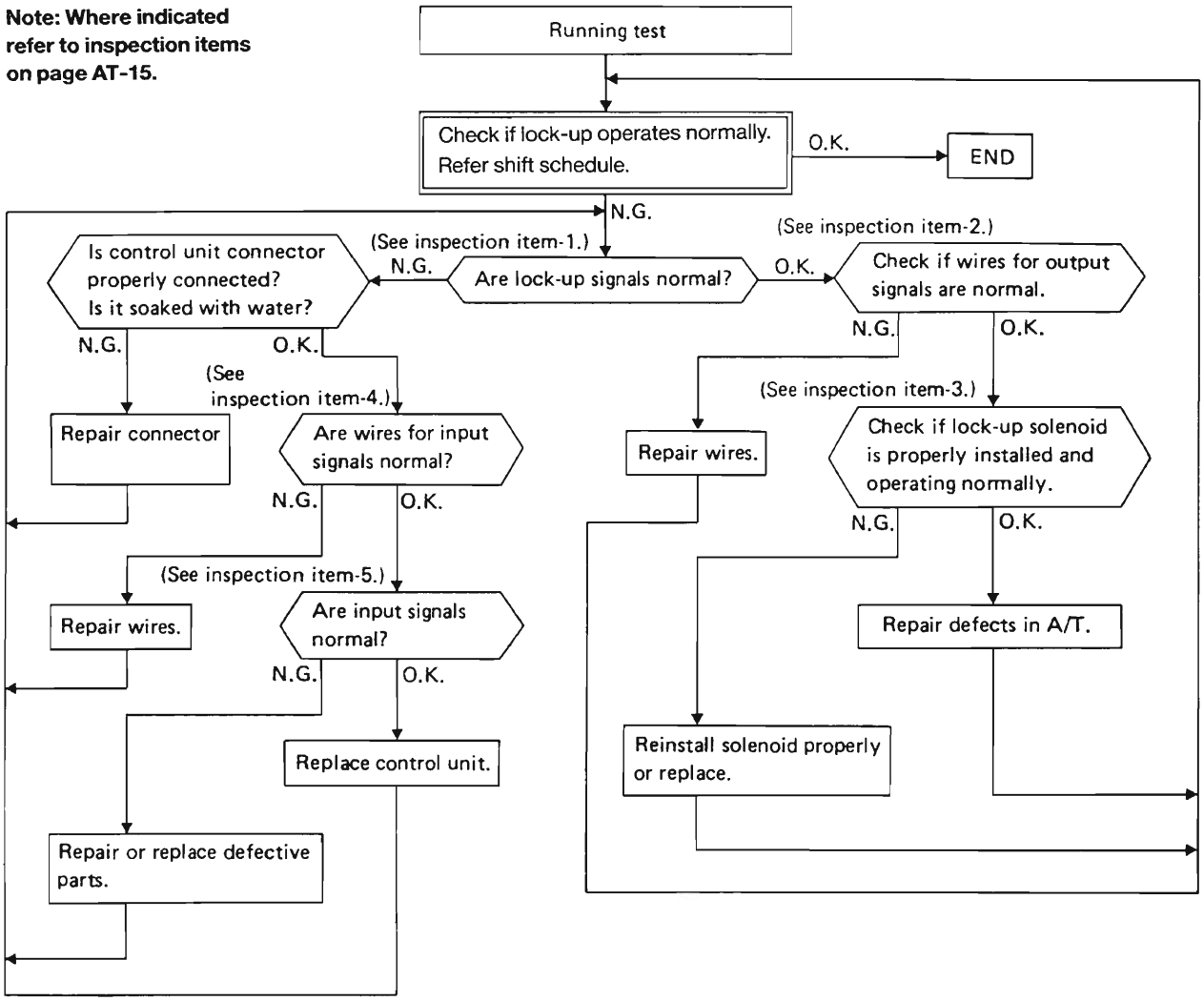
Inspection of Lock-up Control Unit (cont.)

Terminal No.	Wire Colour	Component signal	Test method	Required result
7	L/W	Power shift indicator lamp	Drive vehicle below 30 kph or above 70 kph then quickly depress accelerator	0V when accelerator is depressed 12V more than 3 seconds after accelerator is released
8	Y/P	Idle contact switch	Operate accelerator pedal	Throttle closed — More than 4.8V Part throttle — 0V
9	P/L	Full throttle contact switch	Operate accelerator pedal	Less than ¼ throttle — 0V More than ½ throttle — More than 4.8V
10	G/B	Inhibitor "2" range switch	Move gear selector lever to each position	12V in "2" position 0V in all other positions
11	W/L	Vehicle speed sensor	Drive vehicle at very low speed	Voltage must vary between 0V and 5V
12	W/B	1-2 shift switch	Drive vehicle in "D" range with light throttle setting	D1 range 0V D2, D3, D4 ranges 5V
13				
14				
15	W/G	ASCD O.D. cut signal (T.I. only)	Turn ASCD on and operate accelerate switch above 48 kph	0V when accelerate switch is on 5V when accelerate switch is off
		3-4 shift switch	Drive vehicle in "D" range with light throttle setting	D1, D2, D3 ranges — 0V D4 range — 5V
16	W/R	2-3 shift switch	Drive vehicle in "D" range with light throttle setting	D1, D2 ranges — 0V D3, D4 ranges — 5V
17	Y/R	Power source	Connect voltmeter between terminal 17 and body ground	12V at all times
18	R	Power shift switch	Operate power shift switch	Switch on — 0V Switch off — 5V
19	Y/R	Oil temperature sensor	Test voltage with ignition on If necessary remove switch Conduct continuity test	Voltage Oil temp below 10°C — 0V Oil temp above 20°C — 5V Continuity Below 10°C — Above 20°C —
20				
21	OR	Kickdown switch	Operate accelerator with engine off, ignition on	Full throttle — 0V Other throttle position — 5V
22	B	Ground		

Inspection of Lockup Control (Cont'd)

RB30E

Note: Where indicated refer to inspection items on page AT-15.



Inspection of Lockup Control (Cont'd)

RB30E

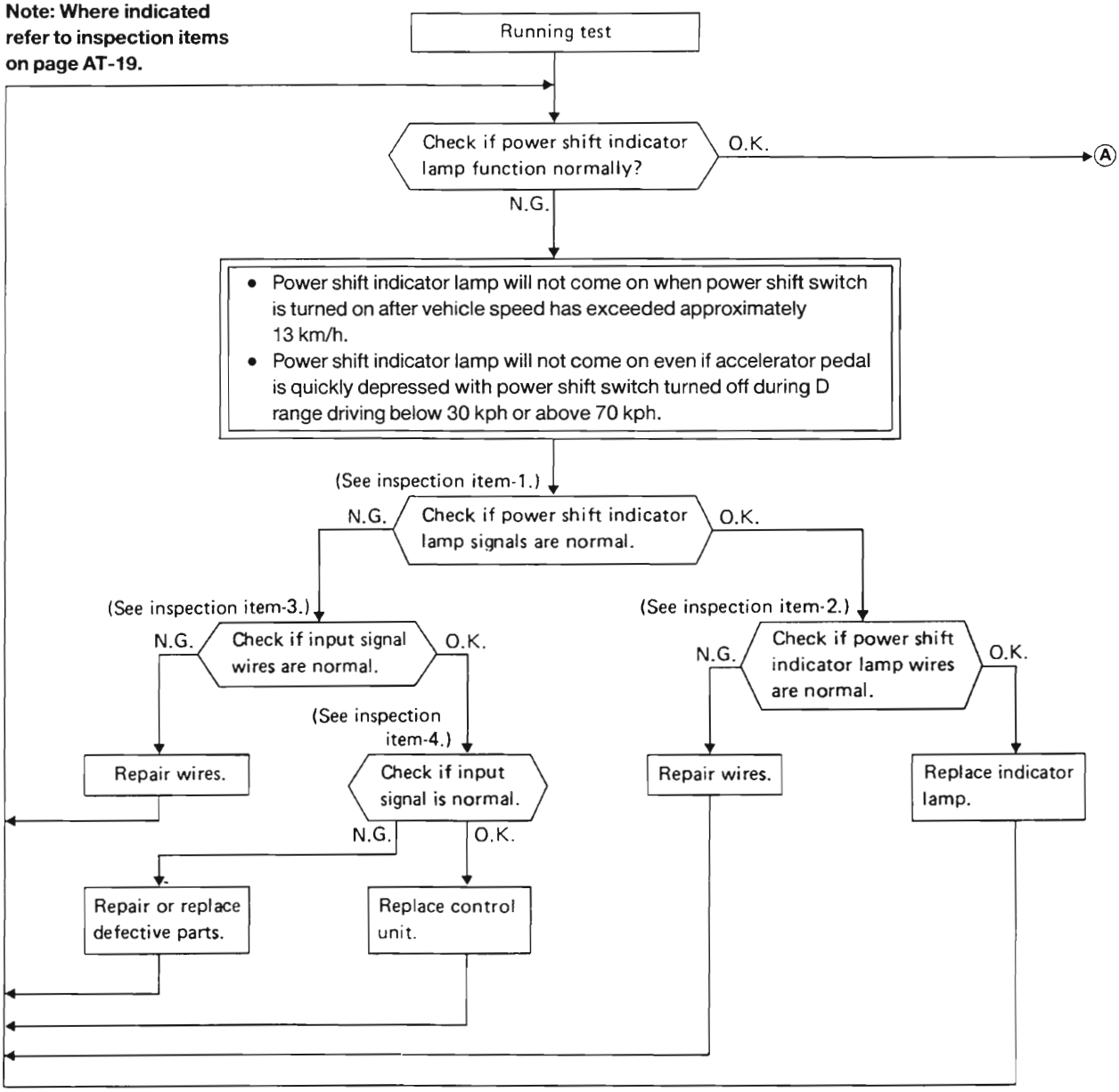
INSPECTION POINTS

Inspection No.	Item to be checked	Checking method
1	Lock-up signals	Refer test for terminal 2 on page AT-12.
2	Wires for output signals	Check if connector between control unit and lock-up solenoid is properly connected. Also, check connector for continuity.
3	Lock-up solenoid	• Check if O-ring is installed to tip of solenoid. • Check operation of solenoid by applying 12V voltage.
4	Wires for input signals	Check if connections are properly made between control unit and following sensors. Also, check connectors for conduction. • Throttle sensor (Idle, high-throttle side) • Inhibitor switch (2 range) • Shift switches (1-2, 2-3 and 3-4) • Low-temperature sensor • Kickdown switch • Vehicle speed sensor • Power shift switch
5	Input signals	Check items given on inspection-4 in chart on pages AT-12 and 13.

RB30E

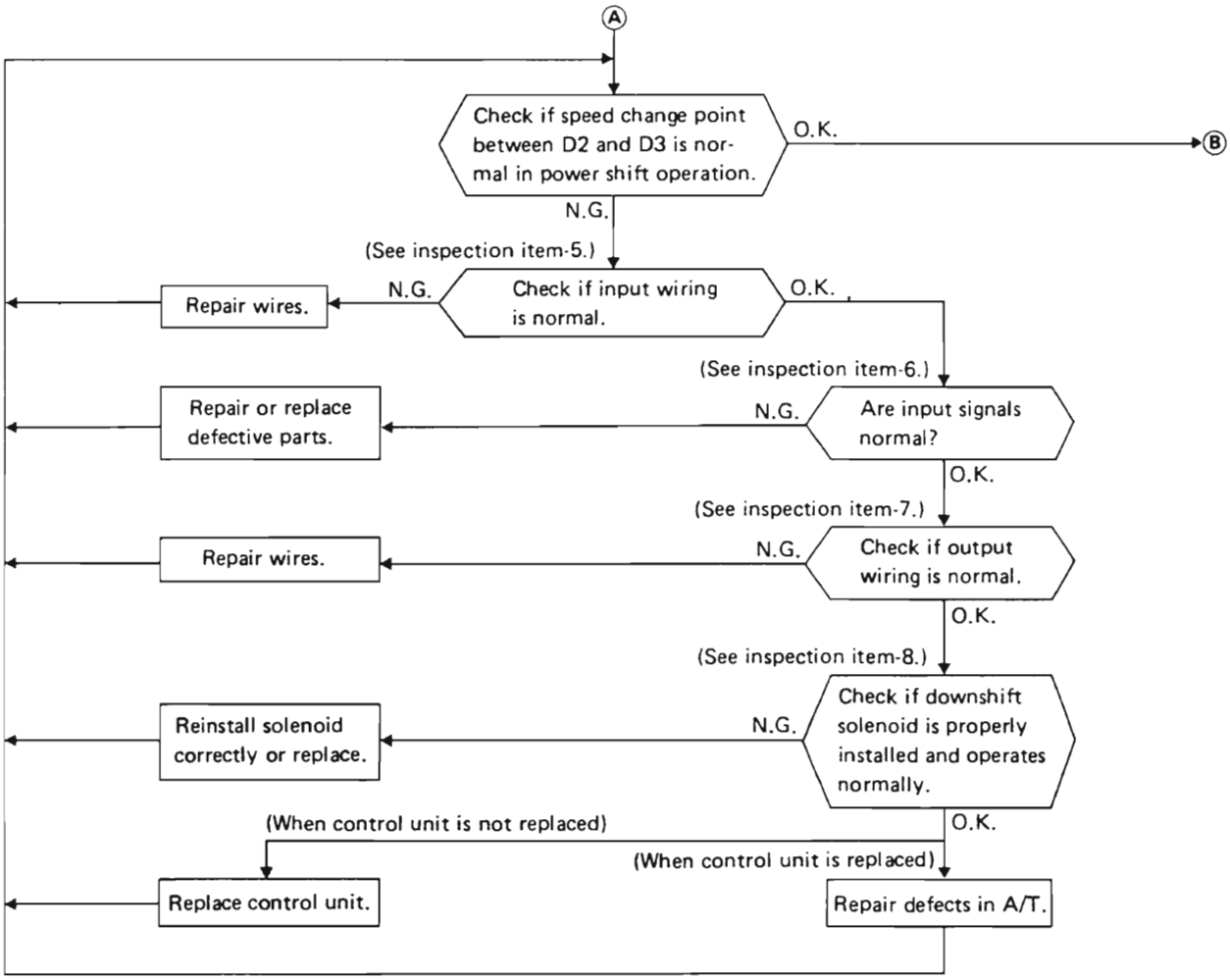
Inspection of Shift Pattern Change Control

Note: Where indicated refer to inspection items on page AT-19.



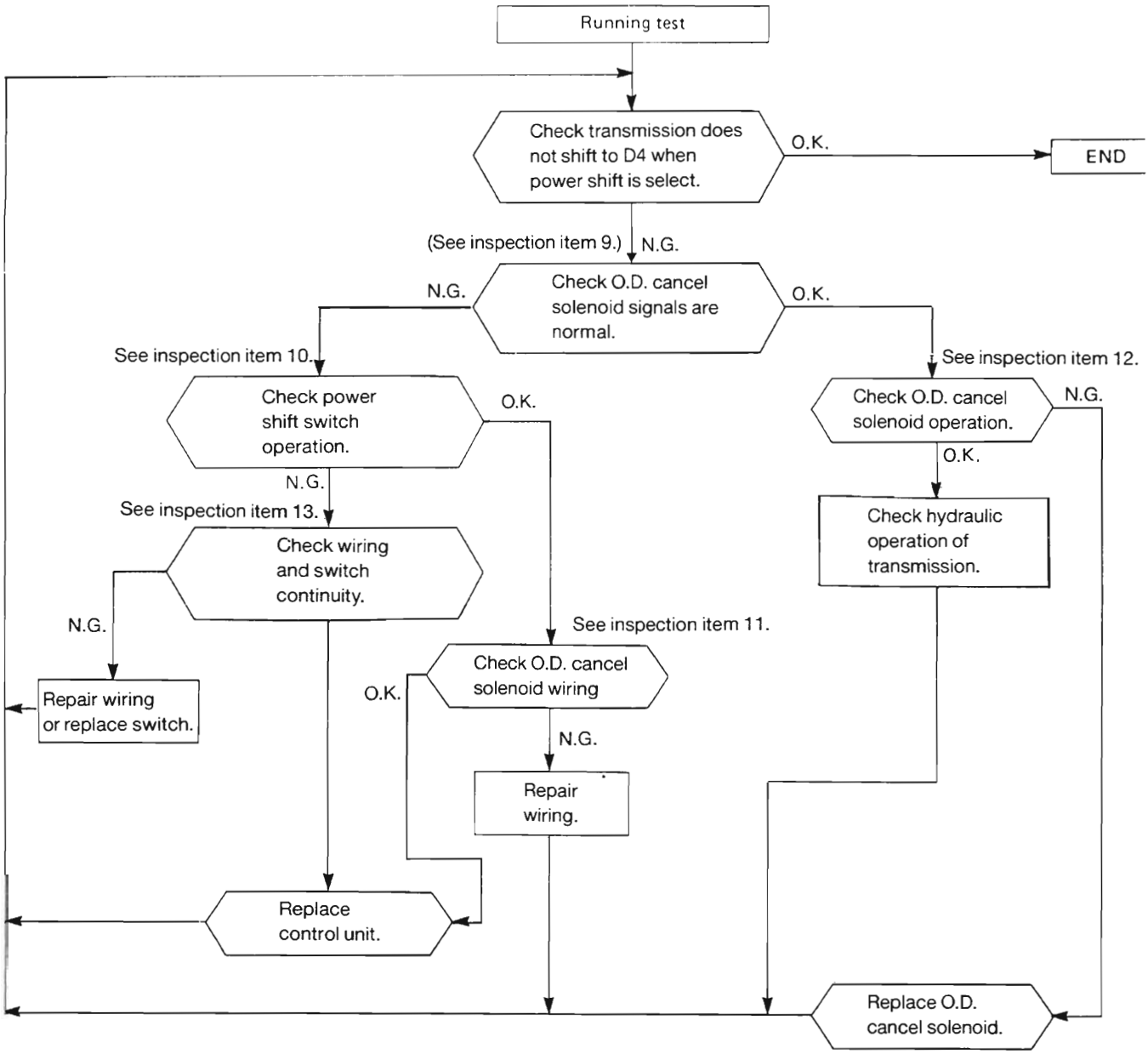
Inspection of Shift Pattern Change Control (Cont'd)

RB30E



Inspection of Shift Pattern Change Control (Cont'd)

RB30E



Inspection of Shift Pattern Change Control (Cont'd)

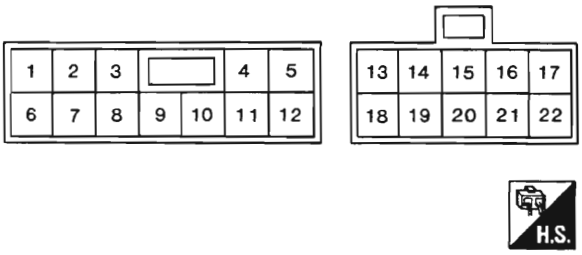
RB30E

INSPECTION POINTS

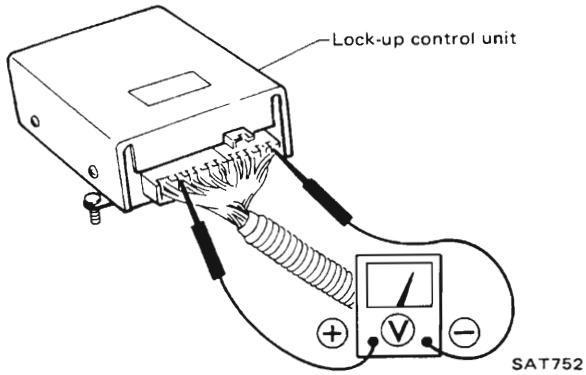
Inspection No.	Item to be checked	Checking method
1	Power shift indicator lamp signals	• Jack up rear wheels and accelerate in D range. When vehicle speed goes over approximately 13 km/h turn on power shift switch. • Jack up rear wheels and quickly depress accelerator pedal while in D range. To confirm if signals come out to turn on power shift indicator lamp in the above condition, check power shift indicator lamp for items given in chart on page AT-12.
2	Power shift indicator lamp wiring	• Check connector between control unit and power shift indicator lamp for proper connection and continuity.
3	Input wiring	Check connectors between control unit and following sensors for proper connections and continuity. • Power shift switch • Throttle sensor • Vehicle speed sensor
4	Input signals	Check same items as inspection-3 given in chart on pages AT-12, and 13.
5	Input wiring	Check connectors between control unit and following sensors for proper connections and continuity. • Inhibitor switch ("2" range) • Shift switches (1-2, 2-3, and 3-4)
6	Input signals	Check same items as inspection-5 given in chart on pages AT-12 and 13.
7	Output wiring	Check connector between control unit and downshift solenoid for proper connections and continuity.
8	Downshift solenoid	• Apply 12V voltage to solenoid proper to see if it functions normally.
9	Input wiring	• Check connector between control unit and 3-4 shift switch for proper connections and continuity.
10	Input signals	Check item "3-4 shift switch" in chart on page AT-13.
11	Output wiring	Check connector between control unit and O.D. cancel solenoid for connections and continuity.
12	O.D. cancel solenoid	Apply 12V voltage to solenoid proper to see if it functions normally.

CA20E

Inspection of Kickdown Control Unit

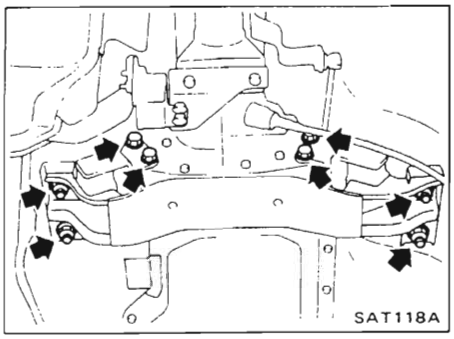


Check voltage between No. 22 terminal (Ground) and each terminal in the following table using tester. Ignition on, engine not running.



Terminal No.	Wire Colour	Component signal	Test method	Required result
1	PU/W	Kickdown solenoid ground circuit	Run vehicle above 10 kph Operate kickdown switch by hand	Switch off — Battery voltage Switch on — 0V
3	R	Throttle sensor power source		Approximately 5V
4	LG/R	Throttle sensor signal line	Depress accelerator	Approximately 4.0V
			Release accelerator	Approximately 0.4V
5	G	Throttle sensor ground circuit	Use Ω meter	Check continuity to ground
6	L/R	O.D. cancel solenoid ground circuit	Operate O.D. cancel switch	O.D. on 12v O.D. cancel 1v
11	W/L	Vehicle speed signal	Rotate prop shaft slowly	Voltage varies between 0V and 5V
17	Y	Power supply to control unit		Battery voltage
21	OR	Kickdown switch signal	Depress accelerator	0 volts
			Release accelerator	Approximately 5 volts

If a fault is detected in vehicle speed or throttle sensor signal, refer to page AT-11 for inspection procedure.

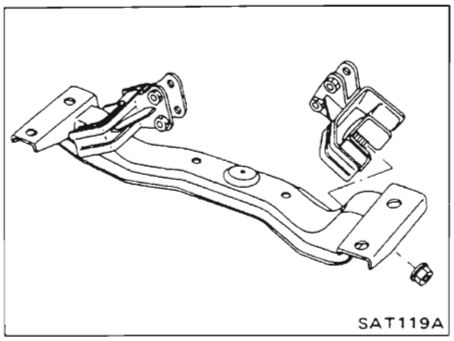


Pressure Testing

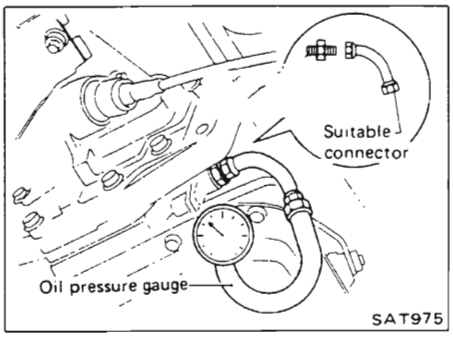
1. Install pressure gauge to line pressure port.

— RB30E —

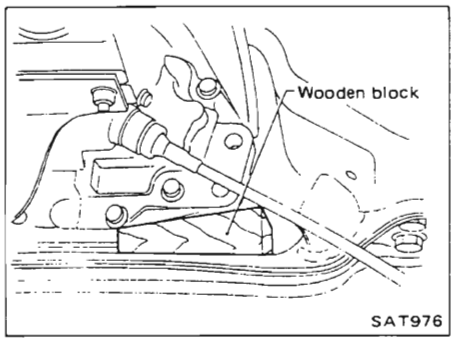
(1) Support transmission with a jack.
(2) Remove rear transmission mounting bracket assembly.



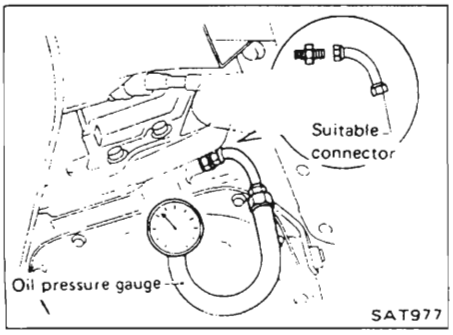
(3) Remove R.H. rear transmission mounting.



(4) Remove line pressure plug and install oil pressure gauge and adapters.



(5) Install rear transmission mounting bracket without rear transmission mounting insulator R.H.
(6) Place a suitably sized wooden block between the transmission and rear transmission mounting bracket.



— CA20E —

Remove line pressure plug and install oil pressure gauge and adapters.

Pressure Testing (Cont'd)

2. Warm up engine until engine oil and A.T.F. reach operating temperature.

   A.T.F. temperature:
   50 - 80°C (122 - 176°F)
3. Set parking brake and block wheels.
4. Measure line pressure at idle and stall point while depressing brake pedal fully.

- **When measuring line pressure at stall point, follow the stall test procedure.**

Line pressure at idling kPa (bar, kg/cm², psi)

Range \ Engine	CA20E	RB30E
R	412 - 549 (4.12 - 5.49, 4.2 - 5.6, 60 - 80)	510 - 696 (5.10 - 6.96, 5.2 - 7.1, 74 - 101)
D	314 - 373 (3.14 - 3.73, 3.2 - 3.8, 46 - 54)	314 - 373 (3.14 - 3.73, 3.2 - 3.8, 46 - 54)
2	412 - 971 (4.12 - 9.71, 4.2 - 9.9, 60 - 141)	549 - 1,128 (5.49 - 11.28, 5.6 - 11.5, 80 - 164)
1	314 - 373 (3.14 - 3.73, 3.2 - 3.8, 46 - 54)	314 - 373 (3.14 - 3.73, 3.2 - 3.8, 46 - 54)

Line pressure at stall testing kPa (bar, kg/cm², psi)

Range \ Engine	CA20E	RB30E
R	1,402 - 1,589 (14.02 - 15.89, 14.3 - 16.2, 203 - 230)	2,089 - 2,393 (20.89 - 23.93, 21.3 - 24.4, 303 - 347)
D	971 - 1,089 (9.71 - 10.89, 9.9 - 11.1, 141 - 158)	1,128 - 1,275 (11.28 - 12.75, 11.5 - 13.0, 164 - 185)
2	902 - 1,089 (9.02 - 10.89, 9.2 - 11.1, 131 - 158)	1,138 - 1,285 (11.38 - 12.85, 11.6 - 13.1, 165 - 186)
1	971 - 1,089 (9.71 - 10.89, 9.9 - 11.1, 141 - 158)	1,128 - 1,275 (11.28 - 12.75, 11.5 - 13.0, 164 - 185)

JUDGMENT BY MEASURING LINE PRESSURE

If line pressure does not rise, first check to make sure that vacuum hose is connected properly.

1) When line pressure is low at all positions, the problem may be due to:

- Wear on interior of oil pump
- Oil leakage at or around oil pump, control valve body, transmission case or governor
- Sticking pressure regulator valve
- Sticking pressure modifier valve

Pressure Testing (Cont'd)

2) When line pressure is low at a particular position, the problem may be due to the following:
- If oil leaks at or around rear clutch or governor, line pressure is low in "D", "2" or "1" range but is normal in "R" range.
- If oil leaks at or around low and reverse brake circuit, line pressure becomes low in "R" or "P" range but is normal in "D", "2" or "1" range.

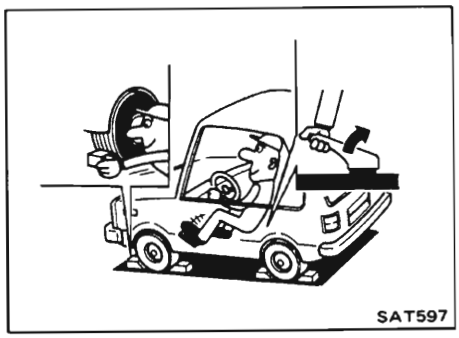
3) When line pressure is high, pressure regulator valve may have stuck.

Stall Testing

The stall test is an effective method of testing clutch and band holding ability, torque converter one-way clutch operation, and engine performance. A stall test should only be performed as a last resort because of the high fluid temperature it generates and the excessive load it places on the engine and transmission.

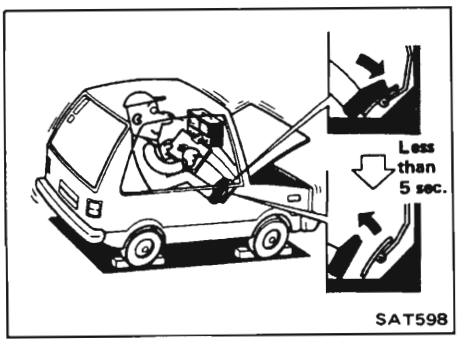
CAUTION:

a. **Transmission and engine fluid levels should always be checked and fluid added as needed.**
b. **Run engine to attain proper warm-up.**
c. **During test, never hold throttle wide-open for more than 5 seconds.**
d. **Do not test more than two gear ranges without driving vehicle to cool off engine and transmission.**


SAT597

STALL TEST PROCEDURE

1. Set parking brake and block wheels.
2. Install a tachometer where it can be seen by driver during test.
3. Start engine and place selector lever in "D" range.



SAT598

4. Apply foot brake and accelerate to wide-open throttle.
5. Quickly note the engine stall speed and immediately release throttle.

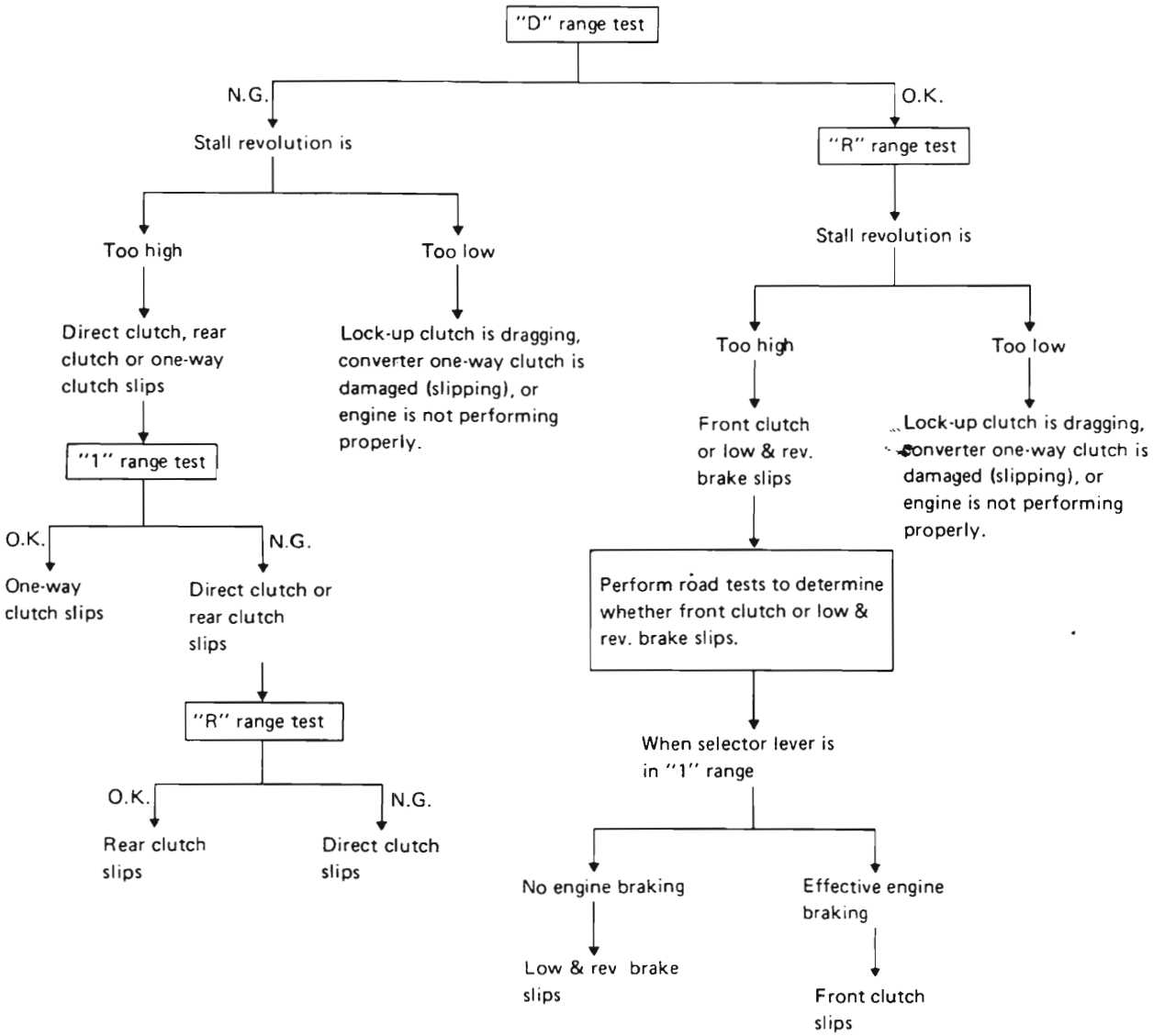
Stall revolution

CA20E:	**2,200 ± 150 rpm**
RB30E:	**2,450 ± 150 rpm**

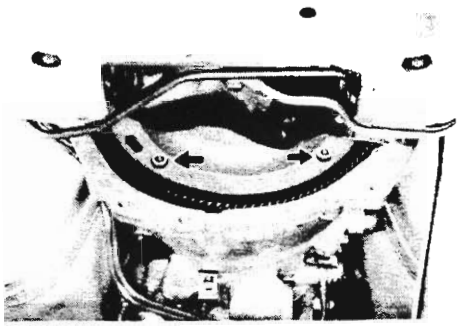
Stall Testing (Cont'd)

6. Shift selector lever to "N".
7. Cool off A.T.F.
8. Perform stall tests in the same manner as in steps 3 through 7 with selector lever in "1" and "R", respectively.

STALL TEST ANALYSIS



If converter one-way clutch is frozen, vehicle will have poor high speed performance and low engine rpm when it is raced in "N" range. If converter one-way clutch is slipping, vehicle will be sluggish up to 50 or 60 km/h.

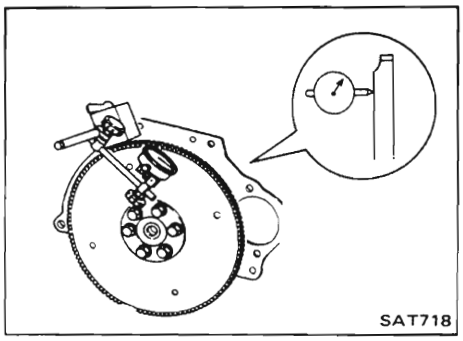


Removal

- Remove bolts securing torque converter to drive plate.
- **Before removing torque converter, inscribe matching marks on two parts so that they may be replaced in their original positions during assembly.**
- Plug up openings such as oil charging pipe, etc.

CAUTION:

Take care not to strike any adjacent parts when removing transmission.



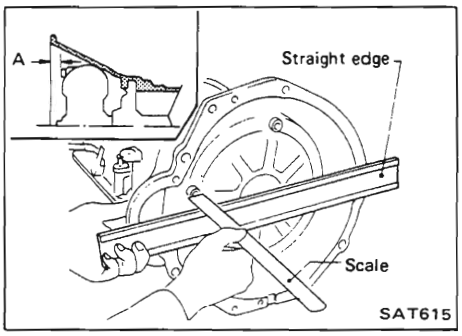
Installation

- Drive plate runout

  Maximum allowable runout:

  0.5 mm (0.020 in)

  If this runout is out of allowance, replace drive plate and ring gear.



- When connecting torque converter to transmission, measure distance "A" to be certain that they are correctly assembled.

  Distance "A":

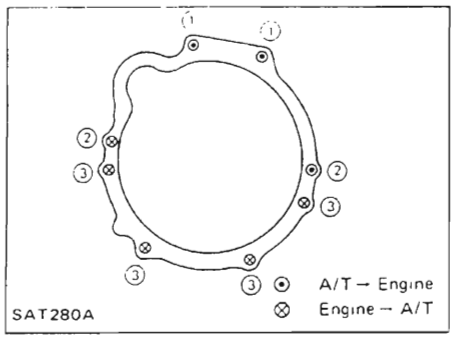
  More than 35 mm (1.38 in)

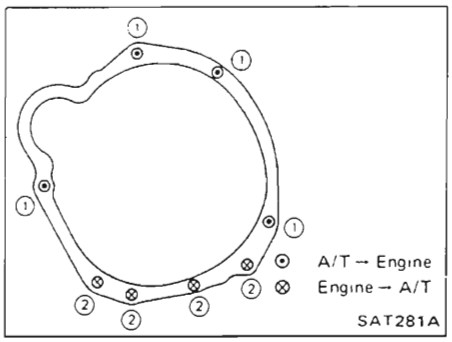
- Install converter to drive plate.

a. **Align matching marks painted across both parts during disassembly.**

b. **Before installing torque converter securing bolts, apply locking sealer to threads of bolts.**

- After converter is installed, rotate crankshaft several turns and check to be sure that transmission rotates freely without binding.





Installation (Cont'd)

- Installation bolt

a. CA20E

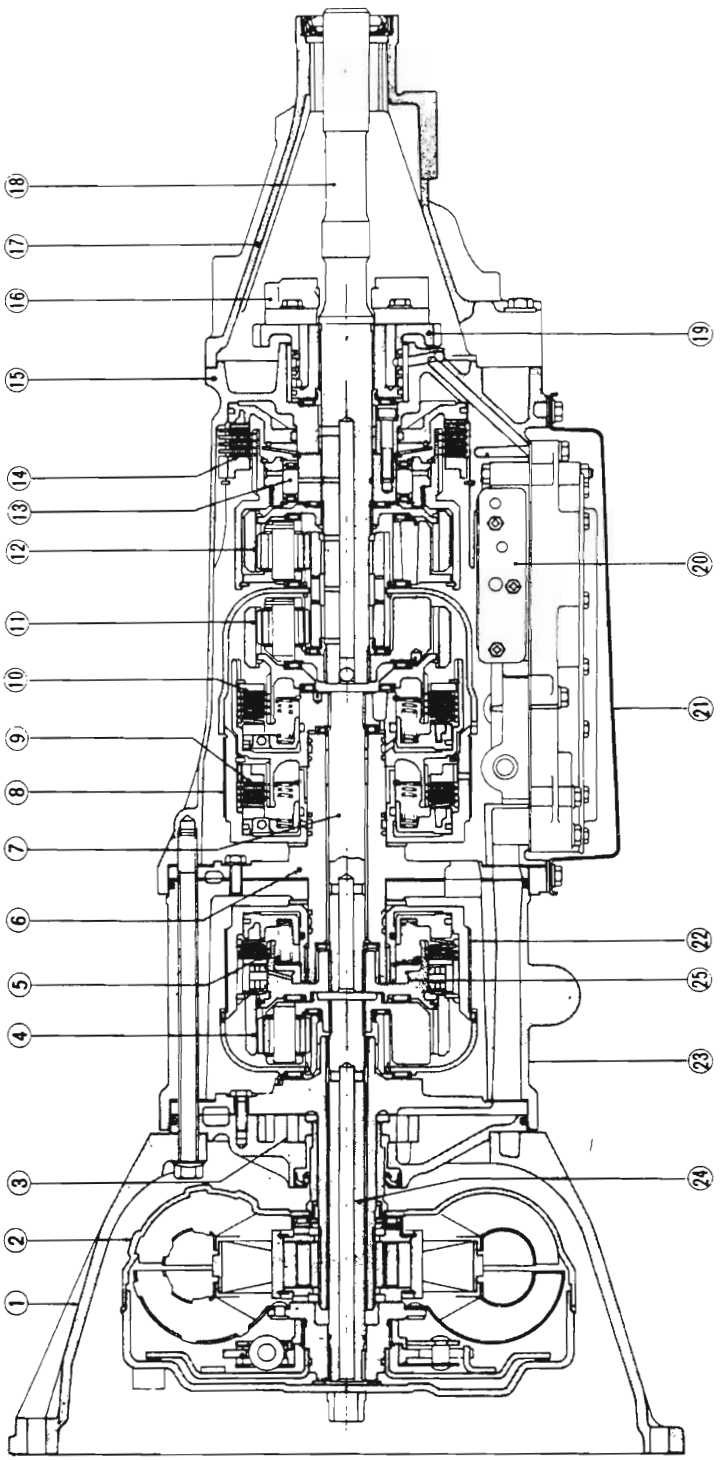
	Tightening torque N·m (kg-m, ft-lb)	Bolt length "L" mm (in)
1	39 - 49 (4 - 5, 29 - 36)	55 (2.17)
2	39 - 49 (4 - 5, 29 - 36)	75 (2.95)
3	29 - 39 (3 - 4, 22 - 29)	25 (0.98)

b. RB30E

	Tightening torque N·m (kg-m, ft-lb)	Bolt length "L" mm (in)
1	39 - 49 (4 - 5, 29 - 36)	40 (1.57)
2	29 - 39 (3 - 4, 22 - 29)	25 (0.98)

- Check inhibitor switch for operation.
- Check fluid level in transmission.
- Move selector lever through all positions to be sure that transmission operates correctly.
  With parking brake applied, run engine at idle speed. Move selector lever through "N" to "D", to "2", to "1" and to "R". A slight shock should be felt each time transmission is shifted.

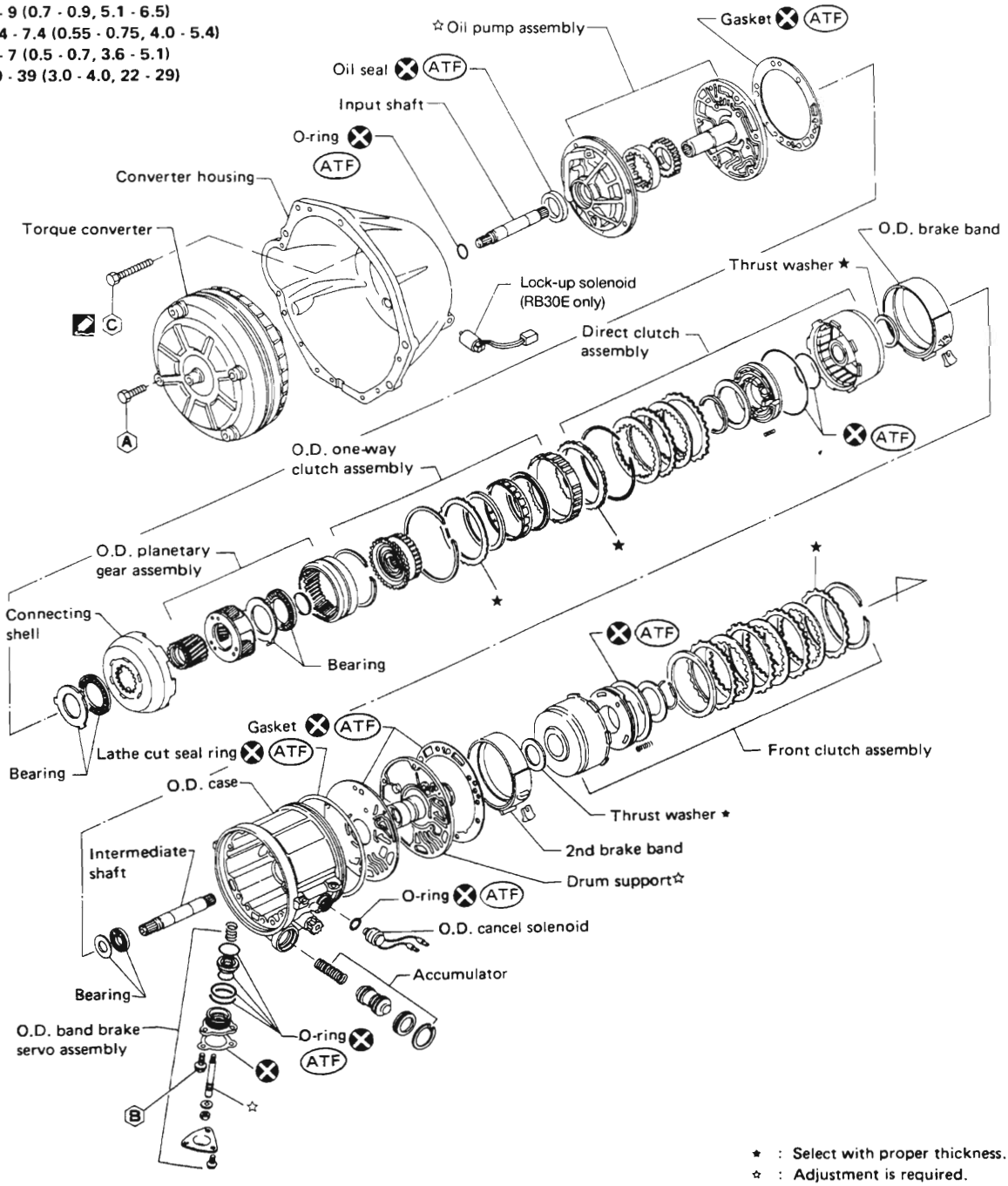
- Check to be sure that line pressure is correct. To do this, refer to Line Pressure Test.
- Perform stall test.



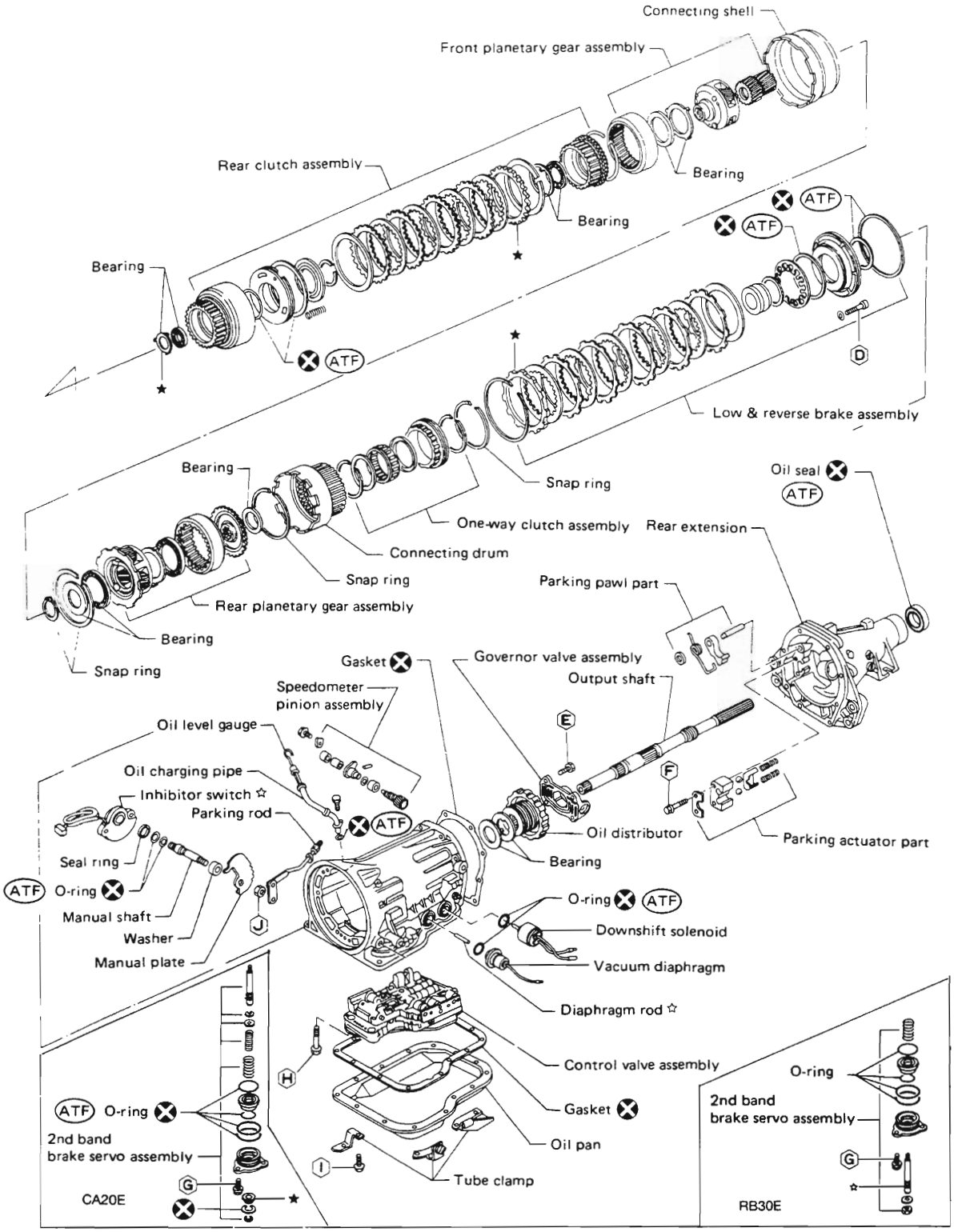
1 Converter housing
2 Torque converter
3 Oil pump assembly
4 O.D. planetary gear
5 Direct clutch
6 Drum support
7 Intermediate shaft
8 2nd band brake
9 Front clutch
10 Rear clutch
11 Front planetary gear
12 Rear planetary gear
13 One-way clutch
14 Low & reverse clutch
15 Transmission case
16 Governor valve assembly
17 Rear extension
18 Output shaft
19 Oil distributor
20 Control valve assembly
21 Oil pan
22 O.D band brake
23 O.D case
24 Input shaft
25 O.D. one-way clutch

SAT226A

: N·m (kg-m, ft-lb)
Ⓐ 39 - 49 (4.0 - 5.0, 29 - 36)
Ⓑ 10 - 15 (1.0 - 1.5, 7 - 11)
Ⓒ 44 - 54 (4.5 - 5.5, 33 - 40)
Ⓓ 13 - 18 (1.3 - 1.8, 9 - 13)
Ⓔ 5 - 7 (0.5 - 0.7, 3.6 - 5.1)
Ⓕ 8 - 11 (0.8 - 1.1, 5.8 - 8.0)
Ⓖ 7 - 9 (0.7 - 0.9, 5.1 - 6.5)
Ⓗ 5.4 - 7.4 (0.55 - 0.75, 4.0 - 5.4)
Ⓘ 5 - 7 (0.5 - 0.7, 3.6 - 5.1)
Ⓙ 29 - 39 (3.0 - 4.0, 22 - 29)



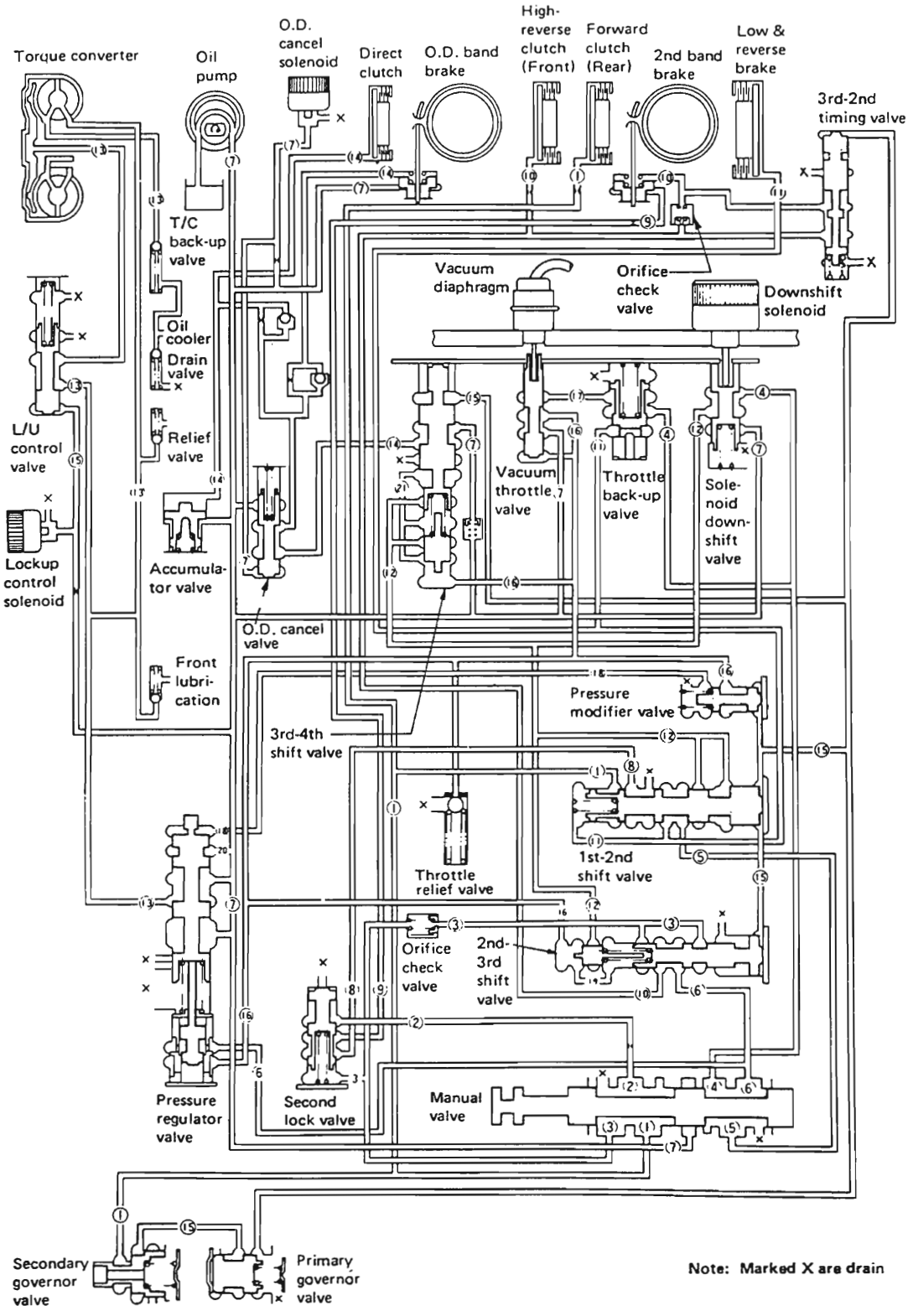
★ : Select with proper thickness.
☆ : Adjustment is required.
ATF : Apply A.T.F.


Connecting shell
Front planetary gear assembly
Rear clutch assembly
Bearing
Bearing
Bearing
ATF
ATF
ATF
D
Low & reverse brake assembly
Bearing
Snap ring
Oil seal
ATF
One-way clutch assembly
Rear extension
Connecting drum
Snap ring
Parking pawl part
Rear planetary gear assembly
Bearing
Snap ring
Gasket
Governor valve assembly
Output shaft
Speedometer pinion assembly
E
Oil level gauge
Oil charging pipe
Inhibitor switch ☆
Parking rod
ATF
F
Oil distributor
Parking actuator part
Seal ring
ATF
O-ring
Bearing
Manual shaft
Washer
Manual plate
J
O-ring
ATF
Downshift solenoid
Vacuum diaphragm
Diaphragm rod ☆
Control valve assembly
H
Gasket
Oil pan
I
Tube clamp
ATF
O-ring
2nd band brake servo assembly
G
CA20E
O-ring
2nd band brake servo assembly
G
RB30E

SAT227A

Hydraulic Control Circuits
RB30E ENGINE

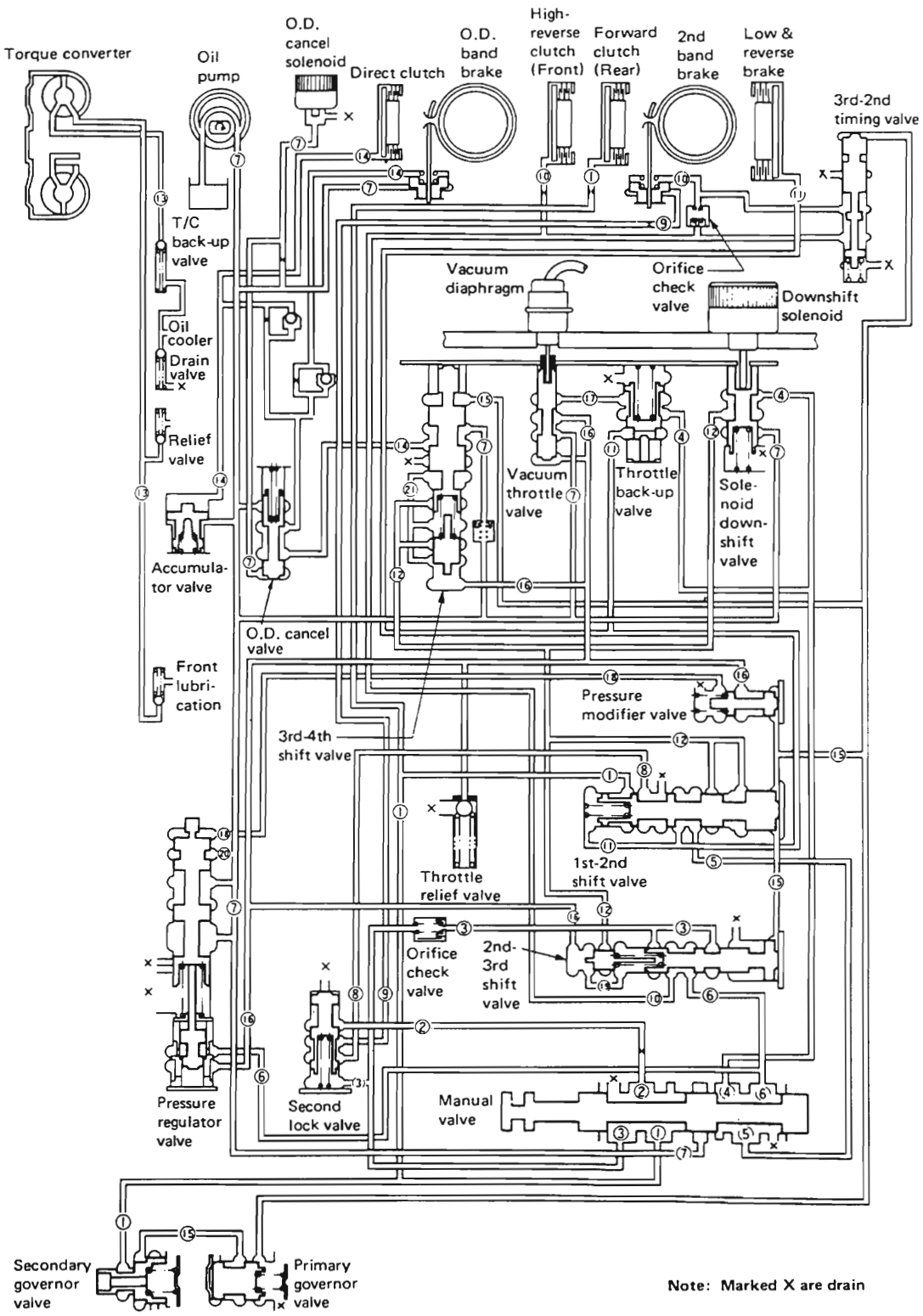
E4N71B



Hydraulic Control Circuits (Cont'd)

CA20E ENGINE

4N71B



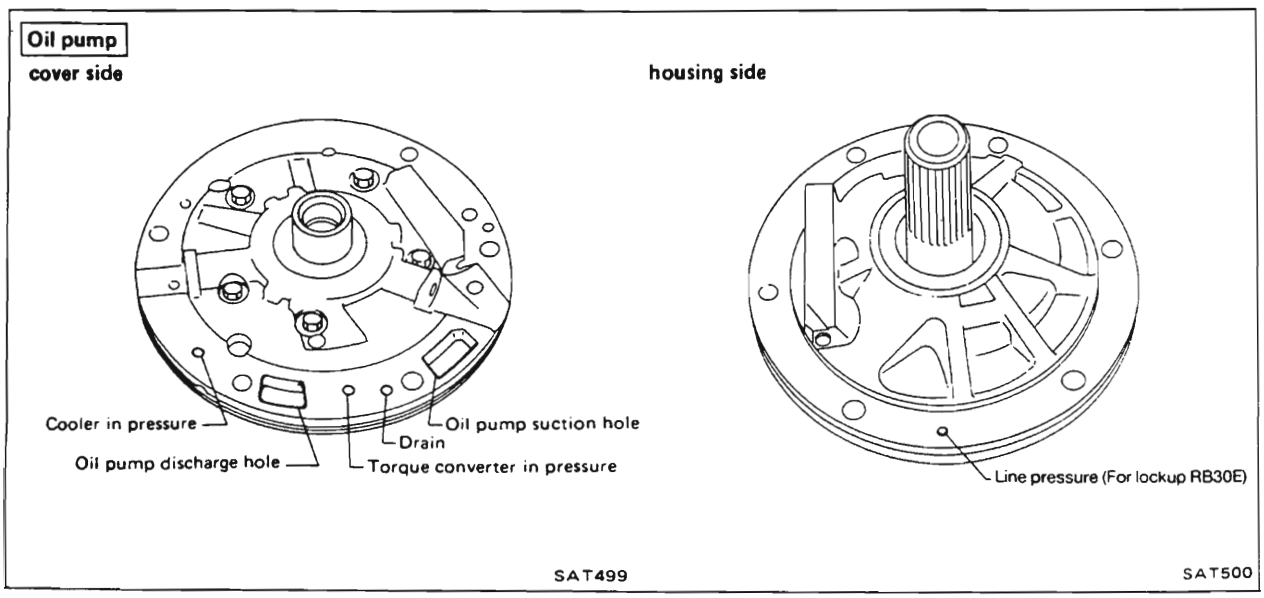
Note: Marked X are drain

Mechanical Operation

Range		Direct clutch	O.D. band servo		Front clutch	Rear clutch	Low & reverse brake	2nd band servo		One-way clutch	Parking pawl
			Apply	Release				Apply	Release		
Park		ON	(ON)	ON			ON				ON
Reverse		ON	(ON)	ON	ON		ON		ON		
Neutral		ON	(ON)	ON							
D	D_1 (Low)	ON	(ON)	ON		ON				ON	
	D_2 (Second)	ON	(ON)	ON		ON		ON			
	D_3 (Top)	ON	(ON)	ON	ON	ON		(ON)	ON		
	D_4 (O.D.)		ON		ON	ON		(ON)	ON		
2	Second	ON	(ON)	ON		ON		ON			
1	1_2 (Second)	ON	(ON)	ON		ON		ON			
	1_1 (Low)	ON	(ON)	ON		ON	ON			ON	

The low & reverse brake is applied in "1_1" range to prevent free wheeling when coasting and allows engine braking.

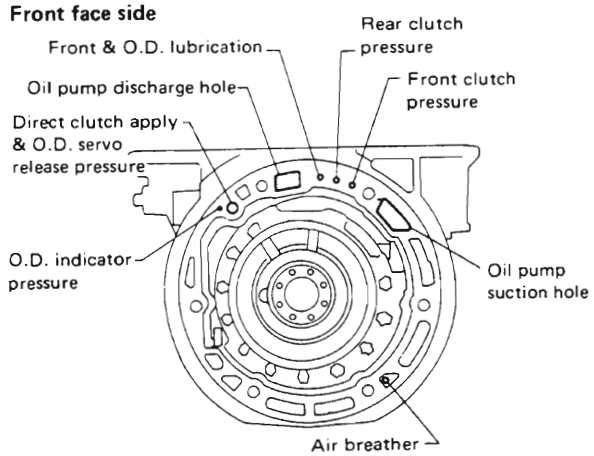
Oil Channel



Oil Channel (Cont'd)

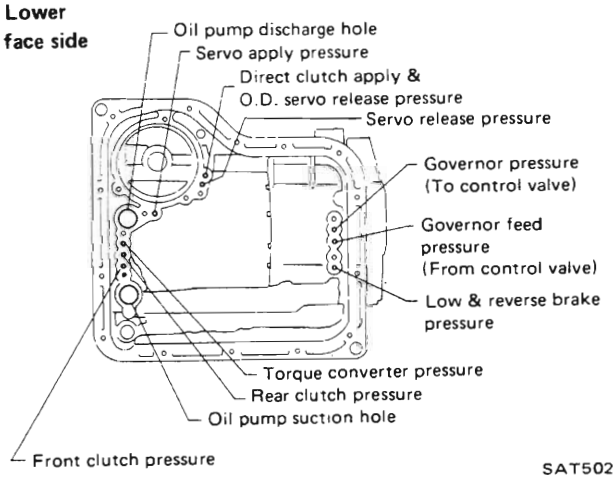
Transmission case

Front face side



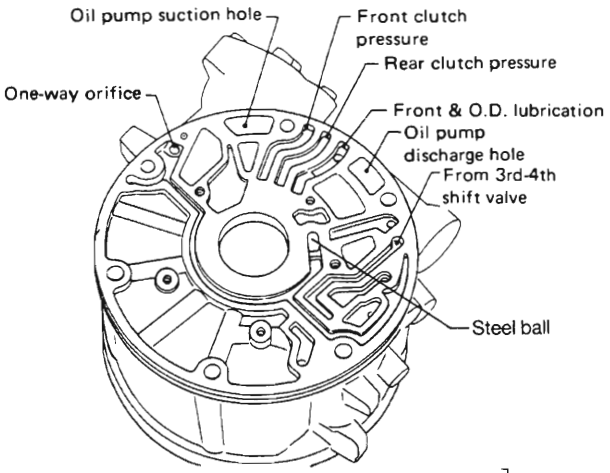
SAT501

Lower face side



SAT502

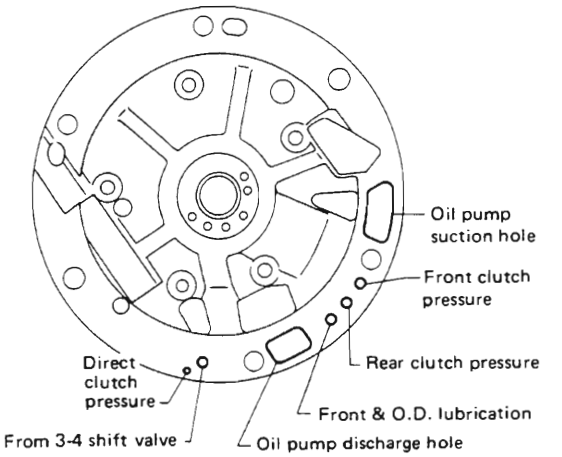
O.D.case



In regard to one-way orifice, refer to page AT-45.

SAT645

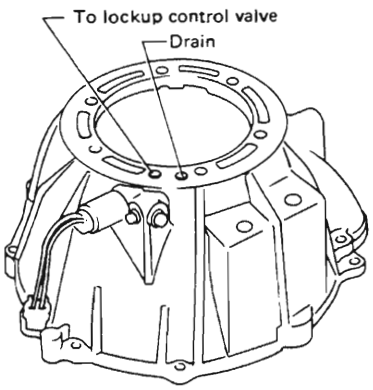
Drum support



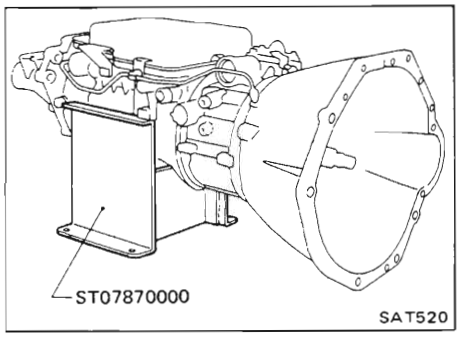
SAT503

Converter housing

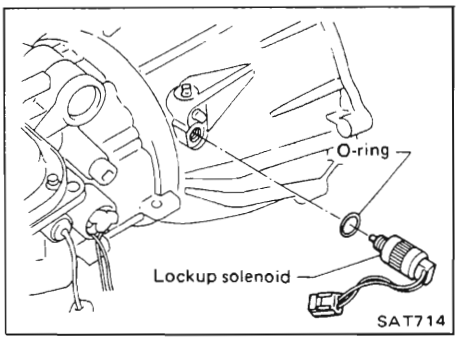
RB30E



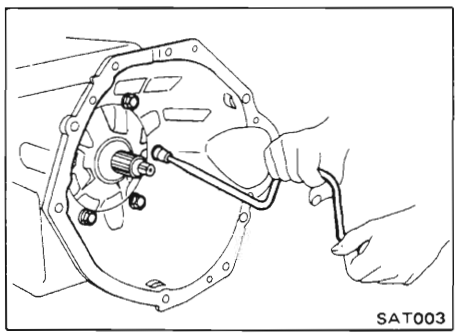
SAT706



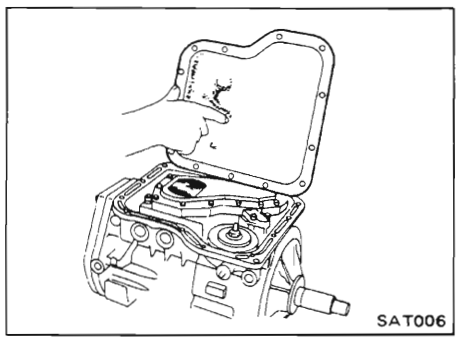
1. Remove torque converter, drain A.T.F. through end of rear extension, and place transmission on Tool.



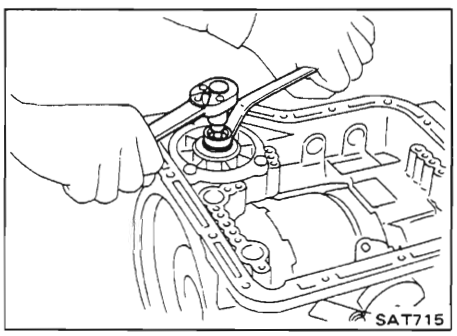
2. Remove lockup solenoid (RB30E engine).



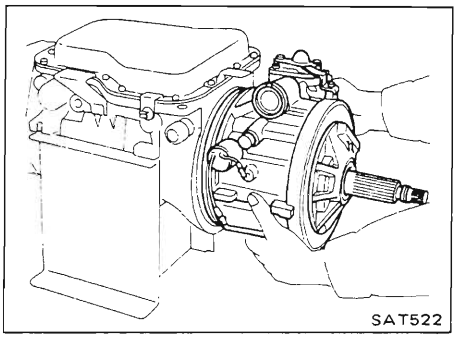
3. Remove converter housing.



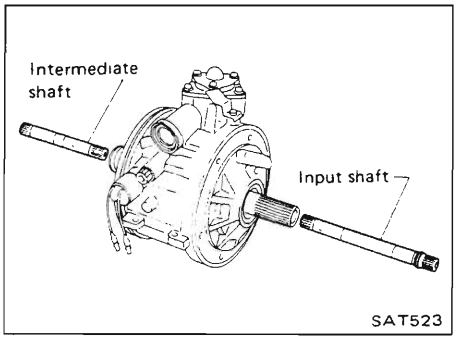
4. Remove oil pan and inspect its contents. An analysis of any foreign matter can indicate the types of problems to look for. If the fluid is very dark, smells burned, or contains foreign particles, the frictional material (clutches, band.) may need replacement. A tacky film that will not wipe clean indicates varnish build up which can cause valves, servo, and clutches to stick and may inhibit pump pressure.



5. Loosen 2nd band servo piston stem lock nut and tighten piston stem (RB30E engine).

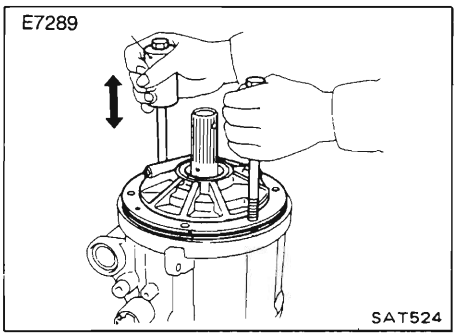

SAT522

6. Remove O.D. component assembly, then remove front clutch thrust washer and needle bearing & race.



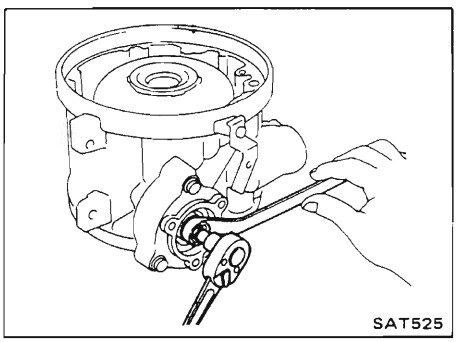
SAT523

7. Draw out input shaft and intermediate shaft.

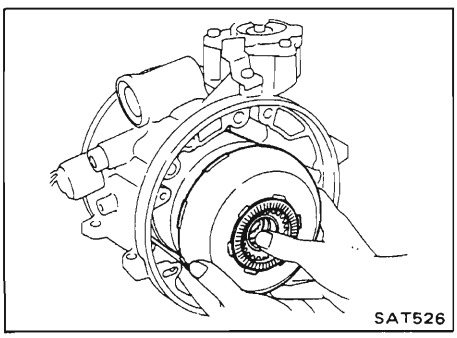


SAT524

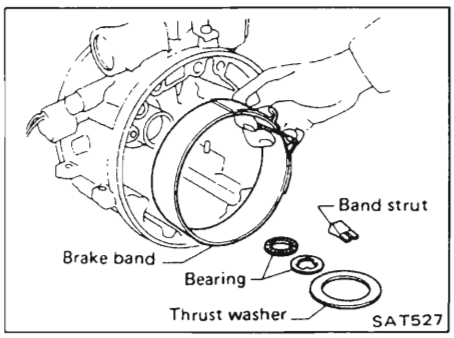
8. Attach Tool to pump and remove pump.


SAT525

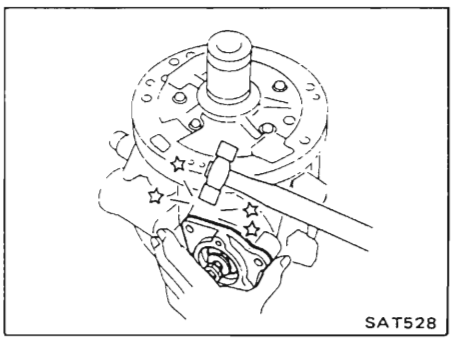
9. Remove O.D. servo cover, then loosen O.D. band servo piston stem.


SAT526

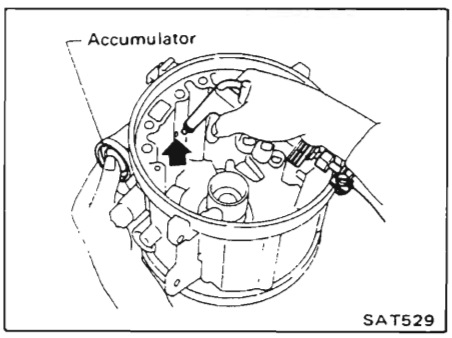
10. Remove O.D. pack (O.D. planetary gear & direct clutch assembly).



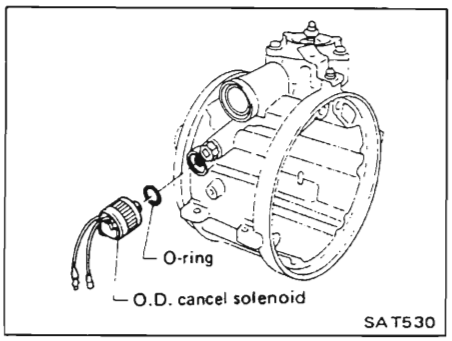
11. Remove needle bearing & race and direct clutch thrust washer, then remove O.D. brake band & strut.



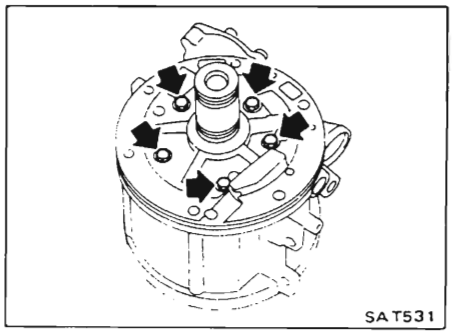
12. Remove O.D. servo assembly by lightly tapping retainer.



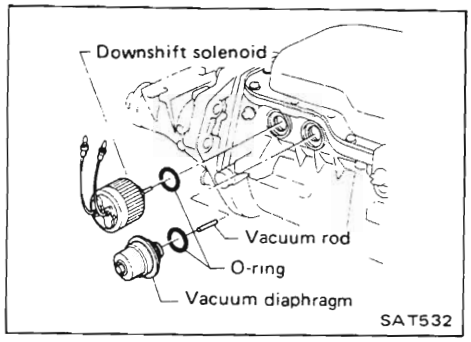
13. Remove accumulator snap ring, then apply pressure to remove accumulator plug, piston and spring.



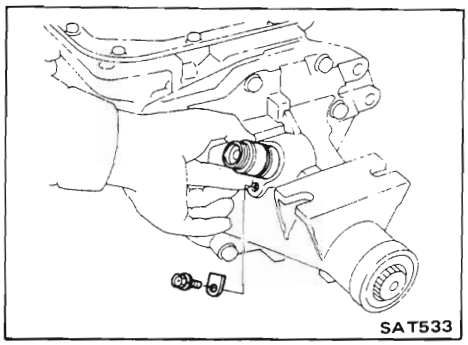
14. Remove O.D. cancel solenoid and O-ring.



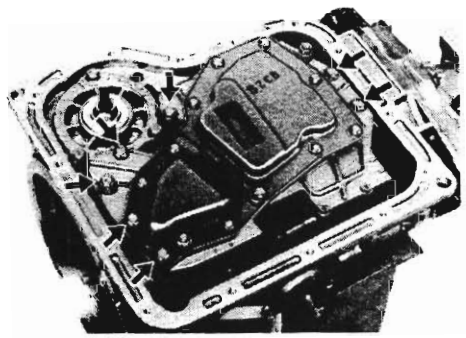
15. Remove drum support.



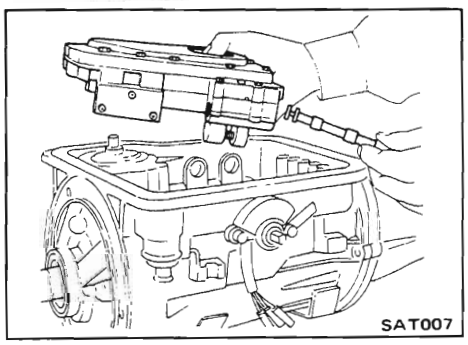
16. Remove downshift solenoid, vacuum diaphragm & rod and O-rings.



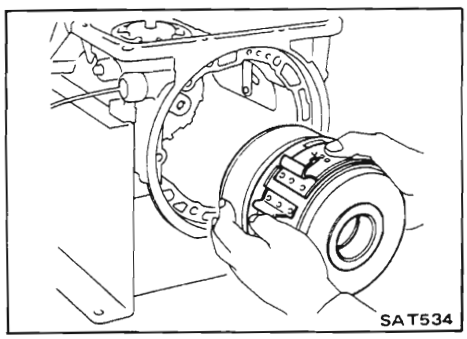
17. Remove speedometer pinion.



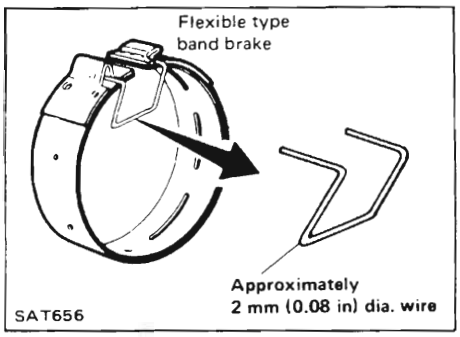
18. Remove control valve body.



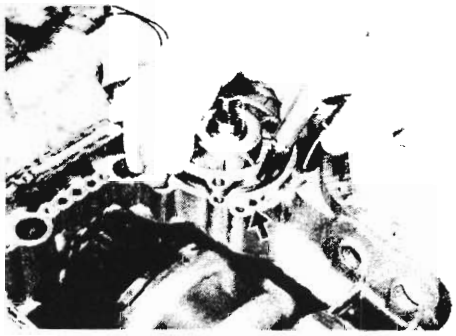
- Remove manual valve from valve body as a precaution, to prevent valve from dropping out accidentally.



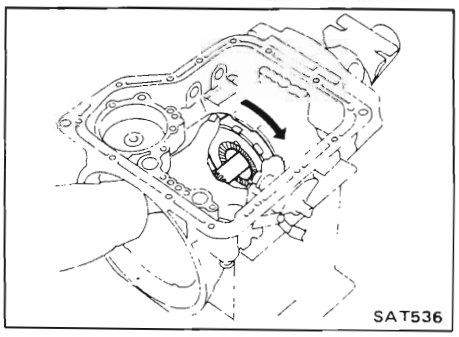
19. Loosen 2nd band Servo Piston Stem.
- Remove 2nd brake band strut. Brake band and clutch & planetary gear pack [including front clutch, rear clutch and front planetary gear] may be removed together.



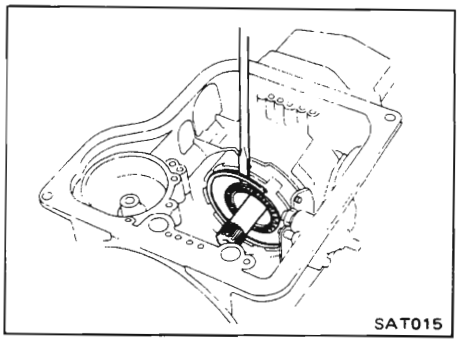
- **To prevent brake linings from cracking or peeling, do not stretch the flexible band unnecessarily. Before removing the brake band, always secure it with a clip as shown in the figure to the left.**
  Leave the clip in position after removing the brake band.



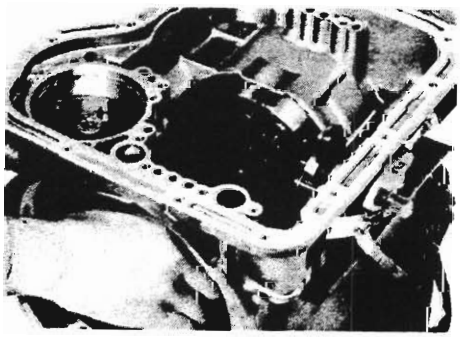
20. Remove 2nd band servo retaining bolts. Apply pressure to remove 2nd band servo.



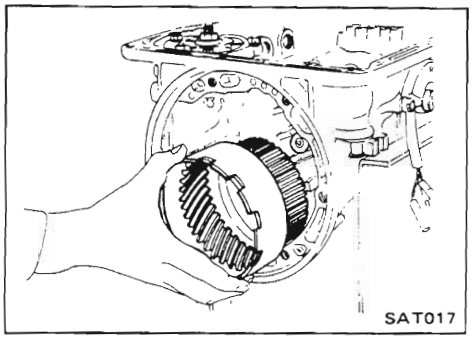
21. Check one-way clutch to see if it operates properly.



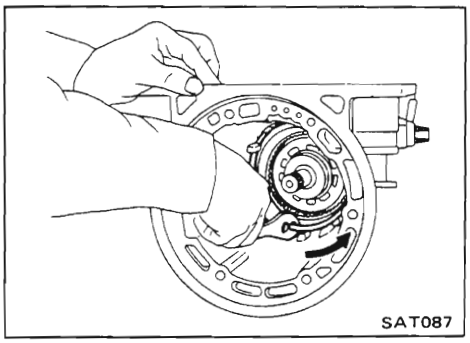
22. Remove rear planetary carrier snap ring and rear planetary carrier.



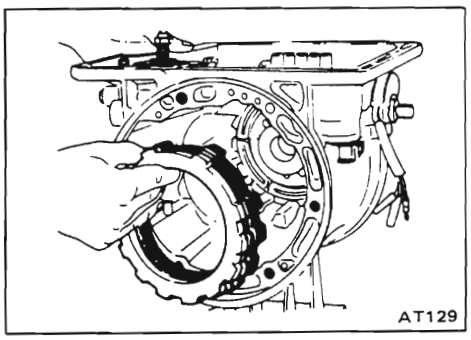
23. Remove output shaft snap ring.



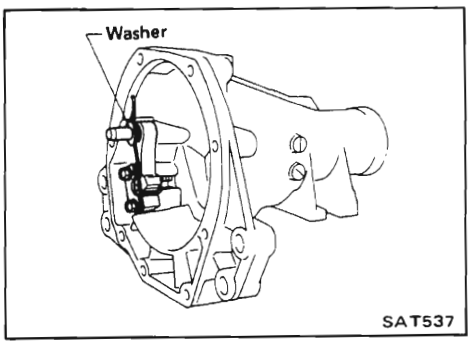
24. Remove connecting drum with internal gear.



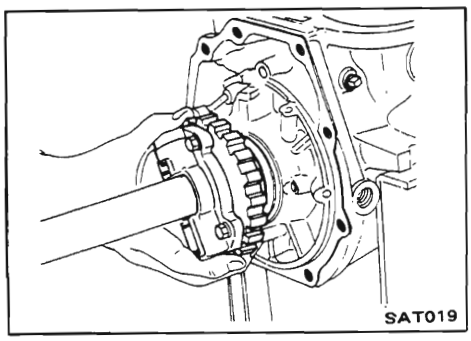
25. Pry off one end of snap ring with a screwdriver. Remove snap ring from low and reverse brake assembly while applying plier force in direction of arrow.



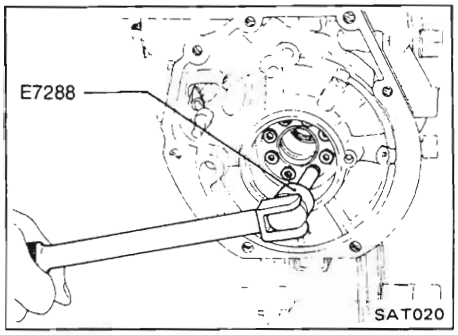
26. Remove low and reverse brake clutch assembly.



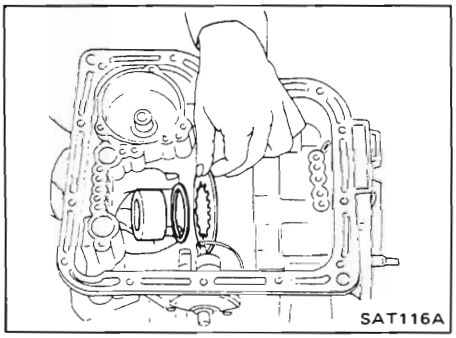
27. Remove rear extension.
Be careful not to lose retainer washer.



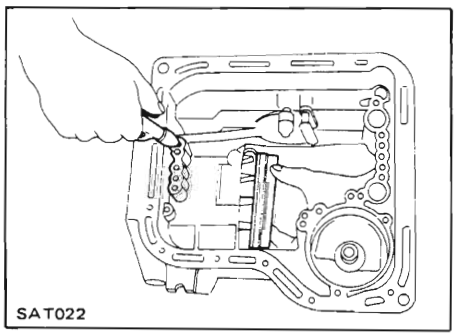
28. Remove output shaft with governor.



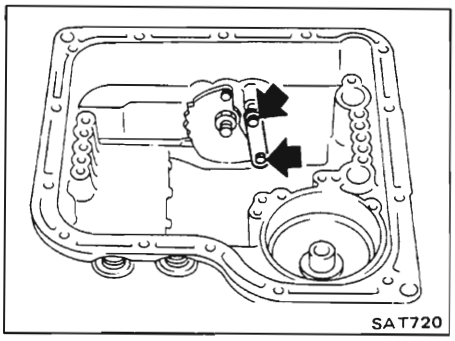
29. Remove governor thrust washer and needle bearing.
    Remove one-way clutch inner race attaching hex-head slotted bolts using Tool.



30. Remove one-way clutch inner race, return thrust washer, low and reverse return spring.



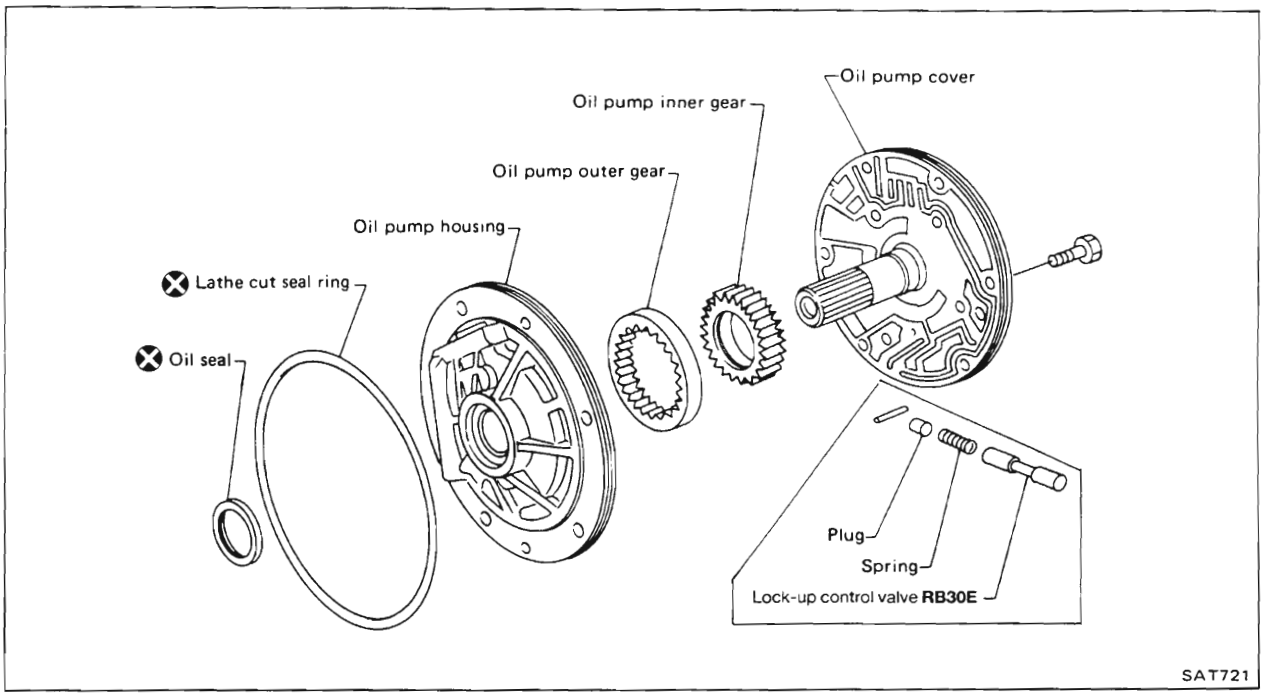
31. Apply air pressure to remove low and reverse brake piston.

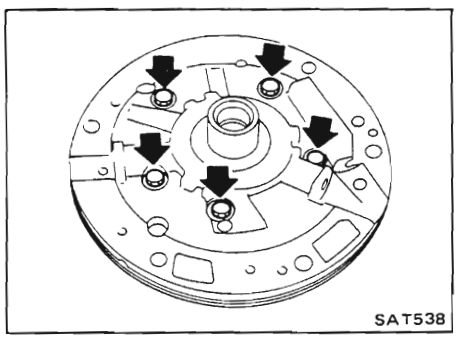


32. Remove snap ring, then remove lock nut, manual plate and parking rod.

33. Remove inhibitor switch and manual shaft.

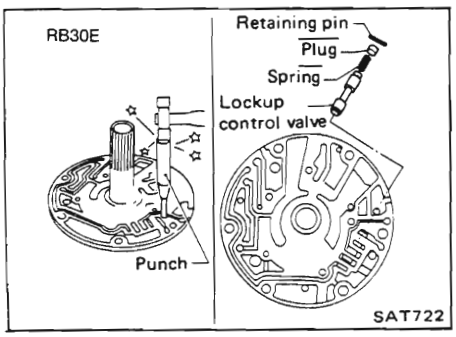
Oil pump





DISASSEMBLY

1. Remove pump cover from pump housing.

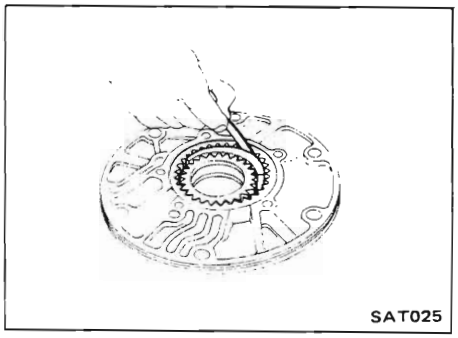


2. (RB30E) Stake off retaining pin with a punch [outer dia. 1.5 to 1.8 mm (0.059 to 0.071 in)], then remove lockup control valve and spring.

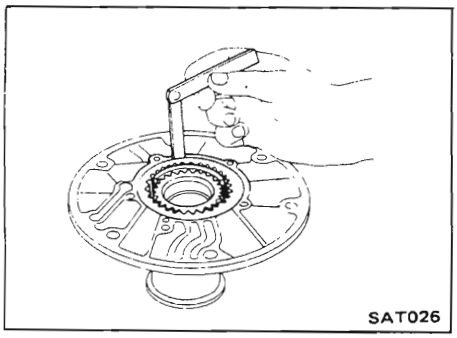
Oil pump (Cont'd)

INSPECTION

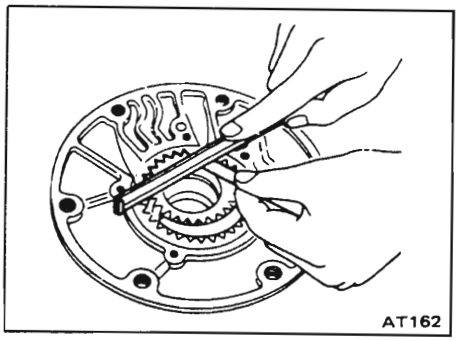
1. Inspect pump body, bushing and pump shaft, for wear.
2. Inspect gears, lockup control valve, spring and all internal surfaces for damage and visible wear.



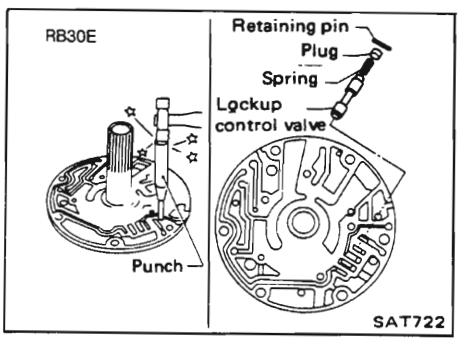
3. Measure clearance between outer gear and crescent.
   Standard clearance:
   0.14 - 0.21 mm (0.0055 - 0.0083 in)
   Wear limit:
   0.25 mm (0.0098 in)



4. Measure clearance between outer gear and pump housing.
   Standard clearance:
   0.05 - 0.20 mm (0.0020 - 0.0079 in)
   Wear limit:
   0.25 mm (0.0098 in)



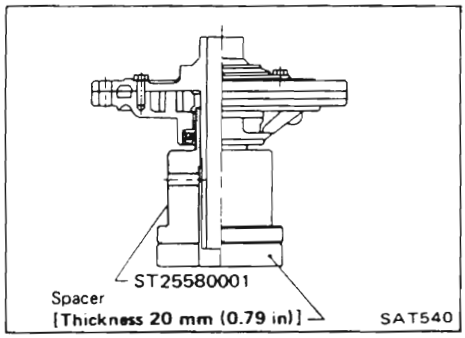
5. Using a feeler gauge and straight edge, measure clearance between gears and pump cover.
   Standard clearance:
   0.02 - 0.04 mm (0.0008 - 0.0016 in)
   Wear limit:
   0.08 mm (0.0031 in)



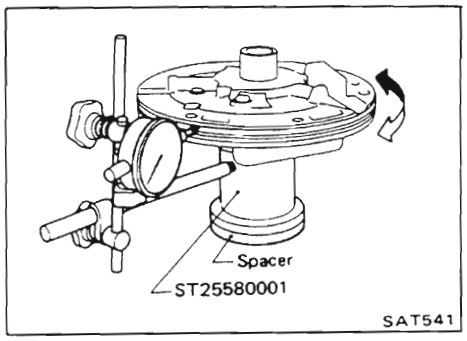
ASSEMBLY

1. (RB30E) Install lockup control valve and spring into oil pump cover, then tap new retaining pin.

Oil pump (Cont'd)



2. Mount pump housing in Tool and suitable spacer. Set up pump housing with inner and outer pump gears on it and install pump cover to pump housing. Temporarily assemble oil pump.

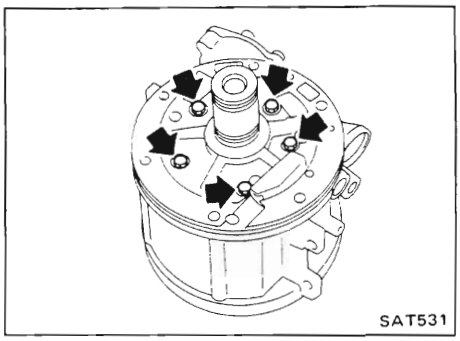


3. Set the cover to within the runout of the specified total indicator reading.

   Total indicator reading:

   Less than 0.07 mm (0.0028 in)

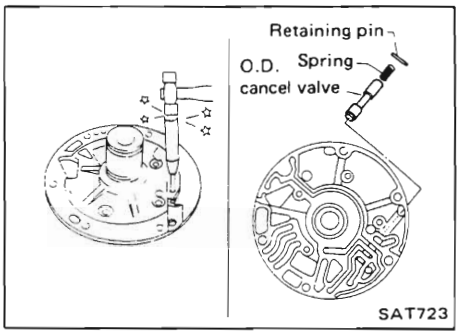
4. Tighten pump securing bolts to the specified torque. Recheck runout.


SAT531

Drum Support

DISASSEMBLY

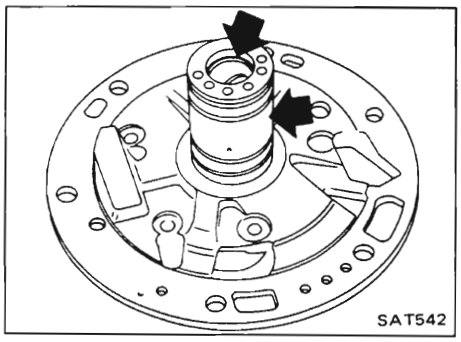
1. Remove drum support and gasket from O.D. case.



SAT723

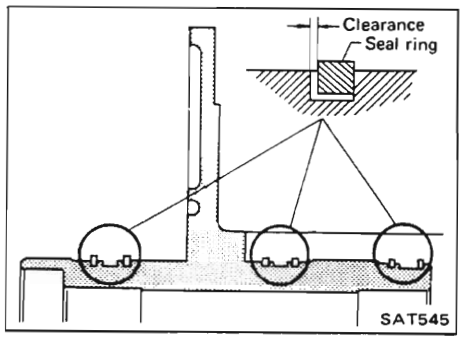
2. Stake off retaining pin using a punch [outer dia. 1.5 to 1.8 mm (0.059 to 0.071 in)], then remove O.D. cancel valve and spring.

Don't stake it off from contacting face side.


SAT542

INSPECTION

- Inspect drum support bushing and ring groove areas for wear.



SAT545

- Measure clearance between seal ring and ring groove.

  Standard clearance:

  0.05 - 0.20 mm (0.0020 - 0.0079 in)

  Wear limit:

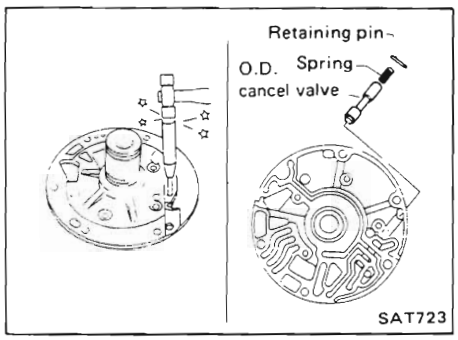
  0.20 mm (0.0079 in)

- Inspect O.D. cancel valve & spring and all internal surfaces for damage visible wear.

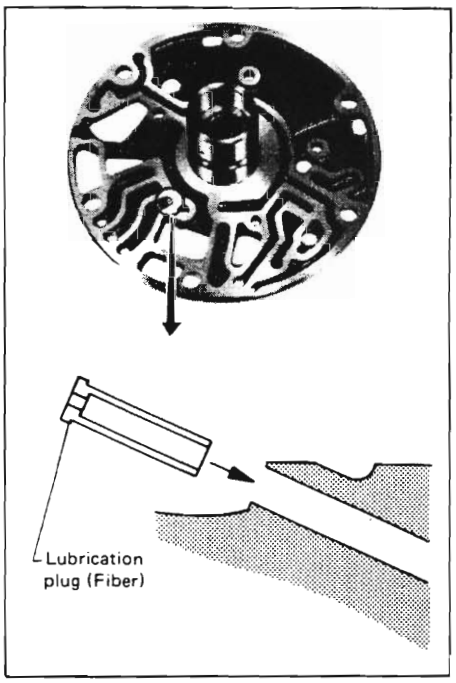
Drum Support (Cont'd)

ASSEMBLY

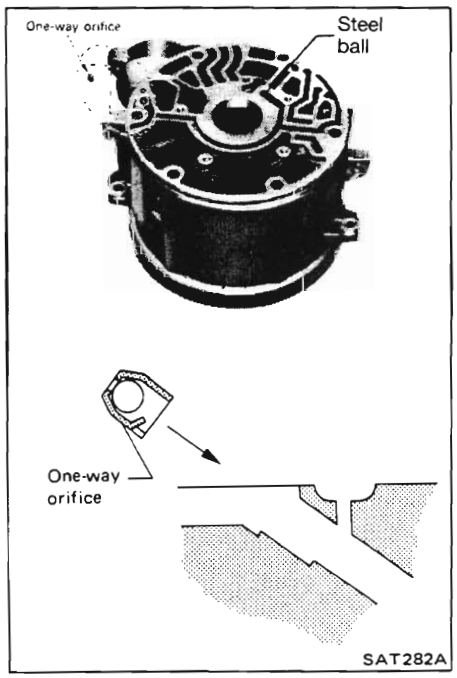
1. Install O.D. cancel valve and spring into drum support, then tap new retaining pins.



2. Install lubrication plug in drum support.

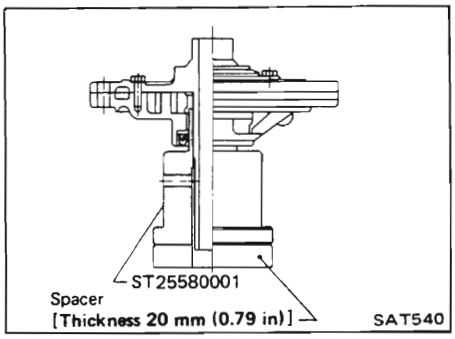


3. Install one-way orifice in O.D. case.



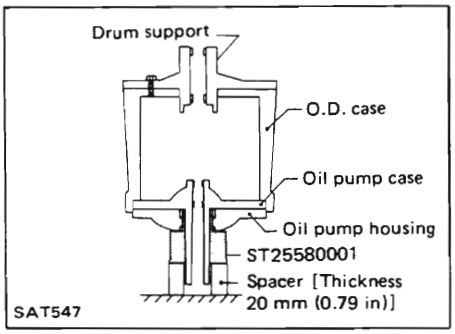
Drum Support (Cont'd)

4. Mount oil pump assembly in Tool and suitable spacer.

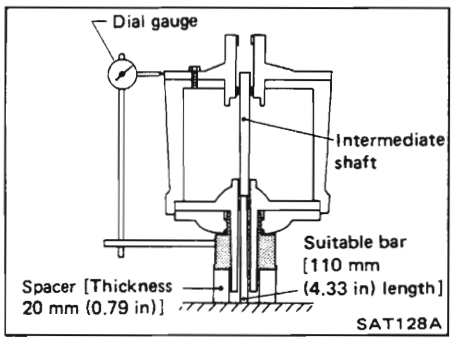


5. Mount O.D. case, drum support and gasket in oil pump assembly.

Ensure O.D. case is inserted properly into oil pump assembly.

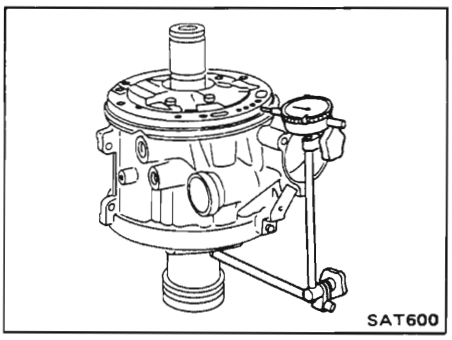


6. Insert an approx. 110 mm (4.33 in) bar into bore in oil pump at shaft location and install intermediate shaft onto it.



7. Set the drum support within the runout of the specified total indicator reading.

Total indicator reading:
Less than 0.05 mm (0.0020 in)

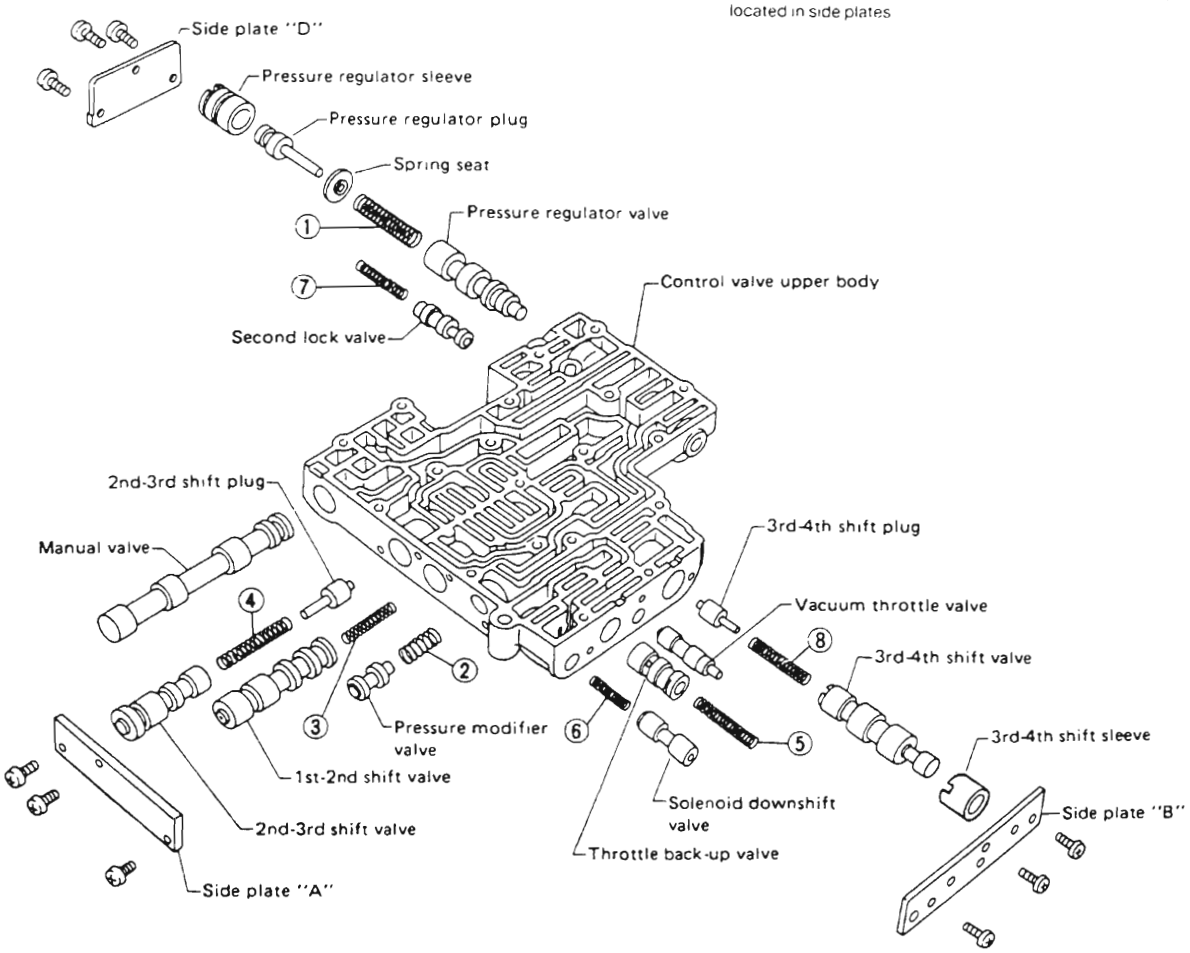


8. Tighten drum support securing bolts to the specified torque. Recheck runout.

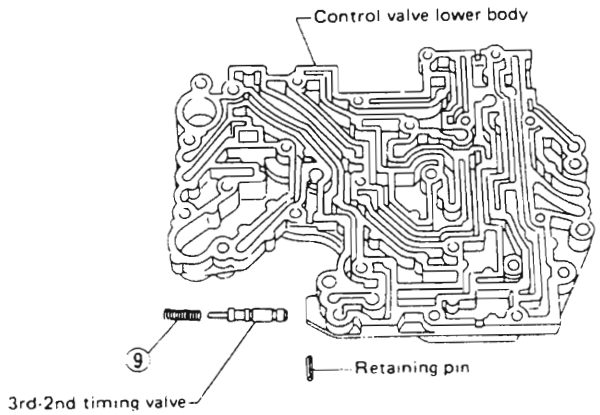
Control Valve Body

Upper body side

NOTE RB30E transmission has shift switches (not shown) located in side plates



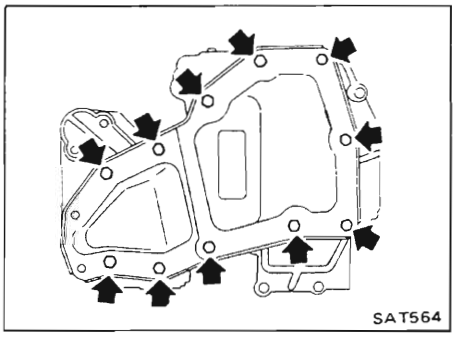
Lower body side



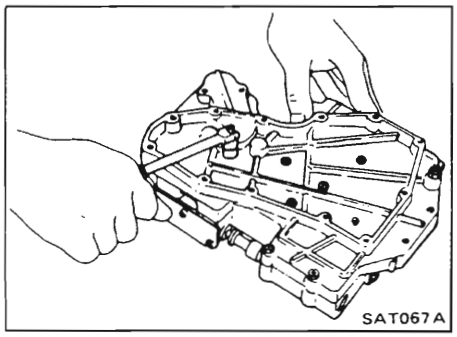
SAT066A

Control Valve Body (Cont'd)

DISASSEMBLY


SAT564

1. Remove oil strainer.


SAT067A

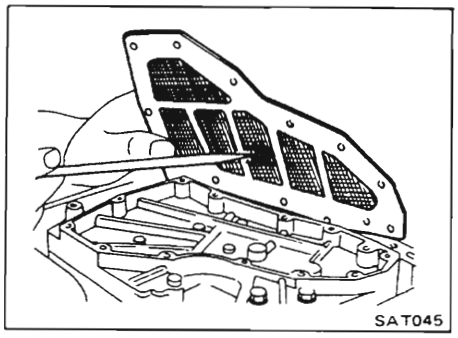
2. Separate lower body, separator plate and upper body.

Be careful not to scatter or lose orifice check valve, servo orifice check valve, or throttle relief check valve (ball) and related springs.

INSPECTION

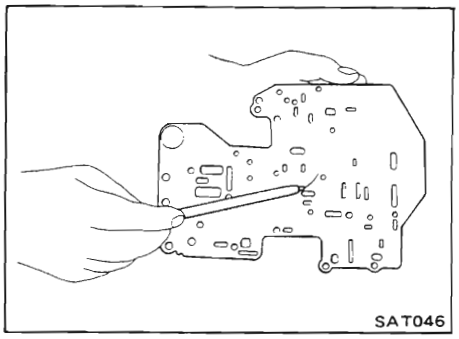
- If inspection reveals excessive clearances, 0.03 mm (0.0012 in) or more, between the valves and the valve body bores, replace the entire valve body.
- During cleaning, do not remove the sharp edges of the valve.
- The valves may be cleaned using alcohol or lacquer thinner. The valve bodies can be dip cleaned with a good carburetor cleaner or lacquer thinner. Do not leave valve bodies submerged in carburetor cleaner longer than five minutes.
- Lubricate all parts in clean A.T.F. before reassembly.

1. Check valves for signs of burning. Replace if beyond clean-up.


SAT045

2. Check oil strainer for general condition. Replace if necessary.

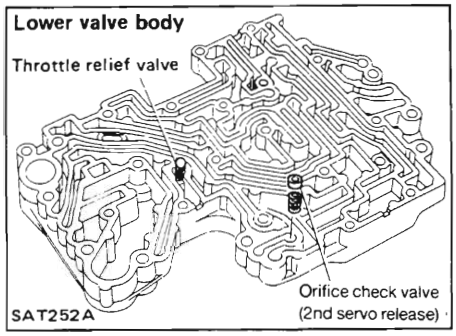
Control Valve Body (Cont'd)

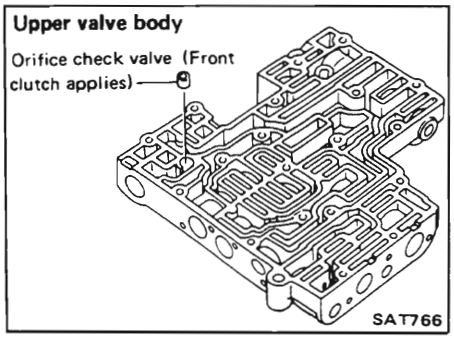


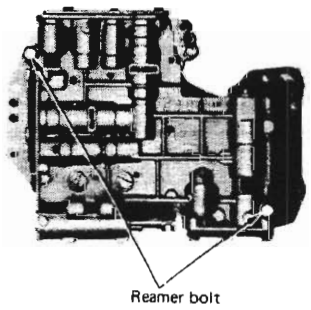
3. Check separator plate for scratches or damage. Replace if necessary. Scratches or score marks can cause oil to by-pass correct oil passages and result in system malfunction.

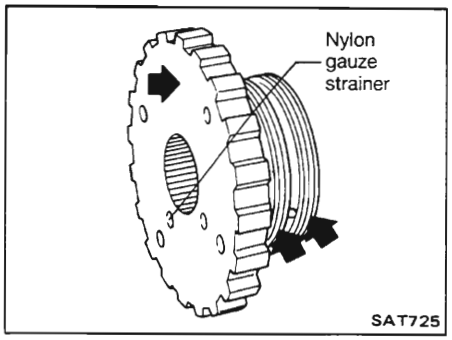
4. Check oil passages in upper and lower valve bodies for varnish deposits, scratches or other damage that would impair valve movement. Check threaded holes and related bolts and screws for stripped threads; replace as needed.
5. Check valve springs for damage. Measure free length of valve springs. If the free length is out of specification, replace it. Numbers of each valve spring listed in table below are the same as those in the figure on page 47.

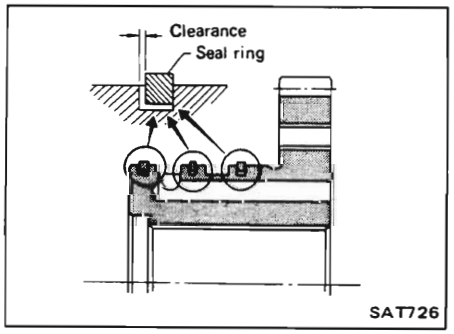
Valve Spring	Free length — mm	
	CA20E	RB30E
① Pressure regulator valve	43.0	←
② Pressure modifier valve	18.5	←
③ 1st-2nd shift valve	32.0	←
④ 2nd-3rd shift valve	41.0	31.39
⑤ Throttle back-up valve	31.8	←
⑥ Solenoid downshift valve	22.0	←
⑦ Second lock valve	33.5	←
Throttle relief check valve	26.8	←
Orifice check valve	15.5	←
⑧ 3rd-4th shift valve	31.4	30.3
⑨ 3rd-2nd timing valve	22.5	←











Control Valve Body (Cont'd)

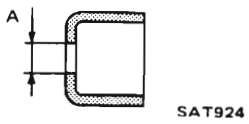
ASSEMBLY

1. Install orifice check valves, valve springs, throttle relief valve spring and steel ball in valve body.

Orifice check valve

Unit: mm (in)

Orifice check valve		Diameter "A"	Identification
2nd servo release	RB30E	1.5 (0.059)	SILVER
	CA20E	1.6 (0.063)	GOLD



2. Assemble separator plate and upper valve body on lower valve body, then tighten bolts.

When installing these bolts, first be sure to install the two reamer bolts to their original positions.

3. Install oil strainer.

Oil Distributor

INSPECTION

- Inspect contacting surface of oil distributor and ring groove areas for wear.

- Measure clearance between seal ring and ring groove.

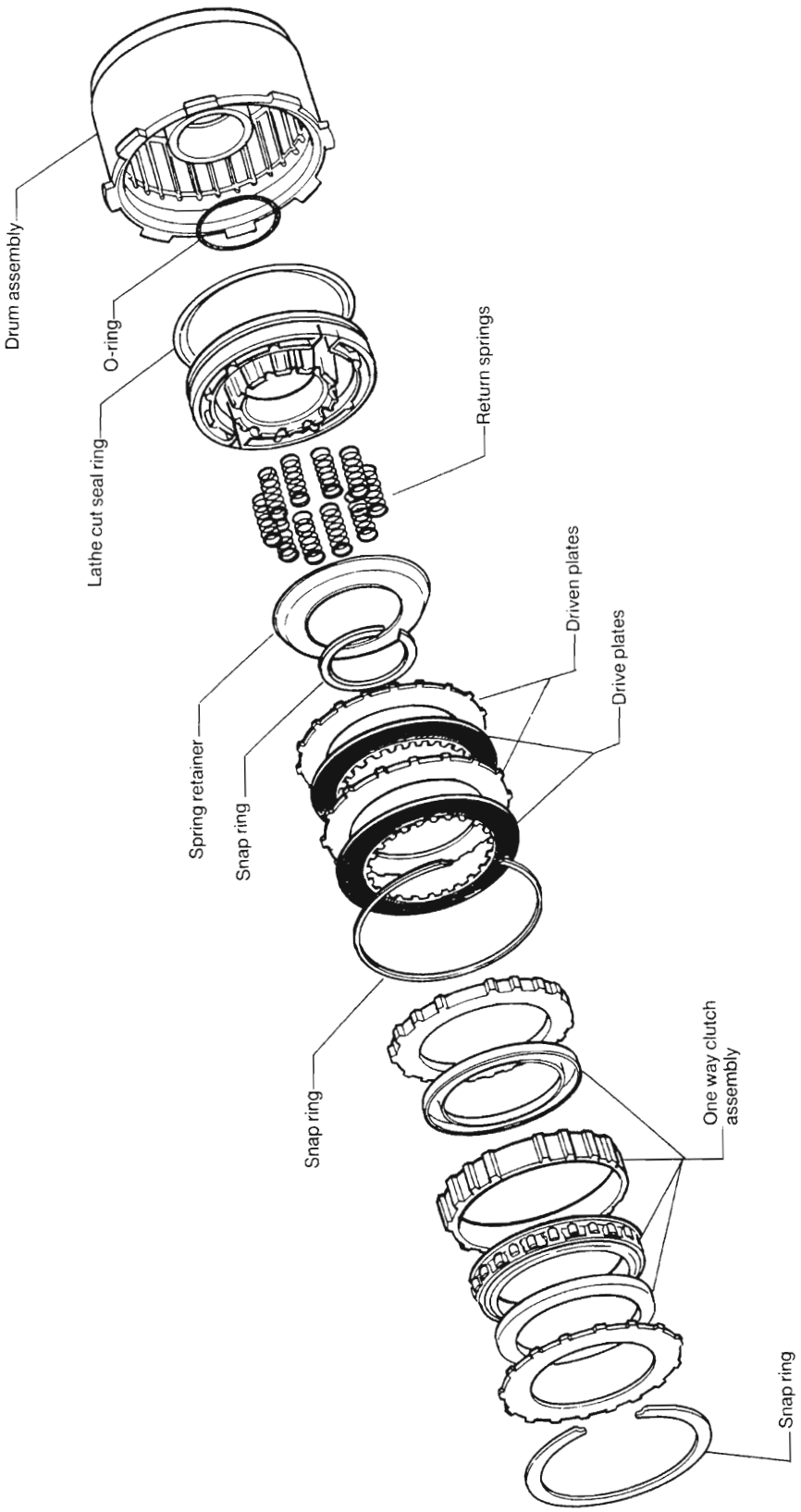
  Standard clearance:

  0.04 - 0.16 mm (0.0016 - 0.0063 in)

  Wear limit:

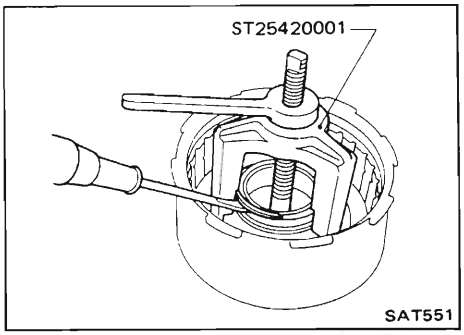
  0.16 mm (0.0063 in)

Direct and One Way Clutch

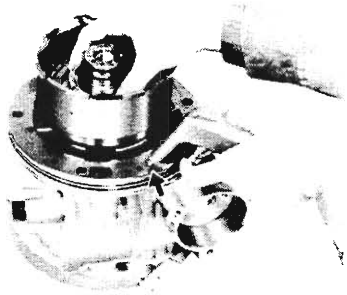


Direct Clutch (Cont'd)

DISASSEMBLY



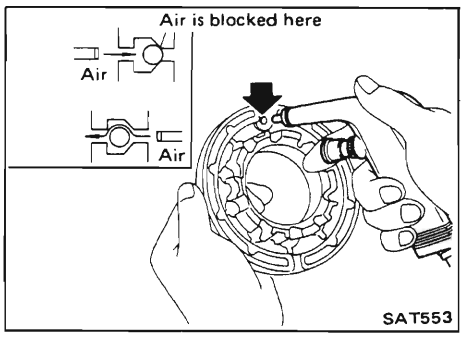
- Compress clutch springs and remove snap ring from spring retainer with Tool.



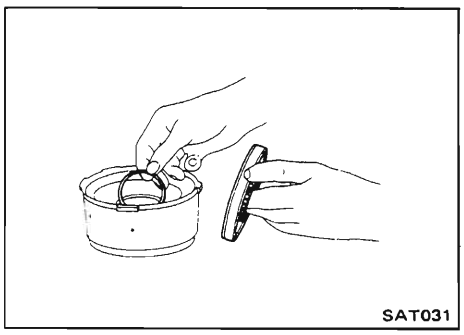
- For easy removal of piston from drum, mount clutch on drum support. Using an air gun, carefully apply air pressure to loosen piston from drum.

INSPECTION AND ASSEMBLY

1. Check clutch drive plate facing for wear or damage.
   Standard thickness:
   1.50 - 1.65 mm (0.0591 - 0.0650 in)
   Wear limit:
   1.4 mm (0.055 in)
2. Check for wear on snapring, weak or broken coil springs, and warped spring retainer.

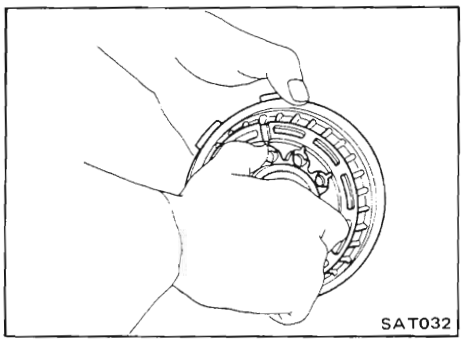


3. Check the operation of check ball in piston using compressed air.

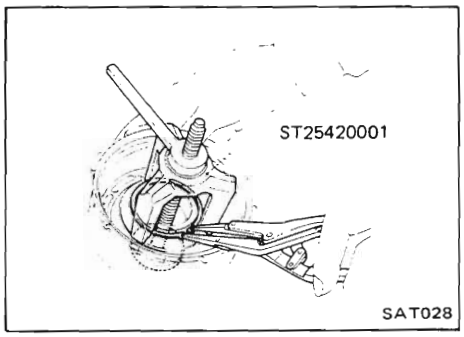


4. Lubricate clutch drum hub and seals, and install inner seal and piston seal as illustrated. Be careful not to stretch seals during installation.

Direct Clutch (Cont'd)

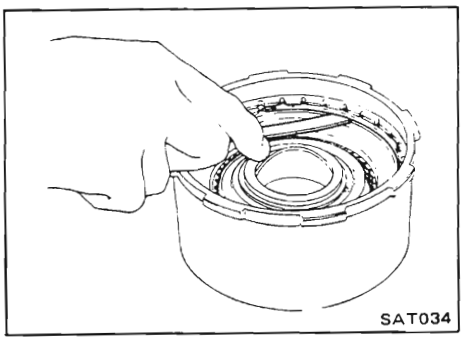


5. Assemble piston, being careful not to allow seal to kink or become damaged during installation. After installing, turn piston by hand to ensure that there is no binding.



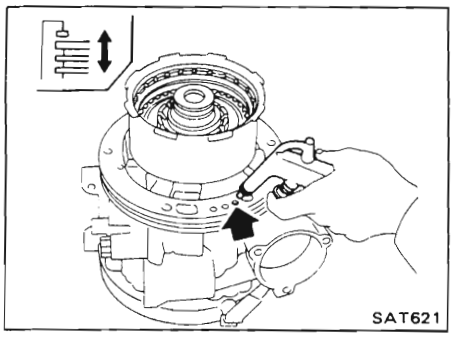
6. Reassemble spring and retainer. Reinstall snap ring. Be sure snap ring is properly seated.

7. Install driven plates, drive plates, and secure with snap ring.
8. Install retainer plate, O.D. one-way clutch assembly, race side, and secure with snap ring.



9. Measure clearance between race side and snap ring.
   Specified clearance:
   1.6 - 1.8 mm (0.063 - 0.071 in)
   If necessary, try other race sides having different thicknesses until correct clearance is obtained.

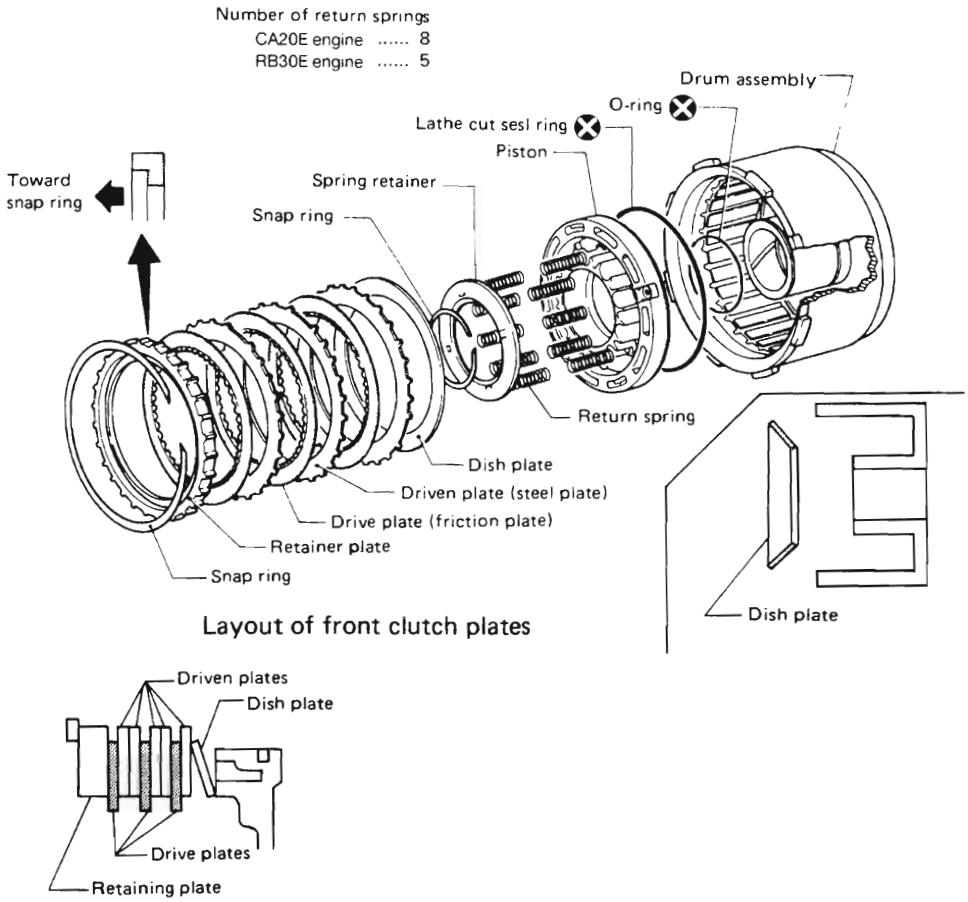
Thickness mm (in)	Part number
0.4 (0.016)	31606-X8501
0.6 (0.024)	31606-X8502
0.8 (0.031)	31606-X8500
1.0 (0.039)	31606-X8503
1.2 (0.047)	31606-X8504



Direct Clutch (Cont'd)

10. Testing direct clutch.
    With direct clutch assembled on drum support, direct a jet of air into hole in drum support for definite clutch operation.

Front Clutch

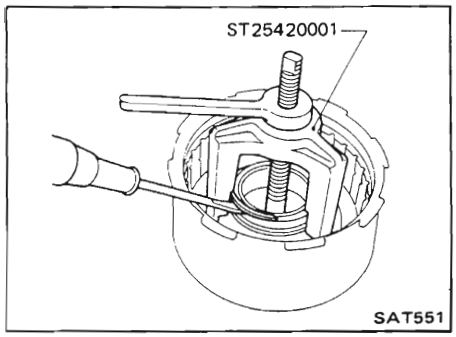


Layout of front clutch plates

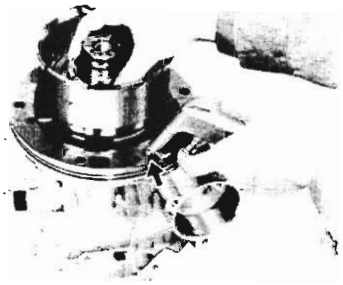
SAT232A

Front Clutch (Cont'd)

DISASSEMBLY



- Compress clutch springs and remove snap ring from spring retainer with Tool.



- For easy removal of piston from drum, mount clutch on drum support. Using an air gun,carefully apply air pressure to loosen piston from drum.

INSPECTION AND ASSEMBLY

1. Check clutch drive plate facing for wear or damage.

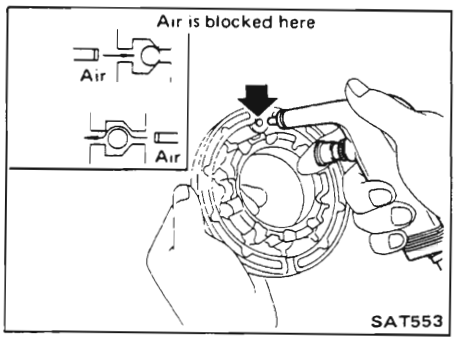
   Standard thickness:

   1.50 - 1.65 mm (0.0591 - 0.0650 in)

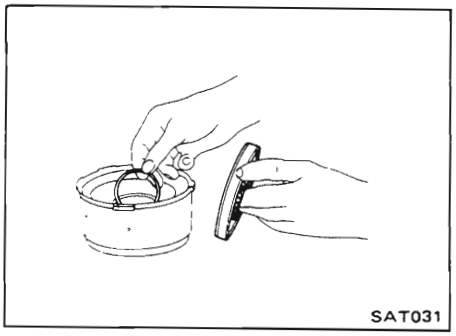
   Wear limit:

   1.4 mm (0.055 in)

2. Check for wear on snap ring, weak or broken coil springs, and warped spring retainer.

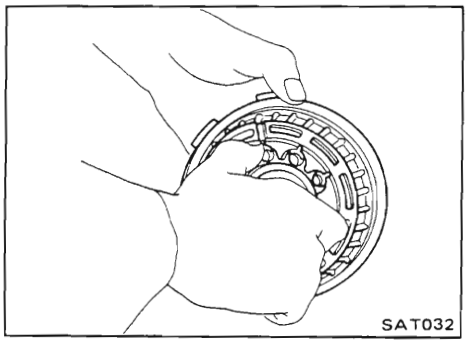


3. Check the operation of check ball in piston using compressed air.

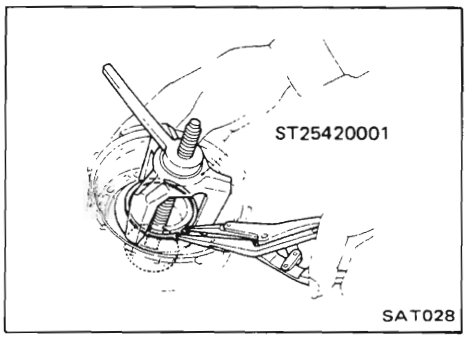


4. Lubricate clutch drum hub and seals, and install inner seal and piston seal as illustrated. Be careful not to stretch seals during installation.

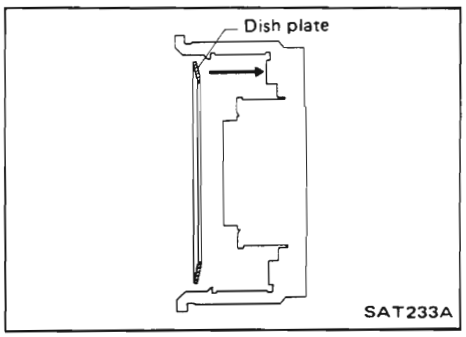
Front Clutch (Cont'd)



5. Assemble piston, being careful not to allow seal to kink or become damaged during installation. After installing, turn piston by hand to ensure that there is no binding.

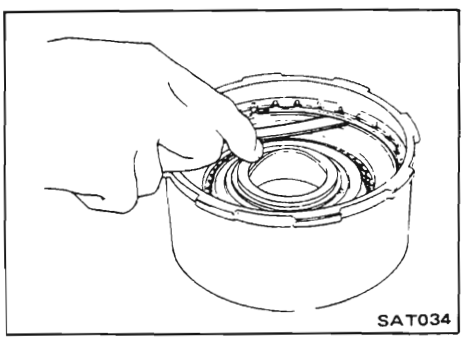


6. Reassemble spring and retainer. Reinstall snap ring. Be sure snap ring is properly seated.



7. Install dish plate.

8. Install driven plates, drive plates, and secure with snap ring.



9. Measure clearance between retainer plate and snap ring.

   Specified clearance:

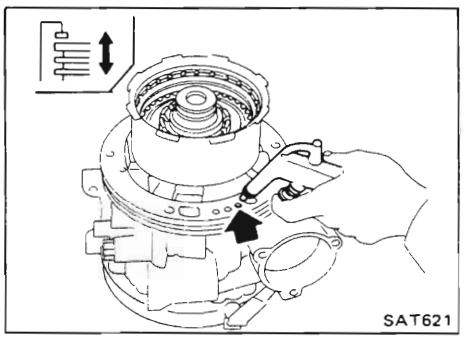
   1.6 - 1.8 mm (0.063 - 0.071 in)

   If necessary, try other retaining plates having different thicknesses until correct clearance is obtained.

Front Clutch (Cont'd)

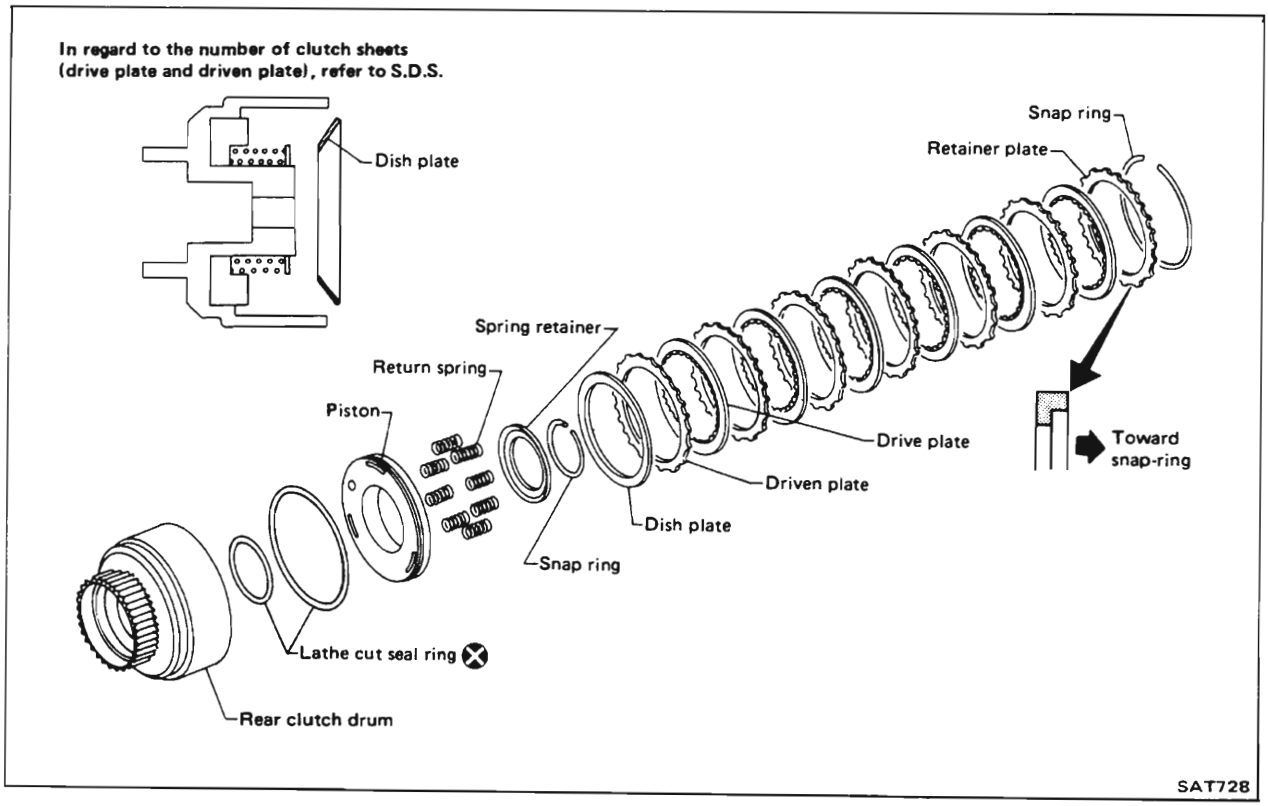
Available retaining plate

Thickness mm (in)	Part number
5.0 (0.197)	31567-X2900
5.2 (0.205)	31567-X2901
5.4 (0.213)	31567-X2902
5.6 (0.220)	31567-X2903
5.8 (0.228)	31567-X2904
6.0 (0.236)	31567-X2905

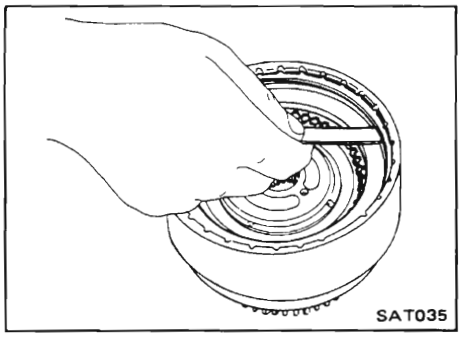


10. Testing front clutch.
    With Front clutch assembled on drum support, direct a jet of air into hole in clutch drum for definite clutch operation.

Rear Clutch

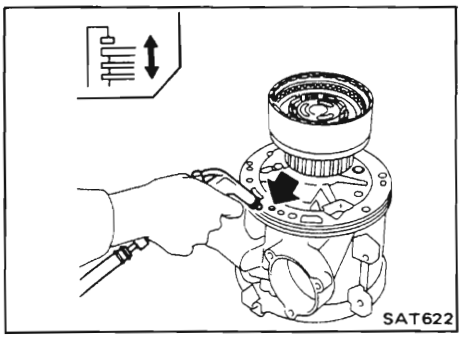


Rear Clutch (Cont'd)



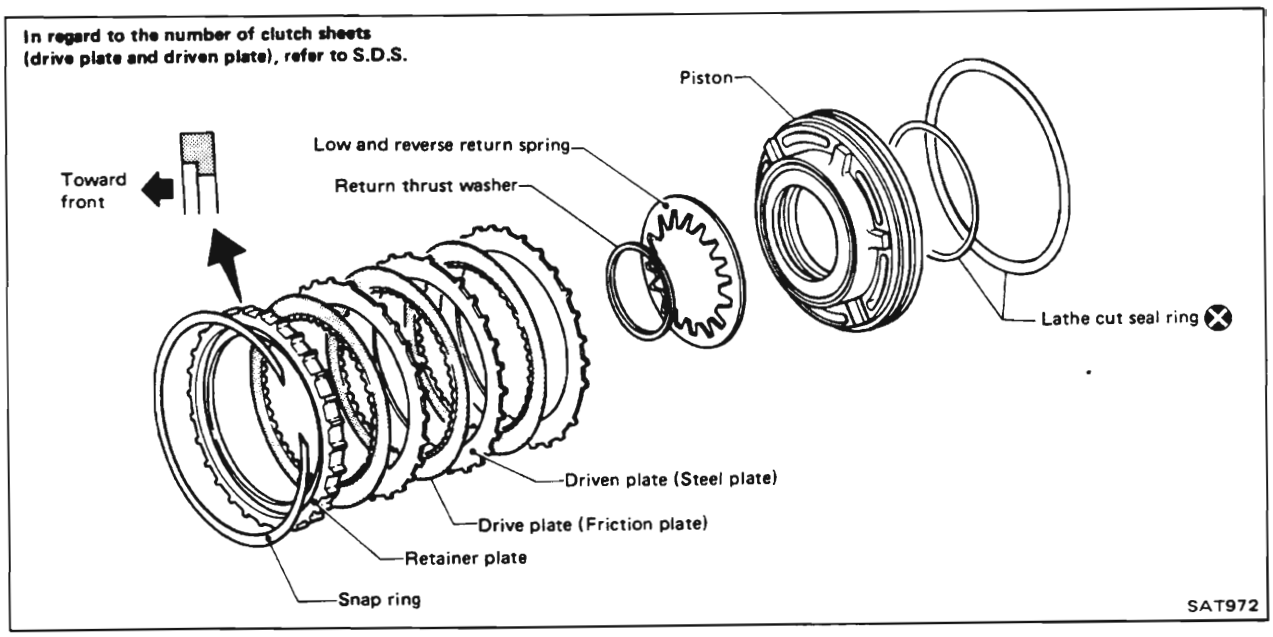
- Service procedures for rear clutch are essentially the same as those for front clutch, with the following exception:

I. **Specified clearance between retainer plate and snap ring:**
0.8 - 1.0 mm (0.031 - 0.039 in)



II. **Testing rear clutch**

Low & Reverse Brake



INSPECTION

- Examine for damaged drive plate facing and worn snap ring.
- Check drive plate facing for wear; if necessary, replace.

Drive plate thickness:

Standard

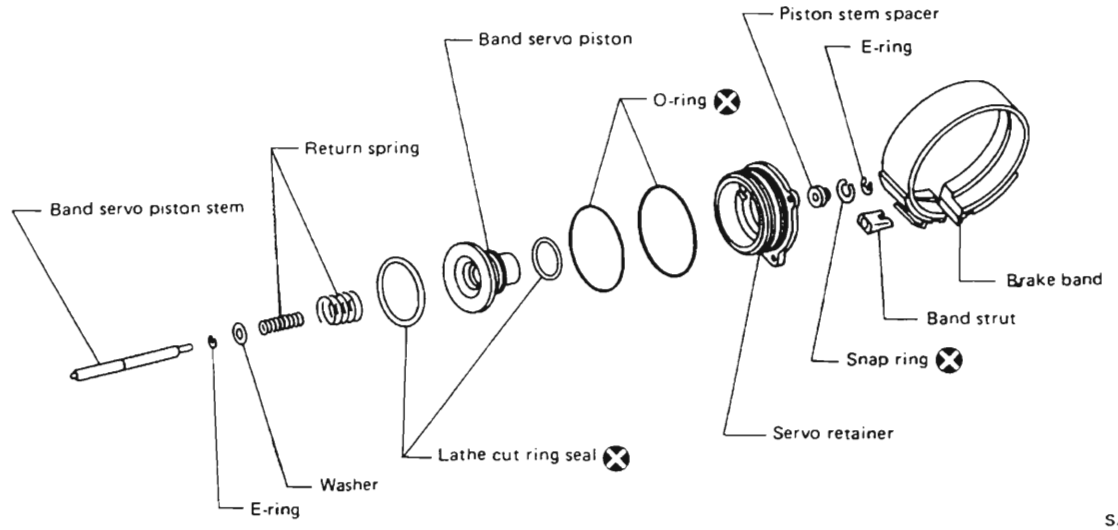
1.90 - 2.05 mm (0.0748 - 0.0807 in)

Allowable limit

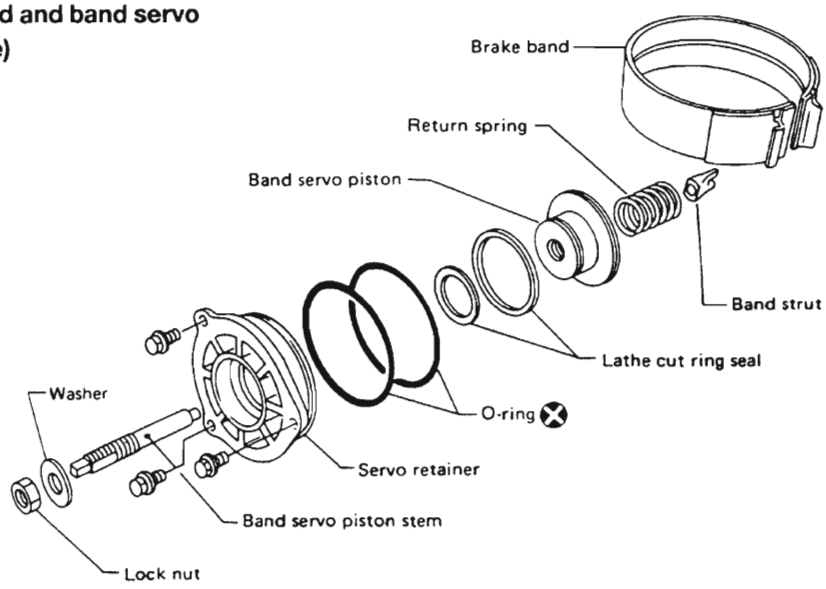
1.8 mm (0.071 in)

Brake Band and Band Servo

2nd brake band and band servo
(CA20E engine)

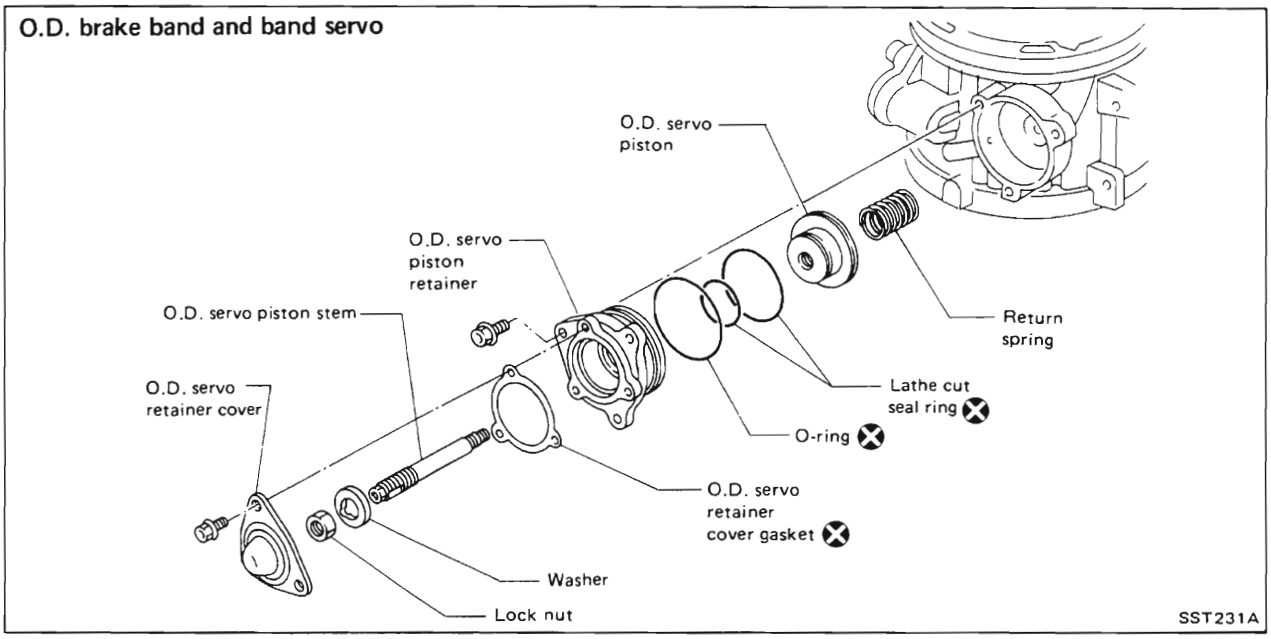


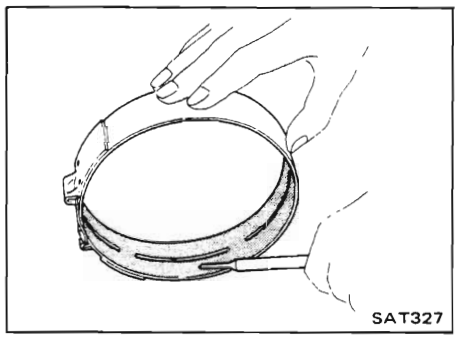
2nd brake band and band servo
(RB30E engine)



Brake Band and Band Servo (Cont'd)

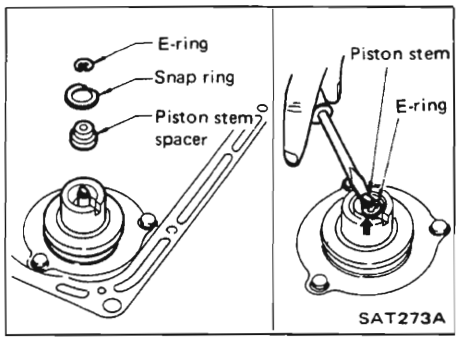
O.D. brake band and band servo





INSPECTION

- Inspect band friction material for wear. If cracked, chipped or burnt spots are apparent, replace the band.
- Check band servo components for wear and scoring.



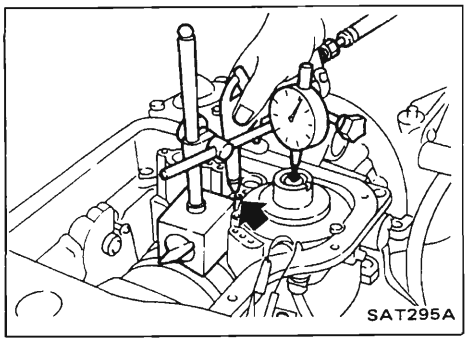
ADJUSTMENT (2nd brake band servo for CA20E engine)

2nd brake band servo adjustment is required when replacing piston stem and/or servo piston.

1. Install 2nd servo piston.
2. Install E-ring while pulling piston stem.

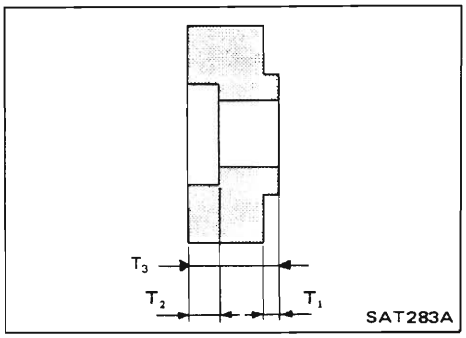
3. Put tip of dial gauge on piston stem.

Brake Band and Band Servo (Cont'd)



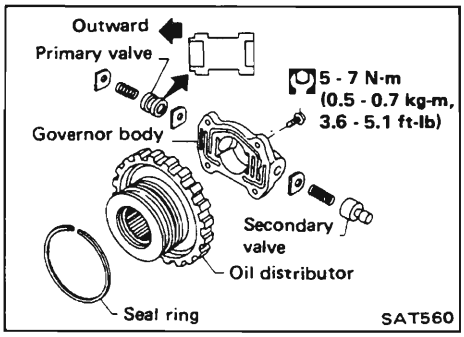
4. Measure movement of piston stem applying air of 441 to 539 kPa (4.41 to 5.39 bar, 4.5 to 5.5 kg/cm², 64 to 78 psi) into hole as shown at left.

   Specified movement of piston stem:
   1.55 - 2.05 mm (0.0610 - 0.0807 in)



5. When movement of piston stem is out of specification, replace piston stem spacer having different thickness.

Part number	Thickness mm (in)		
	T_1	T_2	T_3
31619-X8600	0.5 (0.020)	2.5 (0.098)	8.0
31619-X8601	1.0 (0.039)	3.0 (0.118)	8.5
31619-X8602	1.5 (0.059)	3.5 (0.138)	9.0
31619-X8603	2.0 (0.079)	4.0 (0.157)	9.5
31619-X8604	2.5 (0.098)	4.5 (0.177)	10.0
31619-X8605	3.0 (0.118)	5.0 (0.197)	10.5
31619-X8606	3.5 (0.138)	5.5 (0.217)	11.0



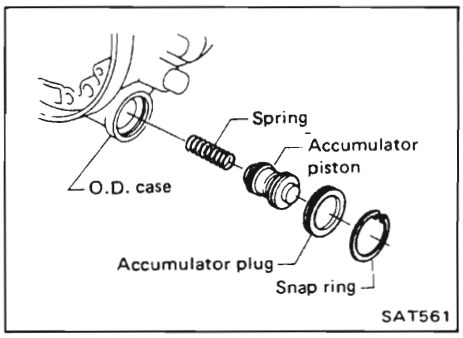
Governor

INSPECTION

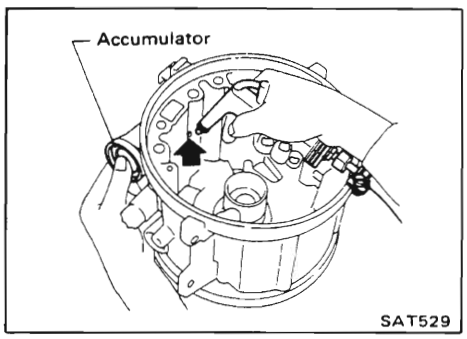
- Check governor valves and valve body for indication of burning or scratches.
- Check valve springs for damage.
  Measure free length of valve springs.

Valve spring		Free length mm
Primary governor	CA20E	21.8
	RB30E	21.8
Secondary governor	CA20E	25.2
	RB30E	21.7

If any abnormalities are found, replace governor body, valves and springs as an assembly.

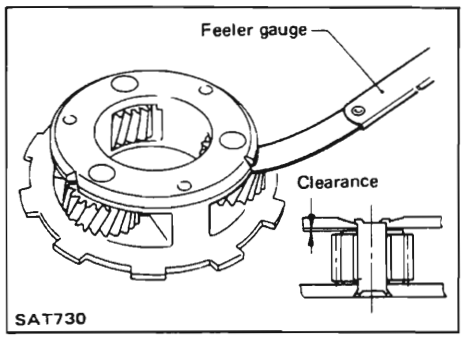


Accumulator



DISASSEMBLY & INSPECTION

- Remove snap ring, then apply pressure to remove accumulator plug, piston and spring.
- Check accumulator components for wear and scoring.



Planetary Carrier

INSPECTION

- Check clearance between pinion washer and planetary carrier with a feeler.

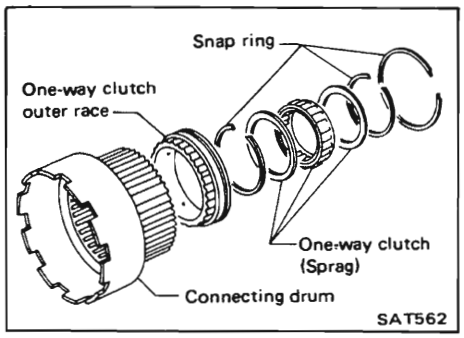
  Standard clearance:

  0.20 - 0.70 mm (0.0079 - 0.0276 in)

  Wear limit:

  0.80 mm (0.0315 in)

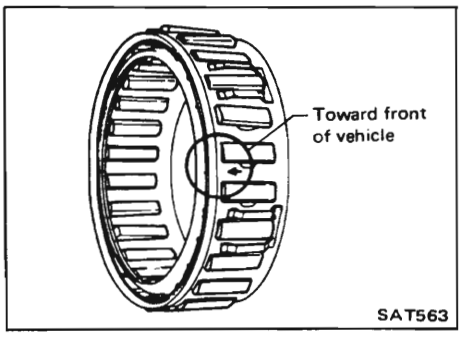
- Check planetary gear sets and bearings for damaged or worn gears.



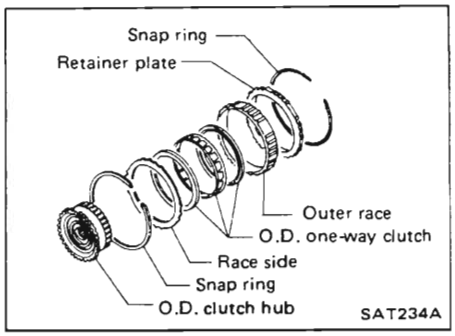
Connecting Drum Assembly

If one-way clutch is out of order as determined during disassembly, repair it as follows:

1. Remove each snap ring, then draw out one-way clutch inner & outer race.



2. Inspect one-way sprag and contacting surface for wear or burns.
   Replace parts as necessary.
3. Assemble those parts.



O.D. One-Way Clutch

If one-way clutch is out of order as determined during disassembly, repair it as follows:

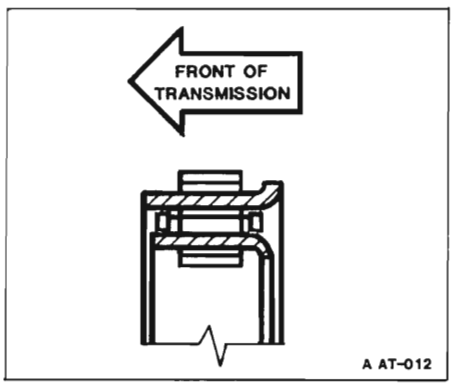
1. Remove each snap ring, then draw out O.D. one-way clutch.
2. Inspect one-way sprag and contacting surface for wear or burns.
   Replace parts as necessary.

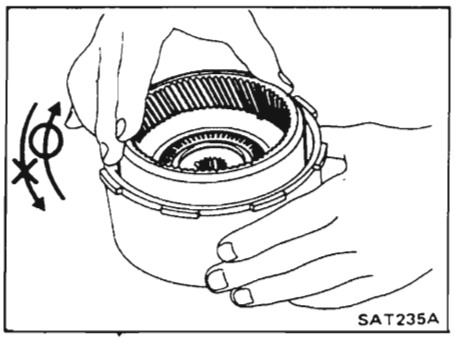
Front side

Rear side

3. Assemble those parts.

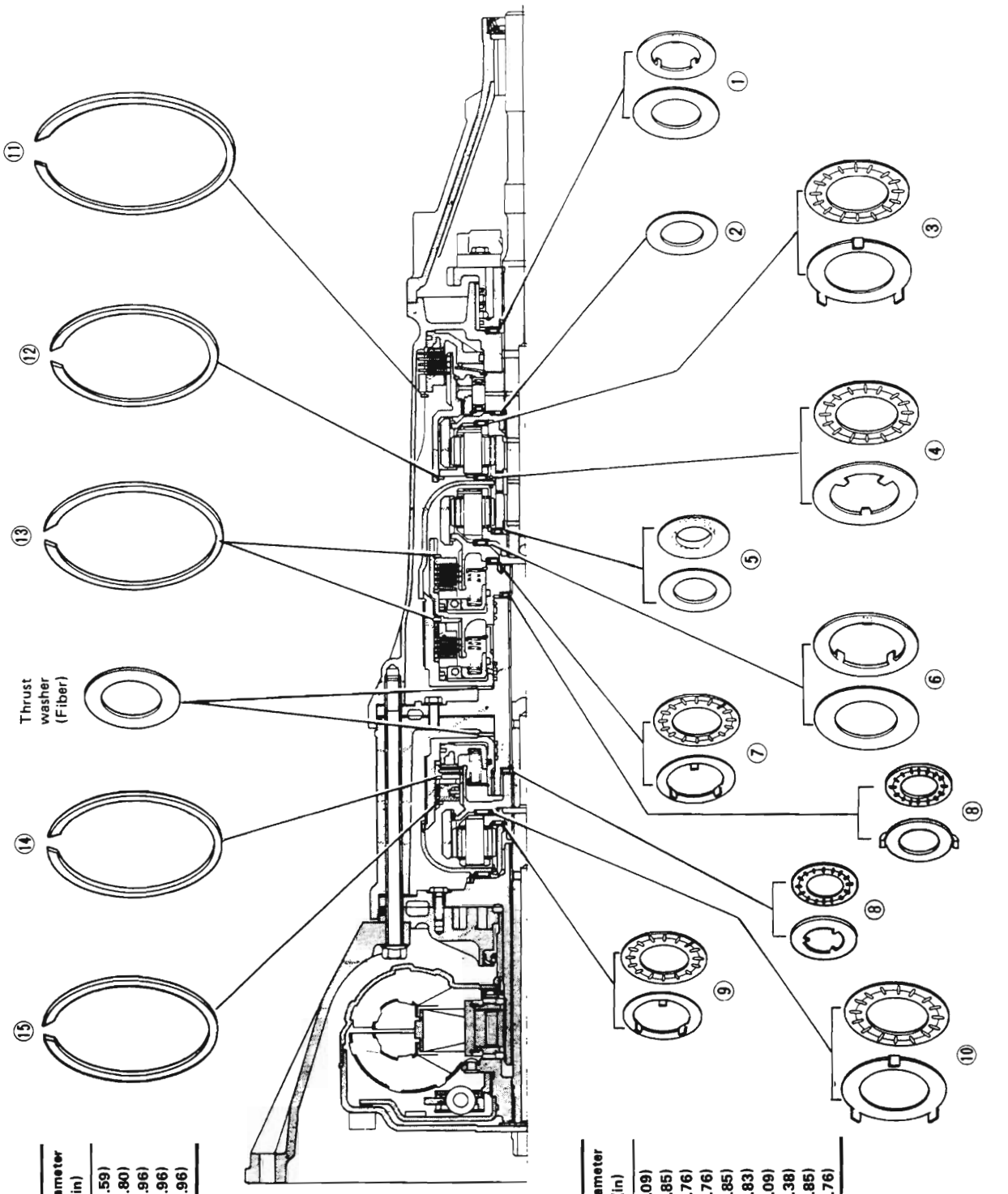
Pay attention to direction of O.D. one-way clutch.





4. After assembly, check O.D. one-way clutch to see if it operates properly.

When installing/assembling needle bearing, bearing race, snap ring and thrust washer, use the following illustration as a guide to installation procedures and locations.

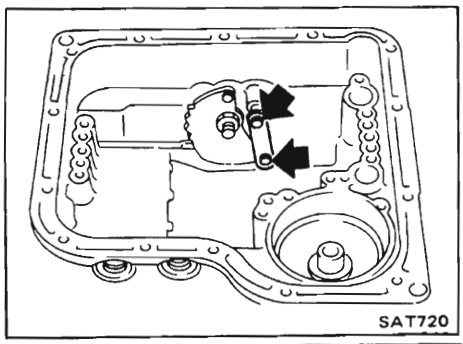


Snap ring

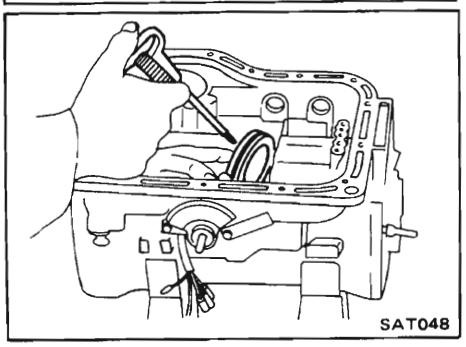
No.	Outer diameter mm (in)
11	142 (5.59)
12	122 (4.80)
13	126 (4.96)
14	126 (4.96)
15	126 (4.96)

Needle bearing

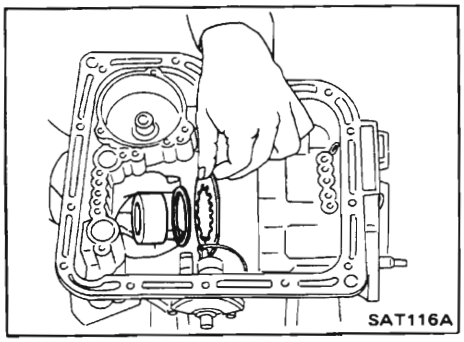
No.	Outer diameter mm (in)
1	53 (2.09)
2	47 (1.85)
3	70 (2.76)
4	70 (2.76)
5	47 (1.85)
6	72 (2.83)
7	53 (2.09)
8	35 (1.38)
9	47 (1.85)
10	70 (2.76)



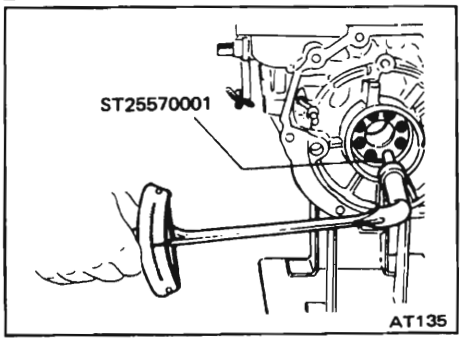
1. Install parking rod, manual plate, manual plate lock nut, parking brake lever and snap rings.



2. Lubricate and install low and reverse piston into the case.

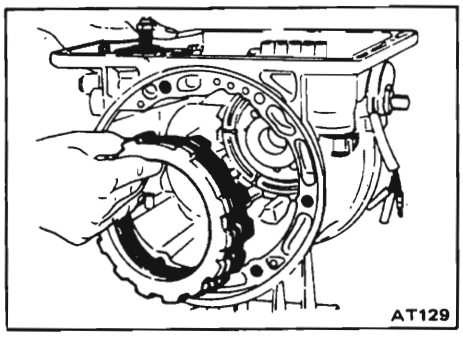


3. Install piston return spring, thrust washer and one-way clutch inner race.

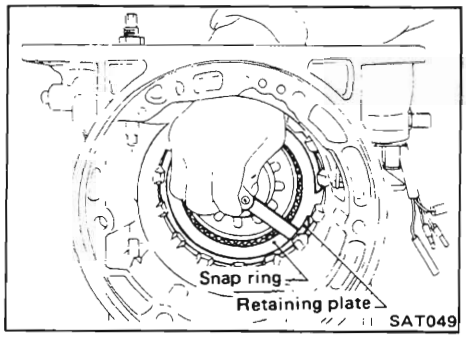


4. Install hex-head slotted bolts.

Check that return spring is centered on race before tightening.



5. Install steel dished plate first, then steel and friction plates, and, finally, retaining plate and snap-ring.



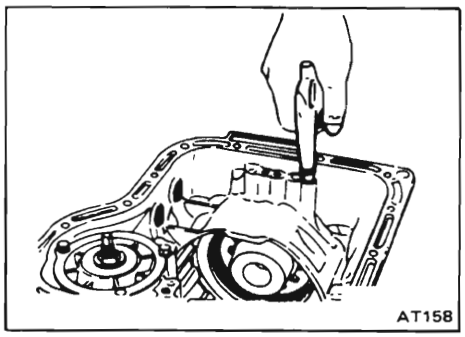
6. After low and reverse brake has been completely assembled, measure clearance between snap ring and retainer plate. If measurement exceeds specifications adjust by replacing retainer plate with one of a different thickness.

Low and reverse brake clearance:

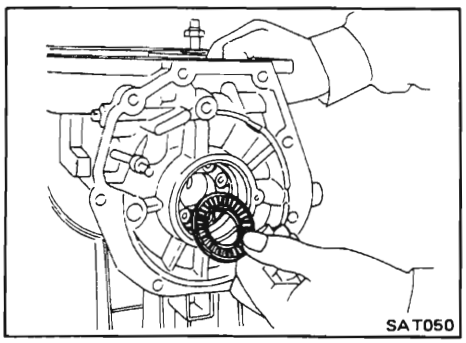
0.80 - 1.05 mm (0.0315 - 0.0413 in)

Available retainer plates

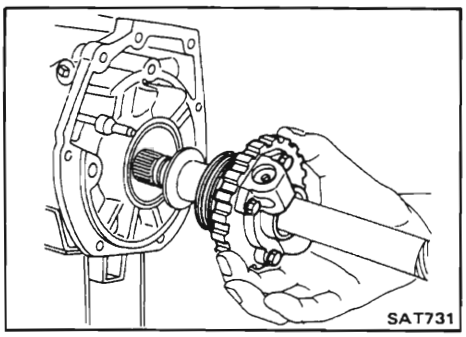
Thickness mm (in.)	Part number
7.8 (0.3070)	31667 - X0500
8.0 (0.3150)	31667 - X0501
8.2 (0.3228)	31667 - X0502
8.4 (0.3307)	31667 - X0503
8.6 (0.3386)	31667 - X0504
8.8 (0.3465)	31667 - X0505



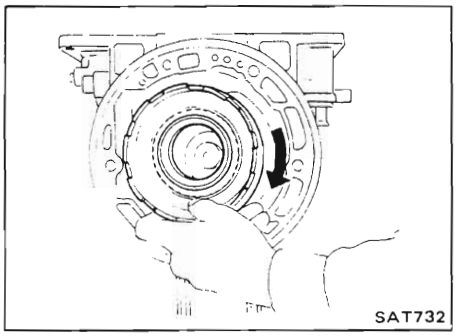
7. Check low and reverse brake operation using compressed air.



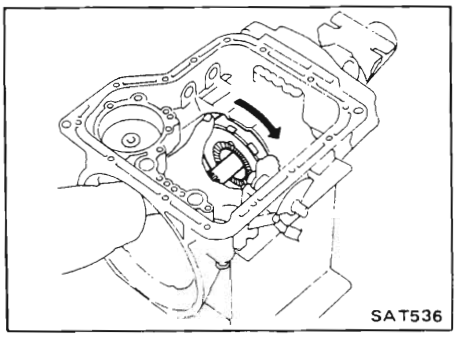
8. Install governor needle bearing.



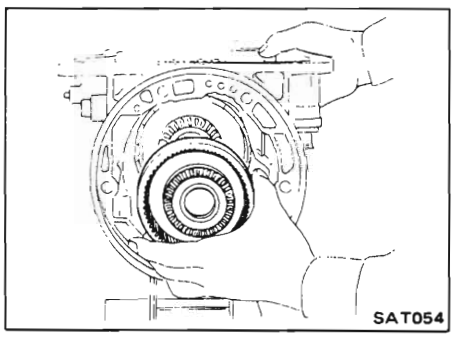
9. Install thrust washer, output shaft and governor distributor into case.



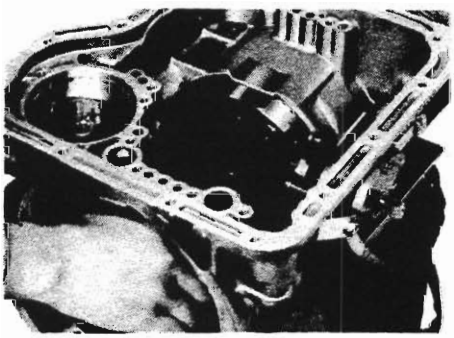
10. Install connecting drum with sprag by rotating drum clockwise.



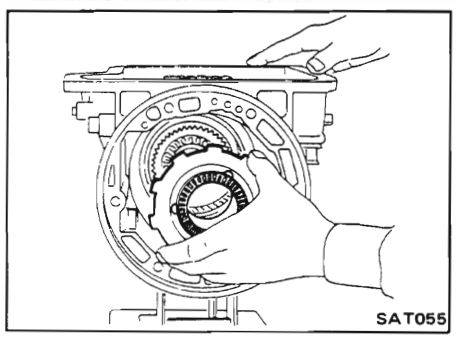
11. Check one-way clutch to see if it operates properly.



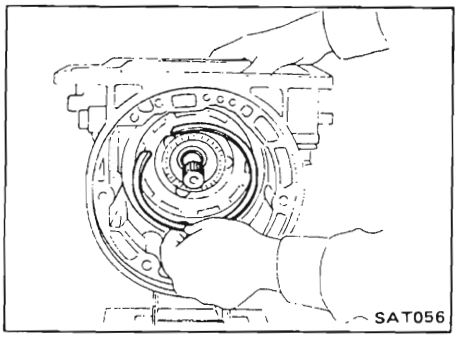
12. Install rear internal gear.



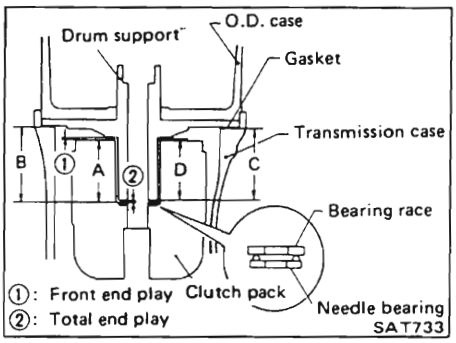
13. Install snap ring.on shaft.



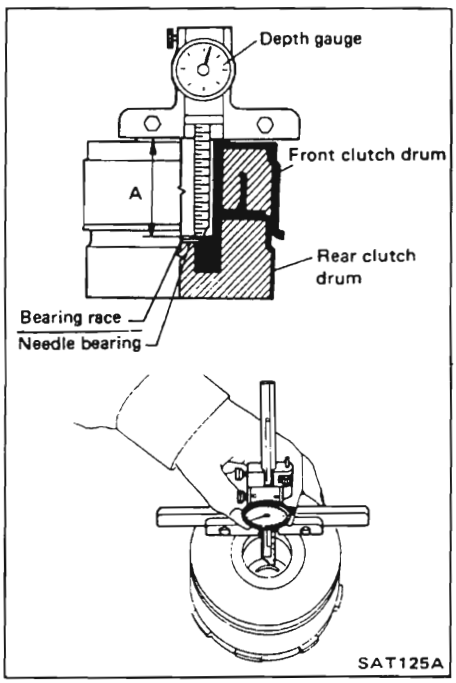
14. Secure thrust bearing and thrust washer with vaseline and install rear planetary carrier.



15. Install rear planetary carrier snap ring.
If you have insufficient space to install snap ring into drum groove, pull connecting drum forward as far as possible.

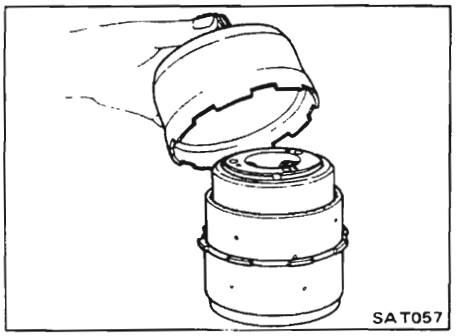


16. Adjust end play as follows:

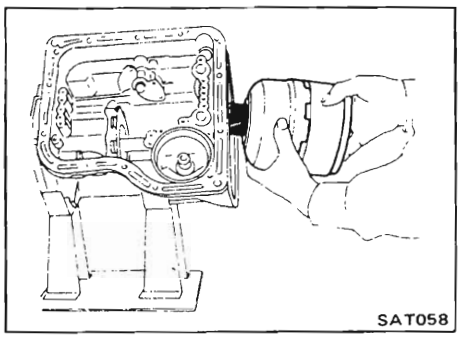


Front end play

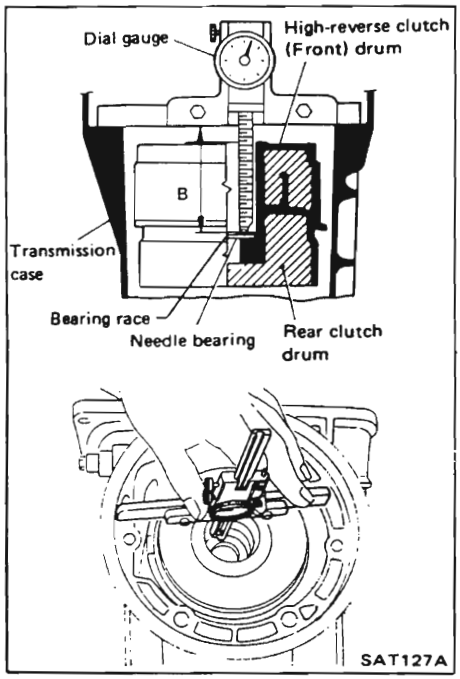
1) Assemble front clutch and rear clutch drum assemblies together and lay them flat on bench. Be sure rear hub needle bearing and bearing race are properly seated. Measure from face of clutch drum to top of bearing race (dimension A).



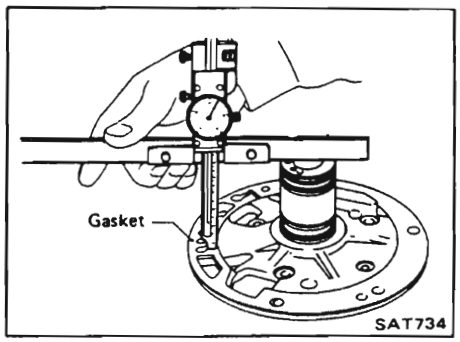
2) Assemble front internal gear, front planetary carrier and connecting shell. Secure needle bearings with vaseline.



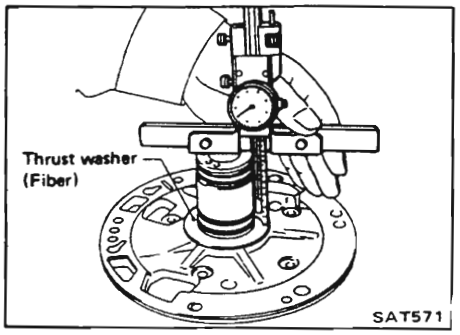
3) Install assembly into transmission case. Check that parts are properly seated before proceeding with measurements.



4) Using a dial gauge or caliper with a 200 mm base, measure from rear hub bearing race to case (dimension B).



5) Measure from top of drum support shaft (front clutch and rear clutch side) to installed gasket (dimension C).



6) Install thrust washer. Measure from top of drum support shaft (front clutch and rear clutch side) to thrust washer (dimension D).

Front end play = [B – A – 0.1 mm (0.004 in)] – (C – D)

Specified front end play:

0.5 - 0.8 mm (0.020 - 0.031 in)

Front end play can be adjusted with front clutch thrust washers.

Available front clutch thrust washer

Thickness mm (in)	Part number
1.3 (0.051)	31528-X0107
1.5 (0.059)	31528-X0105
1.7 (0.067)	31528-X0106
1.9 (0.075)	31528-X0100
2.1 (0.083)	31528-X0101
2.3 (0.091)	31528-X0102
2.5 (0.098)	31528-X0103
2.7 (0.106)	31528-X0104

Total end play

Total end play = [B – 0.1 mm (0.004 in)] – C

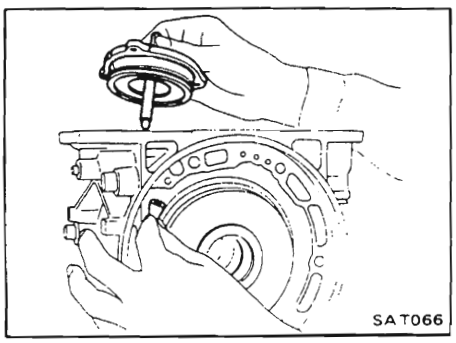
Specified total end play:

0.25 - 0.50 mm (0.0098 - 0.0197 in)

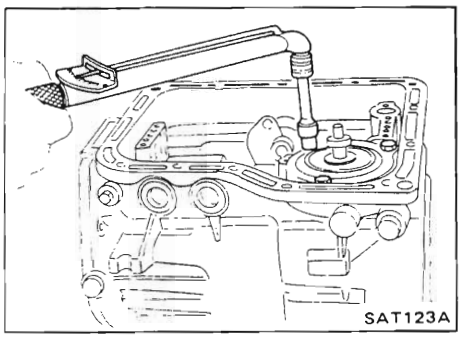
Total end play can be adjusted with bearing race.

Available oil pump cover bearing race

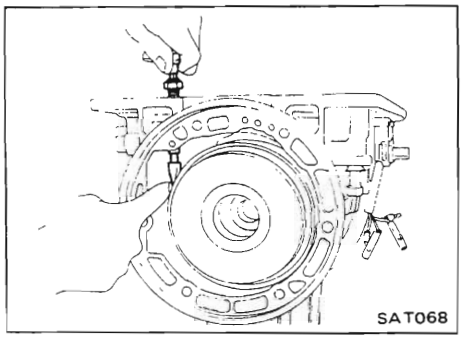
Thickness mm (in)	Part number
1.2 (0.047)	31556-X0100
1.4 (0.055)	31556-X0101
1.6 (0.063)	31556-X0102
1.8 (0.071)	31556-X0103
2.0 (0.079)	31556-X0104
2.2 (0.087)	31556-X0105



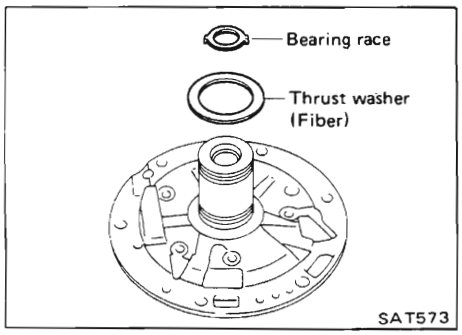
17. Install brake band, band strut, and band servo. Lubricate servo O-rings before installing.



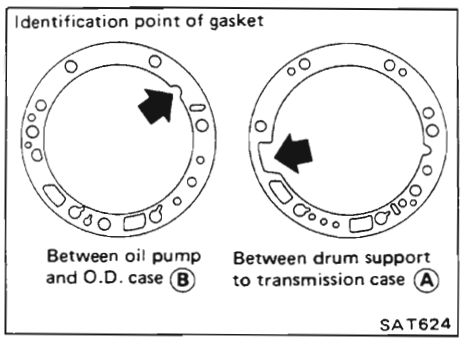
18. Install and tighten the retainer bolts. And then loosen piston stem. (RB30E).



19. Tighten piston stem of brake band servo with finger enough to prevent brake band and strut from falling out (RB30E engine).
- **Do not adjust brake band at this time on model for RB30E engine.**
- **Regarding the adjustment on model for CA20E engine, refer to Adjustment for Brake Band and Band Servo.**

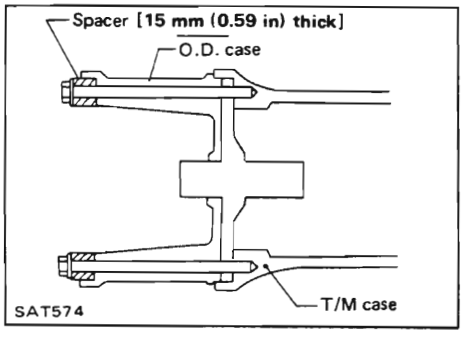


20. Apply vaseline to bearing race and thrust washer, then mount them on drum support.

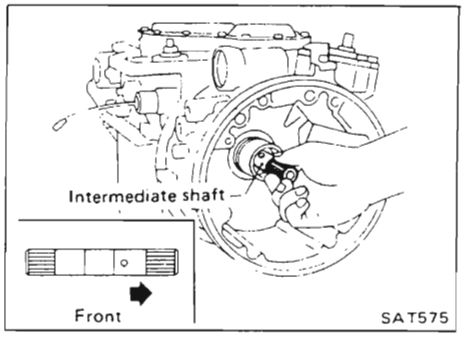


21. Mount drum support (A) on drum support after coating with vaseline. Apply A.T.F. to O-ring of drum support. Align drum support with O.D. case to transmission case and install.
22. Apply A.T.F. to O-ring of drum support, then install drum support and O.D. case.

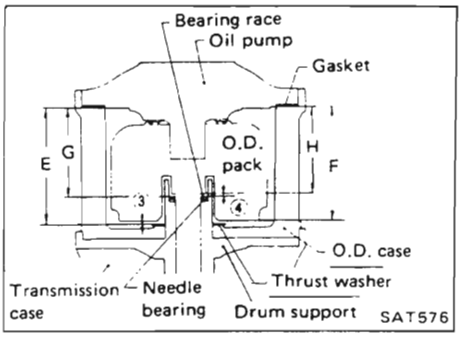
Before installing drum support and O.D. case on transmission case, ensure that they have been centered properly. Refer to Component Parts for Drum Support.



23. Temporarily tighten O.D. case with two converter housing securing bolts.

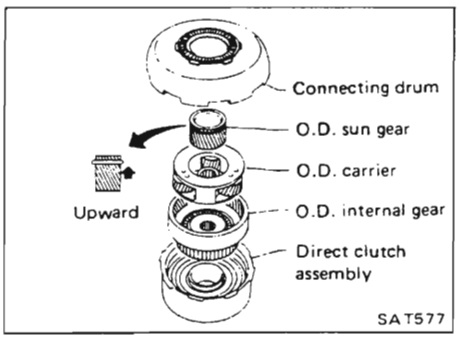


24. Insert intermediate shaft.
Be careful of shaft direction.



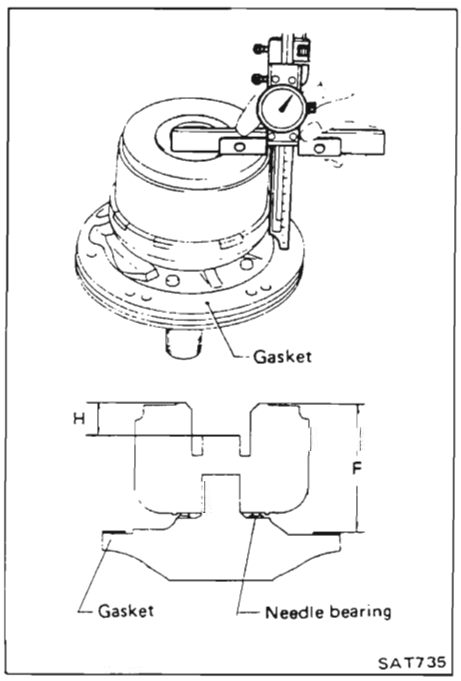
25. Adjust O.D. end play.

③. O.D. pack end play
④. O.D. total end play

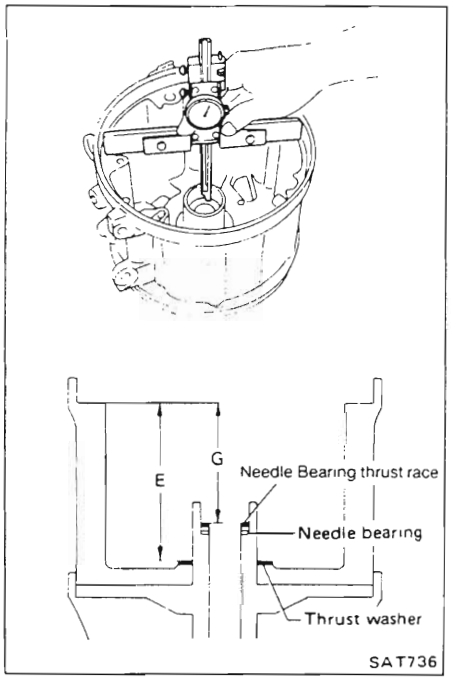


O.D. pack end play

1) Assemble direct clutch assembly, O.D. planetary gear set and connecting drum, and install them on O.D. pack.



2) Install oil pump bearing, gasket and O.D. pack on oil pump, and measure dimensions F and H.



3) Attach thrust washer and needle bearing to drum support and O.D. case, and measure dimensions E and G.

O.D. pack end play = [E – 0.1 mm (0.004 in)] – F

Specified O.D. pack and end play:

0.5 - 0.8 mm (0.020 - 0.031 in)

O.D. pack end play can be adjusted with O.D. thrust washers.

Available O.D. thrust washer

Thickness mm (in)	Part number
1.3 (0.051)	31528 - X0107
1.5 (0.059)	31528 - X0106
1.7 (0.067)	31528 - X0105
1.9 (0.075)	31528 - X0100
2.1 (0.083)	31528 - X0101
2.3 (0.091)	31528 - X0102
2.5 (0.098)	31528 - X0103
2.7 (0.106)	31528 - X0104

O.D. total end play

O.D. total end play = [G – 0.1 mm (0.004 in)] – (F – H)

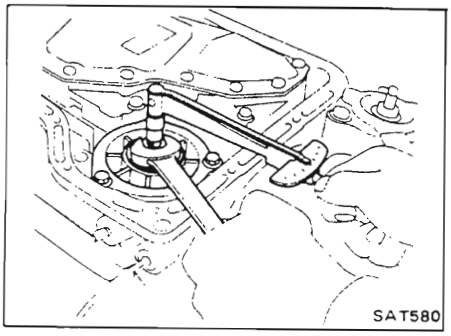
Specified O.D. total end play:

0.25 - 0.50 mm (0.0098 - 0.0197 in)

O.D. total end play can be adjusted with O.D. bearing race.

Available O.D. Needle bearing thrust race.

Thickness mm (in)	Part number
1.2 (0.047)	31556 - X0100
1.4 (0.055)	31556 - X0101
1.6 (0.063)	31556 - X0102
1.8 (0.071)	31556 - X0103
2.0 (0.079)	31556 - X0104
2.2 (0.087)	31556 - X0105



26. Adjust 2nd brake band (RB30E engine). Tighten piston stem to the specified value. Back off three full turns and secure with lock nut.

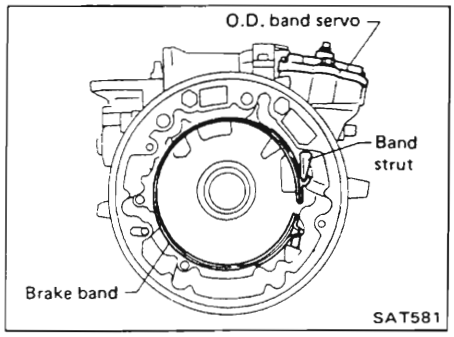
: **2nd brake band piston stem**

12 - 15 N·m (1.2 - 1.5 kg-m, 9 - 11 ft-lb)

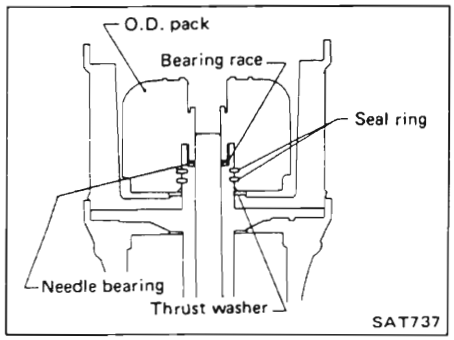
Lock nut

15 - 39 N·m (1.5 - 4.0 kg-m, 11 - 29 ft-lb)

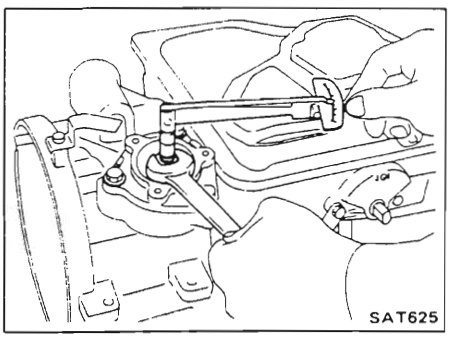
For CA20E 2nd brake band Adjustment, Refer to Adjustment For Brake Band and Servo.



27. Lubricate O.D. servo O-rings, then install O.D. band servo, brake band and band strut.

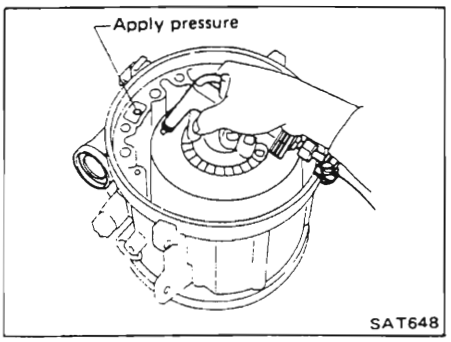


28. Lubricate seal ring of drum support, then install O.D. bearing & race, O.D. thrust washer and O.D. pack on drum support. Make sure that brake band strut is correctly installed.

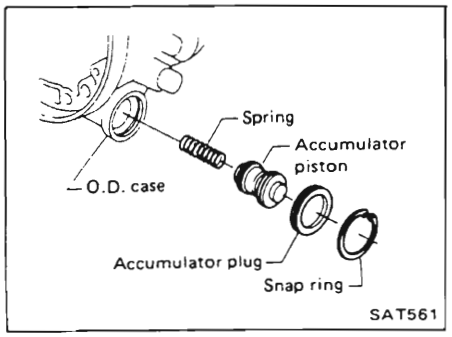


29. Adjust O.D. band. Tighten piston stem to the specified value. Back off two full turns and secure with lock nut.

    : **O.D. band piston stem**
    7 - 10 N·m (0.7 - 1.0 kg-m, 5.1 - 7.2 ft-lb)
    Lock nut
    15 - 39 N·m (1.5 - 4.0 kg-m, 11 - 29 ft-lb)



30. Test O.D. band servo operation using compressed air.

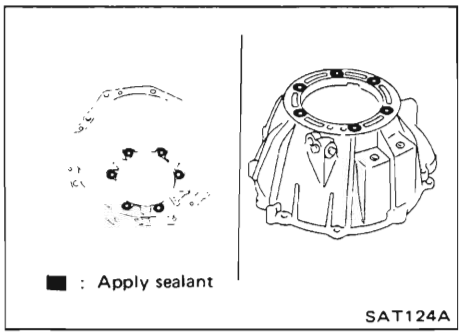


31. Install accumulator parts, then secure with snap ring.

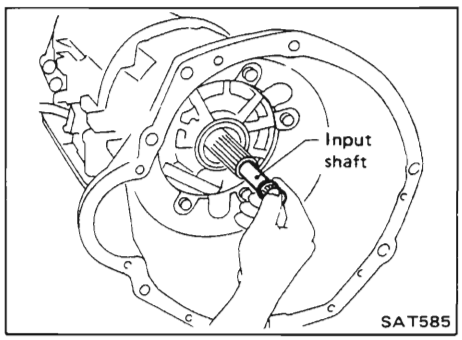
32. Lubricate O-ring of oil pump, then install needle bearing & race and oil pump.

Before installing oil pump housing and oil pump on O.D. case, ensure that they have been centered properly.

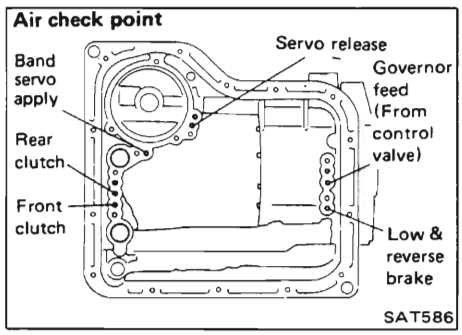
Refer to Oil Pump in Repair for Component parts.



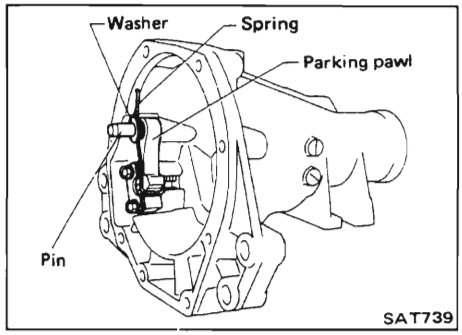
33. Remove the two bolts used to temporarily tighten O.D. case. Apply sealant to seating surface of converter housing around the bolt holes.
34. Install converter housing on O.D. case and tighten to the specified torque.



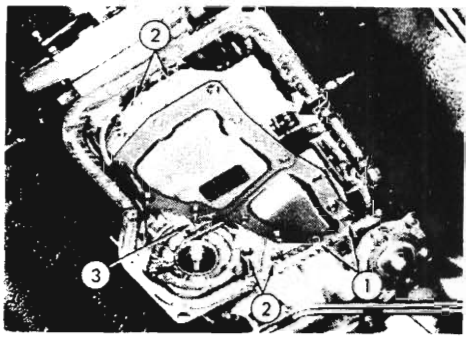
35. Install input shaft.



36. Before installing valve body assembly perform a final operation check of all assembled components, using compressed air.



37. Check that parking pawl, pin, spring and washer are assembled correctly.
38. Install rear extension.

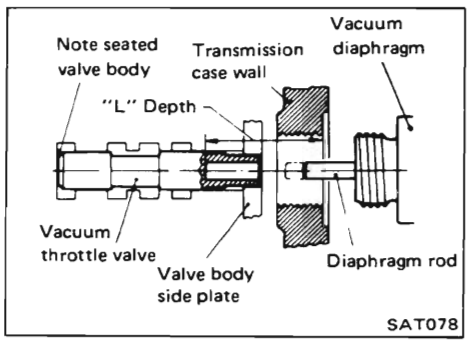


1 40 mm (1.57 in)
2 35 mm (1.38 in)
3 25 mm (0.98 in)

39. Install control valve assembly. Be sure manual valve is in alignment with selector pin. Tighten control valve body attaching bolts.

Securing bolt comes in three different lengths.

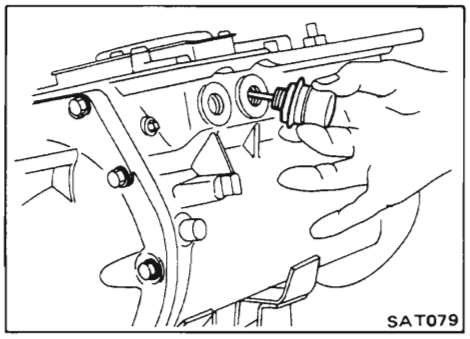
After installing control valve to transmission case, make sure that control lever can be moved to all positions.



40. Before installing vacuum diaphragm valve, measure depth of hole in which it is inserted. This measurement determines correct rod length to ensure proper performance.

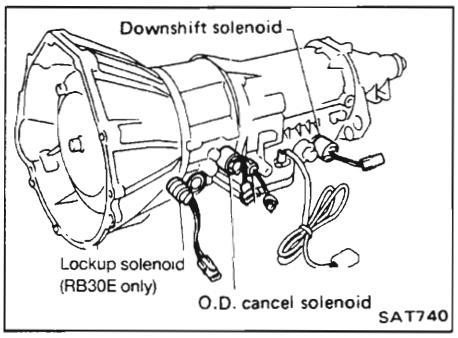
Vacuum diaphragm rod selection

Measured depth "L" mm (in)	Rod length mm (in)	Part number
Under 25.55 (1.0059)	29.0 (1.142)	31932-X0103
25.65 - 26.05 (1.0098 - 1.0256)	29.5 (1.161)	31932-X0104
26.15 - 26.55 (1.0295 - 1.0453)	30.0 (1.181)	31932-X0100
26.65 - 27.05 (1.0492 - 1.0650)	30.5 (1.201)	31932-X0102
Over 27.15 (1.0689)	31.0 (1.220)	31932-X0101

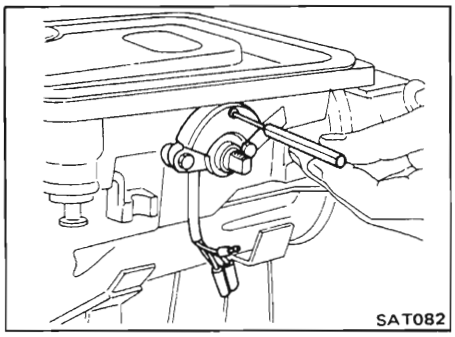


41. Install vacuum diaphragm.

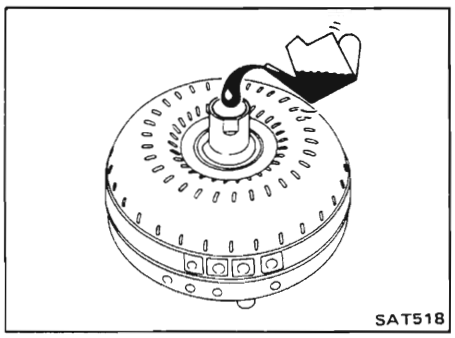
Make sure that vacuum diaphragm rod does not interfere with side plate of control valve.



42. Install downshift solenoid, O.D. cancel solenoid, and lockup solenoid. (RB30E)



43. Install inhibitor switch. Check for proper operation in each range with a circuit tester. Refer to On-vehicle Servide.
44. Before installing oil pan, check parking pawl engagement.
45. Install oil pan with new gasket.



46. Pour approx. 2-liters (1-3/4 Imp qt) of A.T.F. into converter housing.
47. Install torque converter to converter housing.

Be careful not to scratch front oil seal.

General Specifications

Applied model	CA20E	RB30E
Automatic transmission model	4N71B	E4N71B
Transmission model code number	X8307	X8081
Stall torque ratio	2.0 : 1	1.8 : 1
Transmission gear ratio		
1st	2.842	2.458
2nd	1.542	1.458
Top	1.000	1.000
O.D.	0.686	0.686
Reverse	2.400	2.182
Recommended oil	Automatic transmission fluid "Dexron" type	
Oil capacity	7.0 liters (6-1/8 Imp qt)	

Specifications and Adjustment

Transmission model code number	X8307	X8081
Torque converter assembly Stamped mark on the torque converter	NEC	GXA
Direct clutch		
Number of drive plates	2	2
Number of driven plates	2	2
Clearance mm (in) Standard	1.6 - 1.8 (0.063 - 0.071)	
Allowable limit	2.0 (0.079)	
Drive plate thickness mm (in) Standard	1.50 - 1.65 (0.0591 - 0.0650)	
Allowable limit	1.4 (0.055)	
Thickness of race side	Thickness mm (in)	Part number
	0.4 (0.016)	31606-X8501
	0.6 (0.024)	31606-X8502
	0.8 (0.031)	31606-X8500
	1.0 (0.039)	31606-X8503
	1.2 (0.047)	31606-X8504

Specifications and Adjustment (Cont'd)

Transmission model code number	X8307		X8081	
Front clutch				
Number of drive plates	3		3	
Number of driven plates	5		5	
Clearance mm (in)				
Standard	1.6 - 1.8 (0.063 - 0.071)			
Allowable limit	2.2 (0.087)			
Drive plate thickness mm (in)				
Standard	1.50 - 1.65 (0.0591 - 0.0650)			
Allowable limit	1.4 (0.055)			
Thickness of retaining plate	Thickness mm (in)	Part number		
	5.0 (0.197)	31567-X2900		
	5.2 (0.205)	31567-X2901		
	5.4 (0.213)	31567-X2902		
	5.6 (0.220)	31567-X2903		
	5.8 (0.228)	31567-X2904		
	6.0 (0.236)	31567-X2905		
Rear clutch				
Number of drive plates	5		6	
Number of driven plates	5		6	
Clearance mm (in)				
Standard	0.8 - 1.0 (0.031 - 0.039)		0.8 - 1.0 (0.031 - 0.039)	
Allowable limit	1.8 (0.071)		2.0 (0.079)	
Thickness of retaining plate	Thickness mm (in)	Part number	Thickness mm (in)	Part number
	9.4 (0.370)	31567-X8580	6.2 (0.244)	31567-X2906
	9.6 (0.378)	31567-X8581	6.4 (0.252)	31507-X8600
	9.8 (0.386)	31567-X8582	6.6 (0.260)	31507-X8601
	10.0 (0.394)	31567-X8583	6.8 (0.268)	31537-X2800
	10.2 (0.402)	31567-X8584	7.0 (0.276)	31537-X2801
	10.4 (0.409)	31567-X8585	7.2 (0.283)	31537-X0900
	10.6 (0.417)	31537-X0100	7.4 (0.291)	31537-X0901
			7.6 (0.299)	31537-X0902

Specifications and Adjustment (Cont'd)

Transmission model code number	X8307	X8081
Low & reverse brake		
Number of drive plates	5	7
Number of driven plates	5	7
Clearance mm (in)		
Standard	0.8 - 1.05 (0.0315 0.0413)	0.8 - 1.05 (0.0315 - 0.0413)
Allowable limit	1.8 (0.071)	2.2 (0.08)
Drive plate thickness mm (in)		
Standard	1.90 - 2.05 (0.0748 - 0.0807)	
Allowable limit	1.8 (0.071)	

Thickness of retaining plate	Thickness mm (in.)	Part No.
	7.8 (0.307)	31667 - X0500
	8.0 (0.315)	31667 - X0501
	8.2 (0.323)	31667 - X0502
	8.4 (0.331)	31667 - X0503
	8.6 (0.339)	31667 - X0504
	8.8 (0.346)	31667 - X0505

2nd brake band		
Piston size mm (in)		
Big dia.	72 (2.83)	72 (2.83)
Small dia.	44 (1.73)	50 (1.97)
O.D brake band		
Piston size mm (in)		
Big. dia.	56 (2.20)	60 (2.36)
Small dia.	36 (1.42)	40 (1.57)
Front end play mm (in)	0.5 - 0.8 (0.020 - 0.031)	

Thickness of front clutch thrust washer	Thickness mm (in)	Part number
	1.3 (0.051)	31528-X0107
	1.5 (0.059)	31528-X0105
	1.7 (0.067)	31528-X0106
	1.9 (0.075)	31528-X0100
	2.1 (0.083)	31528-X0101
	2.3 (0.091)	31528-X0102
	2.5 (0.098)	31528-X0103
	2.7 (0.106)	31528-X0104

Specifications and Adjustment (Cont'd)

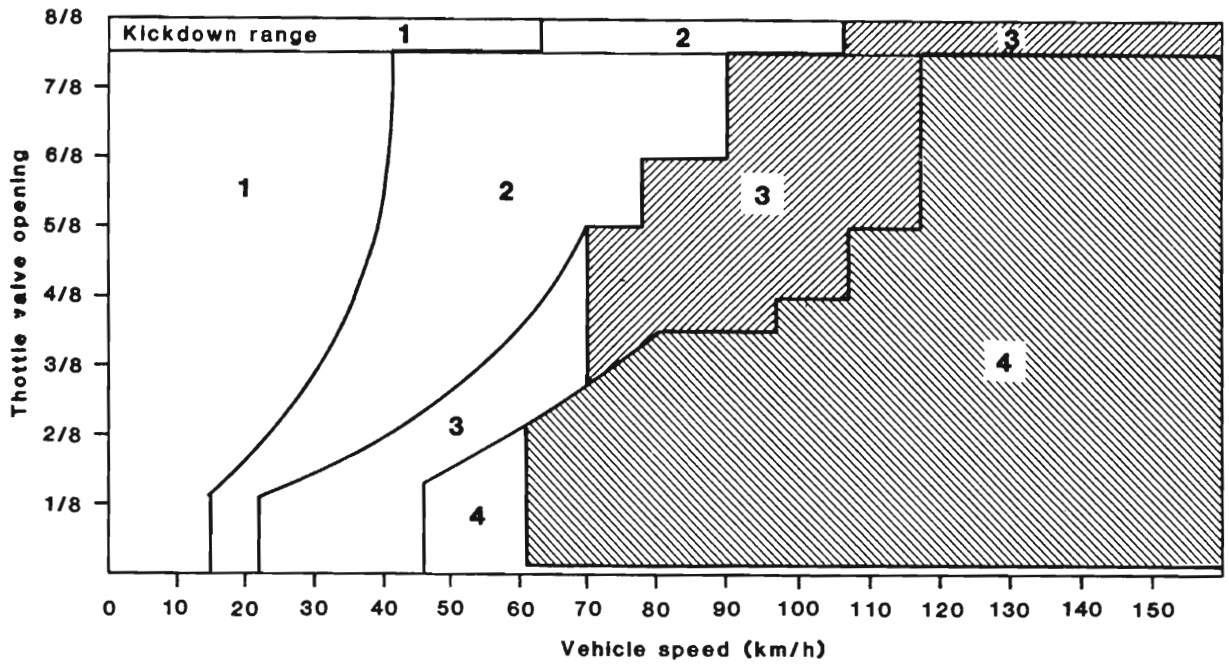
Total end play mm (in)	0.25 - 0.50 (0.0098 - 0.0197)	
Thickness of oil pump cover bearing race	Thickness mm (in)	Part number
	1.2 (0.047)	31556-X0100
	1.4 (0.055)	31556-X0101
	1.6 (0.063)	31556-X0102
	1.8 (0.071)	31556-X0103
	2.0 (0.079)	31556-X0104
	2.2 (0.087)	31556-X0105
O.D. pack end play mm (in)	0.5 - 0.8 (0.020 - 0.031)	
Thickness of O.D thrust washer	Thickness mm (in)	Part number
	1.3 (0.051)	31528-X0107
	1.5 (0.059)	31528-X0106
	1.7 (0.067)	31528-X0105
	1.9 (0.075)	31528-X0100
	2.1 (0.082)	31528-X0101
	2.3 (0.091)	31528-X0102
	2.5 (0.098)	31528-X0103
	2.7 (0.106)	31528-X0104
O.D. total end play mm (in)	0.25 - 0.50 (0.0098 - 0.0197)	
Thickness of O. D. needle bearing thrust race	Thickness mm (in)	Part number
	1.2 (0.047)	31556-X0100
	1.4 (0.055)	31556-X0101
	1.6 (0.063)	31556-X0102
	1.8 (0.071)	31556-X0103
	2.0 (0.079)	31556-X0104
	2.2 (0.087)	31556-X0105

Oil pump clearance mm (in)	
Outer gear-pump housing	
Standard	0.05 - 0.20 (0.0020 - 0.0079)
Allowable limit	0.25 (0.0098)
Outer gear-crescent	
Standard	0.14 - 0.21 (0.0055 - 0.0083)
Allowable limit	0.25 (0.0098)
Gear-pump cover	
Standard	0.02 - 0.04 (0.0008 - 0.0016)
Allowable limit	0.08 (0.0031)
Drum support mm (in)	
Seal ring-ring groove	
Standard	0.05 - 0.20 (0.0020 - 0.0079)
Allowable limit	0.20 (0.0079)
Oil distributor mm (in)	
Seal ring-ring groove	
Standard	0.04 - 0.16 (0.0016 - 0.0063)
Allowable limit	0.16 (0.0063)
Planetary carrier mm (in)	
Clearance between pinion washer and planetary carrier	
Standard	0.20 - 0.70 (0.0079 - 0.0276)
Allowable limit	0.80 (0.0315)
Runout of oil pump cover to housing mm (in)	Less than 0.07 (0.0028)
Runout of oil pump cover to O.D. case mm (in)	Less than 0.05 (0.0020)

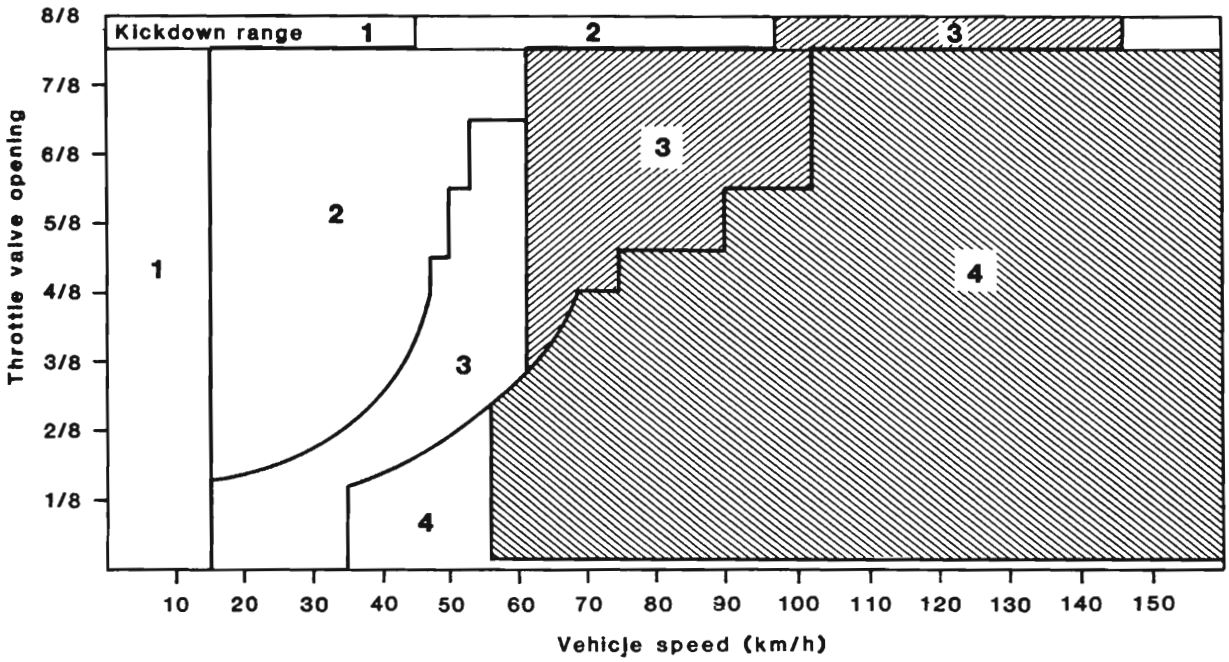
STALL REVOLUTION

CA20E engine	2200 ± 150 rpm
RB30E engine	2450 ± 150 rpm

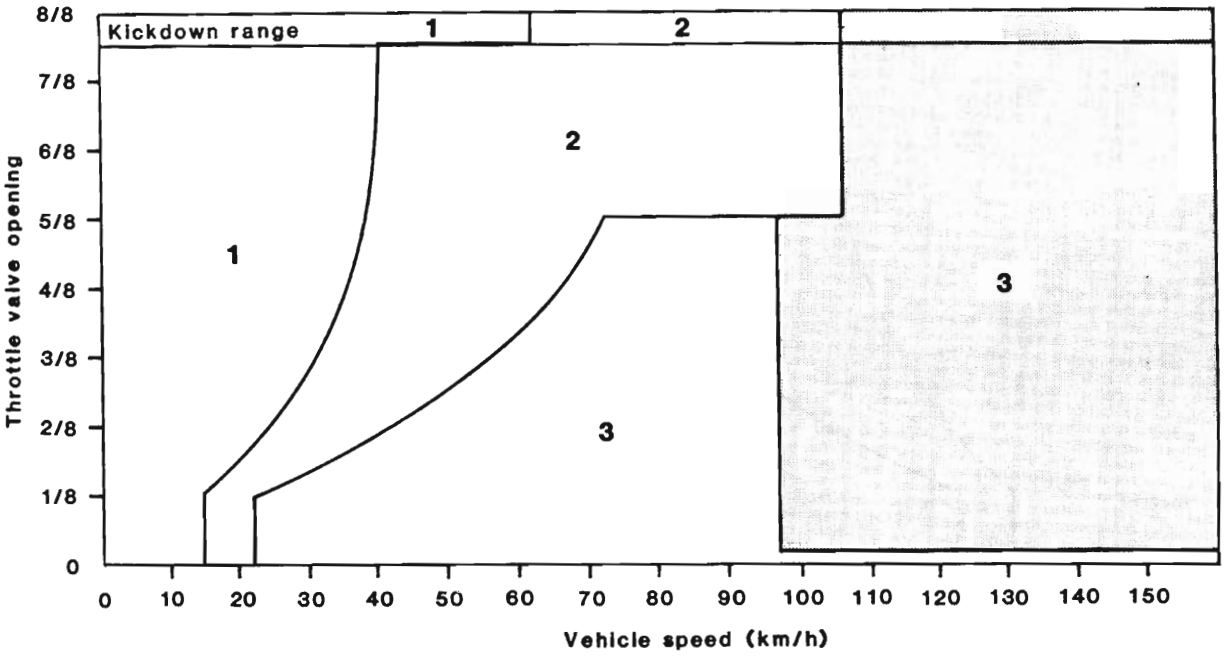
Shift Schedule — RB30 Upshift — Powershift "OFF"



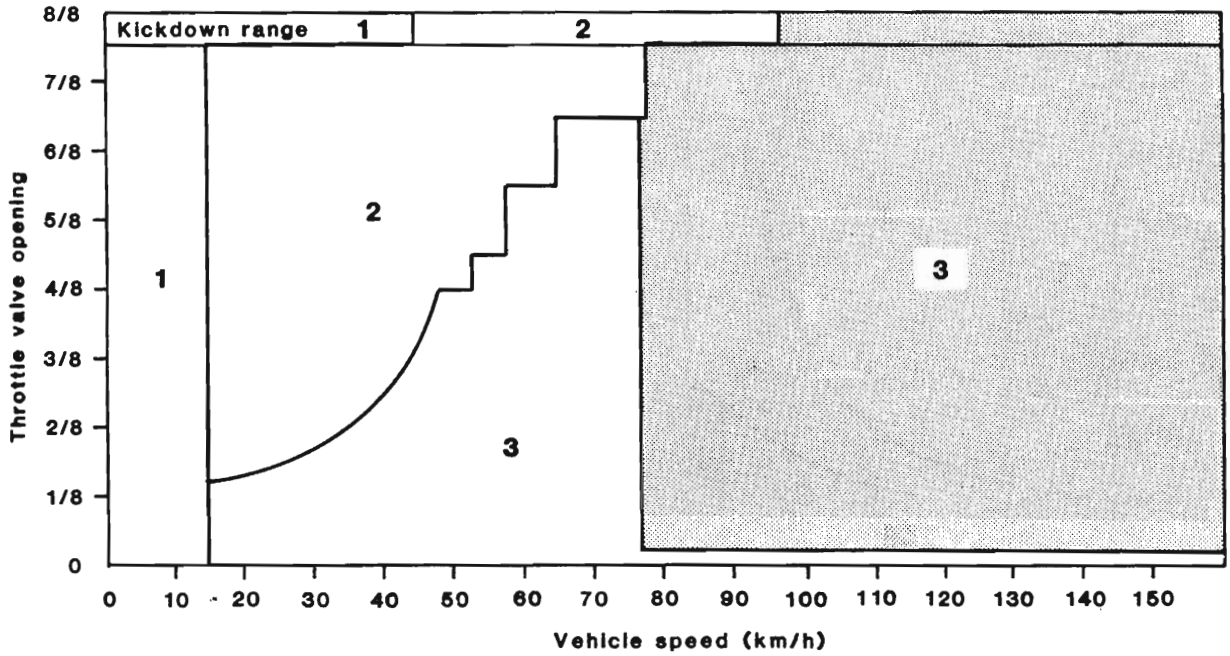
RB30 Downshift — Powershift "OFF"



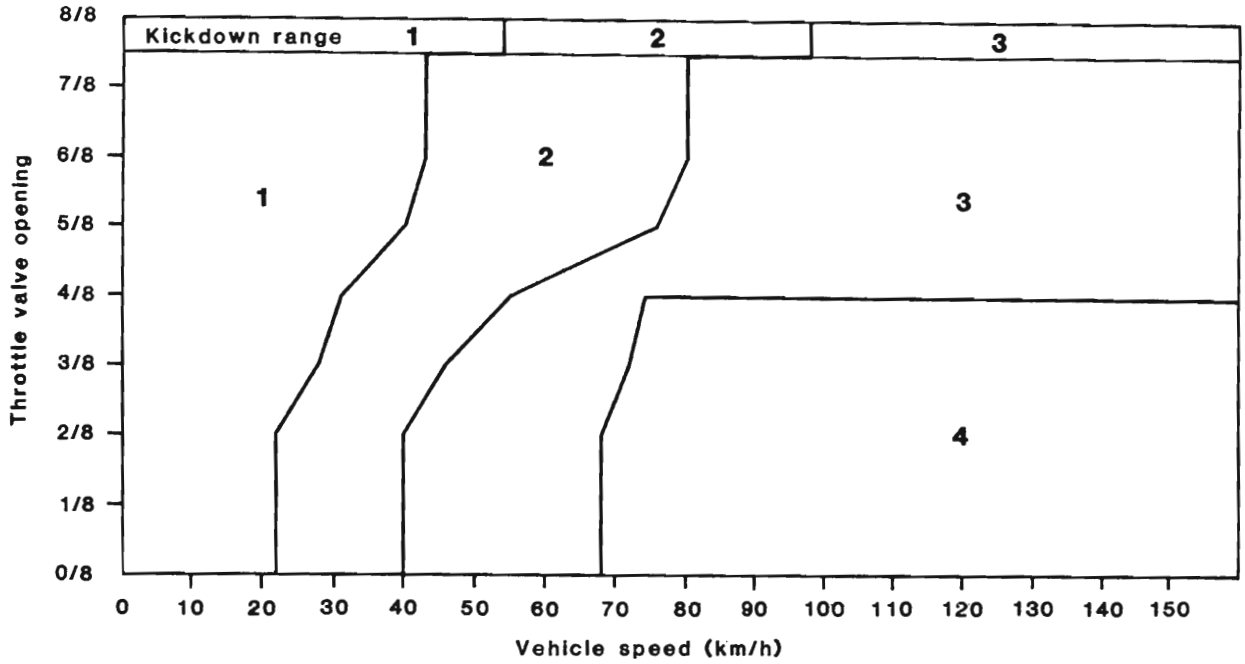
Shift Schedule — RB30 Upshift — Powershift "ON"



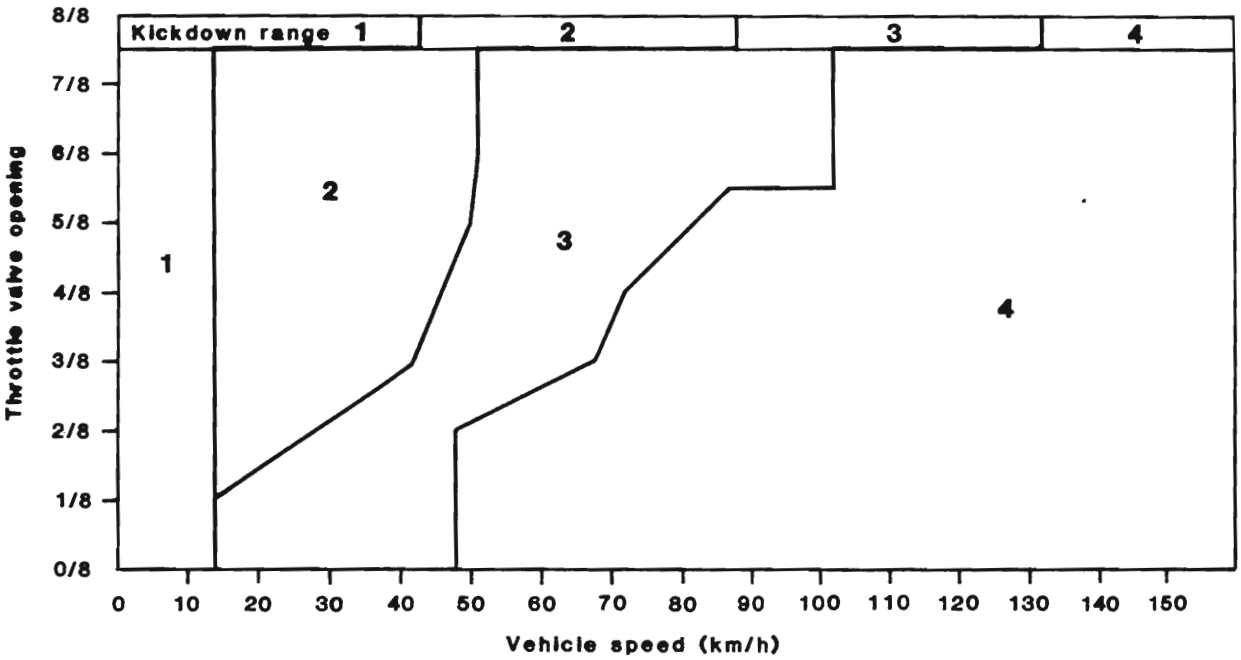
RB30 Downshift — Powershift "ON"



Shift Schedule — CA20 Upshift



CA20 Downshift



Tightening Torque

Unit	N·m	kg-m	ft-lb
Transmission installation			
Drive plate to Crankshaft	137 - 157	14.0 - 16.0	101 - 116
Drive plate to torque converter	39 - 49	4.0 - 5.0	29 - 36
Converter housing to engine	39 - 49	4.0 - 5.0	29 - 36
Gusset to converter housing	29 - 39	3.0 - 4.0	22 - 29
Gusset to engine	29 - 39	3.0 - 4.0	22 - 29
Gusset to converter housing	29 - 39	3.0 - 4.0	22 - 29
Rear mounting bracket to transmission	Refer to section ER.		
Rear mounting bracket to rear insulator			
Rear mounting member to body			
Component part			
Transmission case to converter housing	44 - 54	4.5 - 5.5	33 - 40
Transmission case to rear extension	20 - 25	2.0 - 2.5	14 - 18
Oil pan to transmission case	5 - 7	0.5 - 0.7	3.6 - 5.1
2nd servo piston retainer to transmission case	7 - 9	0.7 - 0.9	5.1 - 6.5
2nd piston stem (when adjusting band brake) (RB30E engine)	12 - 15*1	1.2 - 1.5*1	9 - 11*1
2nd piston stem lock nut (RB30E engine)	15 - 39	1.5 - 4.0	11 - 29
One-way clutch inner rear to transmission case	13 - 18	1.3 - 1.8	9 - 13
Control valve body to transmission case	5.4 - 7.4	0.55 - 0.75	4.0 - 5.4
Lower valve body to upper valve body	2.5 - 3.4	0.25 - 0.35	1.8 - 2.5
O.D. servo piston retainer to O.D. case	10 - 15	1.0 - 1.5	7 - 11
O.D. piston stem (when adjusting band brake)	7 - 10*2	0.7 - 1.0*2	5.1 - 7.2*2
O.D. stem lock nut	15 - 39	1.5 - 4.0	11 - 29
Side plate to control valve body	2.5 - 3.4	0.25 - 0.35	1.8 - 2.5
Nut for control valve reamer bolt	5 - 7	0.5 - 0.7	3.6 - 5.1
Oil strainer to lower valve body	3 - 4	0.3 - 0.4	2.2 - 2.9
Governor valve body to oil distributor	5 - 7	0.5 - 0.7	3.6 - 5.1

Unit	N·m	kg-m	ft-lb
Oil pump housing to oil pump cover	6 - 8	0.6 - 0.8	4.3 - 5.8
Inhibitor switch to transmission case	5 - 7	0.5 - 0.7	3.6 - 5.1
Manual shaft lock nut	29 - 39	3.0 - 4.0	22 - 29
Oil cooler pipe to transmission case	29 - 49	3.0 - 5.0	22 - 36
Test plug (oil pressure inspection hole)	14 - 21	1.4 - 2.1	10 - 15
Support actuator (parking rod inserting position) to rear extension	8 - 11	0.8 - 1.1	5.8 - 8.0
Drum support to O.D case	7 - 9	0.7 - 0.9	5.1 - 6.5

*1 Turn back three turns after tightening.
*2 Turn back two turns after tightening.

PROPELLER SHAFT & DIFFERENTIAL CARRIER

CONTENTS

PREPARATION	PD- 2
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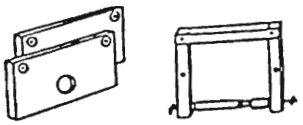
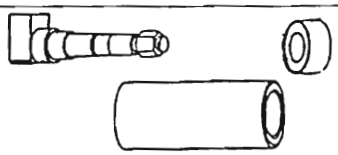
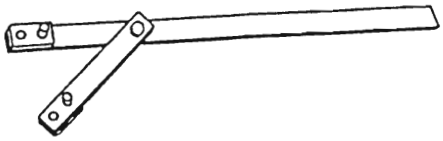
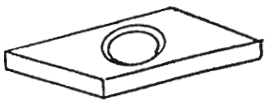
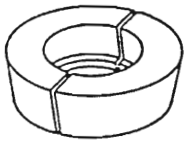
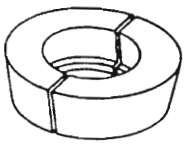
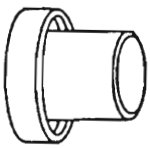
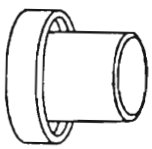
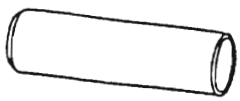
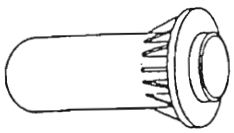
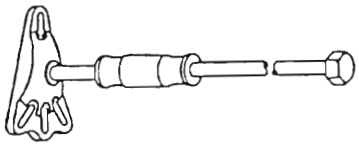
FINAL DRIVE	PD- 8
ON VEHICLE SERVICE	PD-10
FINAL DRIVE — OVERHAUL	PD-11
SERVICE DATA AND SPECIFICATION	PD-22

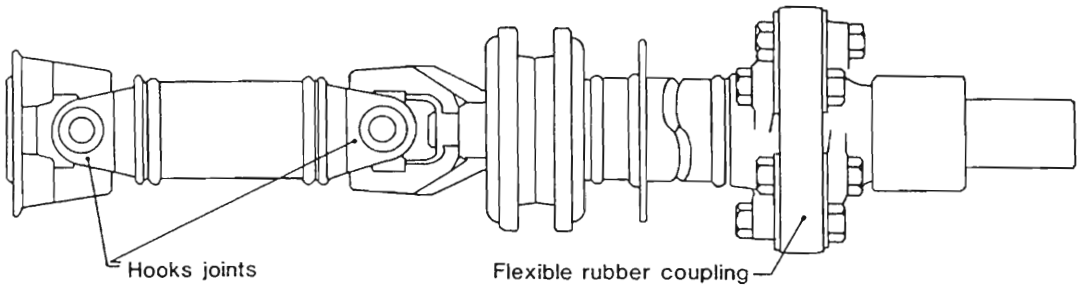
SPECIAL SERVICE TOOLS

Tool name Tool number	Description		Source
Spreader E9255		Removal and Installation of Differential	Litchfield
Pinion Height gauge E9300		Pinion shim selection	Litchfield
Pinion Flange wrench EN1205B		Removal and Installation at Pinion Flange	Litchfield
Press plate E1673P		Pinion and Differential Bearing	Litchfield
Bearing removal plates E1673 A15		Pinion bearing removal Use with E1673P	Litchfield
E1673N15 (RB30E) E1673 B15 (CA20E)		Differential bearing removal	Litchfield
Press tool E3C25		Differential side bearing installation 4 cylinder	Litchfield
E9277		Differential side bearing installation 6 cylinder	Litchfield
Bearing Installer E3C10 AER		Installing Pinion rear bearing	Litchfield

SERVICE TOOLS

Tool name Tool number	Description		Source
Press tool E1673 B16		Support for differential carrier during bearing installation	Litchfield
Seal installer E9055		Pinion seal installation	Litchfield
Axle remover E6662A			Litchfield
Plug Remover E3 M5		Inspection plug removal	Litchfield

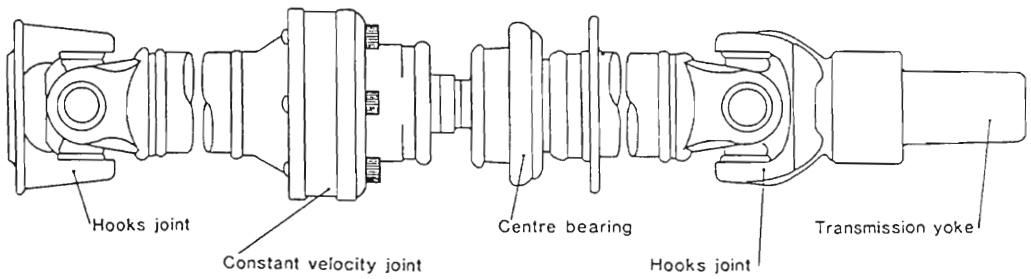
CA20E



A PD-003

CA20E models are equipped with a propeller shaft which has a flexible rubber coupling inserted between two yokes, one on the jack shaft and one on the sliding coupling.

RB30E



A PD-002

RB30E models are equipped with a propeller shaft which has hooks joints at either end and a central constant velocity joint located behind the centre bearing.

Replacing Flexible Coupling (CA20E)

The flexible coupling must be installed facing the correct way. To avoid confusion, replacement couplings are supplied already bolted to the transmission yoke as an assembly. If, for any reason, the coupling is to be removed and refitted, its direction should be marked with an arrow before disassembly to ensure correct orientation on reassembly.

Constant Velocity Joint

Removal (RB30E)

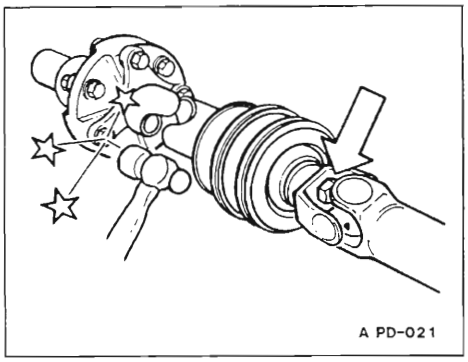
1. Remove propeller shaft from vehicle.
2. To ensure correct orientation of parts on reassembly, mark front and rear prop shafts and CV joint in a manner which indicates their relative alignment.
3. Remove the six cap screws holding the rear shaft assembly to the CV joint.
4. Using a hammer and soft punch, lightly tap the rear propshaft adaptor off the CV joint.
5. Remove the CV joint to prop shaft rear retaining circlip.
6. Using a hammer and a soft punch remove the dust cover forward from the CV joint.
7. Using a centre punch, carefully mark the end face of the CV joint inner race and the end of the splined shaft to ensure reassembly in the same orientation.
8. Slide suitable press plates between the dust cover and CV joint to support the inner area of the CV joint assembly. Press the CV joint off the shaft assembly.
9. Remove the CV joint thrust washer and front circlip and remove the dust cover and boot.

Reassembly

1. Refit boot and dust cover ensuring neither is damaged in any way.
2. Refit front circlip and thrust washer.
3. Align centre punch marks of CV joint inner race and splined shaft and press joint onto shaft until rear circlip groove is just cleared.
4. Fit rear circlip.
5. Ensure the CV joint is packed with 80g of Molybdenum Disulphide grease.
6. Apply a bead of silicon sealant to the inside of the dust cover and rear propshaft adaptor in the areas where they contact the outer body of the CV joint.
7. Assemble the dust cover and rear prop shaft to the CV joint ensuring the marks, made during disassembly are aligned.
8. Coat the threads of the six cap screws with sealant, assemble them into the joint and torque to 40Nm.

CENTRE BEARING

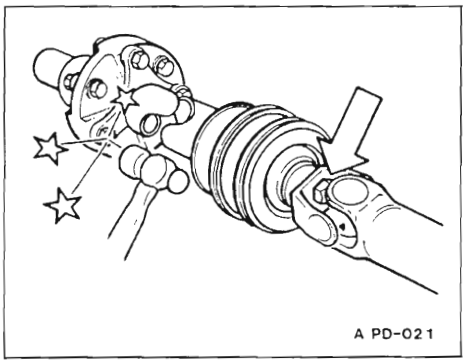
Removal — CA20E



1. To ensure correct orientation of parts on re-assembly, mark front and rear prop shafts in a manner that indicates their relative alignment.
2. Loosen the bolt in the rear end of the front shaft.
3. Using a soft hammer, drive alternatively against the heads of the three flexible coupling attaching bolts to separate the front and rear shafts.
4. Press the bearing assembly from the front shaft and discard the bearing.

Installing CA20E

1. Press a new centre bearing assembly onto the front propeller shaft.
2. Engage splined end of the front shaft in the yoke of the rear shaft, ensuring the marks made before disassembly are aligned.
3. Fit the retaining bolt through the hole in the back of the yoke, then push the two halves of the shaft together and tighten the bolt.



CENTRE BEARING

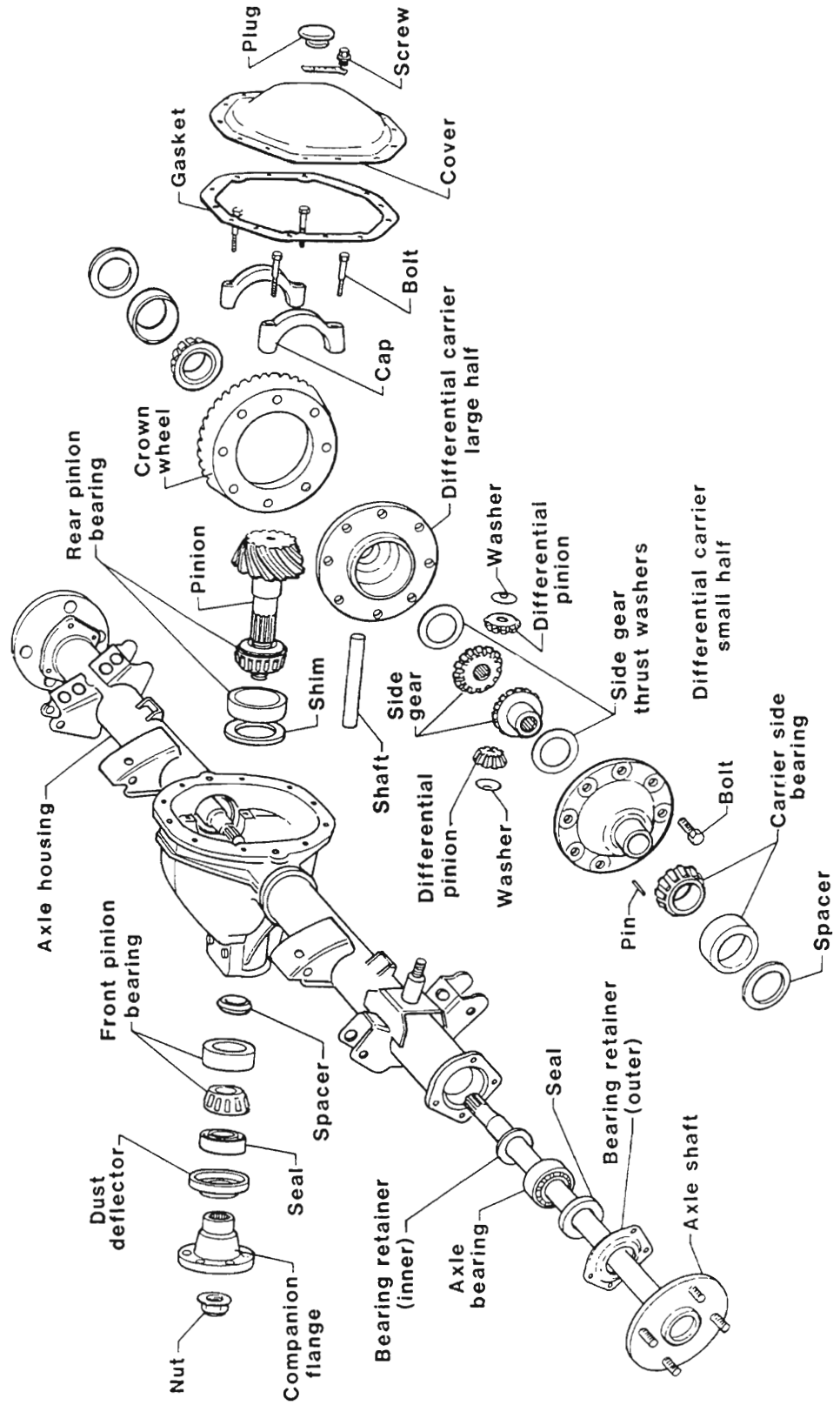
Removal — RB30E

1. Remove CV joint as previously described.
2. Using a hammer and suitable punch, tap the rear dust shield back off the shaft and discard the shield.
3. Remove the centre bearing retaining clip.
4. Press the centre bearing off the prop shaft and discard the bearing.
5. Using a suitable punch and hammer, remove front dust shield and discard.

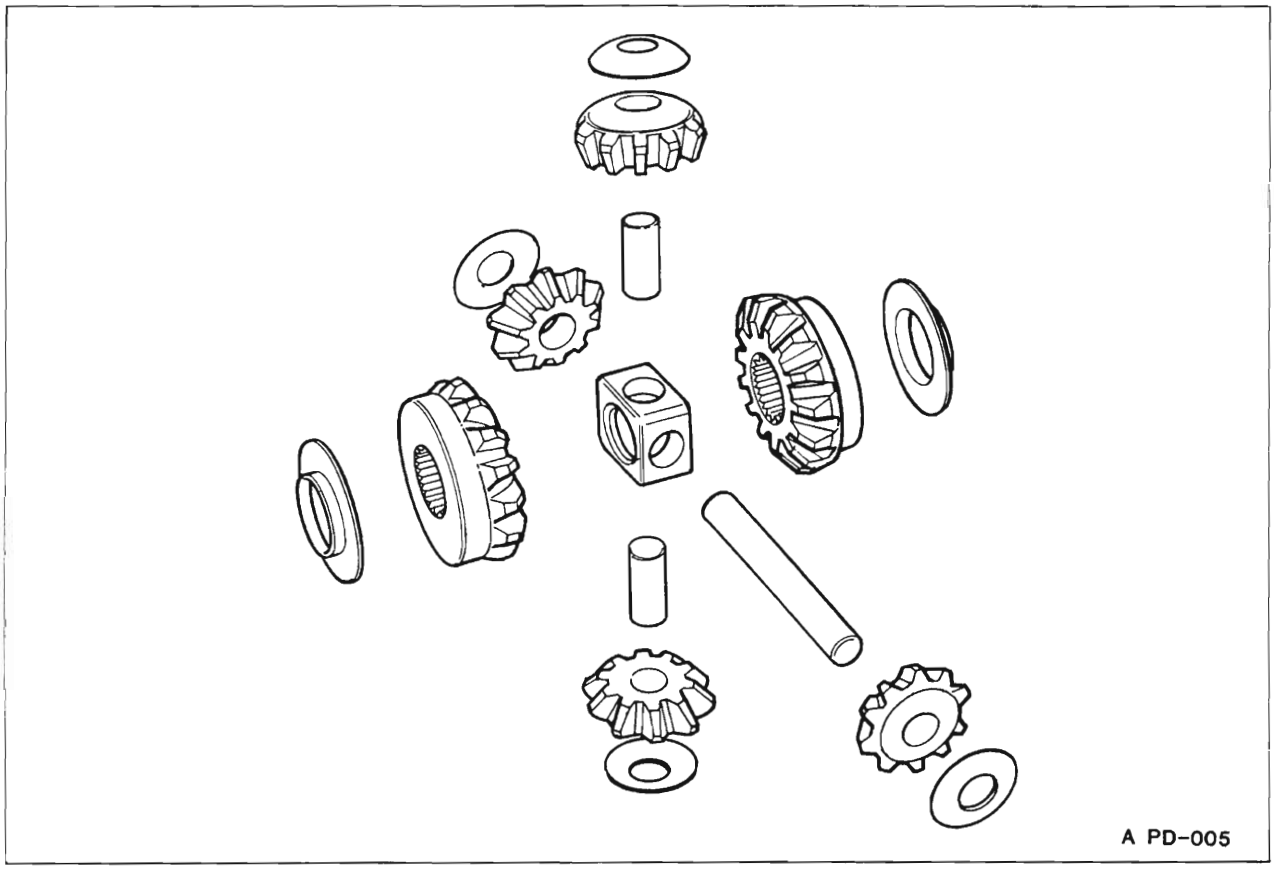
Installing RB30E

1. Using a suitably sized tube, lightly drift a new front dust seal onto the shaft.
2. Using a suitable sized tube against the inner track, press a new centre bearing onto the prop shaft.
3. Install the bearing retaining circlip.
4. Using a suitably sized piece of tube, fit the rear dust seal to the shaft.
5. Refit CV joint.

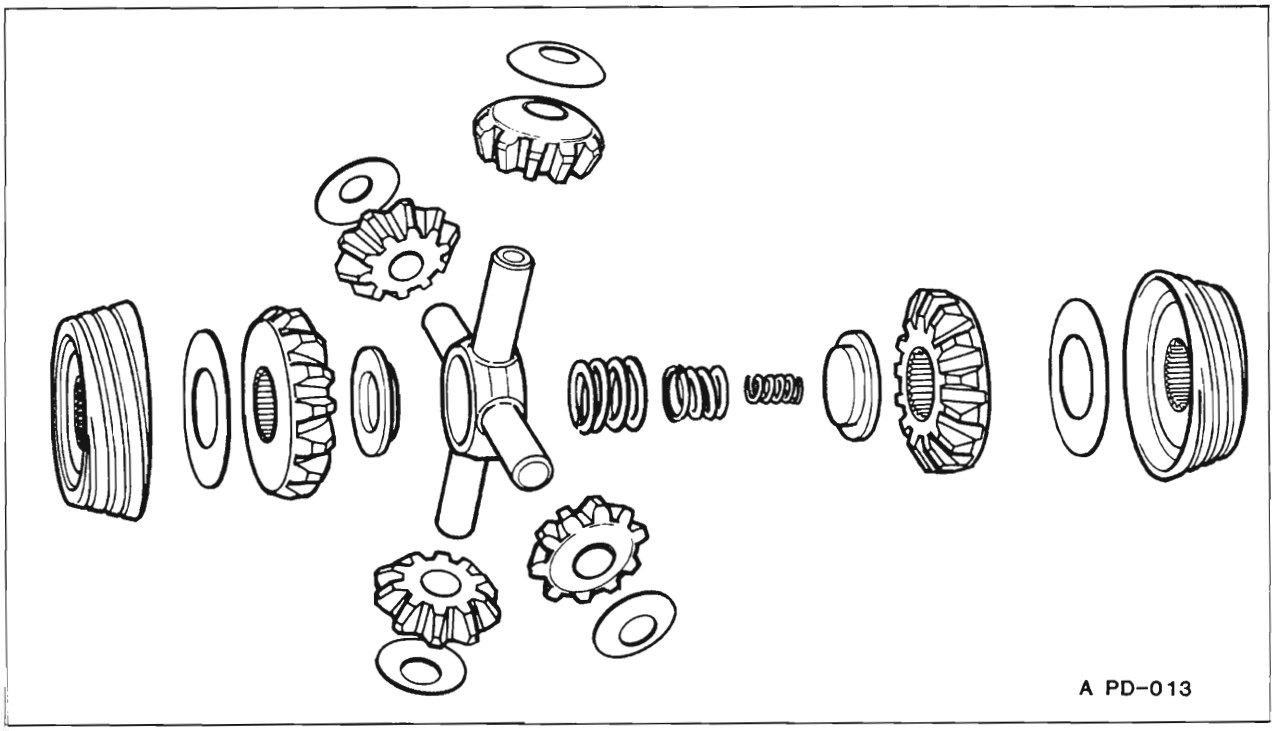
Rear Axle with 2-pinion differential

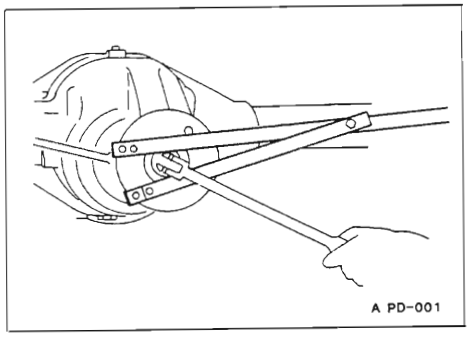


Four Pinion Differential Components



Limited Slip Differential Components





Pinion Oil Seal — Removal

1. Mark and disconnect propeller shaft from companion flange, remove rear wheels and withdraw rear axle shafts.
2. Remove rear cover to drain lubricant.
3. Ensure area around pinion seal is clean.
4. Measure and record Final Drive total preload at pinion.
5. Remove pinion nut.
6. Remove companion flange using puller.
7. Remove pinion seal and discard.

Note: Before installing a new seal, examine the companion flange for wear, scoring, damage, etc., on the seal surface area and in the splines. Also examine the housing bore and remove any nicks or burrs.

Installation

8. Before installation lightly lubricate oil seal lips.
9. Install new seal in housing. (Position seal flush with housing nose).
10. Replace companion flange and tighten nut to achieve the bearing preload as measured in (4) plus 0.5 Nm (5 in.lb.) to allow for the new seal.

Note: If a preload greater than 0.5 Nm above the value measured in (4) is attained then the unit should be rebuilt with a new collapsible spacer as described in Pinion Installation (PD-19).

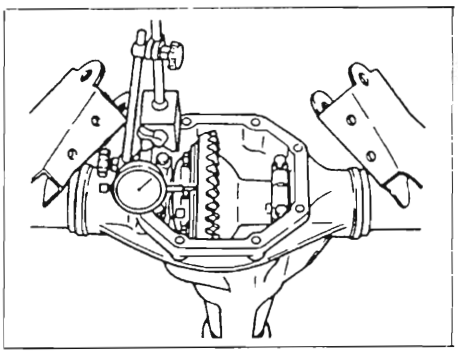
11. Connect propellor shaft, replace axle shafts, brakes and wheels. Replace rear cover plate with a new gasket and tighten bolts to the specified torque.
12. Bring vehicle to normal operational height before refilling with correct lubricant.
13. Reinstall filler plug.

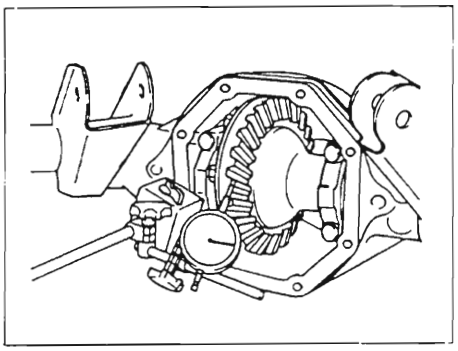
Removal

The rear axle assembly should be removed from the vehicle if overhaul of the final drive is to be performed. Refer to Section RA for procedure.
Also remove rear brake calipers, anchor plates and disc rotors.

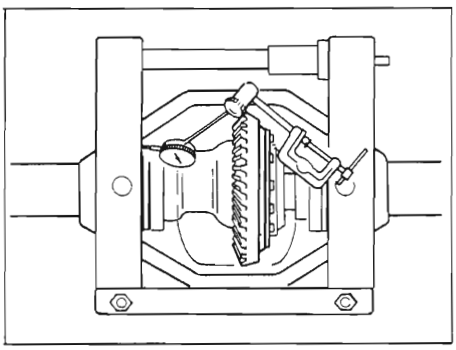
Inspection Before Disassembly

1. Remove the rear cover, drain oil, clean and visually inspect the moving parts for chipped or scuffed surfaces.
2. Use a torque wrench to check the ring gear bolts, the bearing bolts and the pinion flange nut.
3. Rotate the differential carrier through several turns whilst holding a dial indicator gauge against the back face of the ring gear to read the run-out. Refer S.D.S. for runout specification.
4. Leaving the dial indicator set up as in (3) push the ring gear hard one way then hard the opposite way to measure side play — no side play should be present.





5. Using a dial indicator gauge measure the ring gear backlash at three equi-spaced positions. Refer S.D.S. for backlash specification.

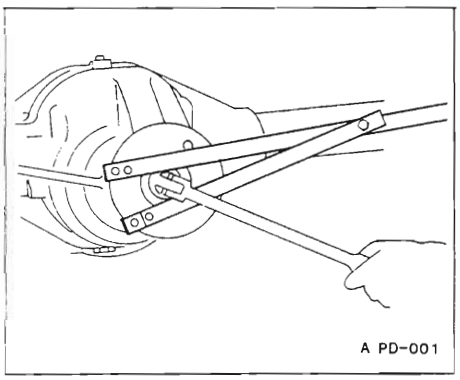


Disassembly

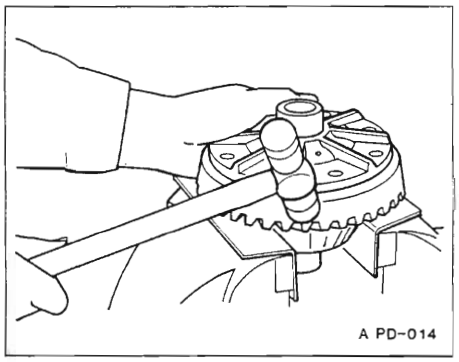
1. Remove bearing caps. Note: Bearing caps are not interchangeable. Mark housing and cap with daub of paint.
2. Attach tool E9255 to spread housing.
3. Set up dial indicator to read housing spread.

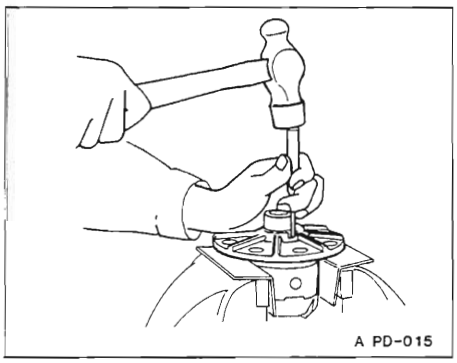
4. Spread the housing the minimum amount which will allow removal of the differential assembly. Usually 0,1 to 0,2 mm (.004" to .008") will be an adequate stretch. Spread to be measured across housing face near differential bearings.
5. Remove differential assembly.
6. Release tension on spreader and remove spreader and dial indicator.

Note: The housing must not be spread more than 0,5 mm (.020") or a permanent set may take place.


A PD-001

7. Remove pinion nut and companion flange using Tool Part No. EN1205B.
8. Remove the hypoid pinion by driving it out of the front pinion bearing cone and withdrawing it through the rear of the housing.
9. Remove the front pinion bearing cone and pinion seal by driving against the cone from the rear of the housing — discard the pinion seal.
10. Remove rear bearing cone from pinion, using tools E1673P and E1673A15.
11. Using a suitable drift remove front and rear pinion bearing cups from housing.

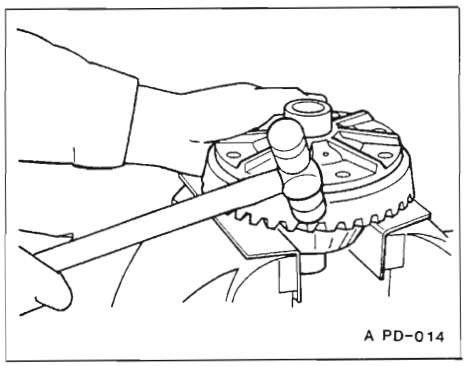

A PD-014


A PD-015

Differential Disassembly (Except L.S.D.)

1. Using tools E1673P and E1673B15 press bearings from differential carrier.
2. Remove ring gear bolts. (Note: L.H. thread ring gear bolts).
3. Using a soft face hammer remove ring gear from differential carrier.
4. Drive out differential pinion cross shaft retaining pin with a suitable punch.
5. Drive differential pinion shaft from carrier using a soft drift.
6. Split differential case by driving against one side gear face with a soft drift.
7. Remove differential pinions, side gears and thrust washers from carrier.

Note:
On six cylinder differentials (four pinion type) remove the remaining two pinions as follows:
Drive the short differential pinion shaft retaining pins (2 off) from the carrier. Drive the short pinion shafts from the carrier. Lift the remaining two pinions, thrust washers and thrust block from the carrier.



Differential Disassembly (L.S.D.)

1. Using tools E1673P and E1673B15 press bearings from differential carrier.
2. Remove ring gear bolts. (Note: L.H. thread gear bolts.)
3. Using a soft face hammer remove ring gear from differential carrier.
4. Before proceeding mark each half of the carrier to enable reassembly in the same orientation.
5. Remove the (8) screws securing the two halves of the carrier and separate the halves.
6. Remove pinion shaft, pinions, side gears, side gear shims (if fitted), spring plates and springs from carrier halves. Discard the springs.
7. Mark each clutch cone before removal to ensure reassembly with the same carrier half.
   If the cones are tight on their seats, lightly tap rim of each cone through the two holes provided in each carrier half.

Component Inspection

All components should be cleaned and inspected for excessive wear.

Cleaning of bearings should be performed with new solvent and should be followed up by coating the bearing with light engine oil to prevent rusting.

Hypoid Gear Set:

Examine for scuffed or chipped teeth. A gear set cannot be made to run quiet if the teeth are scuffed.

Ring gear bore and back face should be clean and free from burrs.

The rear bearing preload abutment faces on the hypoid pinion should be clean and free from burrs.

Examine the thread and bearing journals of the hypoid pinion.

Component Inspection (Cont'd.)

Bearings:
Cups should have an even wear pattern and be free from flaking or pitting. Ensure that the abutment faces are clean and free from burrs or raised metal.
The cone assemblies should feel smooth when turned in the cups. The assembly should be free from loose particles. No cracks should be present in the roller cages and the bores should contain no tears.

Differential Pinions and Side Gears:
Examine the teeth for cracks and hard contact marks. It is advisable to check the teeth for cracks with a red penetrating dye as most cracks in the early stages are not visible under normal visual examination. The side gear splines should be checked for excessive wear.
Check the side gear journals and back thrust face for scoring.
The differential pinion bores and spherical thrust surfaces should be smooth and free from scores.

Thrust Washers:
These should be free from cracks, nicks or burrs.

Differential Pinion Cross Shaft:
Check to see that shaft is not bent and that the surface on which the pinions run is not scored.

Differential Carrier:
Check the casting for general soundness and pay particular attention to the following points:–
If the bearings have been removed, journals must be free from tears as damaged journals result in premature bearing failures.
If bearings have been removed ensure that the bearing abutment faces on the housing are free from dirt and burrs. The ring gear spigot and mounting face should be clean and free from tears and burrs.
The mating surfaces of the two carrier halves should be clean and free from burrs.
The thrust surfaces for the side gears and pinions should be examined for excessive wear.
The side gear journal bores should be clean and free from scores.
The cross shaft bore should not be oval.

Component Inspection (Cont'd.)

Housing:
Check the casting all over for general soundness. All bearing bores and abutment faces to be clean and free from burrs.
Examine oil passages and ensure they are free from obstructions and loose particles.
Bore for pinion seal should be free from tears.
Rear cover face and bolt holes should be checked for damage.

Shims:
All shims should be clean and free from burrs.

Rear Cover:
Check for tears and any damage which may prevent effective sealing.

All Bolts:
Discard all damaged bolts.

L.S.D.:
Check clutch cone seats in carrier halves for scoring or excessive wear.

Check clutch cone spirals. They should be smooth and free from wear.

Check clutch cone splines for wear.

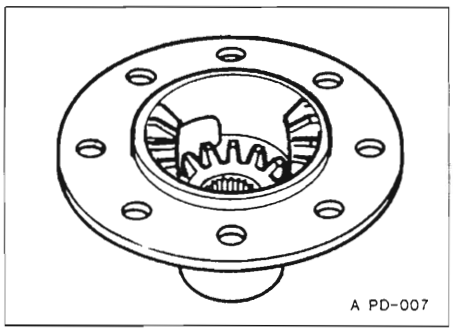
Selecting Side Gear Shims (L.S.D.)
Before assembling the differential, it is necessary to select the correct side gear shims.

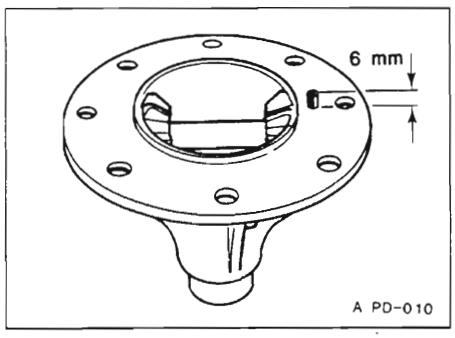
Place each clutch cone in its respective carrier half, pressing down firmly to ensure the cone is fully seated. Measure the distance between the carrier mating surface and the flat surface on the clutch cone. Select a shim for each carrier half in accordance with the table below.

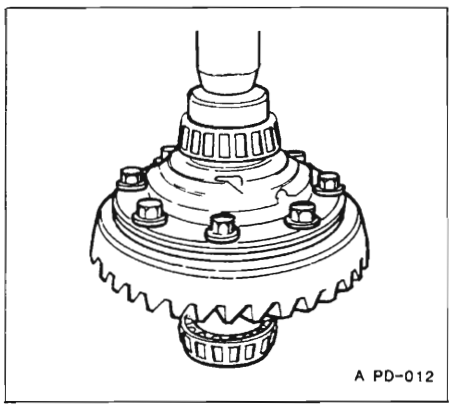
Measured distance mm(in)	Shim required mm(in)
29.34 — 29.52 (1.155 — 1.162)	0
29.53 — 29.65 (1.162 — 1.167)	0.13 (0.005)
29.66 — 29.77 (1.168 — 1.172)	0.25 (0.010)

If the measured distance is greater than 29.77 mm replace clutch cone and repeat measurements.

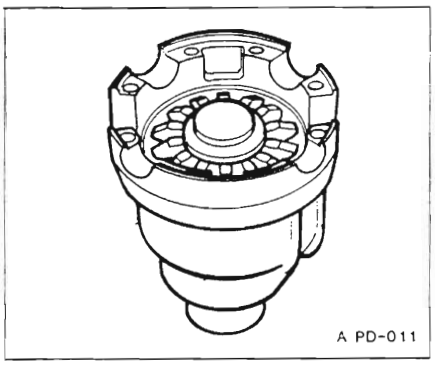
Assembly of Differential (except L.S.D.)

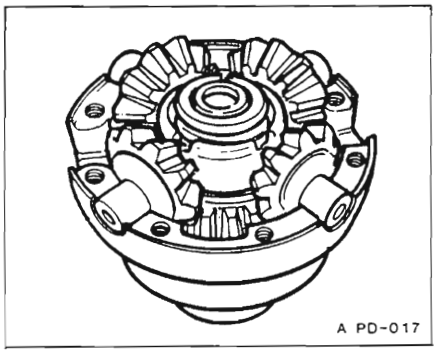


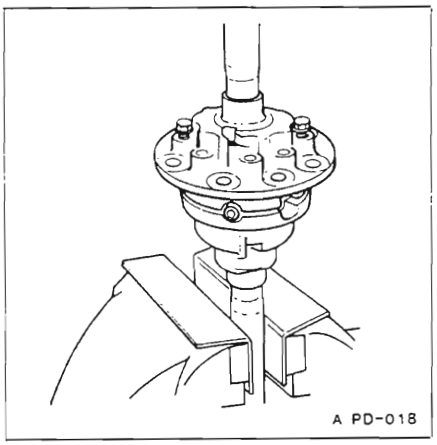


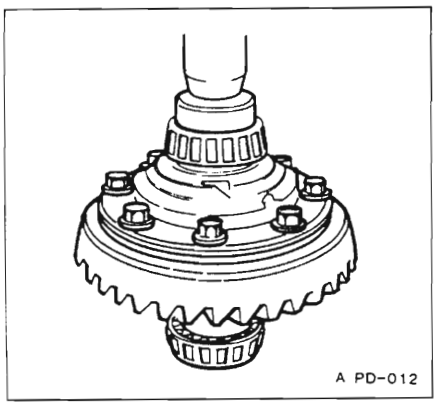


1. Lubricate all gears and thrust washers with the recommended rear axle lubricant before installation.
2. Place a side gear thrust washer in the large carrier half.
3. Position a side gear in the differential carrier large half.
4. Position two differential pinions and thrust washers in the differential carrier large half. On four pinion differentials, also position the thrust block in the carrier.
5. Drive the long pinion cross shaft through the carrier, pinion, and thrust block bores (in four pinion differentials), ensuring that the retainer pin hole lines up with the hole in carrier. Care should be taken not to damage the differential pinion thrust washers.
6. Four pinion differentials only. Position the other two pinions and thrust washers in differential carrier large half, and drive the two short pinion cross shafts through the carrier, pinion and into the thrust block bores, ensuring that the retainer pin hole lines up with the hole in the carrier.
7. Drive the three cross shaft retaining pins through the cross shafts (four pinion differentials) or one retaining pin (two pinion differentials), leaving the long cross shaft retaining pin protruding 6mm from the carrier for locating the other half.
8. Assemble the remaining side gear and thrust washer in the small carrier half.
9. Holding the side gear in position through the axle bore, push the two carrier halves together locating on the retaining pin. Rotate the side gear, if necessary, to ensure that the gear and pinion are correctly meshing.
10. Place the ring gear in position on the carrier and tighten bolts to the specified torque.
11. Press differential bearings on carrier journals, using special tool E3C25 (four cylinder) or E9277 (six cylinder).





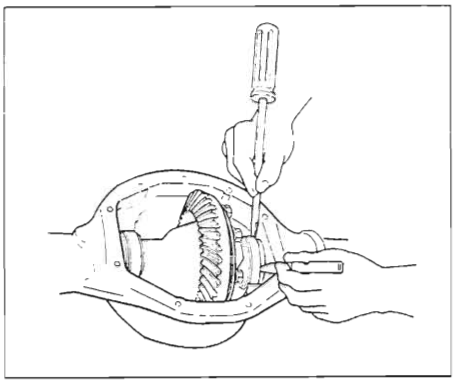




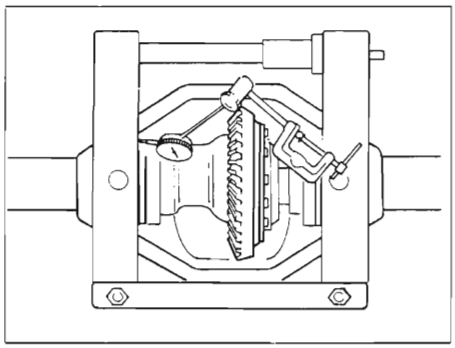
Assembly of Differential (L.S.D.)

1. Lubricate both sides of thrust washers, pinion gear bores and pinion shaft with axle oil before assembly.
2. Assemble the four pinions and spherical thrust washers on the pinion shaft.
3. Place clutch cone, shim (if required) and side gear in the small half of the differential carrier. Prepare a mixture of Molybdenum Disulphide grease and just sufficient axle oil to produce a liquid consistency.
4. Apply some of this mixture to the face of the side gear.
   Position a spring plate on the side gear, convex side up.
5. Assemble differential pinion shaft, pinions and spherical thrust washers in the small carrier half ensuring that the pinions mesh with the side gear.
6. Install the three new concentric thrust springs through the centre of the pinion shaft spider.
   Note: New springs must be used.
7. Assemble second spring plate on to springs (convex side down).
   Apply Molybdenum Disulphide mixture to the face of remaining side gear and locate the side gear, shim (if required) and clutch cone on to spring plate.
8. Position large carrier half over side gear and clutch ensuring that the marks made prior to disassembly are aligned.
9. Install two bolts finger tight. Clamp one axle shaft in a vice so that approx. 80 mm extends beyond vice jaws. Place differential carrier on to axle splines flanged end first. Install the other axle shaft through the opposite end of the carrier. Ensure axles are engaged in both the cone and side gear splines, and that the end of each axle engages the concave depression of each spring plate.
   Insert remaining bolts and tighten to 35-45 Nm (26-33 ft. lb.).
   Remove axle shafts.
10. Place the ring gear in position on the carrier and tighten bolts to the specified torque.
    Flanged head Durlok bolts can be re-used after cleaning.
11. Press differential bearings on carrier journals using special tool E9277.

Setting Differential Bearing Preload

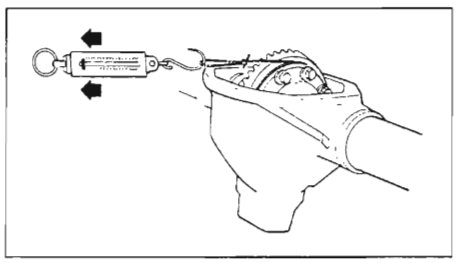


1. Select two differential bearing spacers which will allow positioning of the differential assembly in the housing without having to stretch the housing.
2. Push the assembly hard to one side of the housing and measure the gap between the spacer and the carrier at the other end.
3. Remove assembly and measure spacers.
4. Initial spacer thickness is determined as follows:-
   Total spacer thickness selected in 1 + gap measured in 2 + 0,15 mm (.006").
5. Select two spacers, each half the thickness of the value determined in 4.
6. Spread housing using tool part no. E9255.



7. Spread carrier approximately 0,25 mm (.010") and place differential assembly and spacers in position. (Use an indicator to measure carrier movement).
8. Remove housing spreader.
9. Fit bearing caps and tighten bolts to specified torque.

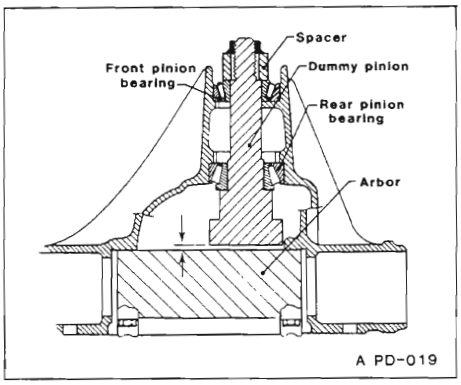
Note: Bearing caps should be in their original positions as they are not interchangeable.



10. Rotate bearings several times to ensure bearings are seated correctly.
11. Wrap a cord round outside diameter of differential carrier flange and check preload by pulling on end of cord with a spring balance.
12. Should the preload not comply to specification adjustments are made by decreasing the spacer thickness for reducing the preload and by increasing the spacer thickness to increase the preload.

Note: A 0,05 mm (.002") alteration to total spacer thickness will usually bring the preload within specification.

13. When the correct preload is obtained remove the differential assembly from the housing and set it aside together with the selected spacers ready for final assembly.

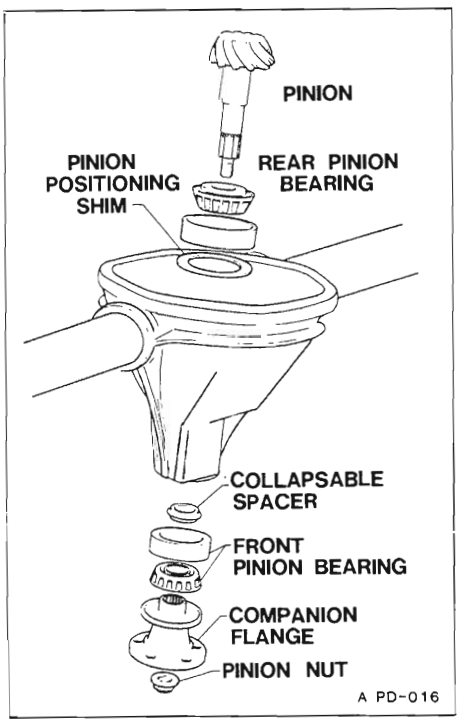


Setting Pinion Height and Bearing Preload

Select pinion head positioning shim using dummy pinion tool E9300.

1. Press front and rear pinion bearing cups in the housing. Slide the rear pinion bearing cone onto the dummy pinion.
2. Install dummy pinion and rear bearing in housing.
3. Assemble front bearing cone and spacer onto dummy pinion.
4. Tighten the nut at the end of the dummy pinion until a turning torque of 1.7 to 2.8 Nm (15-25 lbs.in.) is obtained. Rotate the dummy pinion back and forth during tightening to ensure correct seating of the bearing rollers.
5. Place arbor in housing and lightly clamp with bearing caps.
6. Select a shim which will just slide between the arbor and the dummy pinion head.
   This shim size is the correct one to use if the figure branded on the hypoid pinion is "O".
   Should the hypoid pinion have a figure other than "O" refer to shim selection chart.

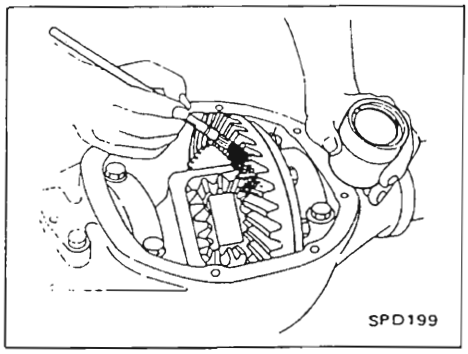
Pinion Branding	Shim Thickness Required
-4	Add .004" to shim selected in (6)
-3	Add .003" to shim selected in (6)
-2	Add .002" to shim selected in (6)
-1	Add .001" to shim selected in (6)
+1	Subtract .001" from shim selected in (6)
+2	Subtract .002" from shim selected in (6)
+3	Subtract .003" from shim selected in (6)
+4	Subtract .004" from shim selected in (6)

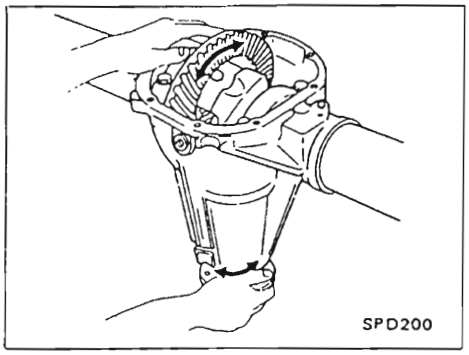


Pinion Installation:

1. Place the pinion head positioning shim into the housing and press the rear pinion bearing cup into housing.
2. Press rear pinion cone onto pinion. Tool No. E3C10AER.
3. Place pinion in housing.
4. Assemble the collapsible spacer and front pinion bearing cone onto pinion whilst supporting pinion under head.
5. Assemble companion flange, and nut onto pinion and tighten nut to specified torque whilst rotating pinion backwards and forwards to seat bearing correctly.

Note: Once used collapsible spacers may be re-used if an additional shim .75 mm (.030") thick is used between the spacer and bearing.
If after tightening pinion nut, the preload is excessive (see S.D.S.) then the collapsible spacer must be replaced and procedure 4 and 5 repeated.


SPD199


SPD200

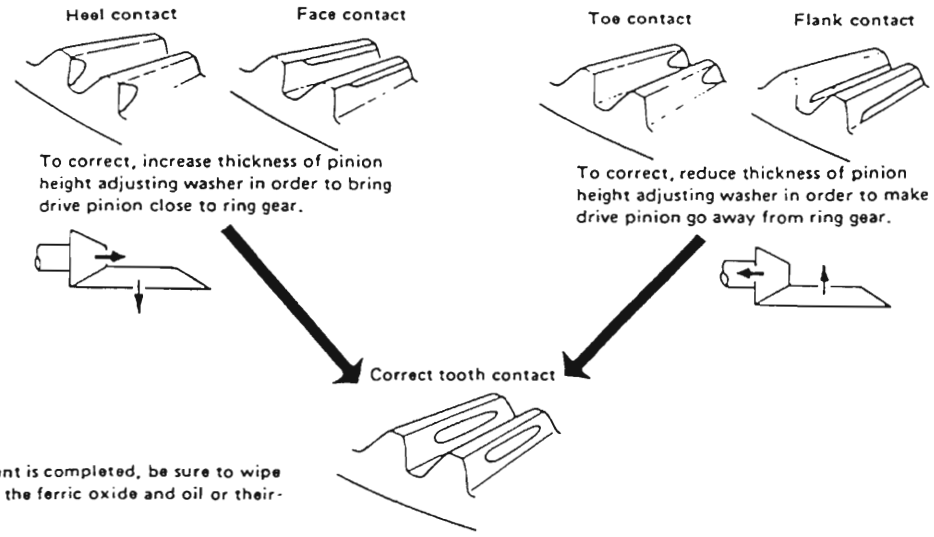
Differential Installation

1. Replace differential assembly using spacers selected earlier.
2. Ensure that pinion nut and bearing cap bolts are tightened to the specified torque.
3. Check backlash on ring gear as described in section headed "Inspection Before Disassembly".
4. If backlash is excessive (see specifications) decrease size of spacer on pinion side of ring gear and increase gear side space by same amount. If backlash is insufficient increase size of spacer on pinion side of gear and decrease gear side spacer by the same amount.

Note: Total thickness of both spacers should not change.

5. Paint gear with marking compound.
6. Observe the tooth contact marking.
7. Make necessary adjustments by altering pinion positioning shim and/or backlash. (See diagram).

Usually the pattern will be correct if you have calculated the shims correctly and the backlash is correct. However, in rare cases you may have to use trial-and-error processes until you get a good tooth contact pattern. The tooth pattern is the best indication of how well the final drive has been set up.



When adjustment is completed, be sure to wipe off completely the ferric oxide and oil or their equivalent.

SPD007

Final Assembly

1. When gear backlash and tooth contact are correct, remove companion flange and install pinion seal.

Note: Lightly grease lip seal with grease.

2. Replace companion flange and tighten nut to specified torque.
3. Fit rear cover and NEW gasket to housing and tighten the bolts to the specified torque.

Important: Do not overtighten bolts as this can cause cover flange distortion, resulting in oil leakage.

4. Place the axle through the brake anchor plate and align axle shaft and side gear splines.
5. Once the splines have been engaged in the side gears the wheel bearing and oil seal maybe pushed into the housing. A light coat of grease on the seal outside diameter will assist in installation.

Note: On axles with L.S.D. do not rotate either axle shaft until both axles are fully installed, otherwise misalignment of the side gear and cone splines will result, preventing assembly of the remaining axle.

6. Tighten the backing plate bolts alternately.

Torque: 22-26 Nm (2.2-2.7 kg-m, 16-20 ft-lb).

7. Refit brake components to axle assembly.
8. Refit axle assembly to vehicle.
9. With the vehicle at its normal driving attitude fill the axle with recommended lubricant until oil level reaches bottom of inspection plug hole - replace plug.
10. Road test vehicle.

Caution (L.S.D. equipped vehicles) Do NOT attempt to run the engine with drive train engaged and only one rear wheel elevated as the other rear wheel will drive also due to the L.S.D. characteristic.

Final Drive

GENERAL SPECIFICATIONS

Item \ Engine		CA20E		RB30E	
Item \ Transmission		M/T	A/T	M/T	A/T
Final drive model		Borg Warner 78			
Gear ratio		4.111		3.700	3.889
Number of teeth	Ring gear	37		37	35
	Drive pinion	9		10	9
Oil capacity (approx.) (Imp pt)		1.7 (3.0)			
Oil Type	Standard	SAE 80W90			
	S.R.D.	SAE 80W90LS			

SERVICE DATA

Drive pinion bearing preload adjusting method	Collapsable spacer
Differential bearing preload New bearings N-m (kg-cm, in-lb) Used bearings	1.1-2.8 (11-28, 10-25) 0.5-1.4 (5-14, 4-12)
Pinion bearing preload (With front oil seal) New bearings N-m (kg-cm, in-lb) Used bearings	1.4-2.8 (14-28, 12-24) 0.7-1.4 (7-14, 6-12)
Pinion bearing Preload (Without oil seal) New bearings N-m (kg-cm, in-lb) Used bearings	0.9-2.3 (9-23, 7-19) 0.2-0.9 (2-9, 2-7)
Side bearing adjusting method	Shim
Backlash Drive pinion to ring gear mm (in)	0.10-0.18 (0.004-0.007)
Rear gear runout limit mm (in)	0.05 (0.002)
Hypoid gear rear face run out (assembled) mm (in)	0.13 (0.005)
L.S.D. break torque (service limit) (N-m (ft-lb)	90 (72)

SIDE BEARING adjusting washer

Thickness mm (in)	Part No.
4.60 (0.181)	38451-J7025
4.64 (0.183)	38452-J7025
4.68 (0.184)	38453-J7025
4.72 (0.186)	38454-J7025
4.76 (0.187)	38455-J7025
4.80 (0.189)	38456-J7025
4.84 (0.191)	38457-J7025
4.88 (0.192)	38458-J7025
4.92 (0.194)	38459-J7025
4.96 (0.195)	38460-J7025
5.00 (0.197)	38461-J7025
5.04 (0.198)	38462-J7025
5.08 (0.200)	38463-J7025
5.12 (0.202)	38464-J7025
5.16 (0.203)	38465-J7025
5.20 (0.205)	38466-J7025
5.24 (0.206)	38467-J7025
5.28 (0.208)	38468-J7025
5.32 (0.209)	38469-J7025
5.36 (0.211)	38470-J7025
5.40 (0.213)	38471-J7025
5.44 (0.214)	38472-J7025
5.48 (0.215)	38473-J7025
5.52 (0.217)	38474-J7025
5.56 (0.219)	38475-J7025
5.60 (0.220)	38476-J7025

PINION HEIGHT adjusting washer

Thickness mm (in)	Part No.
0.2286 (0.009)	38145-J7025
0.2540 (0.010)	38146-J7025
0.2794 (0.011)	38147-J7025
0.3048 (0.012)	38148-J7025
0.3302 (0.013)	38149-J7025
0.3566 (0.014)	38150-J7025
0.3810 (0.015)	38151-J7025
0.4067 (0.016)	38152-J7025
0.4318 (0.017)	38153-J7025
0.4578 (0.018)	38154-J7025
0.4826 (0.019)	38155-J7025
0.5080 (0.020)	38156-J7025
0.5334 (0.021)	38157-J7025
0.5588 (0.022)	38158-J7025
0.5842 (0.023)	38159-J7025
0.6092 (0.024)	38160-J7025
0.6350 (0.025)	38161-J7025
0.6604 (0.026)	38162-J7025
0.6858 (0.027)	38163-J7025
0.7112 (0.028)	38164-J7025
0.7366 (0.029)	38165-J7025
0.7620 (0.030)	38166-J7025

Final Drive (Cont'd)

TIGHTENING TORQUE

Unit	N-m	kg-m	ft-lb
Companion flange to propeller shaft bolt	39-44	4.0-4.5	29-33
Final drive assembly Drive pinion nut	Torque to achieve required pinion bearing preload.		
Ring gear bolts	130-145	13.2-14.8	95-107
Side bearing cap bolt	48-60	4.9-6.1	35-44
Rear cover fixing bolt	23-31	2.3-3.2	17-22

FRONT AXLE & FRONT SUSPENSION

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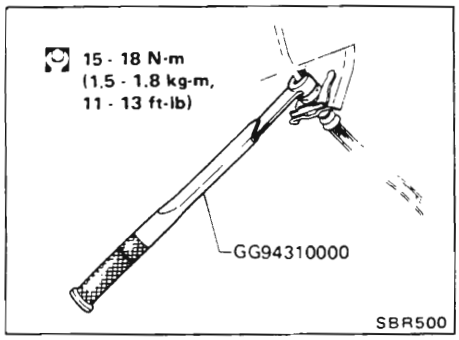
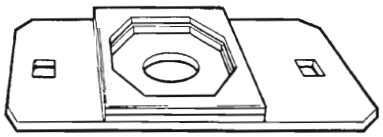
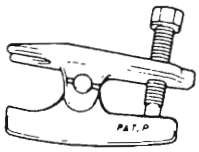
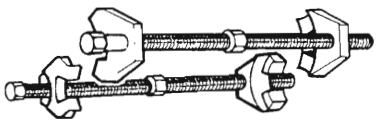
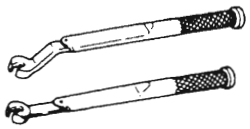
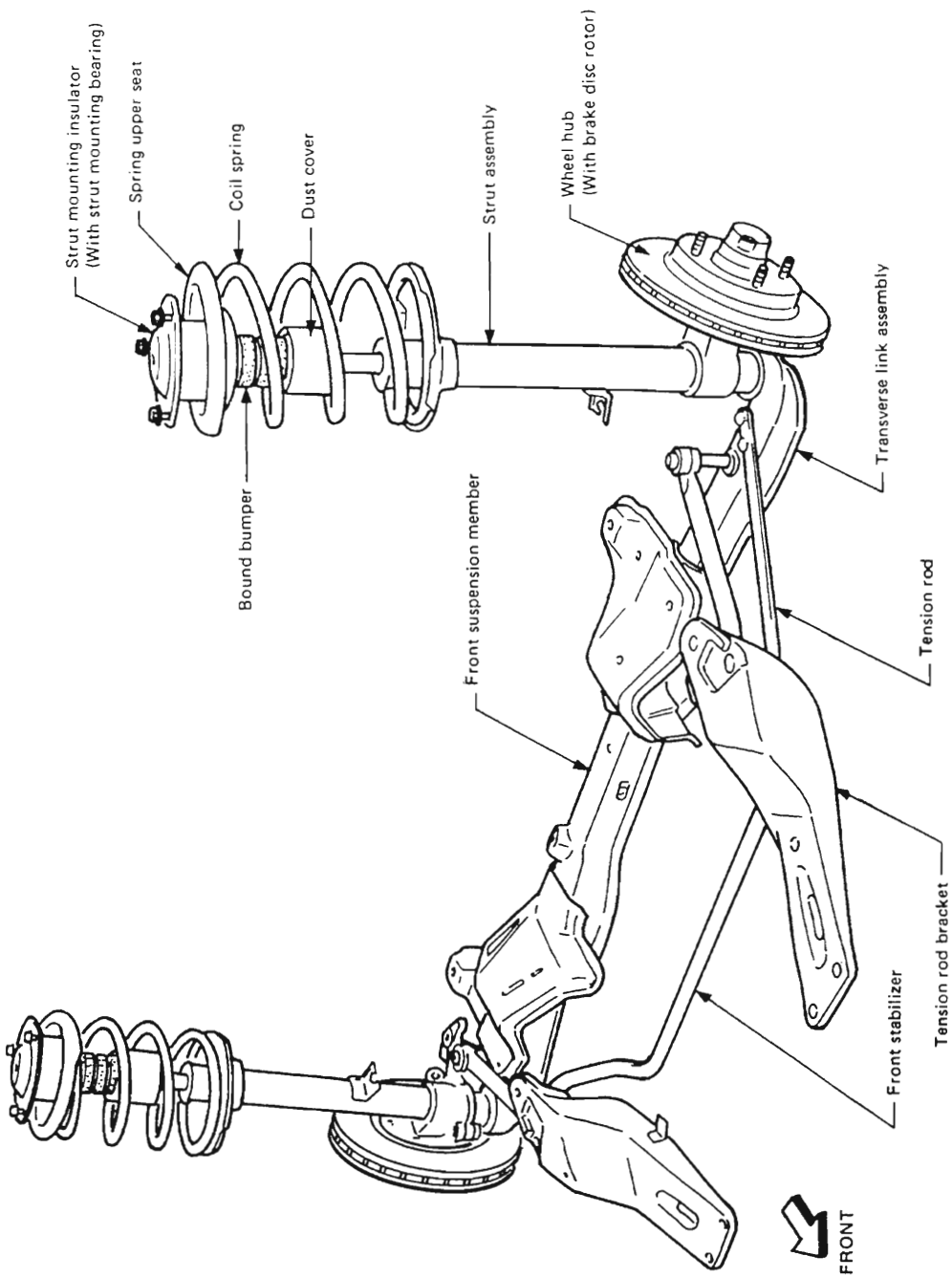


(1) Final tightening of suspension components should be carried out under unladen condition* with tires on ground.
    * Fuel, radiator coolant and engine oil full. Spare tire, jack, hand tools and mats in designed position.
(2) Use Tool when removing or installing brake tubes.

SERVICE TOOLS

* Special tools or commercial equivalent

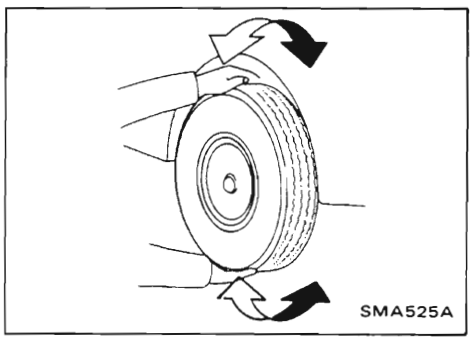
Tool number Tool name	Description		Tool supplier
E7113 Gland packing wrench		Removing and installing gland packing	Litchfield
E2237* Ball joint remover		Removing tie-rod outer end	Litchfield
E2M10F Spring compressor		Removing and installing coil spring	Litchfield
GG94310000* Flare nut torque wrench		Removing and installing brake piping	Nissan



Wheel bearing
- **Axial end play: 0 mm (0 in)**
- **Tightening torque 34 - 39 N·m (3.5 - 4.0 kg-m, 25 - 29 ft-lb)**
- **Return angle 90°**
- **Wheel bearing preload 0.78 N·m (8 kg-cm, 6.9 in-lb) or less (As measured at wheel hub bolt) 13.7 N (1.4 kg, 3.1 lb) or less**
- When measuring preload, do not include "dragging" resistance with brake pads.

Wheel alignment
- **Camber, caster and kingpin inclination cannot be adjusted**
- **The vehicle requires only toe-in adjustments.**
  Toe-in: 0 to 2 mm (0 to 0.08 in)

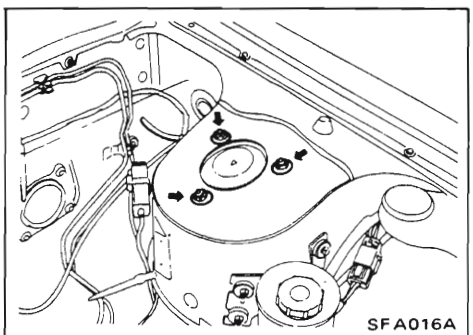
SFA025A


SMA525A

Checking Front Axle and Front Suspension Parts

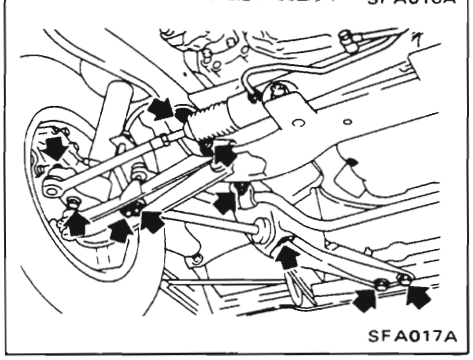
- Check front axle and front suspension parts for looseness, wear or damage.

(1) Shake each front wheel.

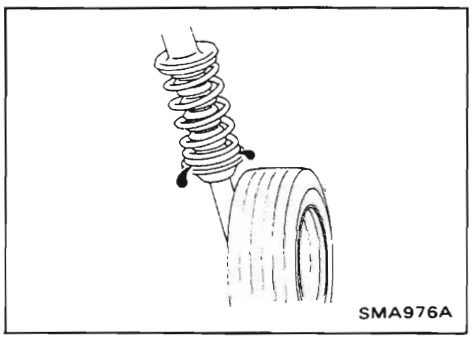

SFA016A

(2) Check tightness of all nuts and bolts.

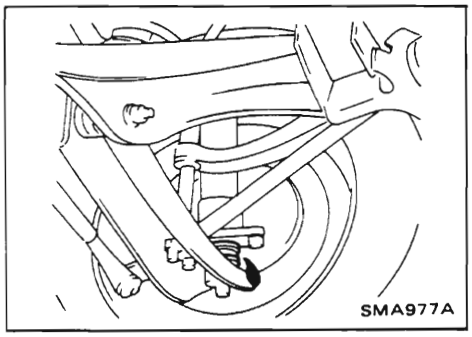
Tightening torque: refer to S.D.S.


SFA017A

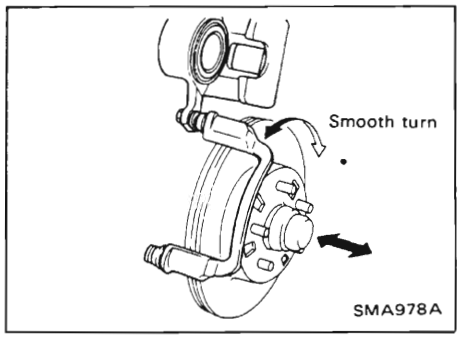
(3) Check front axle and front suspension parts for wear, cracks or damage.


SMA976A

- Check strut (Shock absorber) for oil leakage or damage.


SMA977A

- Check suspension ball joint for grease leakage and ball joint dust cover for damage.



Checking Front Wheel Bearing

Check that wheel bearings operate smoothly, as well as axial end play and grease leakage.

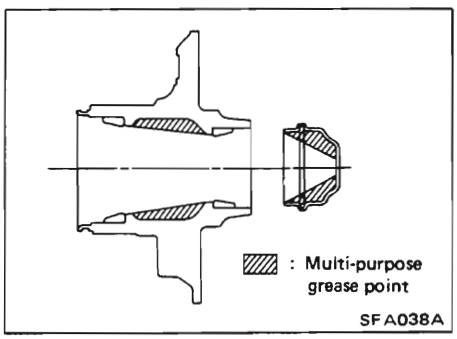
Axial end play: 0 mm (0 in)

PRELOAD ADJUSTMENT

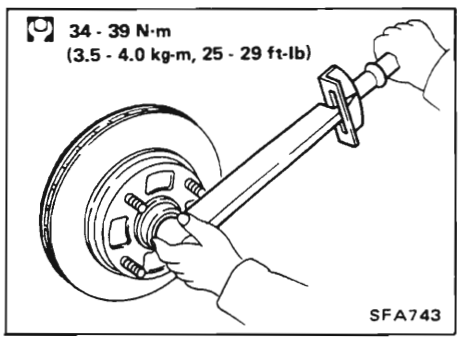
Be sure to adjust wheel bearing preload as described below after wheel bearing has been replaced or front axle has been reassembled.

Adjust wheel bearing preload as follows:

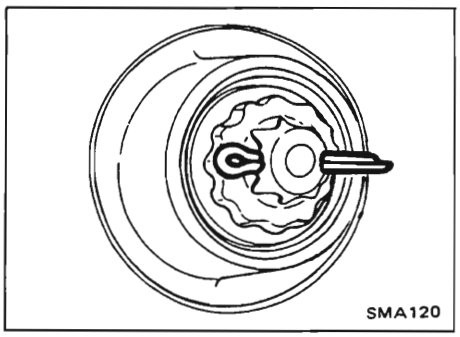
1. Before adjustment, thoroughly clean all parts to prevent dirt entry.



2. Apply multi-purpose grease sparingly to the following parts.
- Rubbing surface of spindle.
- Contact surface between lock washer and outer wheel bearing.
- Hub cap (as shown at the left)
- Grease seal lip.



3. Tighten wheel bearing lock nut to the specified torque.
4. Turn wheel hub several times in both directions to seat wheel bearing correctly.
5. Again tighten wheel bearing nut to the specified torque.
6. Turn back wheel bearing lock nut at 90°.

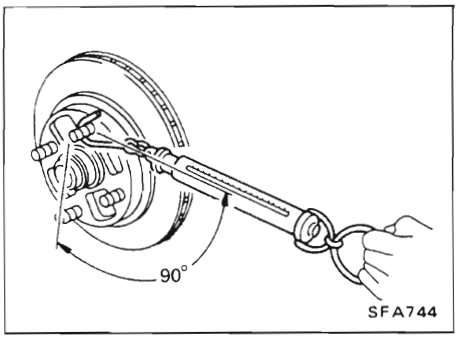


7. Fit adjusting cap and new cotter pin.

Align cotter pin slot, by retightening nut within 15°.

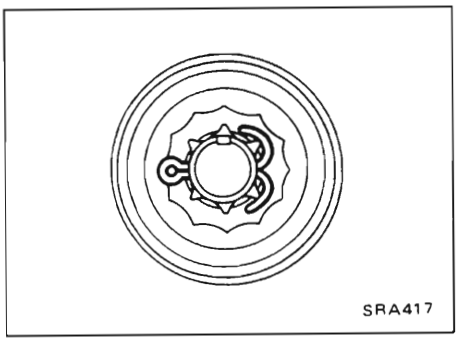
Do not turn nut back for cotter pin insertion.

Checking Front Wheel Bearing (Cont'd)



8. Measure wheel bearing preload and axial end play.
   Axial end play: 0 mm (0 in)
   Wheel bearing preload
   (As measured at wheel hub bolt):
   13.7 N (1.4 kg, 3.1 lb) or less (without brake pad drag)

Repeat above procedures until correct bearing preload is obtained.



9. Spread cotter pin.
10. Install hub cap with new O-ring.

Checking Front Wheel Alignment

PRELIMINARY INSPECTION

- **Tire pressure and wear**
- **Wheel bearing axial end play**
- **Suspension ball joint**
- **Steering gear housing looseness at frame**
- **Steering linkage and connections**
- **Shock absorber operation**
- **Tighten each front axle and suspension part.**
- **Vehicle height (Unladen).**
- **Repair or replace the damaged portion or parts.**

"Unladen"

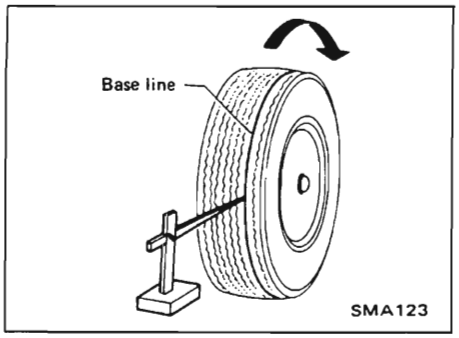
Fuel, radiator coolant and engine oil full. Spare tire, jack, hand tools and mats in designed position.

CAMBER, CASTER AND KINGPIN INCLINATION

Camber, caster and kingpin inclination are preset at factory and cannot be adjusted.

Camber	-50' to 1°
Caster	3°45' -5°15'
Kingpin inclination	11°45' to 13°35'

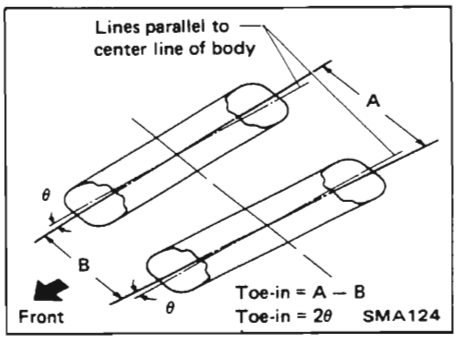
Checking Front Wheel Alignment (Cont'd)



TOE-IN

1. Mark a base line around the tyre.

After lowering front of vehicle, roll vehicle forward and back to settle suspension and set steering wheel in straight ahead position.



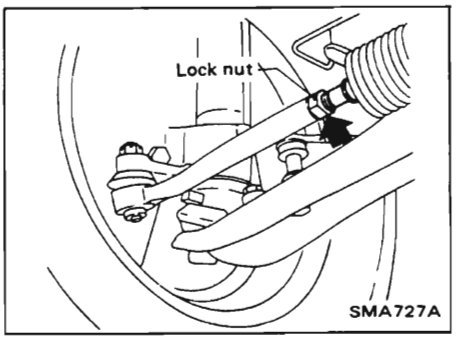
2. Measure toe-in.

Measure distance "A" and "B" at the same height as hub center.

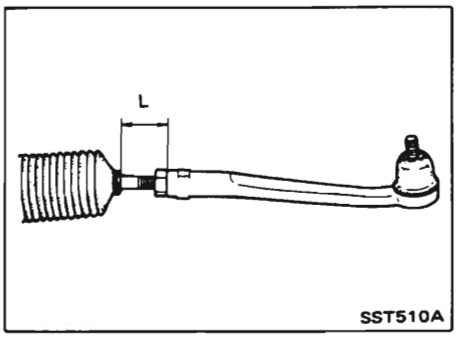
Toe-in:

A-B: 0 to 2 mm (0.00 to 0.08 in)

2θ : 0 to 12'

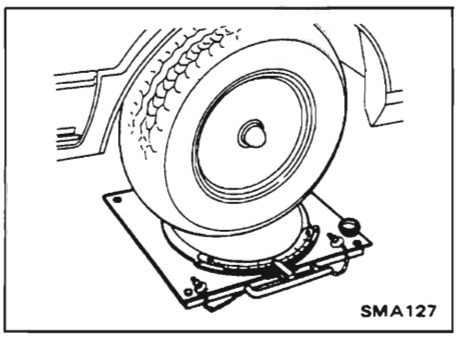


3. Adjust toe-in by varying the length of steering tie-rods.



Make sure that the tie-rods are the same length.

PR25P Power steering models: 42.5 mm (1.673 in)
TRW Power steering models : 55 mm (2.16 in)
TRW Manual steering models : 55 mm (2.16 in)



FRONT WHEEL TURNING ANGLE

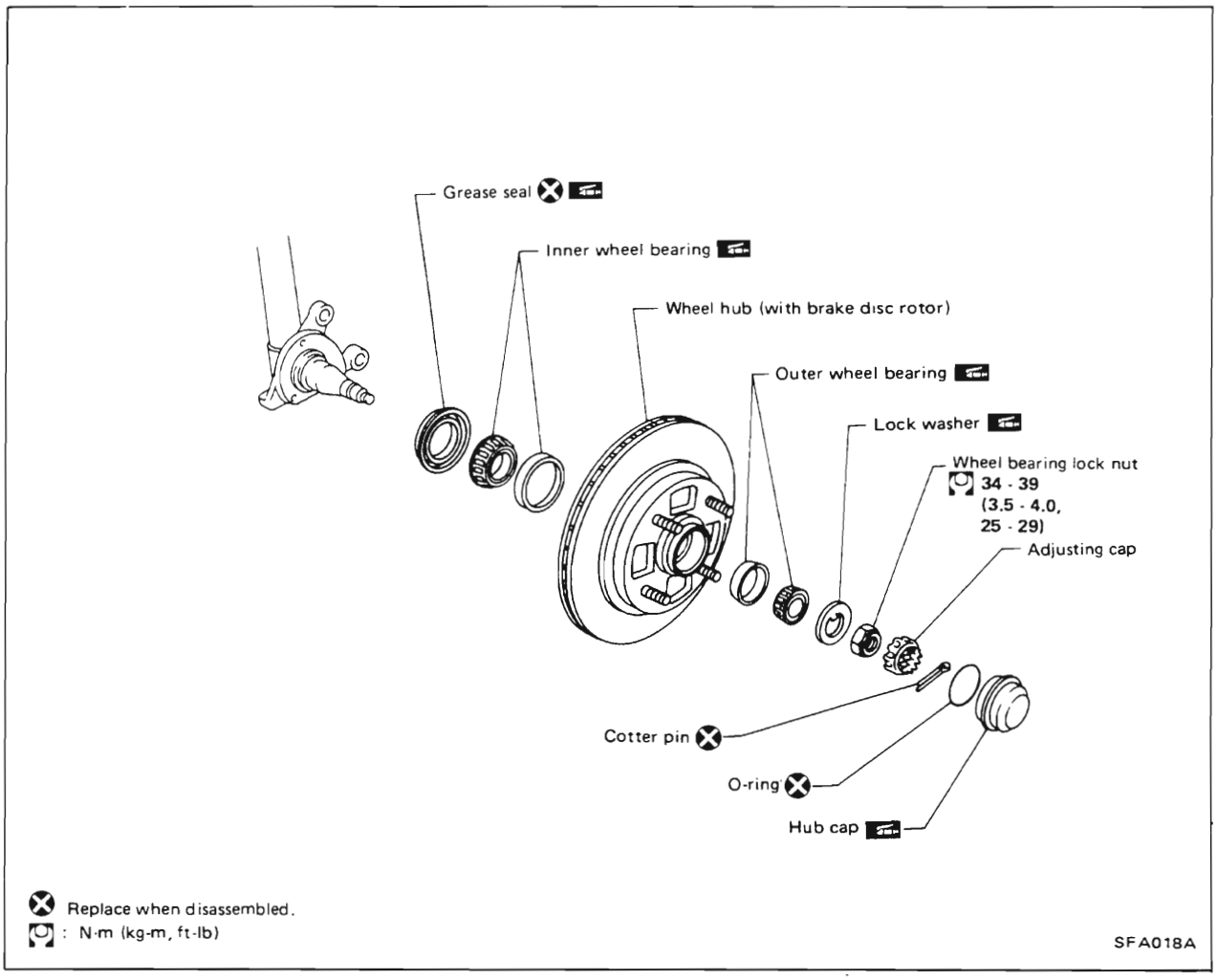
- When measuring full turn angle, turn steering using steering wheel.

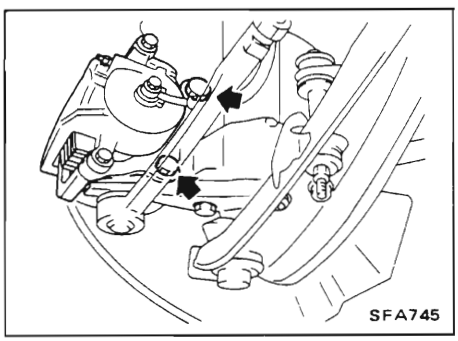
Turning angle:

	Power steering models		Manual steering models	
	Inside	Outside	Inside	Outside
Full turns	41° - 45°	32° - 36°	37° - 41°	30° - 34°
Toe-out turn	21°52'	20°	21°46'	20°

- If it is not within specification, check rack stroke.

Refer to section ST.

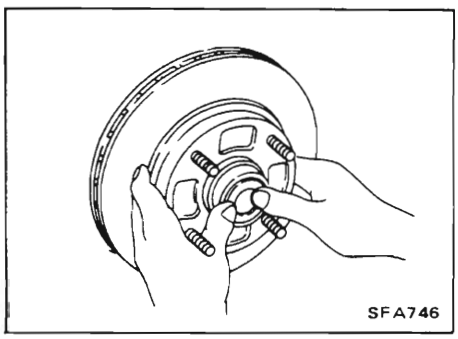




Removal

- Remove brake caliper assembly.

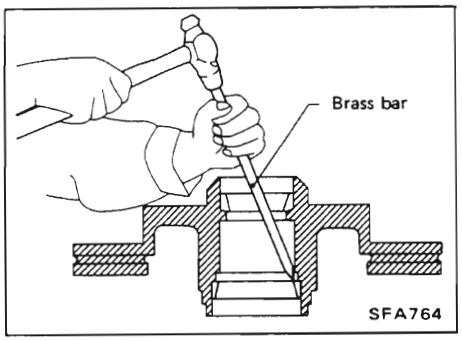
Brake hose does not need to be disconnected from brake caliper.
Be careful not to depress brake pedal, or piston will pop out.
Make sure brake hose is not twisted.



- Remove wheel hub and wheel bearing from spindle.

Be careful not to drop outer bearing.

Removal (Cont'd)



- Drive bearing outer races from hub with suitable brass bar.

Inspection

WHEEL BEARING

Check wheel bearing to see that it rolls freely and is free from noise, crack, pitting, or wear, and replace if damaged.

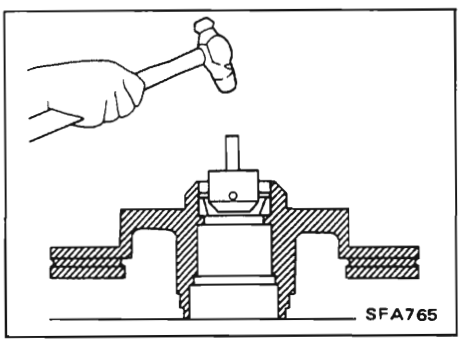
WHEEL HUB

Check wheel hub for crack by a magnetic exploration or dyeing test, and replace if cracked.

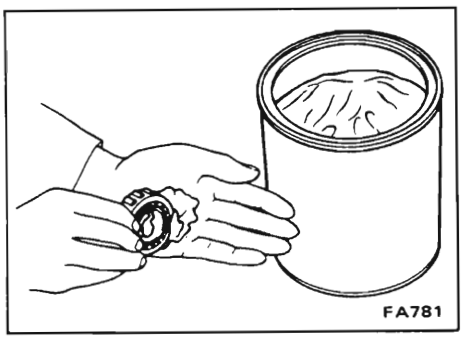
KNUCKLE SPINDLE

Check knuckle spindle for deformation, tapping mark, or cracks (by magnetic or dyeing test) and replace if damaged.

Installation

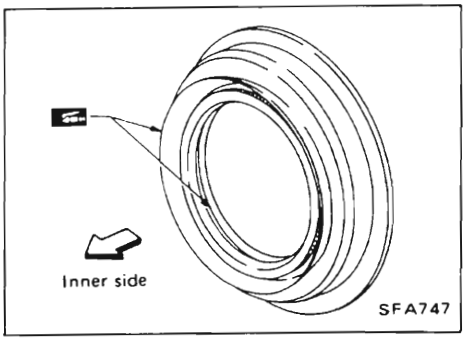


- Install bearing outer race with suitable tool until it seats in tub.

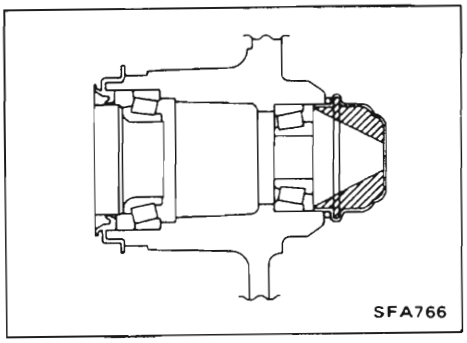


- Apply multi-purpose grease to each bearing cone. (Refer recommended lubricants)

Installation (Cont'd)

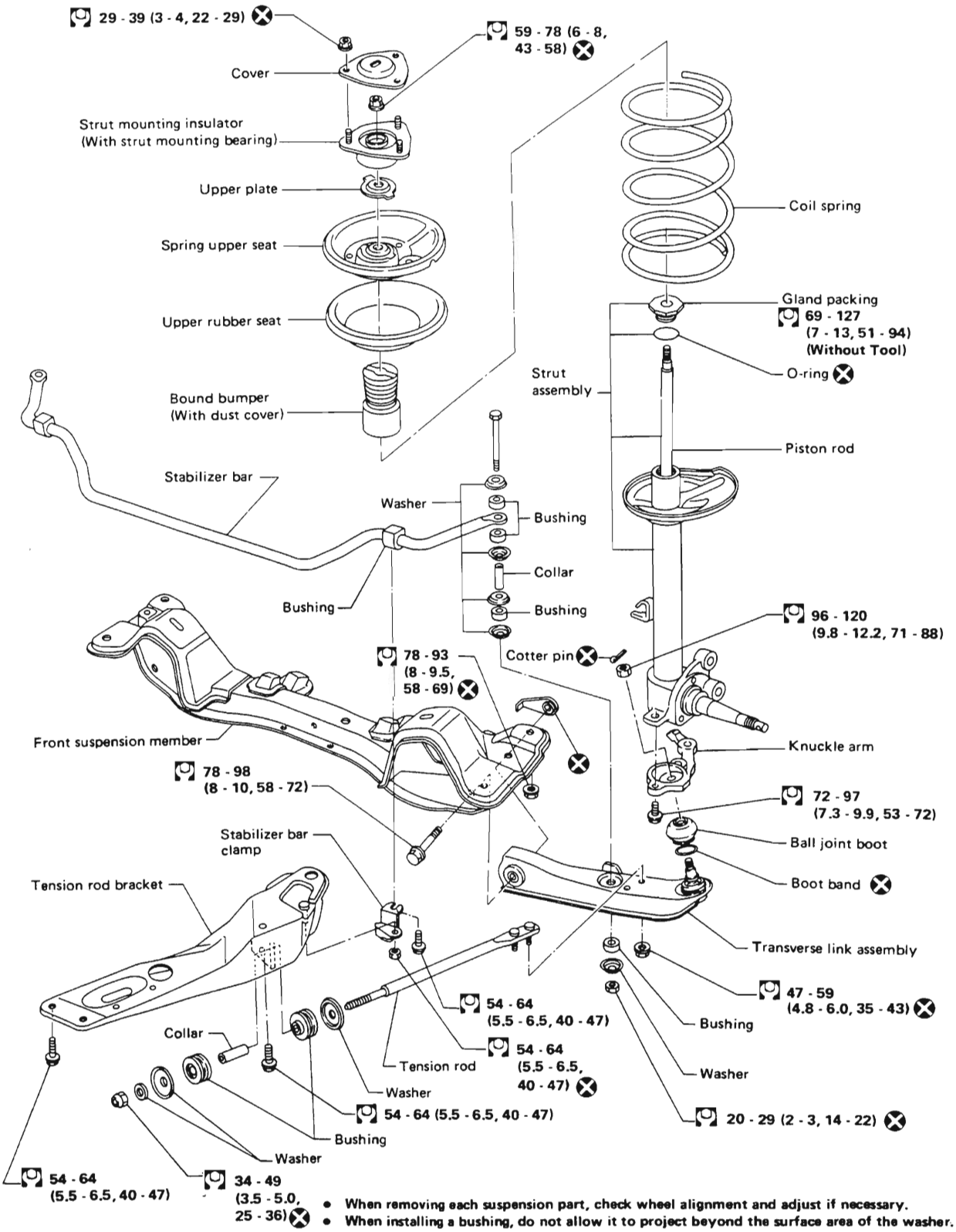


- Pack grease seal lip with multi-purpose grease, then install it into wheel hub with suitable drift.



- Pack multi-purpose grease to hub cap.

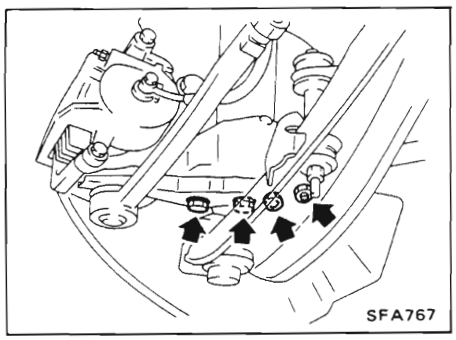
- For pre-load adjustment refer FA-6.



: N·m (kg-m, ft-lb)

- When removing each suspension part, check wheel alignment and adjust if necessary.
- When installing a bushing, do not allow it to project beyond the surface area of the washer.
- Do not allow the bushings and washers to come in contact with grease, oil soapy water, etc.
- When installing stabilizer bar, tension rod and transverse link, final tightening requires to be carried out under unladen condition* with tires on the ground.
  * Fuel, radiator coolant and engine oil full. Spare tire, jack, hand tools and mats in designed position.
- When removing or installing brake tubes, use flare nut torque wrench.

SFA026A

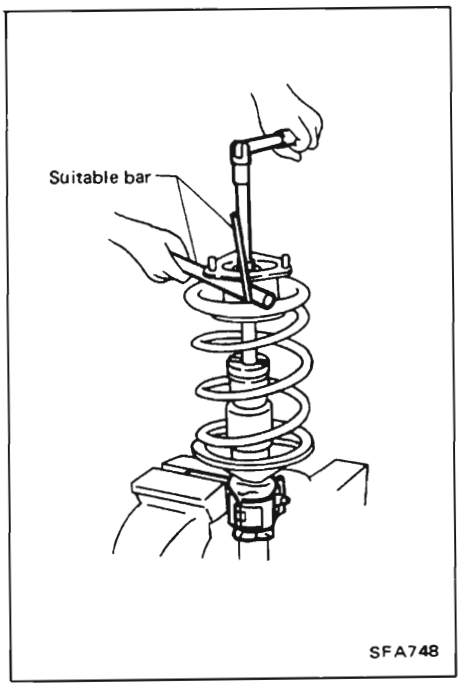


Removal and Installation

- Remove tension rod nuts and knuckle arm fixing bolts.
- Remove caliper securing bolts, unclip brake line from strut and swing aside.
- Remove strut assembly fixing nut (to hoodledge).

Do not remove piston rod lock nut on vehicle.

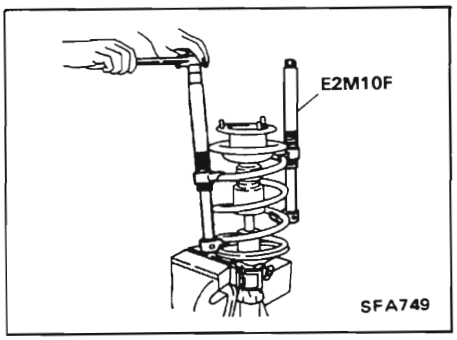
When refitting caliper, ensure brake hose is secure and not twisted.



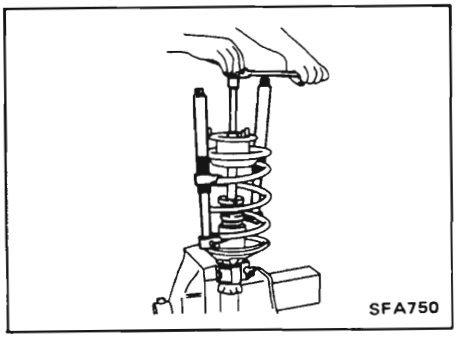
Disassembly

1. Set strut assembly on vice with attachment, then loosen piston rod lock nut.

- **Do not remove piston rod lock nut.**

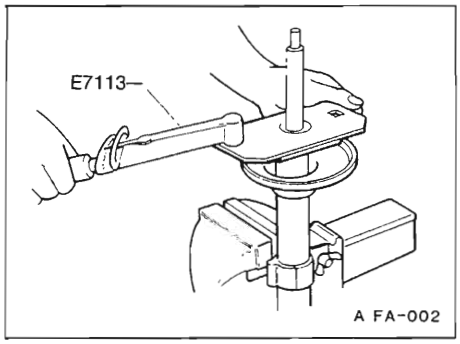


2. Compress spring with Tool so as to permit turning of strut mounting insulator by hand.



3. Remove piston rod lock nut.

Disassembly (Cont'd)



4. Remove gland packing with service tool.
- **Avoid dirt and dust getting into gland packing portion.**
5. Retract piston rod by pushing it down until it bottoms. Then, slowly withdraw piston rod from cylinder together with piston guide.

Inspection

Wash all parts, except for nonmetallic parts, clean with suitable solvent and dry with compressed air.

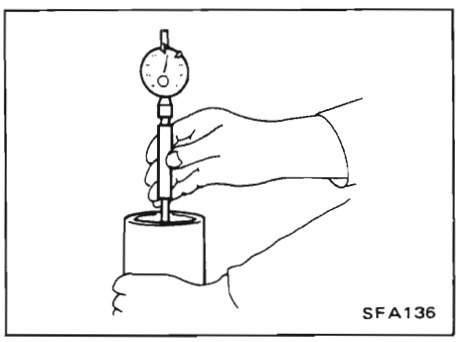
Blow dirt and dust off of nonmetallic parts using compressed air.

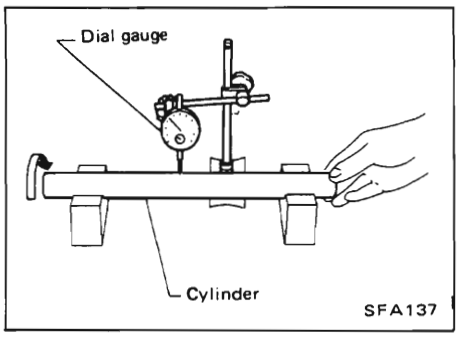
STRUT ASSEMBLY

- **Oil oozing out around gland packing does not need strut replacement.**
  If oil leakage is evident on spring seat, check piston rod gland packing and O-ring.
  If oil leakage occurs on welded portion of outer strut casing, replace strut assembly.
- **If shock absorber itself is malfunctioning, replace as shock absorber kit.**

GLAND PACKING

Check gland packing for oil leakage. Replace gland packing if necessary.





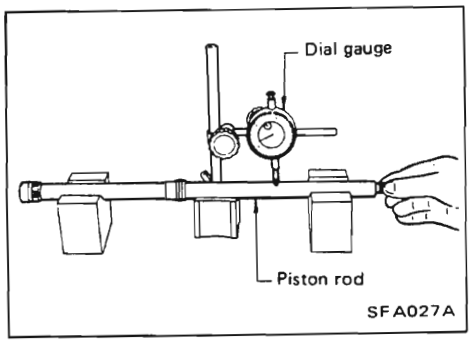
INNER CYLINDER AND OUTER CASING

- Check inner cylinder and outer casing for cracks, deformation or other damage. For inner cylinder damage, replace shock absorber. For outer casing damage, replace strut assembly.

Inner diameter:
Inner cylinder
30.02 - 30.10 mm (1.182 - 1.185 in)

Maximum runout:
Inner cylinder
0.2 mm (0.008 in)

Inspection (Cont'd)



PISTON ROD

- Check piston rod for cracks, deformation or other damage. Replace shock absorber, if necessary.
- Check threads for cracks or other damage. Replace shock absorber, if necessary.

Rod diameter:
21.95 - 21.98 mm (0.8642 - 0.8654 in)
Maximum runout:
0.1 mm (0.004 in)

STRUT MOUNTING INSULATOR

Replace if cemented rubber-to-metal portion are melted or cracked or rubber parts are deteriorated.

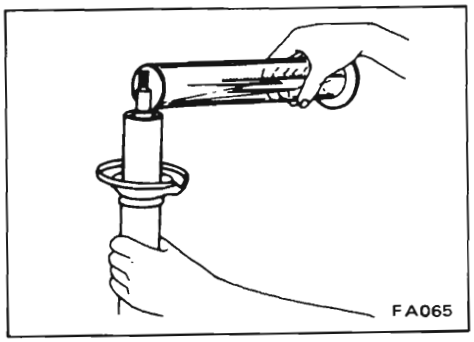
STRUT MOUNTING BEARING

Replace if inspection reveals abnormal noise or excessive rattle in axial direction.

COIL SPRING

Check for cracks, deformation or other damage. Replace if necessary.

Assembly

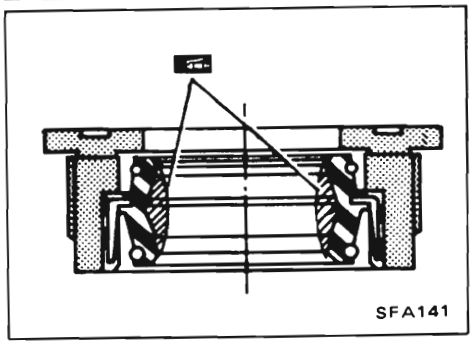


Before assembly, keep away from dust to prevent entry of dust.

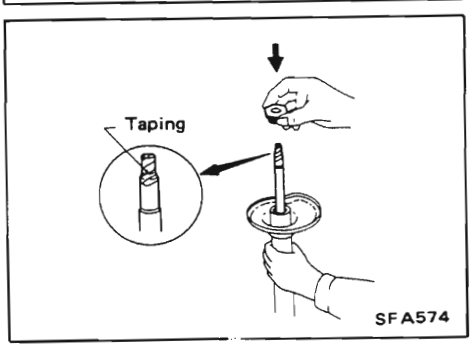
- Add correct amount of fluid.

Use "NISSAN GENUINE STRUT FLUID" or equivalent.
Oil capacity is very important since performance of strut varies with amount of fluid in strut.

Capacity: Refer to S.D.S.



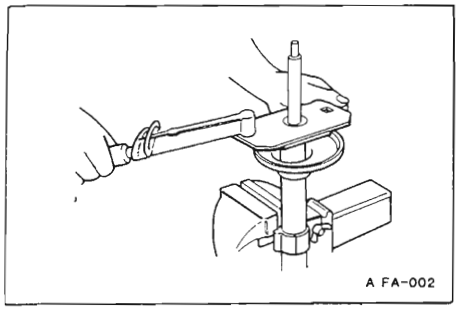
- Lubricate sealing lip of gland packing.



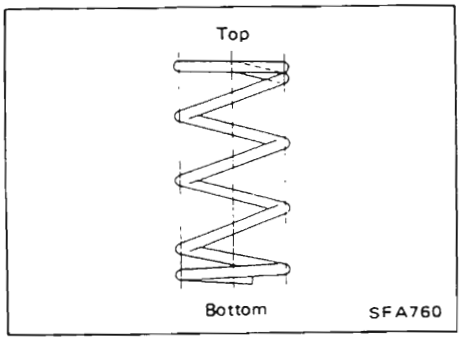
- Install gland packing.

Cover piston rod with tape so as not to damage oil sealing lip.

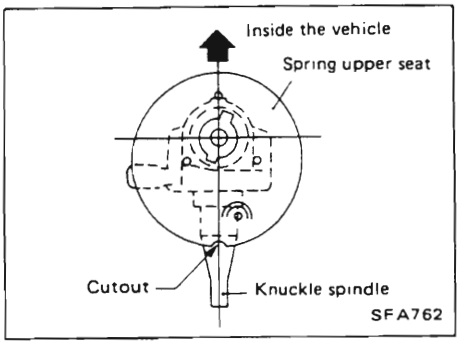
Assembly (Cont'd)



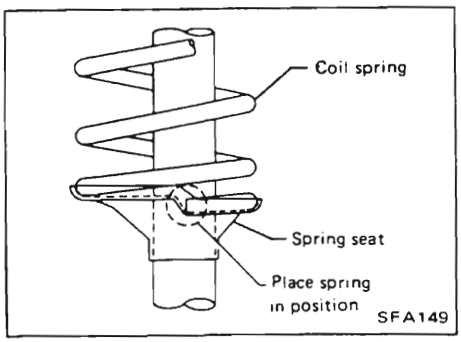
- Using service tool and torque wrench tighten the gland packing (use torque specified on tool).



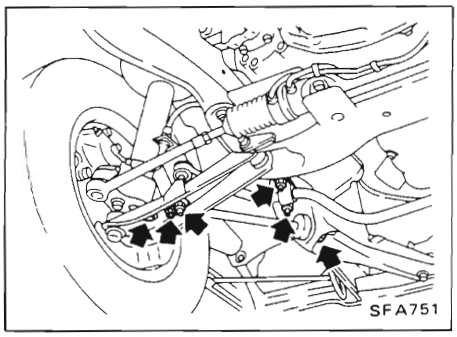
- When installing coil spring, be careful not to reverse top and bottom direction (top end is flat).



- Locate spring upper seat as shown.



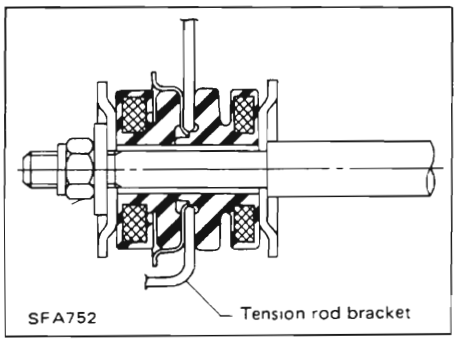
After placing spring in position on lower spring seat, release spring compressor gradually.



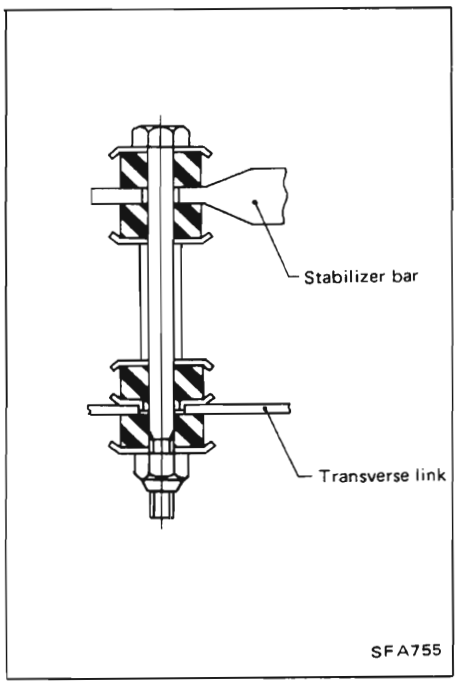
Removal and Installation

- Remove tension rod and stabilizer bar.

Note: Tension rod bushes differ from left to right.
Take care to mark them accordingly.

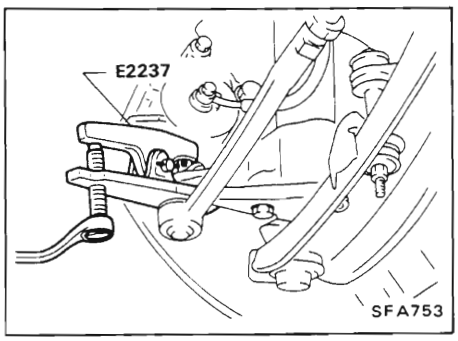


- Install tension rod.
  Refer SDS for tightening torque.

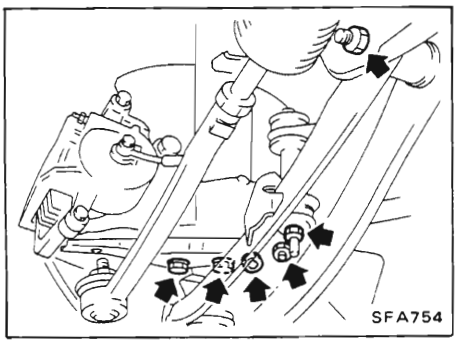


- Install stabilizer rear side bushings, then install front side bushings.
  Refer SDS for tightening torque.

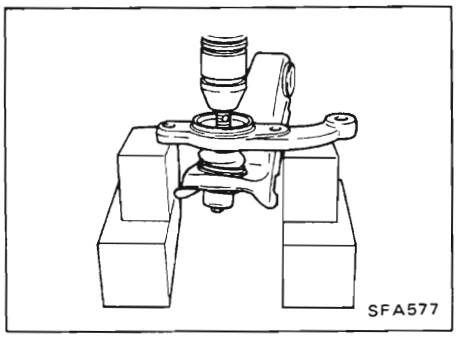
Removal



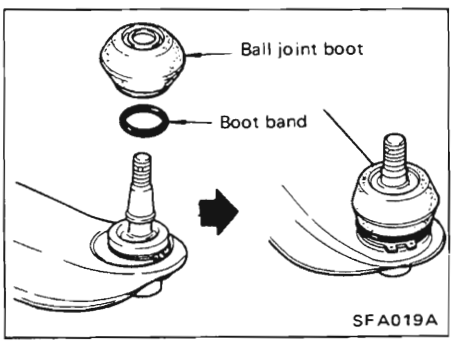
- Separate knuckle arm from tie-rod.



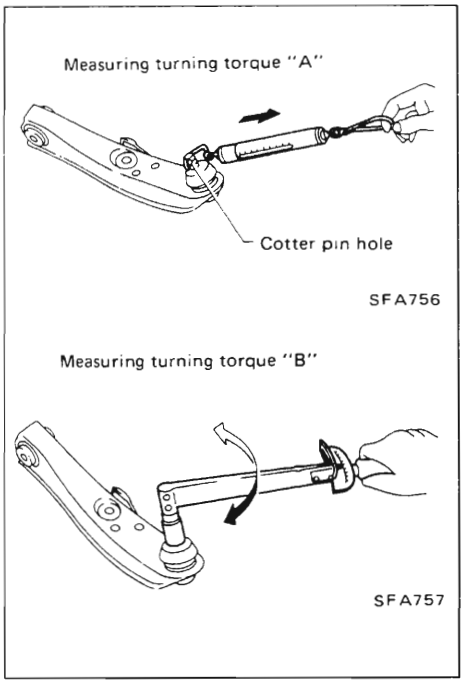
- Separate knuckle arm from strut. Remove stabilizer, tension rod and transverse link assembly.

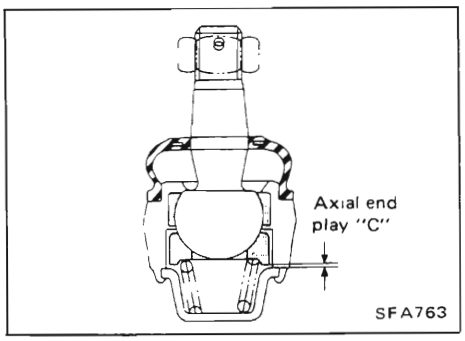


- Separate ball joint from knuckle arm with press.



- If ball joint boot is damaged, replace ball joint boot and boot band as shown at left.





Inspection

- Check transverse link for damage, cracks, deformation; replace transverse link assembly if necessary.
- Check rubber bushing for damage, cracks and deformation; replace transverse link assembly if necessary.
- Check ball joint for turning torque "A" and "B".

Before checking, turn ball joint at least 10 revolutions so that ball joint is properly broken in.

Turning torque "A":
(measure point: cotter pin hole of ball stud)
New parts
24.5 - 80.4 N (2.5 - 8.2 kg, 5.5 - 18.1 lb)
Used parts
7.8 - 80.4 N (0.8 - 8.2 kg, 1.8 - 18.1 lb)
Turning torque "B":
New parts
1.5 - 4.9 N·m (15 - 50 kg-cm, 13 - 43 in-lb)
Used parts
0.5 - 4.9 N·m (5 - 50 kg-cm, 4.3 - 43.4 in-lb)

- Check ball joint for axial end play "C".
  Axial end play "C" under force of approximately 981 N (100 kg, 221 lb)
  0.1 - 1.3 mm (0.004 - 0.051 in)
- If turning torque "A" or "B", or axial end play "C" is not within specified values, replace transverse link assembly.
- Check dust cover for damage.
  Replace dust cover and dust cover band if necessary.
- Refit knuckle arm and retaining nut.
  Refer SDS for torque.

Installation

- When reinstalling, leave transverse link inner bolt loose and do not refit tension rod into transverse link.
- After installing all other parts, refit wheels and lower vehicle onto its suspension ensuring normal laden ride height is achieved.
- Locate transverse link rearwards so that the tension rod attaching holes in the transverse link align with the tension rod attaching studs. Tighten the transverse link pivot bolt to maintain this position. Reassemble tension rod to transverse link.

Note: When reasembling the tension rods, it is essential that studs must pass freely through the holes in the transverse link, with the vehicle on the ground in the unladen condition.

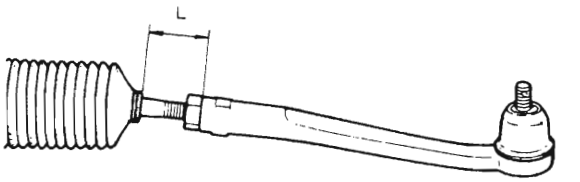
General Specifications

Item \ Engine		CA20E	RB30E	
Coil spring				
Wire diameter	mm (in)	12.8 (0.504)	13.4 (0.528)	13.8 (0.54)
Coil diameter (mean)	mm (in)	158.8 (6.25)	159.4 (6.28)	159.5 (6.28)
Free length	mm (in)	358.5 (14.1)	325 (12.8)	342 (13.46)
Spring constant	N/mm (kg/mm, lb/in)	18.1 (1.84, 103)	23.6 (2.4, 137)	23.5 (2.4, 136)
Identification color		Blue	Yellow	No colour
Effective turns		3.64	3.32	
Strut				
Type		Double acting hydraulic		
Oil capacity	mℓ (Imp fl oz)	270 (9.5)	280 (9.9)	
Inner cylinder				
Inner diameter	mm (in)	30.02-30.10 (1.182-1.185)		
Maximum runout	mm (in)	0.2 (0.008)		
Piston rod				
Rod diameter	mm (in)	22 (0.87)		
Maximum runout	mm (in)	0.1 (0.004)		
Stroke	mm (in)	168 (6.6)		
Damping force [at 0.3 m (1.0 ft)/sec.]				
Expansion	N (kg, lb)	815 (83, 183)	815 (83, 183)	795 (83, 183)
Compression	N (kg, lb)	285 (29, 63.9)	285 (29, 63.9)	310 (32, 69.7)
Tension rod diameter	mm (in)	20 (0.79)		
Stabilizer bar diameter	mm (in)	23 (0.90)	25 (0.98)	

Inspection and Adjustment

WHEEL ALIGNMENT (Unladen*1)

Camber	degree	−50′ to 1°
Caster	degree	3°45′-5°15′
Toe-in	mm (in)	0 to 2 (0.00 to 0.08)
	degree	0 to 12′
Kingpin inclination	degree	11°45′ to 13°35′
Front wheel turning angle Toe-out turn Inside/Outside	degree	Power steering 21 52′/20
		Manual steering 21 46′/20
Full turns*2 Inside/Outside	degree	Power steering 41 - 45 /32 - 36
		Manual steering 37° - 41°/30° - 34′
Tie-rod length "L" (reference data)	mm (in)	PR25P 42.5 (1.673)
		TRW 55 (2.16)



SST510A

*1 Fuel, radiator coolant and engine oil full. Spare tyre, jack, hand tools and mats in designed position.
*2 On power steering models, wheel turning force (at circumference of steering wheel) of 98 to 147 N (10 to 15 kg, 22 to 33 lb) with engine at idle.

WHEEL BEARING

Wheel bearing axial play mm (in)	0 (0)
Wheel bearing lock nut Tightening torque N·m (kg-m, ft-lb)	34 - 39 (3.5 - 4.0, 25 - 29)
Return angle degree	90
Wheel bearing preload With new grease seal N·m (kg-cm, in-lb)	0.78 (8.0, 6.9) or less
With used grease seal N·m (kg-cm, in-lb)	0.78 (8.0, 6.9) or less
At wheel hub bolt N (kg, lb) With new grease seal	13.7 (1.4, 3.1) or less
With used grease seal	13.7 (1.4, 3.1) or less

LOWER BALL JOINT

Axial end play [Under force of approximately 981 N (100 kg, 22 lb)] mm (in)	0.1 - 1.3 (0.004 - 0.051)
Turning torque "A" (Measuring point: cotter pin hole of ball stud) New parts N (kg, lb)	24.5 - 80.4 (2.5 - 8.2, 5.5 - 18.1)
Used parts N (kg, lb)	7.8 - 80.4 (0.8 - 8.2, 1.8 - 18.1)
Turning torque "B" N·m (kg-cm, in-lb) New parts	1.5 - 4.9 (15 - 50, 13 - 43)
Used parts	0.5 - 4.9 (5 - 50, 4.3 - 43.4)

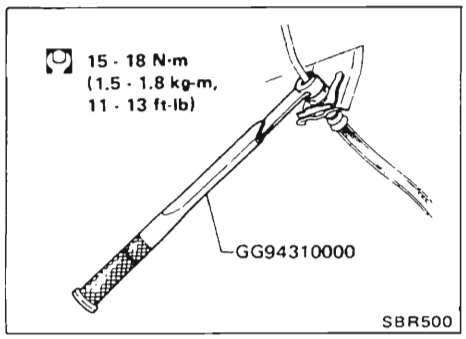
Tightening Torque

Item	N·m	kg-m	ft-lb
Wheel hub			
Wheel hub bearing nut	34 - 39	3.5 - 4.0	25 - 29
Wheel nut	98 - 118	10.0 - 12.0	72 - 87
Knuckle arm and knuckle spindle			
Knuckle arm to strut assembly	72 - 97	7.3 - 9.9	53 - 72
Knuckle arm to tie-rod	54 - 98	5.5 - 10.0	40 - 72
Ball joint to knuckle arm	96 - 120	9.8 - 12.2	71 - 88
Torque member fixing bolt	72 - 97	7.3 - 9.9	53 - 72
Brake tube flare nut	15 - 18	1.5 - 1.8	11 - 13
Tie-rod lock nut	78 - 98	8.0 - 10.0	58 - 72
Strut assembly			
Strut to hoodledge	29 - 39	3.0 - 4.0	22 - 29
Piston rod self-locking nut	59 - 78	6.0 - 8.0	43 - 58
Gland packing (without Tool)	69 - 127	7.0 - 13.0	51 - 94
Transverse link			
Transverse link to front suspension member	78 - 98	8.0 - 10.0	58 - 72
Tension rod			
Tension rod bracket to body	54 - 64	5.5 - 6.5	40 - 47
Tension rod to transverse link	47 - 59	4.8 - 6.0	35 - 43
Tension rod nut	34 - 49	3.5 - 5.0	25 - 36
Stabilizer bar			
Stabilizer bar clamp to tension rod bracket	54 - 64	5.5 - 6.5	40 - 47
Stabilizer bar to transverse link	20 - 29	2.0 - 3.0	14 - 22
Front suspension member			
Suspension member to body	78 - 93	8.0 - 9.5	58 - 69
Engine mounting insulator to suspension member	39 - 49	4.0 - 5.0	29 - 36

REAR AXLE & REAR SUSPENSION

CONTENTS

PRECAUTION AND PREPARATION ..... RA- 2
REAR AXLE AND REAR SUSPENSION ..... RA- 4
REAR AXLE-BEARING AND SEAL ..... RA- 5
REAR SUSPENSION ..... RA- 7
SERVICE DATA AND SPECIFICATIONS RA-11



Precaution

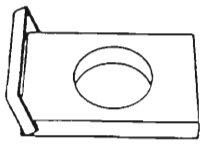
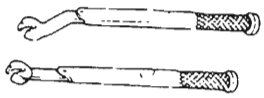
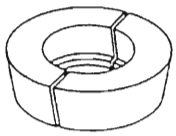
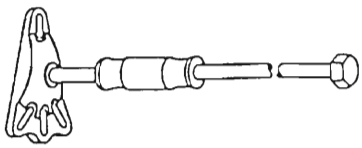
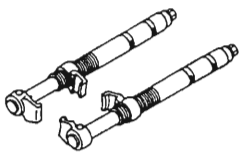
(1) Final tightening requires to be carried out under unladen condition* with tires on ground.
   * Fuel, radiator coolant and engine oil full. Spare tire, jack, hand tools and mats in designed position.

(2) Use Tool when removing or installing brake tubes.

Preparation

SERVICE TOOLS

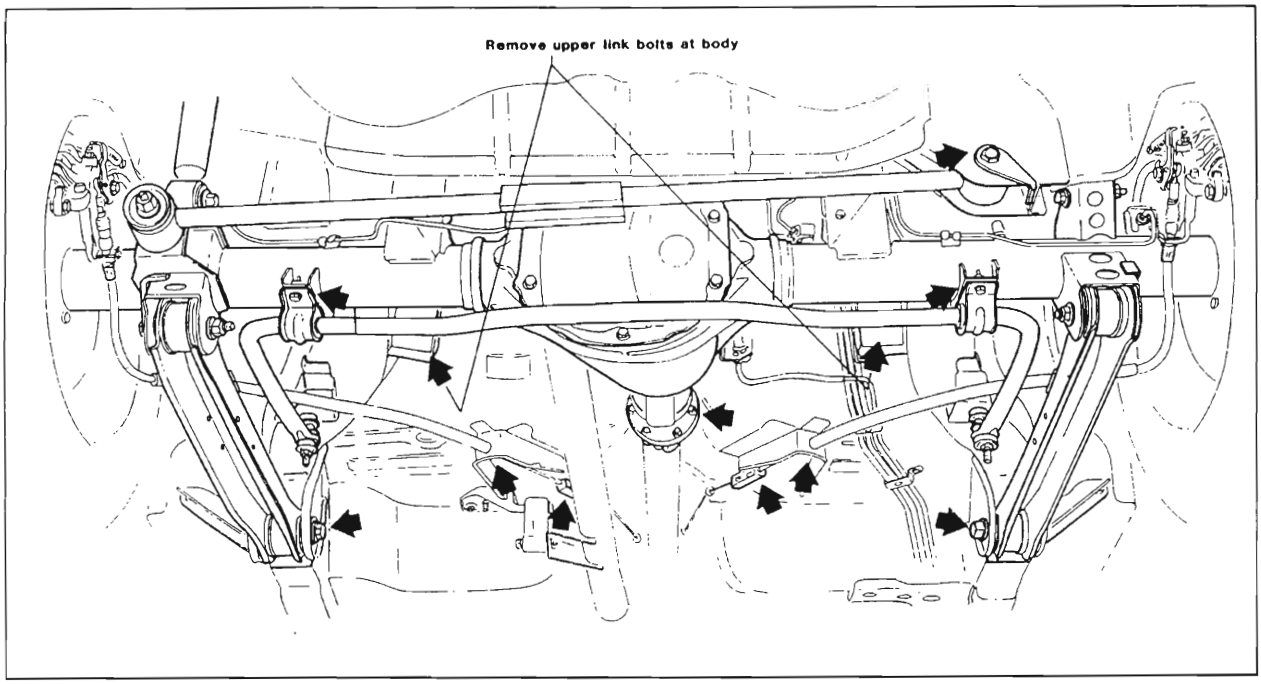
*: Special tool or commercial equivalent

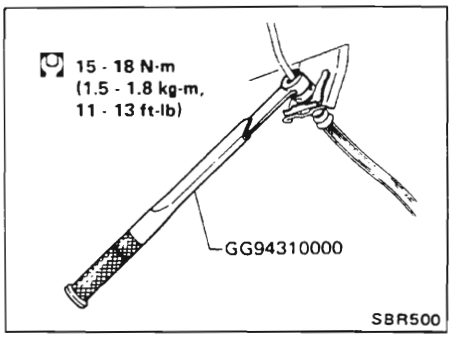
Tool number Tool name	Description		Supplier
E1673P Press plate			Litchfield
GG94310000* Flare nut torque wrench		Removing or installing each type of brake piping	Nissan
E1673Z15		Removing axle bearing use with E1673P	Litchfield
E6662A Axle remover			Litchfield
E2MIOF Spring compressor			Litchfield

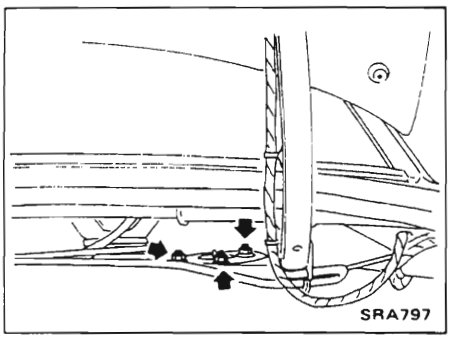
Preparation (Cont'd)

Tool number Tool name	Description	Supplier
E7132 Drift-panhard rod bushing (axle end)	Removing or installing panhard rod bushing (axle end)	Litchfield
E7133 Drift-panhard rod bushing (body end)	Removing or installing panhard rod bushing (body end)	Litchfield
E7131 Drift-lower link bushing	Removing or installing lower bushing	Litchfield

Removal and Installation







- Disconnect brake hydraulic line and parking brake cable.

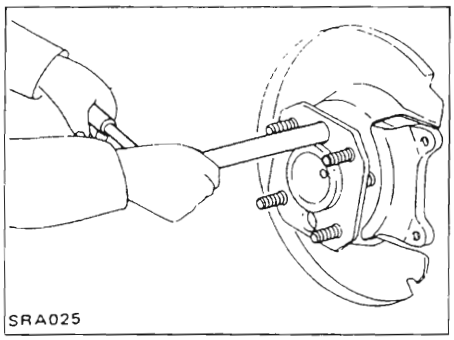
CAUTION:

Use Tool when removing or installing brake tubes.

Final tightening of rubber parts should be carried out under unladen condition with tires on ground.

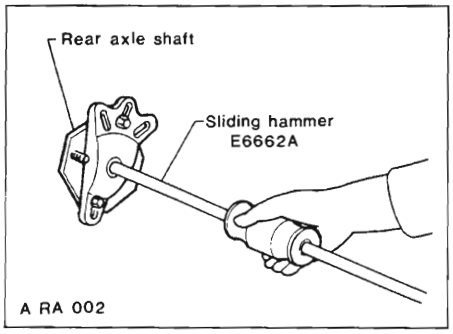
- Disconnect propeller shaft. Refer to section PD.
- Remove upper links and lower links from body.
- Remove panhard rod from body.

- Remove upper end nuts of shock absorber from boot side.


SRA025

Disassembly

- Disconnect parking brake cable and brake tube. Refer to Removal and Installation of REAR AXLE AND REAR SUSPENSION.
- Remove caliper and rotor. Refer to section BR for rear disc brake.
- Remove nuts securing brake anchor plate.



A RA 002

- Draw out axle shaft using suitable slide hammer.

Note: If both axles are removed, the longer of the two must be refitted to the R/H side.

Bearing or Seal Replacement

Drill into the bearing retainer ring perpendicular to the axle shaft — do not drill through into axle shaft, then carefully split the retainer with a chisel at hole location.

Using Special Tool Nos E1673P and E1673Z15 to support the axle bearing, press the axle shaft out of the bearing. Remove seal and outer bearing retainer. Discard seal.

Examine axle shaft bearing/seal journals and splines for excessive wear or damage. If axle shaft is in a satisfactory condition it maybe re-used.

Bearings and inner bearing retainers which have been removed from an axle shaft should not be re-used.

Place the outer bearing retainer plate on the axle shaft.

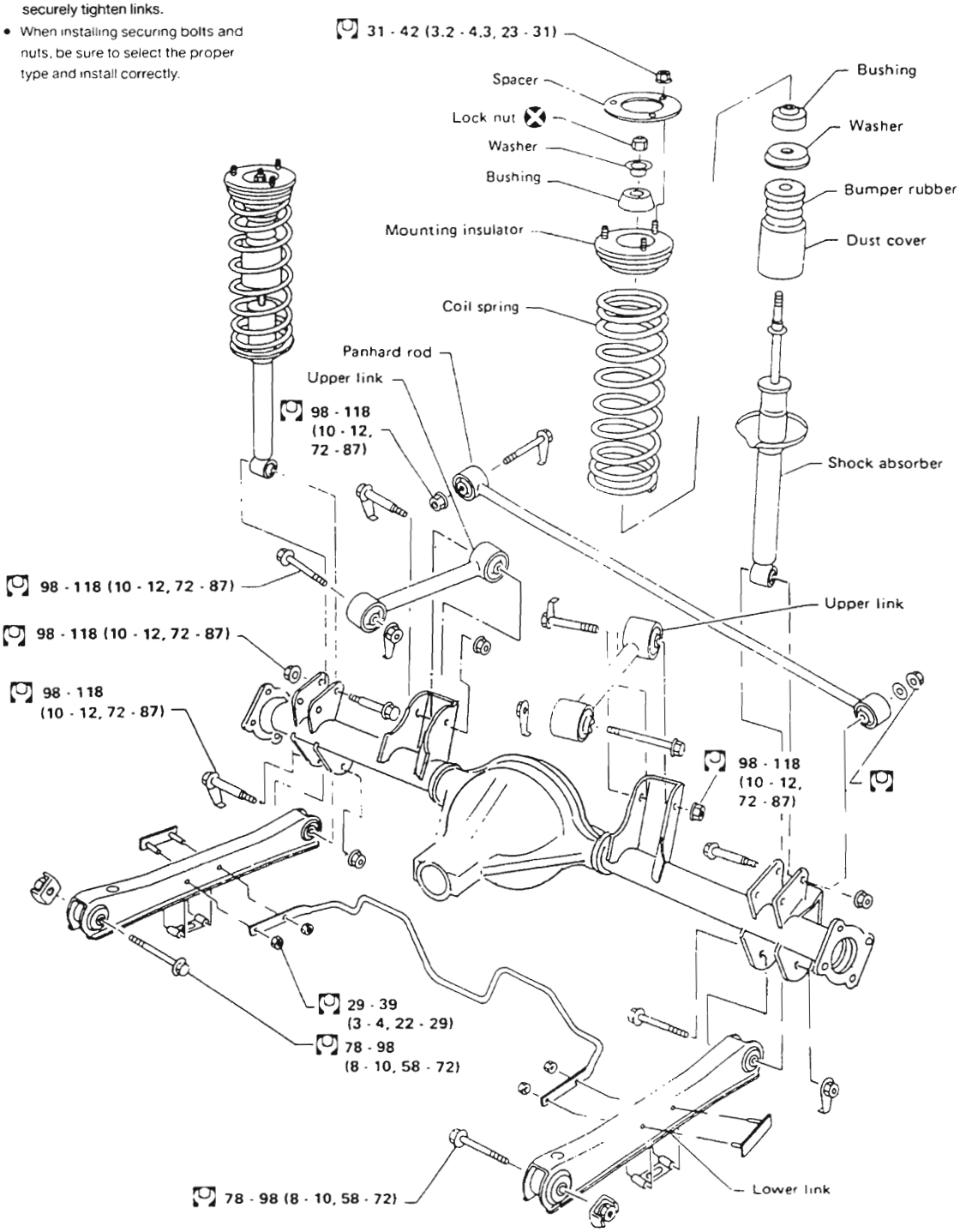
Place the oil seal on the axle shaft ensuring that the spring side of the oil seal faces the centre of the axle. Lubricate seal lip with a **light** coat of grease.
Note: use of excessive amounts of grease may damage seal.

Using suitable blocks or tubular spacer as a support, press wheel bearing and inner bearing retaining collar hard against bearing shoulder on axle shaft, ensuring that the retainer is tight against the bearing and with O.D. chamfer towards bearing.

Place the axle shaft through the brake anchor plate and align axle shaft and side gear splines.

Once the splines have been engaged in the side gears the wheel bearing and oil seal maybe pushed into the housing. A light coat of grease on the seal outside diameter will assist in installation. Tighten the backing plate bolts alternately. (Refer S.D.S. for torque setting.)

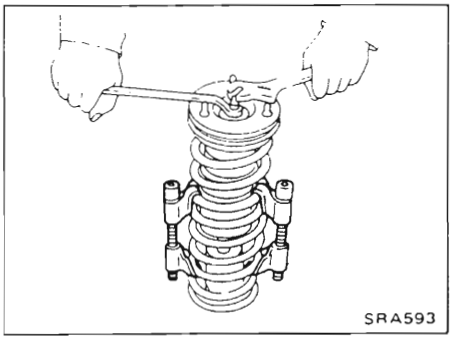
- Loosely install all link nuts and bolts, then lower the vehicle to the ground. After bouncing the body up and down two or three times, securely tighten links.
- When installing securing bolts and nuts, be sure to select the proper type and install correctly.



Sedan shown. Wagon has same torque specs, etc.

N·m (kg-m, ft-lb)
Replace when disassembled.

SRA811



Coil Spring and Shock Absorber

REMOVAL

- Refer to Removal and Installation of REAR AXLE AND REAR SUSPENSION.

DISASSEMBLY AND ASSEMBLY

- Remove coil spring with suitable tool.
- Tighten lock nut as far as it goes when assembling.
- Use special tool no. E2MIOF, compress coil spring to and remove retaining nut to remove coil spring insulator.

INSPECTION

- Check coil spring for yield, deformation or cracks.
- Check coil spring specifications. Refer to S.D.S.
- Check shock absorber for oil leakage, cracks or deformation.
- Check shock absorber specifications. Refer to S.D.S.
- Check shock absorber mounting insulator and other rubber parts for wear, cracks or deformation. Replace if necessary.
- Place coil spring in position, fit spring insulator and new retaining nut.
  Tighten nut to required torque refer S.D.S.

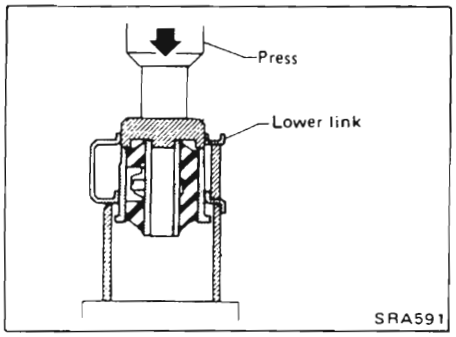
Upper Link, Lower Link and Panhard Rod

INSPECTION

Check for cracks, distortion or other damage. Replace if necessary.

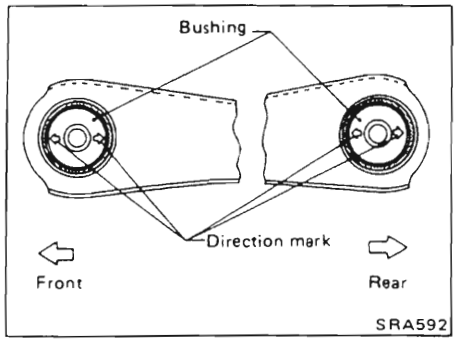
BUSHING REPLACEMENT (Lower Link and Panhard rod only)

Check for cracks or other damage. Replace with Tool if necessary. Upper link bushes are not serviced separately. If bushes are damaged replace link assembly.

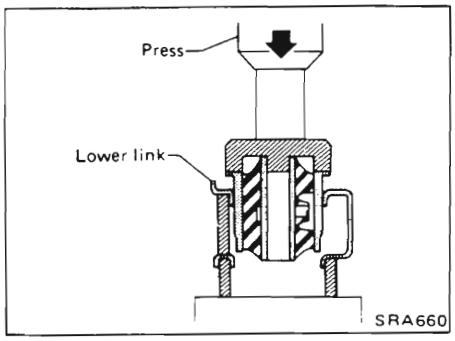


Lower link bushing

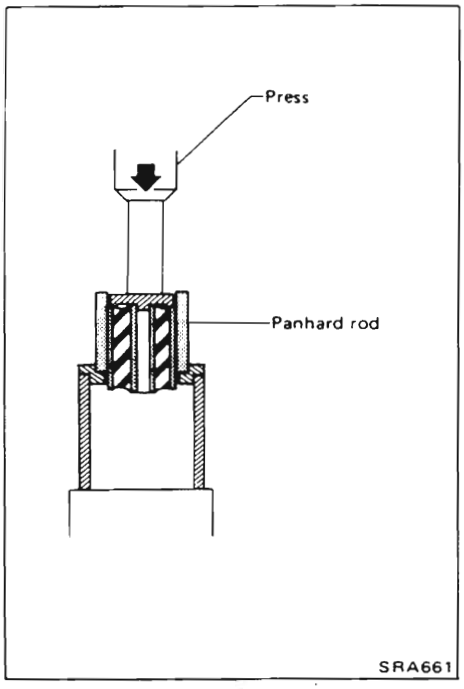
- Remove lower link bushing with Tool.



- When installing, pay attention to its direction.



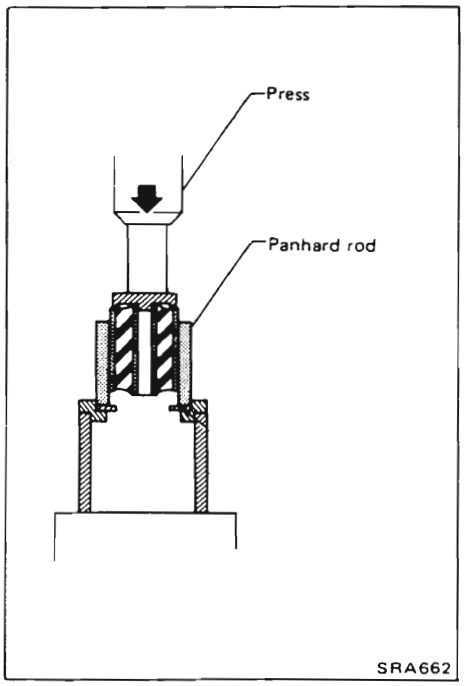
- **When installing lower link bushing, apply a coating of soapy water to outer wall of bushing.**
  Always install new bushing.
  Do not tap end face of bushing directly with a hammer.



Upper Link, Lower Link and Panhard Rod (Cont'd)

Panhard rod bushing

- Remove panhard rod bushing with Tool.

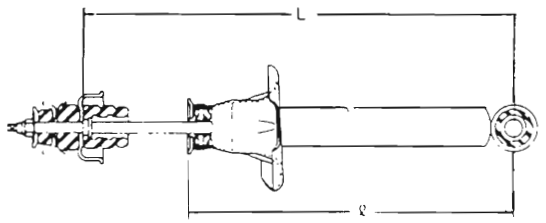


When installing panhard rod bushing, apply a coating of soapy water to outer wall of bushing.
Always install new bushing.
Do not tap end face of bushing directly with a hammer.

General Specifications

SHOCK ABSORBER — CA20E

		Sedan	Wagon
Piston rod diameter	mm (in)	12.4 (0.488)	
Stroke	mm (in)	183 (7.20)	200 (7.87)
Free length "ℓ"	mm (in)	344 (13.5)	320 (12.5)
Maximum length "L"	mm (in)	536 (21.1)	521 (20.5)
Damping force at 0.3 m (1.0 ft)/sec. Expansion	N, (kg, lb)	815 (83, 183)	815 (83, 183)
Compression	N (kg, lb)	285 (29, 64)	285 (29, 64)



SRA678

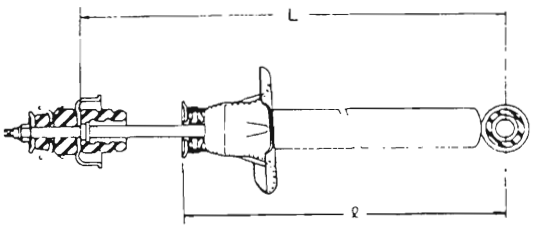
COIL SPRING — CA20E

		Sedan	Wagon
Wire diameter	mm (in)	10.5-11.7 (0.41-0.46)	10.4-12.5 (0.41-0.49)
Mean coil diameter	mm (in)	100	113 mm (4.44)
Free length	mm (in)	380.5 (15.0)	409.5 (16.1)
Length/Weight mm (@ kg		234 (@ 275	231 (@ 330
Spring constant N/mm (kg/mm, lb/in)		18.0 to 33.3 (1.84-3.40, 103-190)	18.0 to 30.6 (1.83-3.12, 102-175)
Identification color		Red	Green

General Specifications

SHOCK ABSORBER — RB30E

		Sedan	Wagon
Piston rod diameter	mm	12.4	Internal
Stroke	mm	180.2	197.5
Free length " "	mm	346	N/A
Maximum length "L"	mm	536	518
Damping force at 0.3 m (1.0 ft)/sec. Expansion	N	895	820
Compression	N	355	400



SRA678

COIL SPRING — RB30E

		Sedan	Wagon
Mean wire diameter	mm	11.2	11.4
Mean coil diameter	mm	100.8	113.4
Free length	mm	380.5	409.5
Length/Weight mm @ kg		234 @ 275	231 @ 330
Spring constant N/mm. (kg/mm, lb/in)		18.0 to 33.3 (1.84-3.40, 103-190)	18.0 to 30.6 (1.83 - 3.12, 102 - 175)
Identification colour		Red	

Tightening Torque

Unit	N·m	kg-m	ft-lb
Wheel nut	98 - 118	10 - 12	72 - 87
Brake tube connector flare nut	15 - 18	1.5 - 1.8	11 - 13
Shock absorber lower end fixing nut	98 - 118	10.0 - 12.0	72 - 87
Shock absorber upper end fixing nut	31 - 42	3.2 - 4.3	23 - 31
Shock absorber shaft lock nut	19 - 26	1.9 - 2.6	13 - 19
Back plate securing nut	22 - 26	2.2 - 2.7	16 - 20
Upper link fixing nut	98 - 118	10.0 - 12.0	72 - 87
Lower link fixing bolt and nut	98 - 118	10.0 - 12.0	72 - 87
Differential carrier-to-axle case nut	16 - 24	1.6 - 2.4	12 - 17
Panhard rod fixing bolt (baly end)	98 - 118	10.0 - 12.0	72 - 87
Stabilizer to lower link	29 - 39	3 - 4	22 - 29

Panhard rod fixing nut torque (on pin at axle end of Panhard rod).
Refer rear axle ID tag for axle serial number.

Model	Axle serial No.	Torque N·m (ft-lb)
Pintara Sedan	Up to 3765	
Pintara Wagon	Up to 1849	
Skyline Manual Sedan	Up to 1066	
Skyline Auto Sedan	Up to 1142	49-59 (36-43)
Pintara Sedan	From 3766	
Pintara Wagon	From 1850	
Skyline Manual Sedan	From 1063	79-98 (58-72)
Skyline Auto Sedan	From 1143	
Skyline Wagon	All	

BRAKE SYSTEM

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BRAKE BLEEDING PROCEDURE ..... BR- 4
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MASTER CYLINDER ..... BR- 9
FRONT DISC BRAKE — Caliper BR-15
FRONT DISC BRAKE — Rotor BR-18
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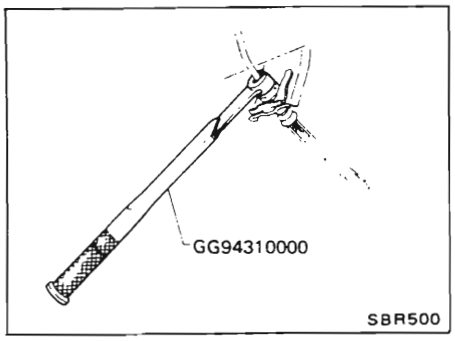
REAR DISC BRAKE — Rotor BR-23
PARKING BRAKE CONTROL BR-29
SERVICE DATA AND SPECIFICATIONS BR-31

Precaution

- **Recommended fluid is brake fluid as detailed on master cylinder reservoir cap.**
- Do not reuse drained brake fluid.
- Be careful not to splash brake fluid on painted areas.
- To clean or wash all parts of master cylinder, disc brake caliper and wheel cylinder, use clean brake fluid.
- Never use mineral oils such as gasoline or kerosene. It will ruin the rubber parts of the hydraulic system.

WARNING:

- Clean pad dust using a dust collector after cleaning with waste cloth.

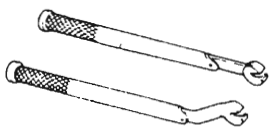
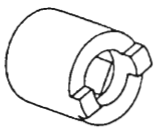


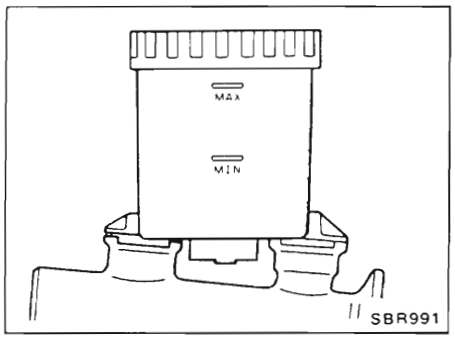
- **Use Tool when removing and installing brake tube.**

Preparation

SPECIAL SERVICE TOOL

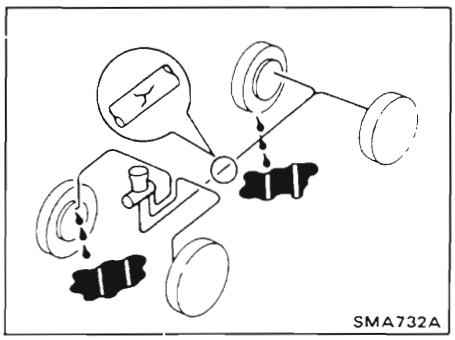
*: Special tool or a commercial equivalent

Tool number Tool name	Description		Source
GG94310000* Flare nut torque wrench		Removing and installing each brake piping	Nissan
E7109 Piston retraction tool		Replacing rear brake pads	Litchfield



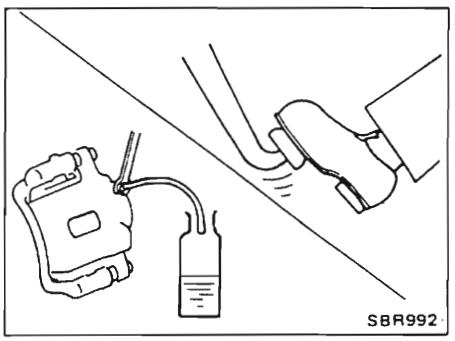
Checking Brake Fluid Level

- Check fluid level in reservoir tank. It requires to be between Max. and Min. lines on reservoir tank.
- If fluid level is extremely low, check brake system for leaks.



Checking Brake System

- Check brake lines (tubes and hoses) for evidence of cracks, deterioration or other damage. Replace any damaged parts. If leakage occurs around joints, re-tighten or, if necessary, replace damaged parts.
- Be sure to check for oil leakage by depressing brake pedal whilst checking lines.

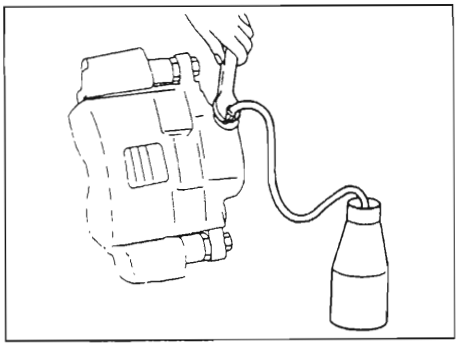


Changing Brake Fluid

1. Drain brake fluid at each air bleeder valve in turn.

2. Refill reservoir with recommended brake fluid as detailed on reservoir cap.
   Continue bleeding until new fluid appears at each air bleeder valve.

- **Refill with recommended brake fluid.**
- **Do not reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas.**



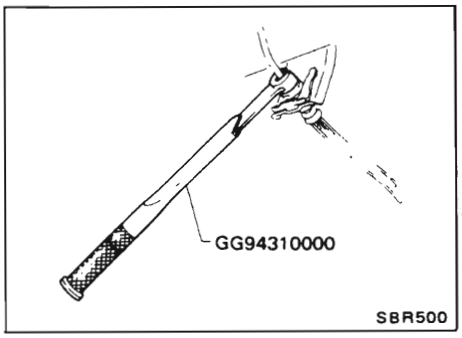
Bleeding Procedure

Bleed brakes in the following order:

Left rear Right rear Left front right front.

1 Attach a length of clear plastic tubing to the bleeder valve and submerge the other end of the tubing in clean brake fluid in a clean transparent container.
2 Ensure master cylinder reservoir is filled to the correct level.
DO NOT PUMP OR STROKE THE BRAKE PEDAL
3 Open the bleeder valve and depress the brake pedal fully.
4 Close the bleeder valve and then allow the brake pedal to return slowly to rest.

- Allow pedal to remain at rest before repeating steps (3) and (4).
- Continue procedure until no further air bubbles are visible at the bleeder valve.



Removal and Installation

CAUTION:

a. **When removing and installing brake tube, use Tool.**

b. **Cover openings to prevent ingress of dirt whenever disconnecting hydraulic line.**

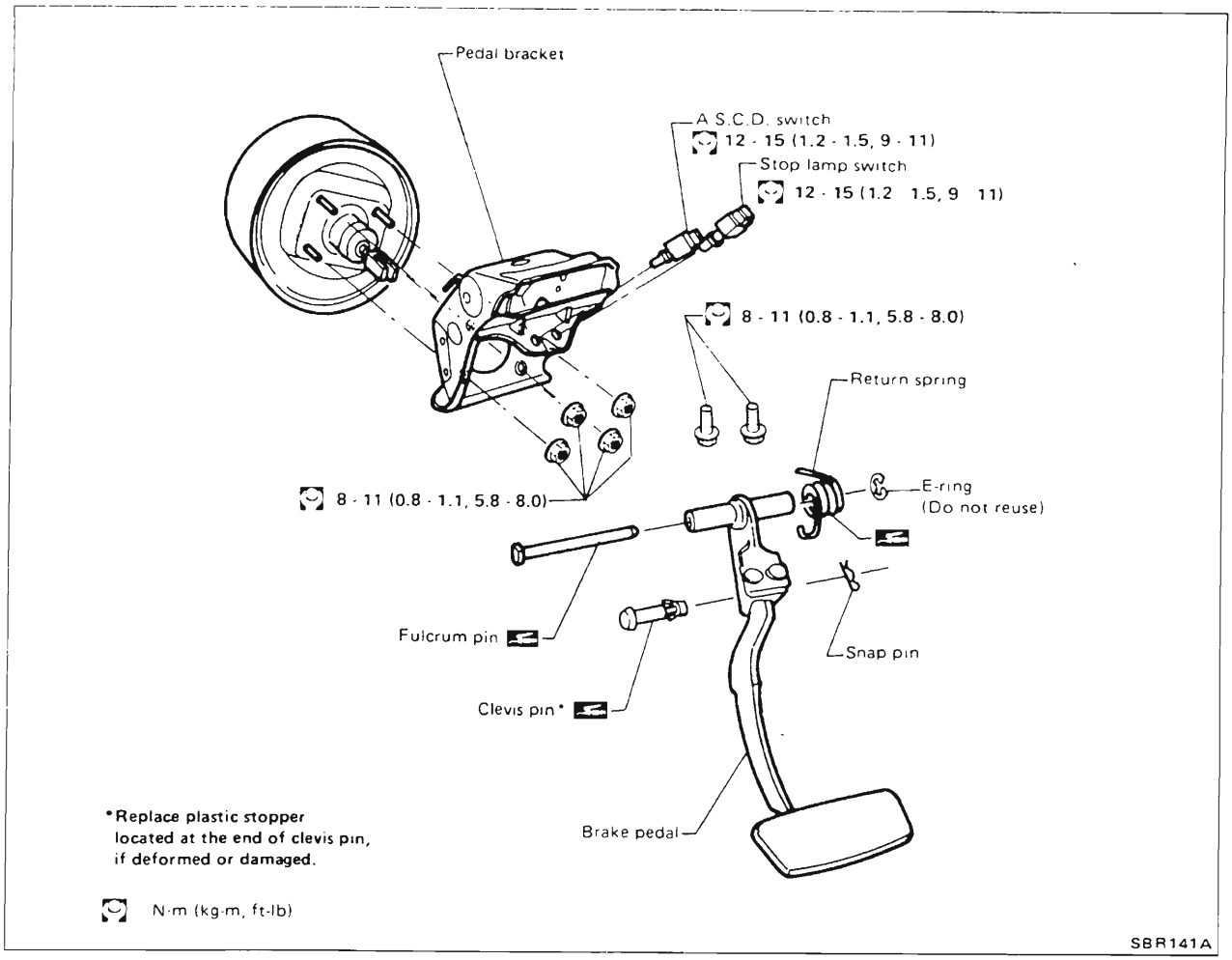
- To remove brake hose, first remove flare nut securing brake tube to hose, then withdraw lock spring. Next disconnect the other side.
- All hoses must be free from excessive bending, twisting and pulling.
- Whenever installing brake lines, be sure to check for oil leakage by fully depressing brake pedal.

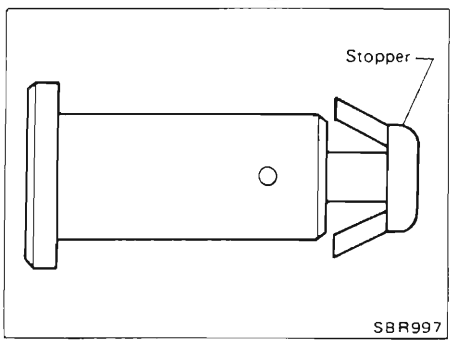
Inspection

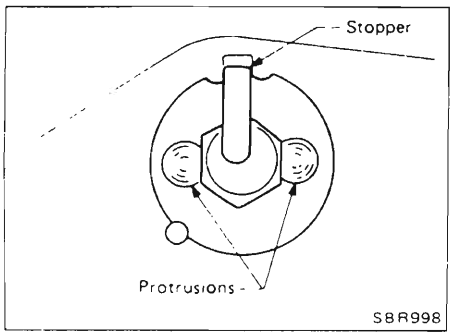
Check brake lines (tubes and hoses) for evidence of cracks, deterioration or other damage. Replace any damaged parts.

If leakage occurs around joints, re-tighten or, if necessary, replace damaged parts.

Removal and Installation







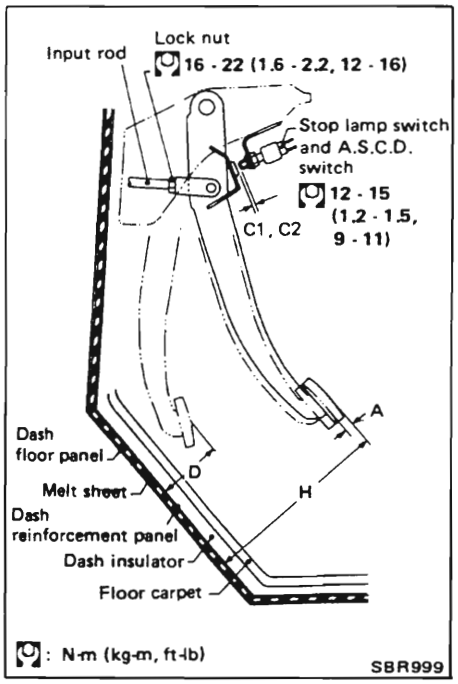
- Remove snap pin.
- Using suitable tool (e.g. small socket) to compress legs of stopper, slide clevis pin out of pedal.
- Insert clevis pin from the R.H. side and secure it with snap pin.

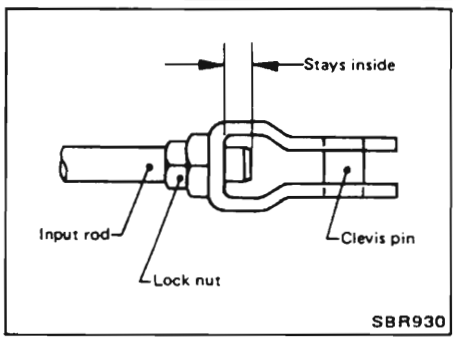
- Straighten pedal bracket stopper before removing it, and install fulcrum pin.
- After inserting fulcrum pin, bend stopper to lock the pin.

Inspection

Check brake pedal for the following items, servicing as necessary.

- Brake pedal bend
- Clevis pin deformation
- Crack for any welded portion





Adjustment

Check brake pedal free height from dash reinforcement panel. Adjust if necessary.

H: **Free height**
Refer to S.D.S.

D: **Depressed height**
Refer to S.D.S.
Under force of 490 N (50 kg, 110 lb) with engine running

C_1: **Clearance between pedal stopper and threaded end of stop lamp switch**
0.3 - 1.0 mm (0.012 - 0.039 in)

C_2: **Clearance between pedal stopper and threaded end of A.S.C.D. switch**
0.3 - 1.0 mm (0.012 - 0.039 in)

A: **Pedal free play**
1 - 3 mm (0.04 - 0.12 in)

1. Adjust pedal free height with brake booster input rod. Then tighten lock nut.

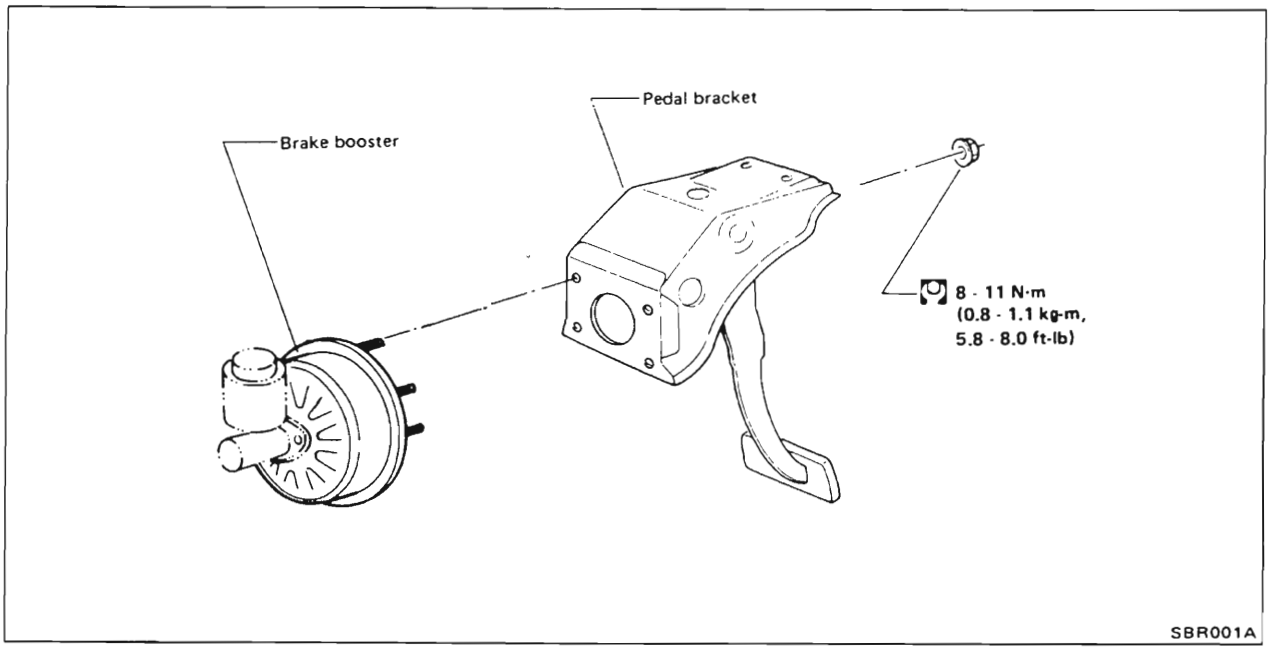
Make sure that the tip of input rod stays inside.

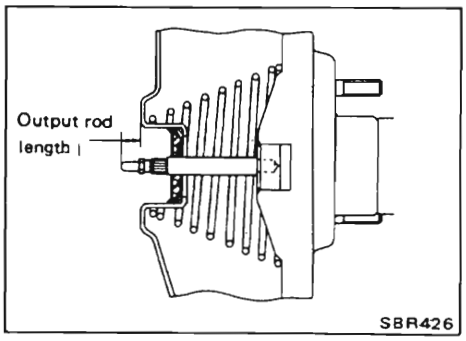
2. Adjust clearance "C_1" and "C_2" with stop lamp switch and A.S.C.D. switch respectively. Then tighten lock nuts.
3. Check pedal free play.

Make sure that stop lamp is off when pedal is released.

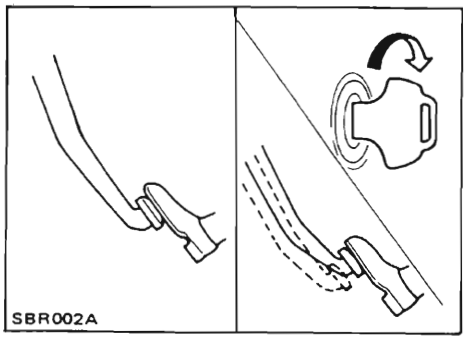
4. Check brake pedal depressed height with engine running.
   If depressed height is below the specified value, check brake system for leaks, accumulation of air or any damage regarding component parts (master cylinder, wheel cylinder, etc.), and make the necessary repairs.

Removal and Installation





Output rod length: 0.58 to 0.84 mm
(not adjustable)



Inspection

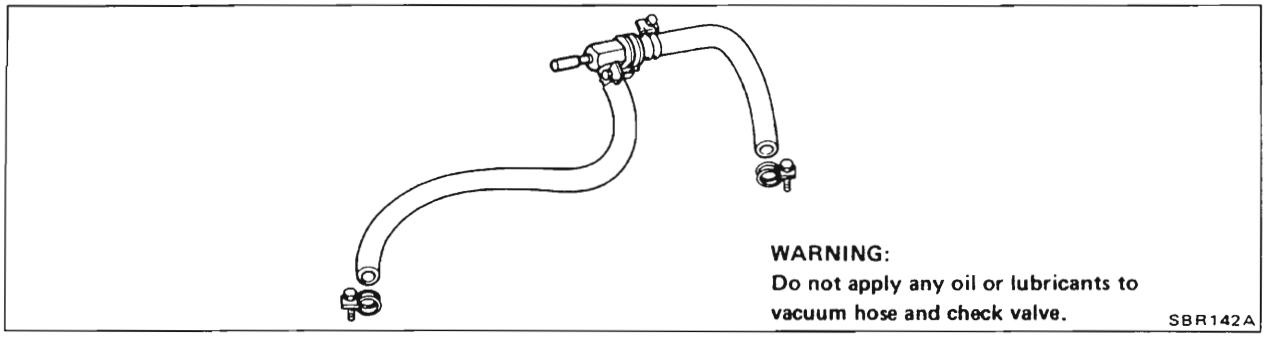
OPERATING CHECK

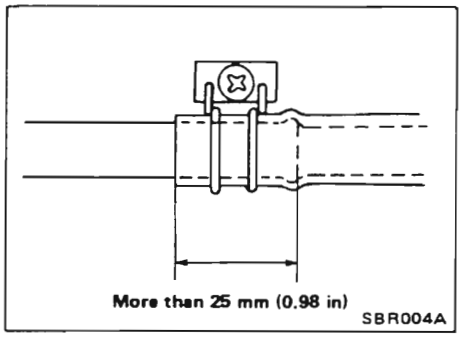
- Depress brake pedal several times with engine off, then check that the pedal stroke remains the same.
- Depress brake pedal, then start engine. If pedal goes down slightly, operation is normal.

AIRTIGHT CHECK

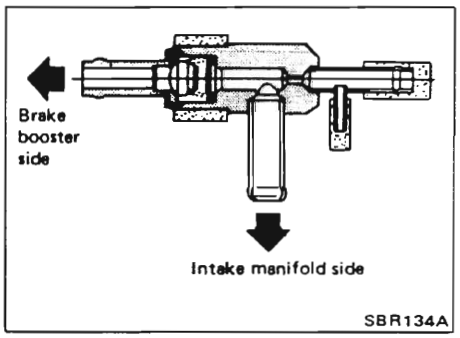
- Start engine, then stop it in one or two minutes. Depress brake pedal several times slowly. If pedal goes further down the first time and gradually rises after second or third time, the booster is airtight.
- Depress brake pedal while engine is running, then stop it with pedal depressed. If there is no change in pedal stroke after holding pedal for thirty seconds, brake booster is airtight.

Removal and Installation





- Insert vacuum tube into vacuum hose more than 25 mm (0.98 in).

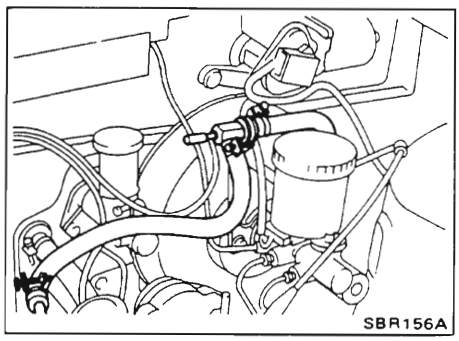


- Install check valve properly paying attention to its direction.

Inspection

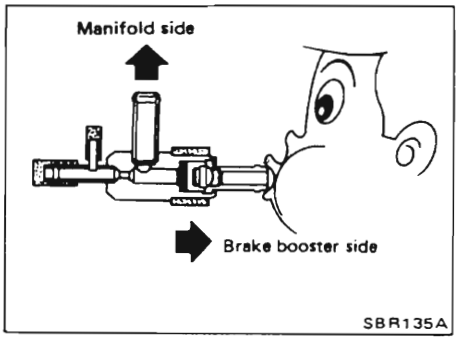
HOSES AND CONNECTORS

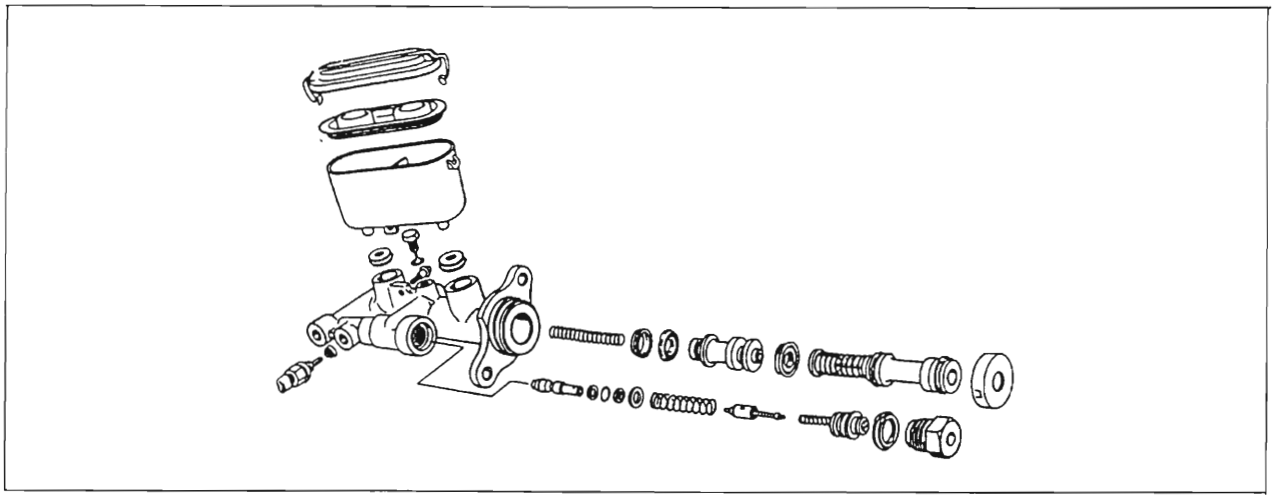
- Check condition of vacuum hoses and connectors.
- Check vacuum hoses and check valve for air tightness.

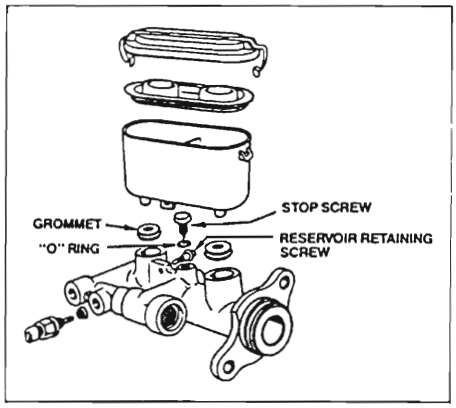


CHECK VALVE

- When pressure is applied to the brake booster side of check valve and valve does not open, replace check valve with a new one.

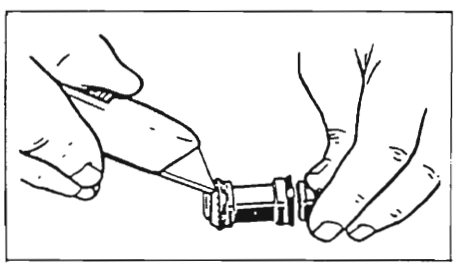


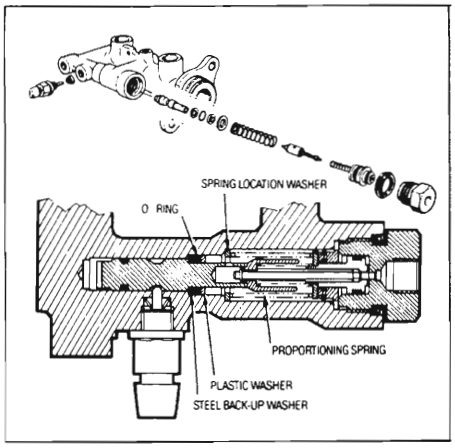


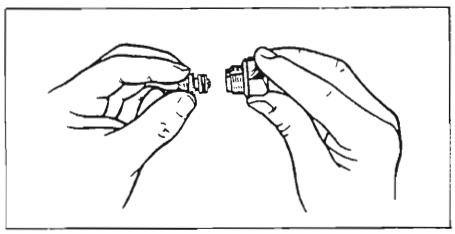


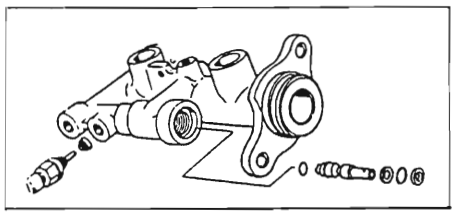
DISASSEMBLY

- Clean the outside of the master cylinder and remove reservoir cap. Pour out any brake fluid that remains in cylinder and discard the old brake fluid.
- Hold cylinder by mounting flange in a vice equipped with soft jaws.
- Unscrew and remove reservoir retaining screw located under reservoir.
- Separate by hand the plastic reservoir from aluminium cylinder body.
- Remove reservoir to body rubber sealing grommets from cylinder reservoir bores.
- Remove pressed steel cap fitted to the opening of the main bore by prising up the two locating lugs.
  CAUTION: HOLD CAP FIRMLY WITH ONE HAND DURING THIS OPERATION TO ENSURE PRIMARY PISTON DOES NOT SPRING OUT OF BORE ONCE CAP IS FREE.
- Carefully remove primary piston assembly from main bore of master cylinder.
  NOTE: CAGED SPRING ON PRIMARY PISTON HAS BEEN SET TO A PREDETERMINED LENGTH. DO NOT ATTEMPT TO ADJUST THE SCREW OR REMOVE THE CAGED SPRING. IF CUPS ARE DAMAGED OR BADLY WORN, THE COMPLETE PRIMARY PISTON ASSEMBLY MUST BE REPLACED (AS SUPPLIED IN REPAIR KIT).
- Fully depress and hold secondary piston down the bore, then remove stop screen and 'O' Ring from cylinder body.
- Remove secondary piston and return spring by using compressed air or lightly tapping the open end of the cylinder bore squarely onto a soft piece of wood.
- Using a sharp knife or razor blade, cut and remove the plastic cup retaining ring on the secondary main bore piston.
- Remove rubber seals from secondary piston taking extreme care not to damage piston.









Disassembly (Cont'd)

- Unscrew and remove the hexagon fitting located at the flange, end of the cylinder.
  CAUTION: HOLD FIRMLY WITH ONE HAND DURING THIS OPERATION TO ENSURE INTERNALS DO NOT SPRING OUT.
  The proportioning piston, seal block and poppet sub assembly, with the exception of the proportioning spring, should withdraw from the bore with the removal of the hexagon fitting. However, if these parts remain in the bore, lightly tap the body on a piece of soft wood to remove.
- Remove proportioning spring from bore.
- Remove proportioning spring location washer from bottom of proportioning bore.
- Separate proportioning piston, seal block and poppet sub assembly from hexagon fitting.

- Unscrew the plastic brake warning switch from the master cylinder body. Ensure electrical earthing spring remains on plunger.
- Carefully withdraw spool assembly from bore, using long nose pliers.
- Carefully remove both 'O' Rings and washers from spool.

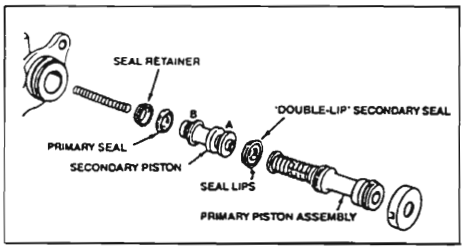
INSPECTION

- Throughly wash master cylinder body, reservoir cap in clean methylated spirits.
- Check all recesses, openings and internal passages to ensure they are open and free from foreign matter.
- Inspect the master cylinder bores for signs of etching, pitting or scoring and if in poor condition, replace the cylinder assembly. **THIS CYLINDER MUST NOT BE HONED.**
- Wash all internal parts in clean brake fluid and inspect the parts for excessive wear damage.

ASSEMBLY

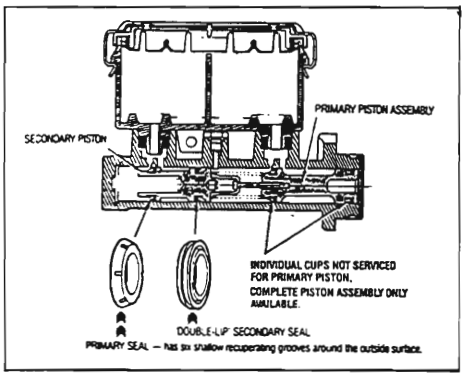
NOTE: Proportioning piston and seal block sub assembly has been pre-lubricated and sealed in plastic bag. DO NOT WASH — ASSEMBLE AS SUPPLIED.

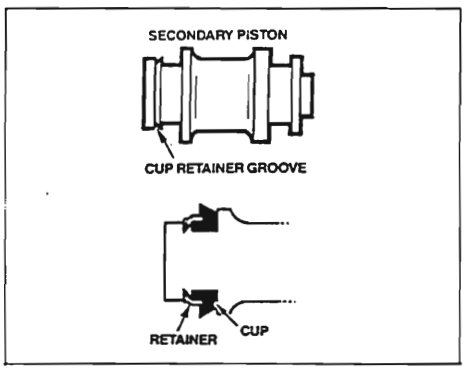
Master Cylinder Main Bore Assembly



- Before assembly, lubricate internal parts and master cylinder bore with clean, recommended brake fluid from sealed container.
- Assemble the double-lip secondary cup seal onto the secondary piston into groove "A" with seal lip facing small drilled hole end.
- Install primary cup seal onto the other end of piston into groove "B" with sealing lip facing away from seal already assembled.

  The primary cup seal can be identified by the six shallow recuperating grooves around the seal's outside surface.





- Locate part of the plastic cup seal retainer in cup retainer groove on piston and hold in position with thumb.

  Using a small pointed tool, clip the retainer into the remaining part of groove ensuring the complete location is achieved.

  NOTE: CARE SHOULD BE TAKEN TO AVOID DAMAGE TO PISTON OR CUP SEAL.

ASSEMBLY (Cont'd)

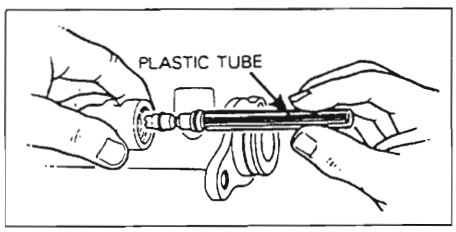
- Fit secondary return spring into end of secondary piston and carefully install piston assembly into main bore (Springend first). Fully stroke secondary piston and while held at the bottom of the bore install stop screw and new 'O' Ring. Assemble stop screw the full length of thread by hand before tightening to 7.3-8.5 Nm.
- Insert primary piston; spring end first into main bore and with piston flush with front end of bore, install retainer plate over end of bore and retain in position by bending the two fixing lugs into the machined groove on the master cylinder body locating spigot.

  NOTE: **The caged spring on the primary piston has been set to a predetermined length — DO NOT attempt to adjust the screw or remove caged spring.**

Differential Warning Switch Assembly

- Before assembly, lubricate bore and internal parts with clean recommended brake fluid from a sealed container.
- Assemble the steel back up washer onto the spool small diameter and against shoulder, followed by the large 'O' Ring and plastic washer.
- Install the small 'O' Ring into the spool groove, opposite end.

  NOTE: TO ASSIST SPOOL ASSEMBLY INTO BODY, A SMOOTH PLASTIC OR METAL TUBE IS REQUIRED THAT WILL LOCATE OVER THE SPOOL SMALL DIAMETER AND HAS AN OUTSIDE DIAMETER NO LARGER THAN THE STEEL BACK UP WASHER.



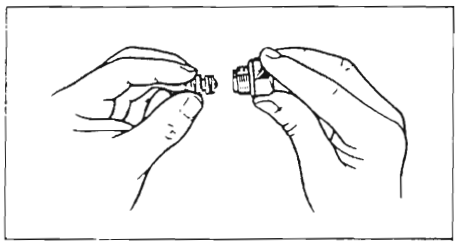
- Locate assembly tube over the spool small diameter against the plastic washer and carefully insert spool assembly into the bore to bottom steel back up washer against spool bore location shoulder.

Proportioning Valve Assembly

NOTE: (a) When using a repair kit install all the new parts supplied. The proportioning piston and seal block sub assembly has been prelubricated and sealed in plastic bag. DO NOT WASH — ASSEMBLE AS SUPPLIED.

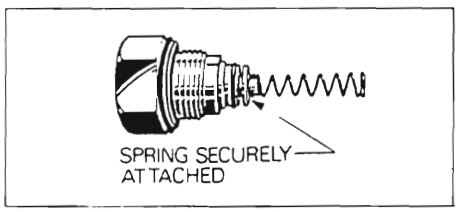
(b) Ensure that the hexagon fitting is free to screw by hand to the full depth of thread.

- Lightly smear the inside of the hexagon fitting bore, and the cylinder proportioning bore with clean brake fluid.
- Assemble the rubber breather washer onto the hexagon fitting.
- Assemble proportioning spring location washer against shoulder in proportioning bore.
- Install proportioning spring into bore against location washer.

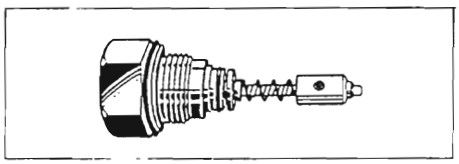


Assembly (Cont'd)

- Assembly proportioning piston and seal block sub assembly into hexagon fitting bore.



- Securely attach poppet retraction spring onto end of proportioning piston.



- Insert poppet sub assembly through retraction spring into proportioning piston.
- Carefully install the proportioning piston and seal block sub assembly and hexagon fitting into the proportioning bore compressing the proportioning spring. Screw the hexagon fitting by hand into the bore and tighten to 40-46 Nm.

Electrical Switch Assembly

- Install onto switch plunger, small end first, the conical electrical earthing spring.
  NOTE: Electrical spring must remain attached to plunger when switch held vertically. Small end of spring may need to be closed down to give required attachment.
- Install electrical switch and tighten to 1.4-1.8 Nm.

Reservoir Assembly

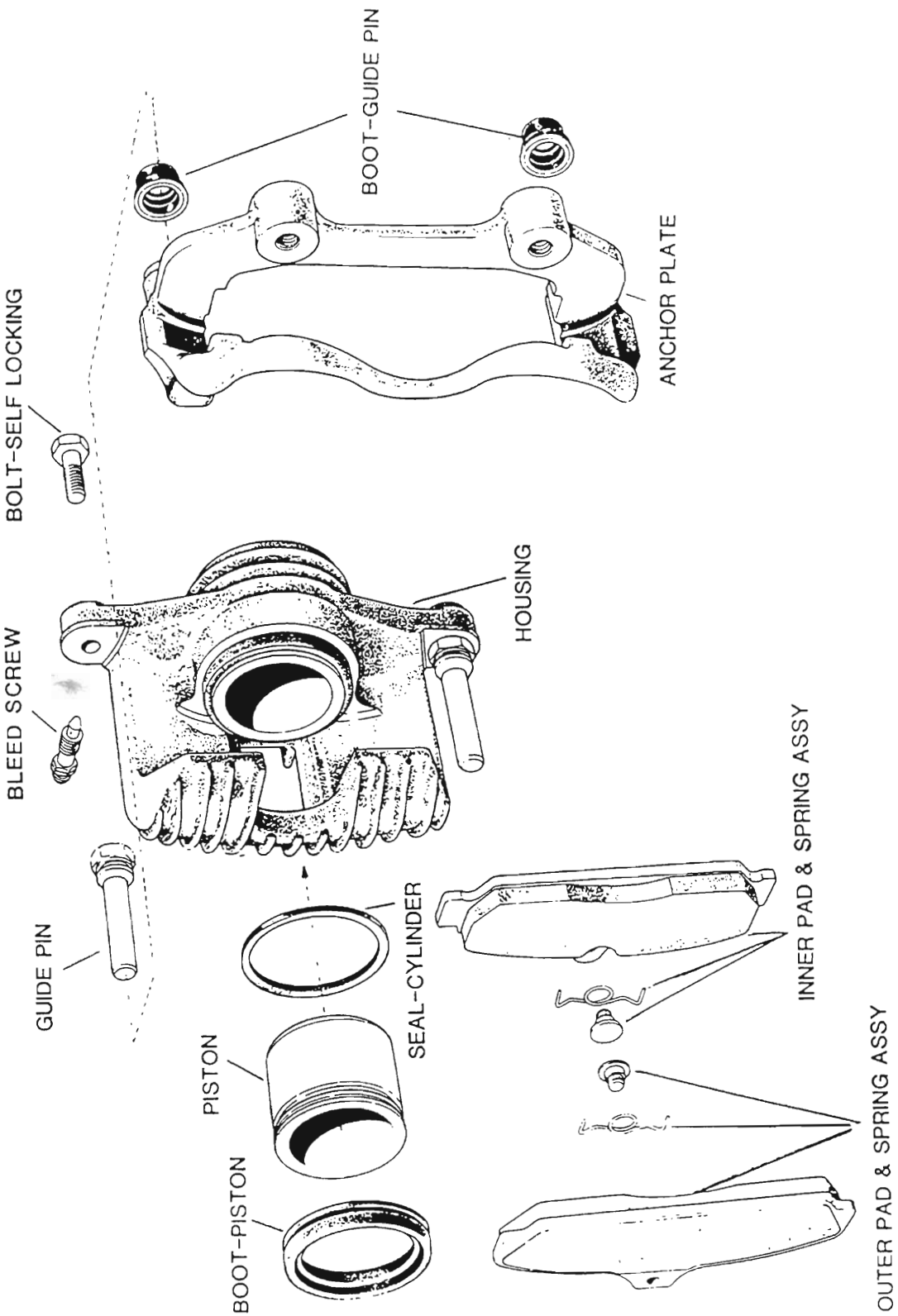
- Lightly smear reservoir bores and grommets with clean brake fluid.
- Carefully assemble grommets into reservoir bore to locate against the shoulder in each bore.
- Assemble reservoir into the joining grommets.
- Push on reservoir to align the retaining screw hole in reservoir and master cylinder body, then assemble retaining screw and tighten to 4.3-4.8 Nm.
  NOTE: BOTH HOLES MUST BE ALIGNED TO AVOID CROSS THREADING.
- Install reservoir seal into cap.
- Smear sealing edges of reservoir seal with clean brake fluid and assemble cap to reservoir.

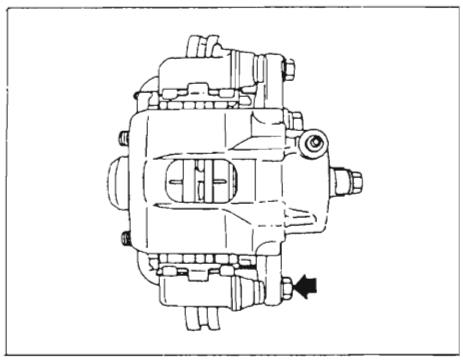
BLEEDING

Fill the master cylinder with recommended brake fluid from a sealed container and bleed on the bench prior to replacing on vehicle. After bleeding ensure the outlet ports are blocked to prevent fluid escaping.

Replace master cylinder ensuring hydraulic pipes are securely connected and bleed brake system. While bleeding each system check that the brake failure warning light operates and resets. Top up reservoir with recommended brake fluid from a sealed container to the full marks on side of reservoir.

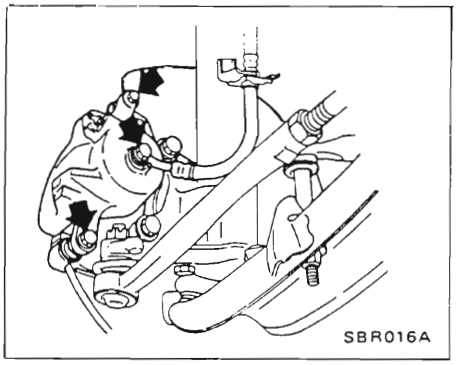
Refer to page BR-4 for correct bleeding procedures.

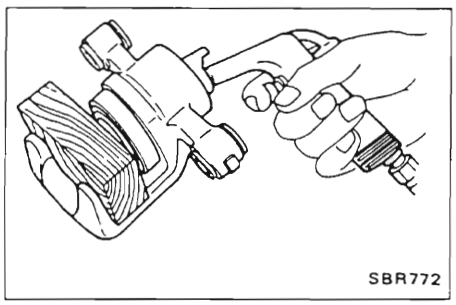

BOOT-GUIDE PIN
ANCHOR PLATE
BOLT-SELF LOCKING
BLEED SCREW
HOUSING
GUIDE PIN
SEAL-CYLINDER
PISTON
BOOT-PISTON
INNER PAD & SPRING ASSY
OUTER PAD & SPRING ASSY



Pad Replacement

1. With vehicle raised evenly on a hoist or jack stands, remove the road wheels.
2. Remove and discard the two housing retaining bolts from housing and guide pins. Due to deterioration of the thread locking patch, these bolts must not be re-used.
3. Lift the caliper housing off the anchor plate and disc.
   DO NOT ALLOW CALIPER HOUSING TO HANG FROM HYDRAULIC BRAKE HOSE.
4. Check the guide pins for freedom of movement, also the condition of the rubber boots. If the guide pins cannot be moved freely by hand, these should be removed and cleaned. Also renew the boots if they are found to be in a deteriorated condition.
   Before fitting the guide pins to the anchor plate they are to be lubricated with Silicone grease (Dow Corning No. 44 Light).
5. Remove pads from anchor plate.
6. Press the piston by hand, evenly into the bore of the housing until the piston is fully bottomed. During this operation, brake fluid will be displaced and this should be discharged into a container via the bleed screw. Beware of air ingress during this operation. If necessary, completely bleed brakes after final assembly.
7. Clean the pad location faces and install new pads into the anchor plate. The pad with the hump on the backplate locates in the outer location.
8. Position the caliper housing over the disc pads. Ensure the pad springs are evenly located either side of the housing slot.
9. Fit new bolts to housing and tighten into guide pins. Torque to 30-34 Nm.
   The bolts have a prevailing torque thread feature (thread locking patch), therefore the guide pin heads will need to be restrained from rotating.
10. Depress the brake pedal several times to actuate the piston to bring the pad assemblies into position against the disc. Check the fluid level in the master cylinder supply tank — top up if necessary.


SBR016A


SBR772

Removal

Disconnect the brake hose from the caliper housing. Plug the exposed end of the hose to prevent ingress of dirt.

Remove caliper housing from anchor plate as outlined in Pad Replacement section (Steps 1, 2 and 4).

Withdraw guide pins and rubber boots from mounting bracket.

Disassembly

Place a suitable packing (e.g. block of soft wood or wad of cloth) between the outer end of the piston and housing outboard legs and apply air pressure at the brake hose port to eject the piston.

CAUTION

Apply light air pressure initially and progressively increase until piston is forced out of the bore. This precaution is advisable to avoid physical injury, as the piston may develop considerable force due to the air pressure.

Remove the rubber boot from the bore.

Using a small pointed wood or plastic tool, remove the piston seal from its groove in the caliper bore and discard, be careful to avoid damaging the seal groove.

Remove the bleeder screw.

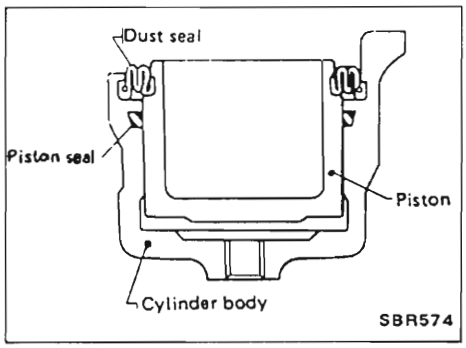
Inspection

Clean all metal parts thoroughly with methylated spirits. Use clean dry compressed air to dry off the parts.

Examine the bore and piston carefully for signs of damage, abrasion, scoring or corrosion.

Renew the piston if any of these factors exist, or if there is any doubt on its condition.

If the bore is unserviceable, a new housing must be fitted.



Assembly

Dip seal in clean brake fluid prior to insertion in the groove in the bore. Install the seal in the piston bore groove, ensuring the seal is not twisted and is fully seated in the groove.

Fit new boot into the outer groove of the bore, ensuring flange of boot is squarely and firmly seated in the groove.

Lubricate the outside diameter of the piston with clean brake fluid and install into the bore. Spread the boot over the piston as the piston is installed, taking care not to disturb the boot in the groove. Apply steady pressure by hand to the piston and press until the Piston is fully seated in the bore. Ensure the outer lip of the boot is located in the groove of the piston. Replace bleed screw.

Lubricate both guide pins with *Silicone grease. Fit new rubber dust covers over guide pins.

Refit caliper housing to anchor plate as detailed in Pad Replacement Section (Steps 7, 8 and 9).

Re-connect the brake hose with a new copper washer ensuring the hose is not twisted during fitting and tightening.

Bleed the system in the recommended manner with new unused brake fluid. After the system has been bled, **depress** the brake pedal several times to bring the pads into position against the disc. Then with load applied to the pedal, check all connections for leaks. Re-check the fluid in the master cylinder reservoir — top up if necessary.

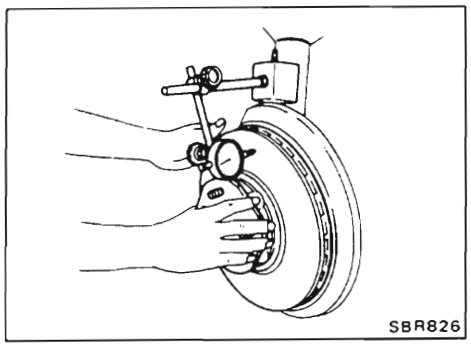
Re-fit road wheels and road test.

After road testing, jack each wheel clear of the ground and ensure wheels turn freely (i.e. calipers are not sticking).

Inspection

RUBBING SURFACE

Check rotor for roughness, cracks or chips.

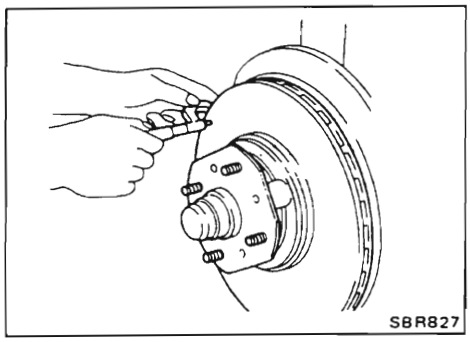

SBR826

RUNOUT

Make sure axle shaft has no axial end play. Then check runout with a dial gauge.

Rotor repair limit:

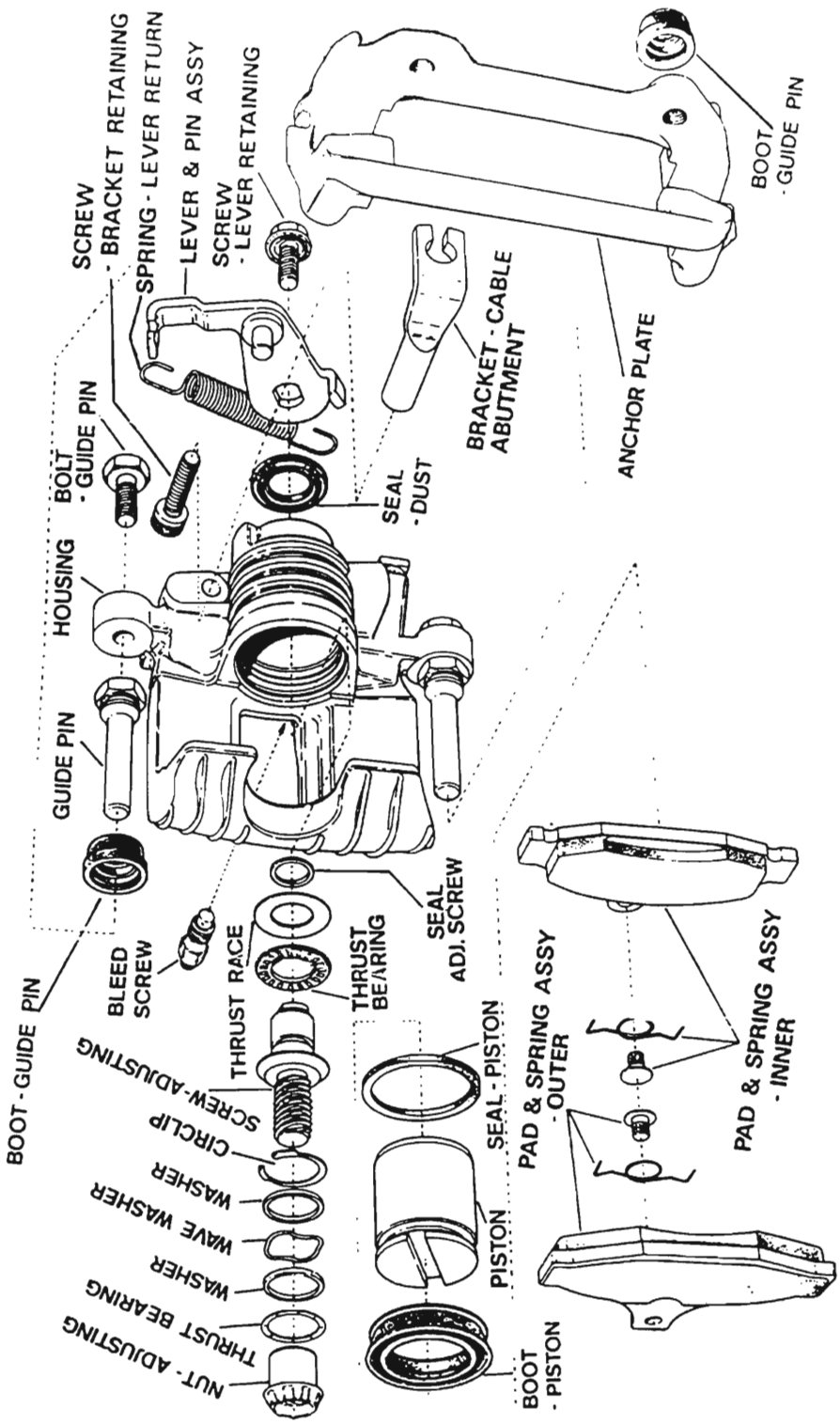
Maximum runout
(Total indicator reading at center of rotor pad contact surface)
0.07 mm (0.0028 in)

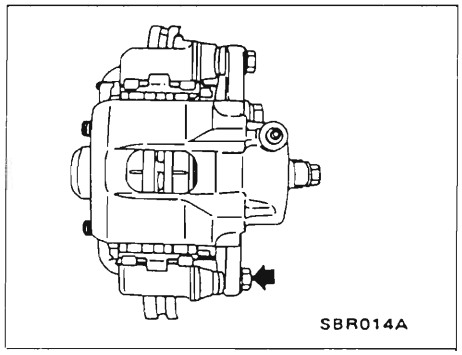

SBR827

THICKNESS

Rotor repair limit:

Minimum thickness
20.0 mm (0.787 in)


SCREW - BRACKET RETAINING
SPRING - LEVER RETURN
LEVER & PIN ASSY
SCREW - LEVER RETAINING
BOOT - GUIDE PIN
BOLT - GUIDE PIN
SEAL - DUST
BRACKET - CABLE ABUTMENT
ANCHOR PLATE
HOUSING
GUIDE PIN
BOOT - GUIDE PIN
BLEED SCREW
THRUST RACE
THRUST BEARING
SEAL ADJ. SCREW
SCREW-ADJUSTING
CIRCLIP
WASHER
WAVE WASHER
WASHER
THRUST BEARING
NUT - ADJUSTING
SEAL - PISTON
PISTON
BOOT - PISTON
PAD & SPRING ASSY - OUTER
PAD & SPRING ASSY - INNER



Pad Replacement

With vehicle raised evenly on a hoist or jack stands, remove the road wheels.

NOTE: IT IS NOT NECESSARY TO DISCONNECT THE HYDRAULIC BRAKE HOSE OR HAND BRAKE CABLE.

Remove the two housing retaining bolts from housing and guide pins. These bolts should be discarded and not re-used.

Check the guide pins for freedom of movement, also the condition of the rubber boots. If the guide pins cannot be moved freely by hand, these should be removed and cleaned. Also renew the boots if they are found to be in a deteriorated condition.

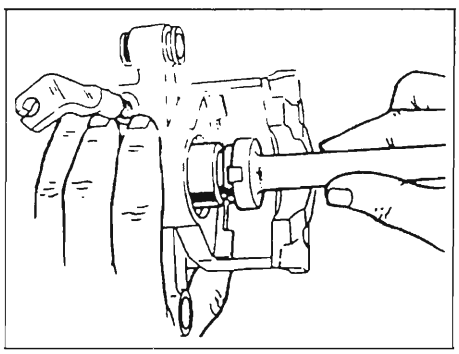
Before fitting the guide pins to the anchor plate they are to be lubricated with *Silicone Grease.

Lift the caliper housing and pads out of the anchor plate and off the disc.

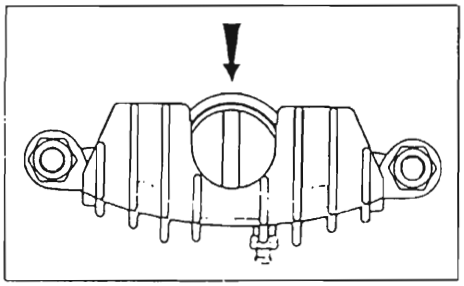
Do not allow caliper housing to hang from hydraulic brake hose.

Remove by hand inner and outer pads from caliper housing.

Inspect caliper assembly for fluid leaks or damage. If leak is evident or caliper damaged, service caliper. Refer section:— Caliper Overhaul.

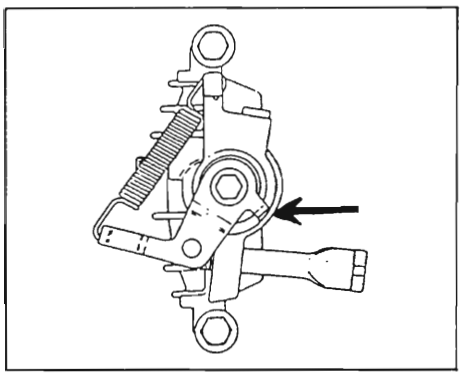


Using special tool E7109 located in end of piston and engaged in piston slot, screw piston into bore by turning clockwise for a left hand caliper and anti-clockwise for a right hand caliper until piston bottoms in caliper. During this operation, brake fluid will be displaced and this should be discharged into a container via the bleed screw. Beware of air ingress during this operation. If necessary, completely bleed brakes after final assembly.



Continue to turn piston in same direction to exactly align piston slot to body.

Clean pad location face, then position inner pad between disc and anchor plate.
Clean outer pad location face and inside of legs of alloy housing. Then install outer pad between disc and anchor plate.
Carefully install caliper housing over disc until pads locate fully between housing and anchor plate, ensuring the lug on the inner pad locates in the piston slot correctly.



Be sure to check the springs on top of the pads are evenly located either side of the housing slot.
Assemble new housing retaining bolts (24) and tighten to 30-34 Nm.
Check that caliper park brake cable levers are fully back against caliper stops, if not, loosen cable adjustment, then with engine running, firmly depress brake pedal to adjust pads to disc.
Re-adjust park brake cable if necessary as outlined in Park Brake Cable Adjustment Procedure.
Check master cylinder fluid level and top up if necessary with clean brake fluid.
Replace road wheels.

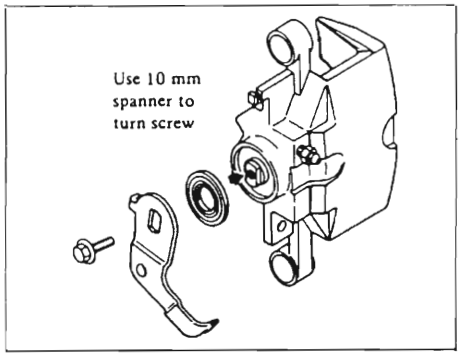
Caliper Overhaul

It is not necessary to remove the anchor plate from the vehicle to overhaul the caliper.

Disconnect hydraulic brake hose and park brake cable from caliper housing.

Remove caliper housing from anchor plate as outlined in section PAD REPLACEMENT.

Remove both guide pins and dust boots from anchor plate.

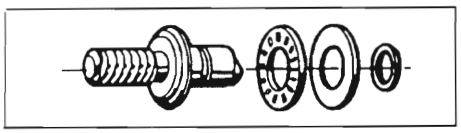


Detach return spring from lever and caliper housing.

Disassemble the park brake lever retaining screw lever and rubber seal from end of adjusting screw. Using a 10 mm open ended spanner fitted to the two flats on end of adjusting screw, remove piston from caliper body through the piston boot by winding the adjusting screw clockwise for R.H. caliper and anti-clockwise for L.H. caliper.

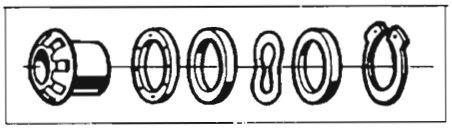
Remove boot from caliper body.

Using a small pointed wood or plastic tool, remove the piston seal from its groove in the caliper bore and discard, be careful to avoid damaging the seal groove.



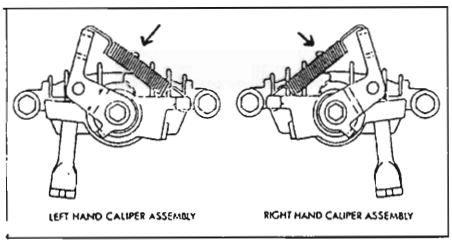
Remove adjusting screw, thrust bearing and thrust race washer from caliper body and discard the adjusting screw square section rubber seal.

NOTE: The adjusting screw, adjuster nut lever and caliper housing are handed, keep together to ensure correct assembly.



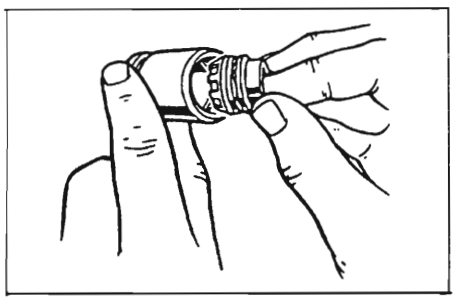
Remove the circlip from inside the piston and shake out the two washers spring wave washer thrust race and adjusting nut.

Wash all parts with methylated spirits and dry with compressed air or lint free cloth.
Using compressed air, blow out the housing bore and all drilled passages.
Inspect the piston for scoring, pitting, corrosion or areas where the chrome plating is worn off. If any damage is present replace the piston, black stains, if they are caused by the seal, will do no harm.
Inspect the caliper housing main bore for scoring, pitting, corrosion or damage and replace housing if any of the above factors exist.
If light scuff marking exists on the piston or in the housing bore, lightly rub down by hand those areas with 600 "wet and dry" paper and thoroughly clean parts with methylated spirits. HOUSING BORE MUST NOT BE HONED.
Inspect all other internal components and replace if damaged or wear exists.



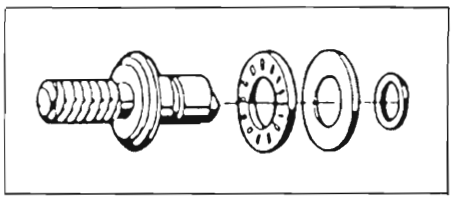
NOTE: The caliper housings, levers, adjusting screws and adjuster nuts are handed — check for the following before assembly.

1. The right hand caliper adjusting screw has a left hand adjusting thread.
2. The left hand caliper adjusting screw has a right hand adjusting thread.
3. Correct lever relationship to bleeder screw in caliper body.

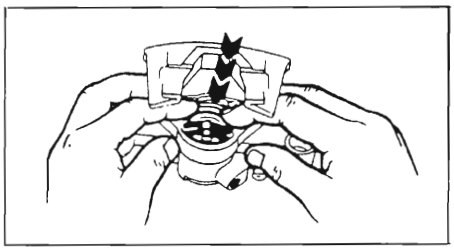


Assemble the thrust race, washer, spring wave washer and second washer onto the adjuster nut and carefully position this sub-assembly in the main piston.
Fit circlip into position to retain adjuster nut etc., ensuring it is securely seated in groove.

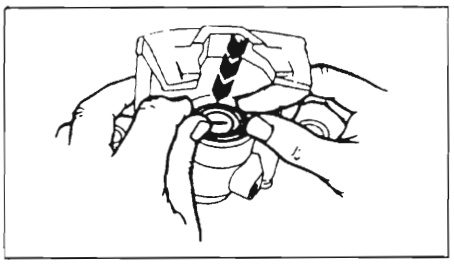
To check for correct piston assembly installation and operation, fit adjusting screw into the adjuster nut, and holding adjusting screw in one hand and piston in the other hand, both parts should pull apart with only the adjuster nut rotating.



Assemble thrust bearing onto the adjusting screw, followed by the thrust race washer.
Install a new square section seal into the groove in adjusting screw being careful to avoid damage or twists. Fit adjusting screw into piston.

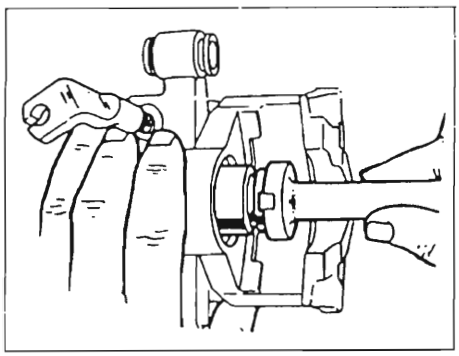


Dip the new piston seal in clean brake fluid and install the seal in the piston bore groove and gently work around the bore with finger until properly seated. Check to ensure that the seal is not twisted or rolled in its groove.
Liberally coat the piston and adjusting screw bore of the housing with clean brake fluid.

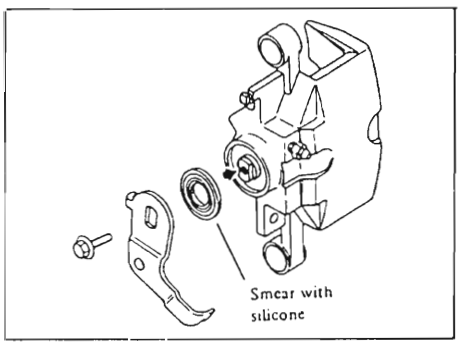


Fit new boot into the outer groove of the bore, ensuring flange of boot is firmly seated in the groove.

Lubricate the outside diameter of the piston/adjuster assembly with clean brake fluid and proceed to install into the bore. Spread boot over the piston as the piston is inserted into the bore. Carefully enter adjusting screw shank through bore in end of housing.
NOTE: The need for excessive force to assemble the adjusting screw into the bore will result in a damaged square section seal.
Apply steady pressure by hand to the piston and press until the piston is fully seated in the bore. Ensure the outer lip of the boot is located in the groove of the piston.



After the piston bottoms in caliper bore, screw the adjusting screw fully home by turning the piston clockwise for left hand caliper and anti-clockwise for a right hand caliper, with the special tool located in the slot provided in the piston. Prevent adjusting screw turning with a 10 mm spanner on flats. Align the piston slot to caliper body (See page BR 19).



Smear the park brake lever dust seal with *Silicone grease and install it over the end of the adjusting screw against the caliper housing.

Position correct handed lever over the flats on end of adjusting screw and secure with lever retaining screw. Torque 24-30 Nm.
Operate lever and check for smooth firm rotation of adjusting screw in caliper housing.
Install return spring onto caliper housing and lever.
Lubricate both guide pins with *Silicone Grease. Fit new guide pin boots over guide pins.
Insert guide pins into anchor plate then fit rubber boots correctly to guide pin grooves and anchor plate.

Install caliper housing as detailed in Pad Replacement Section — Page BR-19.
Re-connect the brake hose, ensuring the hose is not twisted during fitting and tightening.

*Dow Corning No 44 light or equivalent.

Bleed the system in the recommended manner with clean unused brake fluid. After the system has been bled, depress the brake pedal several times to bring the pads into position against the disc. Then with load applied to the pedal check all connections for leaks. Re-check the fluid in the master cylinder reservoir — top up if necessary.

Re-connect park brake cable. Check that park brake levers are fully back against caliper stops. If not, re-adjust park brake cable as outlined in park brake cable adjustment procedure.

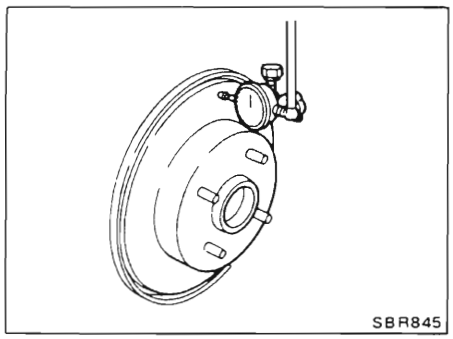
Replace road wheels and road test.

After road testing, jack each wheel clear of ground and ensure wheels turn freely (i.e. calipers are not sticking).

Inspection

RUBBING SURFACE

Check rotor for roughness, cracks or chips. Repair or replace if necessary.


SBR845

RUNOUT

Make sure that axial end play is within the specifications before measuring. Refer to section RA.

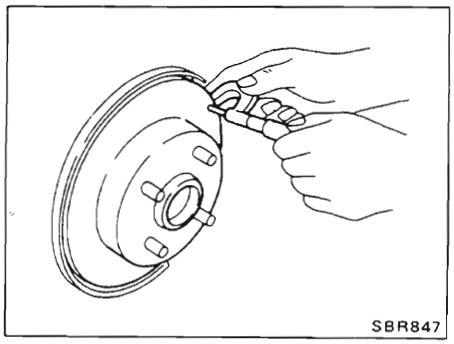
Then check runout with a dial gauge.

Rotor repair limit

Maximum runout

(Total indicator reading at center of rotor pad contact surface)

0.07 mm (0.0028 in)

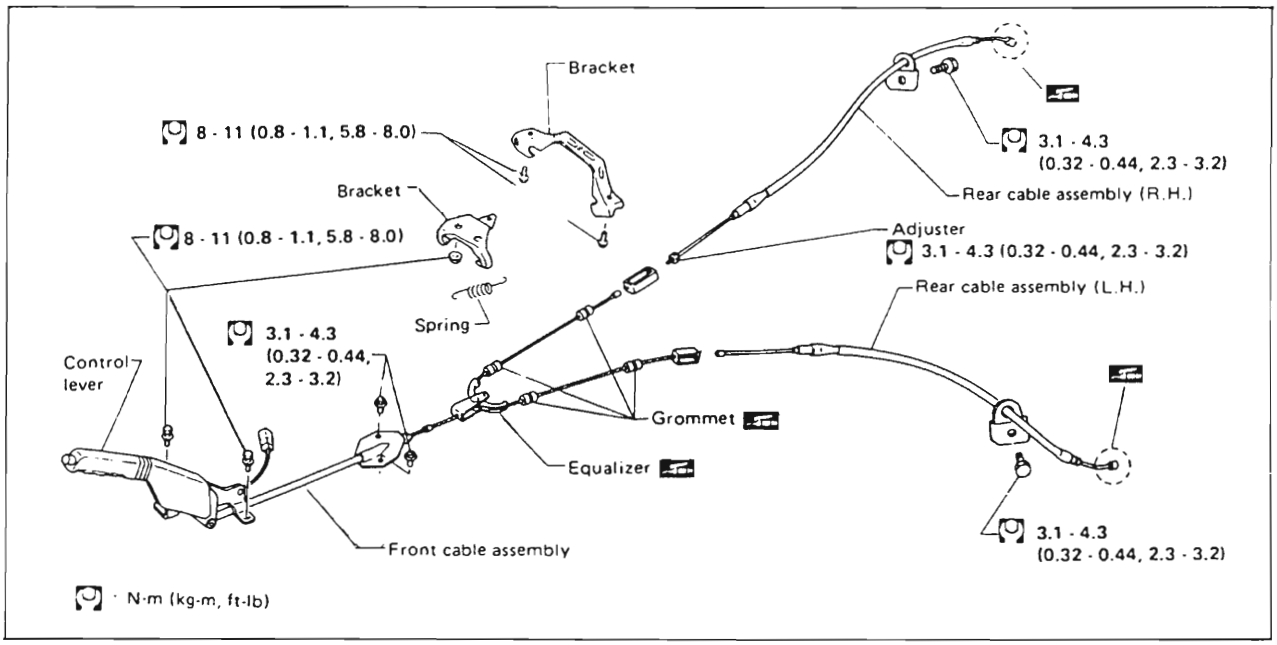

SBR847

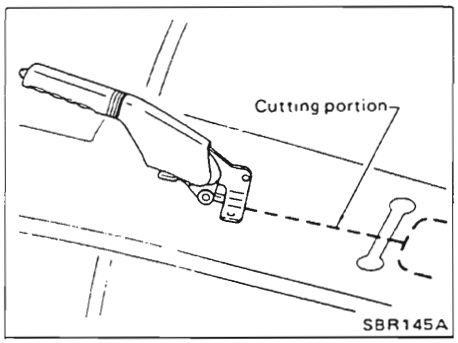
THICKNESS

Rotor repair limit:

Minimum thickness

9.4 mm (0.370 in)





Removal and Installation

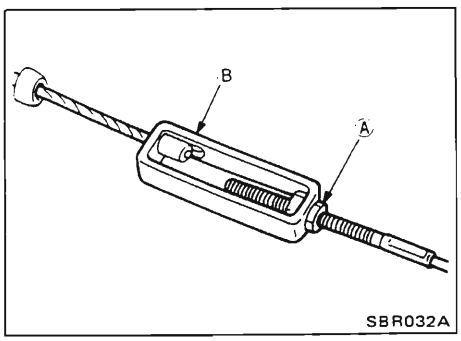
- To replace parking brake cable, cut carpet at the area shown at left.

Inspection

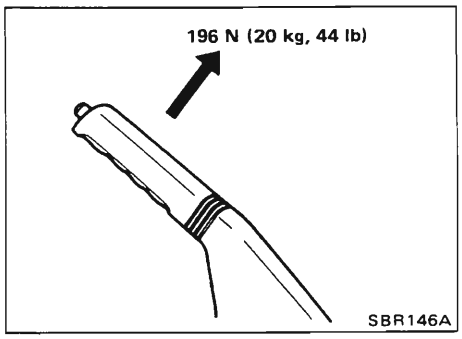
1. Check control lever for wear or other damage. Replace if necessary.
2. Check wires for discontinuity or deterioration. Replace if necessary.
3. Check warning lamp and switch. Replace if necessary.
4. Check parts at each connecting portion and, if found deformed or damaged, replace.

Adjustment

Before adjusting control lever stroke, ensure the caliper park brake levers are resting against their stops. If they are not, **slacken** the cable (using the adjuster) and then depress the brake pedal firmly before carrying out the adjustment.



1. Loosen lock nut Ⓐ, rotate adjuster Ⓑ until the lever stroke is between 7-9 notches.



2. Tighten lock nut.

3. Bend parking brake warning lamp switch plate so that brake warning light comes on when ratchet at parking brake lever is pulled "A" notches and goes out when fully released.
   Number of notches "A": 2.

General Specifications

Front brake Brake model	Girlock Colette
Pad Width x thickness x length mm (in)	43 x 11 x 129 (1.69 x 0.43 x 5.08)
Rotor outer diameter mm (in)	250 (9.84)
Caliper inner diameter mm (in)	54.0 (2.126)
Rear brake Brake model	Girlock Colette
Lining/Pad Width x thickness x length mm (in)	32 × 7.5 × 108 (1.26 × 0.29 × 4.25)
Drum inner diameter/ Rotor outer diameter mm (in)	260 (10.24)
Caliper inner diameter mm (in)	38.0 (1.50)
Master cylinder Inner diameter mm (in)	22.2 (0.875)
Brake booster Model	ISOVAC VH5527
Diaphragm diameter mm (in)	230 (9.06)
Recommended brake fluid	As specified on master cyl. reservoir cap.
Control valve Type	Proportioning valve (within master cylinder)
Reducing ratio	0.45
Split point kPa (bar, kg/cm^2, psi)	3044 (30.4, 31, 441)

Inspection and Adjustment

BRAKE PEDAL

Free height "H" mm (in)	190.5 - 200.5 (7.50 - 7.89)
Depressed height [Under force of 490 N (50 kg, 110 lb) with engine running] mm (in)	
Clearance between pedal stopper and threaded end of stop lamp switch mm (in)	0.3 - 1.0 (0.012 - 0.039)
Clearance between pedal stopper and threaded end of A.S.C.D. switch mm (in)	0.3 - 1.0 (0.012 - 0.039)
Pedal free play mm (in)	1 - 3 (0.04 - 0.12)

PARKING BRAKE

Number of notches when warning lamp switch comes on	2
Number of notches [When pulled under force of 196 N (20 kg, 44 lb)]	7 - 9

DISC BRAKE

Brake model	Front brake	Rear brake
Pad replacement limit		
Minimum thickness mm (in)	3.0 (0.118)	3.0 (0.118)
Rotor repair limit		
Maximum runout mm (in)	0.07 (0.0028)	0.07 (0.0028)
New thickness mm (in)	22.0 (0.866)	10.0 (0.394)
Minimum thickness mm (in)	20.0 (0.787)	9.4 (0.370)

Tightening Torque

Item	N·m	kg·m	ft·lb
Brake pedal			
Pedal bracket to body	8 - 11	0.8 - 1.1	5.8 - 8.0
Stop lamp switch lock nut	12 - 15	1.2 - 1.5	9 - 11
Brake booster			
Brake booster to body	8 - 11	0.8 - 1.1	5.8 - 8.0
Input rod lock nut	16 - 22	1.6 - 2.2	12 - 16
Brake booster to master cylinder	8 - 11	0.8 - 1.1	5.8 - 8.0
Three-way connector			
Three-way connector to brake tube	17 - 20	1.7 - 2.0	12 - 14
Three-way connector mounting bolt	20 - 27	2.0 - 2.8	14 - 20
Brake tube flare nut	15 - 18	1.5 - 1.8	11 - 13
Wheel cylinder air bleeder	7 - 9	0.7 - 0.9	5.1 - 6.5
Front disc brake			
Eye bolt	17 - 20	1.7 - 2.0	12 - 14
Torque member fixing bolt	72 - 97	7.3 - 9.9	53 - 72
Torque member to cylinder body	22 - 31	2.2 - 3.2	16 - 23
Baffle plate fixing bolt	3.1 - 4.3	0.32 - 0.44	2.3 - 3.2
Rear disc brake			
Caliper fixing bolt	38 - 52	3.9 - 5.3	28 - 38
Torque member to cylinder body	31 - 41	3.2 - 4.2	23 - 30
Eye bolt	17 - 20	1.7 - 2.0	12 - 14
Rear drum brake			
Wheel cylinder to back plate	6 - 8	0.6 - 0.8	4.3 - 5.8
Back plate fixing nut	22 - 26	2.2 - 2.7	16 - 20
Parking brake			
Control lever to body	8 - 11	0.8 - 1.1	5.8 - 8.0
Adjuster lock nut	3.1 - 4.3	0.32 - 0.44	2.3 - 3.2
Front cable clamp to body	3.1 - 4.3	0.32 - 0.44	2.3 - 3.2

STEERING SYSTEM

CONTENTS

PRECAUTION ..... ST- 2
PREPARATION ..... ST- 3
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ON-VEHICLE INSPECTION ..... ST- 6
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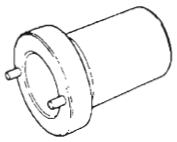
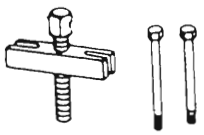
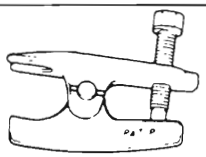
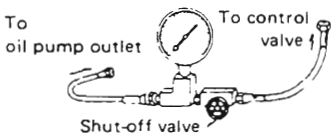
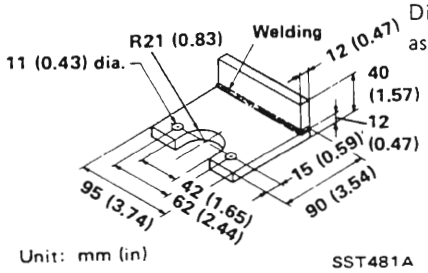
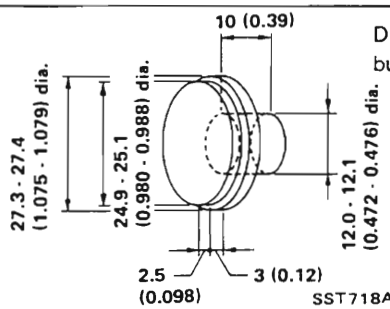
MANUAL STEERING GEAR AND LINKAGE ST-15
POWER STEERING GEAR AND LINKAGE (PR25P) ST-20
POWER STEERING GEAR AND LINKAGE (TRW) ST-33
POWER STEERING PUMP ST-37
SERVICE DATA AND SPECIFICATIONS ST-42

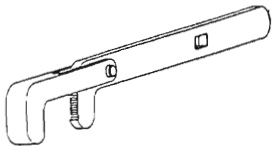
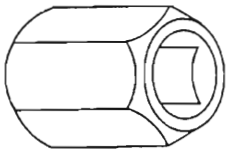
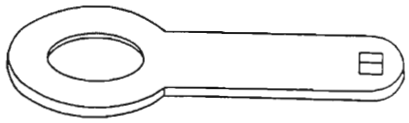
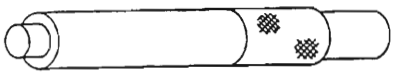
- Before disassembly, thoroughly clean the outside of the unit.
- Disassembly should be done in a clean work area. It is important to prevent the internal parts from becoming contaminated by dirt or other foreign matter.
- When disassembling parts, be sure to place them in order in parts rack so they can be put back in the unit in their proper positions.
- Use a nylon cloth or paper towel for wiping parts clean. Common shop rags can leave lint that might interfere with the operation.
- All parts should be carefully cleaned with a general purpose, non-flammable solvent before inspection or reassembly.
- Before assembly, apply a coat of recommended A.T.F. to hydraulic parts. Vaseline may be applied to O-rings and seals.
- Gaskets, seals, and O-rings should be replaced. Care should be taken to avoid damaging O-rings, seals and gaskets when assembling. It is also very important to perform functional tests whenever it is designated.

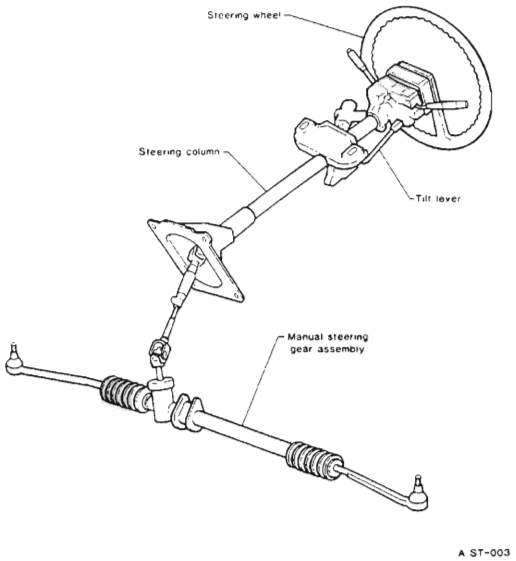
SPECIAL SERVICE TOOLS

*: Special tool or a commercial equivalent

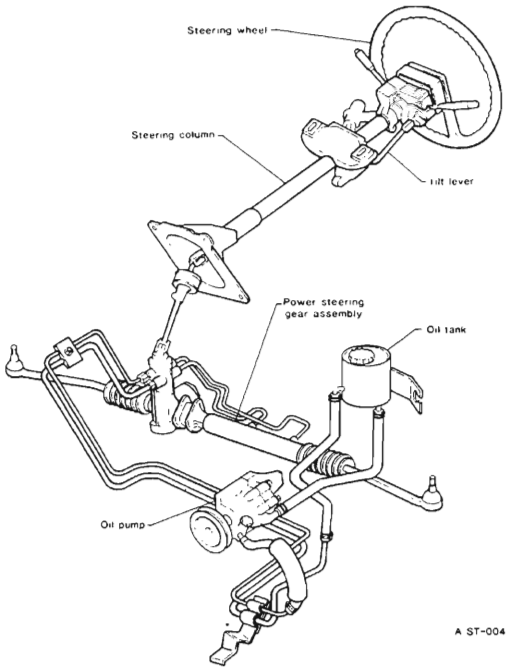
Tool Number Tool Name	Description		Application	Source
E7134 Torque adapter		Measuring pinion rotating torque	PR25P Power Steering	Litchfield
E7135 End cover socket		Removing and installing end cover	PR25P Power Steering	Litchfield
E7124* Steering wheel puller		Removing and installing steering wheel	All	Litchfield
E2237* Ball joint remover		Removing ball joint	All	Litchfield
E7125 Pressure gauge		Measuring oil pressure	All Power Steering	Litchfield
Oil pump attachment		Disassembling and assembling oil pump	All Power Steering	
Oil seal drift adapter		Disassembling center rack bushing and rack packing	PR25P Power Steering	

SPECIAL SERVICE TOOLS (cont.)

Tool Number Tool Name	Description	Application	Source
E8802-6 Ball joint wrench	 Inner ball joint removal and installation	All TRW steering racks	Litchfield
E7110-1 Pinion plug socket	 Pinion plug removal and installation	TRW manual rack	Litchfield
E8802-1 Yoke plug socket	 Yoke plug removal and installation	All TRW steering racks	Litchfield
E8802-2 Lock nut spanner	 Yoke plug lock nut	All TRW steering racks	Litchfield
E7110-2 Press tool	 Pinion lower bearing removal and installation	TRW manual rack	Litchfield



Manual steering system



Power steering system

Checking Steering Wheel Play

- Place wheels in a straight ahead position and check steering wheel play.

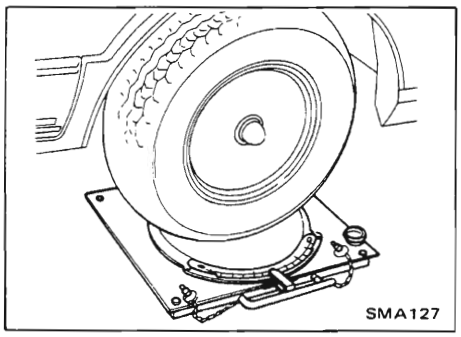
  Steering wheel play:

  35 mm (1.38 in) or less

- If it is not within specification, check tie-rod outer and inner ball joints and/or pinion & rack assembly.

Checking Neutral Position on Steering Wheel

- Check that the steering wheel is in the neutral position when driving straight ahead.
- If it is not in the neutral position, remove the steering wheel and re-install it correctly in the neutral position.
- If the neutral position is between two steering wheel splines, loosen tie-rod lock nut and move tie-rod in the opposite direction by the same amount on both left and right sides to compensate for error in the neutral position.


SMA127

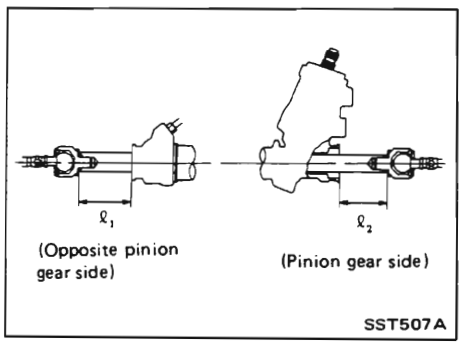
Front Wheel Turning Angle

- Rotate steering wheel all the way right and left; measure turning angle on inner wheel.

  Turning angle:

  Full turns and toe-out turn

  Refer to FA for S.D.S.

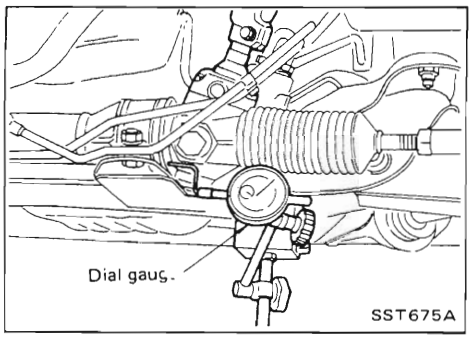


SST507A

- If it is not within specification, check rack stroke.

  Measure length "ℓ_1 & ℓ_2":

  Refer to S.D.S.



Checking Gear Housing Movement

- Movement of steering gear housing in stationary steering is attributable to elastic deformation of mount insulator. The maximum allowable movement is as follows:

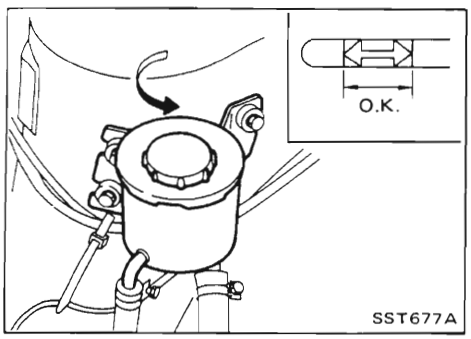
  Movement of gear housing:
  3 mm (0.12 in) (on dry paved surface) or less

Note:
When a force of 49 N (5 kg, 11 lb) is applied to steering wheel. On models equipped with power steering, turn off ignition key while checking.

- If movement exceeds the limit, replace mount insulator after confirming proper installation of gear housing clamps.

Checking and Adjusting Drive Belts (Power Steering)

Refer to MA section for Checking and Adjusting Drive Belts.



Fluid Level Check (Power Steering)

Check the fluid level when the fluid is cold.

CAUTION:

- Do not overfill.
- **Recommended fluid is Automatic Transmission Fluid "Dexron II®".**

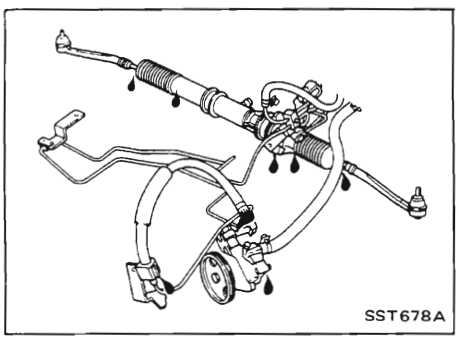
Bleeding Hydraulic System (Power Steering)

1. Raise front end of vehicle until wheels clear ground.
2. While adding fluid, quickly turn steering wheel fully to right and left and lightly touch steering stoppers.
   Repeat steering wheel operation until fluid level no longer decreases.
3. Start engine.
   Repeat step 2 above.

- Imcomplete air bleeding will cause the following to occur. When this happens, bleed air again.

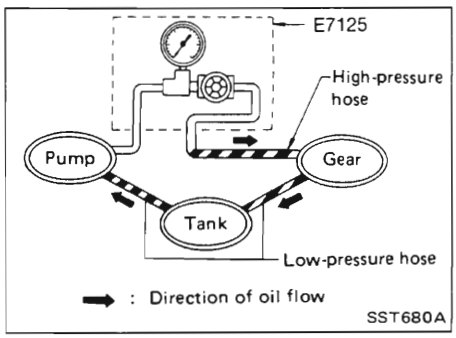
① Generation of air bubbles in reservoir tank
② Generation of clicking noise in oil pump
③ Excessive buzzing in oil pump

In steering while the vehicle is stationary, or when moving wheel slowly, fluid noise may be caused in the valve or oil pump. This type of fluid noise is inherent in an integral power steering system, and it will not affect performance or durability of the system.



Checking Fluid Leakage (Power Steering)

Check lines for proper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.



Hydraulic System Check (Power Steering)

Before starting, check belt tension, driving pulley and tire pressure.

1. Set Tool. Open shut-off valve. Then bleed air. (See "Bleeding Hydraulic System".)
   Run engine and warm up fluid temperature in oil tank to 60 to 80°C (140 to 176°F).

WARNING:

Warm up engine with shut-off valve fully opened. If engine is started with shut-off valve closed, oil pressure in oil pump will increase to relief pressure, resulting in an abnormal rise in oil temperature.

2. Check pressure with steering wheel fully turned in left and right.

CAUTION:

Do not hold steering wheel at lock position for more than fifteen seconds.

Oil pump maximum pressure:
6,865 kPa
(68.6 bar, 70 kg/cm², 995 psi) at idling

3. If oil pressure is beyond the standard, slowly close shut-off valve and check pressure.

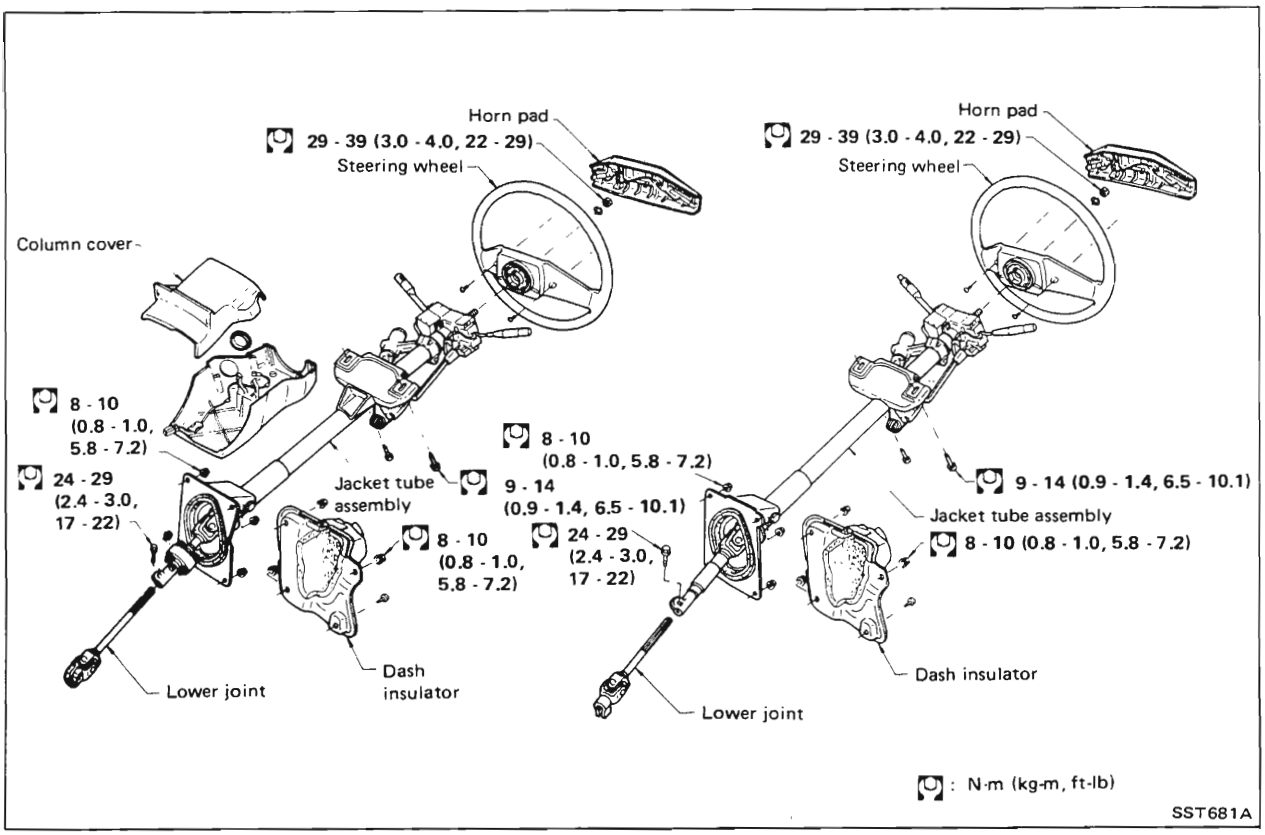
- When pressure becomes standard, gear is damaged.
- When pressure remains beyond standard, pump is damaged.

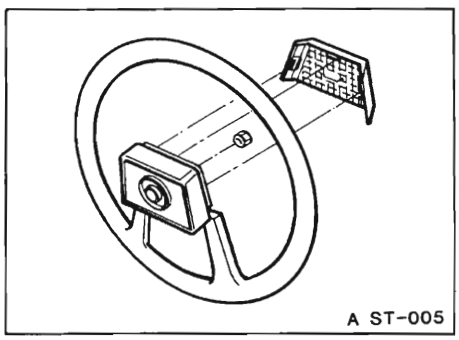
CAUTION:

Do not close shut-off valve for more than fifteen seconds.

4. After checking hydraulic system, remove Tool and add fluid as necessary, then completely bleed air out of system.

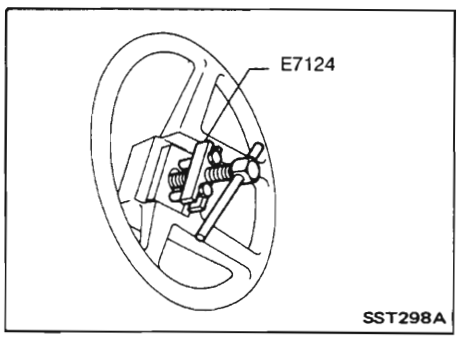
Removal and Installation





STEERING WHEEL

- Unclip steering wheel cover.



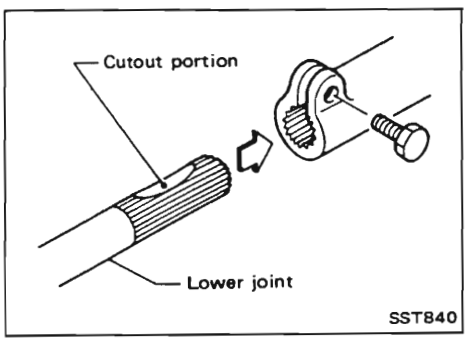
- Remove steering wheel with Tool.

Removal and Installation (Cont'd)

- When installing steering wheel, apply molybdenum grease to entire surface of turn signal cancel pin (both portions) and also to horn contact slip ring.

STEERING COLUMN

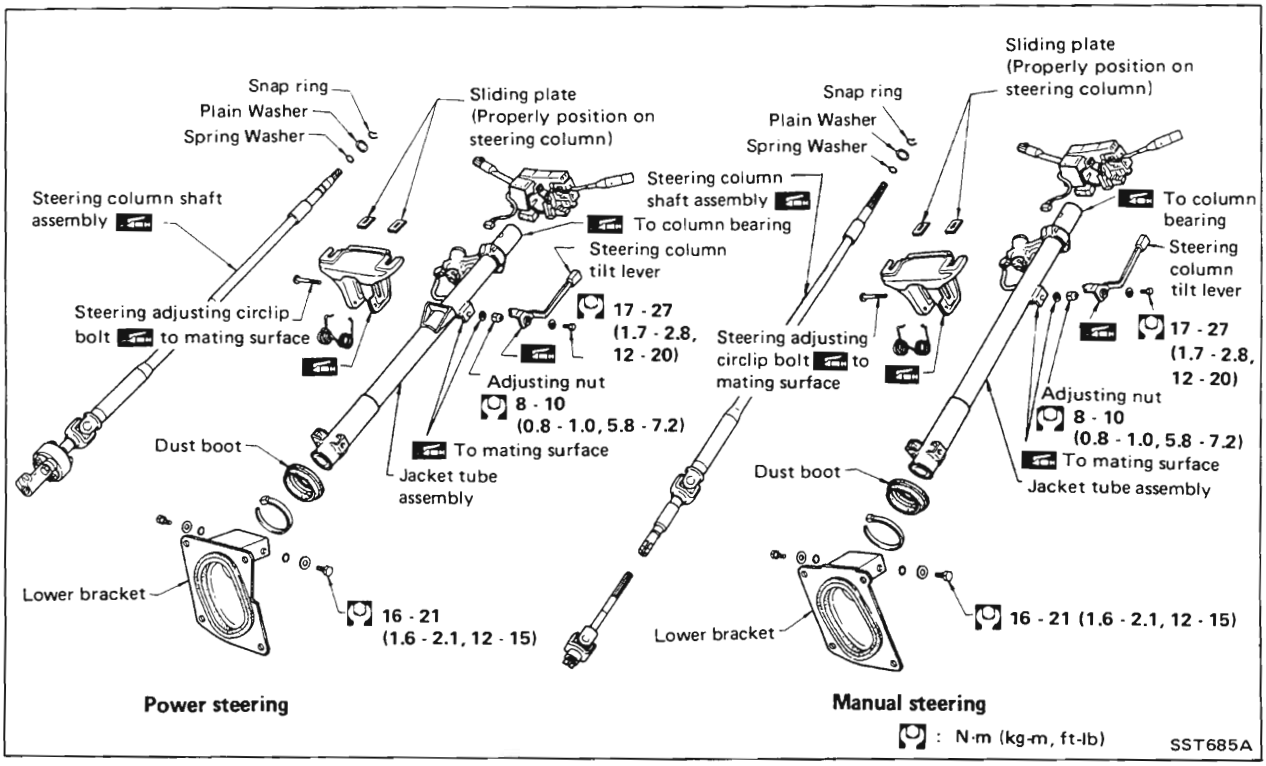
- When installing steering column, loosely tighten all lower bracket and clamp retaining bolts; then retighten them securely. Make sure that undue stress is not applied to steering column.

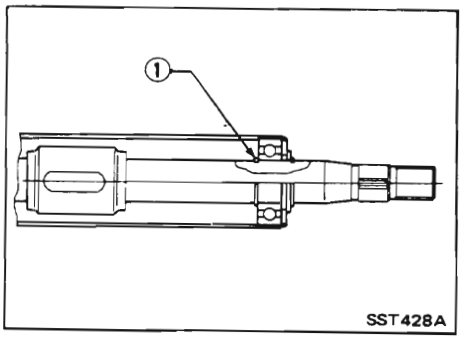


- When fitting steering lower joint, be sure tightening bolt faces cutout portion perfectly.

- After installing steering column, turn steering wheel to make sure it moves smoothly and that the number of turns from the straight forward position to left and right locks are equal.

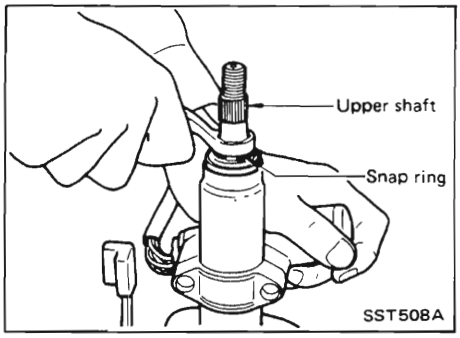
Disassembly and Assembly



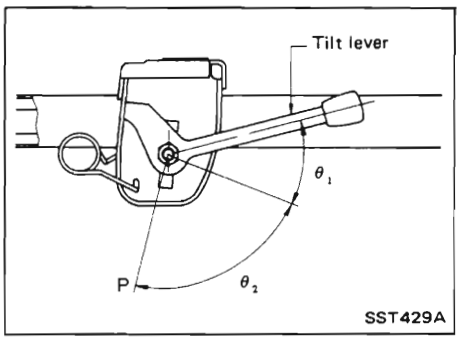


- While disassembling and assembling unlock steering lock with a key.
- Ensure that rounded surface of snap ring faces toward bearing when snap ring is installed.
- Install snap ring ① before inserting shaft into jacket tube.

Disassembly and Assembly (Cont'd)



- Install snap ring on upper shaft with box wrench.



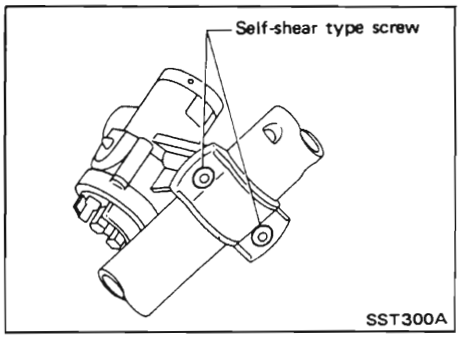
- Adjust tilt lever as follows.

(1) Adjust tilt lever to 13° to 17° (θ_1). Tighten adjusting bolt to specification.

: 8 - 10 N·m
(0.8 - 1.0 kg-m, 5.8 - 7.2 ft-lb)

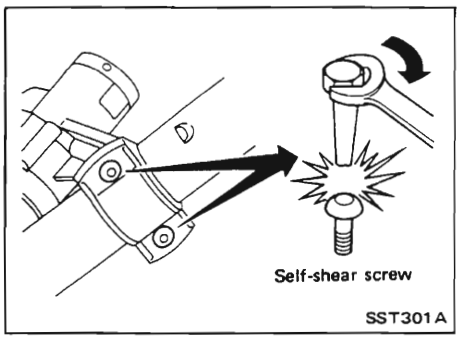
(2) Turn tilt lever by 80° (θ_2) in direction P to make sure steering column moves smoothly without binds.

(3) Return tilt lever to position θ_1. Make sure there is no free play (=0) of steering column when steering wheel is pushed down by force.

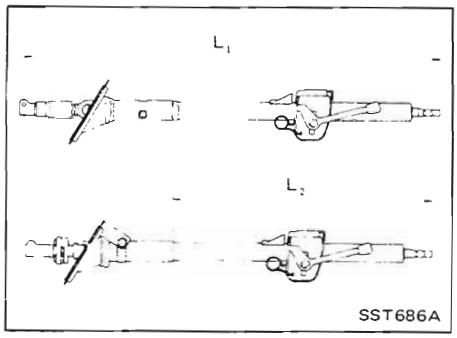


- Steering lock

a) Break self-shear type screws with a drill or other appropriate tool.



b) Install self-shear type screws and then cut off self-shear type screw heads.



Inspection

- When steering wheel can not be rotated smoothly, check the steering column for the following matters and replace damaged parts.

(1) Check column bearings for damage or unevenness. Lubricate with recommended multipurpose grease or replace with a new one as a steering column assembly, if necessary.

(2) Check jacket tube for deformation or breakage. Replace if necessary.

- When the vehicle comes into light collision, check dimension. If it is not within specifications, replace steering column as an assembly.

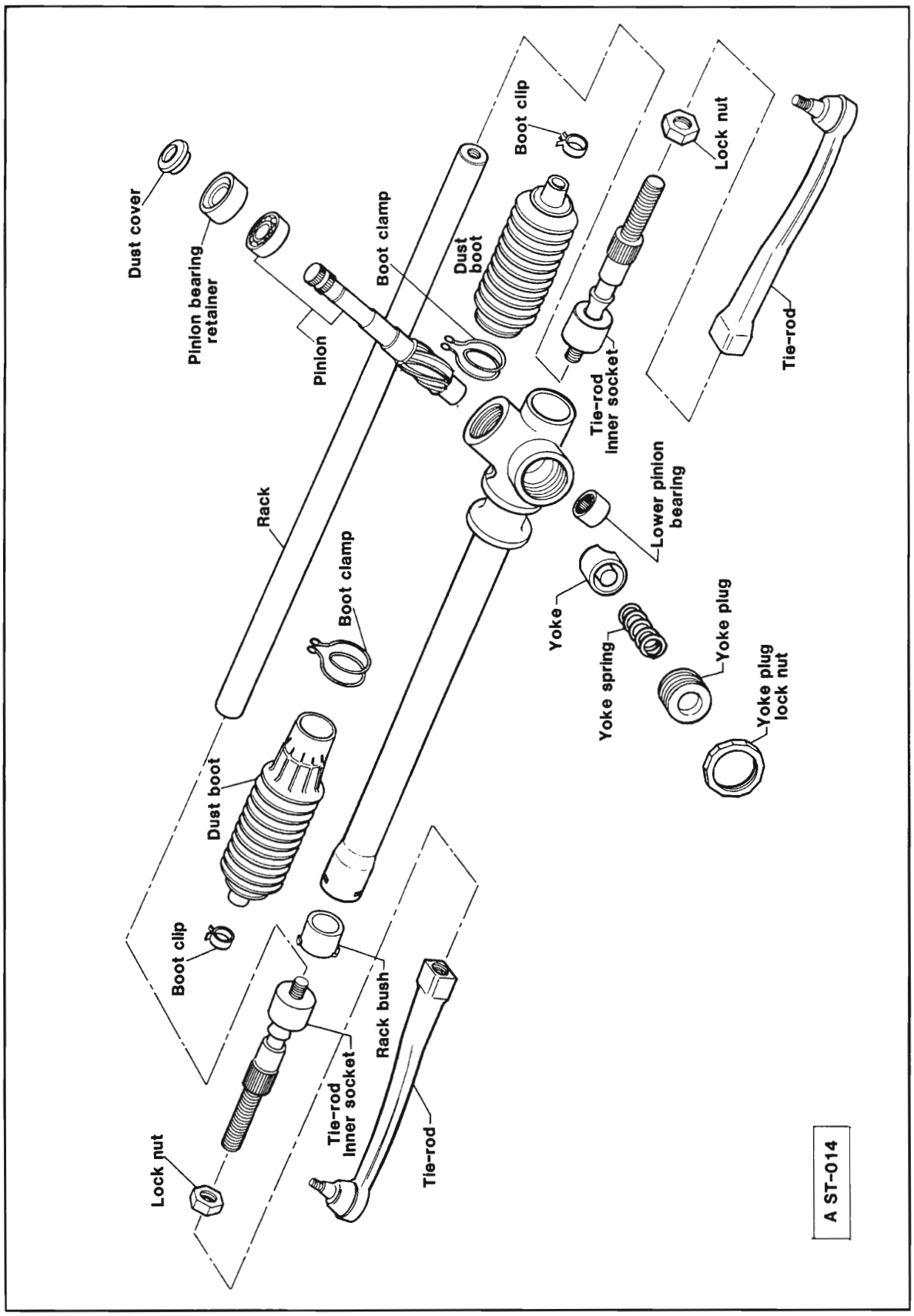
Column length "L_1 & L_2":

Manual steering: L_1

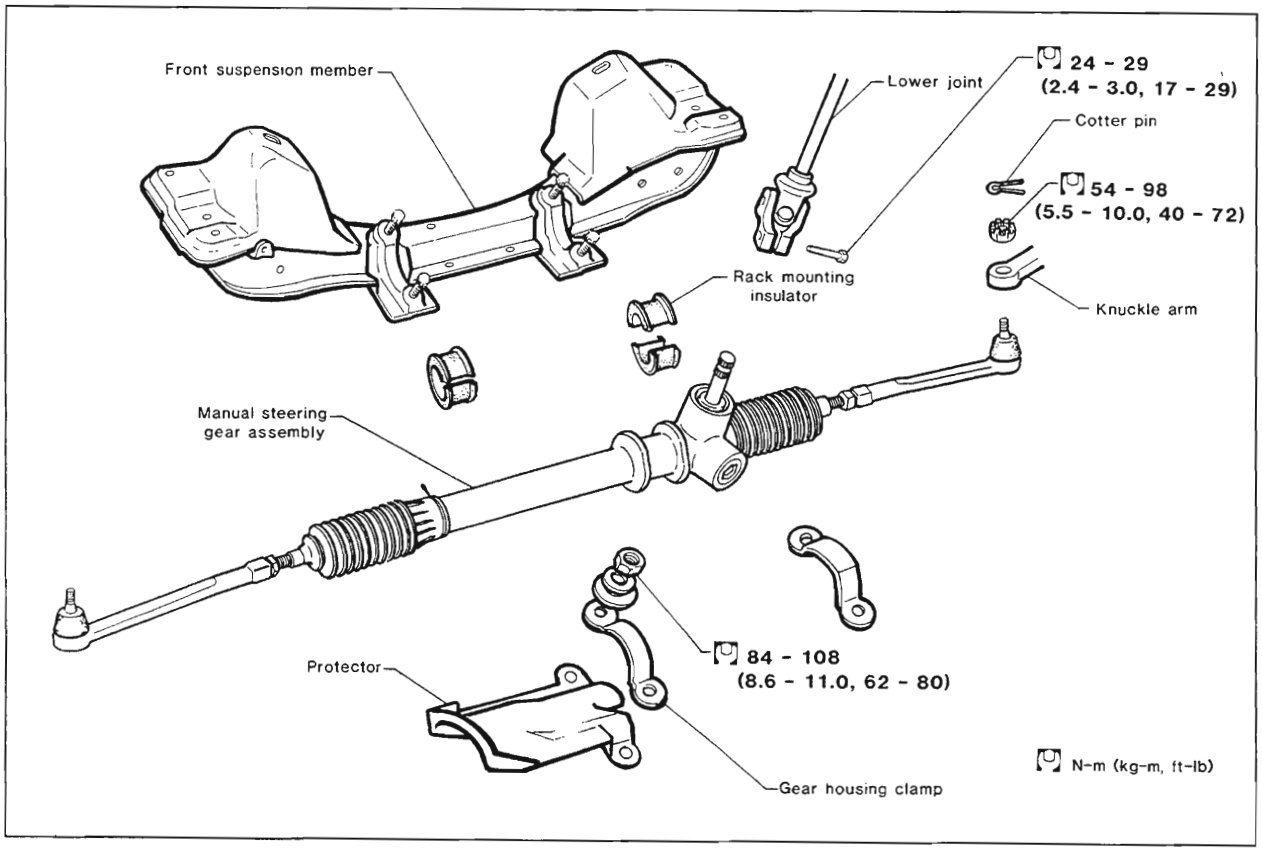
905.7 - 909.3 mm (35.66 - 35.80 in)

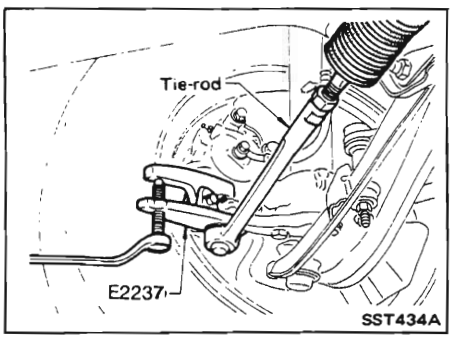
Power steering: L_2

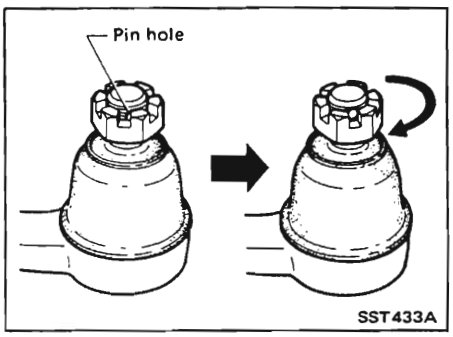
882.7 - 886.3 mm (34.75 - 34.89 in)


Dust cover
Pinion bearing retainer
Pinion
Boot clamp
Dust boot
Boot clip
Lock nut
Tie-rod
Tie-rod inner socket
Lower pinion bearing
Rack
Boot clamp
Yoke
Yoke spring
Yoke plug
Yoke plug lock nut
Dust boot
Boot clip
Rack bush
Tie-rod inner socket
Tie-rod
Lock nut
A ST-014

Removal and Installation







Removal

- Detach tie-rod ball studs from knuckle arms with Tool.

Installation

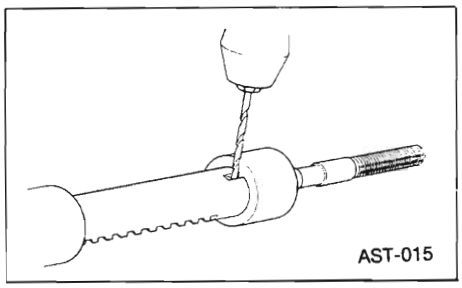
- Initially, tighten nut on tie-rod outer socket and knuckle arm to 54 to 59 Nm (5.5 to 6.0 kg-m, 40 to 43 ft-lb).
- Tighten nut further to align nut groove with the first pin hole so cotter pin can be installed.

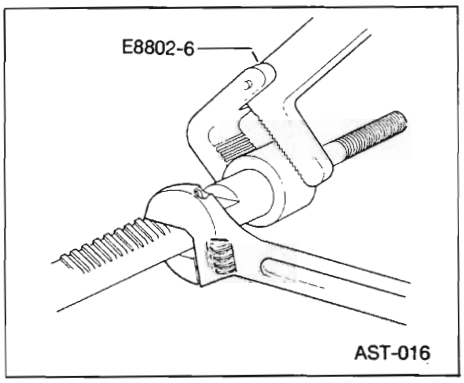
CAUTION:

Tightening torque must not exceed 98 N·m (10 kg-m, 72 ft-lb).

Disassembly

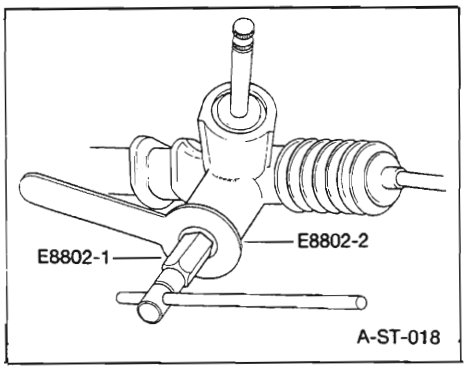
1. Clean all dirt and foreign matter from exterior of steering gear.
2. Clamp steering gear in a soft jawed vice or suitable fixture.
3. Loosen tie rod locknuts and remove outer tie rod ends.
4. Remove clips and boots (discard both).
5. Drill crimping in rack end adjacent to each ball housing with a 4 mm drill to a depth sufficient to break the crimping.



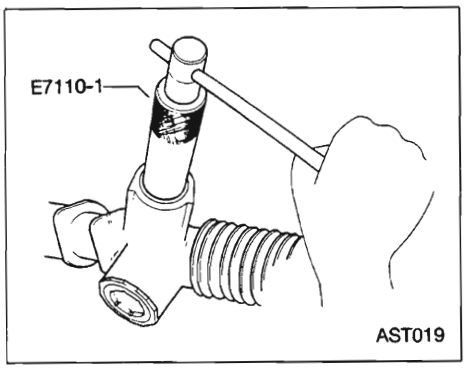


6. Remove inner ball joint assemblies using special tool (Litchfield No E8802-6).

CAUTION: When removing ball housings, use an adjustable wrench on the flat teeth of the rack to prevent rotation and possible damage to the rack or pinion teeth. Be careful not to nick or damage rack on yoke side.



7. Using special tools E8802-1 and E8802-2 loosen lock nut and remove yoke plug. Remove yoke and spring.
8. Remove pinion shaft seal and discard.



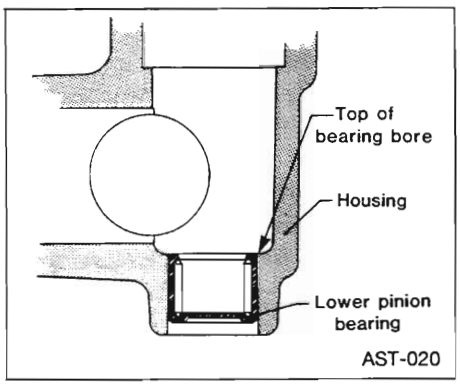
9. Using special tool (Litchfield No E7110-1) remove pinion plug.
10. Remove pinion and rack.
11. Carefully drive out the pinion needle roller bearing and discard.
12. Remove left hand rack bush from tube and discard.

Inspection

- Thoroughly clean and dry all parts.
- Check rack for signs of tooth wear, tooth contact and signs of irregular wear pattern. Check for scoring at yoke and bush contact areas.
- Check pinion for signs of tooth wear and irregular contact.
- Inspect pinion bearing for nicks, scores and signs of brinelling.

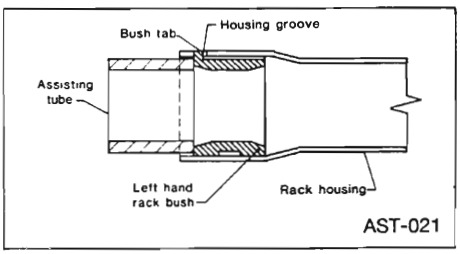
NOTE: Pinion and bearing should not be separated. Damage or wear to either requires replacement of the assembly.

- Check steering gear housing for scoring wear and damage.

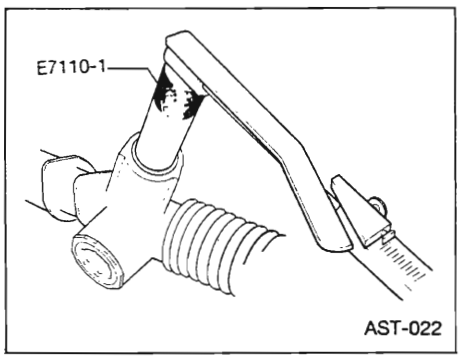


Assembly

1. Lubricate lower pinion bearing and apply a light film of general purpose sealer to outer bearing surface.
2. Press lower pinion bearing into housing so that the upper face of the bearing nearest to the pinion is flush with the top of the bearing bore.

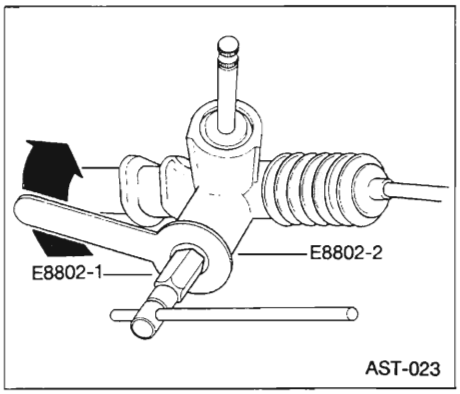


3. Fit left hand rack bushing with a suitable piece of tube, ensuring tabs on bushing are correctly located in housing grooves.
4. Place steering gear in a soft jawed vice or suitable fixture.
5. Apply approximately 30 cc of EPL1 grease in the bottom of the pinion bore.
6. Apply approximately 10 cc of EPL1 grease to the rack teeth and insert rack into housing from pinion end, aligning the rack teeth with the pinion bore. Locate rack so that it protrudes an equal amount each side of the housing.
7. Lubricate pinion and pinion bearing and insert pinion into mesh with the rack.
8. Apply Loctite 242 to pinion plug and install into pinion housing.
   Torque pinion plug to 40-50 Nm using special tool (Litchfield No E7110-1).



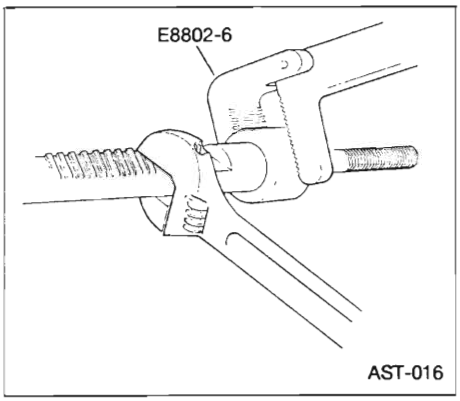
9. With the rack in the straight ahead position, install yoke and yoke spring. Install yoke plug, and using special tool No. E8802-1 tighten to 4.5 Nm then back off 15-25 degrees.
10. Tighten yoke plug lock nut (using Tool No. E8802-2. Yoke plug must be restrained from turning during this operation.

IMPORTANT: Once yoke clearance has been set gear must be racked from lock to lock to ensure wear has not appreciably affected setting, gear should not bind or appear tight over any part of the total travel. Should gear bind or excessive free play appear, adjust yoke plug. If this is not the cause, strip gear and examine rack and pinion for wear or damage.

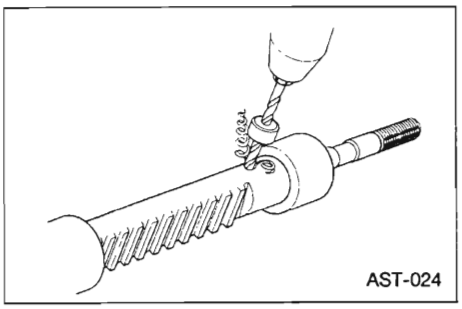


11. Fill the internal lip cavity of the pinion seal with grease and fit the seal over the pinion shaft into the top of the pinion plug.
12. Assemble ball housing to rack, then using special tool (Litchfield No. E8802-6) torque to 80-88 Nm. (Using Special Tool, Torque Wrench will read 47.5 Nm.)

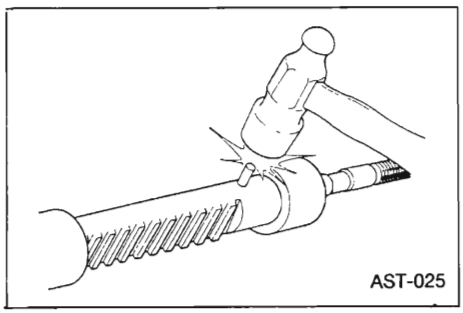
CAUTION: When torquing use an adjustable wrench on the flat teeth of the rack to prevent rack rotation and possible damage to rack or pinion teeth. Be careful not to nick or damage rack on yoke side.



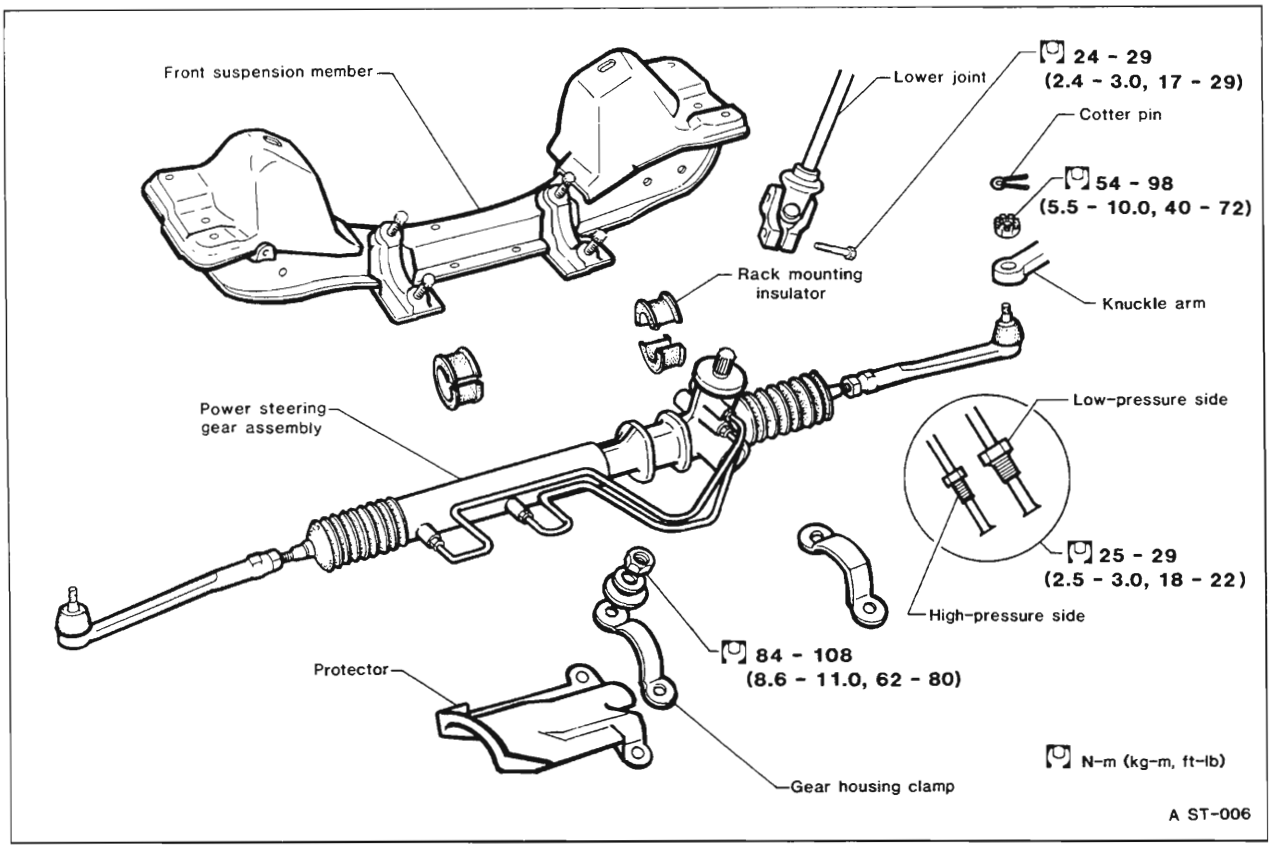
13. Drill a 4 mm dia × 10 mm deep hole into the rack adjacent to each ball housing at 90° to the rack teeth.

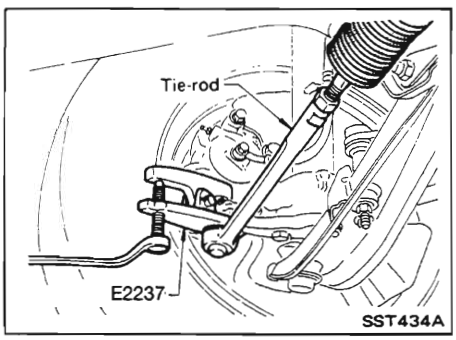


14. Drive a 4 mm dia × 10 mm long pin into each hole.
15. Smear a small quantity of grease in the groove on each tie rod where the sealing boot seats. Assemble boots and clips ensuring the outer clip is accessable when the steering rack is fitted to the vehicle.

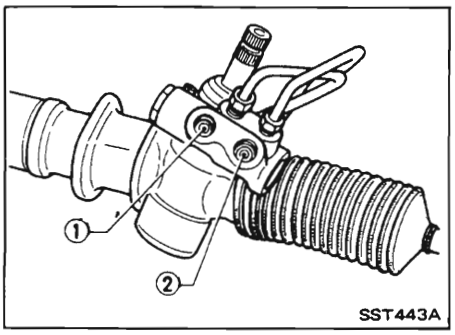


Removal and Installation





- Detach tie-rod ball studs from knuckle arms with Tool.

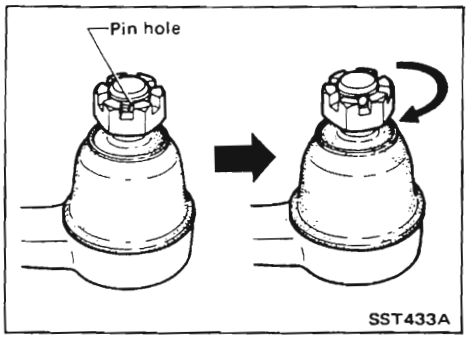


- Before removing power steering gear and linkage, lift the engine to provide sufficient clearance.

CAUTION:

When hoisting engine, maintain vehicle stability.

- Install pipe connector as shown in Figure at left.
  - ① Low-pressure side
  - ② High-pressure side



Installation

- Initially, tighten nut on tie-rod outer socket and knuckle arm fitst to 54 to 59 N·m (5.5 to 6.0 kg-m, 40 to 43 ft-lb). Then tighten further until nut groove is aligned with the first pin hole so cotter pin can be installed.

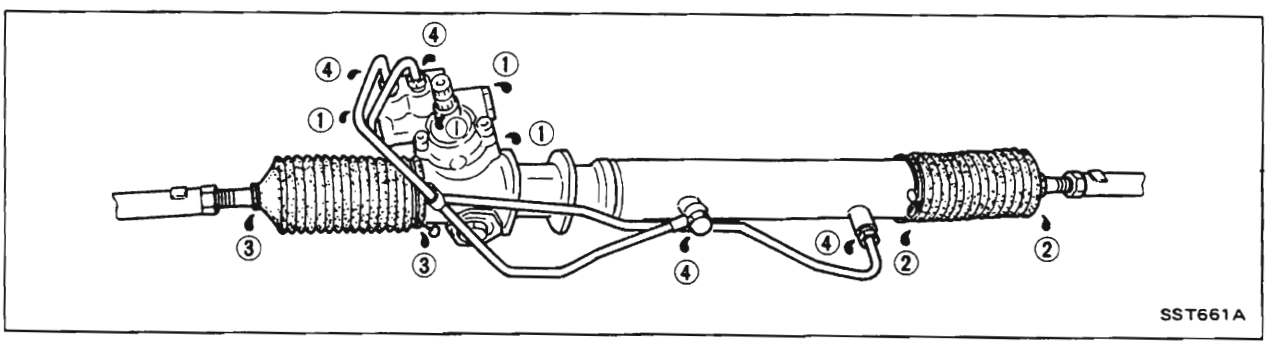
CAUTION:

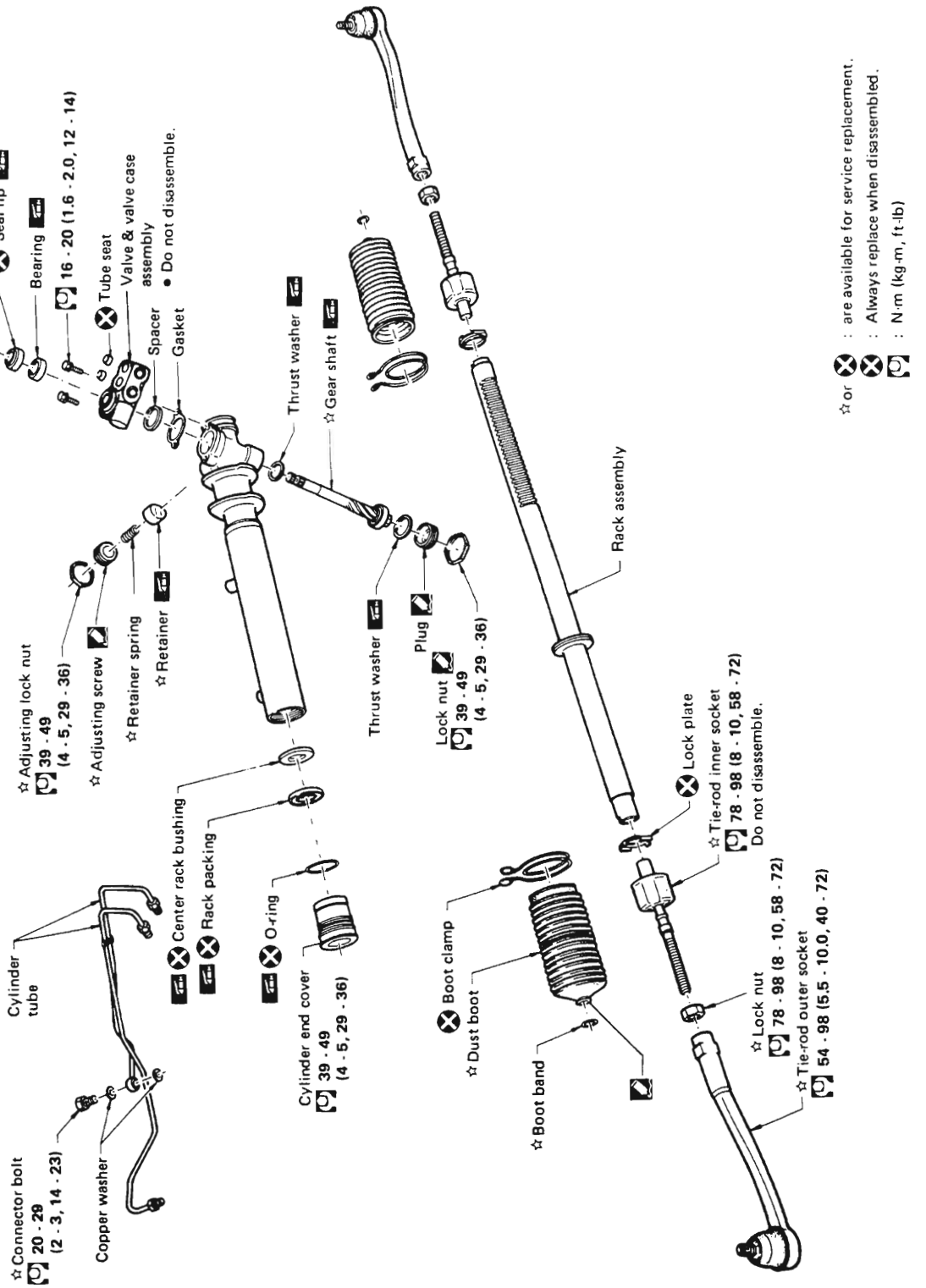
Tightening torque must not exceed 98 N·m (10 kg-m, 72 ft-lb)

Disassembly and Assembly

The table below lists four ways to repair oil leaks in the steering gear, depending on the location of the leak. **See the following Figure for oil leak locations.**

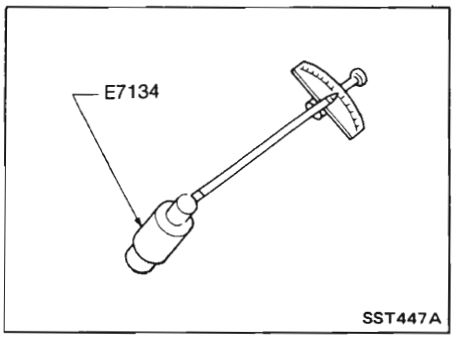
Item \ Position of oil leak	① Valve case	② Dust boot (Pinion housing side)	③ Dust boot (Cylinder end side)	④ Cylinder tube
Operation	■ Replacement • Valve case assembly • Oil seal • O-ring • Gasket	■ Replacement • Valve case assembly • Oil seal • O-ring • Gasket • Center ruck bushing • Pinion end bushing • Ruck packing • U-packing	■ Replacement • Cylinder end cover • U-packing • O-ring	■ Replacement • Tube seat • Cylinder tube assembly • Copper washer • Connector bolt
Procedure	Remove steering gear. ↓ Measure rotating torque of pinion. ↓ Replace parts described above. ↓ Measure rotating torque of pinion. ↓ Adjust adjusting screw. ↓ Measure rotating torque of pinion. ↓ Install steering gear and check for oil leak.		Remove steering gear. ↓ Replace parts described above. ↓ Install steering gear and check for oil leak.	
Service parts to be prepared	1. Valve case assembly • Oil seal • O-ring 2. Gasket	1. Valve case assembly • Oil seal • O-ring 2. Gasket 3. Pinion housing seal kit • Center ruck bushing • Pinion end bushing • Ruck packing • U-packing • O-ring	1. Cylinder end cover seal kit • U-packing • O-ring	1. Cylinder tube kit A • Cylinder tube assembly • Copper washer • Tube seat • Connector bolt 2. Cylinder tube kit B • Cylinder tube assembly • Tube seat




Pinion cap
Seal lip
Bearing
16 - 20 (1.6 - 2.0, 12 - 14)
Tube seat
Valve & valve case assembly
• Do not disassemble.
Spacer
Gasket
Thrust washer
☆Gear shaft
☆Adjusting lock nut
39 - 49
(4 - 5, 29 - 36)
☆Adjusting screw
☆Retainer spring
☆Retainer
Thrust washer
Plug
Lock nut
39 - 49
(4 - 5, 29 - 36)
Rack assembly
Lock plate
☆Tie-rod inner socket
78 - 98 (8 - 10, 58 - 72)
Do not disassemble.
Center rack bushing
Rack packing
O-ring
Cylinder end cover
39 - 49
(4 - 5, 29 - 36)
Cylinder tube
Boot clamp
☆Dust boot
☆Boot band
☆Lock nut
78 - 98 (8 - 10, 58 - 72)
☆Tie-rod outer socket
54 - 98 (5.5 - 10.0, 40 - 72)
☆Connector bolt
20 - 29
(2 - 3, 14 - 23)
Copper washer
☆ or ⊗ ⊗ : are available for service replacement.
⊗ ⊗ : Always replace when disassembled.
: N·m (kg-m, ft-lb)

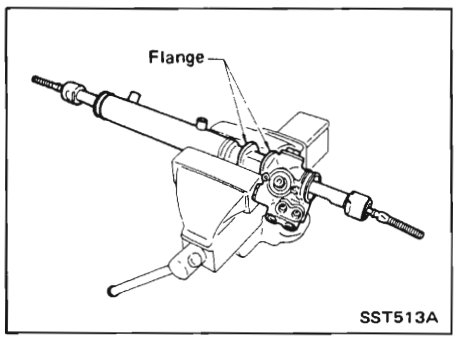
SST689A

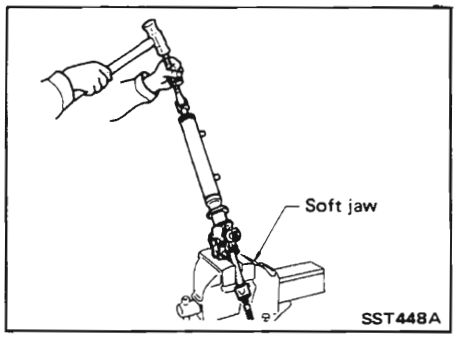
Disassembly



1. Prior to disassembling, measure pinion rotating torque. Record the pinion rotating torque as a reference.

- **Before measuring, be sure to disconnect cylinder tube and drain fluid.**
- **Use soft jaws when holding steering gear housing. Handle it carefully as it is made of aluminum. Do not grip cylinder in a vise.**



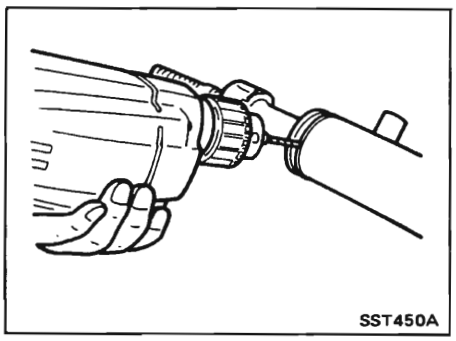


2. Remove tie-rod outer socket and boot. Secure rack teeth in vise with soft jaws.

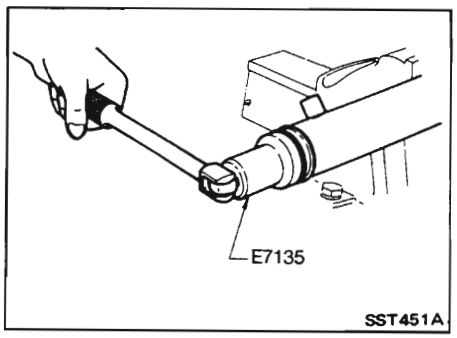
CAUTION:

- **Be careful not to damage rack.**
- **Clamp only the rack teeth.**

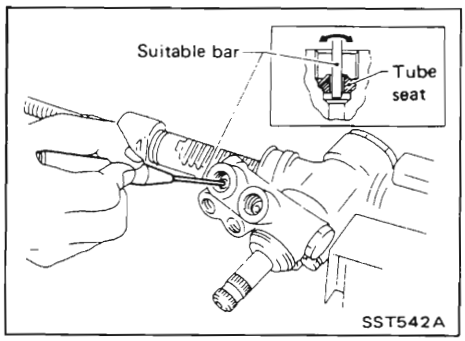
3. Loosen tie-rod inner socket by prying up staked portions (four places), and remove socket.



4. Drill staked portion of cylinder end cover with 2 mm (0.08 in) to 2.5 mm (0.098 in) dia. drill.

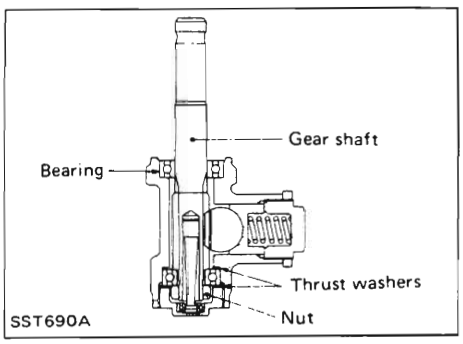


5. Remove cylinder end cover with Tool.



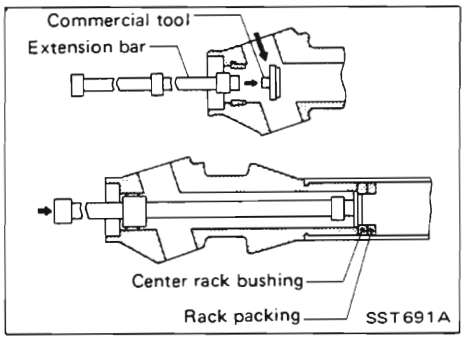
Disassembly (Cont'd)

6. Remove retainer adjusting lock nut, retainer adjusting screw, retainer spring and retainer.
7. Remove tube seats if necessary.



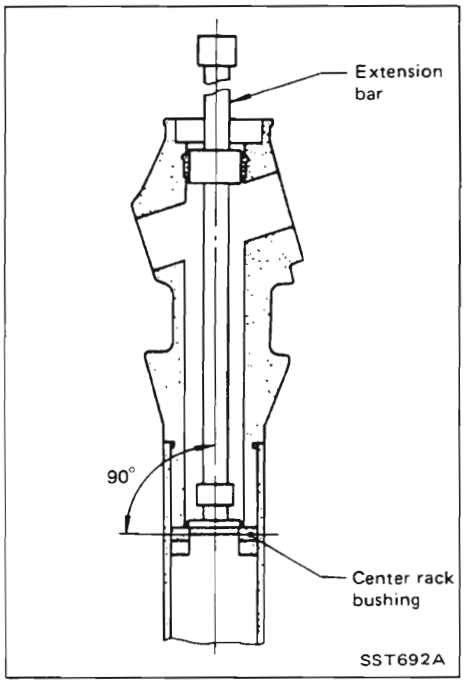
8. Remove pinion cap and valve case fixing bolts, then remove valve and valve case as a set.
9. Remove plug lock nut and plug, then draw out pinion assembly from pinion housing.

Be careful not to drop upper side bearing and thrust washers.



10. Remove centre rack bushing and rack packing using commercial tool* and extension bar.

*** Refer to Preparation.**

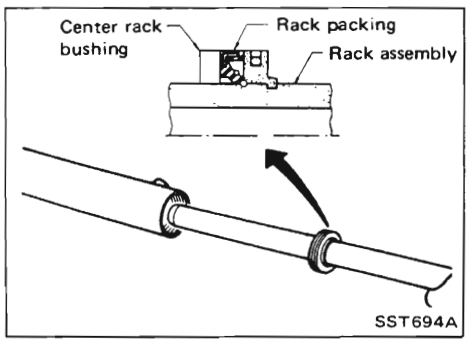


- Push extension bar vertically and remove center rack bushing and rack packing at the same time.

Be careful not to damage inner face of pinion housing and cylinder.

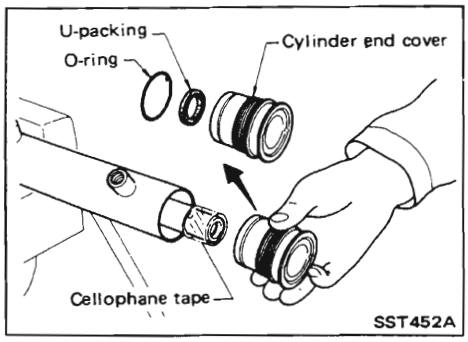
Assembly

1. Install pinion end bushing.

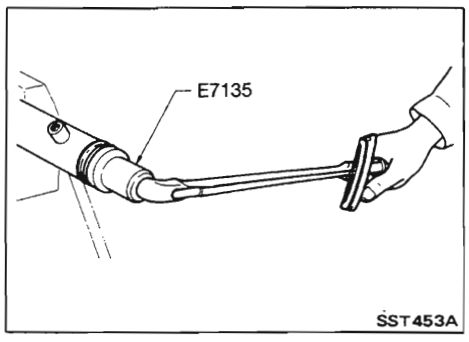


2. Wrap cellophane tape around rack portion, then install new rack packing and center rack bushing on rack assembly.
   Remove cellophane tape, then position rack assembly into cylinder.

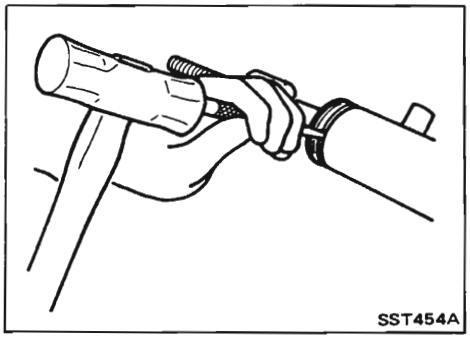
Be careful not to damage inner face of pinion housing and cylinder.



3. Lubricate U-packing and O-ring on cylinder end housing. Wrap cellophane tape around rack end. Then position cylinder end housing on cylinder assembly.

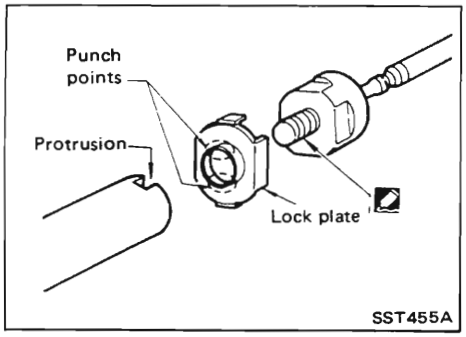


4. Tighten cylinder end cover with Tool.



5. Secure cylinder end cover to cylinder by staking.

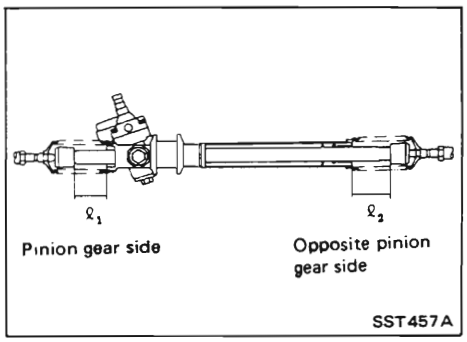
Assembly (Cont'd)



6. Apply locking sealer to threaded portion of inner socket and install inner socket to rack end together with new lock plate.

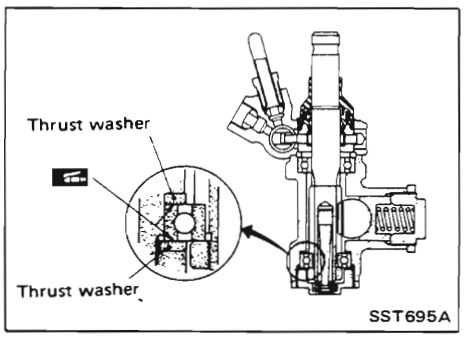
Be sure lock plate ratchet enters groove at end portion of rack so that rack and inner socket fit snugly.

7. Secure lock plate to rack by staking.



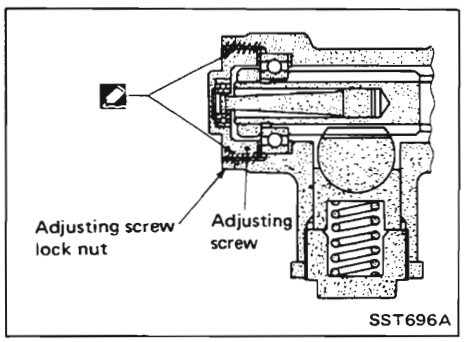
8. Measure rack stroke.

Measure length "ℓ_1 & ℓ_2 : Refer to S.D.S.

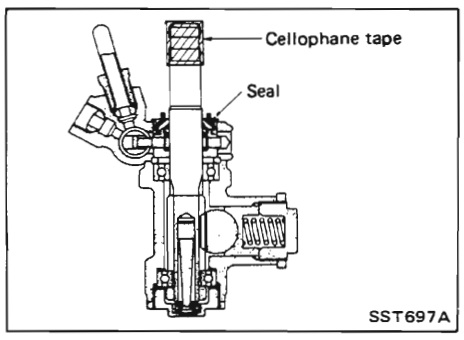


9. Install thrust washers with pinion assembly.

Be sure gray colored surface of washers contact bearing.

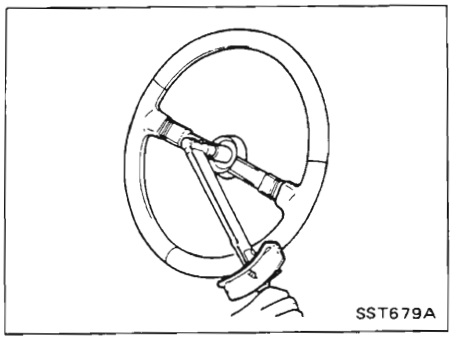


10. Install plug and lock nut.
- Apply locking sealer to threaded area of plug.
- Initially, tighten plug to specified torque 5 to 9 N·m (0.5 - 0.9 kg-m, 3.6 to 6.5 ft-lb), then loosen plug 5° to 15°.
- Tighten lock nut.



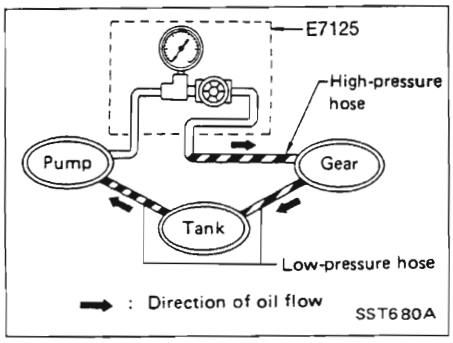
11. Install valve and valve case assembly.
(1) Install spacer and new gasket on pinion housing.
(2) Wrap cellophane tape around serrated area of pinion, then position valve and valve case assembly.
(3) Tighten valve case fixing bolts.
- **When tightening valve case fixing bolts, do not add any thrusting force to valve case which may move neutral position of valve.**
- **If steering rotating torque differs between right and left, retighten valve case fixing bolts once after loosening them.**

Assembly (Cont'd)

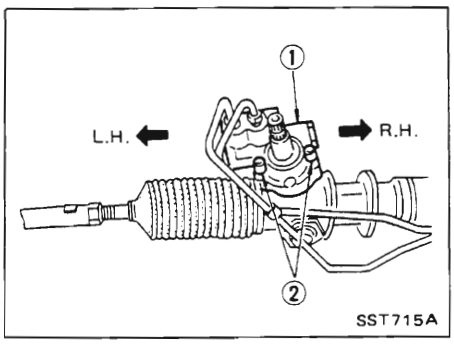


(4) After installing valve and valve case assembly, check the difference between right and left steering rotating torque on vehicle.

Oil pump pressure kPa (bar, kg/cm^2, psi) at idling	Difference between right and left steering rotating torque N·m (kg-cm, in-lb)
490 (4.9, 5, 71)	0.59 (6.0, 5.2) or less
4,904 (49.0, 50, 711)	0.69 (7.0, 6.1) or less



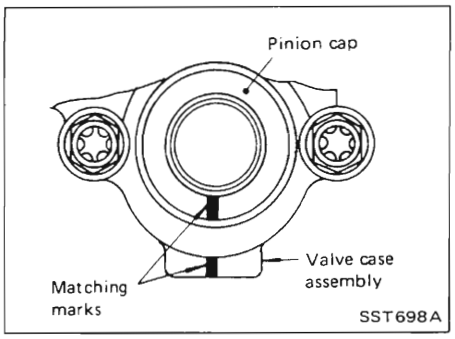
(5) If difference between right and left steering rotating torque is not within specification, adjust valve case assembly as follows.



- Loosen valve case fixing bolts ②.
- Adjust valve case assembly ① to L.H. direction when R.H. steering rotating torque is larger than L.H.

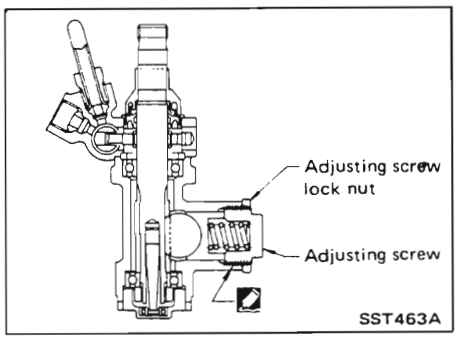
- Adjust valve case assembly ① to R.H. direction when L.H. steering rotating torque is larger than R.H.
- Then tighten valve case fixing bolts ②.

Assembly (Cont'd)

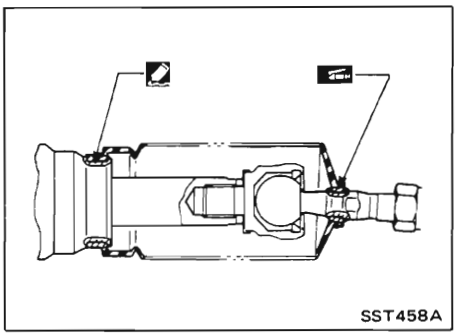


12. Install pinion cap.

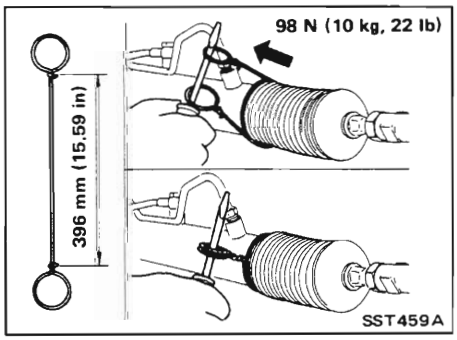
Align cap with neutral mark on valve case.



13. Install retainer, spring and retainer adjusting screw.

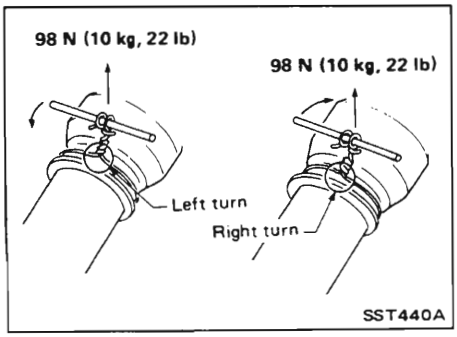


14. Apply a coat of sealant to contact surfaces between boot and cylinder before installing boot.



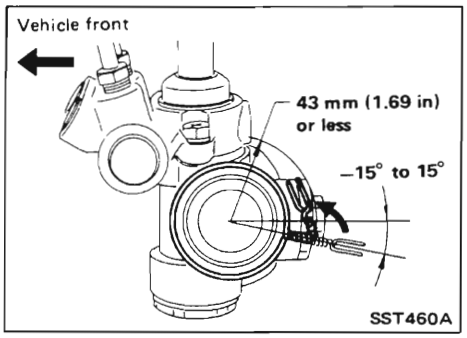
15. Install boot clamps.

- To install, wrap clamp in boot groove twice, and twist both ends of clamp four to four and one-half turns with screwdriver while pulling with a force of about 98 N (10 kg, 22 lb).

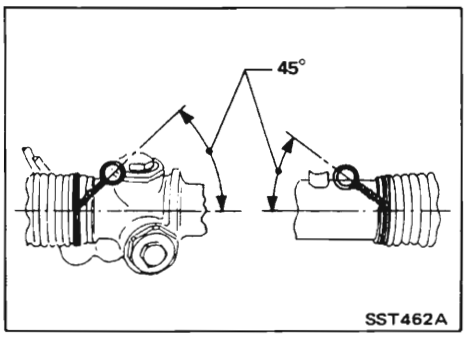


- Twist boot clamp in the direction shown in Figure at left.

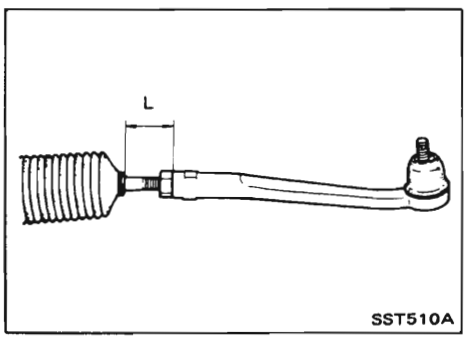
Assembly (Cont'd)



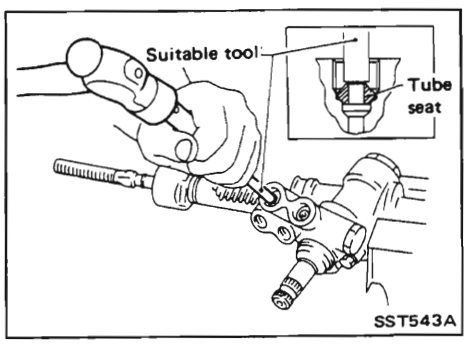
- Install boot clamp so that it is to the rear of the vehicle when gear housing is secured to the body. (This will avoid interference with other parts.)



- After twisting boot clamp four or four and one-half turns, bend twisted end diagonally so it does not contact boot.



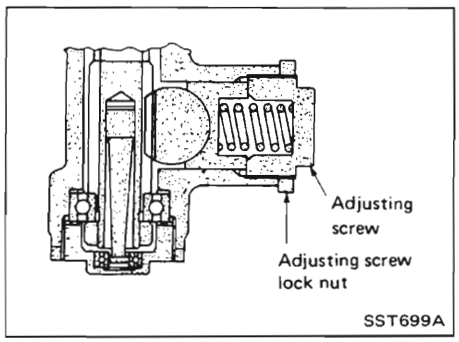
16. Install lock nut and outer socket to inner socket. Adjust tie-rod length "L" and tighten lock nut.
    Tie-rod length "L":
    Refer to S.D.S.



17. Install tube seats.

Inspection

With regard to inspection of tie-rod outer and inner socket, refer to Manual Steering Gear and Linkage for inspection.



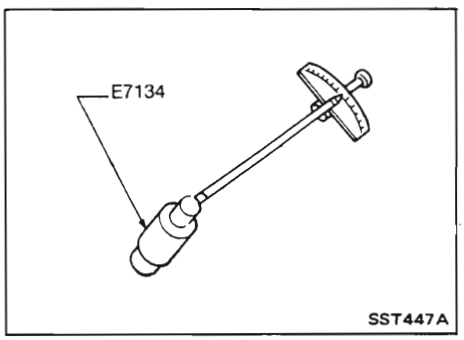
Adjustment

Adjust pinion rotating torque as follows.

1. Loosen retainer adjusting screw completely and apply a coat of sealant to threaded portion of it.

Thoroughly remove old sealant from the threads.

2. Tighten retainer adjusting screw to 4.4 to 5.4 N·m (45 to 55 kg-cm, 39 to 48 in-lb), then back it off to 35° to 45°.
3. Prevent adjusting screw from turning, and tighten lock nut to specified torque.



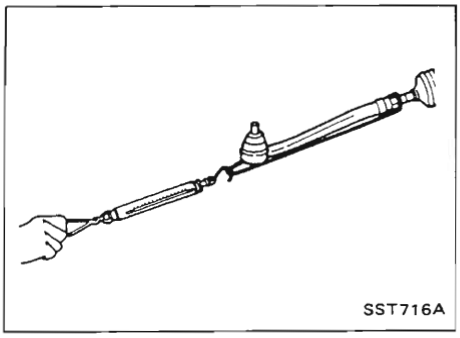
4. Measure pinion rotating torque within the range of ±100° from neutral position.

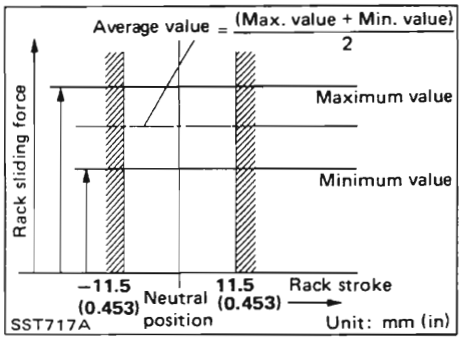
   Average rotating torque:
   [(Max. value + Min. value) x 0.5]
   0.8 - 1.3 N·m
   (8 - 13 kg-cm, 6.9 - 11.3 in-lb)
   Max. allowable fluctuation when ±100° range from neutral position:
   Below 0.4 N·m (4 kg-cm, 3.5 in-lb)

5. If pinion rotating torque is not within the specification, readjust it following steps 1 to 4.

- **Before measuring pinion rotating torque, drain oil from pinion housing.**
- **If pinion rotating torque is outside the specifications after adjustment has been made, gear assembly needs to be replaced.**

Adjustment (Cont'd)


SST716A



SST717A

Adjust rack sliding force on* vehicle after adjusting pinion rotating torque.

1. While slowly pulling tie-rod in the ±11.5 mm (±0.453 in) range from neutral position, make sure its rack sliding force is within the specifications.

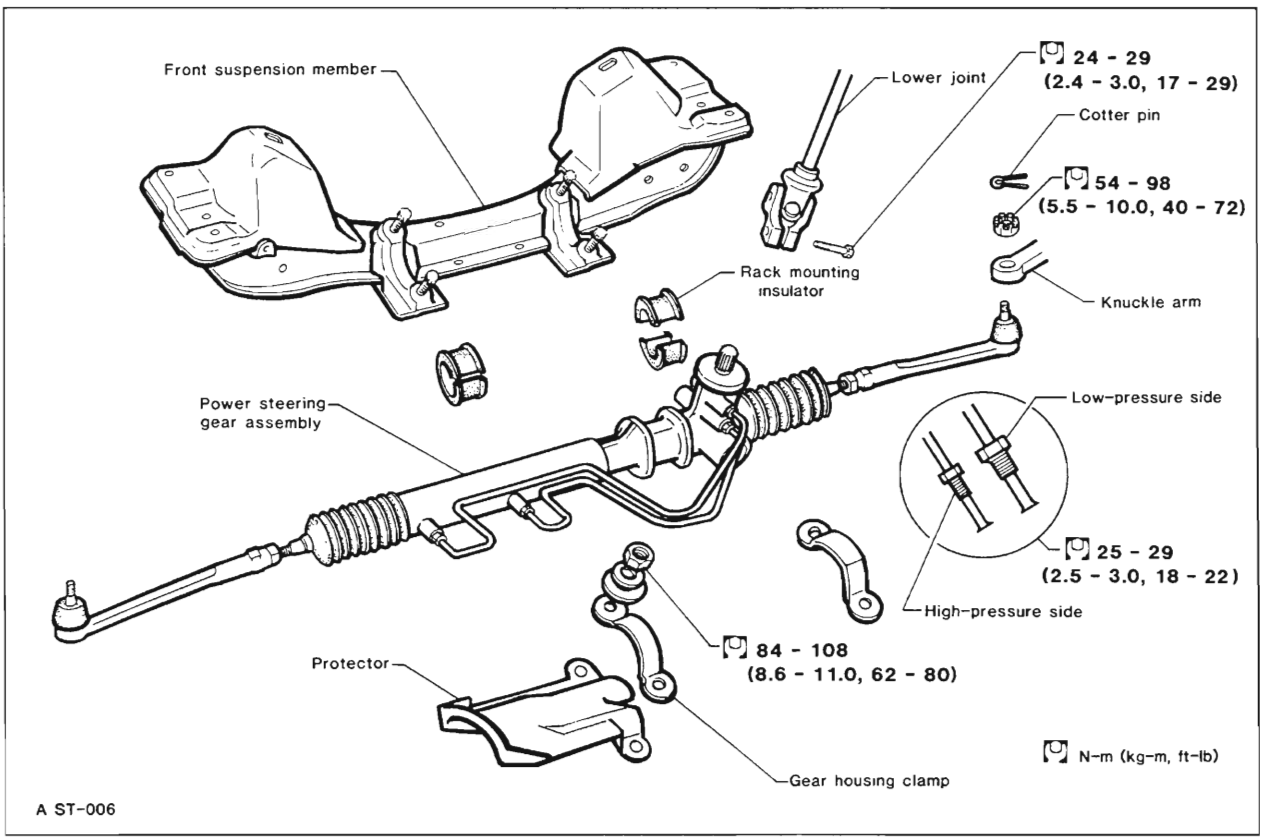
   Average rack sliding force:
   196 - 245 N (20 - 25 kg, 44 - 55 lb)

*: Adjust rack sliding force on vehicle after removing lower joint and steering gear from steering column, and tie-rod from knuckle arm.

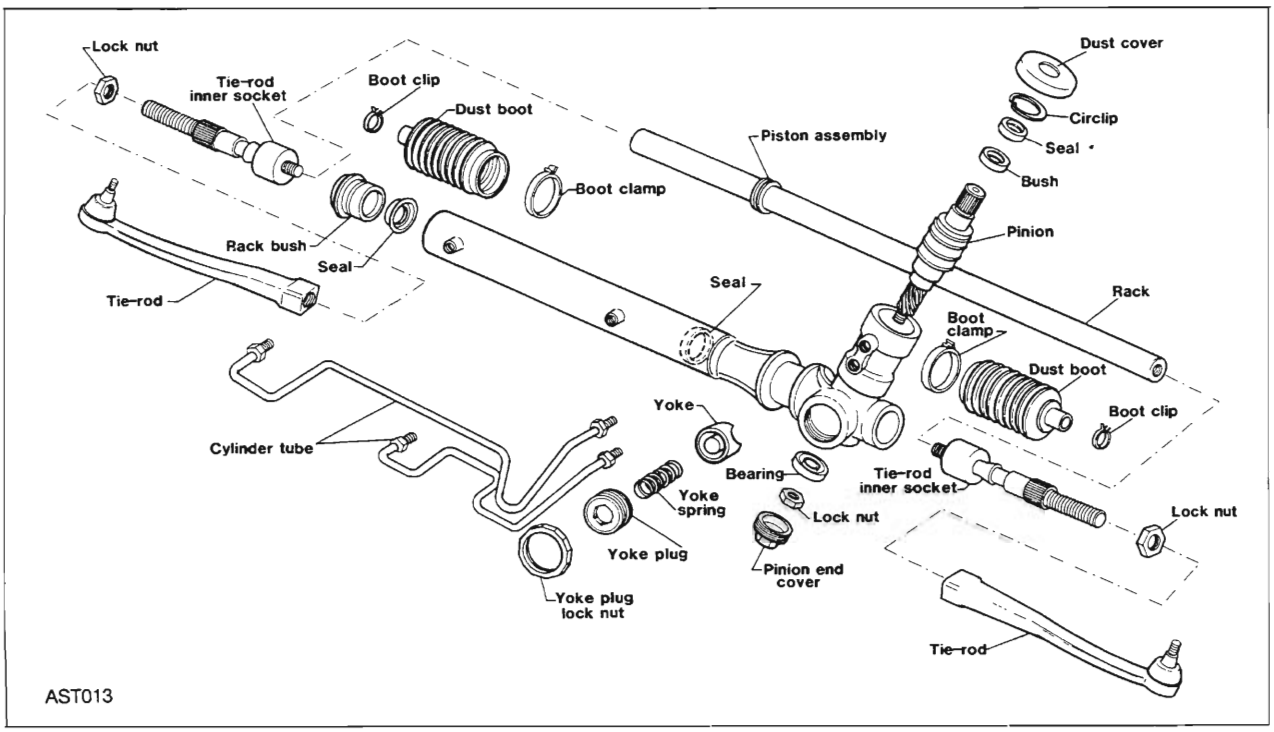
2. If rack sliding force is not within the specifications, readjust pinion rotating torque.

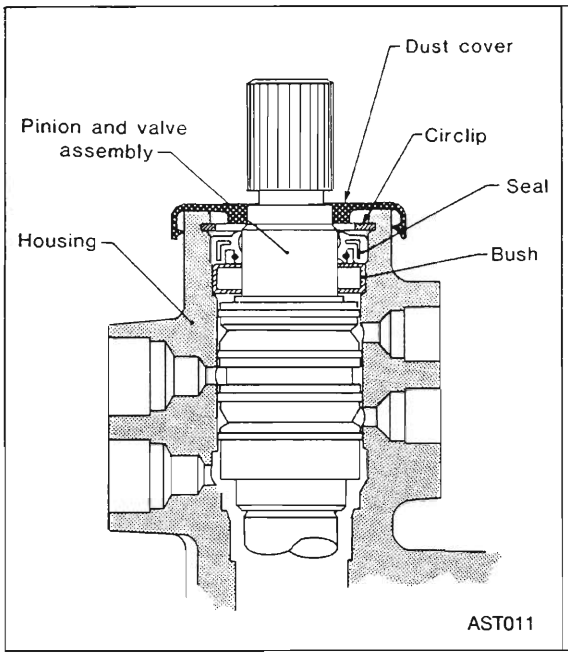
3. If rack sliding force is outside the specifications after adjustment has been made, gear assembly needs to be replaced.

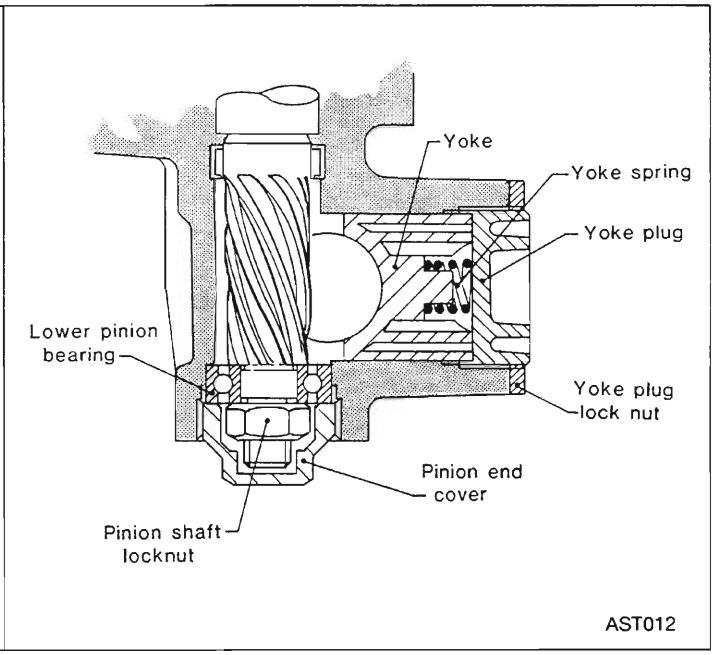
Removal and Installation



Exploded View

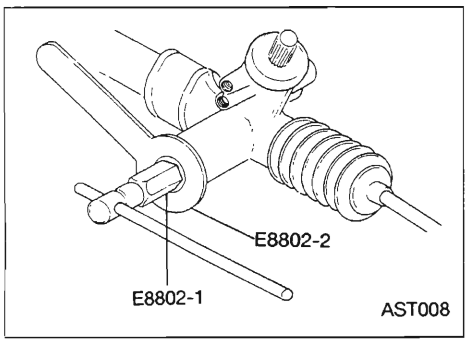






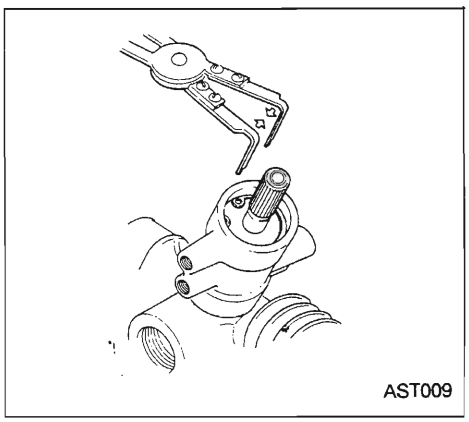
Disassembly — Tie Rods

Inner and outer rod ends are identical to those used on manual TRW rack. Refer pages ST-16 and ST-17 for removal and installation procedures.

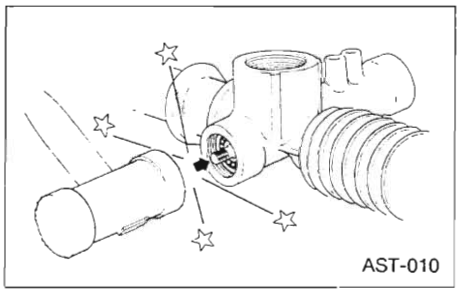


Disassembly — Valve Assembly

1. Using special tool E8802-2 loosen the yoke plug lock nut and unscrew the yoke plug using socket E8802-1. Remove yoke and yoke spring.
2. Remove pinion end cover and unscrew pinion shaft locknut whilst restraining pinion/valve assembly.



3. Remove pinion shaft dust cover (top) and remove circlip.


AST-010

4. Using a soft faced mallet, carefully knock the pinion/valve assembly upwards out of the rack housing. Discard the bush bearing and shaft seal from the top of the pinion/valve assembly.
5. Using a suitable drift, knock the lower pinion bearing out of the rack housing and discard.
6. Remove teflon sealing rings from valve assembly and discard.

Inspection

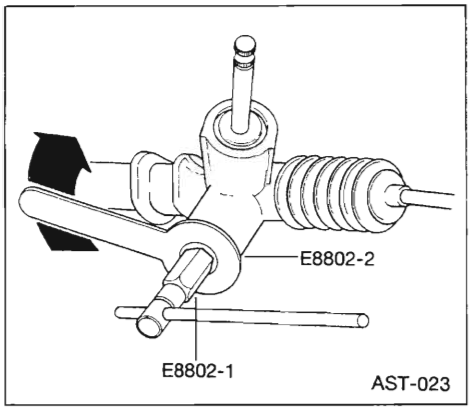
- Thoroughly clean and dry the parts which have been removed.
- Inspect ball housing assemblies and tie rod ends for wear or damage.
- Inspect yoke and spring for wear or damage.
- Inspect valve assembly for visible wear or damage and check splines for burrs.

NOTE: The input shaft, spool valve, pinion and torsion bar are serviced as a balanced assembly and any of the above parts, if found defective, will require the replacement of the whole assembly. Attempts to dismantle and repair will result in a potentially dangerous unbalanced assembly.

The rack housing and ram cannot be dismantled further. New rack housing assembly are available under part number 49003-J7025.

Reassembly

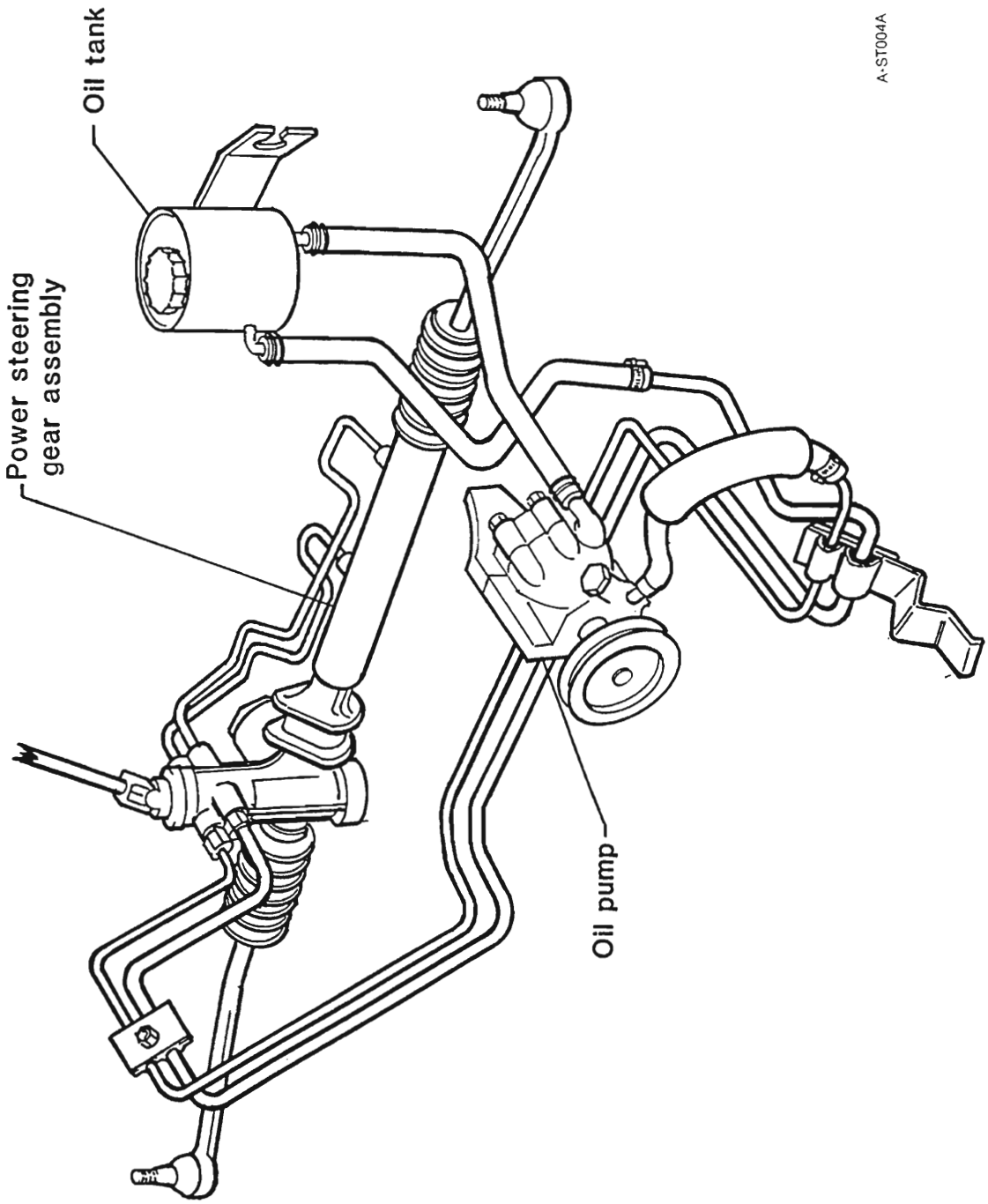
1. Press a new lower pinion bearing into the rack housing. Apply EPL1 grease to the bearing.
2. Fit new teflon sealing rings to valve assembly (it may be necessary to expand the seal rings slightly by hand). Apply a liberal coating of EPL1 grease to the pinion gear.
3. Install pinion/valve assembly into rack housing.
4. Install new top pinion bush and, using suitable hollow drift, tap it fully home into rack housing.
5. Install new pinion shaft top seal and assemble circlip into groove above seal.
6. Fit pinion shaft dust cover.
7. Assemble lock nut to end of pinion shaft and torque to 40-45 Nm.



8. With rack in straight ahead position, install yoke and yoke spring.
9. Install yoke plug and tighten to 4.5 Nm then back off 15-25 degrees (using tool E8802-1).
10. Tighten yoke plug lock nut (using tool E8802-2). Yoke plug must be restrained from turning during this operation.

IMPORTANT: Once yoke clearance has been set gear must be racked from lock to lock to ensure localised wear has not appreciably affected setting, gear should not bind or appear tight over any part of the total travel. Should gear bind or excessive free play appear, adjust yoke plug. If this is not the cause, strip gear and examine rack and pinion for wear or damage.

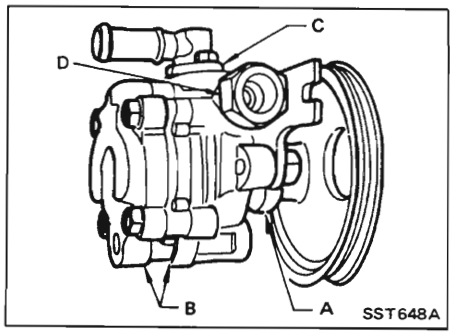
Removal and Installation



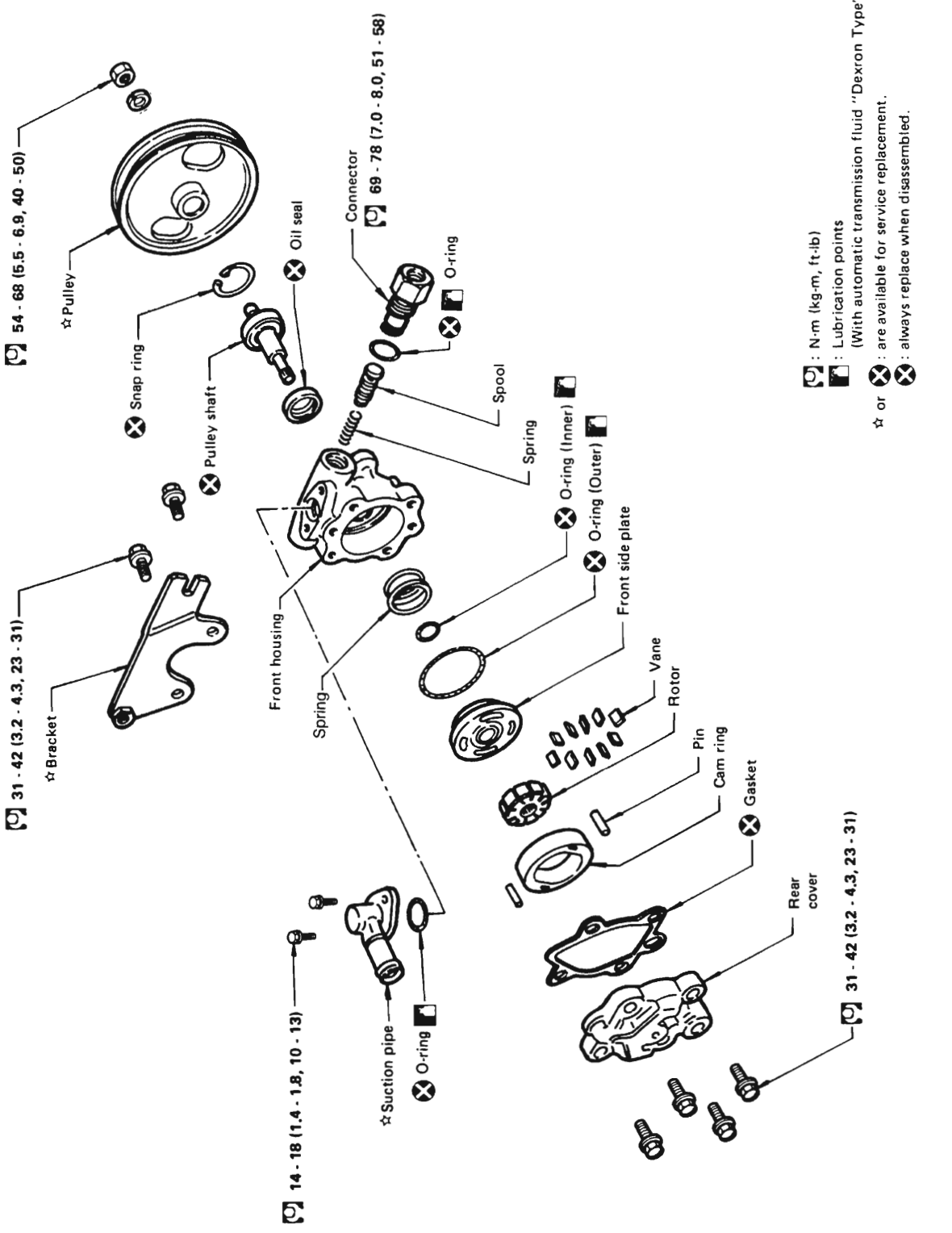
Disassembly and Assembly

The table below lists four ways to repair oil leaks in oil pump and tank, depending on location of the leak.
See the following Figure for oil leak locations.

Item \ Position of oil leak	Pulley shaft oil seal (A)	Housing (B)	Outlet port and return port (C)	Connector (D)
Operation	■ Replacement • Oil seal • Snap ring • Washer (steel)	■ Replacement O-rings (cam case and rear cover)	■ Replacement Return port O-ring	■ Replacement Copper washer
Procedure	Removal from vehicle → Disassemble, and replace parts. (See the above.) → Check each part, then reassemble.	Removal from vehicle → Replace parts described above.	Removal from vehicle → Replace O-ring of return port.	Removal from vehicle → Replace copper washer.
	Installation to vehicle. → Bleed air, check oil level, check oil pressure, and check steering wheel turning torque. → Check for oil leak.			
Service parts to be prepared	Seal kit-power steering pump	O-ring kit-power steering pump	O-ring kit-power steering pump	Copper washer



Disassembly and Assembly (Cont'd)



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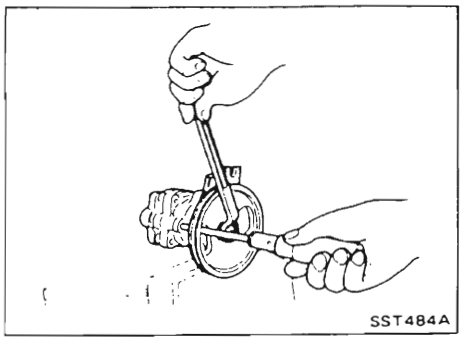
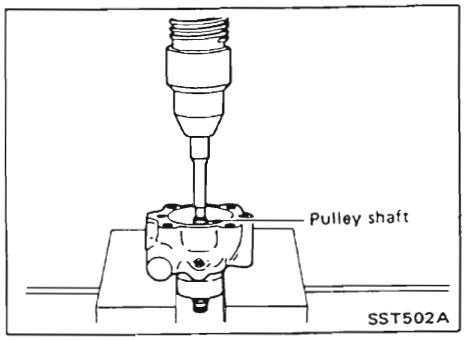
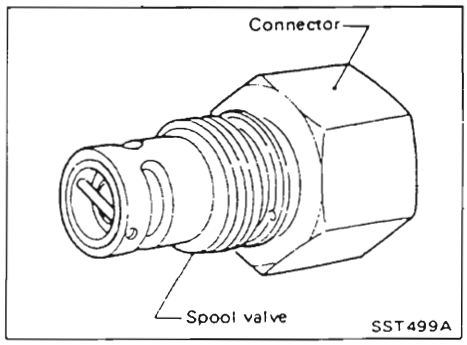


Disassembly

1. Using pump bracket, clamp unit in vice or similar.
2. Remove suction pipe, pulley securing nut and pulley.
3. Remove rear cover, vane and rotor assembly.
4. Remove spring and "O" ring seals.
5. Remove front circlip.



6. Using press or soft faced hammer, push shaft out of front cover.
7. Use a suitable tool to remove the seal.



8. Remove connector with valve assembly.
   Do not remove valve from connector.
9. Remove spool and spring from housing.

Inspection

- When inspecting vanes and rotor, take care that all parts are returned to their original places.

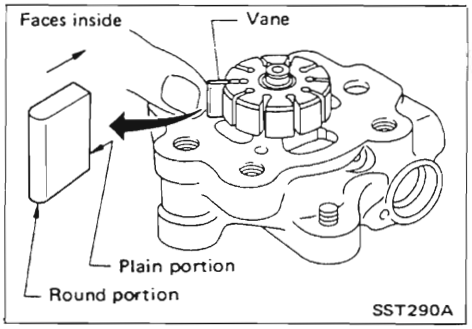
- Inspect following parts for damage and scratches.

(1) Mating surfaces between front housing and rear housing.
(2) Cam ring
(3) Front side plate
(4) Pulley shaft
(5) Rotor
(6) Vanes

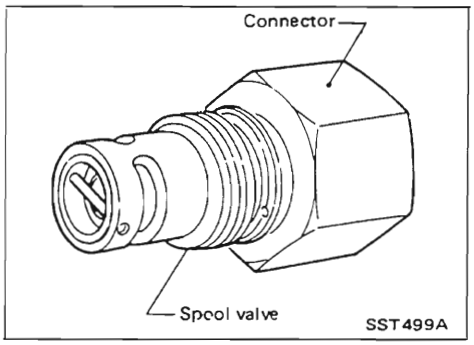
Assembly

During assembly, liberally coat all seals, valves, etc, with A.T.F.

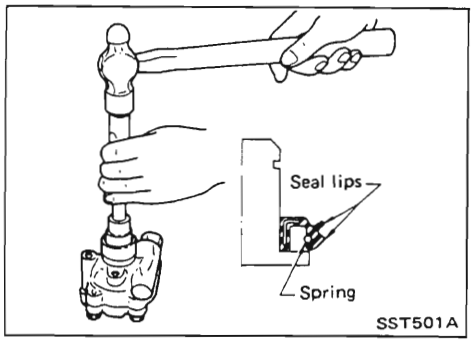
1. Assemble cam ring, pins, rotor and vane assembly with new "O" ring (inner) onto rear cover.
2. Seat spring on top of front side plate.



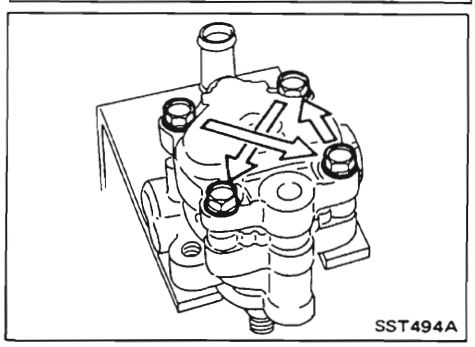
3. Refit spool and spring to front housing.
4. Refit connector with valve assembly.
   Note: Use new "O" ring and torque to specification. Refer S.D.S.



5. Using suitable tool, fit new seal to front cover.
6. Refit pulley shaft to housing, tap home with a soft hammer and refit circlip.
7. Fit new "O" ring (outer) against shoulder in front cover.



8. Using a new gasket, lower front housing assembly onto rear cover assembly. Take care to align splined pulley shft with rotor.
9. Refit bolts and tighten cross-fashion. Torque to specification. Refer S.D.S.
10. Refit suction pipe, with new "O" ring, and front pulley and torque to specification. Refer S.D.S.



General Specifications

Steering gear type	Manual steering	Power steering
	TRW	PR25P and TRW
Steering column	Collapsible	
	Tilt type	
Turns of steering wheel (Lock to lock)	3.9	3.2

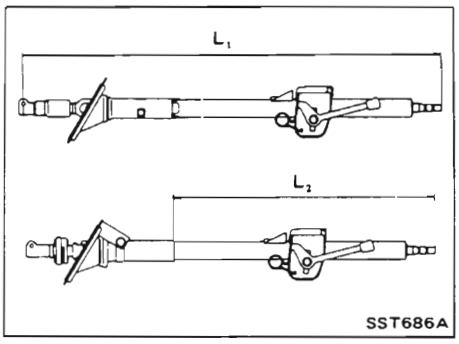
Inspection and Adjustment

GENERAL

Steering wheel axial play mm (in)	0 (0)
Steering wheel play mm (in)	35 (1.38) or less
Movement of gear housing mm (in)	0.3 (0.12) or less

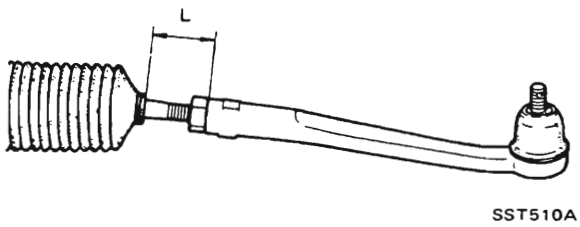
STEERING COLUMN

Steering column length "L_1 & L_2" mm (in)	
Manual steering: L_1	905.7 - 909.3 (xx (35.66 - 35.80)()
Power steering: L_2	882.7 - 886.3 (34.75 - 34.89)



STEERING GEAR AND LINKAGE

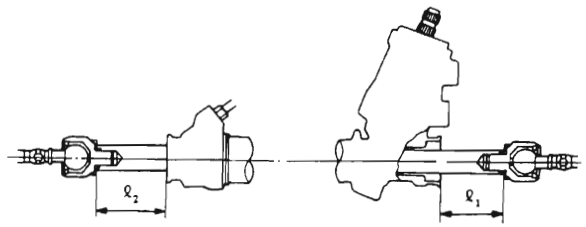
Steering gear type	TRW	PR25P
Tie-rod outer ball joint swinging force* N (kg, lb)	—	4.9 - 98.1 (0.5 - 10, 1.1 - 22.1)
Tie-rod inner ball joint swinging force* N (kg, lb)	0 - 30.0 (0 - 3.1, 0 - 6.7)	2.0 - 156.9 (0.2 16, 0 4 35.3)
Tie-rod outer ball joint rotating torque N·m (kg-cm, in-lb)	1 - 6 (10.2 - 61.1, 8.8 - 53.0)	0.15 - 2.94 (1.5 - 30, 1.3 - 26.0)
Tie-rod outer ball joint axial play mm (in)	0 (0)	1.3 (0.051) or less
Tie-rod length "L" mm (in)	55 (2.16)	42.5 (1.673)



Pinion rotating torque (Pinion gear and rack gear assembly) N·m (k- ,m, in-lb)	0.9 - 1.9	0.8 - 1.3 (8 - 13, 6.9 - 11.3)

Inspection and Adjustment (Cont'd)

Steering gear type	TRW Manual	TRW Power	PR25P
Measured length mm (in) Pinion gear side "ℓ_1"	65 (2.55)	62 (2.44)	56.2 (2.213)
Opposite pinion gear side "ℓ_2"	—	—	71 (2.80)



(Opposite pinion gear side) (Pinion gear side)

SST507A

POWER STEERING PUMP

Normal operating temperature of fluid °C (° F)	60 - 80 (140 - 176)
Fluid capacity ℓ (Imp pt)	0.7 - 0.8 (1.2 - 1.4)
Oil pump maximum pressure kPa (bar, kg/cm^2, psi)	6,865 (68.6, 70, 995)

Tightening Torque

STEERING COLUMN

Unit	N·m	kg-m	ft-lb
Steering wheel nut	29 - 39	3.0 - 4.0	22 - 29
Lower joint to column	24 - 29	2.4 - 3.0	17 - 22
Lower joint to gear	24 - 29	2.4 - 3.0	17 - 22
Hole cover to dash panel	8 - 10	0.8 - 1.0	5.8 - 7.2
Steering column clamp to mounting bracket	9 - 14	0.9 - 1.4	6.5 - 10.1

STEERING GEAR AND LINKAGE

Model TRW

Unit	N·m	kg-m	ft-lb
Tie-rod to knuckle	54 - 98	5.5 - 10.0	40 - 72
Tie-rod lock nut	78 - 98	8 - 10	58 - 72
Ball housing to rack	80 - 88	8.1 - 9.0	59 - 65
Gear housing clamp bolt	84 - 108	8.6 - 11.0	62 - 80
Pinion plug	40 - 50	4.1 - 5.1	29 - 37
Yoke plug	4.5	0.5	3
	Then back off 15 - 25 degrees		

Model PR25P

Unit	N·m	kg-m	ft-lb
Tie-rod to knuckle	54 - 98	5.5 - 10.0	40 - 72
Tie-rod lock nut	78 - 98	8 - 10	58 - 72
Tie-rod to gear	78 - 98	8 - 10	58 - 72
Gear housing clamp bolt	84 - 108	8.6 - 11.0	62 - 80
Cylinder end cover to cylinder	39 - 49	4 - 5	29 - 36
Valve case to pinion housing	16 - 20	1.6 - 2.0	12 - 14
Plug lock nut	39 - 49	4 - 5	29 - 36
Retainer adjusting screw lock nut	39 - 49	4 - 5	29 - 36
Cylinder tube flare nut	29 - 39	3 - 4	22 - 29
Cylinder tube connector bolt	20 - 29	2 - 3	14 - 22

Tightening Torque (Cont'd)

OIL PUMP, TANK AND HOSES

Unit	N·m	kg-m	ft-lb
High-pressure hose to pump	49 - 69	5 - 7	36 - 51
Pump to bracket	31 - 42	3.2 - 4.3	23 - 31
Suction pipe to casing	14 - 18	1.4 - 1.8	10 - 13
Hose to oil tank	3 - 4	0.3 - 0.4	2.2 - 2.9
Pulley lock nut	54 - 68	5.5 - 6.9	40 - 50
Connector bolt	69 - 78	7 - 8	51 - 58
Rear cover securing bolt	31 - 42	3.2 - 4.3	23 - 31
Pump belt adjusting bracket fixing bolt	16 - 21	1.6 - 2.1	12 - 15
PR25P			
High-pressure pipe to gear	29 - 39	3 - 4	22 - 29
Low-pressure pipe to gear	39 - 49	4 - 5	29 - 36
TRW			
Fluid pipes to gear	25 - 29	2.5 - 3.0	18 - 22

BODY

CONTENTS

GENERAL SERVICING
(Including all clips & fasteners for this model) ..... BF- 2
BODY END
(Including trunk lid opener) ..... BF- 7
DOOR BF-10
INSTRUMENT BF-12
INTERIOR AND EXTERIOR
(Including weatherstrips and rubber seals) BF-16
WINDSHIELD AND WINDOWS BF-24
REAR COMBINATION LAMP
(It is installed with nut and butyl sealant) BF-27
BODY ALIGNMENT — Engine Compartment & Underbody
(Including actual dimensions between points and the co-ordinates of the points BF-28

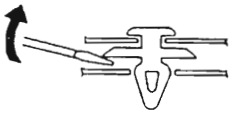
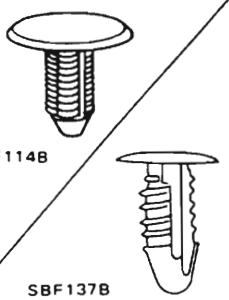
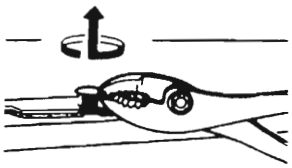
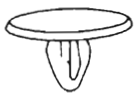
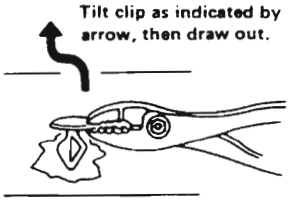
* For power door and window circuits refer Section EL.

Precautions

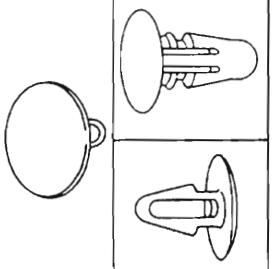
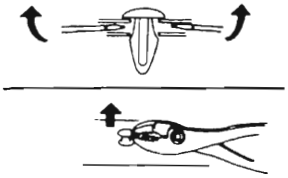
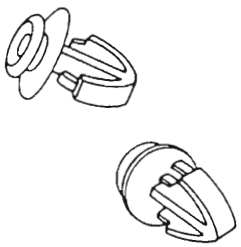
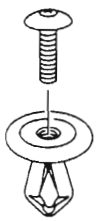
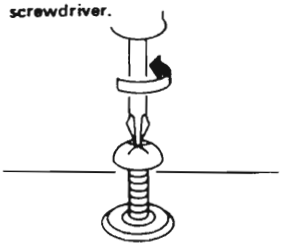
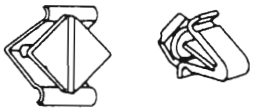
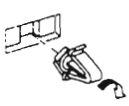
- When removing or installing various parts, place a cloth or padding onto the vehicle body to prevent scratches.
- Handle trim, moulding, instruments, grille, etc. carefully during removing or installation. Be careful not to soil or damage them.
- Apply sealing compound where necessary when installing parts.
- When applying sealing compound, be careful that the sealing compound does not protrude from parts.
- When replacing any metal parts (for example body outer panel, members, etc.), be sure to take rust prevention measures.

Clip and Fastener

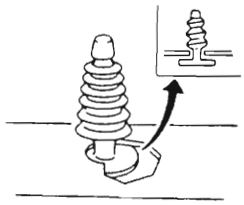
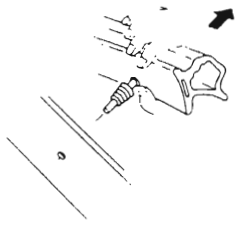
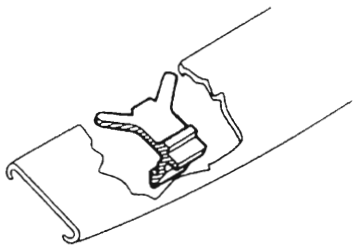
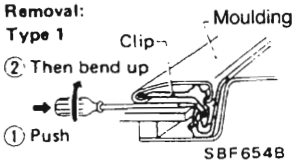
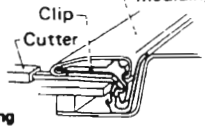
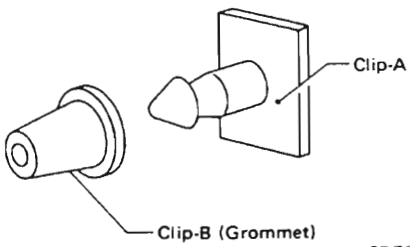
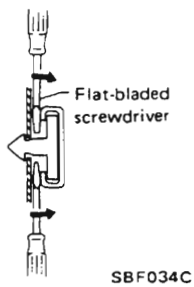
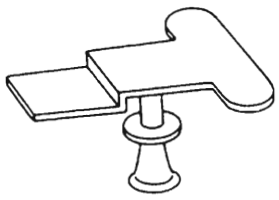
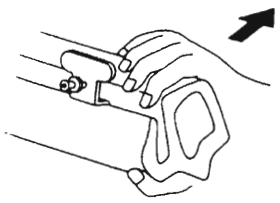
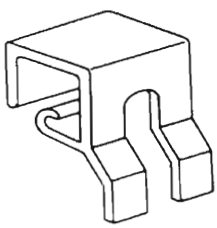
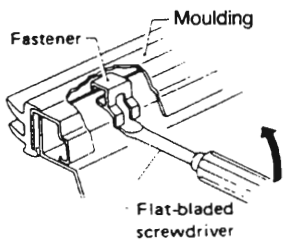
- Clips and fasteners in BF section correspond to the following numbers and symbols.
- Replace any clips and/or fasteners which are damaged during removal or installation.

Symbol	Shape	Removal & Installation	Location
 SBF092B	 SBF109B	**Removal:** **Remove by bending up with a flat-bladed screwdriver.**  SBF094B	• Door trim • Floor rear insulator • Rear pillar garnish • Rear pillar garnish cover
 SBF113B	 SBF114B SBF137B	 **Removal:** **Pull up by rotating** SBF115B	• Trunk trim • Rear parcel shelf • Luggage room trim • Luggage floor carpet • Luggage floor side insulator
 SBF141B	 SBF142B	**Removal:** **Tilt clip as indicated by arrow, then draw out.**  SBF143B	• Rear pillar garnish • Floor carpet

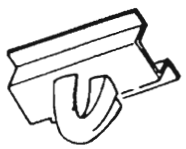
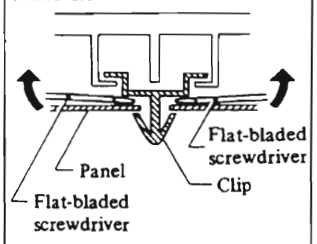
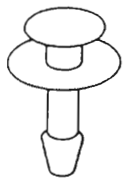
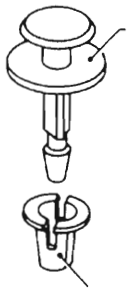
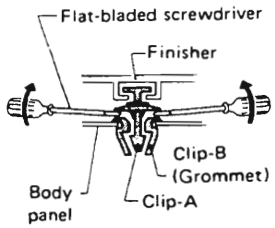
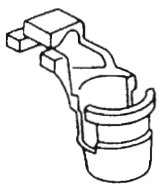
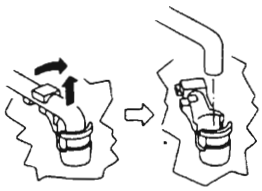
Clip and Fastener (Cont'd)

Symbol	Shape	Removal & Installation	Location
 SBF089B	 SBF090B	Removal: Remove with flat-bladed screwdrivers or pliers.  SBF091B	• Hood front sealing rubber • Cowl top grille
 SBF365B	 SBF366B	Removal: Remove by bending up with flat-bladed screwdrivers.  SBF367B	• Front seatback
 SBF564B	 SBF565B	Removal: Remove by bending up with a flat-bladed screwdriver.  SBF566B	• Rear parcel shelf
 SBF138B	 SBF139B	Removal: Screw out with a Phillips screwdriver.  SBF140B	• Front fender protector
 SBF144B	 SBF145B	Removal:  Rotate 45° to remove.  Removal:	Installation:  SBF085B • Front grille

Clip and Fastener (Cont'd)

Symbol	Shape	Removal & Installation	Location
 SBF103B	 SBF104B	**Removal:**  SBF147B	• Hood rear sealing rubber • Door weatherstrip
 SBF653B	**Removal:** **Type 1** Moulding Clip ② Then bend up ① Push  SBF654B **Type 2** Moulding Clip Cutter **Remove molding by cutting off the clip.**  SBF914B	• Windshield upper molding • Rear window upper & side moulding
 SBF032C	**Removal:**  SBF034C	• Front & rear pillar drip moulding
 SBF028C	**Removal:**  SBF029C	• Door weatherstrip
 SBF030C	**Removal:**  SBF031C	• Door waist outer moulding

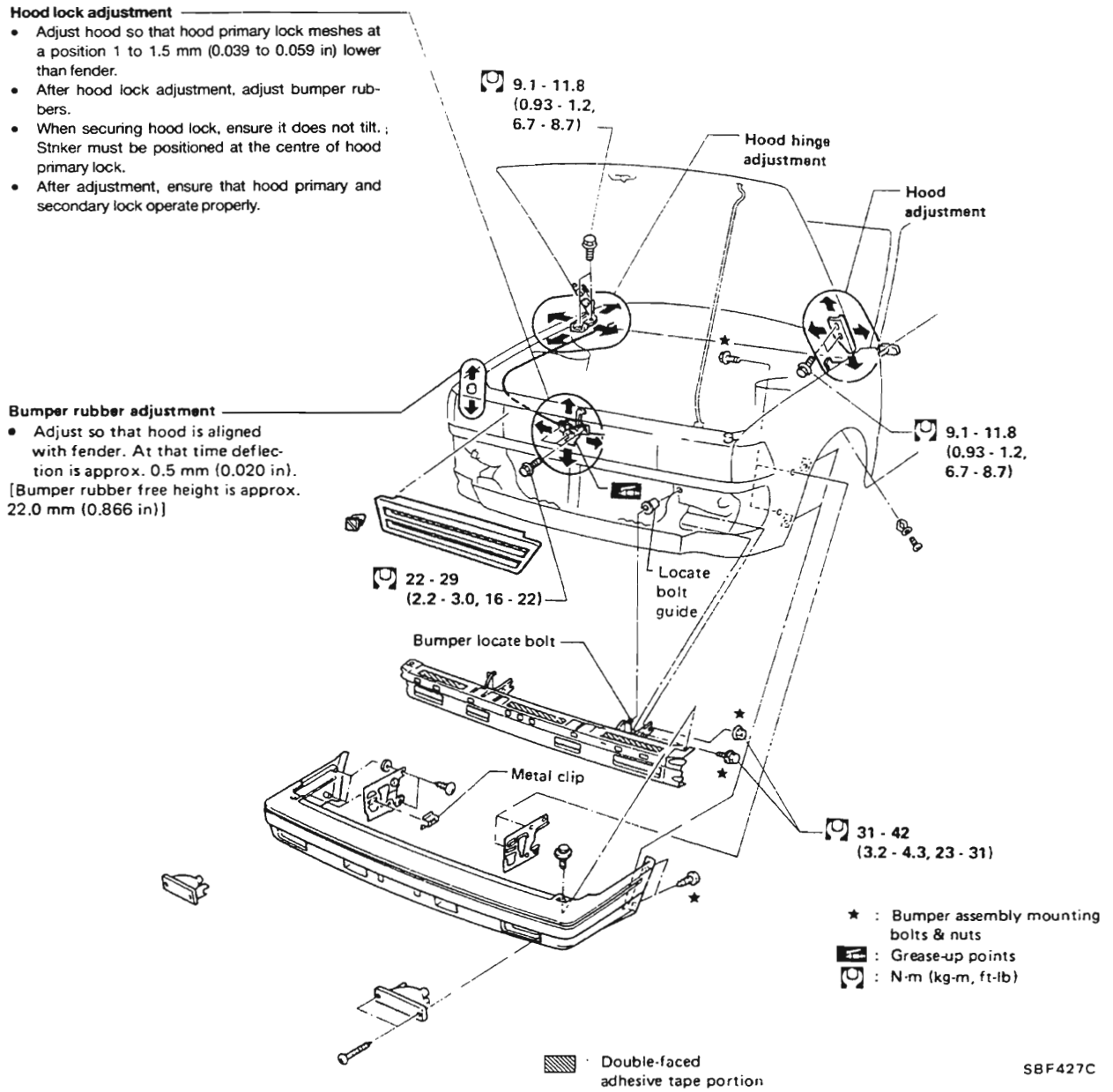
Clip and Fastener (Cont'd)

Symbol	Shape	Removal & Installation	Location
	 SBF116B	**Removal:**  SBF117B	• Bumper moulding
 SBF035C	 SBF036C	**Removal:**  SBF652B	• Rear spoiler
 SBF768B		**Removal:** **Holder portion of clip must be spread out to remove rod.**  SBF770B	• Front & rear door lock linkages • Trunk lid key cylinder

- When removing and installing bonnet or boot lid, place a cloth or other padding on bonnet or boot lid corners to avoid scratching vehicle body.
- When removing clip or fastener, refer to CLIP & FASTENER.
- Apply sealing compound where necessary when installing parts.

Body Front End

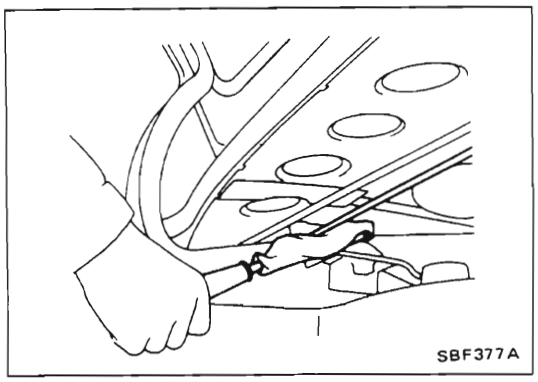
- Hood adjustment: Adjust at hinge portion.
- Hood lock adjustment: After adjusting, check hood lock control operation. Apply a coat of grease to hood lock engaging mechanism.
- Hood opener: Do not attempt to bend cable forcibly. Doing so increases effort required to unlock hood.
- Bumper fascia: It is made of plastic, so do not use excessive force and take care to keep oil away from it.
- Front grille: It is made of plastic, so do not use excessive force and take care to keep oil away from it.



Body Rear End and Opener

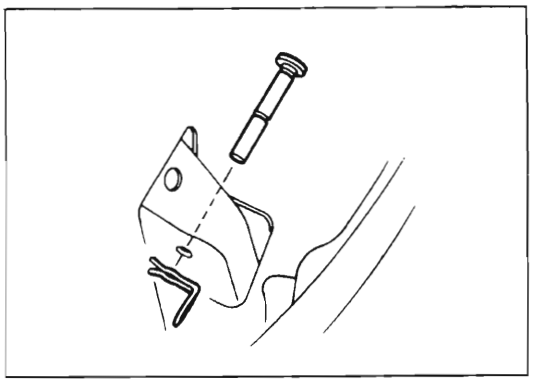
- Boot lid adjustment: Adjust at hinge-trunk lid portion for proper boot lid fit.
- Boot lid lock system adjustment: Adjust striker so that it is in the centre of the lock. After adjustment, check boot lid lock operation.
- Bumper fascia: It is made of plastic, so do not use excessive force and take care to keep oil away from it.
- Opener cable: Do not attempt to bend cable using excessive force.
- After installation, make sure that boot lid and fuel filler lid open smoothly.

Boot lid torsion bar removal & installation

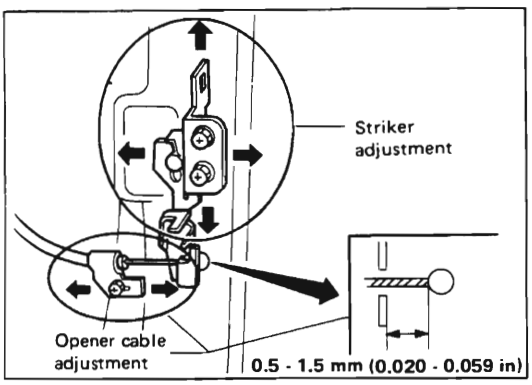


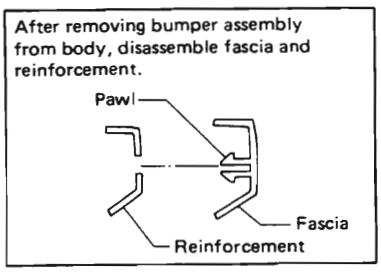
WARNING:
When removing and installing torsion bar, be careful as it is under tension.

Boot lid hinge removal

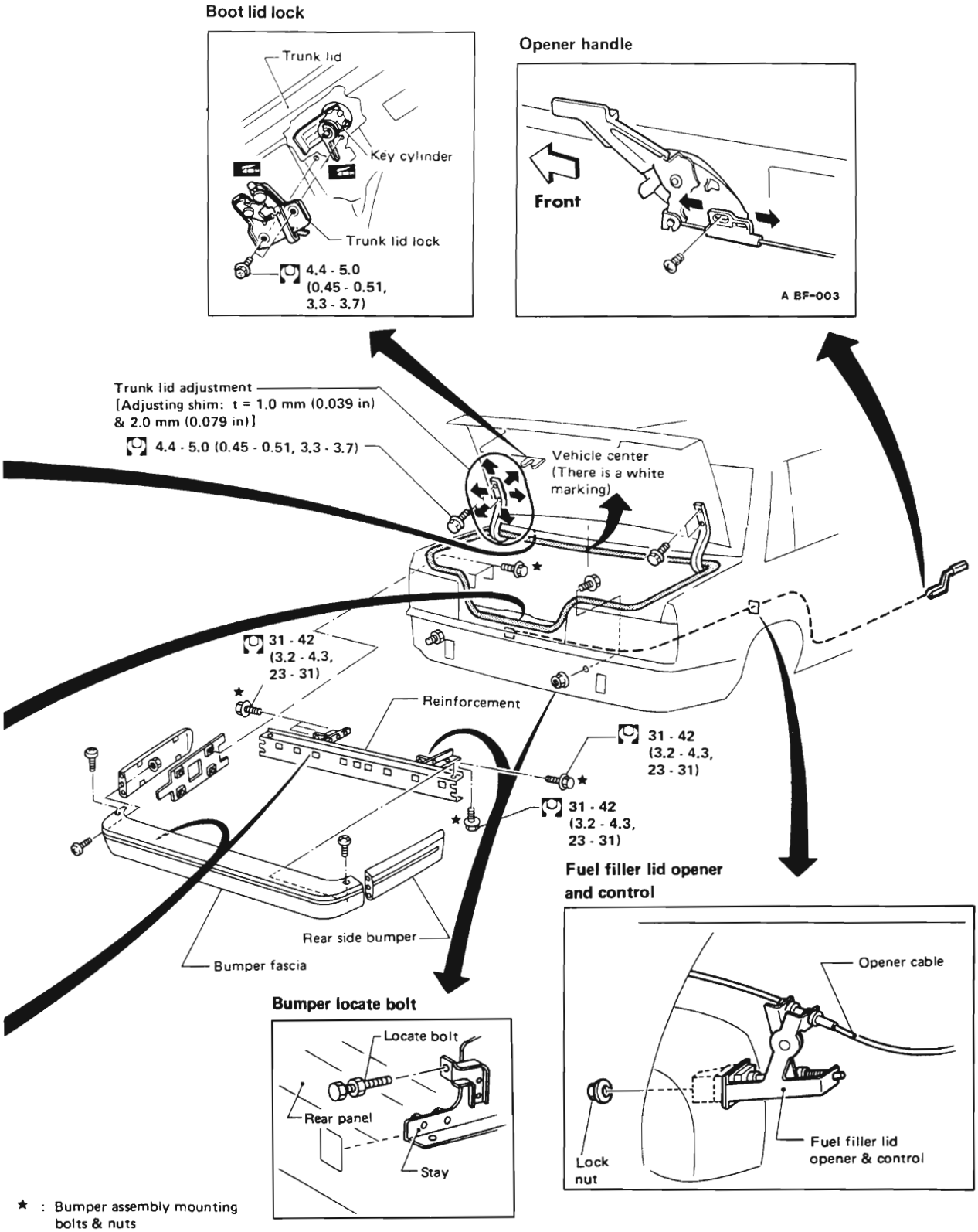


Boot lid striker adjustment





Body Rear End and Opener (Cont'd)

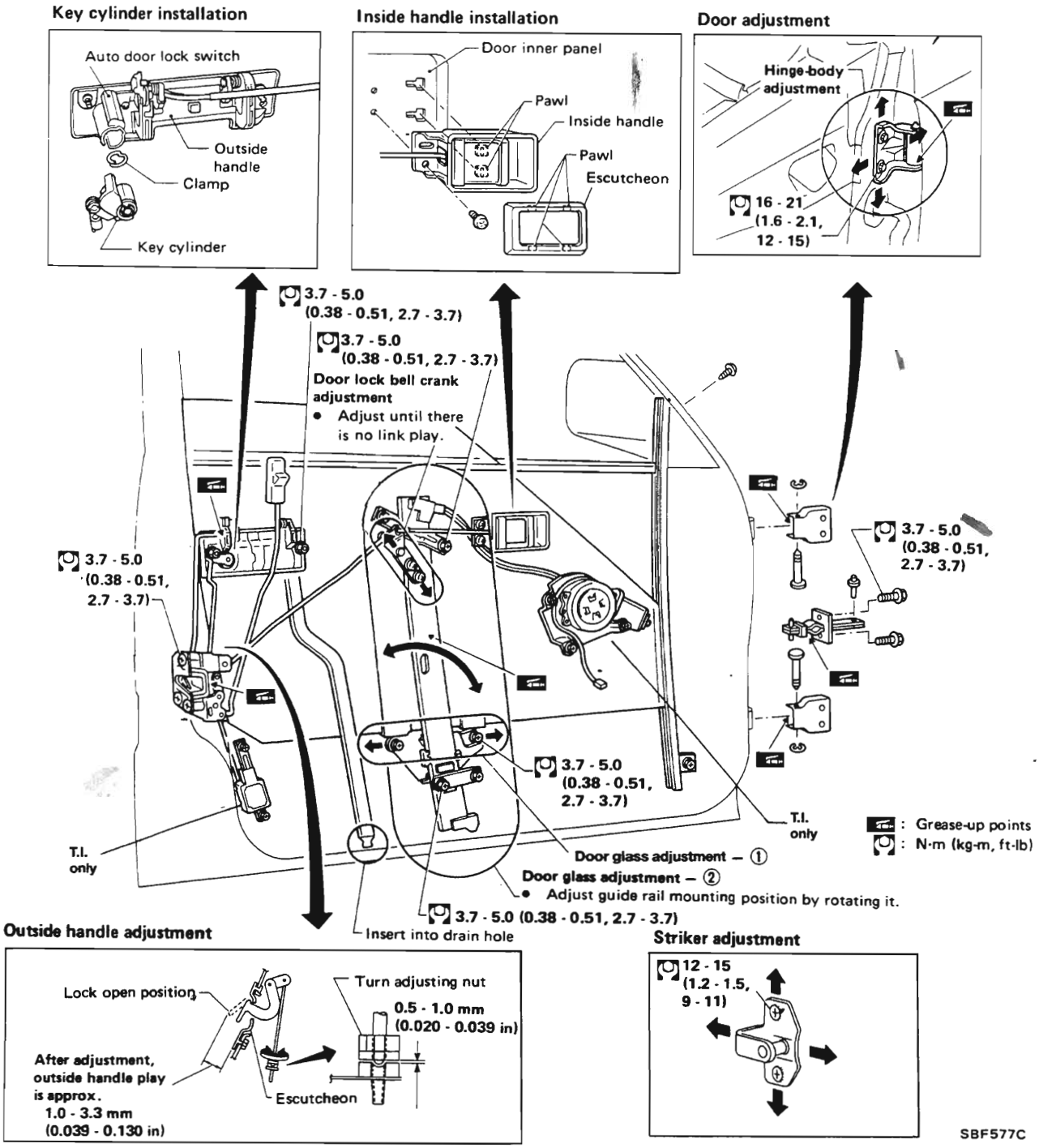


SBF425C

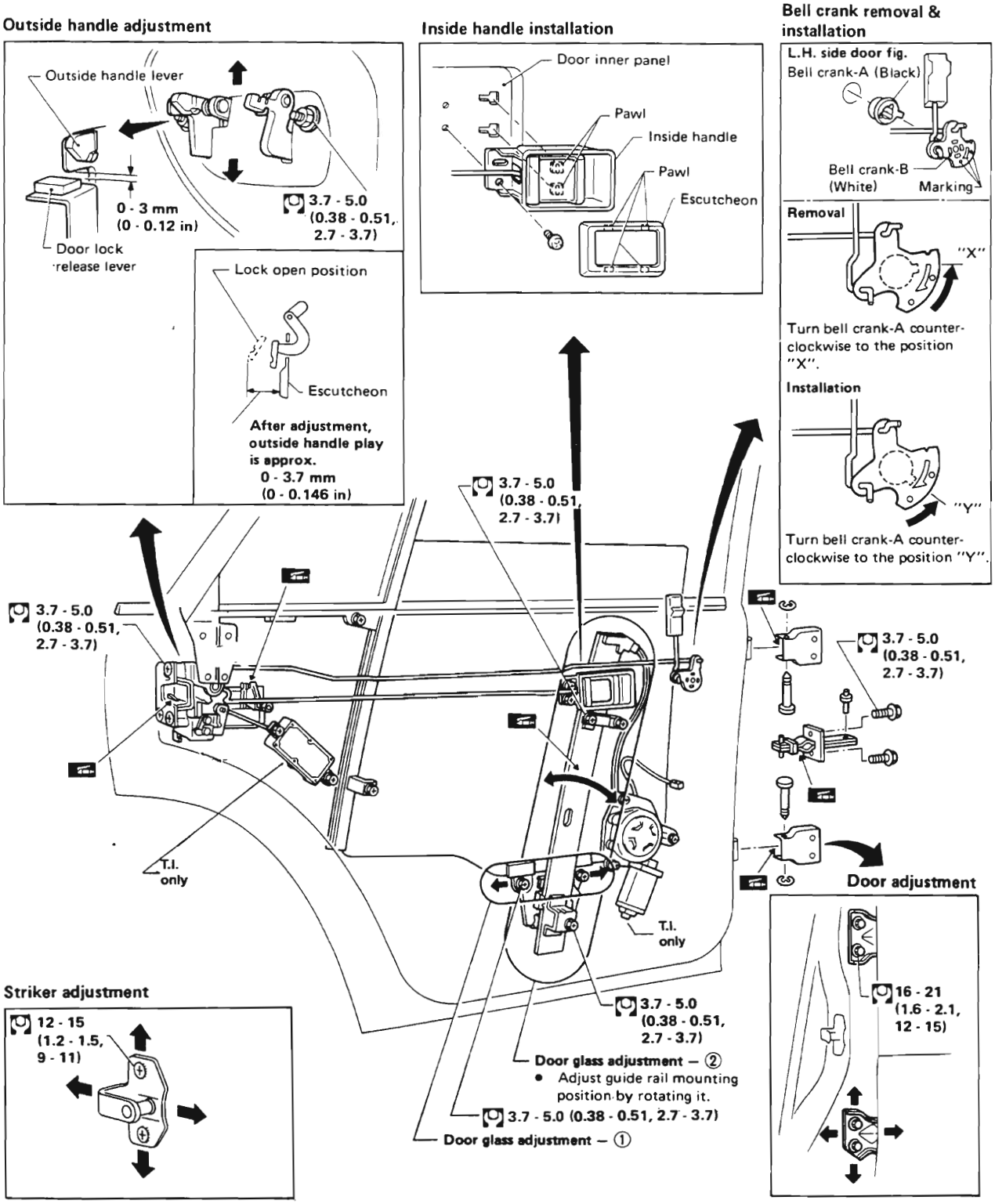
- When removing door, be sure not to scratch vehicle body.
- When removing clip or fastener, refer to CLIP & FASTENER.
- After adjusting door and door lock, check door lock operation.
- For electrical circuits on power locking and windows refer Section EL.

Front Door

- When removing front door, it is better to remove front fender first.



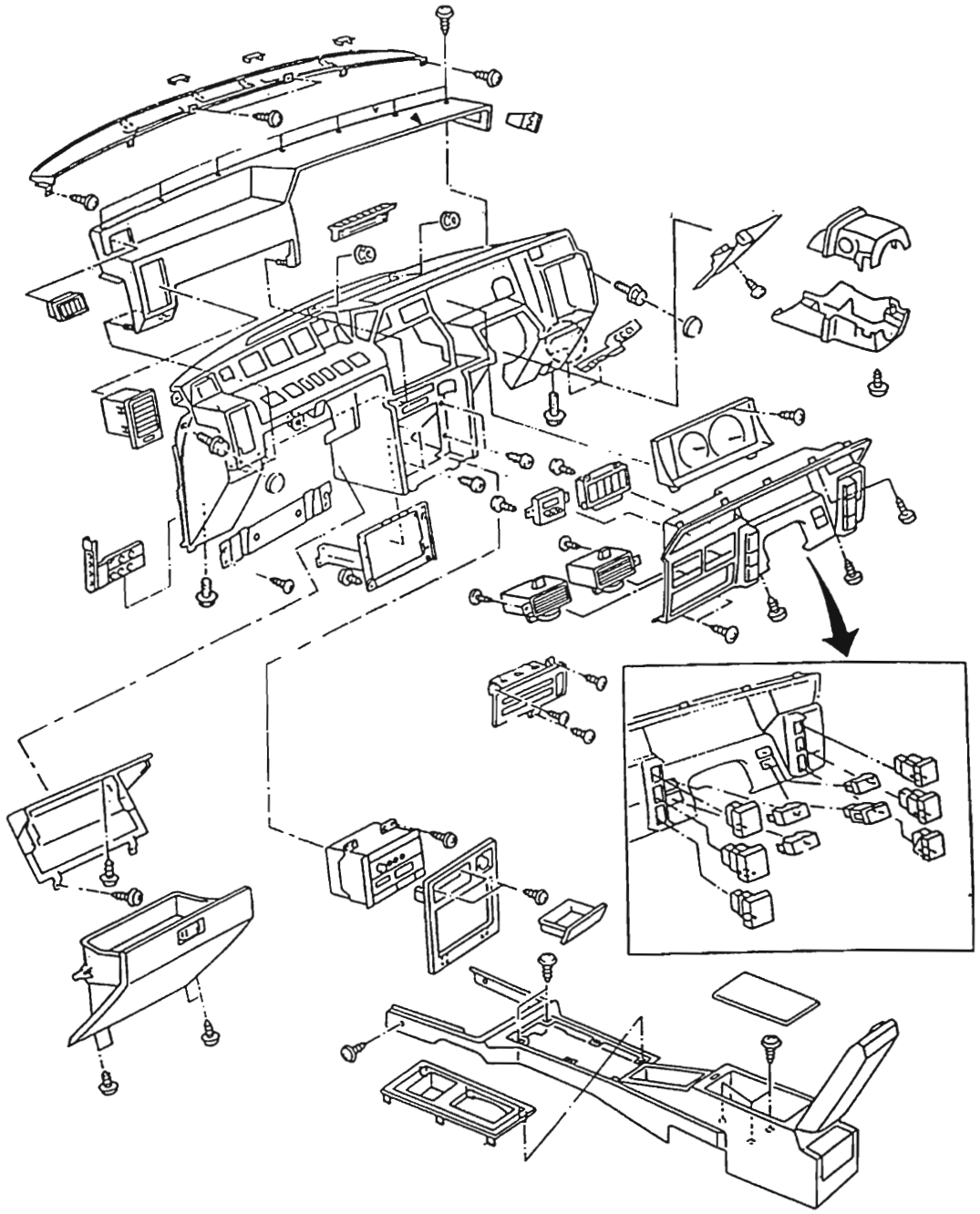
Rear Door



: N·m (kg-m, ft-lb)
: Grease-up points

SBF578C

- Some parts are made of plastic, so do not use excessive force and be careful not to damage them.



Dash Assembly — Removal

1. Remove radio fascia retaining screws, tilt fascia out at top, disconnect cigarette lighter wires, remove fascia.
2. Remove the two screws either side of radio.
3. Remove steering column shroud (2 halves).
4. Remove the two steering column bracket retaining bolts and lower the steering column assembly until wheel rests on seat cushion.
5. Disconnect R.H. footwell lamp harness, remove lower heater nozzle duct, and bonnet release handle screws.
6. Disconnect two S.M.J. harness connectors from lower side of fuse box assembly.
7. Remove two dash retaining bolts at either side of dash (1 facing rearward, 1 downward).
8. Remove heater control knobs and position control levers centrally.
9. Remove both A pillar garnishes. (lever out at top to release 3 upper clips then lift to release lower clip).
10. Remove upper dash garnish (screws located beneath covers).
11. Remove two dash retaining nuts (located under upper garnish).
12. Lift out demister duct covers.
13. Pull dash out and remove from car.

Caution: Cover steering column and console to prevent damage to fascia or console. Be careful not to damage heater control finisher or control levers.

Instrument Cluster — Removal

1. Remove ashtray and cigarette lighter and remove 3 screws retaining top of radio fascia.
2. Pull radio fascia out at top, sufficiently to disconnect cigarette lighter wires.
3. Remove lower dash fascia and steering column surround.
4. Remove the two steering column bracket retaining bolts and lower the steering column assembly until wheel rests on seat cushion.

Caution: Cover column assembly to prevent damage of cluster during removal.

5. Remove 6 screws from instrument cluster fascia lower edge and 5 screws from fascia top edge.
6. Gently lift leading edge of dash pad to allow fascia to be removed, top edge first.
7. Disconnect wiring harness plugs.
8. Remove 4 instrument cluster retaining screws, pull cluster forward and remove multi-pin connector, carefully withdraw cluster.

Fig. ① Upper garnish

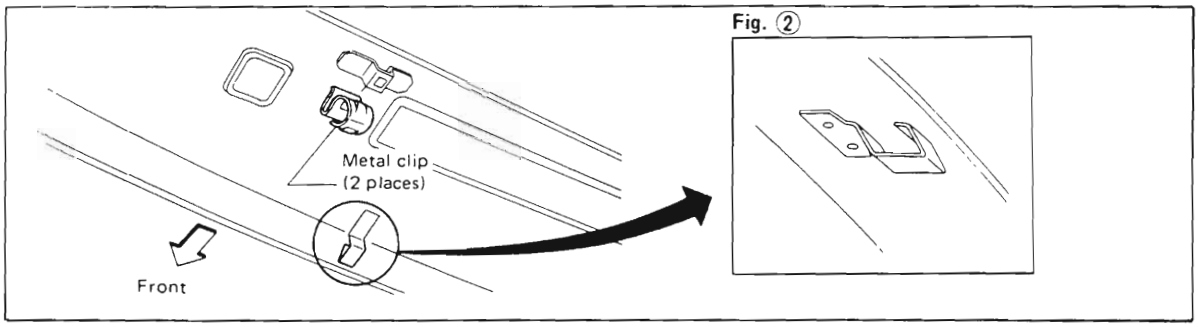


Fig. ③ Front defroster grille

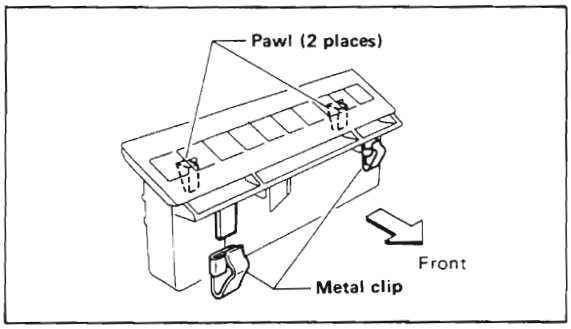


Fig. ④ Side defroster grille I

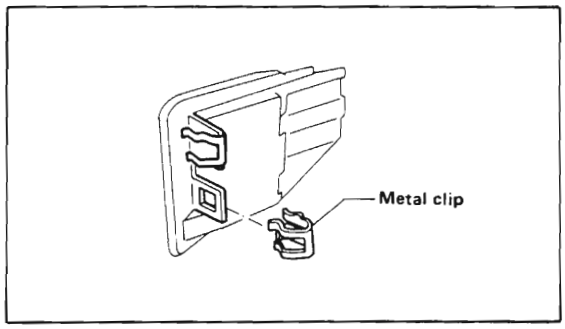


Fig. ⑤ Side defroster grille II

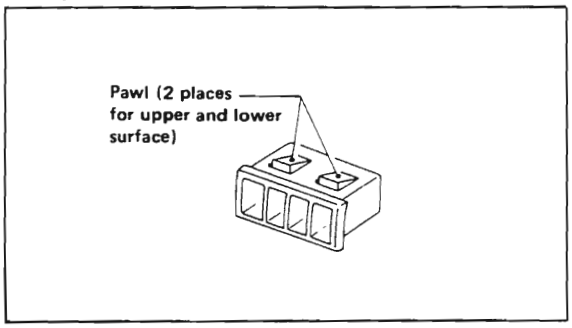


Fig. ⑥ Side VENT.

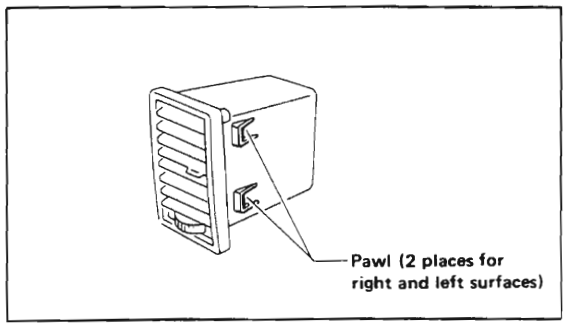


Fig. ⑦ Super multiple junction

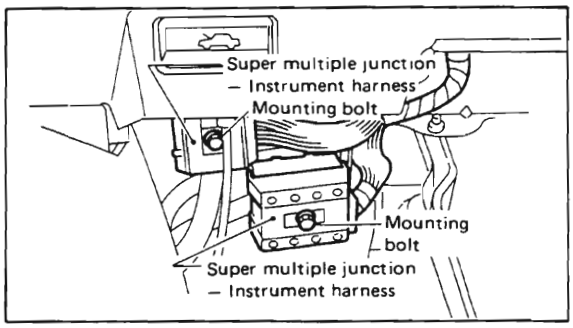
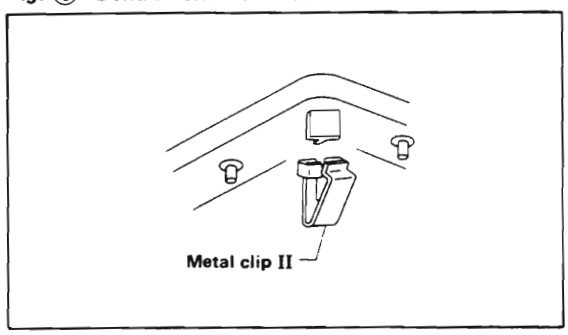


Fig. ⑧ Centre console finisher



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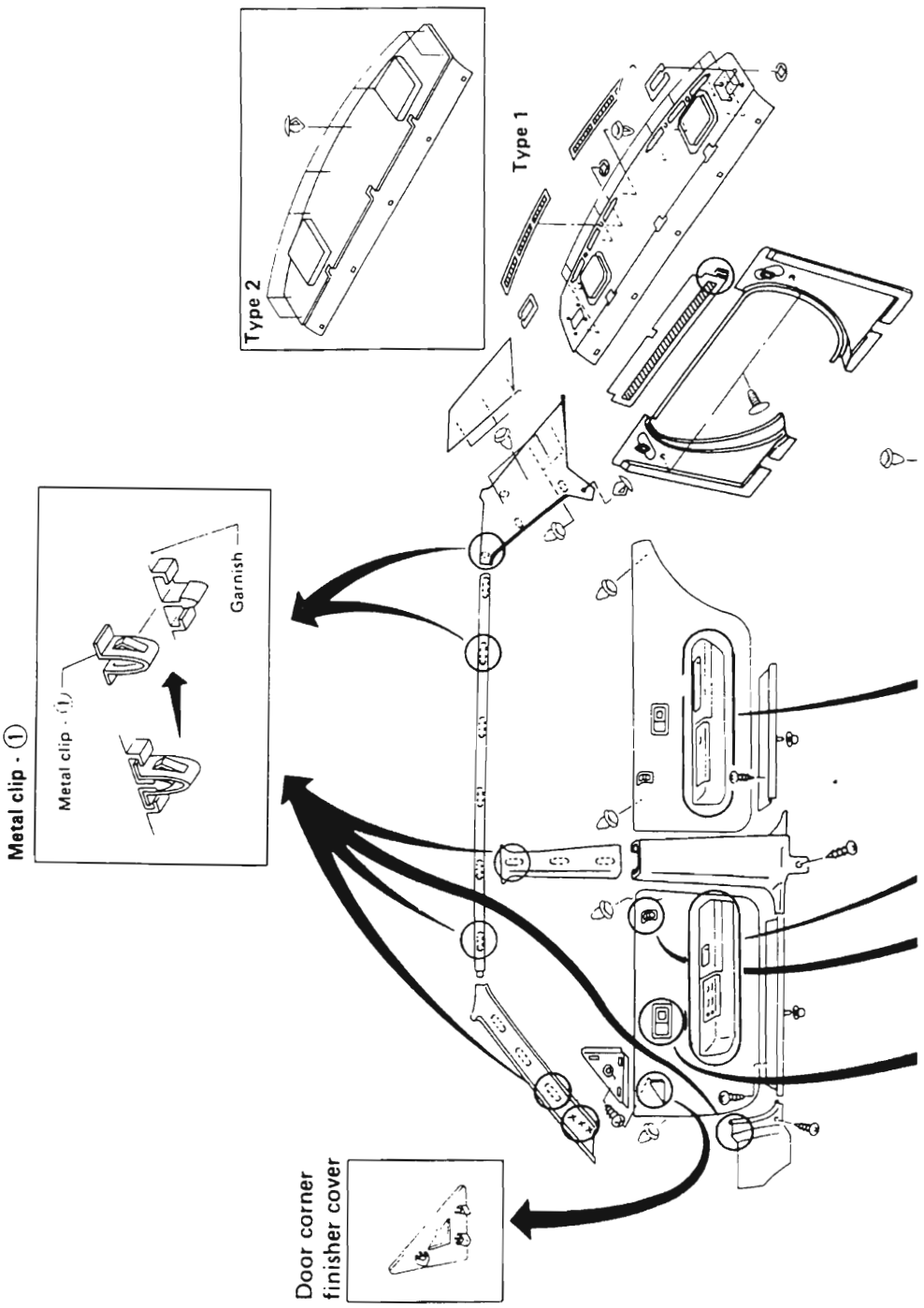
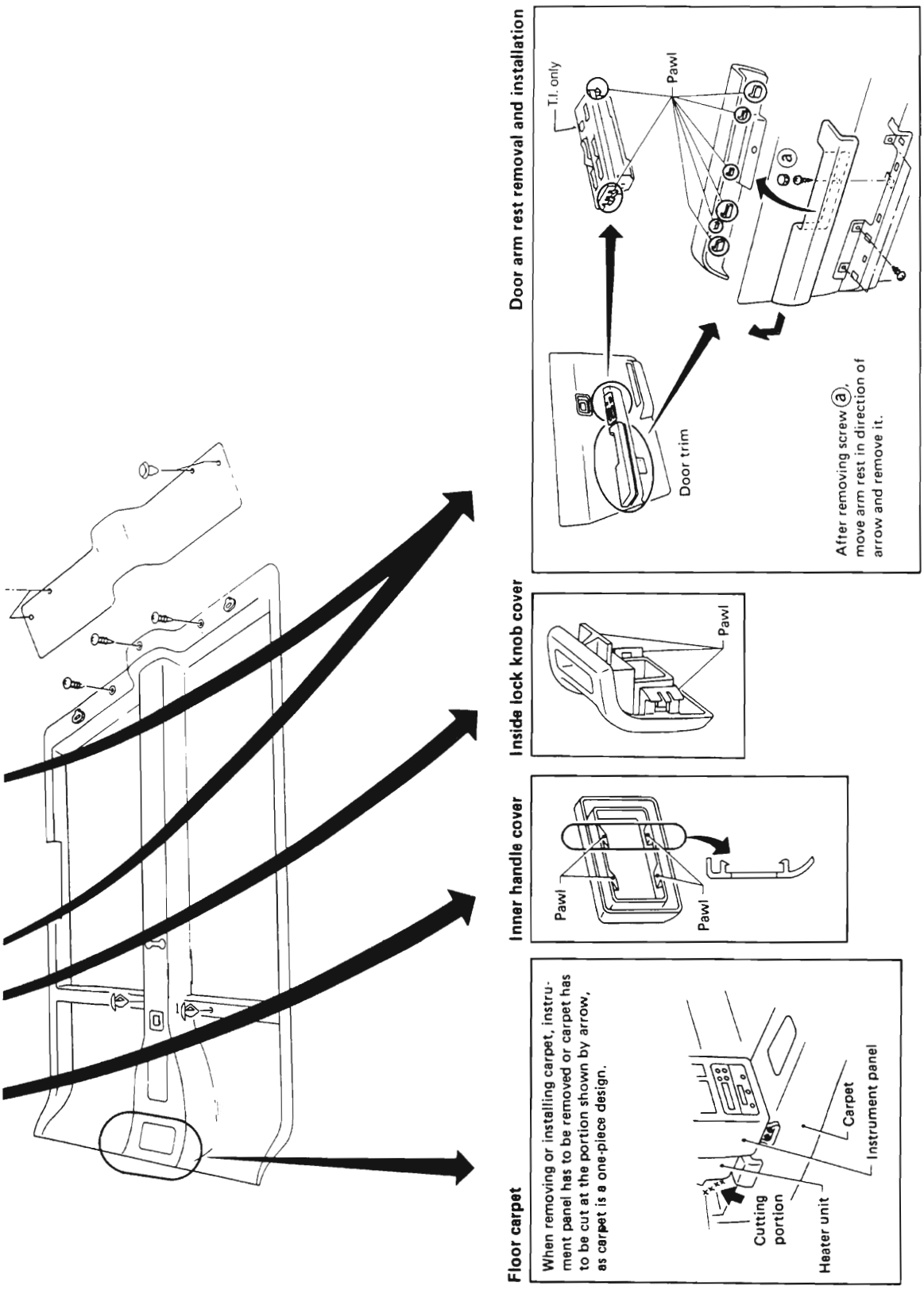
- When removing clip or fastener, refer to CLIP & FASTENER.
- When handling interior or exterior, do not use excessive force and take care not to damage them.

Interior

SIDE AND FLOOR TRIM – Passenger room



Interior (Cont'd)



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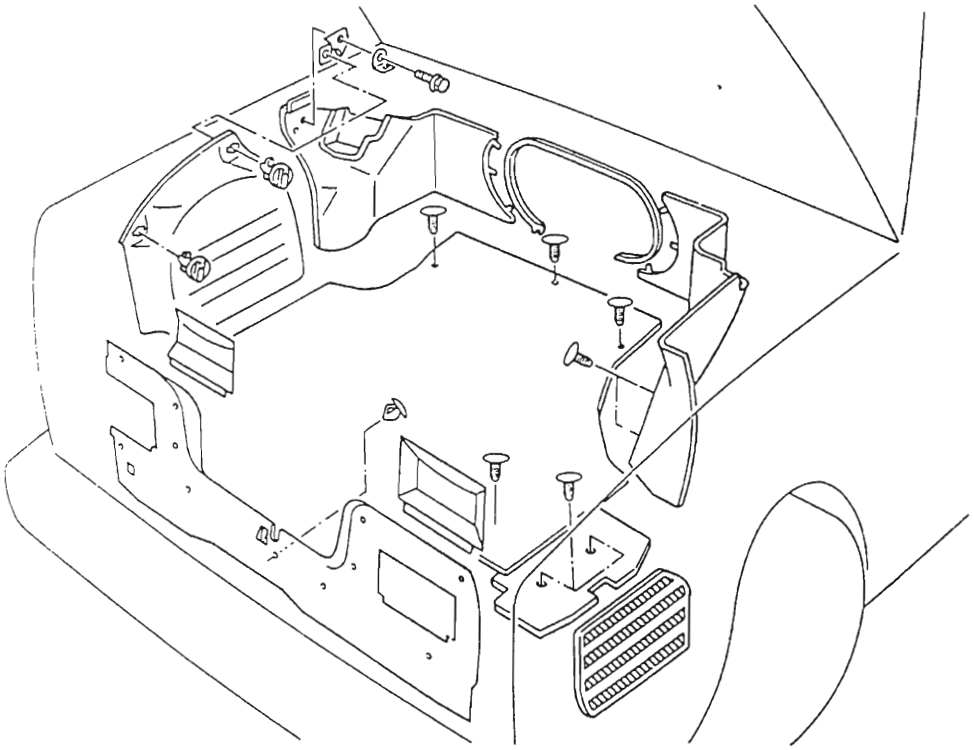
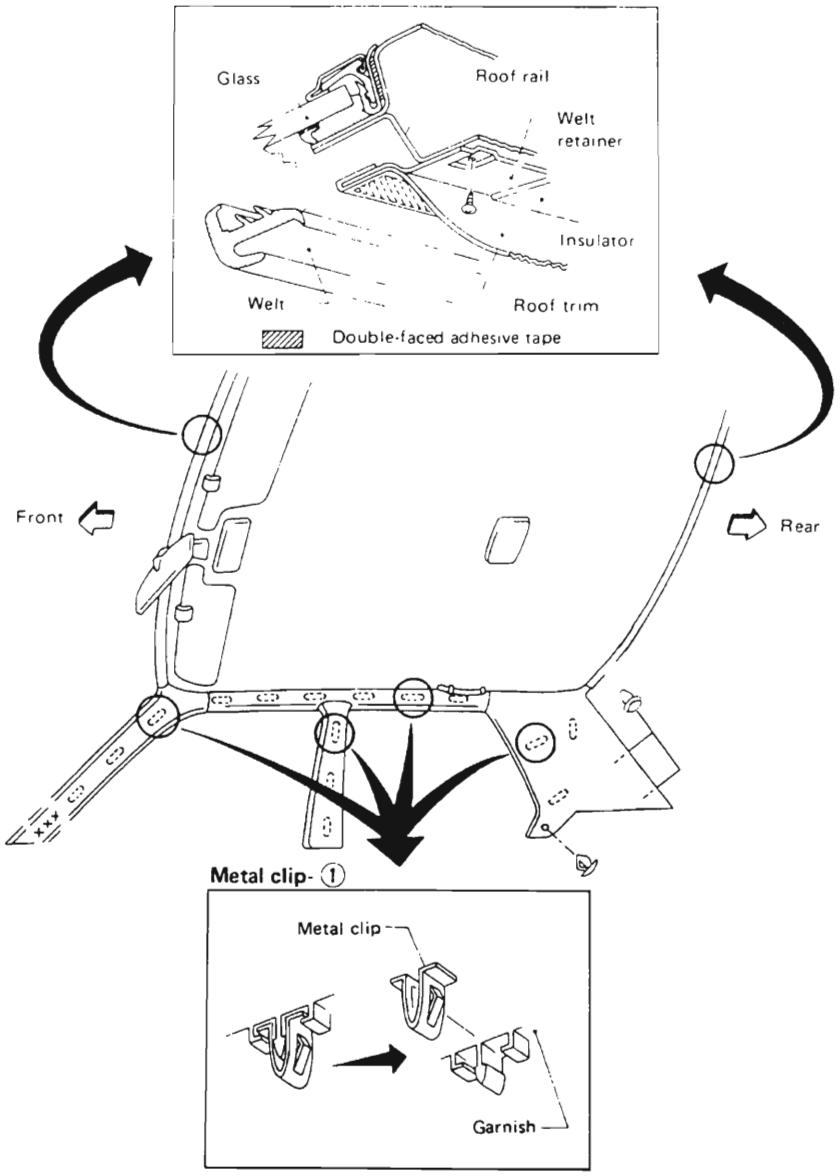
Interior (Cont'd)

LUGGAGE ROOM TRIM — Boot space



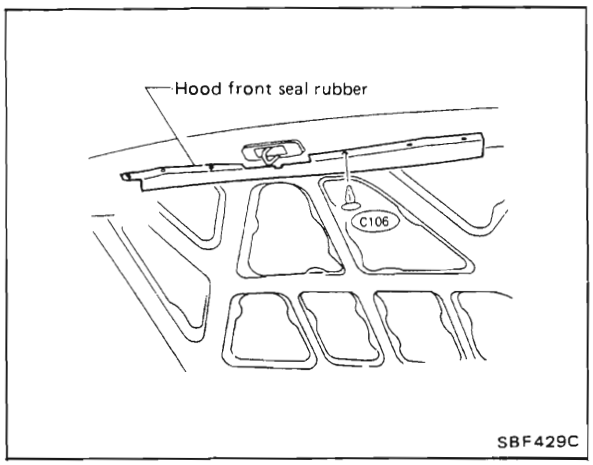
Interior (Cont'd)

ROOF TRIM

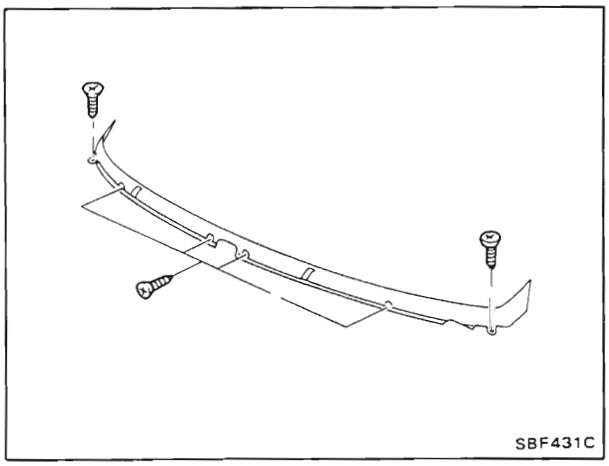


Exterior

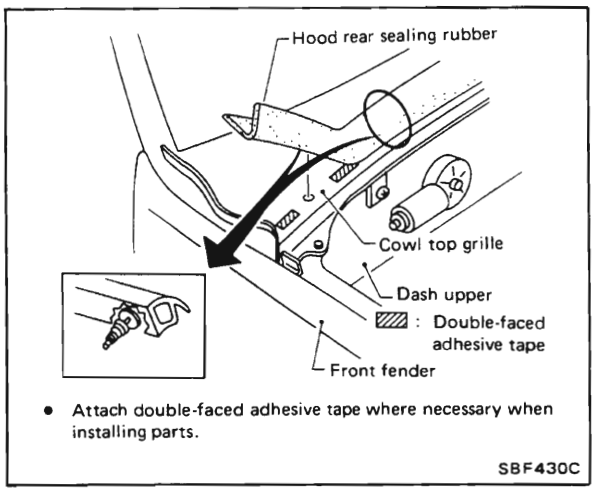
Hood front sealing rubber



Windshield lower molding

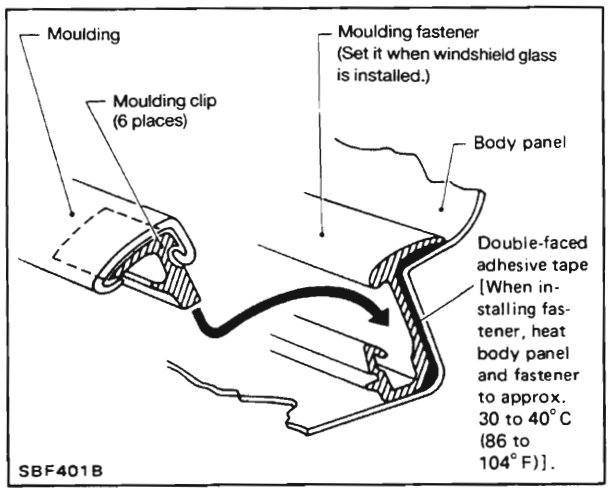


Hood rear sealing rubber

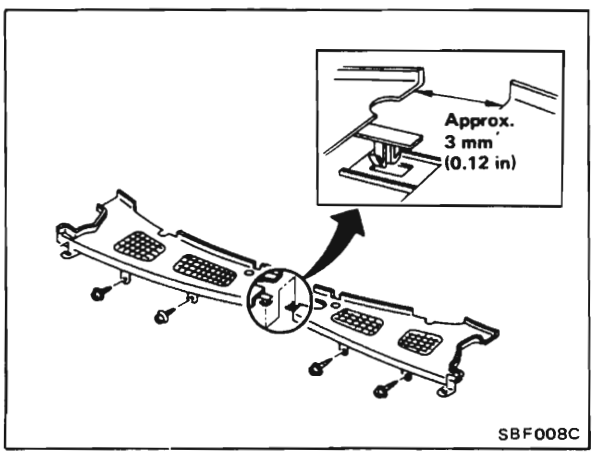


- Attach double-faced adhesive tape where necessary when installing parts.

Windshield upper moulding



Cowl top grille



Rear window upper and side moulding

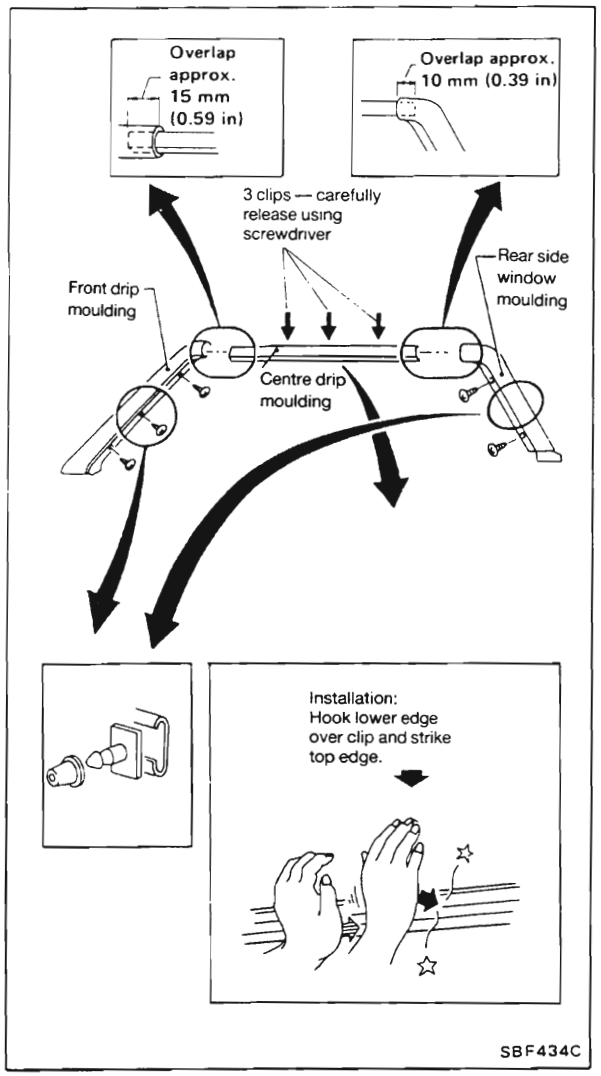
Basically the same as windshield upper moulding. It differs from windshield upper moulding in that the rear window upper moulding has six clips while side moulding has five clips.

Rear window lower moulding

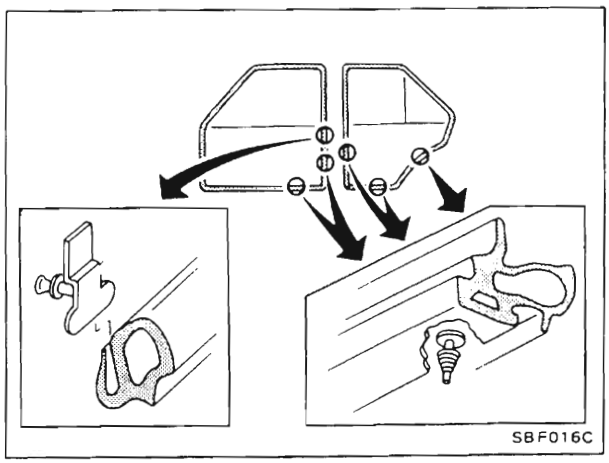
Basically the same as windshield lower moulding.

Exterior (Cont'd)

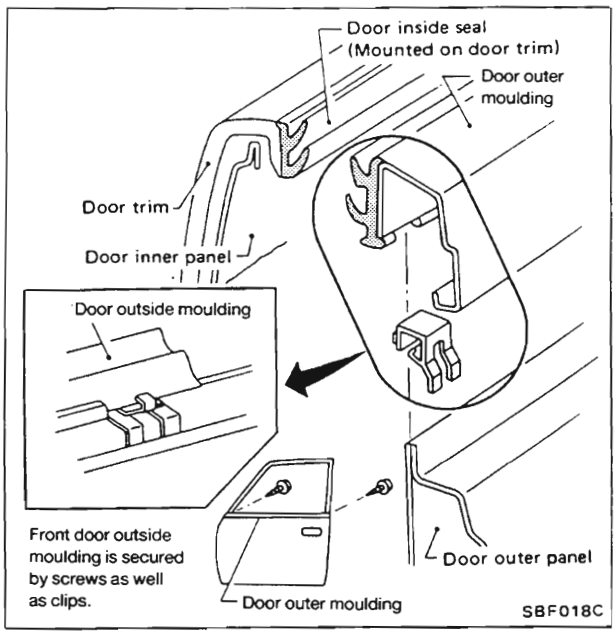
Drip moulding



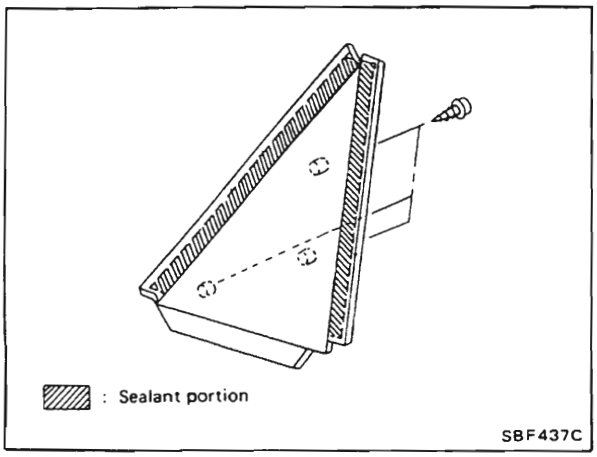
Door weatherstrip



Door outside moulding and inside seal

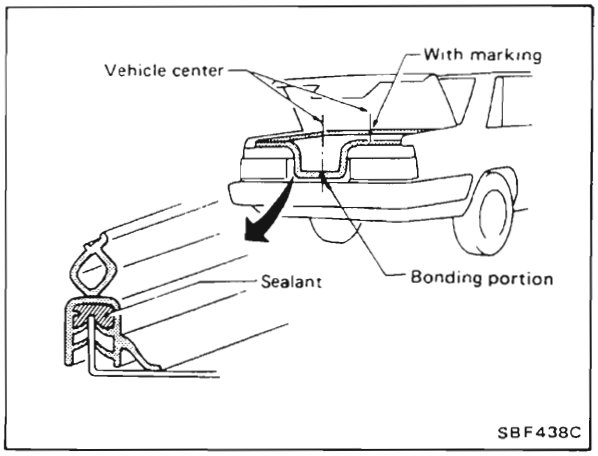


Door corner outer finisher

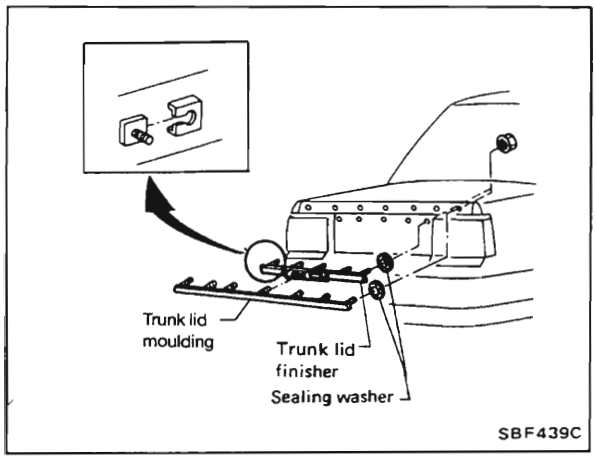


Exterior (Cont'd)

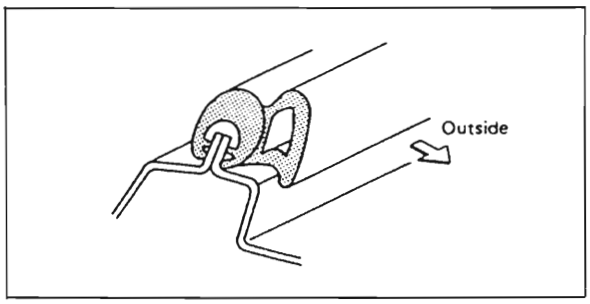
Trunk lid weatherstrip



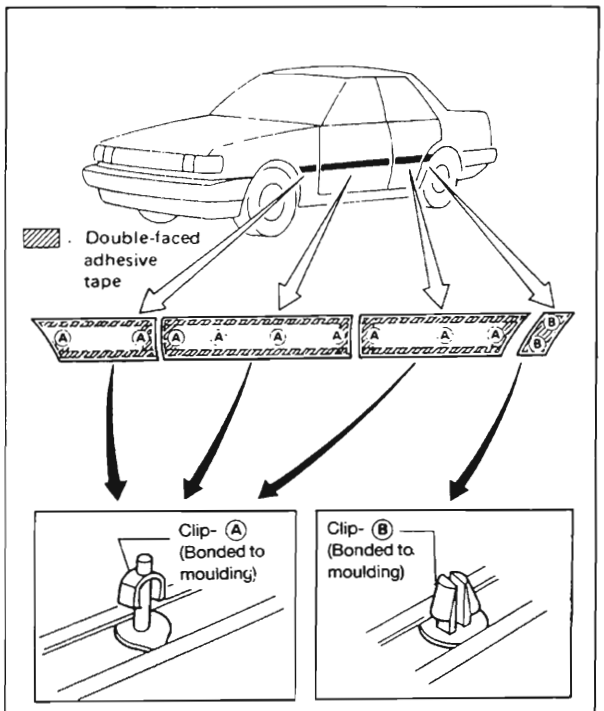
Trunk lid moulding and finisher



Body side welt

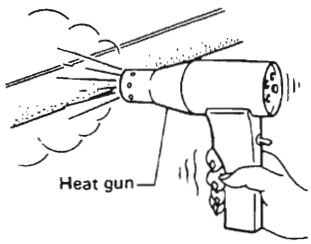


Side guard moulding



- **Remove it only if it is necessary to do so.**
- **Removal:**

1. Heat moulding portion to 30 to 40°C (86 to 104°F) with a heat gun.



2. Raise end of moulding and, while cutting off bonding agent, detach moulding.

- **Installation**

1. Remove all traces of bonding agent from body panel. Then clean contact face of body.
2. Heat body panel and moulding to 30 to 40°C (86 to 104°F) with a heat gun. Then install moulding.

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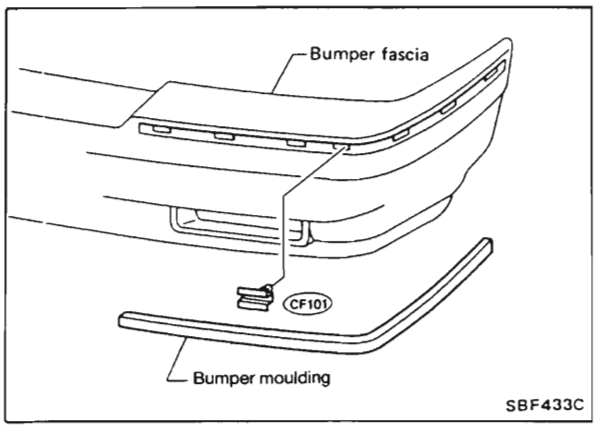
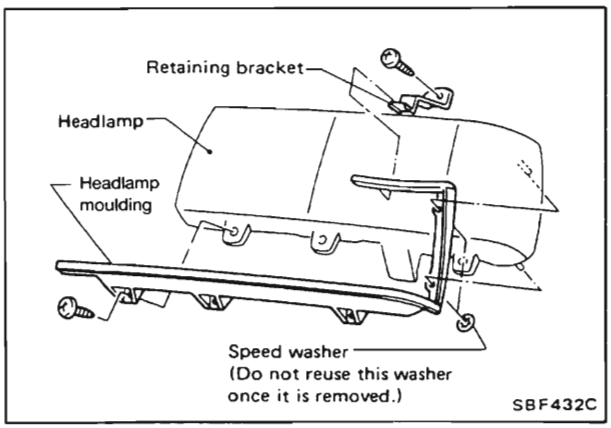
Exterior (Cont'd)

Bumper moulding



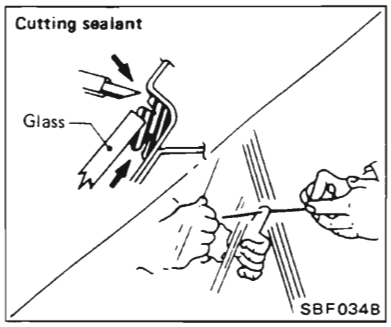
Headlamp moulding



Windshield and Rear Window

REMOVAL

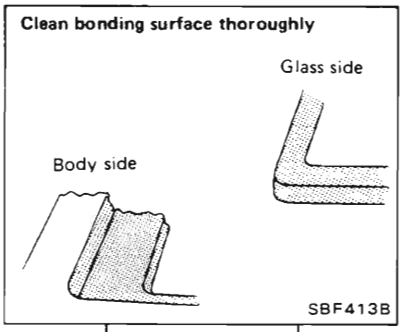
After removing mouldings remove glass.



CAUTION:
Be careful not to scratch glass when removing.

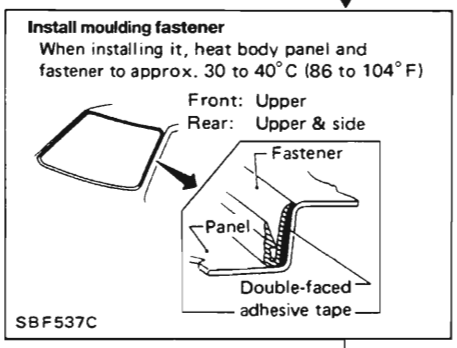
INSTALLATION

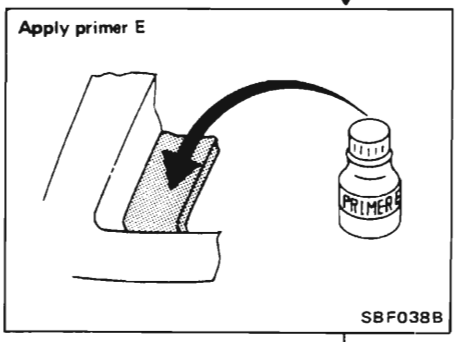
- **Use genuine Nissan Sealant kit or equivalent. Follow instructions furnished with it.**
- **After installation, the vehicle should remain stationary for about 24 hours.**
- **Do not use sealant which is more than 12 months past its production date.**
- **Do not leave cartridge unattended with its cap open.**
- **Keep Primers and sealant in a cool, dry place. ideally, sealant should be stored in a refrigerator.**
- **Be sure to install mouldings.**



WARNING:
Keep heat or open flames away as Primers are flammable.

Body side

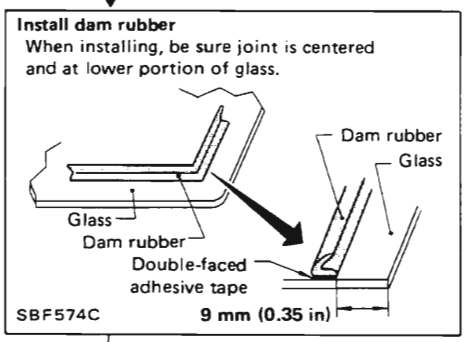




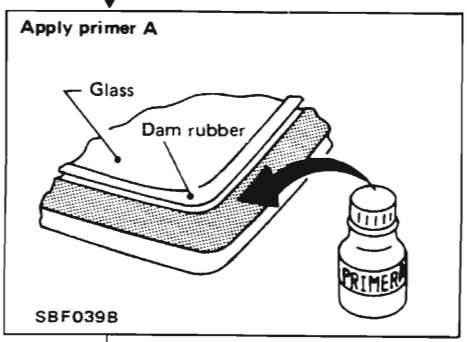
CAUTION:
Allow Primers to dry for 10 to 15 minutes before proceeding to the next step.

Ⓐ

Glass side



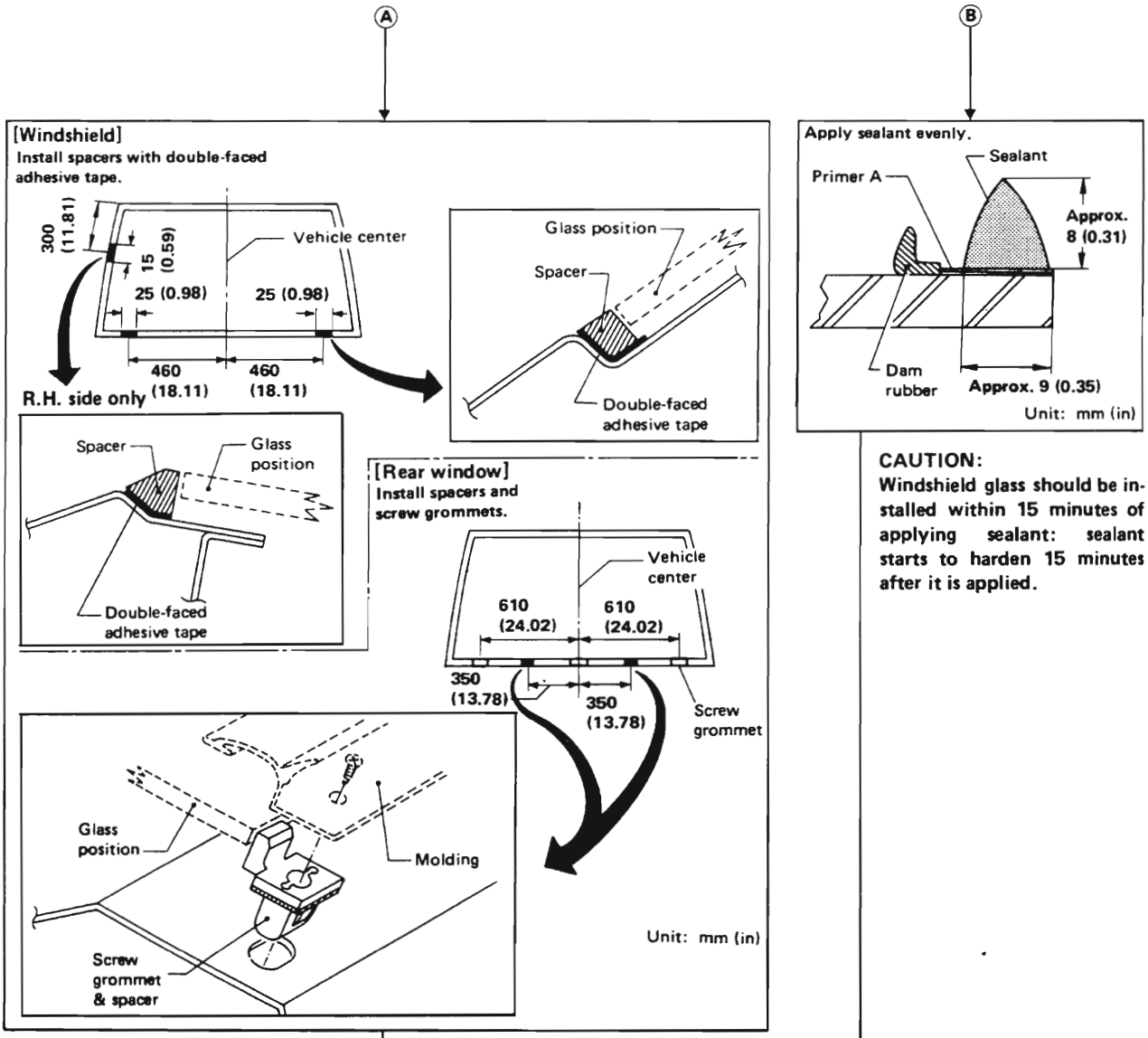
CAUTION:
Do not apply Primer A to windshield opening flanges.



CAUTION:
Do not apply Primer A to windshield opening flanges.

Ⓑ

Windshield and Rear Window (Cont'd)



CAUTION:
Windshield glass should be installed within 15 minutes of applying sealant: sealant starts to harden 15 minutes after it is applied.

Set glass in position and press glass lightly and evenly.

Check for water leakage.

Install mouldings.

CAUTION:
Moulding must be installed securely so that it is in position and leaves no gap.

Windshield and Rear Window (Cont'd)

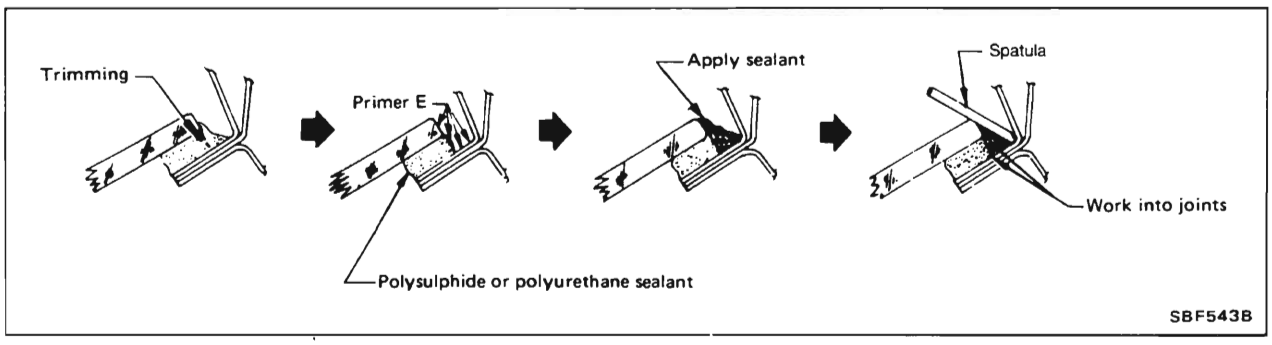
Reference: Period required for sealant to dry to desired hardness.

Temperature °C (°F) \ Relative humidity %	90	50	25
25 (77)	0.8	1.5	2.9
5 (41)	1.8	4.7	8.2

CAUTION:
Advise the user of the fact that vehicle should not be driven on rough roads or surfaces until sealant has properly vulcanized.

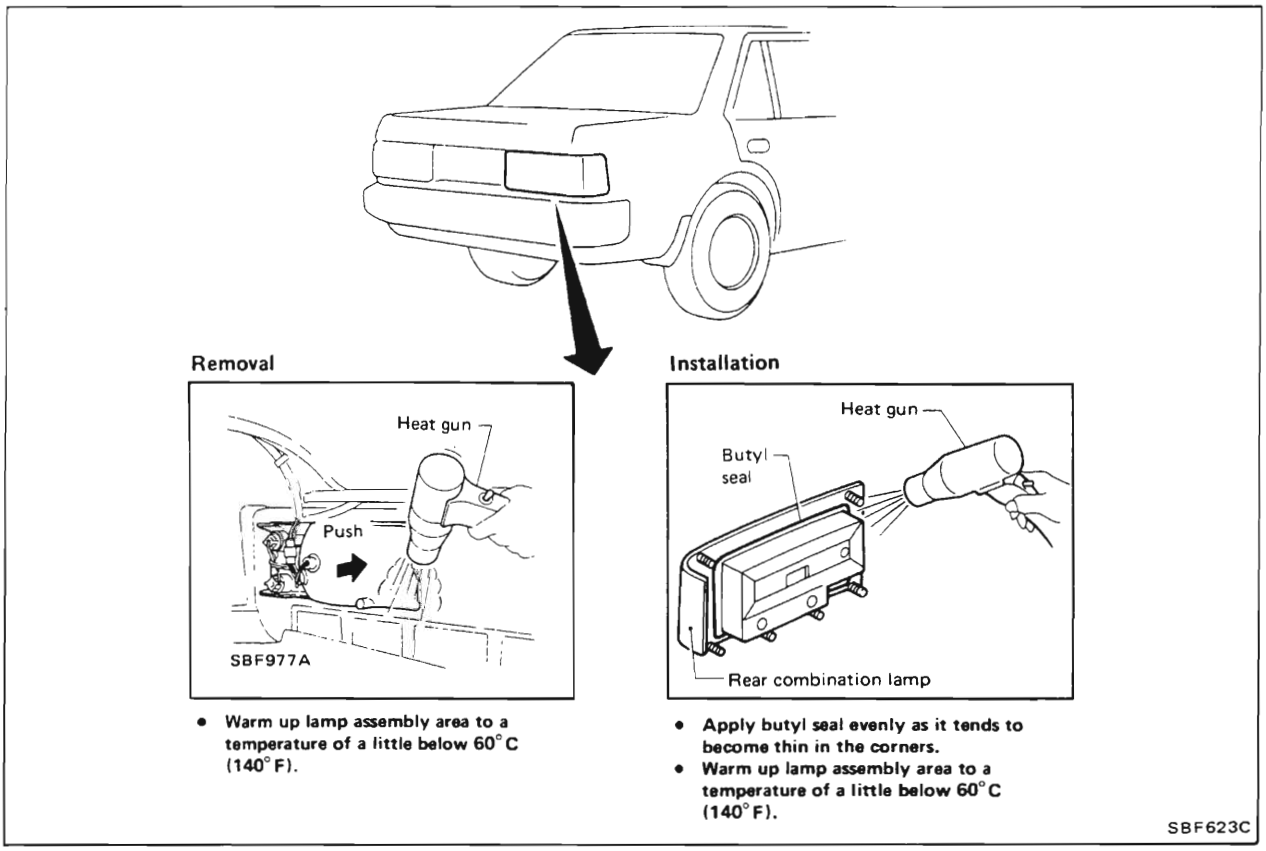
Repairing Water Leak

Leaks can be repaired without removing and reinstalling glass.
If water is leaking between caulking material and body or between glass and caulking material, determine the extent of the leak by applying water while pushing glass outward.
To stop the leak, apply primer and then sealant to the leak point.



REAR COMBINATION LAMP

- Rear combination lamps are installed with nuts and butyl sealant.



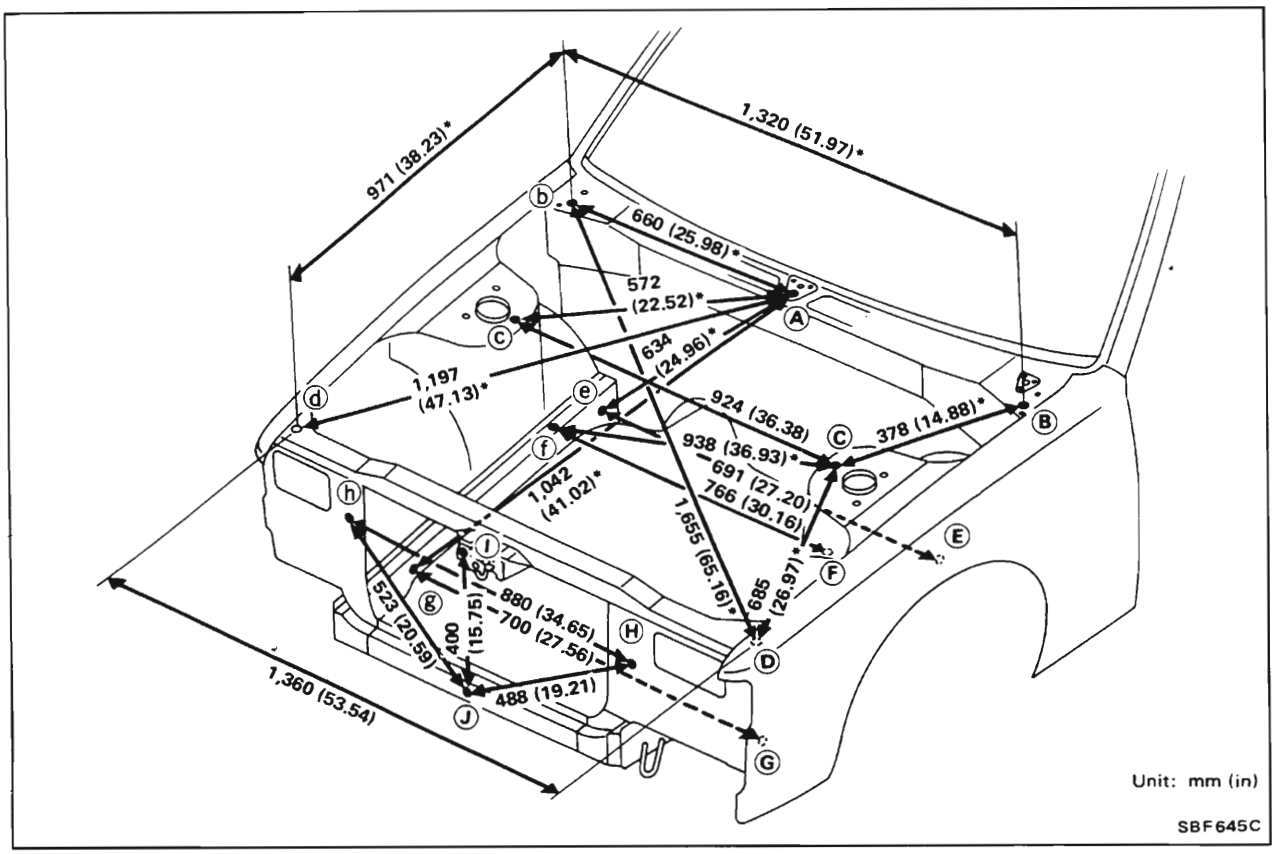
- **Warm up lamp assembly area to a temperature of a little below 60°C (140°F).**

- **Apply butyl seal evenly as it tends to become thin in the corners.**
- **Warm up lamp assembly area to a temperature of a little below 60°C (140°F).**

- All dimensions indicated in figures are actual ones.
- When a measuring tape is used, check to be sure there is no elongation, twisting or bending.
- Measurements should be taken at the center of the mounting holes.
- An asterisk (*) following the value at the measuring point indicates that the measuring point on the other side is symmetrically the same value.
- Measurement points
  The coordinates of the measurement points are the distances measured from the respective dimension lines in the directions of "x", "y" and "z".
  Dimension lines: "x" line – Center line of vehicle
  "y" line – Center line of front axle (Any measurement point in front of the dimension line refers to a minus "–" value.)
  "z" line – Datum line (Any measurement point under the dimension line refers to a minus "–" value.)

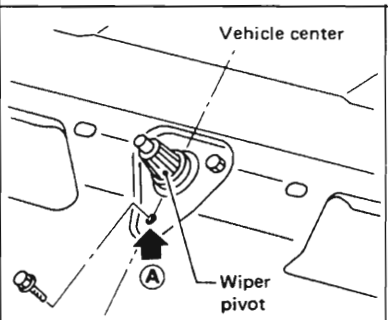
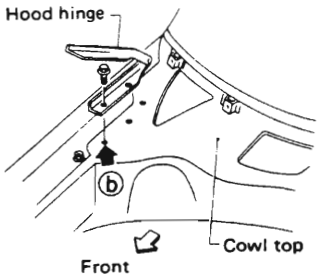
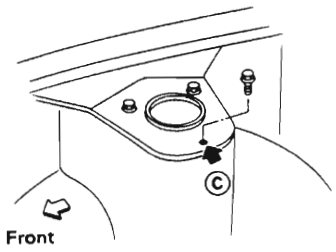
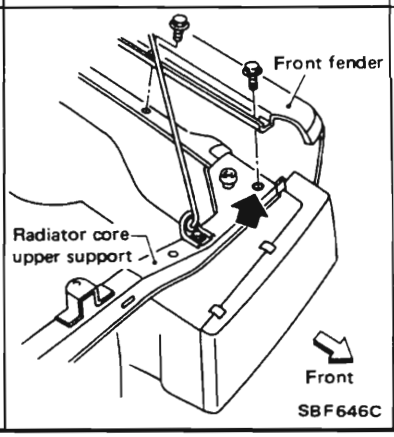
Engine Compartment

MEASUREMENT

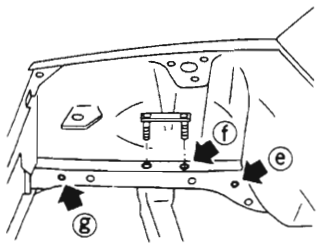
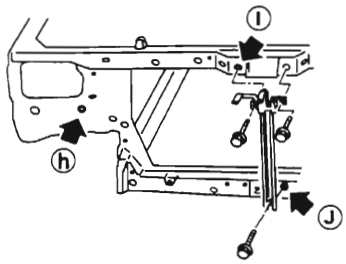


Engine Compartment (Cont'd)

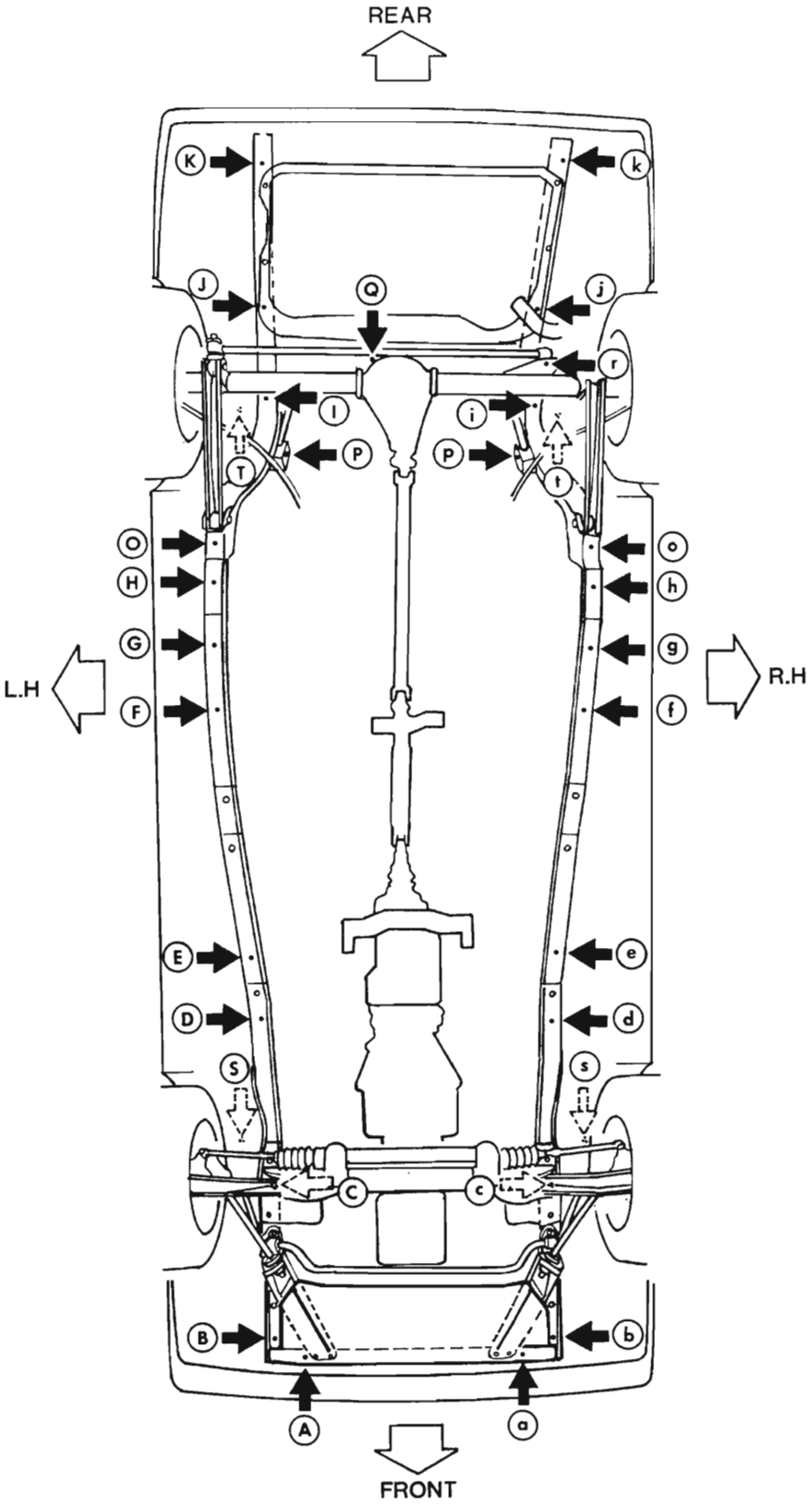
DETAILED MEASUREMENT POINTS

Points	Hole dia. mm (in)	Detailed points		Coordinates mm (in)		
				"x"	"y"	"z"
Ⓐ	7 (0.28)	 SBF080C	Hole for wiper pivot mounting at vehicle center	0.0 (0.00)	378.7 (14.91)	655.4 (25.80)
Ⓑ ⓑ	12 (0.47)	 SBF673B	Hole for hood hinge mounting (Front side hole)	660.0 (25.98)	367.0 (14.45)	634.8 (24.99)
Ⓒ ⓒ	11 (0.43)	 SBF674B	Hole for front suspension upper mounting	461.8 (18.18)	48.8 (1.921)	582.7 (22.94)
Ⓓ ⓓ	M6 (0.24) Welded nut	 SBF646C	Hole for front fender mounting at upper-side of radiator core upper support	680.0 (26.77)	−598.0 (−23.54)	525.8 (20.70)

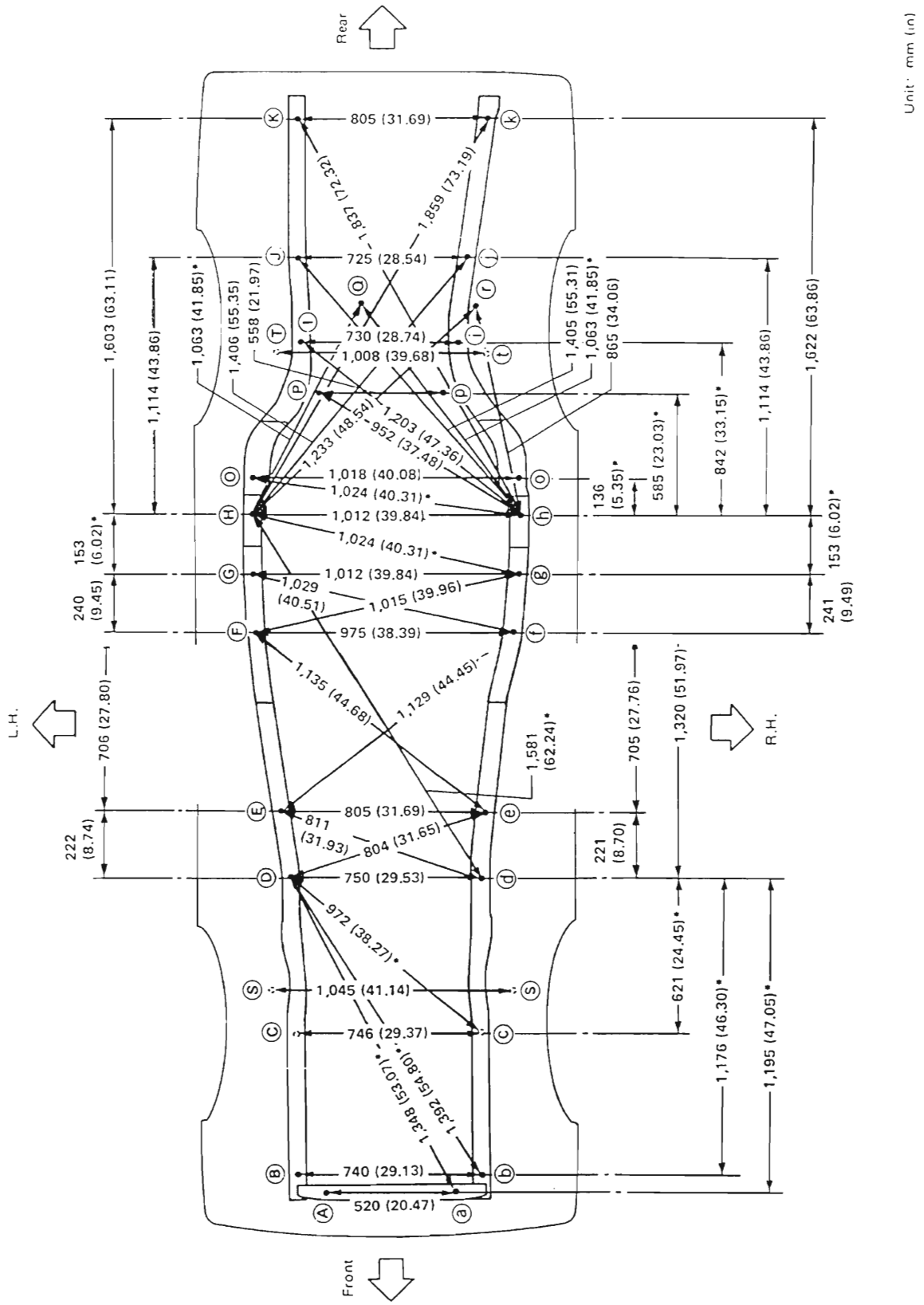
Engine Compartment (Cont'd)

Points	Hole dia. mm (in)	Detailed points		Coordinates mm (in)		
				"x"	"y"	"z"
Ⓔ ⓔ	20 (0.79)	 SBF647C	Hole for locating at the side of front side member (Rear portion)	345.5 (13.60)	249.9 (9.84)	140.0 (5.51)
Ⓕ ⓕ	13 (0.51)		Hole for suspension member mounting at upperside of front side member (Rear side hole)	383.0 (15.08)	37.0 (1.457)	175.0 (6.89)
Ⓖ ⓖ	14 (0.55)		Hole for locating at the side of front side member (Front portion)	350.0 (13.78)	−450.0 (−17.72)	130.0 (5.12)
Ⓗ ⓗ	10 (0.39)	 SBF648C	Hole for locating at radiator core side support	440.0 (17.32)	−595.0 (−23.43)	330.0 (12.99)
Ⓘ	13 (0.51)		Hole for hood lock mounting (R.H. side hole)	R.H. side 35.5 (1.398)	−633.0 (−24.92)	481.5 (18.96)
Ⓙ	11 (0.43)		Hole for hood lock support lower mounting	L.H. side only 20.0 (0.787)	−633.4 (−24.94)	85.0 (3.35)

Underbody (Cont'd)



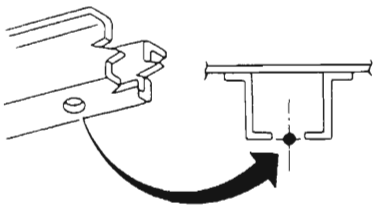
Underbody (Cont'd)



Underbody (Cont'd)

DETAILED MEASUREMENT POINTS

Points	Hole dia. mm (in)	Detailed points	Coordinates mm (in)		
			"x"	"y"	"x"
Ⓐ a	12 (0.47)	Hole for locating at underside of radiator core lower support	260.0 (10.24)	−605.0 (−23.82)	44.5 (1.752)
Ⓓ d	13 (0.51)	Hole for locating at underside of front side member extension	375.0 (14.76)	580.0 (22.83)	−58.0 (−2.28)
Ⓔ ⓔ	12 (0.47)	Hole for locating at underside of center-side member — front	398.6 (15.69)	800.0 (31.50)	−58.0 (−2.28)
Ⓕ ⓕ	20 (0.79)	Hole for locating at underside of center side member — rear	480.0 (18.90)	1,500.0 (59.06)	−62.2 (−2.45)
Ⓖ ⓖ	20 (0.79)		506.0 (19.92)	1,740.0 (68.50)	−62.2 (−2.45)
Ⓗ ⓗ	20 (0.79)	Hole for locating at underside of rear side member front extension	506.0 (19.92)	1,893.0 (74.53)	−63.3 (−2.49)
Ⓘ ⓘ	14 (0.55)	Hole for locating at underside of rear side member	365.0 (14.37)	2,663.0 (104.84)	246.6 (9.71)
Ⓞ ⓞ	12 (0.47)	Hole for locating at underside of rear suspension lower link bracket	508.9 (20.04)	2,027.8 (79.83)	−46.0 (−1.81)
Ⓠ	12 (0.47)	Hole for locating at underside of panhard rod mounting member	0.0 (0.00)	2,775.0 (109.25)	246.6 (9.71)



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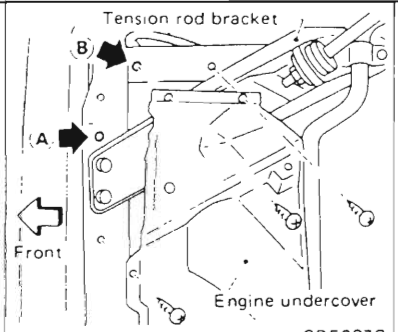
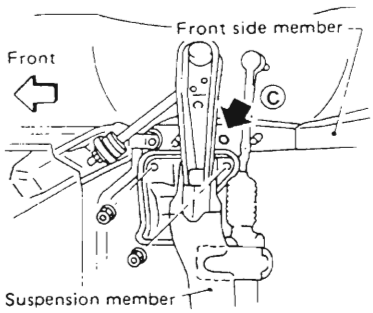
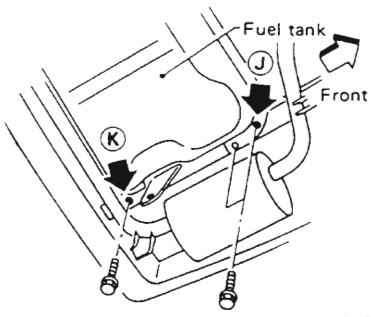
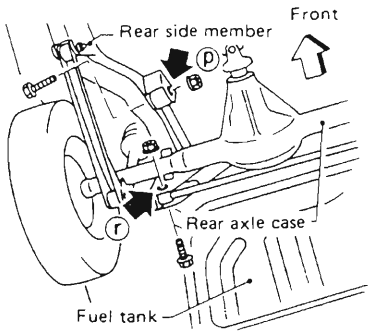
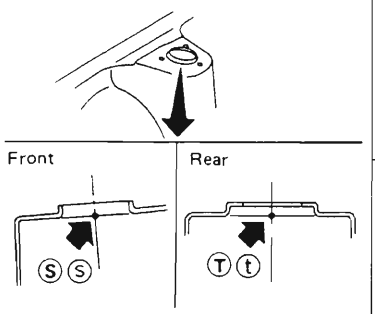
Underbody (Cont'd)

Points	Hole dia mm (in)	Detailed points		Coordinate mm (in)		
				"x"	"y"	"z"
B b	4.8 (0.19)	 SBF087C	Engine undercover mounting hole at front side member front portion	370.0 (14.57)	−590.0 (−23.23)	60.9 (2.40)
Ⓒ ⓒ	16 (0.63)	 SBF088C	Hole for locating on front suspension member mounting portion (Underside of front side member)	373.0 (14.69)	−23.0 (−0.91)	90.0 (3.54)
Ⓙ ⓙ	14 (0.55)	 SBF089C	Fuel tank mounting hole	363.0 (14.29)	2,970.0 (116.93)	183.6 (7.23)
Ⓚ ⓚ	14 (0.55)		Rear bumper front mounting hole	408.0 (16.06)	3,493.0 (137.52)	183.6 (7.23)

Underbody (Cont'd)

Points	Hole dia mm (in)	Detailed points		Coordinate mm (in)		
				"x"	"y"	"z"
Ⓟ Ⓟ	12 (0.47)	 SBF091C	Rear suspension upper link mounting hole	279.2 (10.99)	2,387.1 (93.98)	152.0 (5.98)
Ⓡ	13.5 (0.53)		Rear suspension panhard rod mounting hole	R.H side only 381.0 (15.00)	2,736.1 (107.72)	87.0 (3.43)
Ⓢ Ⓢ	82.8 (3.26)	 SBF092C	Front suspension upper mounting	522.4 (20.57)	48.6 (1.91)	590.8 (23.26)
Ⓣ Ⓣ	53 (2.09)		Rear suspension upper mounting	504.1 (19.85)	2,679.3 (105.48)	667.4 (26.28)

HEATER & AIR CONDITIONER

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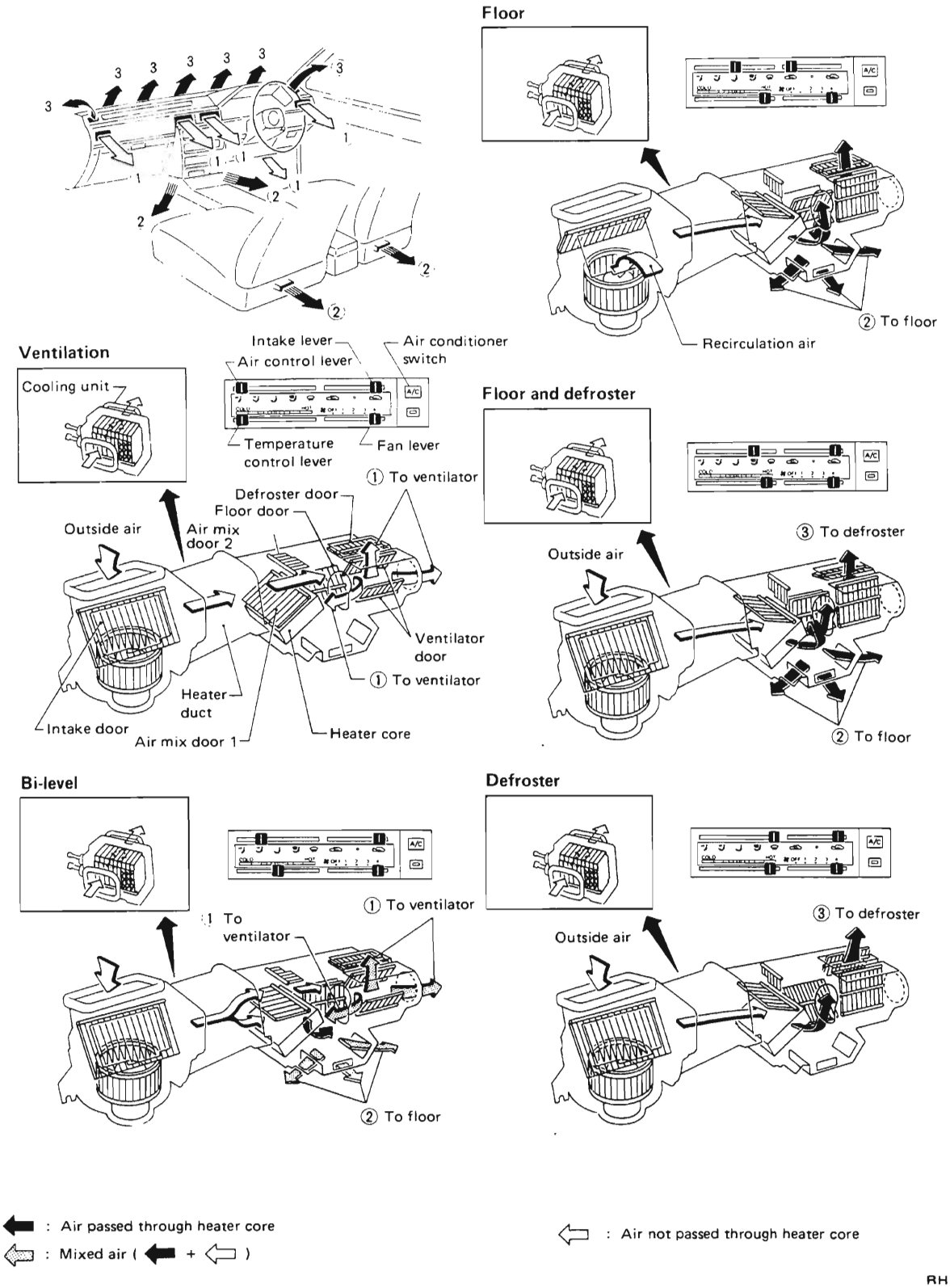
Air Flow



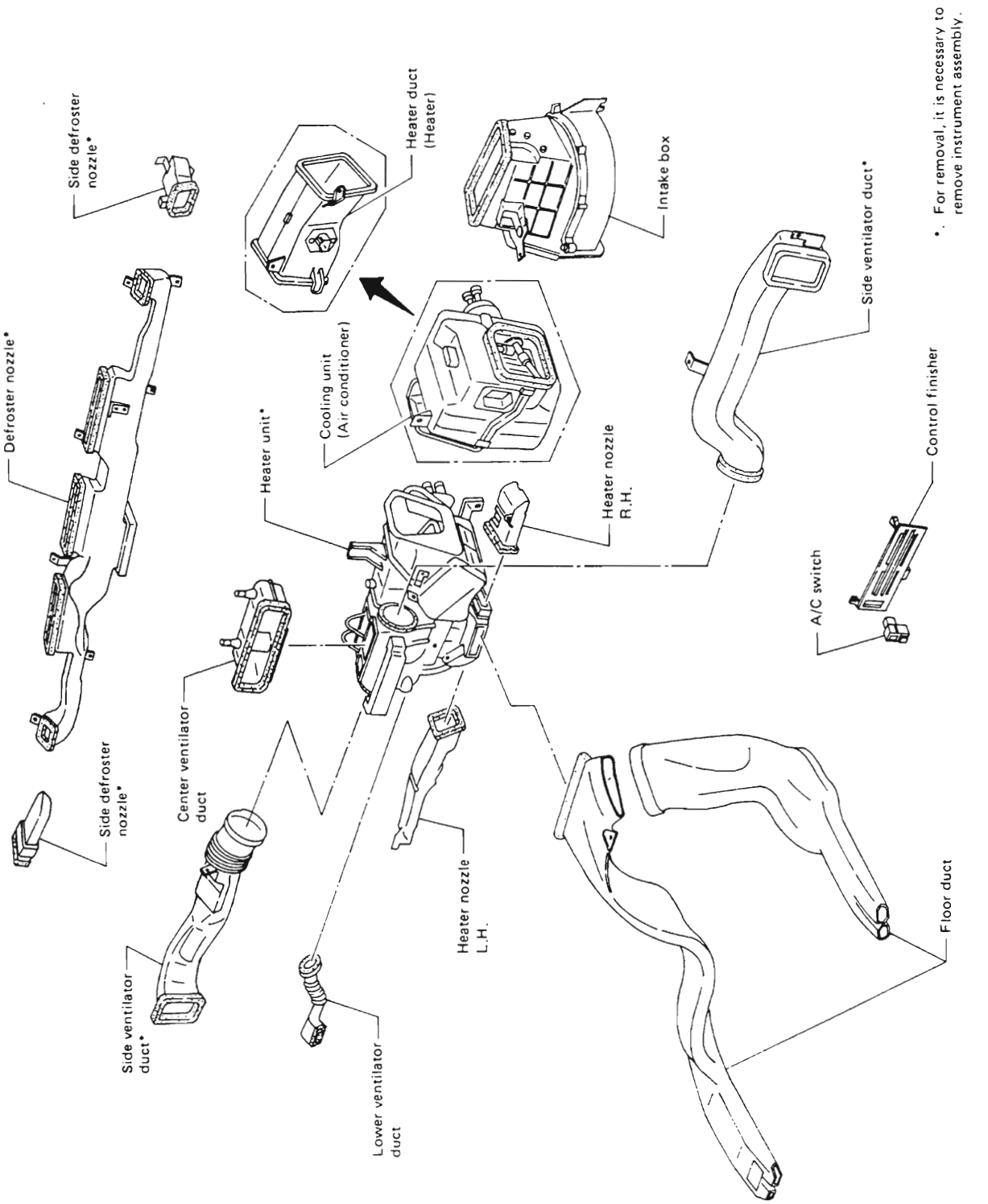
: Air passed through heater core

: Mixed air (+)

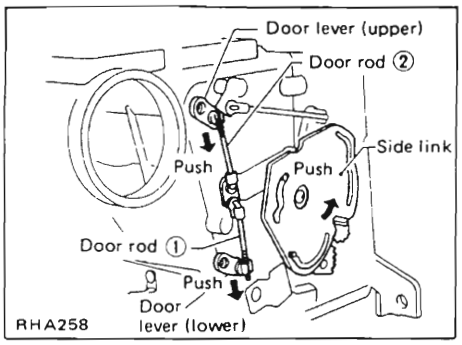
: Air not passed through heater core

RHA432

Component Layout



RHA433

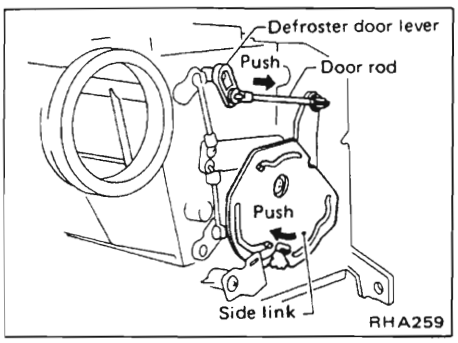


Control Cable and Rod Adjustment

- When adjusting ventilator door rod and defroster door rod, disconnect air control cable from side link first, and then adjust door rod.
  Reconnect air control cable and readjust it.

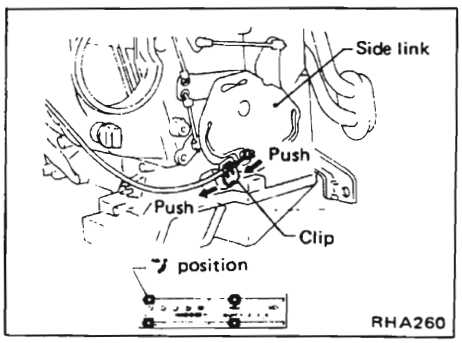
VENTILATOR DOOR CONTROL ROD

1. Move side link in direction of arrow.
2. With upper and lower ventilator door levers held in the direction of the arrow, connect rods ① and ② to their corresponding ventilator door levers in that order.



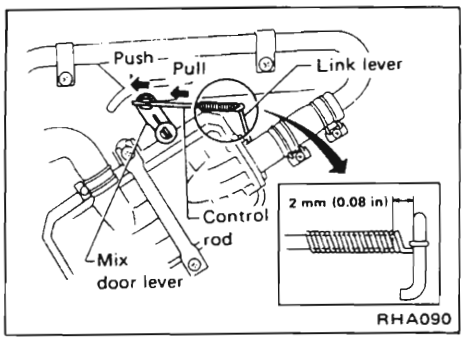
DEFROSTER DOOR CONTROL ROD

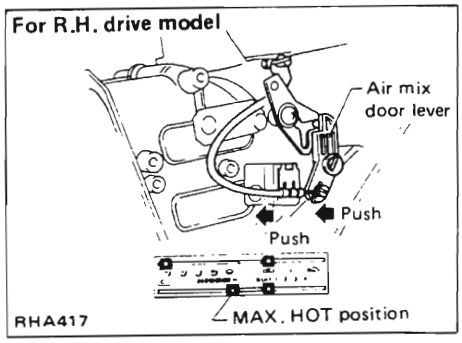
1. Move side link in direction of arrow.
2. Connect rod to side link while pushing defroster door lever in direction of arrow.

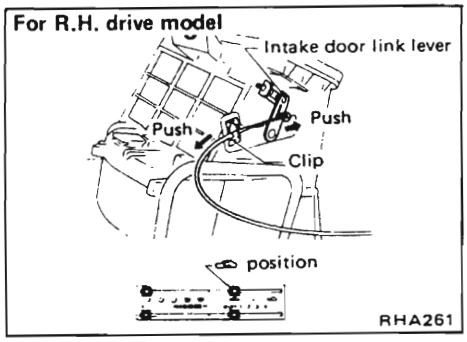


AIR CONTROL CABLE

- Clamp the cable while pushing cable outer case and side link in direction of arrow.







WATER COCK CONTROL ROD

- **When adjusting water cock control rod, first disconnect temperature control cable from air mix door lever and then adjust control rod. Reconnect temperature control cable and readjust it.**

1. Push air mix door lever in direction of arrow.
2. Pull control rod of water cock in direction of arrow so as to make clearance of about 2 mm (0.08 in) between ends of rod and link lever and connect the rod to door lever.

TEMP CONTROL CABLE

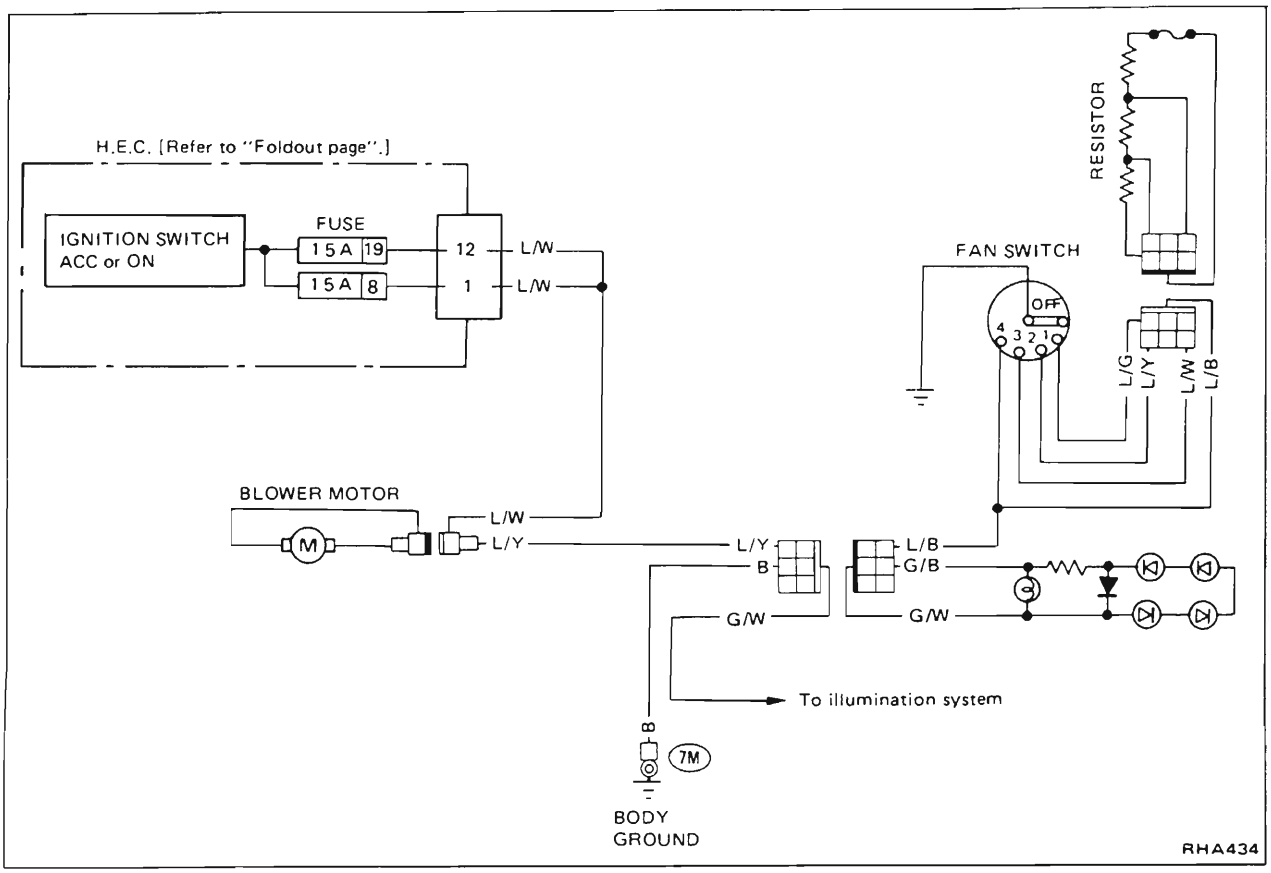
- Clamp the cable while pushing cable outer case and air mix door lever in direction of arrow.

INTAKE DOOR CONTROL CABLE

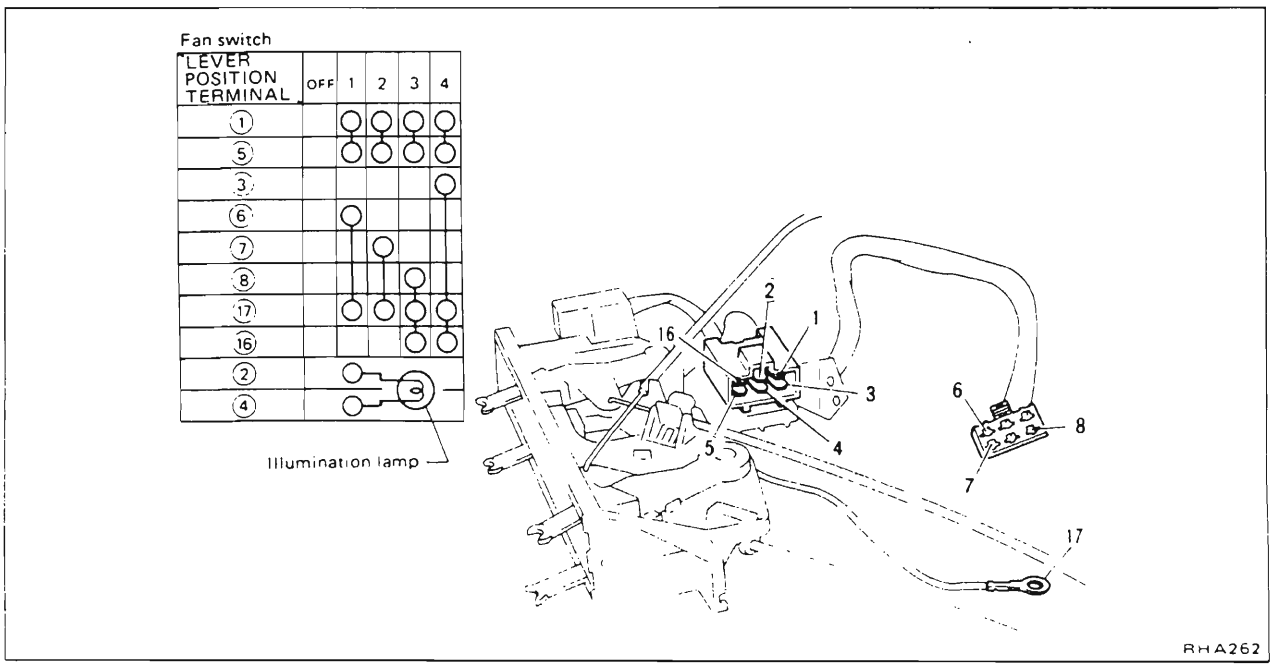
- Clamp the cable while pushing cable outer case and intake door lever in direction of arrow.

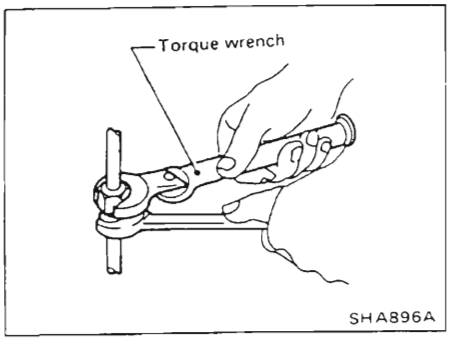
HEATER ELECTRICAL CIRCUIT

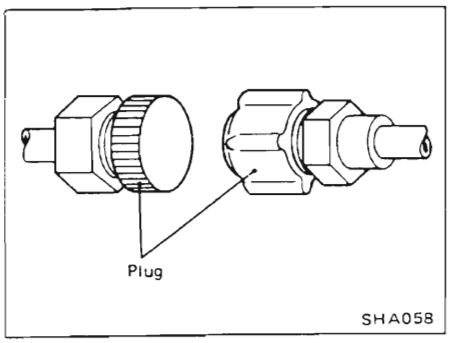
Wiring Diagram

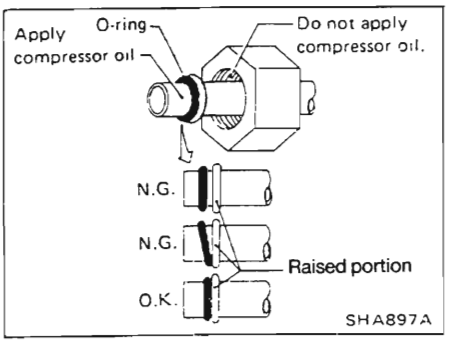


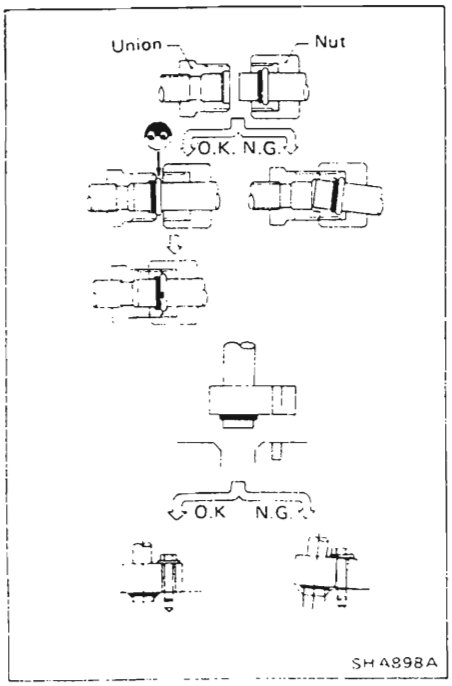
Fan Switch Check











PRECAUTIONS

WARNING:

- Always be careful that refrigerant does not come in contact with your skin.
- Always wear eye protection when working around the system.
- Work in well-ventilated area because refrigerant gas evaporates quickly and breathing may become difficult due to the lack of oxygen.
- Keep refrigerant away from open flames because poisonous gas will be produced if it burns.
- Compressed air must never be used to clean a dirty line. Clean with refrigerant gas.

WARNING:

Gradually loosen discharge side hose fitting, and remove it after remaining pressure has been released.

When replacing or cleaning refrigerant cycle components, observe the following.

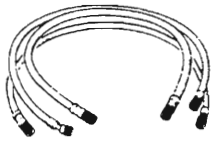
- Do not leave compressor on its side or upside down for more than 10 minutes, as compressor oil will enter low pressure chamber.
- When connecting tubes, be sure to use a torque wrench.
- After disconnecting tubes, plug all openings immediately to prevent entrance of dirt and moisture.

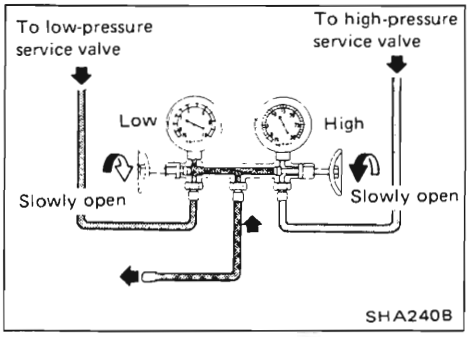
- Always use new O-rings.
- When connecting tube, apply compressor oil to portions shown in illustration. Be careful not to apply oil to threaded portion.
- O-ring must be positioned against the raised portion of tube.

- After inserting tube into union until O-ring is not visible, tighten nut to specified torque.
- After connecting line, conduct leak test and make sure that there is no leakage from connections. If a gas leakage point is found, disconnect that line and replace the O-ring. Re-test fitting for leakage.

AIR-CONDITIONING PREPARATION

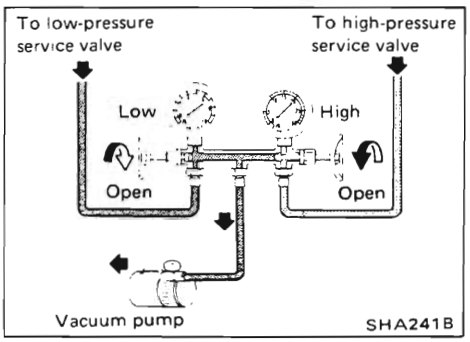
SERVICE TOOLS

Tool name	Description	
Manifold gauge		**Discharging and charging refrigerant into system**
Charging hose		**Discharging and evacuating charge refrigerant into system**
Thermometer		**Checking temperature**
Vacuum pump		**Evacuating refrigerant system**
Electric leak-detector	**Nominal sensitivity:** **15 - 25 g (0.53 - 0.88 oz)/year** 	**Checking refrigerant leaks**



Discharging

Slowly open the valves to discharge only refrigerant. If they are opened quickly, compressor oil will also be discharged.



Evacuating the System—①

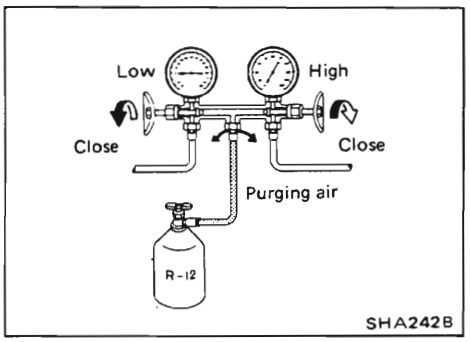
1. Start pump, then open both valves and run pump for about 5 minutes.
2. When low gauge has reached approx. 101.3 kPa (1,013 mbar, 760 mmHg, 29.92 inHg), completely close both valves of gauge and stop vacuum pump. Let it stand for 5 to 10 minutes in this state and confirm that the reading does not rise.

a. **The low-pressure gauge reads lower by 3.3 kPa (33 mbar, 25 mmHg, 0.98 inHg) per 300 m (1,000 ft) elevation. Perform evacuation according to the following table.**

b. **The rate of ascension of the low-pressure gauge should be less than 3.3 kPa (33 mbar, 25 mmHg, 0.98 inHg) in five minutes.**

Elevation m (ft)	Vacuum of system kPa (mbar, mmHg, inHg)
0 (0)	101.3 (1,013, 760, 29.92)
300 (1,000)	98.0 (980, 735, 28.94)
600 (2,000)	94.6 (946, 710, 27.95)
900 (3,000)	91.3 (913, 685, 26.97)

*: Values show reading of the low-pressure gauge.



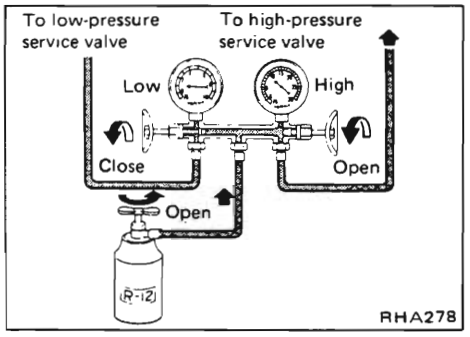
Charging — ①

1. Evacuate refrigerant system.

Refer to "Evacuating the System ①".

2. Close manifold gauge valves securely and disconnect charging hose from vacuum pump.
3. Purge air from center charging hose.

1) Connect center charging hose to refrigerant can through can top.
2) Break seal of refrigerant can and purge air.

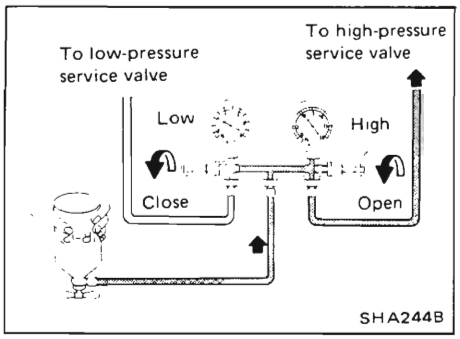


4. Charge refrigerant into system.

WARNING:

Ensure that engine is off.

1) Open high-pressure valve of manifold gauge and charge refrigerant into system.

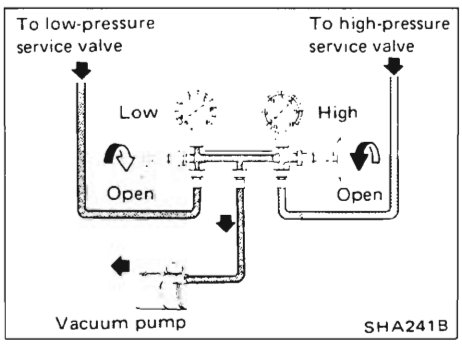


Charging — ① (Cont'd)

CAUTION:

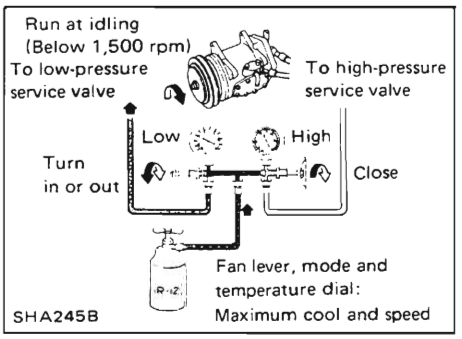
If charging liquefied refrigerant into the system with the can turned upside down to reduce charging time, charge it only through high-pressure (discharge) service valve. After charging, the compressor should always be turned several times manually.

2) **When low-pressure gauge reading is 98 kPa (0.98 bar, 1.0 kg/cm², 14 psi), completely close high-pressure valve of manifold gauge and stop charging.**



Evacuating the System—②

1. Close manifold gauge valve securely and disconnect charging hose from refrigerant can.
2. Connect center charging hose to vacuum pump.
3. Start pump, then open both valves and run pump for about 20 minutes.



Charging — ②

Refer to "Charging- ①" of No. 2 ~ 4.

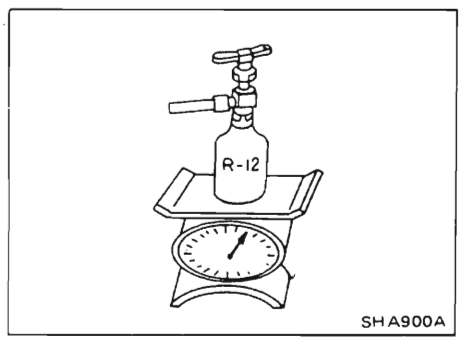
5. When refrigerant charging speed slows down, close high-pressure valve of manifold gauge and open low-pressure valve of manifold gauge and charge it while running the compressor for ease of charging.

WARNING:

Never charge refrigerant through high-pressure side (discharge side) of system since this will force refrigerant back into re-firigerant can and can may explode.

6. Charge refrigerant while controlling low-pressure gauge reading at 275 kPa (2.75 bar, 2.8 kg/cm², 40 psi) or less by turning in or out low-pressure valve of manifold gauge.

- **Be sure to purge air from charging hose when replacing can with a new one.**



7. Charge the specified amount of refrigerant into system by weighing charged refrigerant with scale. Overcharging will cause discharge pressure to rise.

Refrigerant amount:

0.95-1.-05 kg (2.1-2.3)

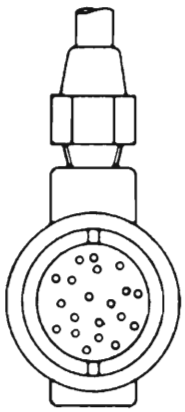
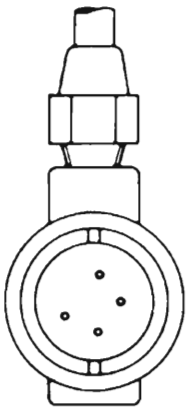
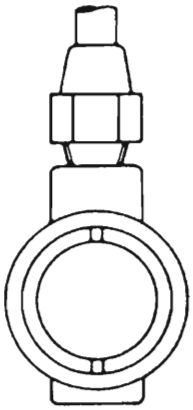
The state of the bubbles in sight glass should only be used for checking whether the amount of charged refrigerant is small or not. The amount of charged refrigerant can be correctly judged by means of discharge pressure.

8. After charging, be sure to install valve cap on service valve.
9. Confirm that there are no leaks in system by checking with a leak detector.

Checking Refrigerant Level

CONDITION

- Door window: Open
- A/C switch: ON
- TEMP. lever position: Max. COLD
- FAN lever position: Maximum speed
- Check sight glass after a lapse of about five minutes.

Check item \ Amount of refrigerant	Almost no refrigerant	Insufficient	Suitable	Too much refrigerant
Temperature of high-pressure and low-pressure lines.	Almost no difference between high-pressure and low-pressure side temperature.	High-pressure side is warm and low-pressure side is fairly cold	High-pressure side is hot and low-pressure side is cold.	High-pressure side is abnormally hot.
State in sight glass.	Bubbles flow continuously. Bubbles will disappear and something like mist will flow when refrigerant is nearly gone.  AC256	The bubbles are seen at intervals of 1 - 2 seconds.  AC257	Almost transparent. Bubbles may appear when engine speed is raised and lowered. No clear difference exists between these two conditions.  AC258	No bubbles can be seen.
Pressure of system.	High-pressure side is abnormally low.	Both pressures on high and low-pressure sides are slightly low.	Both pressures on high and low-pressure sides are normal	Both pressures on high and low-pressure sides are abnormally high.
Repair	Stop compressor immediately and conduct an overall check.	Check for gas leakage, repair as required, replenish and charge system.		Discharge refrigerant from service valve of low pressure side.

MEASUREMENT STANDARD

If any reaction is noted using a detector having a nominal sensitivity of 15 to 25 g (0.53 to 0.88 oz)/year, the leak must be repaired.

- The nominal sensitivity of the detector is determined under the assumption that all the leaking gas is collected by the detector. Accordingly, the quantity of gas actually leaking can amount to five to ten times the indicated value. Generally speaking, leakage of 150 to 200 g (5.29 to 7.05 oz) of refrigerant can cause insufficient cooling.
- Oil deposited during assembling must be wiped off before inspection. Refrigerant easily dissolves in oil, and the presence of oil can cause an error in measurement.
  This precaution is important when checking a used car for refrigerant leakage.
- If any trace of oil is noted at or around connection fittings, it is a sure indication that refrigerant is leaking.

COMPRESSOR OIL — For DKS-15BH (DIESEL-KIKI make)

Checking and Adjusting

The oil used to lubricate the compressor is circulating with the refrigerant.
Whenever replacing any component of the system or a large amount of gas leakage occurs, add oil to maintain the original amount of oil.

OIL CAPACITY

Unit: mℓ (Imp fl oz)

Capacity	
Total in system	150 (5.3)
Amount of oil which can be drained	175-100 (2.6-3.5)

*: All oil cannot be drained from system.

OIL RETURN OPERATION

Before checking and adjusting oil level, operate compressor at engine idling speed, with controls set for maximum cooling and high blower speed, for 20 to 30 minutes in order to return oil to compressor.

CHECKING AND ADJUSTING FOR USED COMPRESSOR

1. After oil return operation, stop the engine and discharge refrigerant and then remove compressor from the vehicle.
2. Remove oil drain plug, drain compressor oil from compressor oil sump and measure the amount.

Oil is sometimes hard to extract when compressor is cooled. Remove oil while compressor is warm [maintained to 40 to 50°C (104 to 122°F)].

3. If the amount is less than 75 m (2.6 Imp fl oz), some refrigerant may have leaked out. Conduct leak tests on connections of each system, and if necessary, repair or replace faulty parts.
4. Check the purity of the oil and then adjust oil level following the procedure below.

   (a) When oil is clean

Unit: mℓ (Imp fl oz)

Amount of oil drained	Adjusting procedure
Above 75 (2.6)	Oil level is right. Pour in same amount of oil as was drained out.
Below 75 (2.6)	Oil level may be low. Pour in 115 mℓ (4.0 Imp fl oz) of oil.

*: If amount of oil drained is much greater than under normal circumstances, flush air conditioner system with refrigerant. Then pour in 150 m (8.8 Imp fl oz) of oil into air conditioner system.

   (b) When oil contains chips or other foreign material. After air conditioner system has been flushed with refrigerant, replace receiver dryer. Then pour in 150 m (5.3 Imp fl oz) of oil into air conditioner system.

CHECKING AND ADJUSTING FOR COMPRESSOR REPLACEMENT

150 m (5.3 Imp fl oz) of oil is charged in compressor (service parts). So it is necessary to drain the proper amount of oil from new compressor. Follow the procedure below.

1. After oil return operation, drain compressor oil from used compressor and measure the amount.
   (It is the same procedure as CHECKING AND ADJUSTING FOR USED COMPRESSOR.)

Checking and Adjusting (Cont'd)

2. Check the purity of the oil and then adjust oil level following the procedure below.

   (a) When oil is clean.

Unit: mℓ (Imp fl oz)

Amount of oil drained from used compressor	Draining amount of oil from new compressor
Above 75 (2.6)*	150 (5.3) — [Amount of oil drained + 15 (0.5)]
Below 75 (2.6)	70 (2.4

*: If amount of oil drained is much greater than under normal circumstances, flush air conditioner system with refrigerant. Then install new compressor [150 (5.3) of oil is charged in compressor service parts.]

Example:

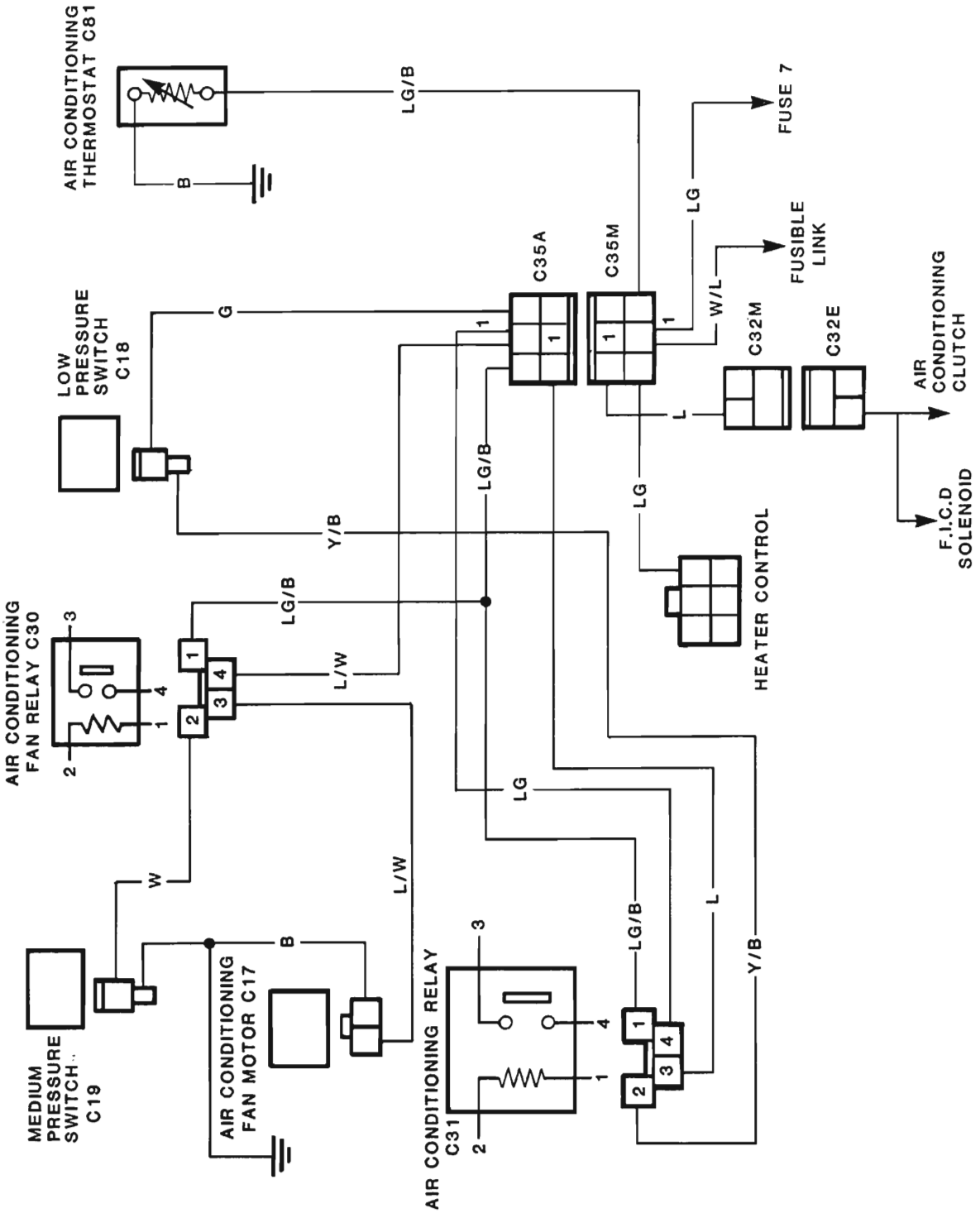
Unit: mℓ (Imp fl oz)

Amount of oil drained from used compressor	Draining amount of oil from new compressor
95 (3.3)	40 (1.4)
55 (1.9)	70 (2.4)

   (b) When oil contains chips or foreign material. After air conditioner system has been flushed with refrigerant, replace receiver drier. Then install new compressor [150 m*l* (5.3 Imp fl oz) of oil is charged in compressor service parts.].

A/C ELECTRICAL CIRCUIT

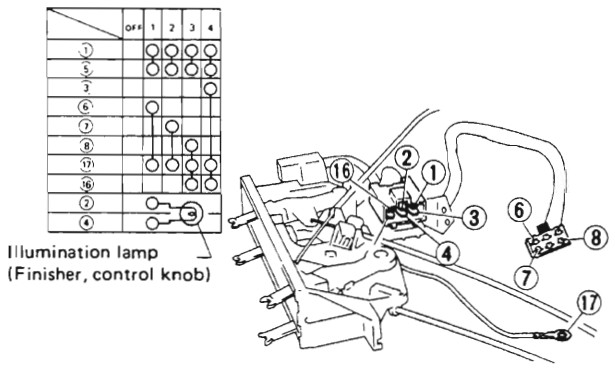
Wiring Diagram



Inspection

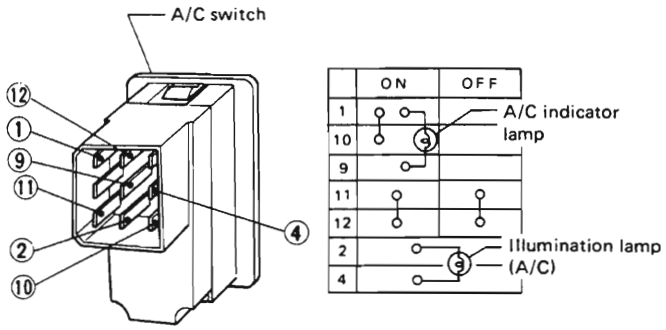
FAN SWITCH AND A/C SWITCH

Fan switch



RHA262

A/C switch



RHA274

FOR RELAY LOCATION REFER SECTION EL.

General Specifications

LUBRICATION OIL

Model	DIESEL-KIKI make DKS 15BH
Type	SUNISO 5GS
Capacity mℓ (Imp fl oz) Total in system	250 (8.8)
Remaining oil in system after oil return operation and draining it	115 - 165 (4.0 - 5.8)
Compressor (Service parts) charging amount	250 (8.8)

REFRIGERANT

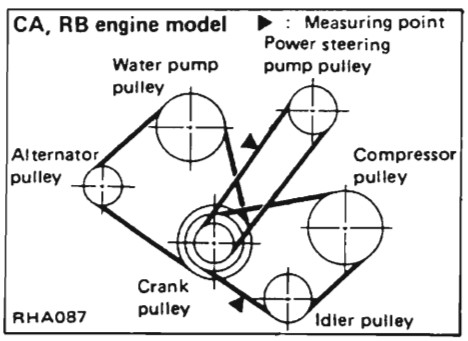
Type		R-12
Capacity	kg (lb)	0.8 - 1.0 (1.8 - 2.2)

Inspection and Adjustment

BELT TENSION

Belt Deflection mm(in) (Applied pressure is 98N(10kg, 22lb)

	CA20E			RB30E		
	Used deflection		Deflection of new belt	Used deflection		Deflection of new belt
	Limit	Adjust		Limit	Adjust	
Alternator	13 (0.51)	7-10 (0.28-0.39)	6-8 (0.24-0.32)	7.5 (0.295)	4-6 (0.16-0.24)	3-5 (0.12-0.20)
Air Conditioner Compressor	7 (0.28)	3-5 (0.12-0.20)	3-5 (0.12-0.20)	12 (0.47)	7-9 (0.28-0.35)	6-8 (0.24-0.31)
Power Steering Oil Pump	15 (0.59)	8-11 (0.31-0.43)	6-9 (0.24-0.35)	15 (0.59)	9-11 (0.35-0.43)	8-10 (0.31-0.39)



ENGINE IDLING SPEED

When A/C is ON (F.I.C.D. is actuated)

Unit: rpm

Transmission	Engine model	
	CA20E	RB30E
Manual	850±50	700 ± 50
Automatic (At "N" range)		

Tightening Torque (Cont'd)

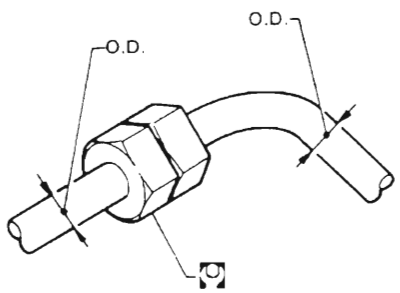
COMPRESSOR INSTALLATION

	N·m	kg-m	ft-lb
Compressor bracket to cylinder block	36 - 50	3.7 - 5.1	27 - 37
Compressor to compressor bracket	36 - 50	3.7 - 5.1	27 - 37

REFRIGERANT LINE

When connecting lines made of different material, basically use the lower tightening torque of the two.

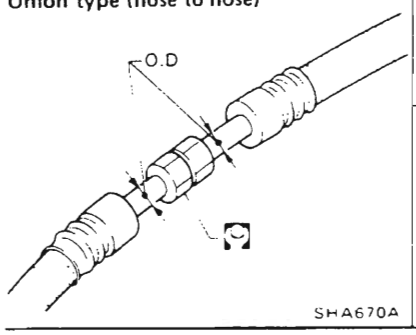
Union type (pipe to pipe)



SHA669A

Pipe O.D mm (in)	Material					
	Steel or copper			Aluminum		
	N·m	kg-m	ft-lb	N·m	kg-m	ft-lb
6 (1/4)	10 - 20	1.0 - 2.0	7 - 14	–	–	–
8 (5/16)	15 - 25	1.5 - 2.5	11 - 18	10 - 20	1.0 - 2.0	7 - 14
10 (3/8)	15 - 25	1.5 - 2.5	11 - 18	10 - 20	1.0 - 2.0	7 - 14
12 (1/2)	20 - 29	2.0 - 3.0	14 - 22	15 - 25	1.5 - 2.5	11 - 18
16 (5/8)	25 - 34	2.5 - 3.5	18 - 25	20 - 29	2.0 - 3.0	14 - 22
19 (3/4)	25 - 34	2.5 - 3.5	18 - 25	20 - 29	2.0 - 3.0	14 - 22

Union type (hose to hose)



SHA670A

Pipe O.D mm (in)	Material					
	Steel or copper			Aluminum		
	N·m	kg-m	ft-lb	N·m	kg-m	ft-lb
6 (1/4)	10 20	1.0 - 2.0	7 - 14	–	–	–
8 (5/16)	15 25	1 5 - 2.5	11 - 18	10 - 20	1.0 2.0	7 - 14
10 (3/8)	15 25	1.5 2 5	11 18	10 20	1.0 2.0	7 14
12 (1/2)	25 34	2.5 3.5	18 - 25	20 - 29	2 0 3 0	14 22
16 (5/8)	25 34	2 5 3.5	18 25	20 29	2 0 3 0	14 22

ELECTRICAL SYSTEM

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HARNESS CONNECTOR ..... EL- 2
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POWER SUPPLY ROUTING ..... EL- 4
HYBRID ELECTRIC CONTROL UNIT (H.E.C.) ..... EL- 6
STARTING SYSTEM — Starter — RB30E ..... EL- 8
STARTING SYSTEM — Starter — CA20E EL-14
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WIRING DIAGRAMS EL-78

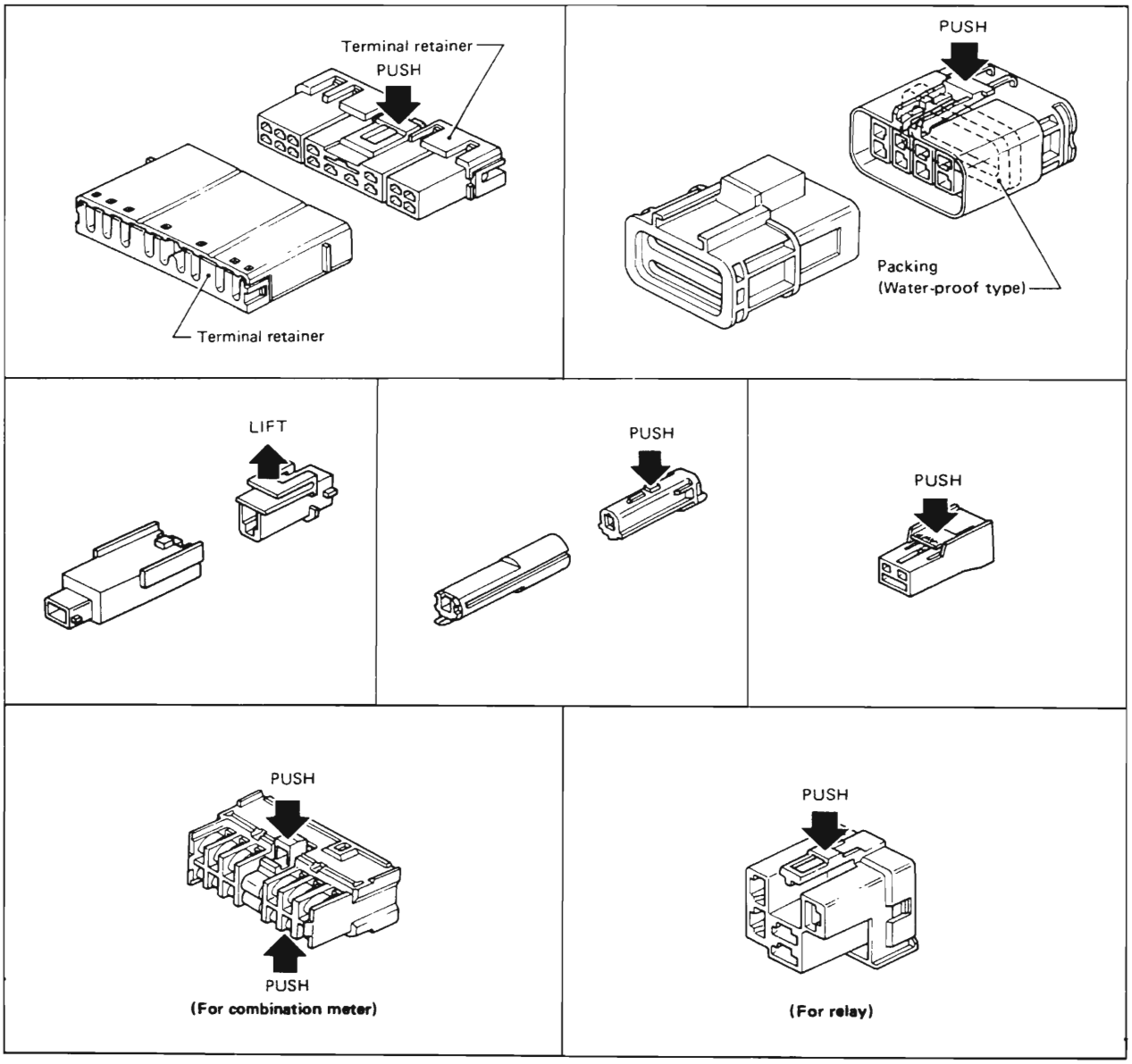
- The connector can be disconnected by pushing or lifting the locking section.

CAUTION:

Do not pull the harness when disconnecting the connector.

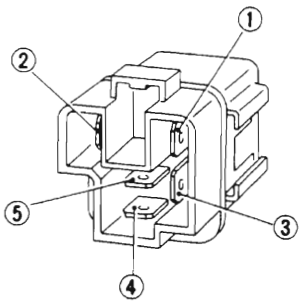
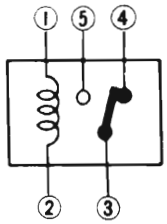
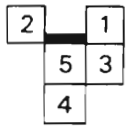
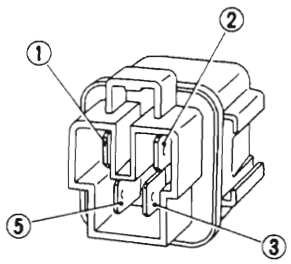
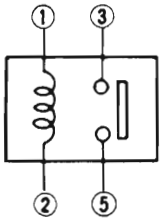
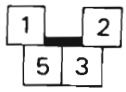
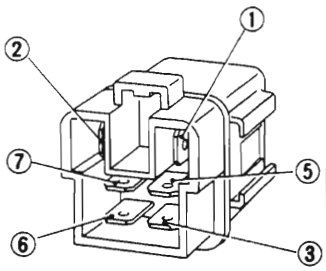
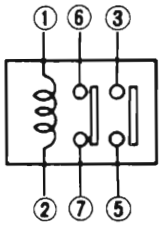
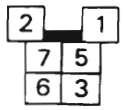
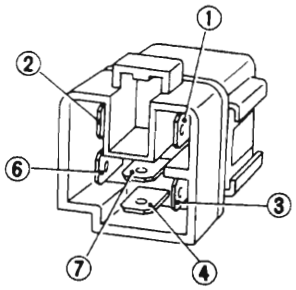
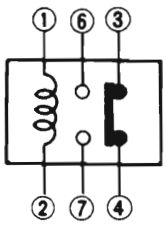
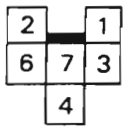
Unless otherwise stated, turn ignition off when connecting or disconnecting electrical components.

[Example]

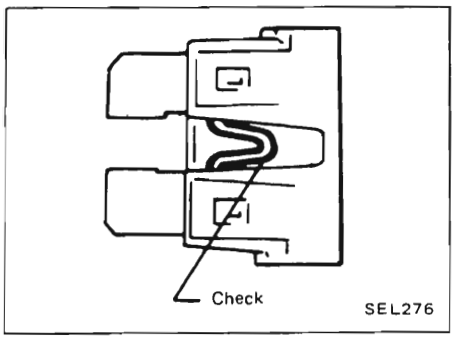


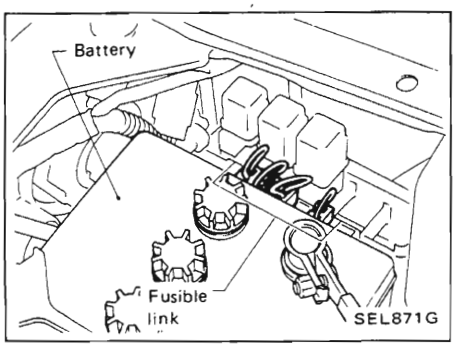
SEL769D

STANDARDIZED RELAY

Type	Outer view	Circuit	Symbols	Case color
1T				BLACK
1M				BLUE
2M				BROWN
1M·1B				GREY

SEL639D





Fuse

a. If fuse is blown, be sure to eliminate cause of problem before installing new fuse.
b. Use fuse of specified rating. Never use fuse of more than specified rating.
c. Do not install fuse in oblique direction; always insert it into fuse holder properly.
b. Remove fuse for clock if vehicle is not used for a long period of time.

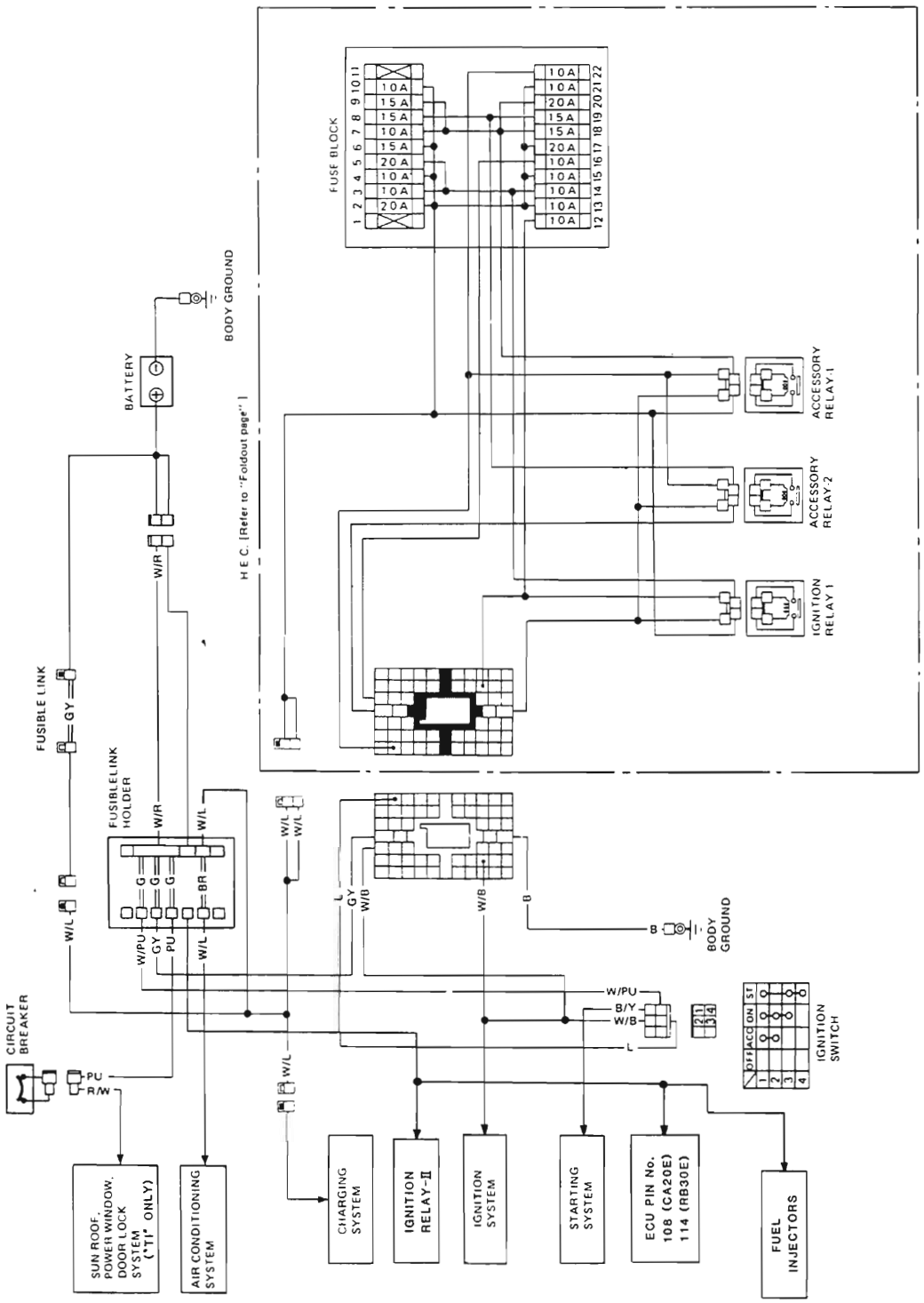
Fusible Link

A melted fusible link can be detected either by visual inspection or by feeling with finger tip. If its condition is questionable, use circuit tester or test lamp.

CAUTION:

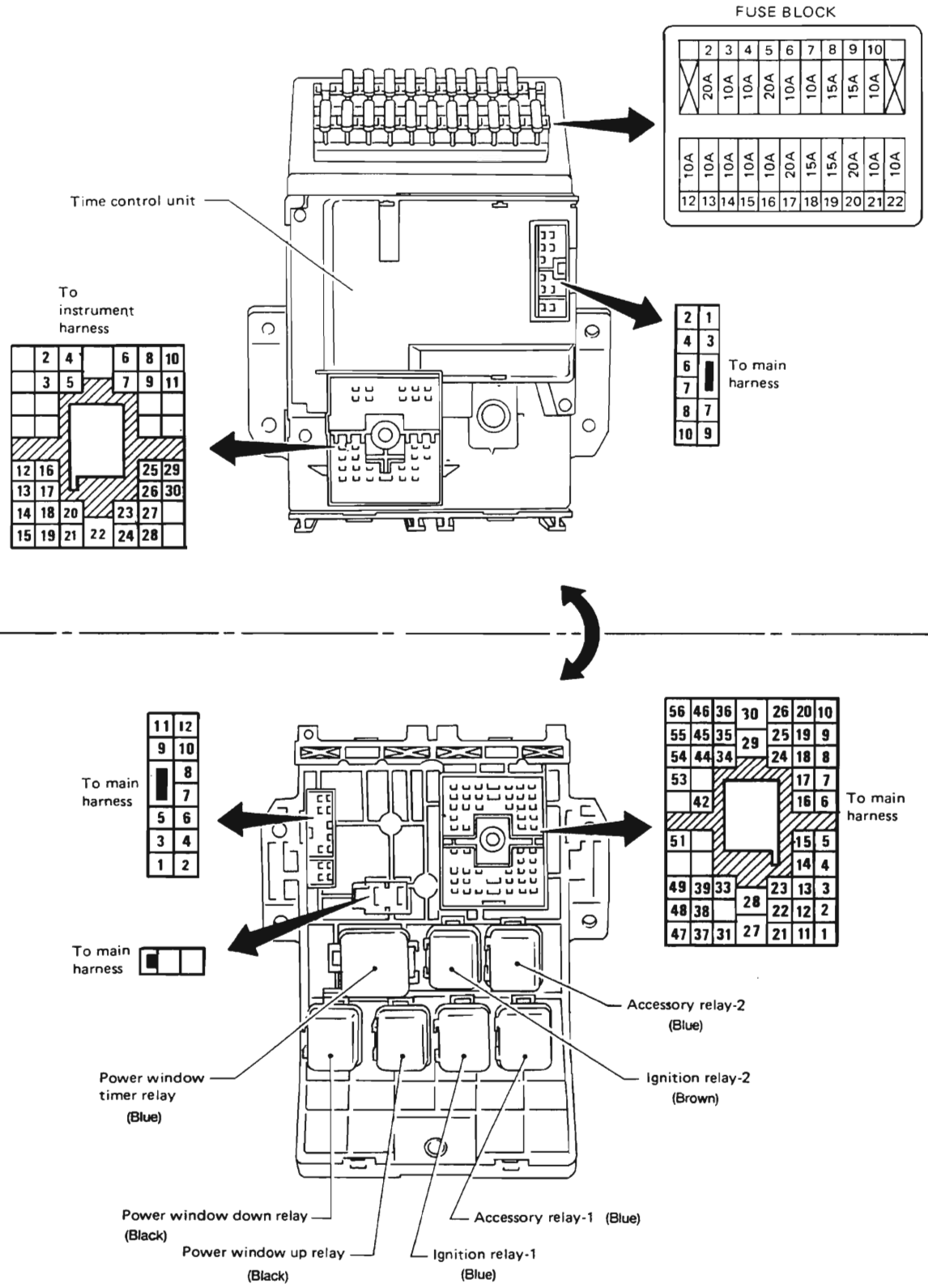
a. If fusible link should melt, it is possible that critical circuit (power supply or large current carrying circuit) is shorted. In such a case, carefully check and eliminate cause of problem.
b. Never wrap periphery of fusible link with vinyl tape. Extreme care should be taken with this link to ensure that it does not come into contact with any other wiring harness or vinyl or rubber parts.

Wiring Diagram

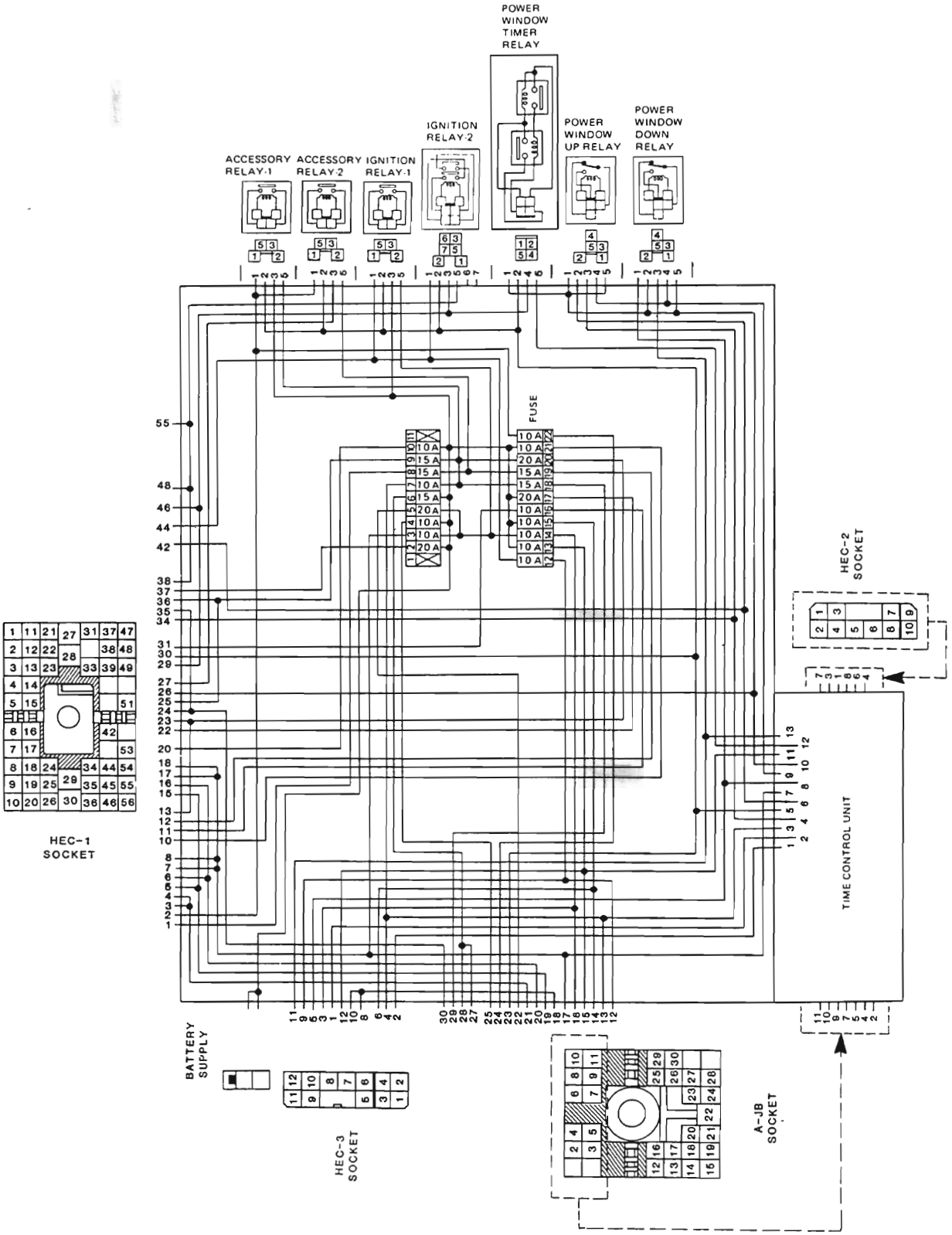


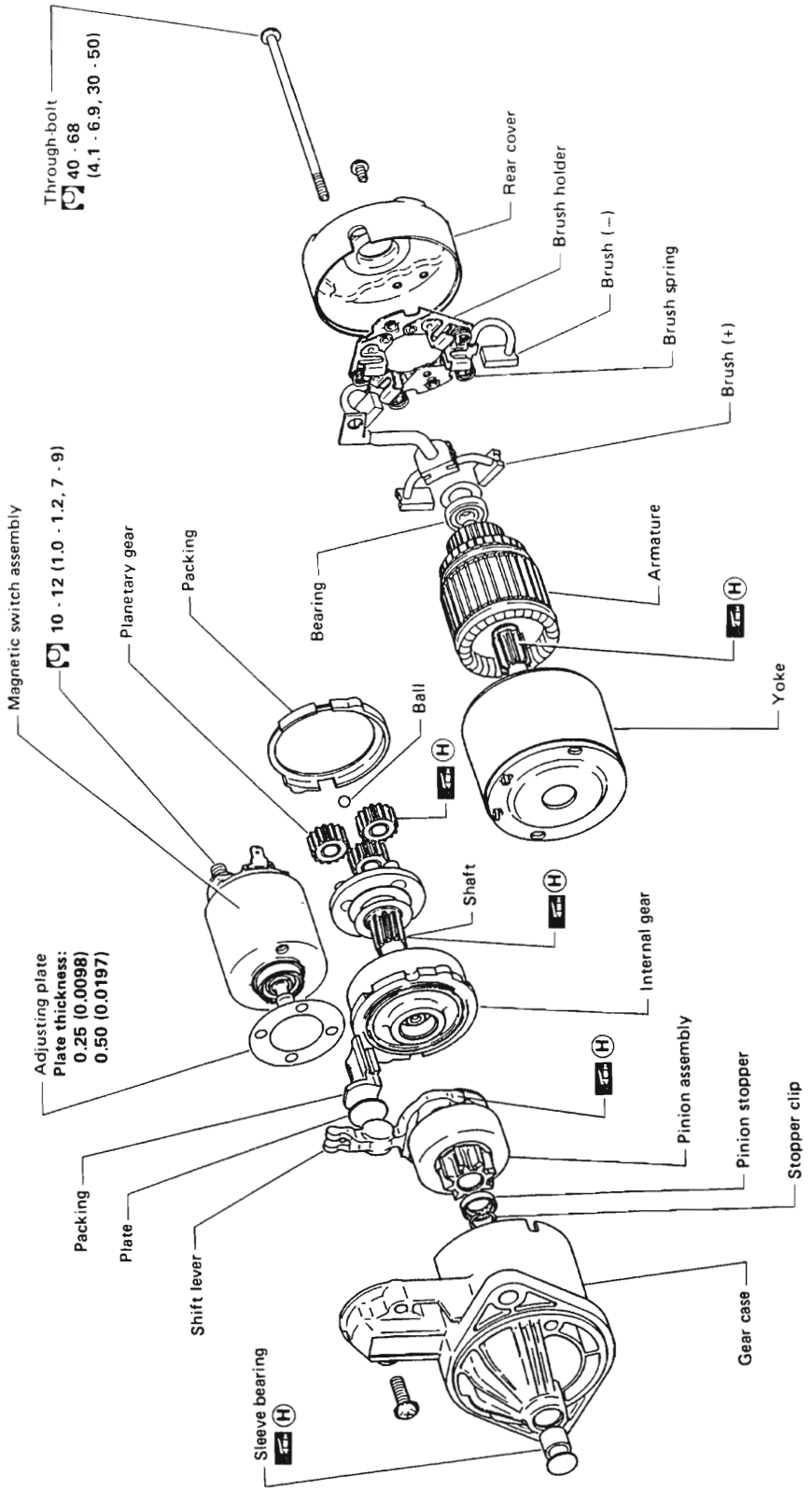
SEL826G

Construction and Terminal Arrangement

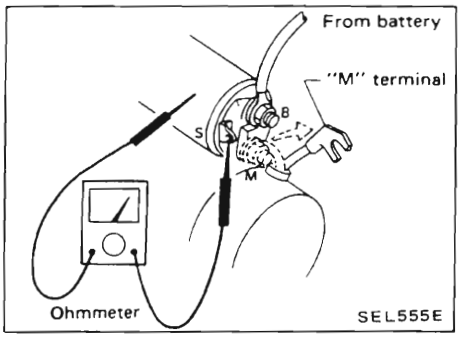


Internal Circuit




Through-bolt
40 - 68
(4.1 - 6.9, 30 - 50)
Rear cover
Brush holder
Brush (−)
Brush spring
Brush (+)
Magnetic switch assembly
10 - 12 (1.0 - 1.2, 7 - 9)
Planetary gear
Packing
Bearing
Armature
Ball
Yoke
Shaft
Internal gear
Adjusting plate
Plate thickness:
0.25 (0.0098)
0.50 (0.0197)
Pinion assembly
Pinion stopper
Stopper clip
Packing
Plate
Shift lever
Gear case
Sleeve bearing
Unit: mm (in)
: N·m (kg-m, ft-lb)
: High-temperature grease point

SEL893G

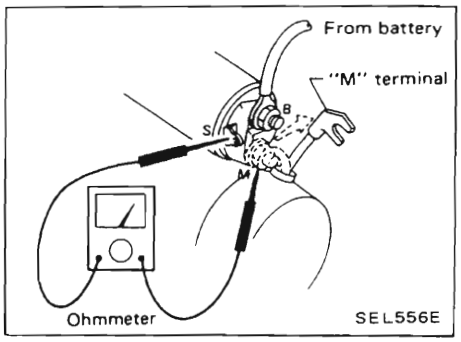


Magnetic Switch Check

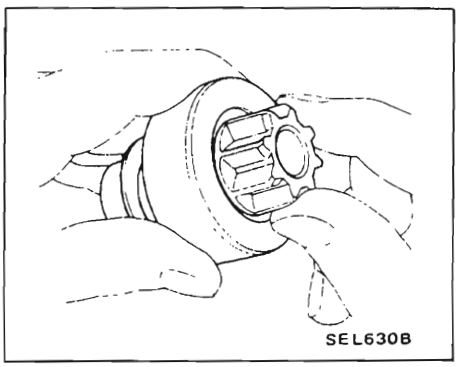
MAGNETIC SWITCH CHECK

- Before starting to check, disconnect battery ground cable.
- Disconnect "M" terminal of starter motor.

1. Continuity test (between "S" terminal and switch body).
- No continuity ... Replace.

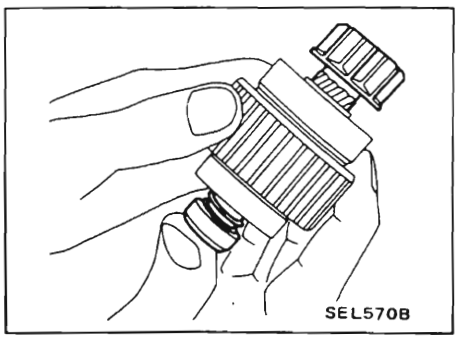


2. Continuity (between "S" terminal and "M" terminal).
- No continuity ... Replace.



Pinion/Clutch Check

1. Check to see if pinion locks in one direction and rotates smoothly in the opposite direction.
   - If it does not lock (or locks) in either direction or usual resistance is evident ... Replace.



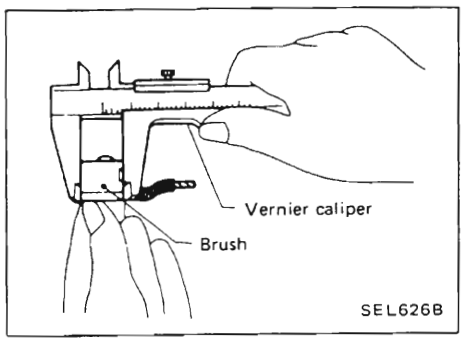
2. Check pinion movement.
   - If it is hard to move, apply grease or, if necessary, replace.

Pinion/Clutch Check (Cont'd)

3. Inspect pinion teeth.
4. • Replace pinion if teeth are worn or damaged. (Also check condition of ring gear teeth.)

   Inspect reduction gear teeth.

   • Replace reduction gear if teeth are worn or damaged. (Also check condition of armature shaft gear teeth.)



Brush Check

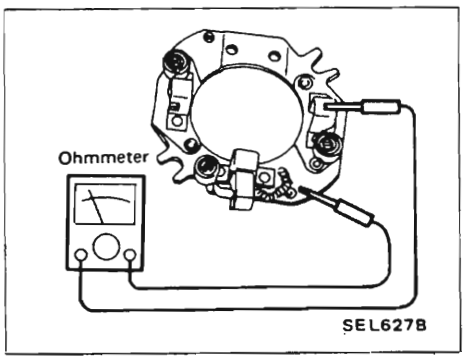
BRUSH

Check wear of brush.

Wear limit length:

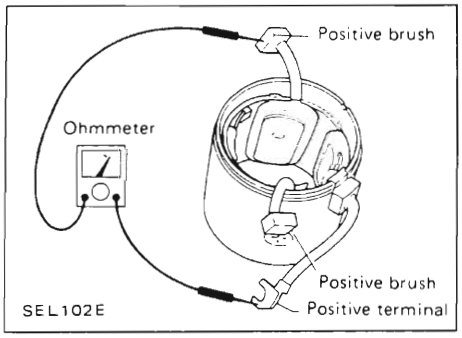
Refer to "Service Data and Specifications."

- Excessive wear ... Replace.



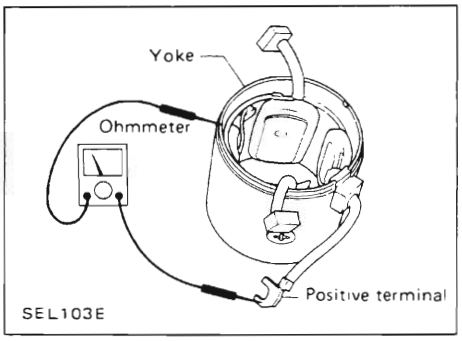
BRUSH HOLDER

1. Perform insulation test between brush holder (positive side) and its base (negative side).
   - Continuity exists ... Replace.
2. Check brush to see if it moves smoothly.
   - If brush holder is bent, replace it; if sliding surface is dirty, clean.

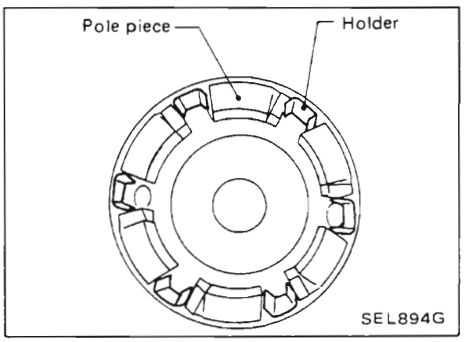


Field Coil Check

1. Continuity test (between field coil positive terminal and positive brushes).
   - No continuity ... Replace field coil.

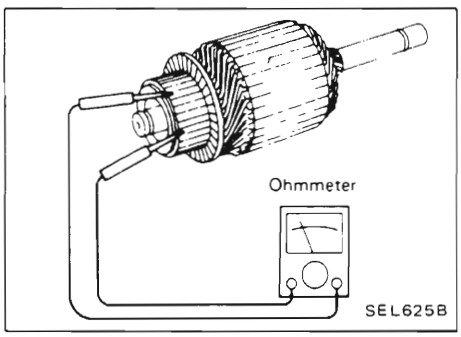


2. Insulation test (between field coil positive terminal and yoke).
   - Continuity exists ... Replace field coil.



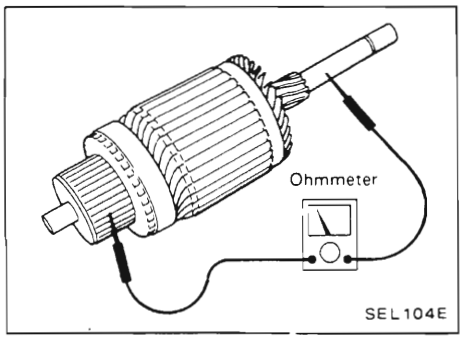
Pole Piece Check

Pole piece is secured to yoke by bonding agent. Check pole piece to see that it is secured to yoke and for any cracks. Replace malfunctioning parts as an assembly.
Holder may move slightly as it is only inserted and not bonded.



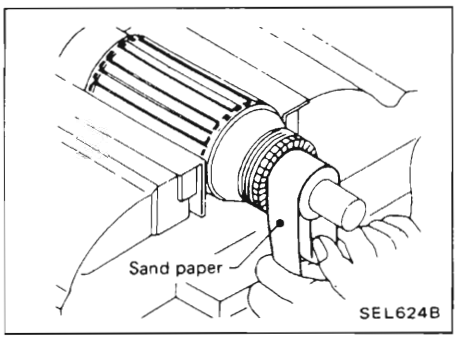
Armature Check

1. Continuity test (between two segments side by side).
   - No continuity ... Replace.

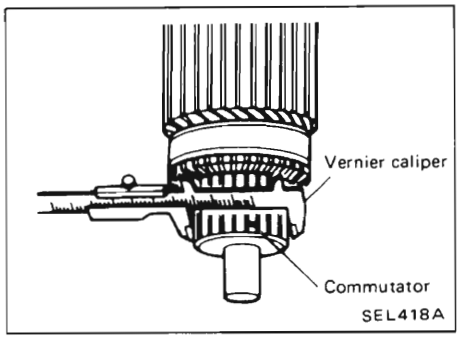


2. Insulation test (between each commutator bar and shaft).
   - Continuity exists ... Replace.

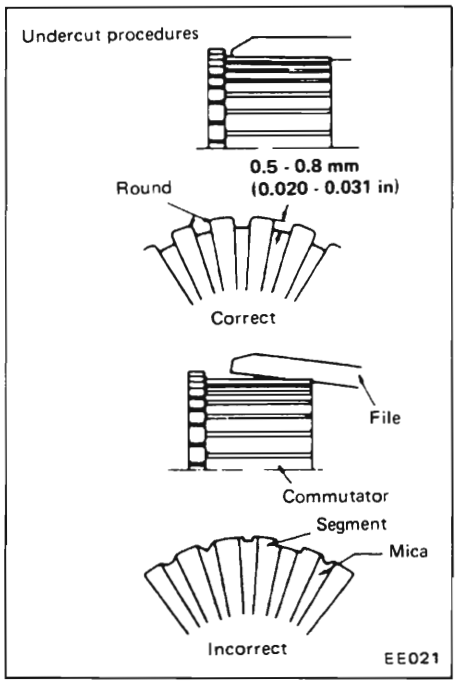
Armature Check (Cont'd)



3. Check commutator surface.
   - Rough ... Sand lightly with No. 500 - 600 sandpaper.



4. Check diameter of commutator.
   Commutator minimum diameter:
   Refer to "Service Data and Specifications."
   - Less than specified value ... Replace.



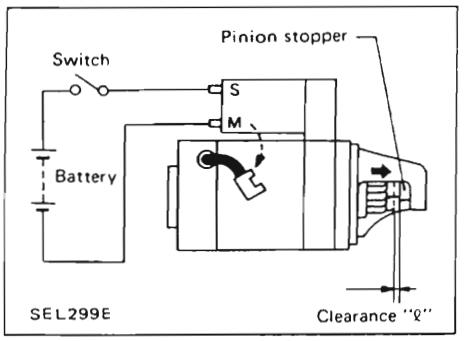
5. Check depth of insulating mica from commutator surface.
   - Less than 0.2 mm (0.008 in) ... Undercut to 0.5 - 0.8 mm (0.020 - 0.031 in)

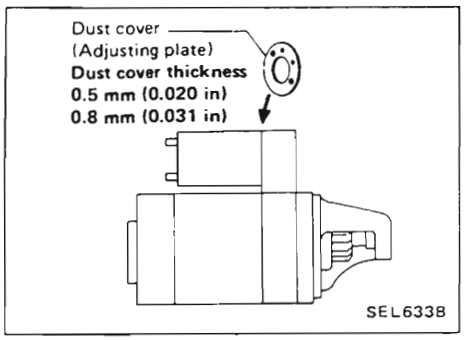
Assembly

Carefully observe the following instructions.

GREASE POINT

- Rear cover metal
- Gear case metal
- Center bracket metal
- Frictional surface of pinion
- Moving portion of shift lever
- Plunger of magnetic switch
- Reduction gear





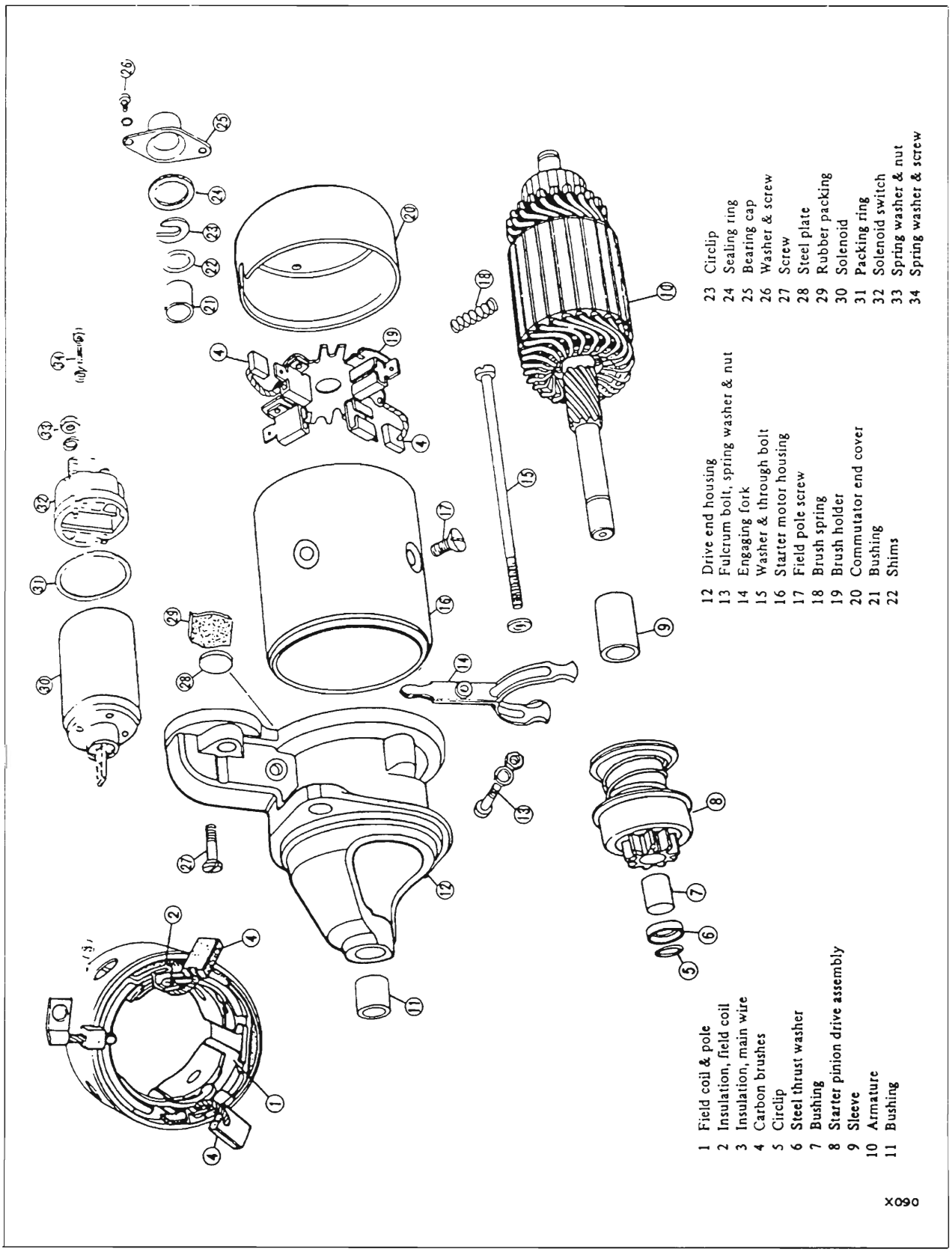
Assembly (Cont'd)

PINION PROTRUSION LENGTH ADJUSTMENT

With pinion driven out by magnetic switch, push pinion back to remove slack and measure clearance "ℓ" between the front edge of the pinion and the pinion stopper.

Clearance "ℓ":
0.3 - 2.5 mm (0.012 - 0.098 in)

- If not within the specified value . . . Adjust by dust cover (adjusting plate).



1 Field coil & pole
2 Insulation, field coil
3 Insulation, main wire
4 Carbon brushes
5 Circlip
6 Steel thrust washer
7 Bushing
8 Starter pinion drive assembly
9 Sleeve
10 Armature
11 Bushing
12 Drive end housing
13 Fulcrum bolt, spring washer & nut
14 Engaging fork
15 Washer & through bolt
16 Starter motor housing
17 Field pole screw
18 Brush spring
19 Brush holder
20 Commutator end cover
21 Bushing
22 Shims
23 Circlip
24 Sealing ring
25 Bearing cap
26 Washer & screw
27 Screw
28 Steel plate
29 Rubber packing
30 Solenoid
31 Packing ring
32 Solenoid switch
33 Spring washer & nut
34 Spring washer & screw

X090

OPERATION

When the starting motor is at rest, the rear edge of the cutout in the solenoid plunger is firmly up against the engagement fork holding the drive assembly back against sleeve (9) on the armature shaft. (Refer exploded view).

The difference between the width of the engagement fork and the length of the cutout in the solenoid plunger is called "free travel".

As soon as the solenoid is energized the solenoid plunger pulls in, takes up the "free travel" and pushes the drive assembly forward. The helical splines on the armature shaft rotate the pinion slowly during the forward movement to assist in engagement.

The "free travel" described above is necessary to give the solenoid plunger an initial movement without load, so that the solenoid plunger moves into the magnetic field of the solenoid winding more efficiently.

In engaged position the front end of the solenoid plunger cutout is firmly up against the engagement fork. Once the starter switch is released, the magnetic field in the solenoid collapses and the solenoid plunger moves forward again taking up the available "free travel".

The "free travel" in this case ensures that the solenoid plunger positively breaks the electrical contacts within the solenoid. After the pinion has returned into its rest position, the solenoid plunger spring will now exert a pressure on to sleeve 9 which in turn presses the armature back towards the brush holder plate.

The ridge moulded onto the commutator now rubs on the brush holder plate acting as a brake.

ENGAGEMENT SEQUENCE

Closing the solenoid switching circuit energizes the pull-in and hold-in solenoid windings. The soft iron plunger is drawn in moving the engaging fork which in turn moves the drive assembly toward the ring gear. The helical splines on the armature shaft rotate the pinion slowly to assist in engagement.

Should a tooth of the advancing pinion abut a tooth of the ring gear, the engaging lever will compress the helical spring at the pinion until the switch contacts close.

The pinion is then turned and engages with the ring gear under the helical spring pressure. Before the pinion is completely in mesh, the contacts in the solenoid switch are closed by the action of the soft iron plunger.

The starter then rotates and cranks the engine. When the starter rotates, the pull-in winding is de-energized by the isolation of its ground connection, providing more power for cranking.

As the starting speed of the engine exceeds that of the starter, the pinion rotates freely. Once the starter switch is released, the plunger return spring moves the pinion to its rest position and the switch contacts open.

DISASSEMBLY

1. Disconnect cable between solenoid switch and starting motor.
2. Remove the two solenoid switch attaching screws.
3. Remove solenoid by lifting and unhooking the plunger yoke from engaging fork.
4. Remove the two bearing cap screws, pull off commutator end bearing cap, remove circlip.
5. Remove through bolts.
6. Remove commutator end cover.
7. Unbend brush spring retaining lugs and remove springs and brushes. Remove brush holder plate.
8. Withdraw armature with drive end housing and engaging fork.
9. Remove engaging lever fulcrum bolt to release engaging fork and armature from drive end housing.
10. Press stop ring on armature shaft towards drive assembly.
11. Remove spring ring.
12. Remove drive assembly.

TESTING STARTER COMPONENTS

Clean and inspect all parts. Check all bushings, bearing surfaces, pinion, engaging mechanism and electrical contacts for wear and replace worn parts. Check electrical joints and connections and repair where necessary.

FIELD COILS

Test field coils for open circuits with an incandescent low-voltage test lamp in series. Test lamp must light if circuit through field coils is complete.

Disconnect all ground connections and connect test lamp from field winding terminal to ground. Test lamp will not light if field coil insulation is good.

Defective field coils should be removed with an approved pole shoe screwdriver only.

ARMATURE

Test armature winding for short circuits in a growler and test insulation to ground with test lamp as well as field coils.

The commutator should not be eroded or out-of-round (max. permissible out-of-round 0.05 mm (0.002"). If it is necessary to re-dress the commutator, ensure its minimum diameter is not less than 33.5 mm (1.32"). Undercut mica between segments to a depth of 0.79 mm (0.30"), using a ground down hacksaw blade or undercutting machine.

CARBON BRUSHES

Make sure brushes slide smoothly in their holders, brush connections are good and brushes are clean and not chipped. Brushes worn to less than ½" long should be replaced, at which time the commutator must be machined. Always replace the complete brush set. Check brush spring tension according to the prescribed figures of 19N ±1N (1.94 kg. 4.27 lb.) with spring balance. Replace springs that do not conform to specifications.

BUSHINGS

Replace worn bushings by pressing the old bushing out with a correct fitting mandrel and press the new bushing into place in like manner. New sintered bushings should be soaked in oil for one hour before installation.

SOLENOID SWITCH

Remove switch cover fastening screws. Unsolder external joints where the winding ends are connected to the terminals and remove cover. Inspect contact bolts and contact plate for wear and replace worn solenoid cover.

The operation of the detached switch can be checked by connecting a battery supply though a variable resistance to both pull-in windings and hold-in windings and increasing the voltage gradually until at 6.0 volts or less the plunger moves into its operational position. The plunger should return to the rest position when the voltage is reduced to, from 0.05 to 0.4 volts.

When an ignition coil resistor short circuiting terminal is incorporated in the switch cover, the terminal must be energized when the switch is in the closed position.

ASSEMBLY

To reassemble starter, reverse disassembly procedure.

Note: Ensure that a water tight seal is made at rubber packing.

LUBRICATION

Bushings:

Drive end, Pinion, Intermediate plate, Commutator end – SAE 30 OIL

Armature shaft bearing surfaces and helical splines – Shell MDL 2

Drive assembly helical splines inside – Shell MDL 2

Engaging lever bearing surfaces and fork – Shell MDL 2

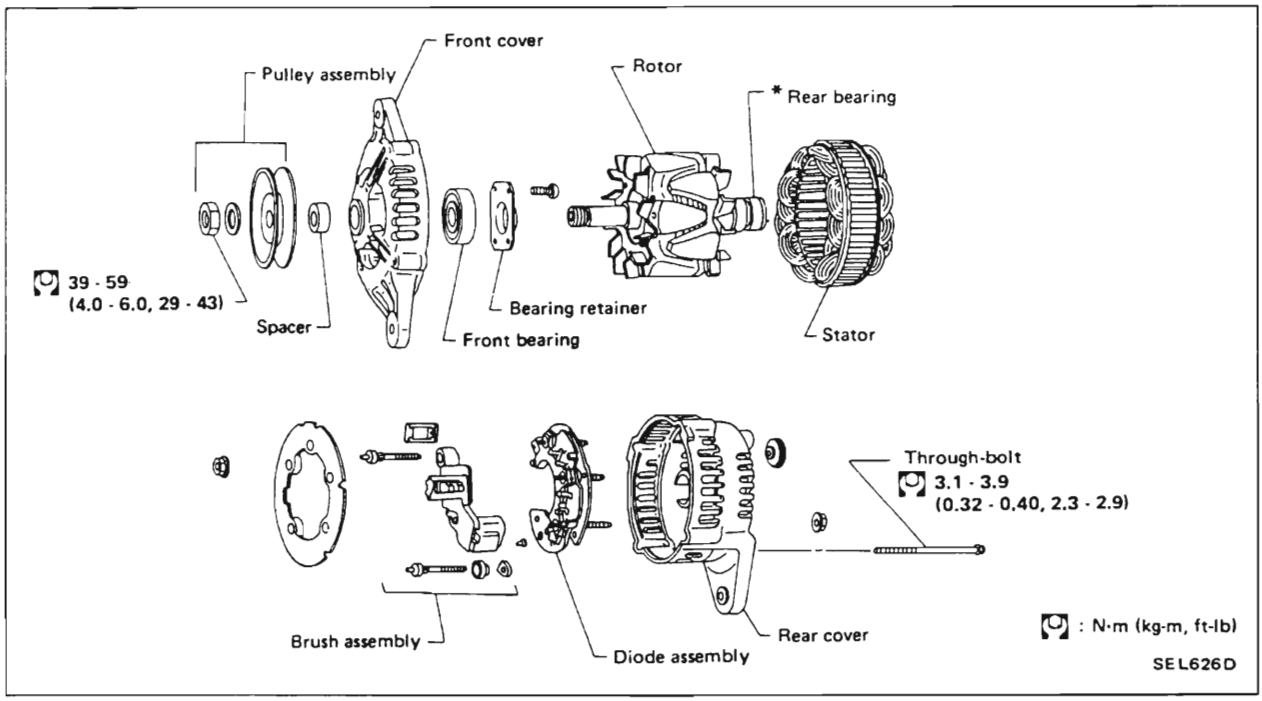
ARMATURE END PLAY

The armature end play is the lengthwise travel (longitudinal) of the armature in its bearings. Too little or too much end play results in increased wear of the bearings.

The end play is adjusted by placing or removing shims at the commutator end between the end cover and circlip on the armature. End play should be 0.002" to 0.012" (0.05 mm to 0.30 mm).

Service Data and Specifications

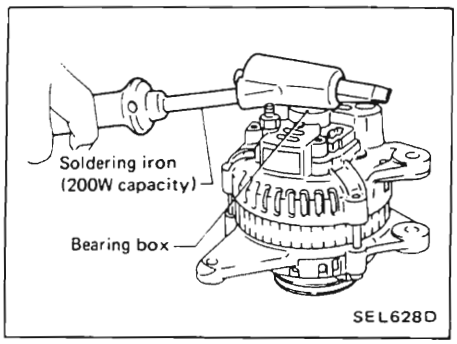
Type			Bosch EF	Mitsubishi M1T70685
			Non-reduction gear type	Reduction gear type
Applied model			CA20E	RB30E
System voltage		V	12	12
No-load	Terminal voltage	V	12	11
	Current	A	Less than 65	50 - 75
	Revolution	rpm	More than 7500	3,000 - 4,000
Outer diameter of commutator		mm (in)	More than 33.5 (1.31)	More than 28.4 (1.12)
Minimum length of brush		mm (in)	12 - 7 (0.50)	12 (0.47)
Brush spring tension		N (kg, lb)	18 - 20 (1.83 - 2.04, 4.0 - 4.5)	13.7 - 25.5 (1.4 - 2.6, 3.1 - 5.7)
Clearance between bearing metal and armature shaft		mm (in)	Less than 0.3 (0.012)	—
Clearance "ℓ" between pinion front edge and pinion stopper		mm (in)	—	0.3 - 2.5 (0.012 - 0.98)



*Rear bearing

CAUTION:

Rear cover may be hard to remove because a ring is used to lock outer race of rear bearing. Be careful not to lose this ring during removal.



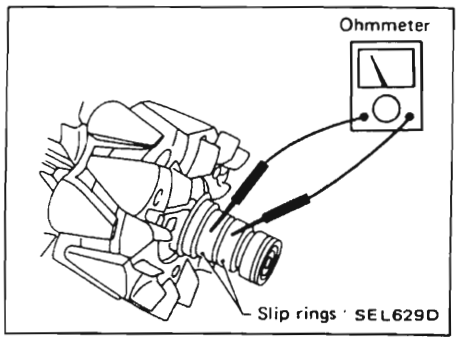
Disassembly

REAR COVER REMOVAL

CAUTION:

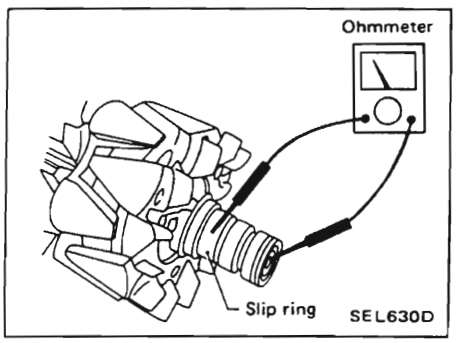
Rear cover may be hard to remove because a ring is used to lock outer race of rear bearing. To facilitate removal of rear cover, heat just bearing box section with a 200-watt soldering iron.

Do not use a heat gun, as it can damage diode assembly.



Rotor Slip Ring Check

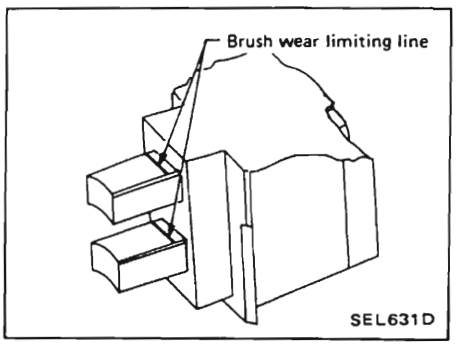
1. Continuity test
   - No continuity ... Replace rotor.



2. Insulator test
   - Continuity exists ... Replace rotor.
3. Check slip ring for wear.

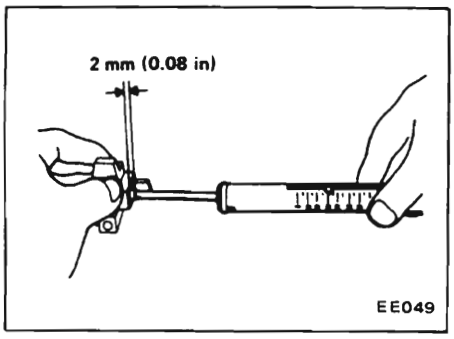
   Slip ring minimum outer diameter:

   Refer to "Service Data and Specifications."



Brush Check

1. Check smooth movement of brush.
   - Not smooth ... Check brush holder and clean.
2. Check brush for wear.
   - Replace brush if it is worn down to the limit line.



3. Check brush lead wire for damage.
   - Damaged ... Replace.
4. Check brush spring pressure.

   Measure brush spring pressure with brush projected approximately 2 mm (0.08 in) from brush holder.

   Spring pressure:

   Refer to "Service Data and Specifications."
   - Not within the specified values ... Replace.

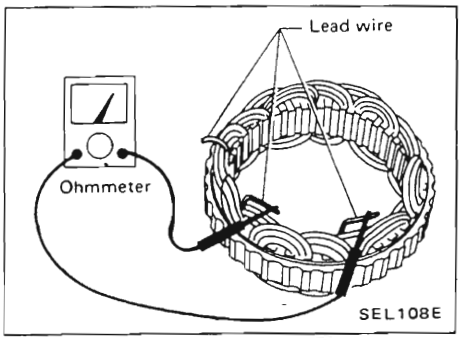
Stator Check

To test the stator or diode, you must separate them by unsoldering the connecting wires.

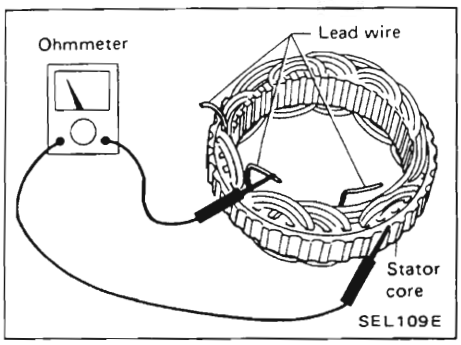
CAUTION:

Use only as much heat as required to melt solder.

Diodes will be damaged by excessive heat.



1. Continuity test
   - No continuity ... Replace stator.



2. Ground test
   - Continuity exists ... Replace stator.

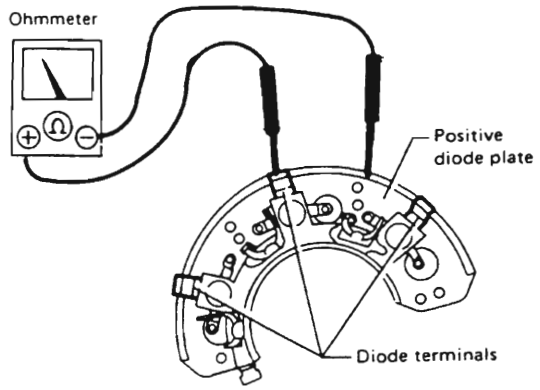
Diode Check

MAIN DIODES

- Use an ohmmeter to check condition of diodes as indicated in chart below.
- If any of the test results is not satisfactory, replace diode assembly.

	Ohmmeter probes		Continuity
	Positive ⊕	Negative ⊖	
Diodes check (Positive side)	Positive diode plate	Diode terminals	Yes
	Diode terminals	Positive diode plate	No
Diodes check (Negative side)	Negative diode plate	Diode terminals	No
	Diode terminals	Negative diode plate	Yes

Positive side



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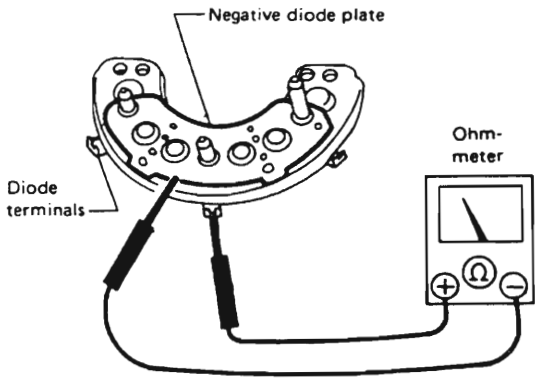
Negative side



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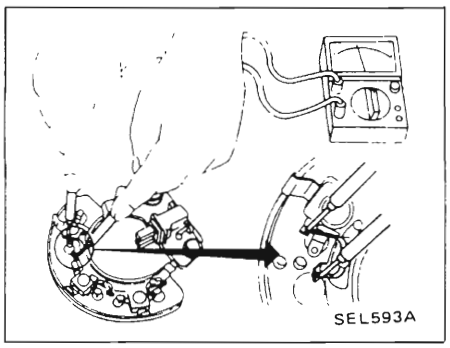
Diode Check (Cont'd)



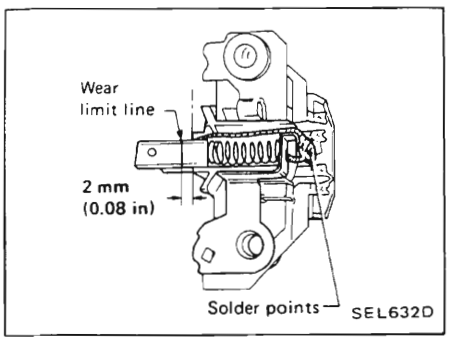
SUB-DIODES

- Attach ohmmeter's probe to each end of diode to check for continuity.
- Continuity is N.G. ... Replace diode assembly.

Assembly

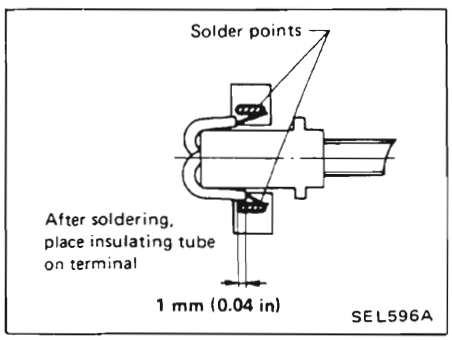
Carefully observe the following instructions.

- When soldering each stator coil lead wire to diode assembly terminal, carry out the operation as fast as possible.



WHEN SOLDERING BRUSH LEAD WIRE

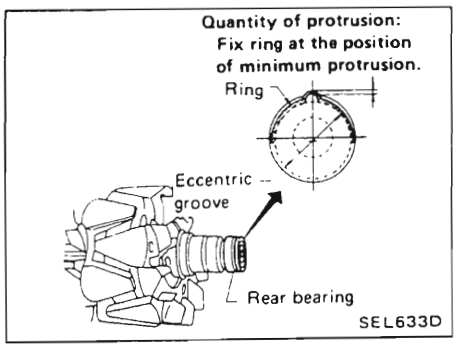
- Position brush so that its wear limit line protrudes 2 mm (0.08 in) beyond end face of brush holder.



(2) Coil lead wire 1.5 times around terminal groove. Solder outside of terminal.

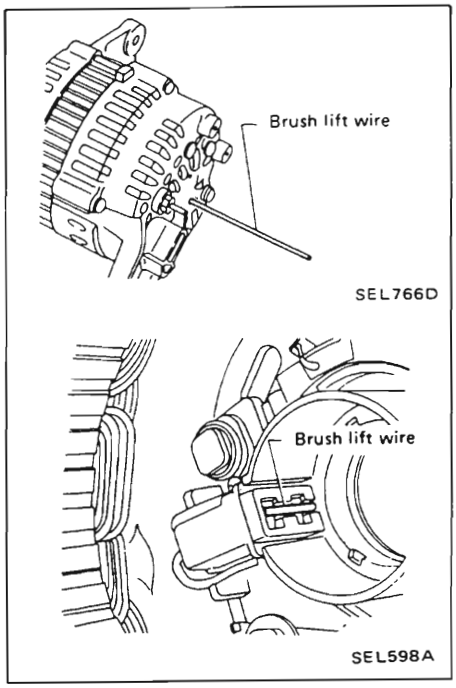
When soldering, be careful not to let solder adhere to insulating tube as it will weaken the tube and cause it to break.

Assembly (Cont'd)



RING FITTING IN REAR BEARING

- Fit ring into groove in rear bearing so that it is as close to the adjacent area as possible.

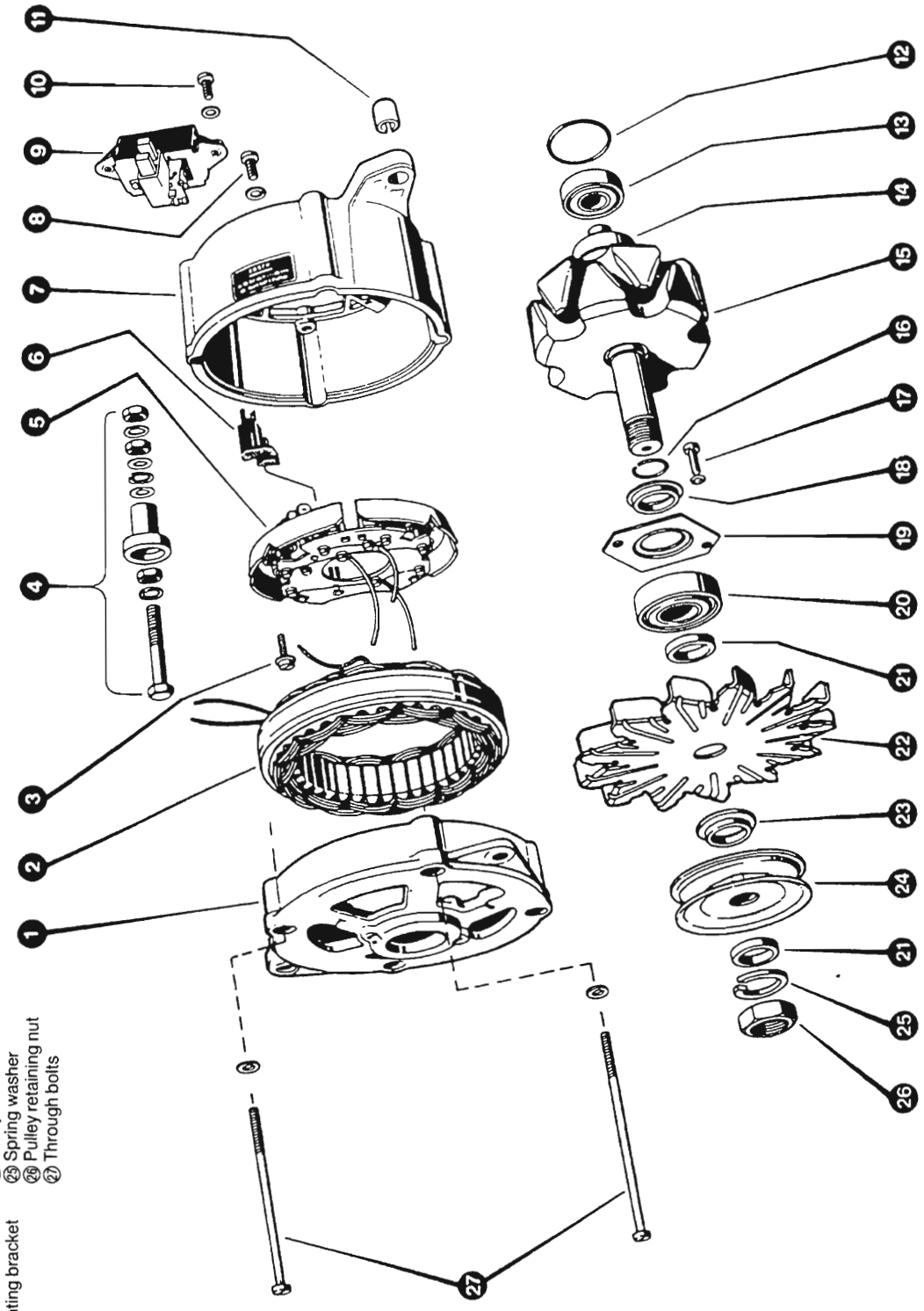


REAR COVER INSTALLATION

(1) Before installing front cover with pulley and rotor with rear cover, push brush up with fingers and retain brush, by inserting brush lift into brush lift hole from outside.
After installing, remove wire for brush lift.

(2) After installing front and rear sides of alternator, pull brush lift by pushing toward center.

Do not pull brush lift by pushing toward outside of cover as it will damage slip ring sliding surface.



① End plate front
② Stator
③ Screw
④ B + bolt
⑤ Rectifier
⑥ Connector assy.
⑦ End plate rear
⑧ Screw
⑨ Brush holder & regulator
⑩ Screw
⑪ Split bush mounting bracket
⑫ 'O' ring
⑬ Bearing
⑭ Slip rings
⑮ Rotor
⑯ Circlip
⑰ Screw
⑱ Spacer
⑲ Bearing retainer
⑳ Bearing
㉑ Spacers, fan
㉒ Fan
㉓ Spacer
㉔ Pulley
㉕ Spring washer
㉖ Pulley retaining nut
㉗ Through bolts

X093

ALTERNATOR
Bosch K1-80

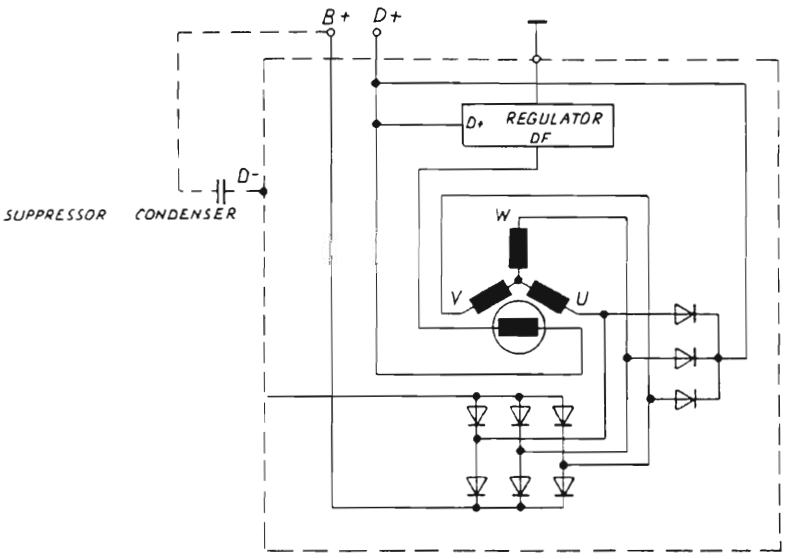
DESCRIPTION

The 3 phase BOSCH alternator is a 12 pole machine equipped with silicon diodes for rectification and a built-in electronic regulator. Cooling is by an external fan located behind the pulley. The six diodes are arranged in a 3 phase bridge connection whereby 3 diodes have anodes at the connection (normal polarity) and 3 diodes have anodes at the housing (reverse polarity). See Figure 2.

The alternator is designed for negative ground operation. When an indicator lamp is used in the system a further 3 smaller diodes are fitted into the rectifier assembly.

The stator winding has a star connection — see Figure 1 — with three outlets which are connected to the rectifier assembly.

The rotor comprises the slip rings and exciter winding and is constructed of imbricated poles which form alternator north and south poles. The exciter winding is wound concentric with the shaft inside the claw poles and has its ends connected to the slip rings.



X091

Fig. 1. 9-diode alternator with built-in regulator

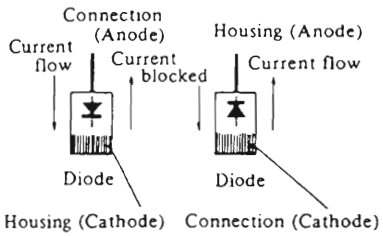


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Fig. 2 Diode connections

ALTERNATOR OPERATION

(See Figure 1 for wiring diagram.)

When the ignition switch is turned to the 'ON' position, battery current is supplied to the exciter winding through the warning lamp. If we look at one pair of rotor poles, it will be seen that the magnetic field of the rotor will be broken by one loop of the stator winding as the rotor is turned.

A voltage will be induced in this conductor and because of the closed circuit a current will flow away from the wire connection through a phase winding. Since the phase is connected to both a positive and a negative diode, the current will flow thorugh the positive diode, which is open to current flow in this direction. The negative diode of this phase obstructs current flow. From the positive diode the current passes into the heat sink, which is common to the B+ terminal, and then to the battery.

To complete the circuit a return path from the negative battery terminal to the alternator stator star point must be found.

The negative heat sink is directly connected to the alternator housing, therefore, the return circuit is firstly through the negative diodes. However, the negative diode, which is connected at the bridge connection, is open to current flow in this direction but is opposed by the equal potential of the phase. The remaining negative diodes are free at this period and the circuit back to the star point can be completed through either of these diodes and associated phases. The interconnected positive diodes also have the phase potential and resist the direct flow of current across the bridge connection. If the rotor is now moved until the other loop of the phase winding is affected, a current will flow in the opposite direction and so complete the other half of the sine wave. Actually, this cycle takes place very quickly in the phases and the output is a continuous current flow.

VOLTAGE REGULATOR OPERATION

Voltage from D+ is supplied to voltage dividers R5, R6 and R7, whereby R7 is adjusted to the correct value during production. The centre tapping of the voltage divider is taken to a zener diode through diode D2 which provides the necessary temperature compensation. The zener diode controls the base of T3 which opens to ground when set voltage is exceeded. This renders T3 conductive, thereby switching off T2 and T1 which are arranged in a Darlington pair.

With this switching action the current flow through the exciter winding and T1 to ground is interrupted. With the collapse of the excitation the output voltage decreases until the zener diode blocks positive potential from reaching the base of T3. T1 and T2 now become conductive again and the output voltage will rise until the switching cycle is repeated

Diode D1 is for the protection of transistor T1. Condenser C1 is a stabilising condenser to reduce any instability of the zener diode arrangement.

ALTERNATOR TERMINALS

D+ Exciter diode junction-connection for indicator lamp

B+ Battery connection (direct to battery).

TESTING ON THE TEST BENCH

The alternator may only be run on a test bench when the fan is fitted. Use only correct sockets and cable ends for the various alterantor connections. **Do not use temporary connection clips.** A 12 volt battery must always be connected in parallel with the machine when it is being tested. The battery acts as a buffer and eliminates voltage peaks which occur when a load is switched on and off.

When voltage peaks exceed safe limits, the rectifier action of the diodes will be destroyed.

Set up the alternator on an approved test bench. As the construction of the alternator does not readily lend itself to clamp type mounting, a suitable adapter should be used.

Connect a 12V warning lamp of at least 2 watts between terminals D+ and B+.

Connect the test bench voltmeter between terminals D- and B+ and the ammeter in the cable to B+. If the test bench is not fitted with a battery load resistor, a load resistor rated at 40A must be connected in parallel with the battery.

Start test bench and increase speed but maintain a maximum of 14V by adjusting the load resistor.

With a warm alternator i.e. after 5 minutes operation at maximum output values as per test instruction should be obtained.

TESTING ON THE CAR

a) Ignition switch off.
b) Connect ampmeter between B+ connector and B+ lead at rear of alternator.
c) Connect voltmeter between B+ connector and earth.
d) Bridge B+ and D+ with a 2 watt globe.
e) Connect tachometer.
f) Run engine at 900 RPM.
g) Switch on consumers to achieve an output of 26 amps ±2 amps and check that voltage is within specifications 13.6 to 14.4 volts.

Note: **If consumers are unable to supply required load, connect additional load in parallel.**

DISASSEMBLY

1. Mark relative positions of stator ② and end plates ① and ⑦ with centre punch.
2. Loosen brush holder and regulators ⑨ by unscrewing 2 screws ⑩
3. Extract brush holder/regulator. Unsolder wire connection linking it to the rectifier.
4. Remove 2 nuts and lower rear mounting bracket. Unscrew 4 through bolts.
5. Withdraw end plate ⑦ together with rectifier ⑤ and stator ②.

6. Unsolder the 3 stator connections from rectifier assembly and remove stator.
7. Remove screws ③ and terminal nuts (B±). Withdraw rectifier assembly.
8. Hold rotor ⑮ in vice (soft jaws!) and unscrew pulley retaining nut ⑭.
9. Remove pulley ㉔ fan ㉒ and 2 spacers.
10. Drive end plate can now be supported on a press and the rotor ⑮ pressed out.
11. Remove ball bearing in drive end plate by unscrewing two screws ⑰ and remove ball bearing ⑳.
12. Remove ball bearing ⑬ on slip ring end of rotor with a suitable puller.

CLEANING

Thoroughly clean all parts with compressed air, do not immerse windings and bearings in solvents. The free passage of cooling air around the heat sinks is essential for maximum efficiency, therefore dirt and oil traces must be cleaned from and around the rectifier assembly

TESTING INDIVIDUAL PARTS

Rectifier assembly

The rectifier assembly is not repairable and should, in case of diode failure, be replaced. In order to establish whether the diodes are functioning properly observe the following points:

Use only test lamps up to 24V. With diodes of normal (+) polarity the test lamp must light up if the positive probe of the test lamp is connected to the anode and the negative probe to the cathode (housing). This process has to be reversed for negative diodes. (See Figure 1.)

There are two main possibilities which can destroy a diode during service, either breakdown in resistance to current flow caused by high current and high temperature, or open circuit in both directions. This is almost always the consequence of excess voltage

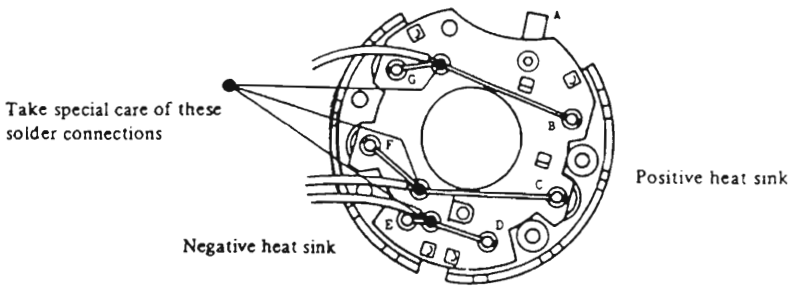


Fig 3 Rectifier connections

Power diodes

Apply test probes as described above to points B, C, D or E, F, G (see Figure 3) and the appropriate heat sink. Establish by reversing the test probes (polarity) whether the diodes are functioning properly If diodes G–B, F–C or E–D are short circuited, all 6 power diodes will show a short circuit when tested with the test lamp.

Exciter diodes

Apply test probes between points A and B, C, D By reversing to probes it can be established if one or several of the exciter diodes failed due to an open or short circuit

Stator winding

Test stator for short circuit to ground with a test lamp of up to 40V. Test winding resistance between phases according to the values given. Refer to Service Data and Specifications. Insulation and short circuit tests on windings should only be carried out with the diodes disconnected.

Testing of exciter winding

Test for short circuit to ground with a test lamp of up to 40V. Measure the resistance of the exciter winding between the slip rings. Resistance should be according to the values given Refer to Service Data and Specifications.

Regulator and brush assembly

The regulator is not serviceable and should be replaced as an assembly.

If the brushes are worn, new brushes should be soldered into the brush holder allowing 0.43 to 0.47" (11 to 12 mm) of brush to protrude from holder. Worn slip rings can be turned in a lathe in the usual manner.

Ball bearings

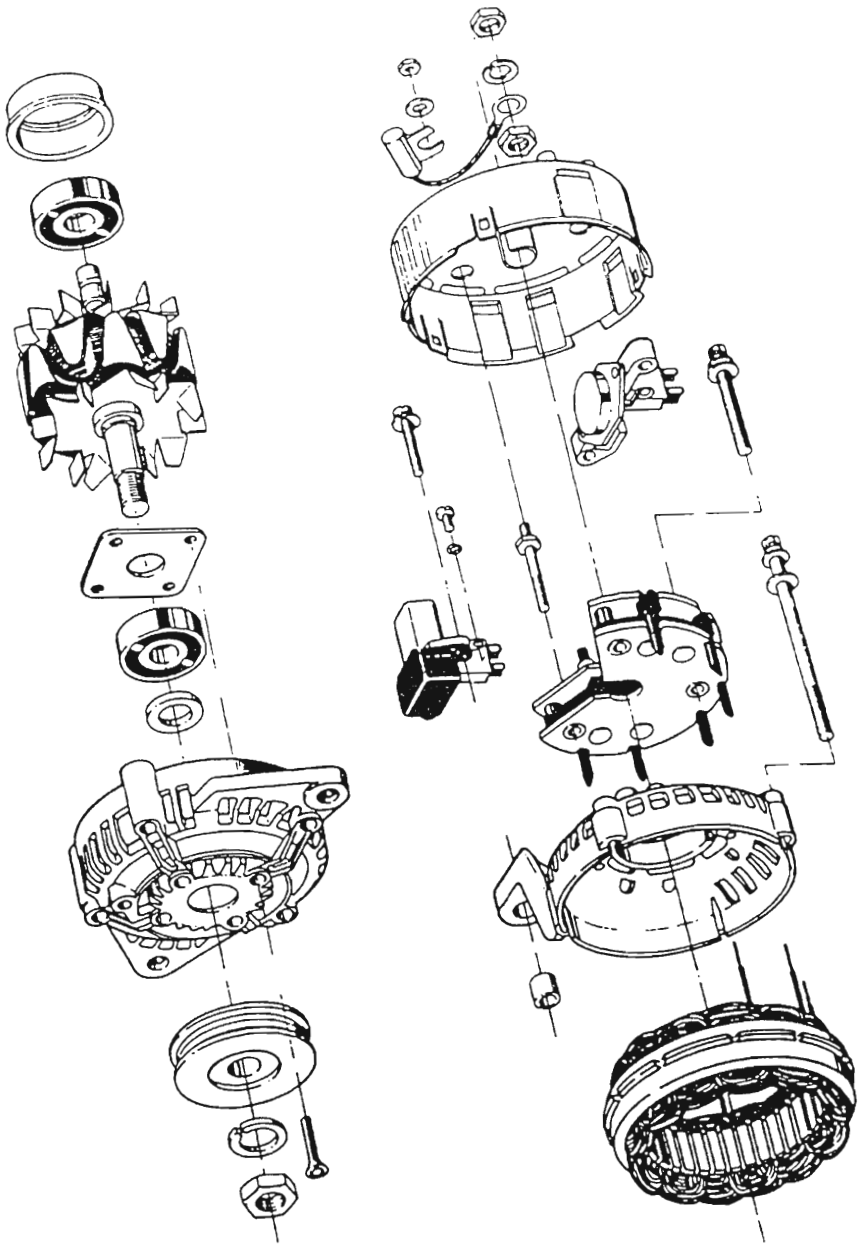
Check ball bearings for wear and roughness. Renew defective bearings with approved bearings only and lubricate with BOSCH Grease Etlv34.

ASSEMBLY

(Reverse disassembly procedure)

a) Tighten the through bolts evenly. The air gap between rotor and stator must be equal at all points. If the air gap is not even, loosen the through bolts and reposition the end plates on the stator

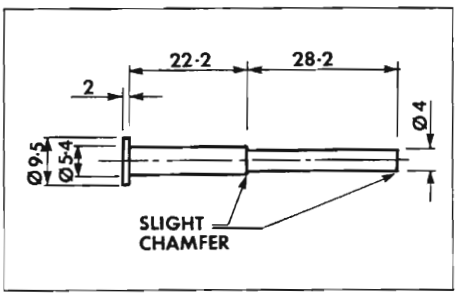
b) Tighten pulley nut to 40 to 50 ft-lb (5.53 to 6.91 kg-m) torque.



Disassembly

1. Clamp alternator mounting bracket in vice and remove supressor — Remove nut and washer completely.
2. Take hold of rear cover and lever snap-in connections off their seats — withdraw cover.
3. Remove regulator by first unscrewing 'B±' Phillips head screw and undoing top nut of phase terminal. Remove two holding screws (5 mm star-socket) and lift off regulator.
4. The rectifier assembly is held to the generator by two screws (6 mm star-socket) and one earth bolt. The six stator wires are best separated in the following manner: with a soldering iron heat the solder spot and pull off the crimped solder sleeve, keep heat on and separate wire from rectifier tongue. Once all wires at the outside of the rectifier plate have been isolated remove holding screws and assembly. (Mark position of earth bolt.)
5. Remove four through-bolts (6 mm star-socket) and slide off rear half of housing. Pull off plastic bearing sleeve.
6. Mark position of stator in housing and withdraw stator.
7. Hold rotor shaft with 8 mm allen head socket and unscrew pulley nut. Remove spring washer and pulley.
8. Support housing half properly on press and push shaft assembly from housing.
9. Unscrew bearing retaining plate and remove bearing and spacer from housing.
10. TO REMOVE SLIP RING BEARING, GREAT CARE MUST BE TAKEN SO AS TO AVOID DAMAGE TO THE SLIP RING.
    A puller support as per drawing should be made up to prevent pressure reaching the slip-ring end of the rotor shaft. Insert pin into hole of shaft end and with suitable puller remove bearing.

Note: in the event of slip-ring damage the complete rotor assembly must be replaced.

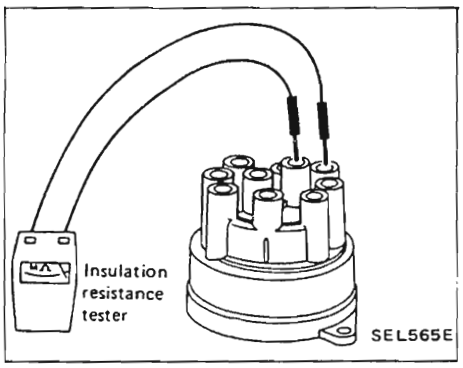


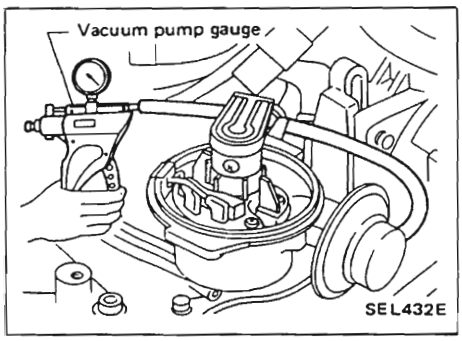
Assembly

1. Place drive side bearing in drive end plate and fit bearing retaining plate with four screws — tighten to specified torque.
2. Place slip-ring end bearing on table of press so that inner race is well supported, and enough clearance is provided for downward moving rotor shaft. Place rotor shaft into bearing with slip-ring facing downwards and press shaft home.
3. Position pre-assembled drive end plate (see 1) on upper (threaded) part of rotor shaft. The spacer is now also positioned on the rotor-shaft with its lip facing the bearing.
4. With slip ring bearing still in position as per point 2 above, and using a cylindrical press tool of 19 mm (¾") inner diameter and a minimum length of 30 mm, press drive end plate on rotor shaft.
5. Fit pulley, spring washer and nut — tighten to specified torque.
6. Clamp drive end plate by its lug into vice and fit stator. Line up markings as made on disassembly.
7. Position plastic bearing sleeve in slip-ring end plate. Carefully guide plate over stator wire ends and secure with four bolts.
8. Fit rectifier assembly by guiding stator wires through conduits and secure with two screws and one bolt. Tighten housing through bolts and rectifier assembly screws to prescribed torque.
   Slip solder sleeves over stator wire ends and rectifier assembly tongues and crimp sleeves before soldering these joints. Fit regulator — torque screws as below.
9. Place rear cover into position and attach capacitor.
10. Test alternator according to test sheet.

ALTERNATOR

Type			LR170-714	Bosch U-K1		Bosch KK
Applied Model			RB30E	CA20E	RB30E	RB30E
Nominal Rating		V-A	12-70	12 - 60	12 - 70	12 - 70
Ground polarity			Negative	Negative		Negative
Minimum revolution under no-load (When 14 volts is applied)		rpm	Less than 950	—		
Hot output current		A/alternator rpm	More than 22/1,300 More than 50/2,500 More than 68/5,000	More than 16/1300 More than 40/2200 More than 60/6000		More than 10/1050 More than 30/1500 More than 70/6000
Regulated output voltage		V	14.1 - 14.7	14.3 - 14.7		14.25 - 14.55
Minimum length of brush		mm (in)	More than 6.0 (0.236)	—		4.0
Brush spring pressure		N (g, oz)	1.373 - 3.334 (140 - 340, 4.94 - 11.99)			
Slip ring outer diameter		mm (in)	More than 26.8 (1.055)			
Torque	pulley nut	Nm (ft-lb)	39 - 59 (29 - 43)	54 - 68 (40 - 50)		45 - 50 (33 - 37)
	Through bolts	Nm (in.-lb)	3.1 - 3.9 (28 - 35)	3.8 to 5.5 (34 to 49)		4.5 - 5.5 (40 - 49)





Cap and Rotor Head

1. Check cap and rotor head for dust, carbon deposits and cracks.
2. Measure insulation resistance between electrodes on ignition coil and side of spark plug.

   Insulation resistance:

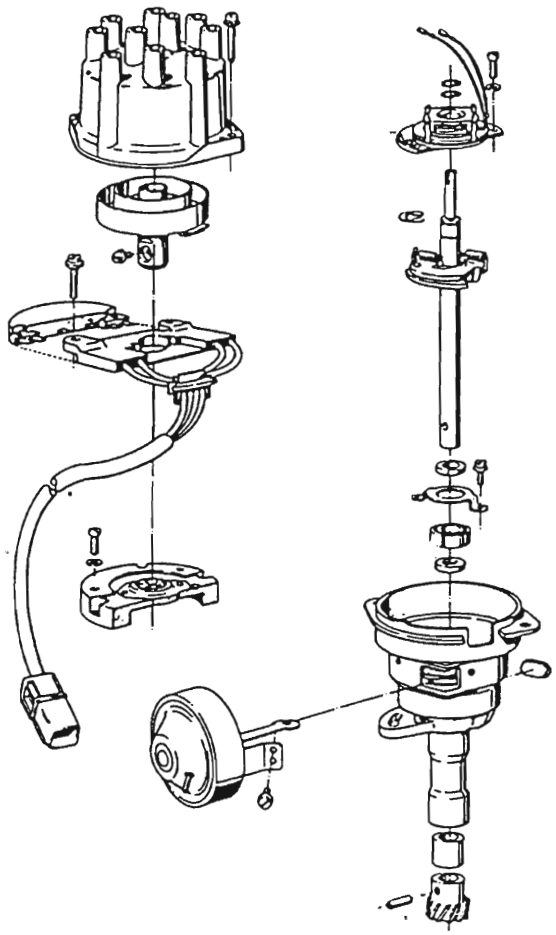
   More than 50 [MΩ]

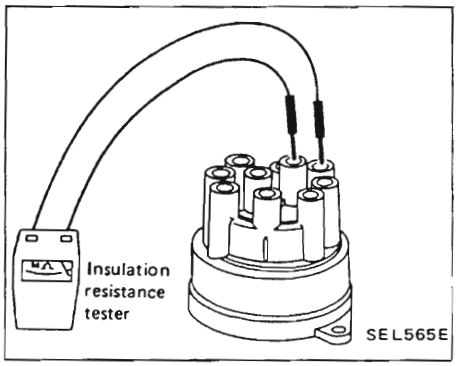
   - Less than specified value ... Replace.

Check Vacuum Advance

1. Connect vacuum pump to the vacuum unit and gradually draw a vacuum while watching breaker plate movement. Check for smooth operation with no evidence of binding.
2. Turn breaker plate right and left to check for freedom of movement.

Note: for further checks and operation refer section EF.





Cap and Rotor Head

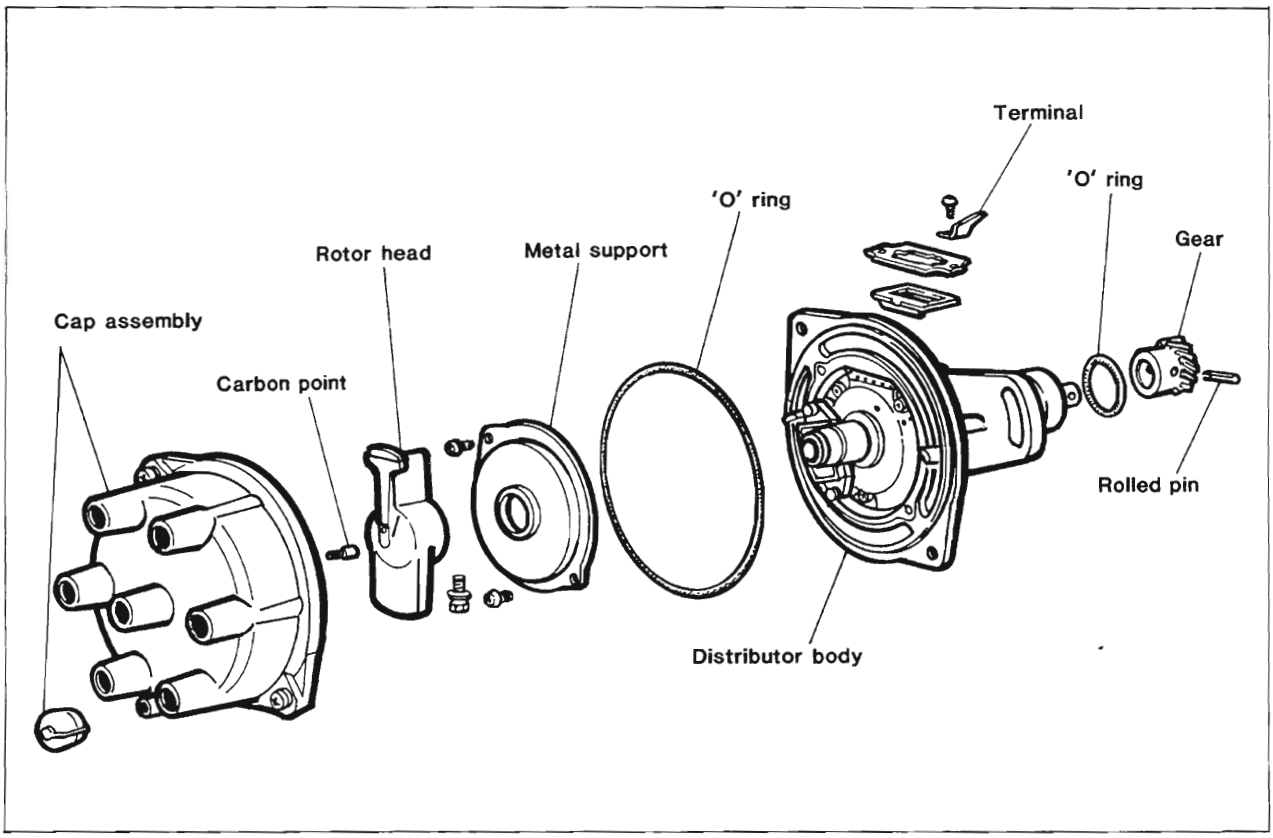
1. Check cap and rotor head for dust, carbon deposits and cracks.
2. Measure insulation resistance between electrodes on ignition coil and side of spark plug.

   Insulation resistance:

   More than 50 [MΩ]

   - Less than specified value ... Replace.

Note: for further checks and operation refer section EF.

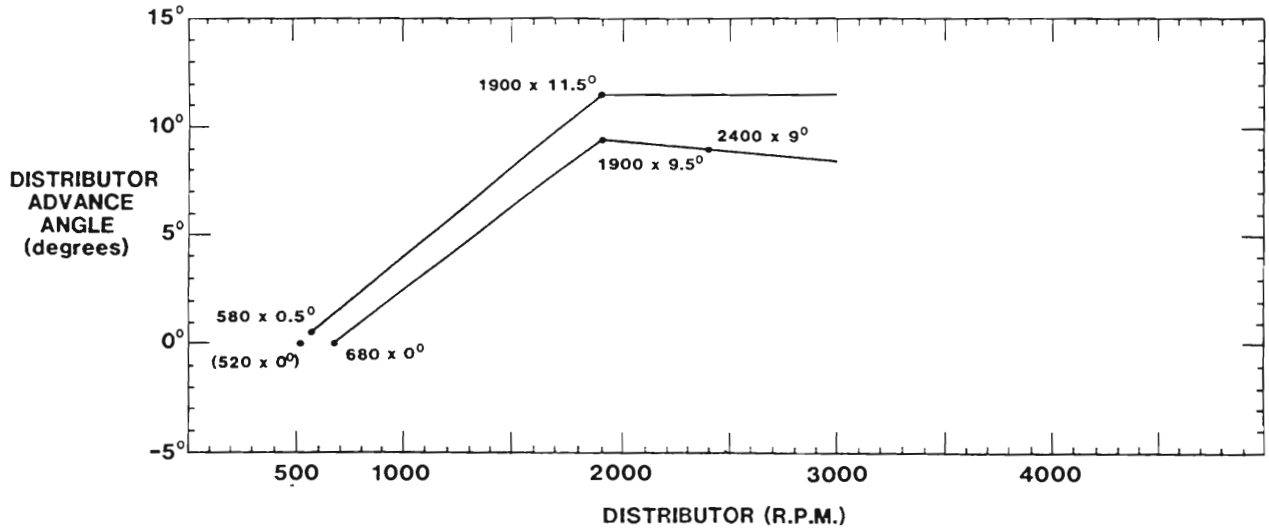


Service Data and Specifications

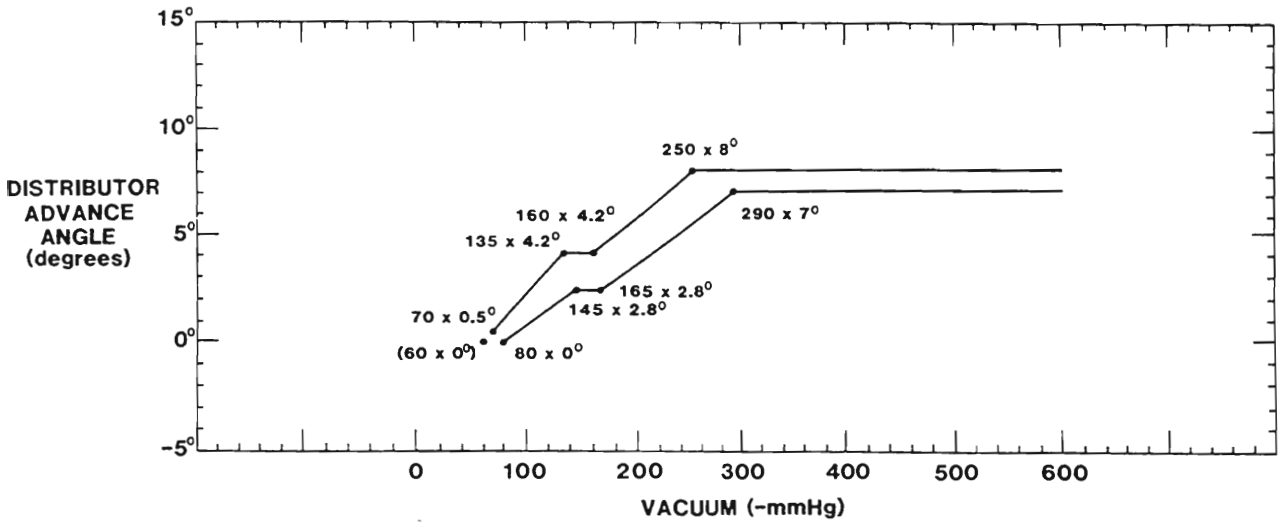
DISTRIBUTOR

Type	Bosch 9 230 066 041	Hitachi (TOT type)
Applied model	CA20E	RB30E
Firing order	1 - 3 - 4 - 2	1 - 5 - 3 - 6 - 2 - 4
Rotational direction	Counter clockwise	Counter clockwise
Cap insulation resistance M	More than 50	More than 50
Rotor head insulation resistance M	More than 50	More than 50
Vacuum advance Distributor degrees/vacuum Kpa (m bar, mm Hg, in Hg)	0°/9.3 (93, 70, 2.76) 3.5°/20.0 (200, 150, 5.92) 7.5°/35.9 (359, 270, 10.6)	N/A
Centrifugal advance Distributor degree/distributor rpm	0°/600 10.5°/1900	N/A

(CA20E Only)



(CA20E Only)



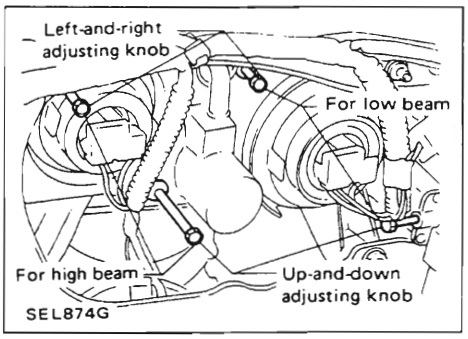
Aiming Adjustment

When performing headlamp aiming adjustment, use an aiming machine, aiming wall screen or headlamp tester. For operating instructions of any aimer, it should be in good repair, calibrated and used according to respective operation manuals supplied with the unit.

If any aimer is not available, aiming adjustment can be done as follows:

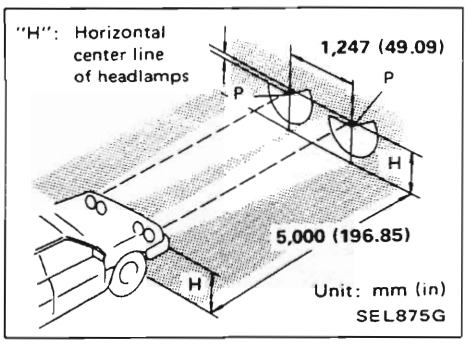
CAUTION:

a. **Keep all tires inflated to correct pressures.**
b. **Place vehicle and tester on one and same flat surface.**
c. **See that there is no load in vehicle (coolant, engine oil filled up to correct level and full fuel tank) other than the driver (or equivalent weight placed in driver's position).**

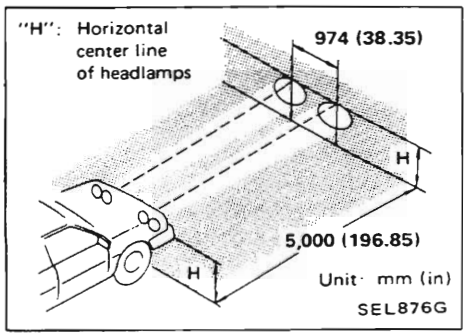


LOW BEAM

1. Turn headlamp low beam on.
2. While observing the screen, use adjusting knobs to perform aiming adjustment.



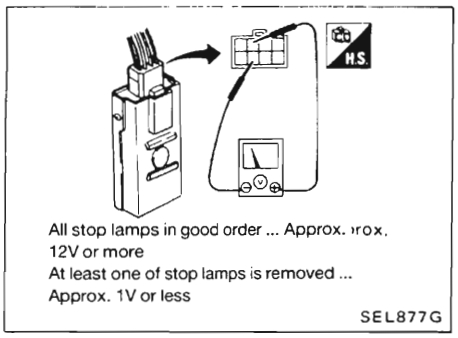
a. **Adjust headlamps so that main axis of light is parallel to center line of body and is aligned with point P shown in illustration.**
b. **Dotted lines in illustration show centre of headlamp.**



HIGH BEAM

Turn headlamp high beam on.

a. **Adjust high beams so that main axis of light is parallel to center line of body.**
b. **Dotted lines in illustration show center of headlamp.**



All stop lamps in good order ... Approx. 12V
12V or more
At least one of stop lamps is removed ...
Approx. 1V or less

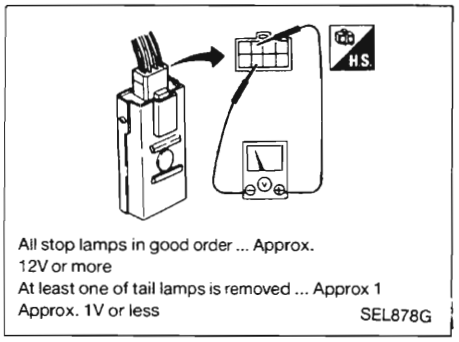
SEL877G

Stop and Tail Lamp Sensor Check

- Before checking, ensure that bulbs meet specifications.

STOP LAMP

1. Start engine.
2. Stop lamp switch on.

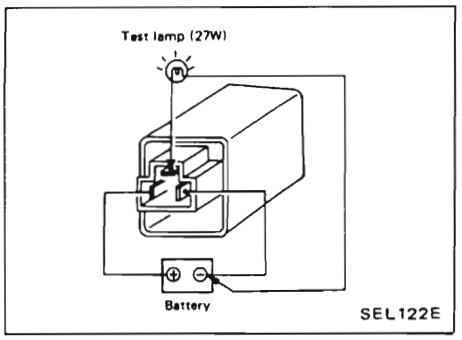


All stop lamps in good order ... Approx.
12V or more
At least one of tail lamps is removed ... Approx 1
Approx. 1V or less

SEL878G

Tail Lamp

1. Start engine.
2. Lighting switch on.



SEL122E

Combination Flasher Unit Check

- Before checking, ensure that bulbs meet specifications.
- Connect a battery and test lamp to the combination flasher unit, as shown below. Combination flasher unit is properly functioning if it blinks when power is supplied to the circuit.

Bulb specifications	(w)
Headlight Q/H	60/55
Headlamp Inner	55
Composite Beam (6 cylinder)	55
Parking light	5
Turn Signal Light	21
Stop/Tail Light	21/5
Back-Up Light	21
Number Plate Light	5
Interior Light	10
Maplight	10
Boot Light	3.4
Luggage Compartment Light (Station Wagon)	10
Glove Box Light	3.4
Step Light where fitted	3
Footwell Light	3.4
Cigarette Lighter Light	2.2
Ash Tray Light	1.2
Instrument Illumination and Indicator Lights	3.4 & 1.2

Speedometer Sensor — Checking

1. Jack vehicle or raise on hoist so that rear wheels are clear of ground. **(Observe safety precautions).**
2. Disconnect sensor harness plug beside the gearbox, unscrew the sensor and remove. (Check for oil in the sensor drive end or leaking from gear box when the sensor is removed. This indicates speedo pinion seal failure.)
3. Check that speedo pinion drive turns when tailshaft is rotated.
4. Probe into the back of the red wire of the **vehicle harness side** of the plug with a voltmeter (12V scale) and connect the negative probe of the voltmeter to vehicle body earth. Verify that there is approximately 7.5 volts at the wire. (ignition on).
   If N.G., check for short to ground on red wire or at pin 10 (red wire) of trip computer (where fitted).
5. Ignition off. Reconnect sensor to harness. Ignition on.
6. **Slowly** turn sensor input shaft by hand and verify that voltage switches from 0 volts to 7.5 volts ten times in one revolution of the sensor input shaft.
   If not, replace sensor.
7. If OK, disconnect the harness plug and refit sensor to gearbox.

Note: ensure the sensor shaft drive tongue is correctly engaged in the pinion drive slot before attempting to engage the thread.

8. Re-connect sensor to harness plug.

Speedo Divider Circuit and Wiring — Checking

1. Remove instrument cluster (refer BF-14) leaving wiring plug connected.
2. Remove speedo sensor from gear box as described in 2. above and reconnect sensor to harness.
3. Back probe pin 13 (red wire) of instrument cluster connector and that voltage between it and ground varies from 7.5V to 0V as sensor input shaft is rotated. If N.G., check wiring continuity between sensor connector and instrument cluster connector.
4. Back probe pin 12 (white/blue wire) of instrument cluster connector and confirm that voltage between it and ground varies between 5V and 0V twice per revolution of sensor input shaft.
   If OK, check continuity between pin 12 and the unit where faulty speed signal was detected. If N.G., check for short to ground in wiring or at pin 11 — auto trans control unit; pin 29 — E.C.U. (Skyline only); pin 30 — A.S.C.D. control unit (where fitted); white/green wire — door lock timer (where fitted).
   If no short is evident, replace speedometer/divider circuit assembly.

Speedometer and Tachometer — Testing

Note: Before removing instrument cluster to test with instrument tester, check power supplies, fuses and wiring continuity.

1. Remove instrument cluster (refer BF-14) and unplug connector.
2. Connect tester (P. No. E-7114) to cluster and plug power lead into cigarette lighter socket. Turn ignition to 'ACC' position.

Ensure Tachometer and Speedometer indicate the readings for each switch position as detailed on the tester.

Minor Gauges

Fuel, water temperature and oil pressure gauges can be tested using gauge tester Part No. 77777-00017. Instrument tester (Part No. E-7114) is provided with three separate coloured wires to enable connection to gauge tester (77777-00017) between each instrument and body ground. Gauge tester P. No. 77777-00017 can be used by itself using the following method.

Fuel Gauge

Disconnect fuel pump harness connector in boot and connect Gauge tester between Yellow/green wire at the vehicle harness plug and vehicle body ground.

Water temperature gauge

Disconnect wire from temperature sensor and connect tester between wire and body ground.

Oil pressure gauge

Disconnect plug from oil pressure sensor and connect tester between yellow/green wire and body ground.

See S.D.S. for specified values.

Instrument assembly and disassembly

1. Remove trip meter knob.
2. Remove 4 screws rear of speedo.
3. Remove 3 screws rear of tachometer or econometer.
4. Depress clips and remove the front cover.
5. Slide out speedo/tachometer separating strip.
6. Using one original screw, (inserted in rear of assembly) push tacho from rear to remove.
7. Lift out speedo.
8. Remove nuts from rear of gauges to remove from assembly.
9. To reassemble use reverse of above procedure.

Service Data and Specifications

Instrument tester Part No. (E-7114) — Test Data

Tester switch position	Instrument reading		
	Speedometer (kph)	CA20E Tachometer (rpm)	RB30E Tachometer (rpm)
1	19^{+8}_{-0}	960^{+240}_{-80}	640^{+240}_{-80}
2	38^{+8}_{-0}	1920^{+240}_{-80}	1280^{+240}_{-80}
3	76^{+8}_{-0}	3840^{+240}_{-80}	2560^{+240}_{-80}
4	152^{+8}_{-0}	7680^{+240}_{-80}	5120^{+240}_{-80}

Gauge tester Part No. 77777-00017 — Test Data

Gauge	Tester resistance (Ω)	Gauge reading
Fuel	282	E
	40	F
Water	310	C
Temperature	32	H
Oil	10	O
Pressure	180	6

Preparation — Remove A.S.C.D. control unit from its mounting (behind R/H kick panel), leaving the harness connected.
Note: relays located under bonnet at relay bracket.

FAULT — Type 1. Cruise speed cannot be set.

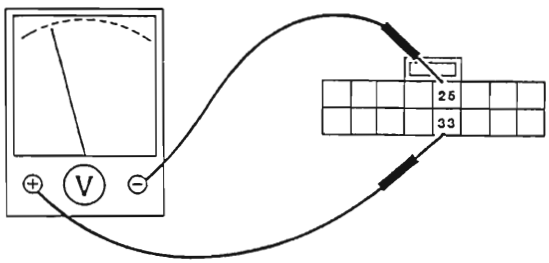
Turn A.S.C.D. main switch "OFF" and then "ON" to make sure "Cruise On" light illuminates.

Yes

Check for loose vacuum hose to A.S.C.D. activator.

O.K.

1. Release brake pedal
2. Place gear selection in "D"
3. Turn ignition switch "ON"
4. Turn A.S.C.D. switch "ON"
5. Check voltage between pins 33 and 25 of A.S.C.D. harness plug. Should be approx. 12V.



O.K.

Ⓐ

No

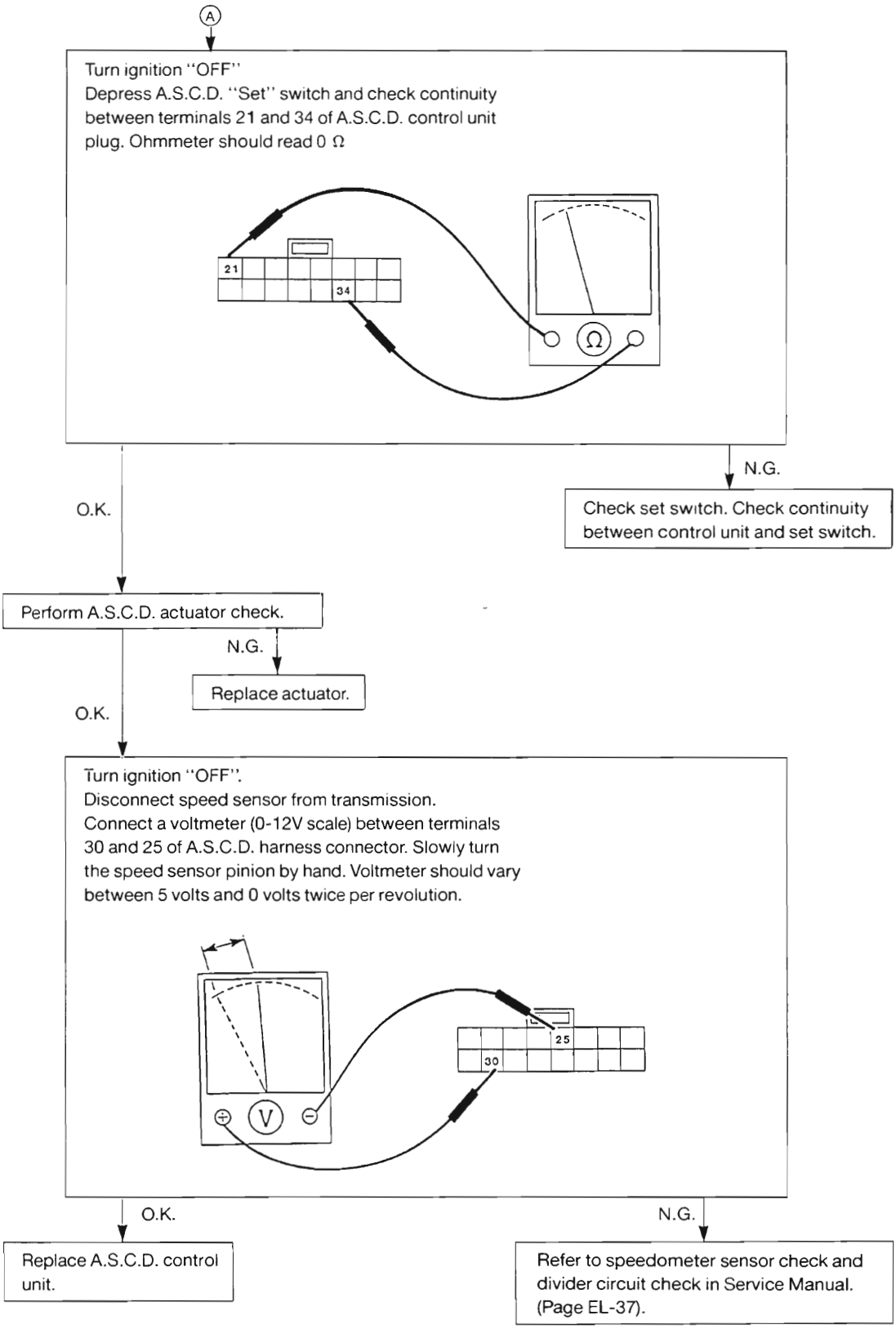
Check A.S.C.D. main switch and A.S.C.D. relay No. 1.

N.G.

Check stop switch, inhibitor switch, inhibitor relay, A.S.C.D. relay No. 1.

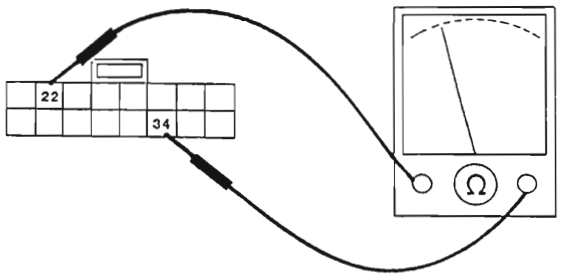
O.K.

Check continuity between terminal 33 of A.S.C.D. harness plug and stop switch (Blue/Green wire, and between stop switch (Blue wire) and A.S.C.D. relay No. 2.


A
Turn ignition "OFF"
Depress A.S.C.D. "Set" switch and check continuity between terminals 21 and 34 of A.S.C.D. control unit plug. Ohmmeter should read 0 Ω
21
34
Ω
N.G.
Check set switch. Check continuity between control unit and set switch.
O.K.
Perform A.S.C.D. actuator check.
N.G.
Replace actuator.
O.K.
Turn ignition "OFF".
Disconnect speed sensor from transmission.
Connect a voltmeter (0-12V scale) between terminals 30 and 25 of A.S.C.D. harness connector. Slowly turn the speed sensor pinion by hand. Voltmeter should vary between 5 volts and 0 volts twice per revolution.
25
30
V
O.K.
Replace A.S.C.D. control unit.
N.G.
Refer to speedometer sensor check and divider circuit check in Service Manual. (Page EL-37).

FAULT — Type 2. Resume switch does not operate.

Turn ignition switch "OFF".
Turn resume switch on and check continuity between terminals 22 and 34 of A.S.C.D. control unit harness plug.
Ohmmeter should read 0 Ω

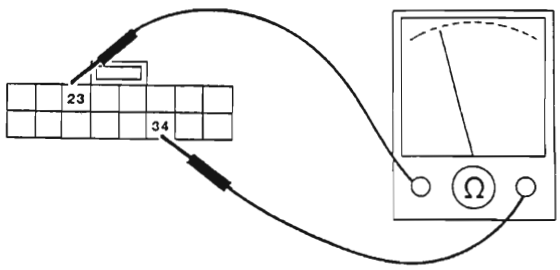


O.K. → Replace A.S.C.D. Control unit.

N.G. → Check resume switch.

FAULT — Type 3. Accelerate switch does not operate.

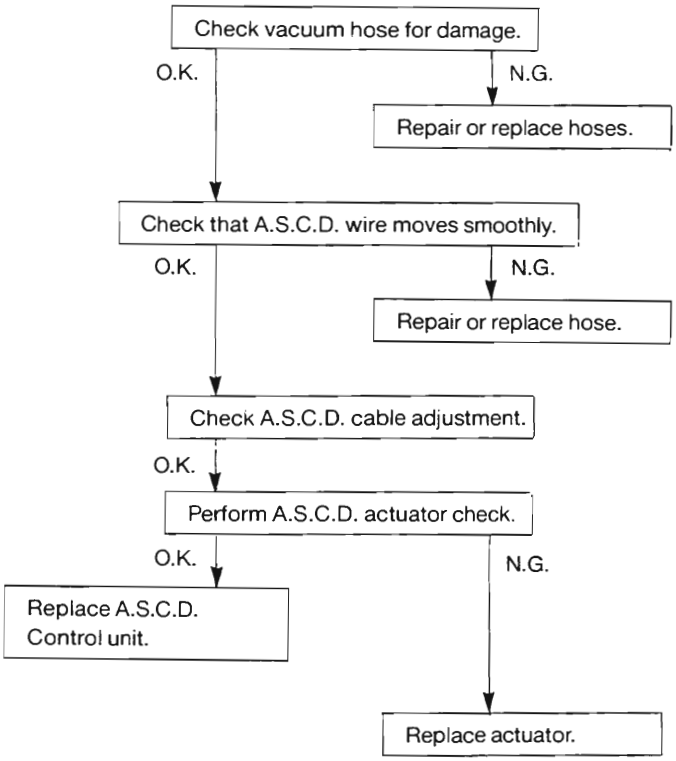
Turn ignition switch "OFF".
Turn accelerate switch to "ON" and check continuity between terminals 23 and 34. Ohmmeter should read 0 Ω



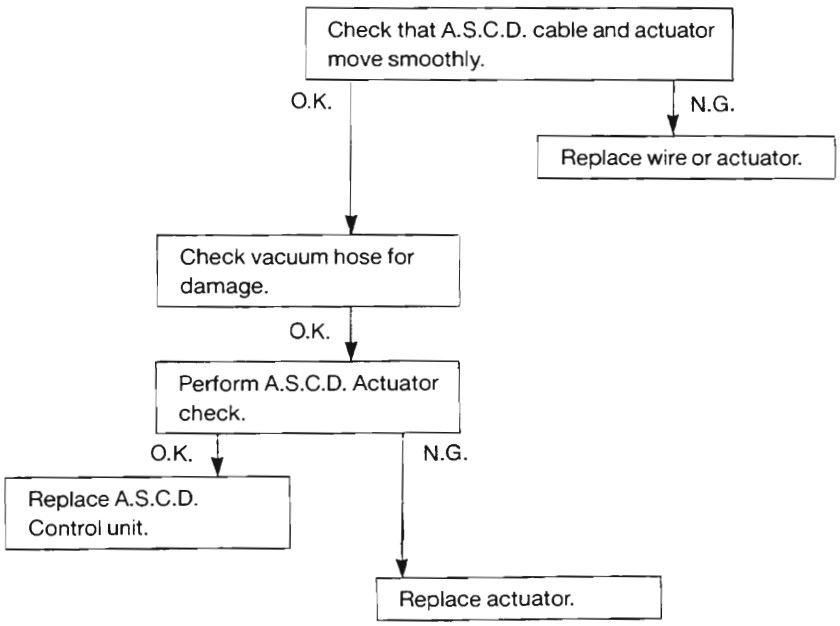
O.K. → Replace A.S.C.D. Control unit.

N.G. → Check accelerate switch.

FAULT — Type 4. Engine hunts.

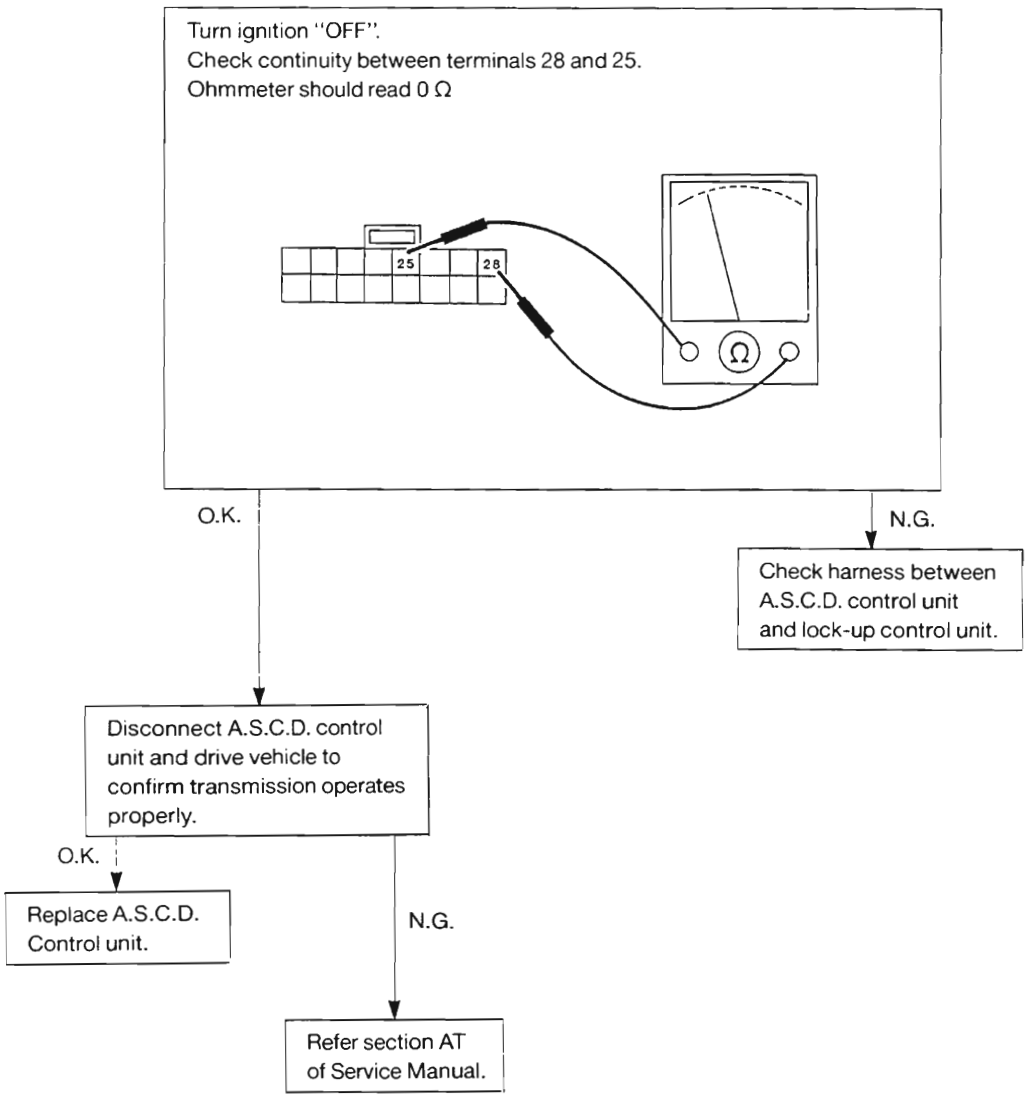


FAULT — Type 5. Large difference between set vehicle speed and actual speed.



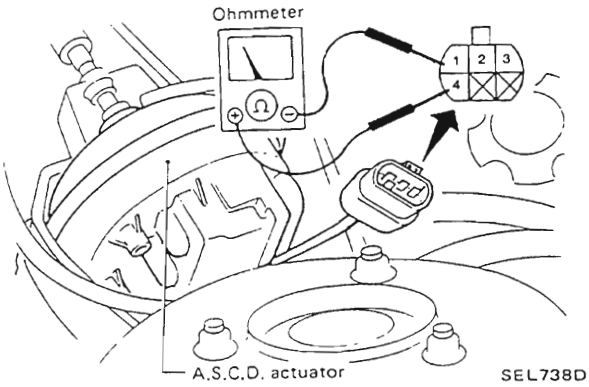
FAULT — Type 6. When A.S.C.D. is "set", transmission shifts out of O.D. and remains in 3rd thereafter.

FAULT — Type 7. When driving with A.S.C.D. operating, speed drops more than 6 kph below set speed and O.D. is **not** cancelled.



A.S.C.D. Actuator Check.

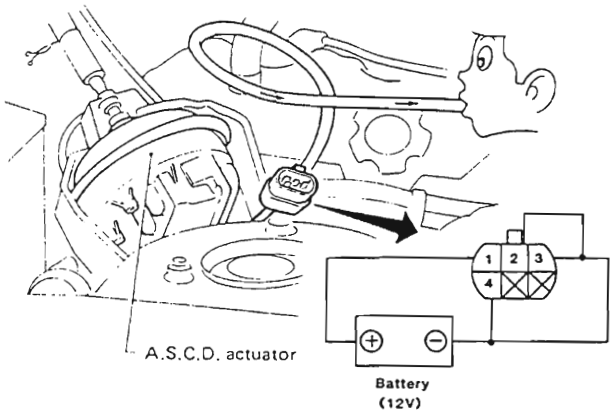
1. Check continuity between terminal 1 and terminals 2, 3, 4. Continuity should exist.



CAUTION: Do not attempt to remove valves from actuator.

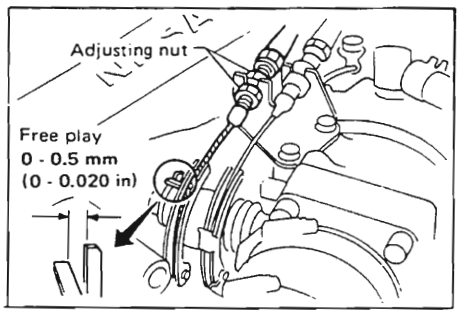
2. Connect battery voltage to harness connector of actuator as shown below and apply vacuum to actuator.

If diaphragm moves smoothly, actuator is okay.



A.S.C.D. Wire Adjustment

With accelerator released, check free play between A.S.C.D. wire drum and throttle shaft lever. Free play: 0-0.5 mm.



Description

FUNCTION

- Time control unit has the following functions.

	Item	Details of control
1	Intermittent wiper control	Regulates intermittent time from approximately 3 to 12 seconds depending on the intermittent wiper volume setting.
2	Washer and wiper combination control	Wiper is operated in conjunction with washer switch.
3	Illumination control	Regulates brightness of illumination depending on the illumination control switch setting.
4	Light warning chime timer	When driver's door is opened with light switch ON and ignition switch OFF, warning chime sounds.
5	Seat-belt warning lamp timer	Seat-belt warning lamp blinks for about 7 seconds when ignition switch is turned to "ON".
6	One-touch (Auto) operation of power window system	Fully opens or closes the driver's window automatically by one-touch (Auto) operation of driver's door window switch.
	Interior lamp operation (some models)	Interior lamp switch on door position
	Keylamp (some models)	Some models connected to interior lamp delay.

OPERATING CONDITIONS

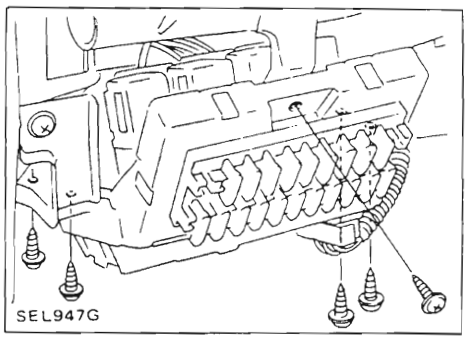
- For power window system, refer to BF section.

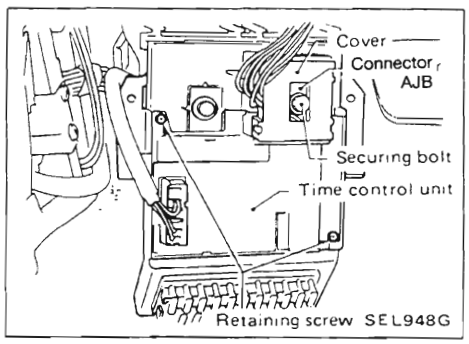
Input signal / Input terminal / Output terminal / Item		Power source from fuse 13	Ignition switch	Light switch	Wiper switch "INT"	Washer switch	Driver's side door switch *	Illumination control switch
		TCU 11	TCU 3 or 7	AJB 11	HEC 2 pin 1	HEC 2 pin 3	HEC 2 pin 3	AJB pin 25
Intermittent wiper control	HEC 2 pin 6	ON	ACC or ON		ON			
Washer and wiper combination control	HEC 2 pin 6	ON	ACC or ON			ON		
Illumination control	AJB pin 10	ON		ON				ON
Light warning chime timer	AJB pin 2	ON	OFF or ACC	ON			ON	
Seat-belt warning lamp timer	AJB pin 4	ON	OFF or ACC → ON					

* Door switch is turned ON when door is opened.

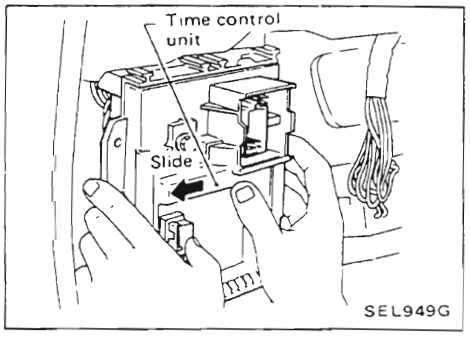
Trouble-shooting

Trouble		Refer to TROUBLE-SHOOTING PROCEDURE
Wiper and washer	Intermittent wiper does not operate.	1
	Intermittent time of wiper cannot be adjusted.	2
	Wiper and washer activate individually but not in combination.	3
Illumination	Illumination control system does not actuate.	4
Warning	Light warning chime does not activate.	5
	Seat belt warning lamp does not go off nor come on.	6


SEL947G



SEL948G



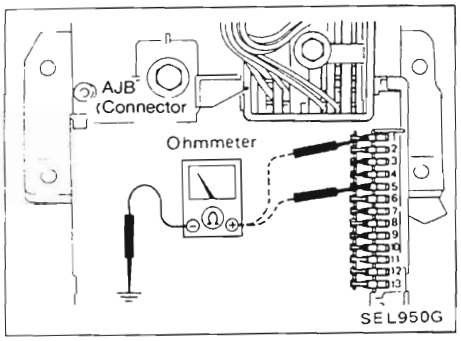
SEL949G

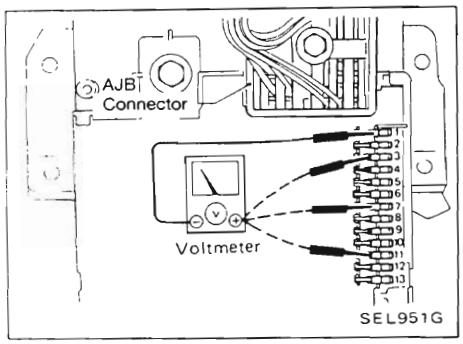
PREPARATION FOR TROUBLE-SHOOTING

1. Remove bonnet cable and accelerator pedal assemblies.
2. Loosen five retaining screws.
3. Remove the hybrid electric control unit (H.E.C.) with harness connected.

4. Remove the cover of the A-JB connector.
5. Loosen the securing bolt of the A-JB connector and remove the connector from the H.E.C.
6. Loosen two retaining screws for the time control unit.

7. Slide the time control unit as shown in the left figure and remove the time control unit.





Trouble-shooting (Cont'd)

BODY GROUND CIRCUIT CHECK

1. Reconnect the A-JB connector.
2. Check continuity between terminals ①, ⑤ and body ground.

Ohmmeter terminals		Continuity
(+)	(−)	
①, ⑤	Body ground	Yes

POWER SUPPLY CIRCUIT CHECK

Measure voltage across terminals ③, ⑦, ⑪ and terminal ①.

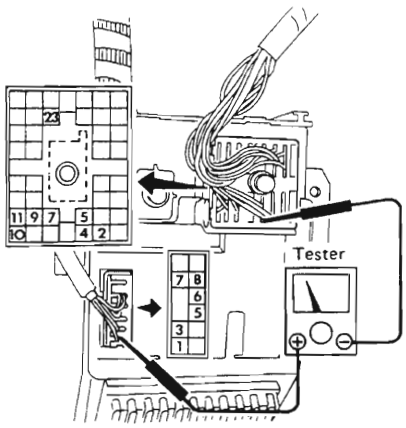
Voltmeter terminals		Ignition switch position		
(+)	(−)	OFF	ACC	ON
⑪	①	Approx. 12 V	Approx. 12 V	Approx. 12 V
③	①	0V	Approx. 12 V	Approx. 12 V
⑦	①	0 V	0 V	Approx. 12 V

Disconnect battery and refit time control unit.

Trouble-shooting (Cont'd)

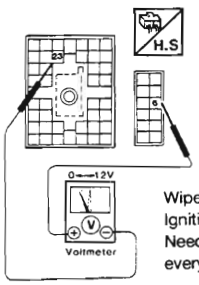
TERMINALS RELATED TO THE TIME CONTROL UNIT

Terminal 23 is used for body ground.



T.C.U. OUTPUT FOR WIPER RELAY CIRCUIT CHECK

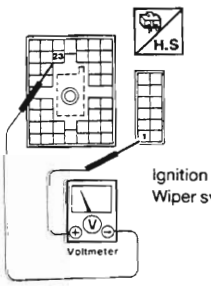
1. Turn wiper switch to "INT".
2. Turn ignition switch to "ACC".
3. Connect voltmeter from harness side.
4. Measure voltage across ⑥ and ㉓.



Wiper switch..... INT
Ignition switch ..... ACC
Needle moves from 12V to 0V every 3 to 12 seconds.

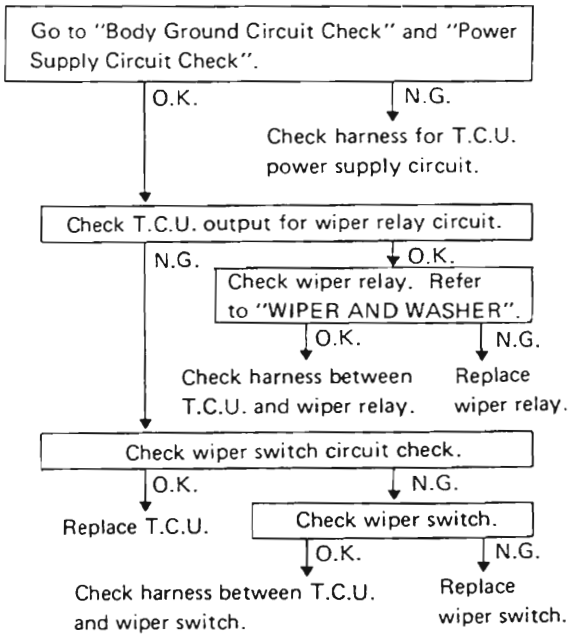
WIPER SWITCH CIRCUIT CHECK

1. Turn wiper switch to "INT".
2. Turn ignition switch to "OFF".
3. Connect voltmeter from harness side.
4. Measure voltage across ① and ㉓.



Ignition switch ..... OFF
Wiper switch..... INT: 0V
OFF: 12V

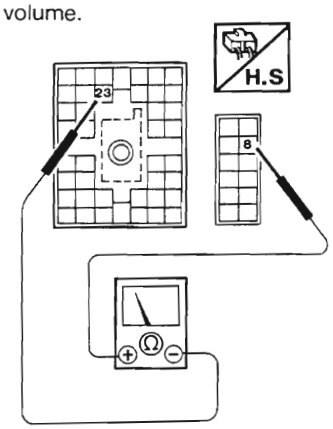
1	Intermittent wiper does not operate.



Trouble-shooting (Cont'd)

INTERMITTENT WIPER VOLUME CIRCUIT CHECK

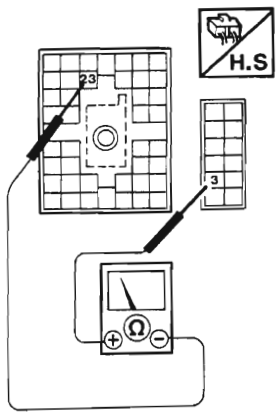
1. Turn ignition switch to "OFF".
2. Connect ohmmeter from harness side.
3. Measure resistance across ⑧ and while turning intermittent wiper ㉓ volume.



Approx. 15Ω at ◀◀◀ position
Approx. 1.8 kΩ at ◀ position

WASHER SWITCH CIRCUIT CHECK

1. Turn ignition switch to "OFF".
2. Turn washer switch to "ON".
3. Connect ohmmeter from harness side.
4. Check continuity between ③ and ㉓



2	Intermittent time of wiper cannot be adjusted.

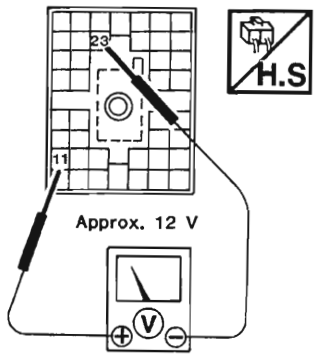
Check intermittent wiper volume circuit.
- O.K. → Replace T.C.U.
- N.G. → Check intermittent wiper volume.
  - O.K → Check harness between T.C.U. and intermittent wiper volume.
  - N.G. → Replace wiper switch.

3	Wiper and washer activate individually but not in combination.

Check washer switch circuit.
- O.K. → Replace T.C.U.
- N.G. → Check harness between T.C.U. and washer switch.

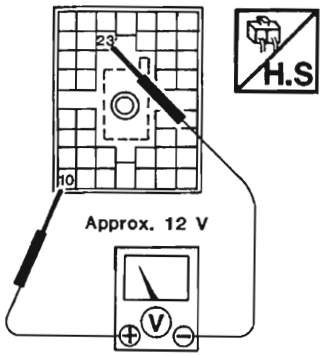
Trouble-shooting (Cont'd)

T.C.U. OUTPUT FOR LIGHT SWITCH CIRCUIT CHECK



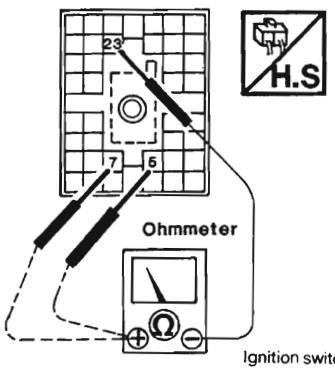
Voltmeter — Ignition switch ..... OFF
Light switch ..... ON

ILLUMINATION CIRCUIT CHECK



Ignition switch ..... OFF
Lighting switch ..... ON

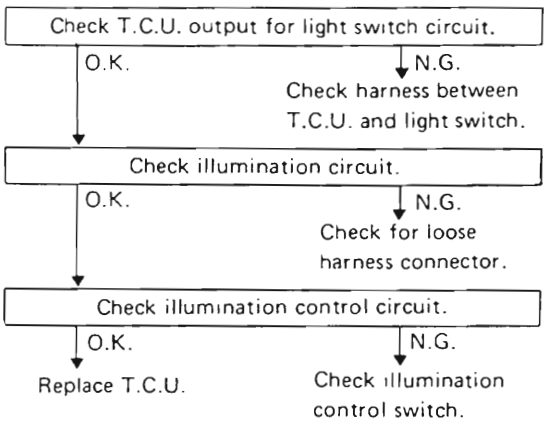
ILLUMINATION CONTROL CIRCUIT CHECK



Ignition switch OFF

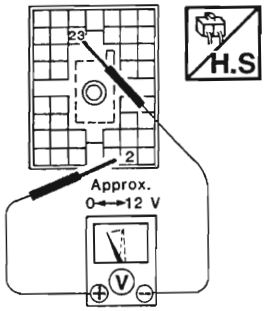
Ohmmeter		Illumination control switch	
(+)	(−)	DARK	BRIGHT
⑦	㉓	0 Ω	Infinity
⑤	㉓	Infinity	0 Ω

4	Illumination control system does not actuate.



T.C.U. OUTPUT FOR CHIME CIRCUIT CHECK

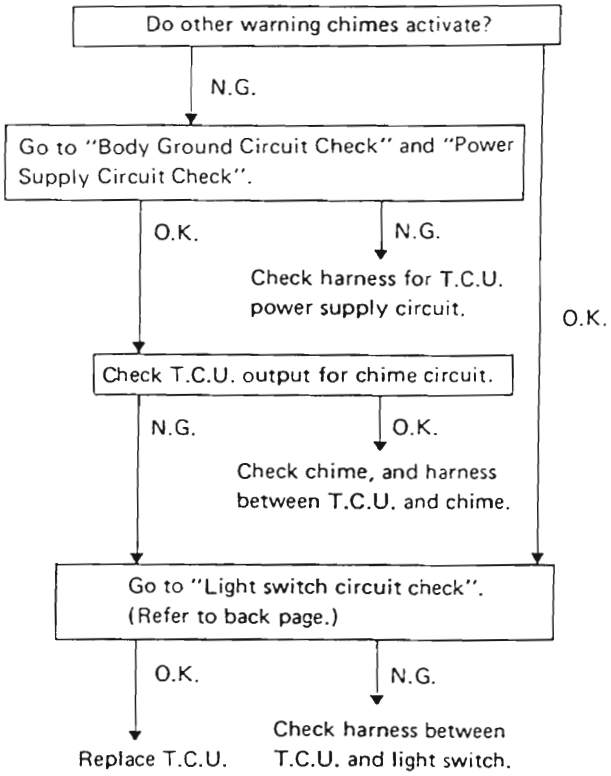
1. Turn ignition switch to "OFF".
2. Connect voltmeter from harness side.
3. Measure voltage across ② and ㉓ when driver's door is opened and closed.



Ignition switch ... OFF
Light switch ... 1st

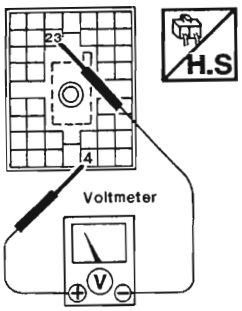
- Approx. 0V when driver's side door is closed.
- Voltmeter needle swings when driver's side door is opened.

5	Light warning chime does not activate.



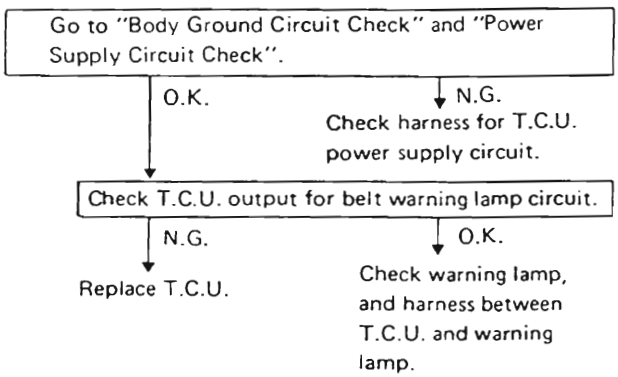
T.C.U. OUTPUT FOR BELT WARNING LAMP CIRCUIT CHECK

1. Unfasten seat belt.
2. Connect voltmeter from harness side.
3. Measure voltage across ㉓ and ④ when ignition switch is "ON".



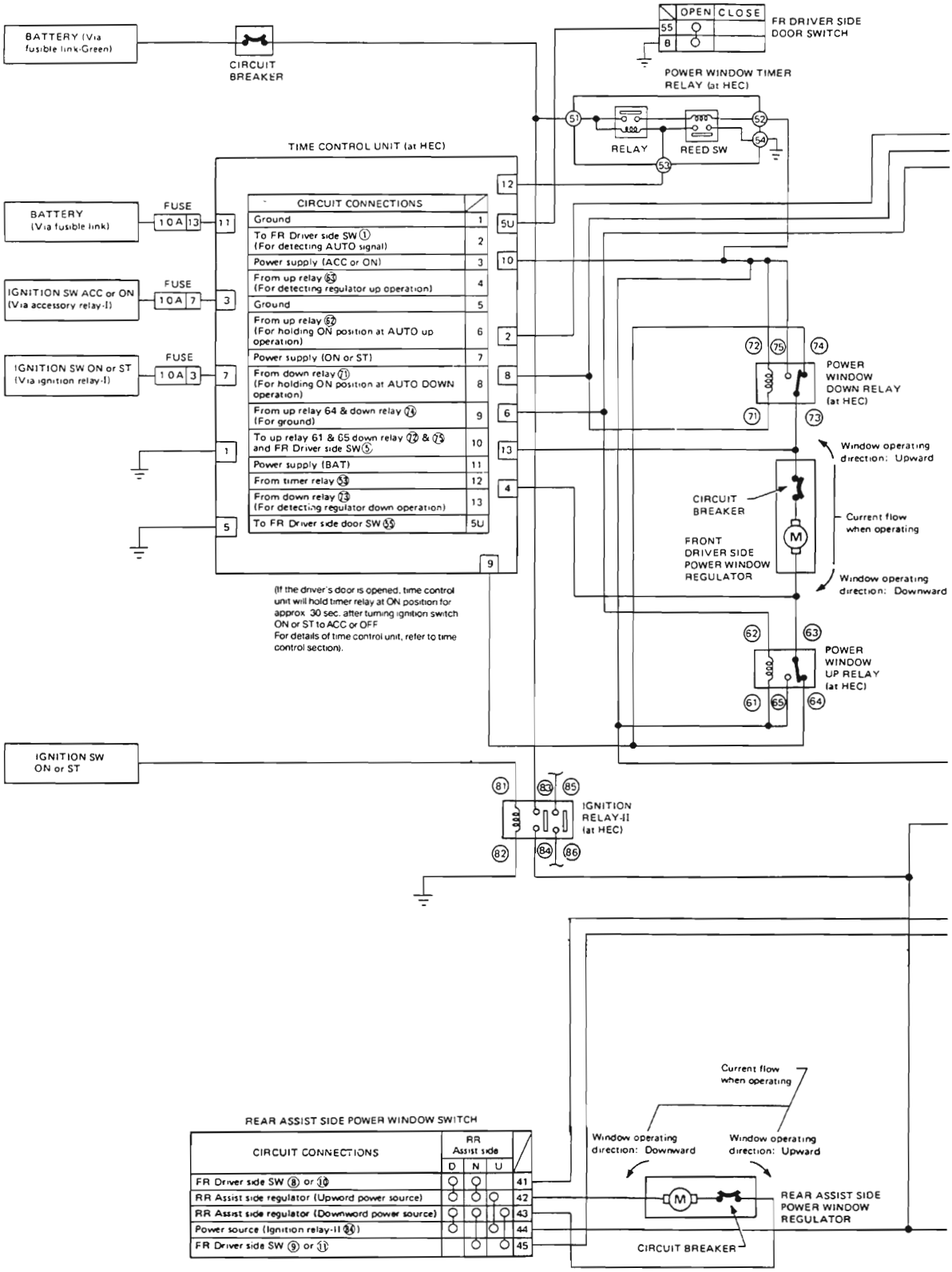
Voltmeter needle keeps swinging (approx. 0 ⟷ 12V) for about 7 seconds after ignition switch is turned ON.

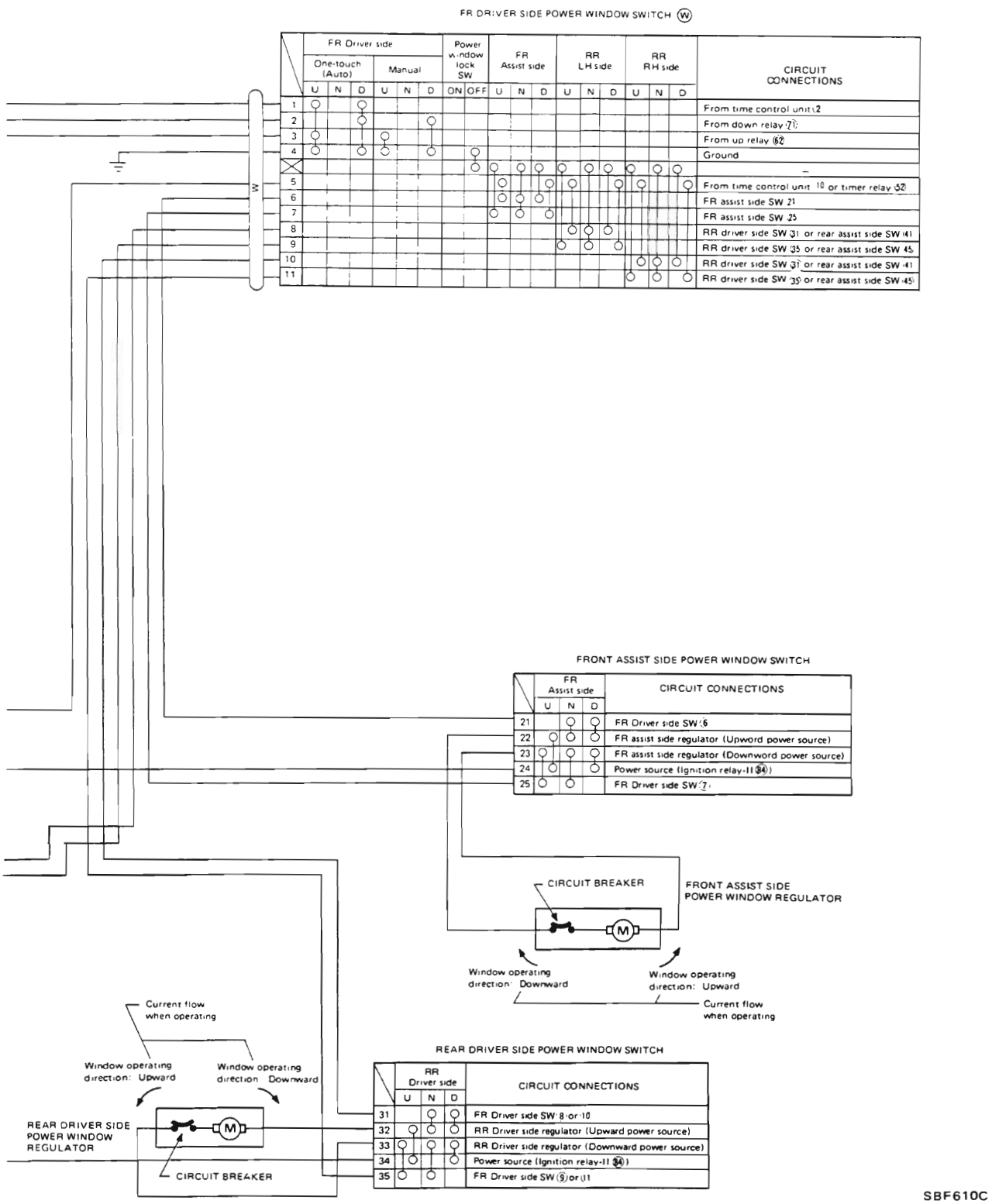
6	Seat belt warning lamp does not go off nor come on.



Notes

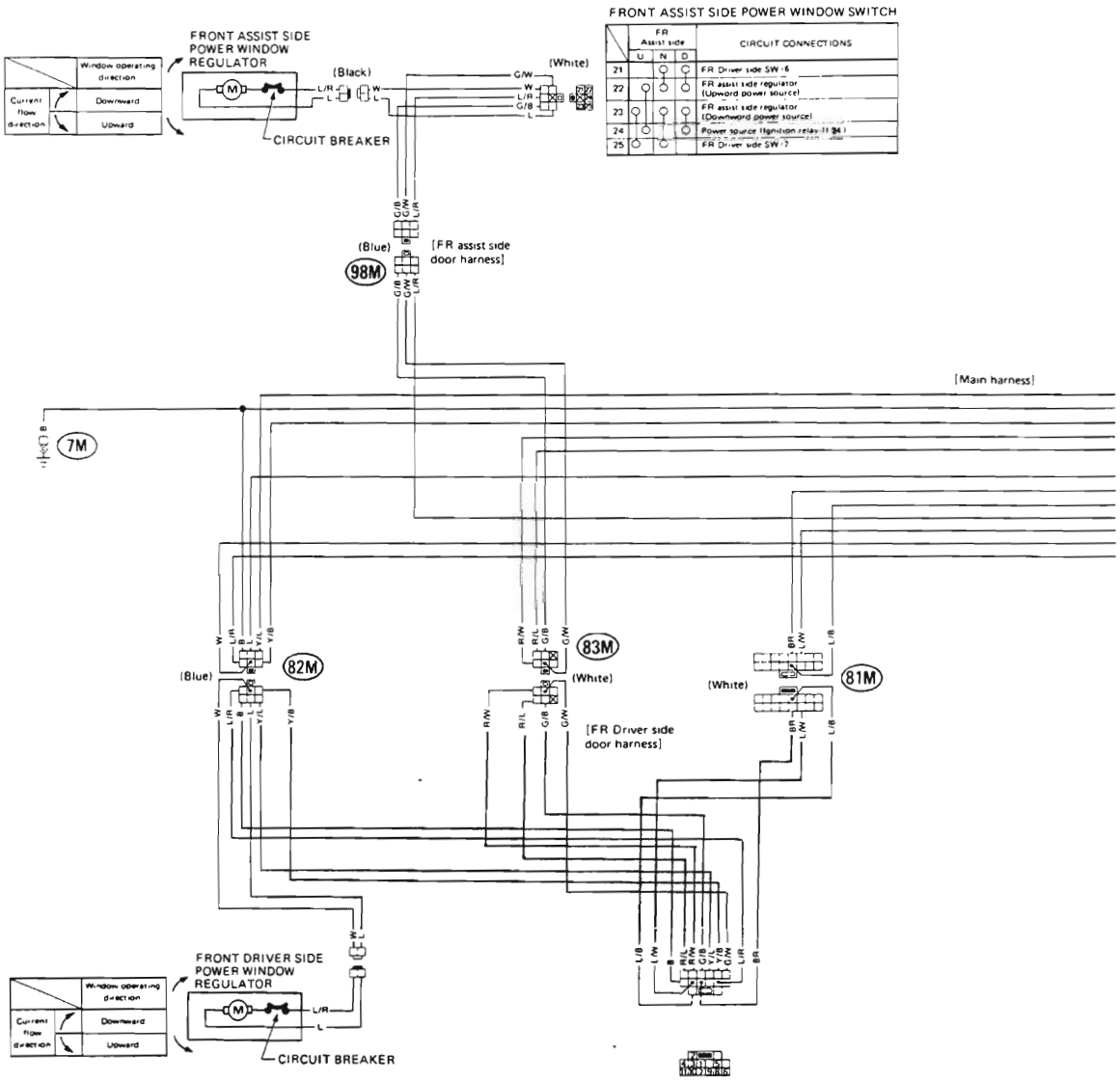
SCHEMATIC


BATTERY (Via fusible link-Green)
CIRCUIT BREAKER
OPEN CLOSE
55
8
FR DRIVER SIDE DOOR SWITCH
POWER WINDOW TIMER RELAY (at HEC)
RELAY
REED SW
TIME CONTROL UNIT (at HEC)
BATTERY (Via fusible link)
FUSE
10A 13
IGNITION SW ACC or ON (Via accessory relay-I)
10A 7
IGNITION SW ON or ST (Via ignition relay-I)
10A 3
CIRCUIT CONNECTIONS
Ground 1
To FR Driver side SW ① (For detecting AUTO signal) 2
Power supply (ACC or ON) 3
From up relay ⑬ (For detecting regulator up operation) 4
Ground 5
From up relay ⑫ (For holding ON position at AUTO up operation) 6
Power supply (ON or ST) 7
From down relay ⑪ (For holding ON position at AUTO DOWN operation) 8
From up relay 64 & down relay ⑭ (For ground) 9
To up relay 61 & 65 down relay ⑫ & ⑭ and FR Driver side SW ⑤ 10
Power supply (BAT) 11
From timer relay ⑬ 12
From down relay ⑭ (For detecting regulator down operation) 13
To FR Driver side door SW ⑮ 5U
(If the driver's door is opened, time control unit will hold timer relay at ON position for approx. 30 sec. after turning ignition switch ON or ST to ACC or OFF. For details of time control unit, refer to time control section).
POWER WINDOW DOWN RELAY (at HEC)
POWER WINDOW UP RELAY (at HEC)
Window operating direction: Upward
Current flow when operating
Window operating direction: Downward
CIRCUIT BREAKER
FRONT DRIVER SIDE POWER WINDOW REGULATOR
IGNITION SW ON or ST
IGNITION RELAY-II (at HEC)
REAR ASSIST SIDE POWER WINDOW SWITCH
CIRCUIT CONNECTIONS
RR Assist side D N U
FR Driver side SW ⑧ or ⑩ 41
RR Assist side regulator (Upword power source) 42
RR Assist side regulator (Downword power source) 43
Power source (Ignition relay-II ⑭) 44
FR Driver side SW ⑨ or ⑪ 45
Current flow when operating
Window operating direction: Downward
Window operating direction: Upward
REAR ASSIST SIDE POWER WINDOW REGULATOR
CIRCUIT BREAKER


FR DRIVER SIDE POWER WINDOW SWITCH (W)
FR Driver side
One-touch (Auto)
Manual
Power window lock SW
FR Assist side
RR LH side
RR RH side
U N D U N D ON OFF U N D U N D U N D U N D
CIRCUIT CONNECTIONS
1 From time control unit (2)
2 From down relay (71)
3 From up relay (62)
4 Ground
5 From time control unit (10) or timer relay (52)
6 FR assist side SW (21)
7 FR assist side SW (25)
8 RR driver side SW (31) or rear assist side SW (41)
9 RR driver side SW (35) or rear assist side SW (45)
10 RR driver side SW (31) or rear assist side SW (41)
11 RR driver side SW (35) or rear assist side SW (45)
W
FRONT ASSIST SIDE POWER WINDOW SWITCH
FR Assist side
U N D
CIRCUIT CONNECTIONS
21 FR Driver side SW (6)
22 FR assist side regulator (Upword power source)
23 FR assist side regulator (Downword power source)
24 Power source (Ignition relay-II (34))
25 FR Driver side SW (7)
CIRCUIT BREAKER
FRONT ASSIST SIDE POWER WINDOW REGULATOR
M
Window operating direction: Downward
Window operating direction: Upward
Current flow when operating
Current flow when operating
Window operating direction: Upward
Window operating direction: Downward
REAR DRIVER SIDE POWER WINDOW REGULATOR
M
CIRCUIT BREAKER
REAR DRIVER SIDE POWER WINDOW SWITCH
RR Driver side
U N D
CIRCUIT CONNECTIONS
31 FR Driver side SW (8) or (10)
32 RR Driver side regulator (Upward power source)
33 RR Driver side regulator (Downward power source)
34 Power source (Ignition relay-II (34))
35 FR Driver side SW (9) or (11)

SBF610C

WIRING DIAGRAM



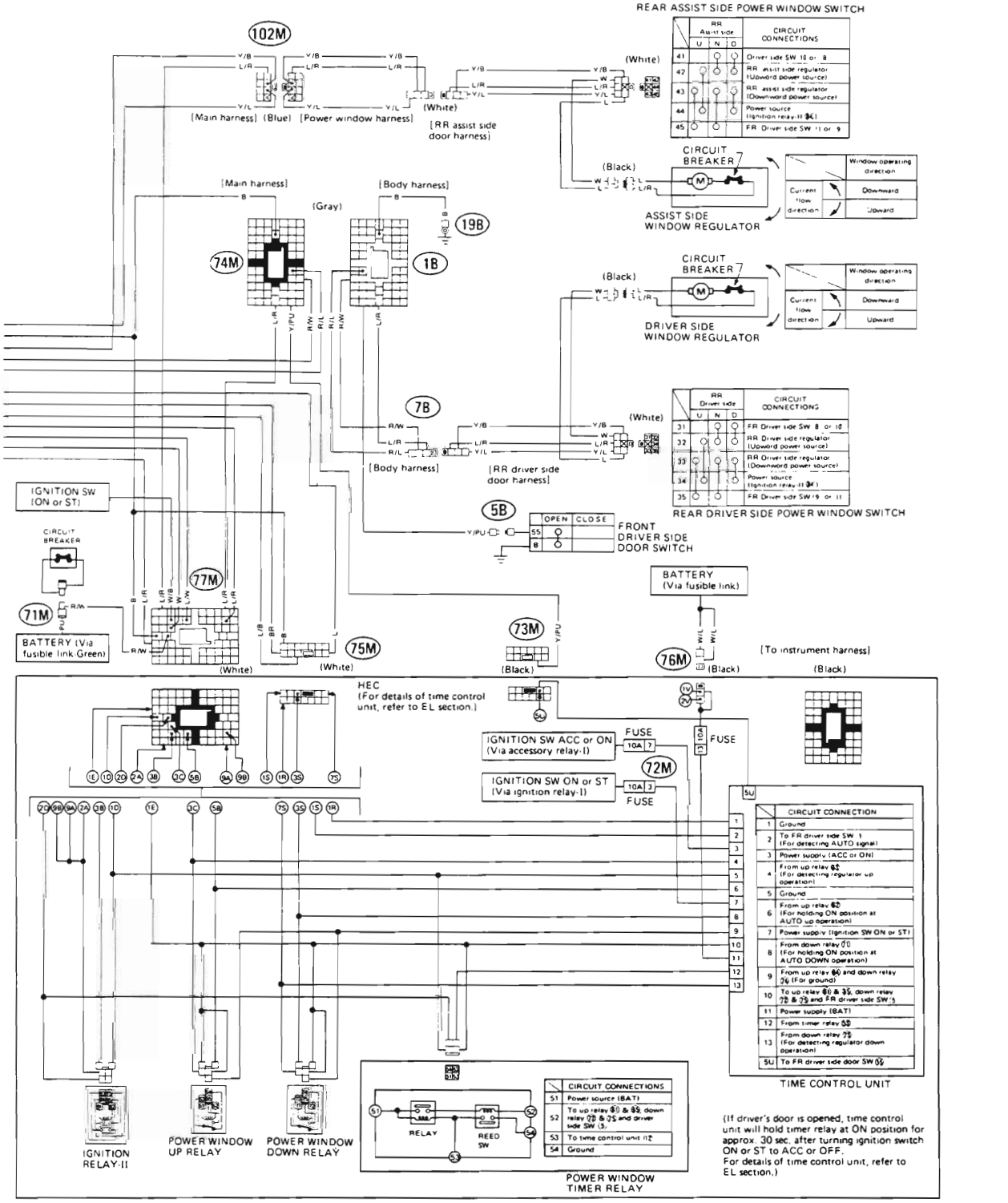
FRONT ASSIST SIDE POWER WINDOW SWITCH

	FR Assist side U	FR Assist side N	FR Assist side D	CIRCUIT CONNECTIONS
21		○	○	FR Driver side SW -6
22	○	○	○	FR assist side regulator (Upward power source)
23	○	○	○	FR assist side regulator (Downward power source)
24	○	○		Power source (Ignition relay-II 34)
25	○			FR Driver side SW -7

FRONT DRIVER SIDE POWER WINDOW SWITCH

[With one-touch (Auto) operation system]

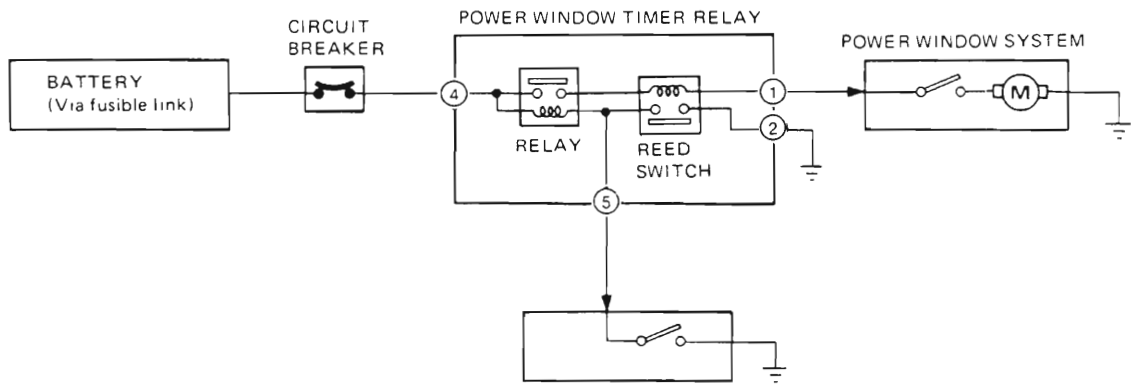
	FR Driver side One-touch (Auto) U	N	D	Manual U	N	D	Power window lock SW ON	OFF	FR Assist side U	N	D	RR LH side U	N	D	RR RH side U	N	D	CIRCUIT CONNECTIONS
1	○		○				○											From time control unit ②
2	○		○				○											From down relay ⑦
3	○			○				○										From up relay ⑥
4	○			○				○										Ground
X																		—
5									○	○	○	○	○	○	○	○	○	From time control unit ⑲ or timer relay ⑭
6									○	○	○							FR assist side SW ㉑
7									○	○	○							FR assist side SW ㉕
8												○	○	○				RR driver side SW ㉓ or assist side SW ㊶
9												○	○	○				RR driver side SW ㉗ or assist side SW ㊺
10															○	○	○	RR driver side SW ㉛ or assist side SW ㊶
11															○	○	○	RR driver side SW ㉟ or assist side SW ㊺


REAR ASSIST SIDE POWER WINDOW SWITCH
102M
[Main harness] (Blue)
[Power window harness]
(White)
[RR assist side door harness]
(White)
(Black)
CIRCUIT BREAKER
ASSIST SIDE WINDOW REGULATOR
[Main harness]
[Body harness]
(Gray)
19B
74M
1B
(Black)
CIRCUIT BREAKER
DRIVER SIDE WINDOW REGULATOR
7B
[Body harness]
(White)
[RR driver side door harness]
REAR DRIVER SIDE POWER WINDOW SWITCH
5B
FRONT DRIVER SIDE DOOR SWITCH
IGNITION SW (ON or ST)
CIRCUIT BREAKER
71M
BATTERY (Via fusible link-Green)
77M
(White)
75M
(White)
73M
(Black)
BATTERY (Via fusible link)
76M
(Black)
[To instrument harness]
(Black)
HEC
(For details of time control unit, refer to EL section.)
IGNITION SW ACC or ON (Via accessory relay-I)
IGNITION SW ON or ST (Via ignition relay-I)
FUSE
72M
5U
TIME CONTROL UNIT
IGNITION RELAY-II
POWER WINDOW UP RELAY
POWER WINDOW DOWN RELAY
RELAY
REED SW
POWER WINDOW TIMER RELAY
(If driver's door is opened, time control unit will hold timer relay at ON position for approx. 30 sec. after turning ignition switch ON or ST to ACC or OFF.
For details of time control unit, refer to EL section.)

SBF611C

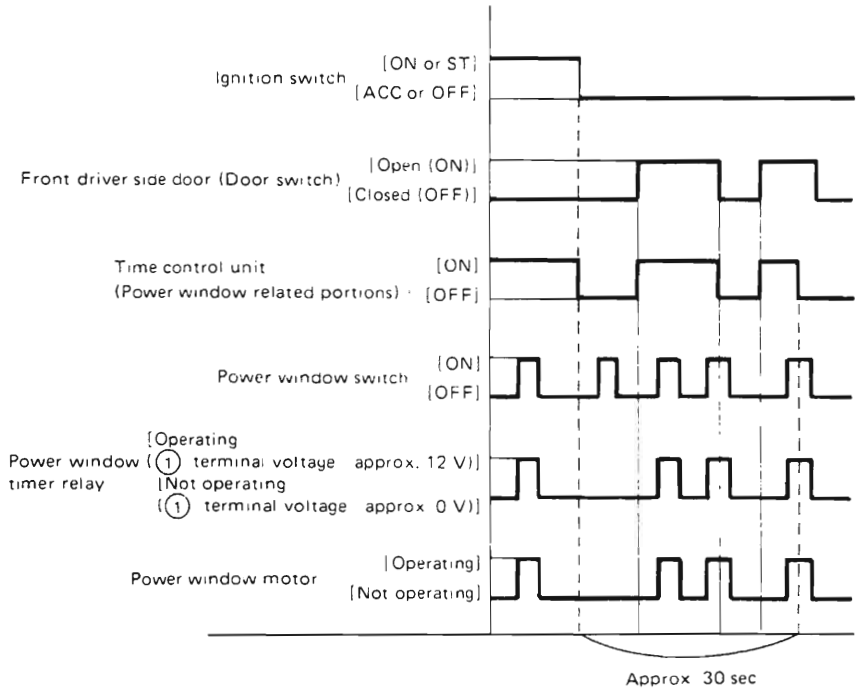
POWER WINDOW TIMER OPERATION CHECK

Timer system operation



TIME CONTROL UNIT – Refer to EL section.
If driver's door is opened, time control unit will hold ON position for approx. 30 sec. after turning ignition switch from "ON or ST" to "ACC or OFF"

System operation



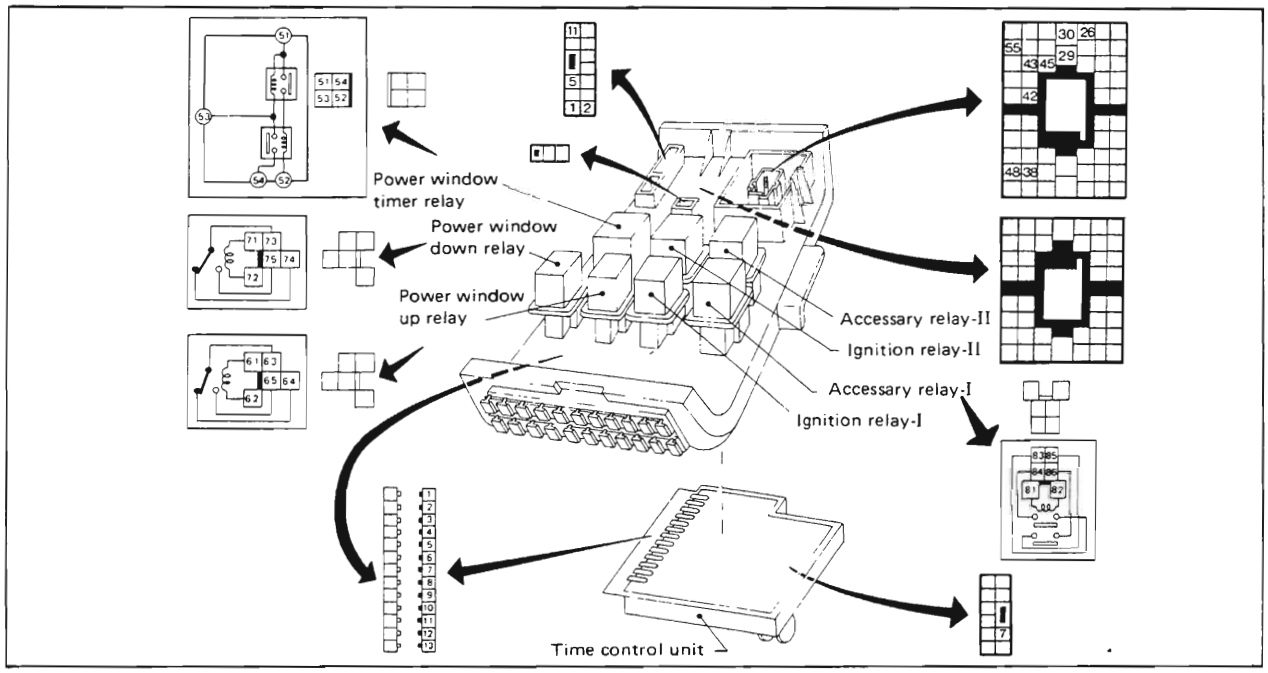
SBF691B

Timer system inspection

If only this system cannot operate properly, check the following items first, using wiring diagram & schematic.

- Timer relay operation [Refer to "Timer relay inspection".]
- HEC internal circuit continuity

Timer relay ⑫ – Up relay ⑥① & ⑥⑤	:	Up relay power source
Timer relay ⑫ – Down relay ⑦② & ⑦⑤	:	Down relay power source
Timer relay ⑤④ – Connector (1D)	:	Timer relay ground
Timer relay ⑤③ – Time control unit ⑫	:	Holding timer relay at ON position for approx. 30 sec. after turning OFF ignition switch
Connector (5U) – Time control unit (5U)	:	Front driver side door condition signal
Timer relay ⑤① – Connector (2D)	:	Timer relay power source

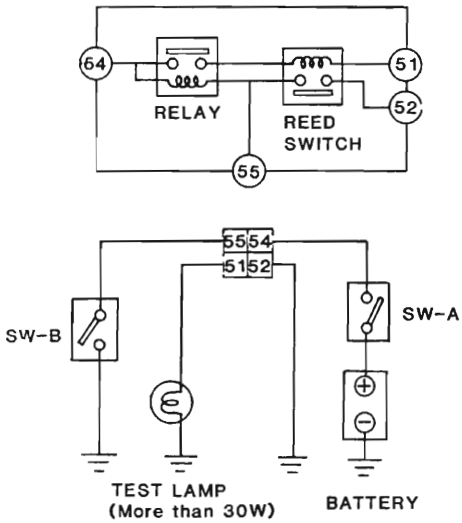


- Front driver side door switch operation
- Front driver side door switch mounting (For ground)
- Main harness continuity between body harness & HEC (Y/PU wire)
- Body harness continuity between main harness & front driver side door switch (Y/PU wire)
- Body ground in the main harness & the body harness

If the above are in proper condition, replace time control unit and then recheck system operation.

Fault: Window timer system does not operate correctly.

- Check page EL-55 for correct system operation.
- Check timer relay operation.



- **This test circuit must be wired by the technician.**

SW-A operation	OFF	ON	ON	ON
SW-B operation	ON	OFF	ON	OFF
	OFF			
Test lamp operation	OFF	OFF	ON	ON

(Carry out inspection in this chart from left to right.)

- Check HEC internal circuitry as detailed in the table below.

From	To	Circuit Function
Timer relay socket pin 1	Up relay socket pins 1 and 5	Up relay power source
Timer relay socket pin 1	Down relay socket pins 2 and 5	Down relay power source
Timer relay socket pin2	HEC-1 socket pin30	Timer relay ground
Timer relay socket pin 5	Time control unit socket pin 12	Holds relay "ON" for 30 seconds after ignition "OFF"
Timer relay socket pin 4	HEC-1 socket pin 29	Timer relay power source

- Check operation of all door switches.
- Check door switch mounting (for ground continuity).
- Check continuity between door switches and HEC-2 plug terminal 7.
- Check continuity between HEC-1 plug terminal 30 and body ground.

If all the above are in proper condition, replace time control unit and recheck system operation.

System Fault Diagnosis

Before conducting any of the following tests, check the power supply for the power window circuitry as follows:

- Check for 12V at fuse 13 (battery supply), fuse 7 (ignition switch "ACC" or "ON"), fuse 3 (ignition switch "ON" or "ST").
- Check condition of these fuses.
- Continuity between pin 29 SMJ main harness plug and ground.
- Check for 12V at HEC-1 plug, terminal 29.

If any faults are detected, refer to HEC internal circuit map or wiring diagram.

Fault: Auto (one-touch) control of driver's window does not operate correctly.

- Check HEC internal circuit, continuity as detailed in table below.

From	To	Circuit Function
Time control unit socket Pin 2	HEC-3 socket Pin1	Auto (one-touch) signal to time control unit
Time control unit socket Pin 6	Window up relay socket Pin 2 and HEC-1 socket Pin 42	Holds relay "ON" during auto up operation
Time control unit socket Pin 8	Window down relay socket Pin 1 and HEC-3 socket Pin 5	Holds relay "ON" during auto down operation
Time control unit socket Pin 4	Window up relay socket Pin 3 and HEC-1 socket Pin 34	Power supply for regulator (up) and detection of regulator operation during auto up
Time control unit socket Pin 13	Window down relay socket Pin 3 and HEC-3 socket Pin 11	Power supply for regulator (down) and detection of regulator operation during auto down

- Check operation of driver's side power window switch (terminals 1, 2, 3 and 4).
- Check driver's side front door harness for continuity (wire colours BR, L/B, L/W, B).
- Check continuity of main harness between the following points. (Refer wiring diagram for plug numbers.)
  Plug C76M terminal 3 and HEC-3 plug terminal 5.
  Plug C76M terminal 9 and HEC-3 plug terminal 1.
  Plug C76M terminal 8 and HEC-1 plug terminal 42.
  Plug C168M (black wire) and body ground.

If all the above are in proper condition, replace time control unit and recheck system operation.

Fault: Driver's window does not operate correctly.

- Check inside door for dust, damaged runners, loose or broken components.
- Check regulator operation.
- Check driver's power window switch operation (terminals 2, 3, 4) (refer wiring diagram).
- Check driver's door harness for continuity (wire colours LB, LW, L, W, B).
- Check continuity of main harness between the following points (refer wiring diagram for plug numbers).
  Plug C76M terminal 3 and HEC-3 plug, terminal 5.
  Plug C76M terminal 8 and HEC-1 plug, terminal 42.
  Plug C168M (blue wire) and HEC-3 plug, terminal 11.
  Plug C168M (white wire) and HEC-1 plug, terminal 34.
  Plug C168M (black wire) and body ground.
- Check power window up relay operation.
- Check power window down relay operation.
- Check HEC internal circuit continuity as detailed in table below.

From	To	Circuit Function
Time control unit socket pin 10	Window up relay socket pins 1 and 5	Up relay power source
Time control unit socket pin 10	Window down relay socket pins 2 and 5	Down relay power source
Time control unit socket pin 9	Up relay socket pin 4	Ground source for down operation
	Down relay socket pin 4	Ground source for up operation
HEC-1 socket, pin 34	Up relay socket pin 3	Power to regulator for up operation, ground for down operation
HEC-3 socket pin 11	Down relay socket pin 3	Power to regulator for down operation, ground for up operation
HEC-1 socket pin 42	Up relay socket pin 2	Grounds up relay coil via switch
HEC-3 socket pin 5	Down relay socket pin 1	Grounds down relay coil via switch

- If all the above are in proper condition, replace time control unit and recheck system operation.

Fault: Passenger windows will not operate properly only when switched from driver's door.

- Check driver's power window switch operation (terminals 4-11).
- Check passenger window switch operation.
- Check continuity of driver's door harness (L/R wire).
- Check continuity of main harness between plug C168M (L/R wire) and HEC-1 plug terminal 26.
- Check HEC internal continuity between:
  HEC-1 socket, pin 26 and time control unit socket, pin 10.

If all the above are in proper condition, replace time control unit and then recheck system operation.

Fault: Passenger window will not operate properly only when its own switch is used.

- Check driver's power window switch continuity when all switches are in neutral position. There should be continuity between terminal 4 and terminals 6, 7, 8, 9, 10, 11 (see switch map).

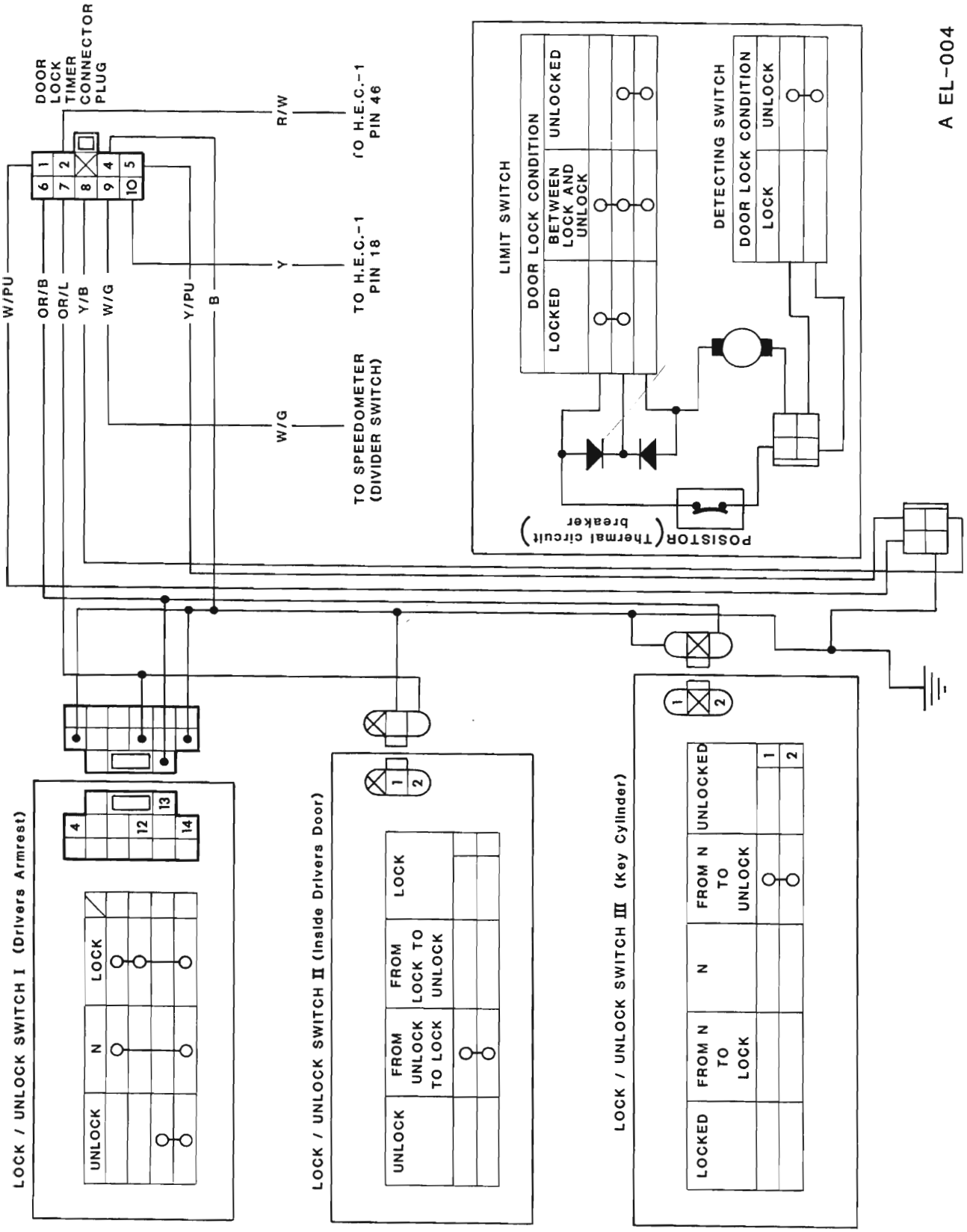
On the door which has faulty window operation, check the following.

- Window switch operation.
- Check continuity of harness between window switch connector terminal 4 and the corresponding power supply terminal in HEC-1 plug.
  LH/FR door — HEC-1 terminal 38.
  LH/RR door — HEC-1 terminal 55.
  RH/RR door — HEC-1 terminal 48.
- Check operation of ignition relay II.
- Check HEC internal circuit continuity between ignition relay II socket, pin 5 and HEC-1 socket pins 55, 48 and 38.

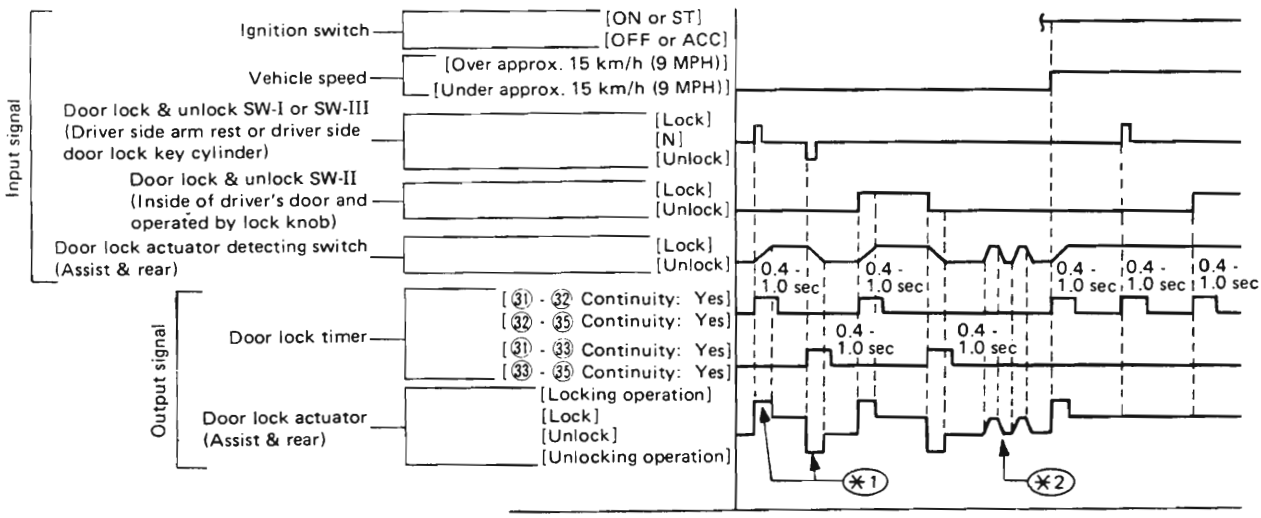
Fault: Passenger window will not operate at all.

- Check inside door for dust, damaged runners, loose or broken components.
- Check operation of driver's power window switch.
- Check operation of relevant passenger window switch.
- Check continuity between driver's window switch connector (terminal 4) and body ground.
- Check operation of relevant window regulator.
- Check continuity of door harness wiring.
- Check continuity in main harness between driver's window switch connector and passenger window switch connector (see wiring diagram).
- Check continuity between switch and regulator.

WIRING DIAGRAM



SYSTEM OPERATION



*1 : The actuator is operated to "Lock" or "Unlock" position, then stopped automatically by the actuation of the limit SW.
*2 : At a speed of about 15 km/h or less, each door (assist and rear) can be easily locked or unlocked using the lock knob on the door.

*3 : At a speed of about 15 km/h or more, each door (assist and rear) cannot be unlocked by the door lock and unlock SW-I or the door lock and unlock SW-II.
*4 : At a speed of about 20 km/h or more, each door (assist and rear) can be unlocked using the lock knob (assist and rear). If you want to unlock the door (assist and rear), use the lock knob and, after the actuator is activated up to the "Unlock" position, maintain the lock knob in the "Unlock" position longer than the delay time of the door lock timer (0.4 to 1.0 sec).

TIMER INSPECTION

TESTING OPERATION

- For this test, technician have to make vehicle running condition.

	Vehicle speed	Under approx. 15 km/h									Over approx. 15 km/h											
Input signal	SW-A operation	OFF	Turns ON	ON	Turns OFF	OFF	OFF	OFF	Turns ON	Turns OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Turns ON	ON	Turns OFF	OFF
	SW-B operation	OFF	OFF	OFF	OFF	Turns ON	ON	Turns OFF	After SW-A operation, immediately turns ON	Turns OFF	OFF	OFF	OFF	Turns ON	ON	Turns OFF	OFF	OFF	OFF	OFF	OFF	Turns ON
	SW-C operation	ON or OFF	ON or OFF	ON or OFF	ON or OFF	ON or OFF	ON or OFF	ON or OFF	ON or OFF	ON	ON	Turns OFF	OFF	OFF	OFF	OFF	Turns ON	ON	ON	Turns OFF	OFF	After SW-C operation, immediately turns ON
Output signal	Test lamp operation	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	OFF	ON → OFF → ON → OFF	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	ON (0.4 ~ 1.0 sec) → OFF	OFF	OFF	ON → OFF → ON → OFF

- Carry out the inspection in this chart from left to right continuously.

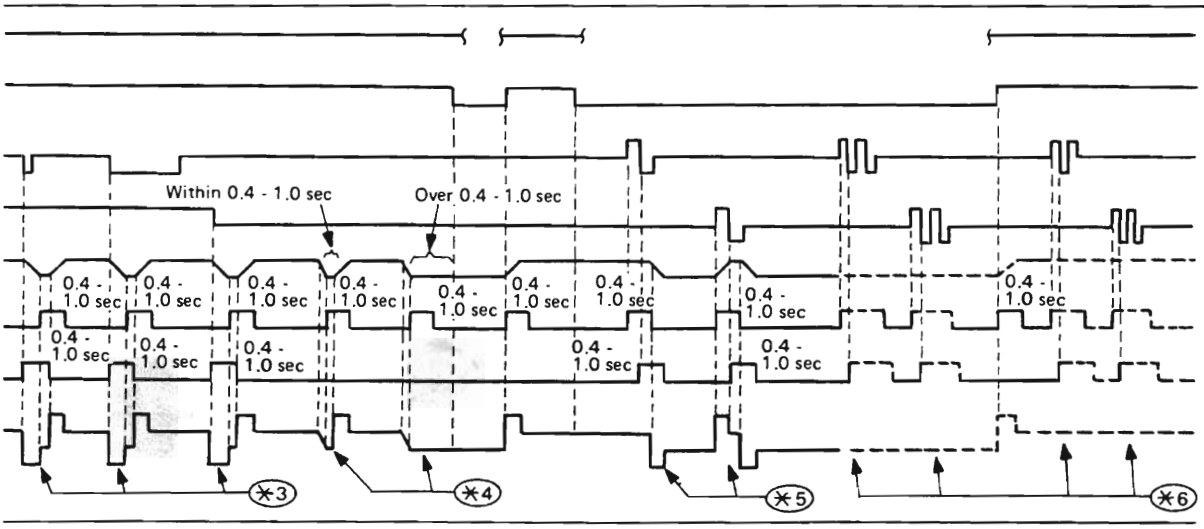
Lighting period of test lamp differs according to SW-B operation. Moreover, test lamp may come on once or it may not come on at all. If this occurs, do not judge it faulty solely from this step, but use other steps to make final judgment.

Lighting period of test lamp differs according to SW-C operation. Moreover, test lamp may come on once or it may not come on at all. If this occurs, do not judge it faulty solely from this step, but use other steps to make final judgment.

- Do not carry out any switch operations that are not described in the above chart to avoid breaking door lock timer.

CIRCUIT BREAKER INSPECTION

This circuit breaker is the same as the one for power window. So refer to "Power Window".

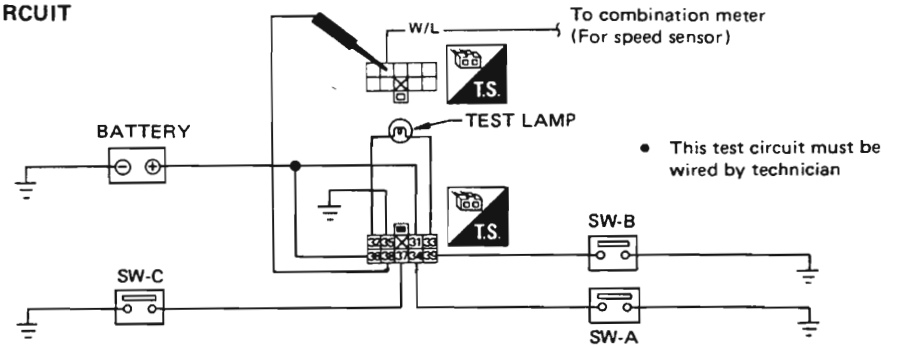


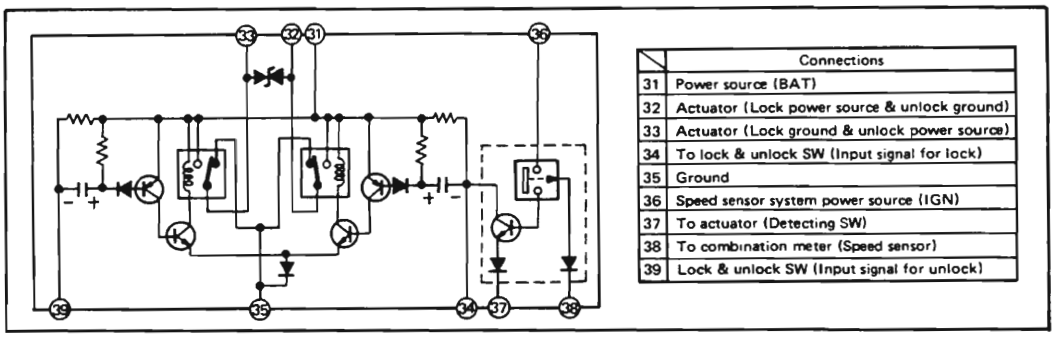
*5 : At a speed of about 15 km/h or less when you mistakenly operate the door lock and unlock SW-I or the door lock and unlock SW-II and operate the switch continuously, the actuator should operate slowly.

*6 : When Lock-Unlock is repeated many times using the door lock and unlock SW-I, SW-II or SW-III, the door may either be locked or unlocked by itself, or the actuator may not be activated. This depends on the Lock-Unlock operation period and other conditions. Avoid this type of operation as a system fault may occur.

SBF608C

INSPECTION CIRCUIT





DOOR LOCK TIMER

	Connections
31	Power source (BAT)
32	Actuator (Lock power source & unlock ground)
33	Actuator (Lock ground & unlock power source)
34	To lock & unlock SW (Input signal for lock)
35	Ground
36	Speed sensor system power source (IGN)
37	To actuator (Detecting SW)
38	To combination meter (Speed sensor)
39	Lock & unlock SW (Input signal for unlock)

SBF609C

Trouble Shooting Procedure

Preparation

Remove the Power Door Timer from its mounting behind the R.H. kick panel and disconnect the harness connector. Remove plastic insert from rear of connector to enable voltmeter probes to be inserted.

Note: Test 1 and 2 below must be performed before any other tests, otherwise incorrect fault diagnosis may occur.

Test 1 — Timer Ground Wiring

Connect an ohmmeter between terminal 4 and body ground. Ohmmeter should read OΩ. If not, check earth wiring in harness (refer wiring diagram).

Test 2 — Timer Power Supply

Connect a voltmeter (15V scale or higher) between terminals 2 (+ve probe) and 4. Voltmeter should read 12V. If not check the following:–

Fusible Link No. 3
Power Door/Window — Circuit Breaker
Continuity between — Circuit Breaker and HEC-1 connector terminal 29
— HEC-1 connector terminal 46 and timer connector terminal 2.

Check internal continuity of HEC between pins 29 and 46 of HEC-1 socket.

Test 3 — Door Unlock Signal

Reconnect harness to timer.

a) Connect voltmeter between terminals 6 (+ve) and 4. Voltmeter should read 12V. If not, disconnect timer and check insulation between terminals 4 and 6 of harness plug using ohmmeter.
If ohmmeter reads ∝Ω — insulation OK, replace timer.
If ohmmeter reads other than ∝Ω — check wiring harness for short and check operation of driver's switches I and III.

b) With timer connected and voltmeter connected between terminals 6 and 4, depress "Door unlock" switch on driver's armrest and operate key to unlock door. In both cases, voltage should drop momentarily from 12V to 0V.
If not, check operation of relevant switch (I or III) and continuity of wiring.

Test 4 — Door Lock Signal

a) Connect voltmeter between terminals 7 (+ve) and 4. Voltmeter should read approx. 12V.

If not, disconnect timer and check insulation between terminals 7 and 4 of harness plug using ohmmeter.
If ohmmeter reads ∝Ω — insulation OK, replace timer.
If ohmmeter reads other than ∝Ω — check wiring harness for short and check operation of driver's door switches I and II.

Test 4 — Door Lock Signal (Cont'd)

b) With timer connected and voltmeter connected between terminals 7 and 4, depress driver's "Door lock" switch on driver's armrest and lock driver's door using snib. In both cases voltage should drop momentarily from 12V to 0V.
If not, check operation of relevant switch (I or II) and continuity of wiring.

Test 5 — Passenger Door Detecting Switch Signal (Timer connected)

Connect voltmeter between terminals 8 (+ve) and 4.

a) With all passenger doors locked voltmeter should read 12V.

If not, disconnect timer and check insulation between terminals 8 and 4 of harness plug using ohmmeter.

If meter reads $\propto\Omega$, insulation OK, replace timer.

If meter reads other than $\propto\Omega$, check harness for shorts and operation of each passenger door detecting switch.

b) Unlock each passenger door in turn, voltage should drop to 0V in each case. If not, check continuity of harness and operation of relevant door detecting switch.

Test 6 — Unlocking Function — Power Supply to Actuator (Timer connected)

Connect voltmeter between terminals 1 (+ve) and 4.

Voltmeter should read 0V. If not, replace timer.

As driver's door is unlocked using armrest switch or key, voltage should rise momentarily to 12V.

If not, refer test 3.

If test 3 is OK, disconnect each passenger door harness in turn and check for 12V, while unlocking driver's door.

If no good, replace timer.

If OK, check relevant door lock actuator.

Test 7 — Locking Function — Power Supply to Actuator (Timer connected)

Connect voltmeter between terminals 5 (+ve) and 4.
Voltmeter should read 0V.
If not replace timer.
As driver's door is locked using armrest switch or snib, voltage should rise momentarily to 12V.
If not, refer test 4.
If test 4 OK disconnect each passenger door harness in turn and check for 12V while locking door.
If no good, replace timer.
If OK, check relevant door lock actuator.

Test 8 — Speed Sensing Function — Power Supply

Connect voltmeter between terminals 10 and 4.
With ignition "ON" voltmeter should read 12V.
If not, check —
- Fuse 3
- Ignition relay I
- HEC internal continuity between:
  - Fuse 3 and HEC-1 pin 18
  - Fuse 3 and ignition relay I, terminal 5
  - Battery input pins to ignition relay I, terminal 3.

Test 9 — Reed switch signal (Speed sensing function)

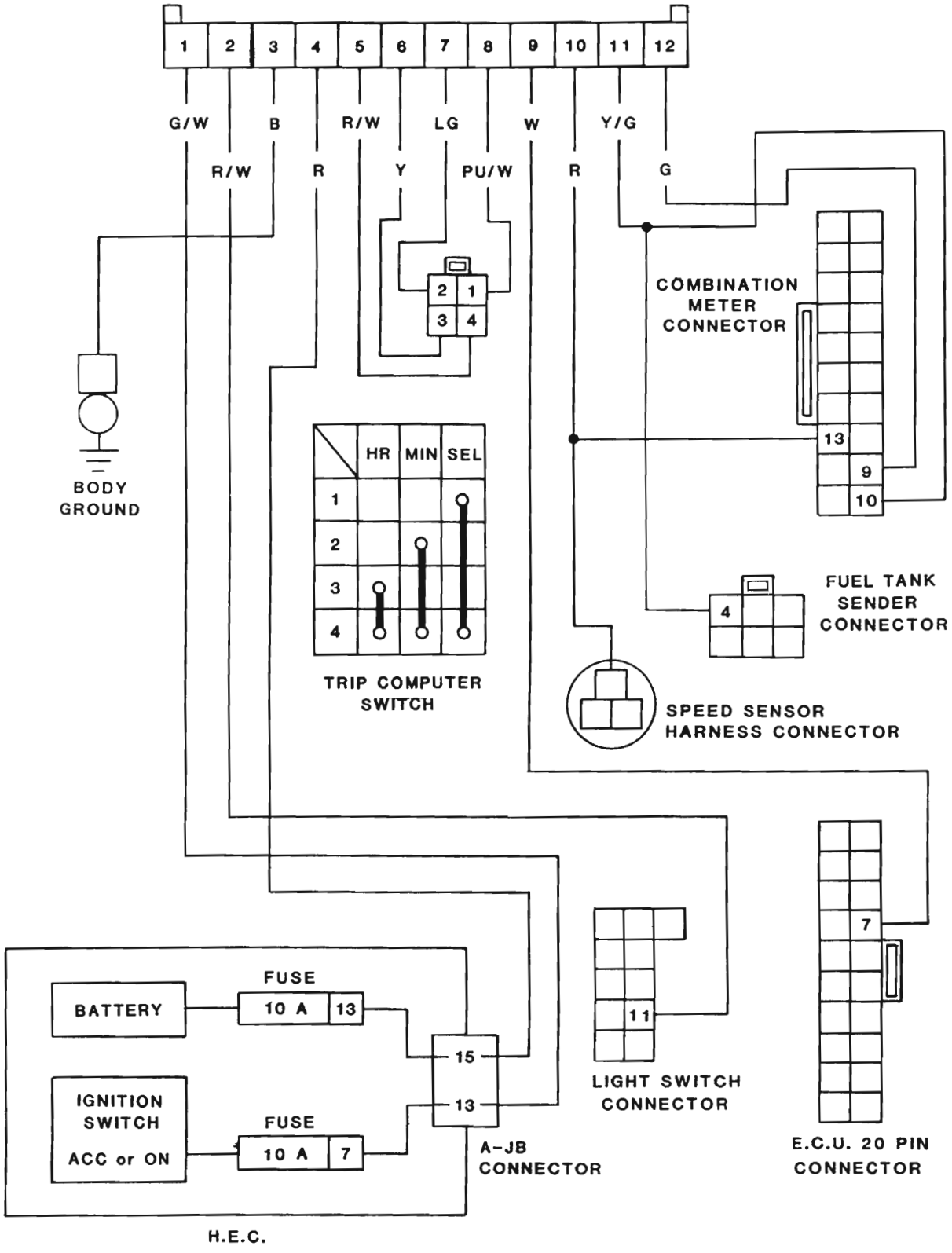
Connect voltmeter between terminals 9 (+ve) and 4.
- Turn ignition on
- Roll vehicle approx. 5 m
- Voltmeter should read 5V then 0V, alternately.

If not, refer to speed sensor check (page EL-37)
If speed sensor OK, check continuity and insulation of wiring between sensor and speedometer,
- speedometer and timer
- speedometer and ECCS control unit
- speedometer and Lockup control unit
- (see wiring diagram.)

If all OK replace speedometer.

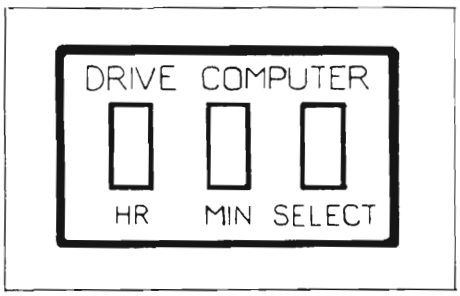
TRIP COMPUTER

WIRING DIAGRAM



A EL-003

Trouble Shooting



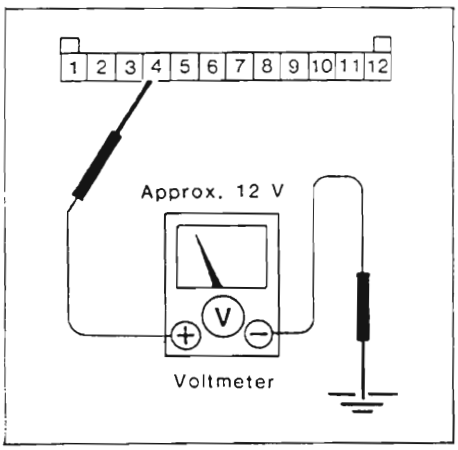
Test 1: Display Test

A. Depress buttons HR and SELECT simultaneously. All bars of the display should be illuminated. (Press SELECT button to cancel test display.) If all display bars do not illuminate, perform following test.

B. Ensure ignition and componentry switches are in the "OFF" position. Remove battery negative terminal, then reconnect. All bars of the display should be illuminated for about 5 seconds. If all bars do not illuminate, the display is faulty and trip computer should be replaced. If test B shows O.K. but test A shows fault, trip computer switch and wiring should be checked.

Before proceeding with tests 2-8 it is necessary to gain access to the back of the trip computer.

Refer to Instrument Cluster Removal instructions on page BF-13. Carry out steps 1, 2, 3, 5 and 6. Disconnect 10 pin connector from back of trip computer.



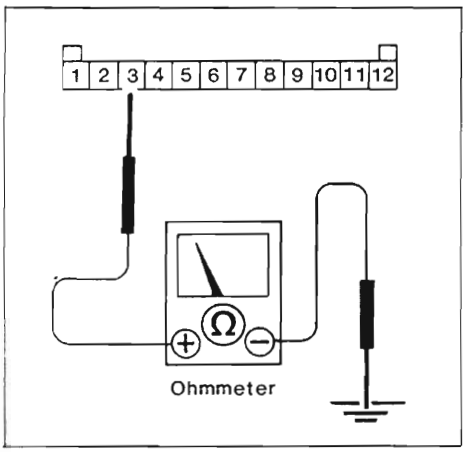
Test 2: Battery Supply

Using a voltmeter (15V scale or higher) check battery voltage. Connect the voltmeter between terminal 4 of connector and vehicle body ground. Voltage should be the same as battery voltage.

If voltage is not correct, check the following.

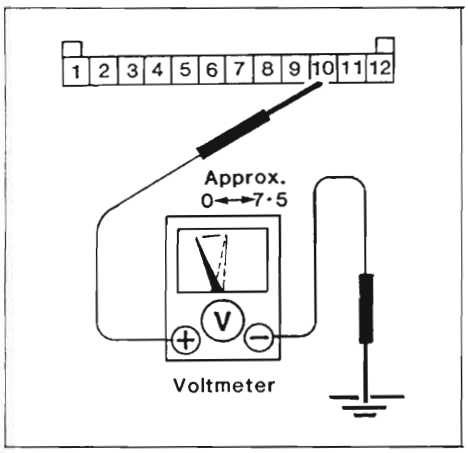
1. 12V output from fuse 13.
2. 12V at A-JB connector pin 15.
3. Continuity of wire between A-JB pin 15 and trip computer connector pin 4.

Trouble Shooting (Cont'd)



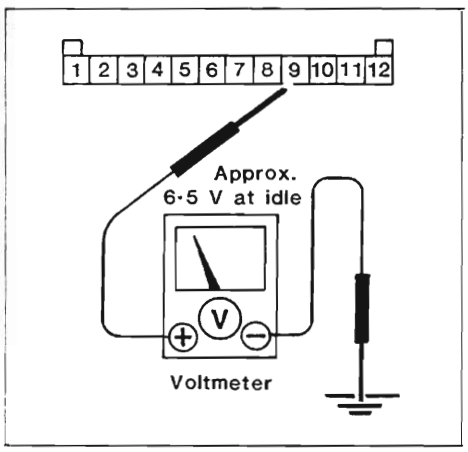
Test 3: Earth Circuit

Connect an ohmmeter between terminal 3 and body ground. There should be continuity.



Test 4: Speed Sensor Signal

Connect a voltmeter (12V scale) between terminal 10 and body ground. Disconnect speed sensor harness plug beside gear box. Unscrew and remove sensor and reconnect it to the harness. Turn ignition switch to "ON". Slowly turn sensor input shaft by hand. Voltmeter should change from 7.5 volts to 0 volts ten times in one revolution of input shaft.



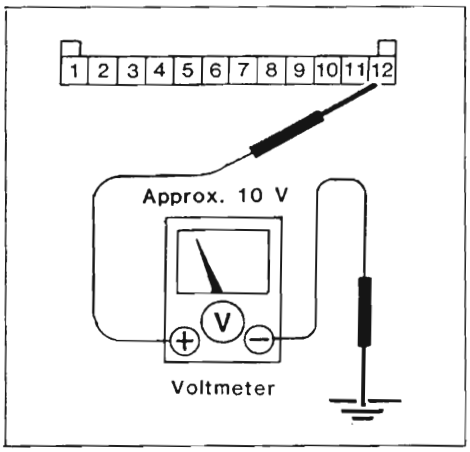
Test 5: Injection Pulse Signal

Connect a voltmeter (12V scale) between terminal 9 and body ground. Start engine. Voltmeter should read approximately 6.5V at idle. Voltage should drop when engine speed is suddenly increased.

If voltages are not correct, proceed as follows:

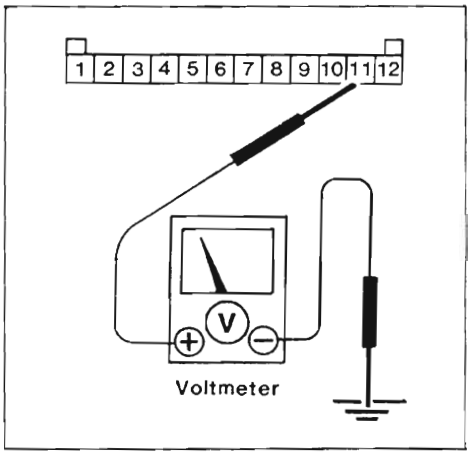
Make sure ignition and component switches are "off". Disconnect battery. Remove LH kick panel. Remove screws securing ECCS control unit, and remove 20 pin connector. Using an ohmmeter, check continuity between terminal 7 of ECCS connector and terminal 9 of trip computer connector.

Trouble Shooting (Cont'd)

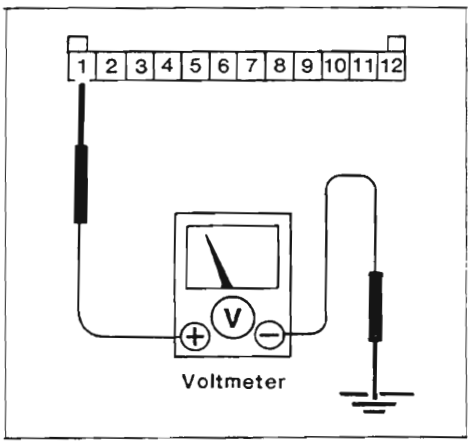


Test 6: Fuel Signal and Voltage Reference

Connect voltmeter (12V scale) between terminal 12 and body ground. Turn ignition "ON". Voltmeter should read 10V. Connect voltmeter between terminal 11 and body ground. Disconnect harness from fuel tank sender unit and connect gauge tester (P/no 77777-00017) between the yellow/green wire on the harness plugside and vehicle body ground. With ignition "ON" vary resistance value of tester and confirm voltmeter reading varies in accordance with the table opposite.



Tester Ω resistance	Voltmeter reading (V)
40	4.5
95	6.5
280	8.5



Test 7: Illumination Circuit

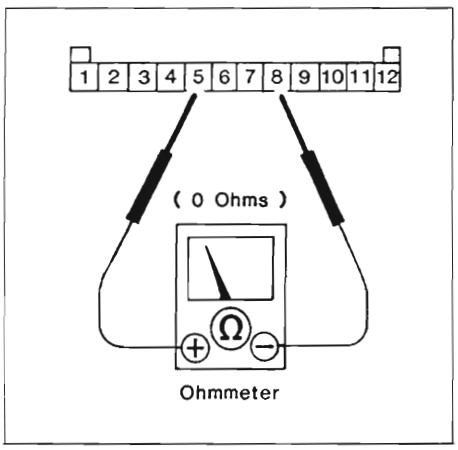
Connect voltmeter (12V scale) between terminal 1 and body ground voltage should be as shown.

If voltage is not present check:

1. Fuse 7.
2. Continuity between trip computer connector terminal 1 and A-JB instrument harness connector terminal 13.
3. HEC internal continuity — between output of fuse 7 and pin 13 of AJ-B.

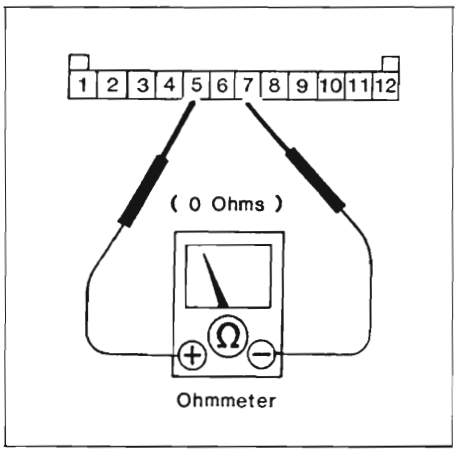
Ignition switch position	Voltage (V)
"LOCK", "OFF", "START"	0
"ACC", "ON"	12

Trouble Shooting (Cont'd)

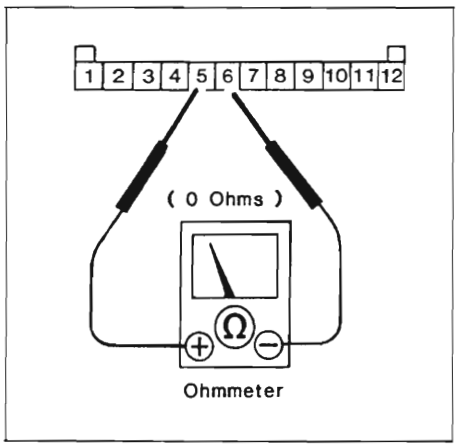


Test 8: Switch Circuits

A. Connect an ohmmeter between terminals 5 and 8.
There should be continuity (0 Ω) **only** when HR button is depressed.

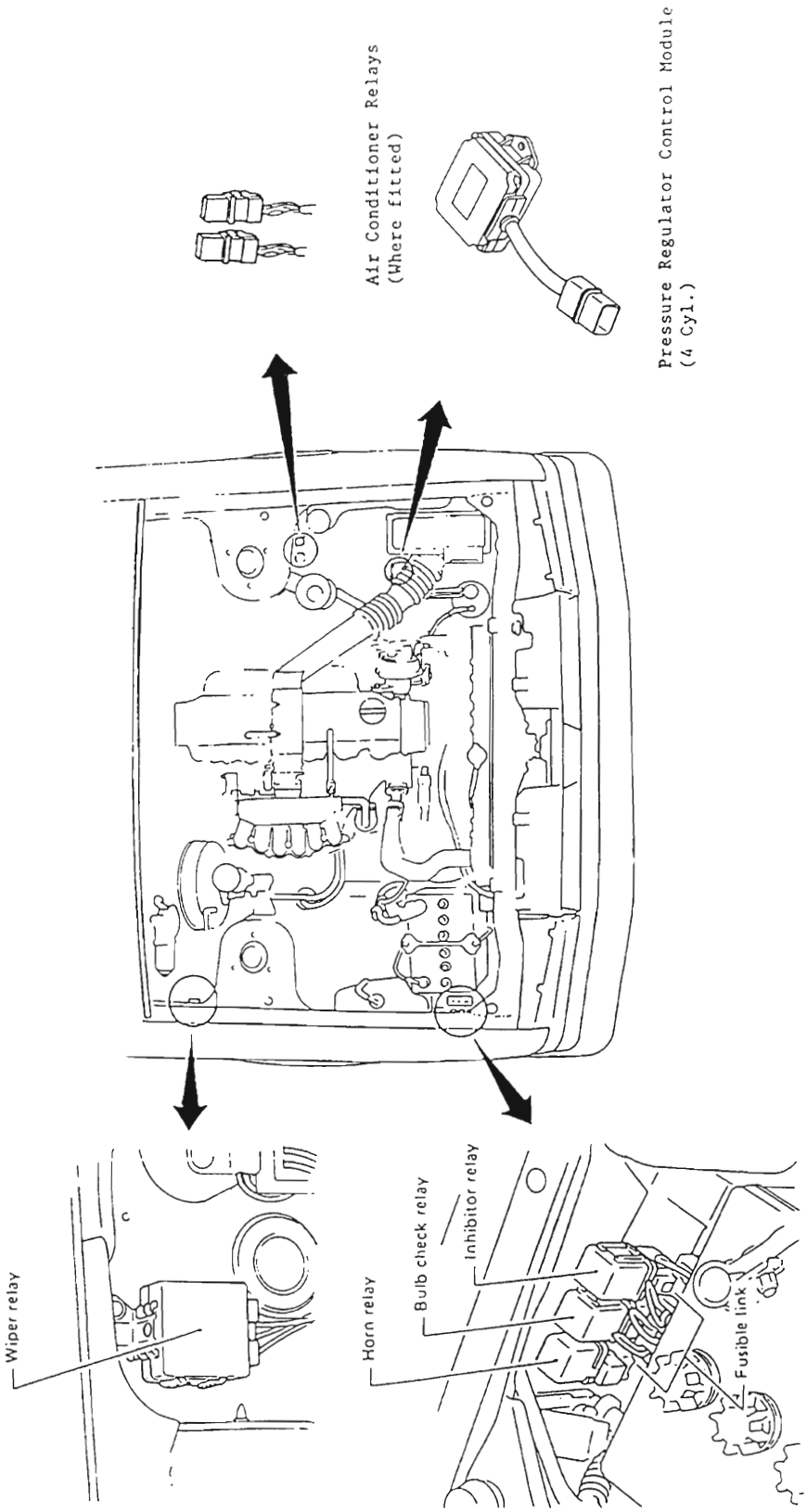


B. Connect on ohmmeter between terminals 5 and 7.
There should be continuity (0 Ω) **only** when MIN button is depressed.

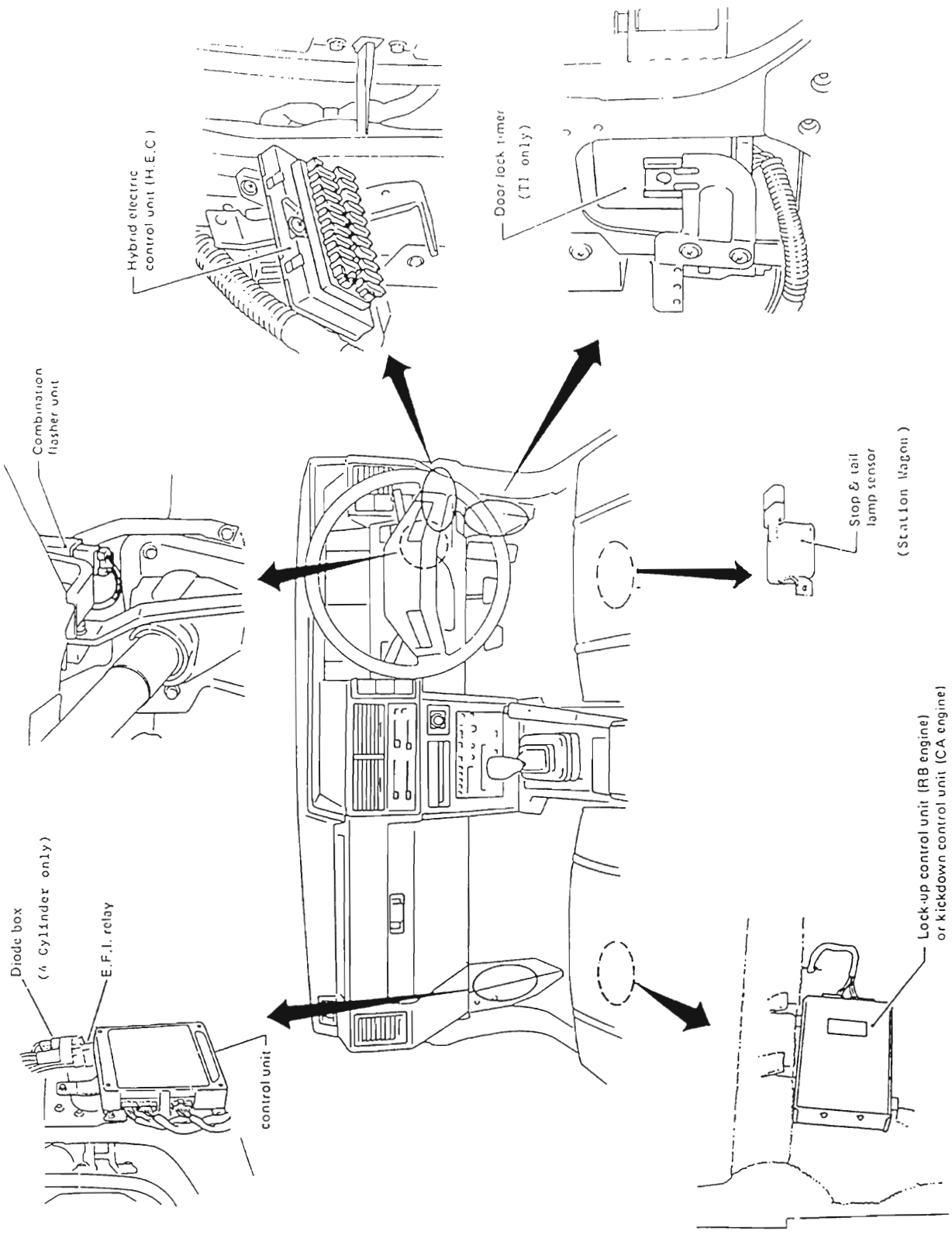


C. Connect an ohmmeter between terminals 5 and 6.
There should be continuity (0 Ω) **only** when SELECT button is depressed.

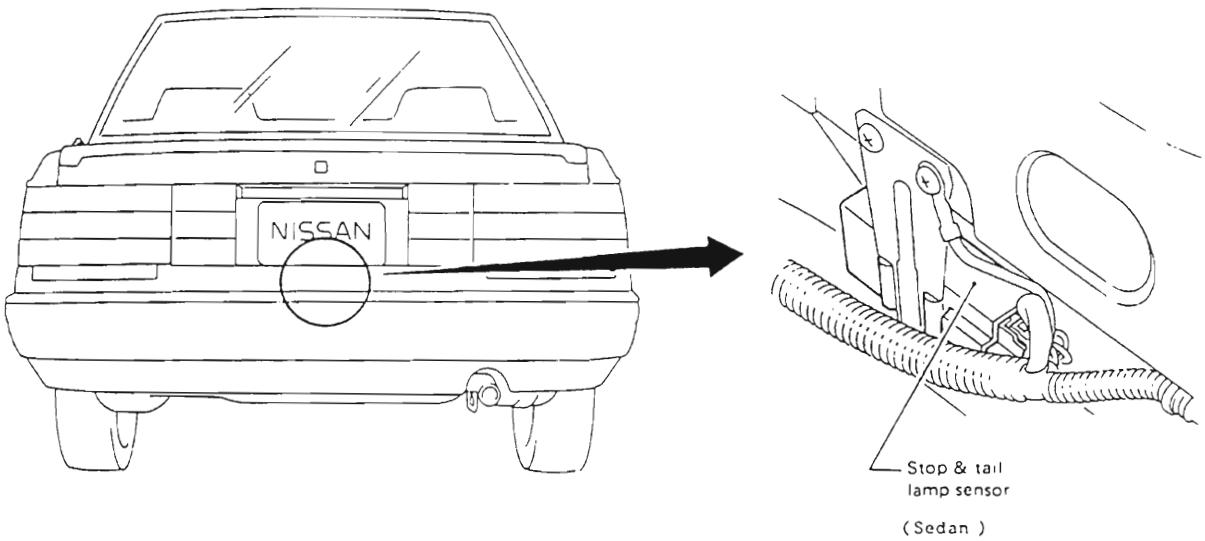
Engine Compartment



Passenger Compartment



Luggage Compartment



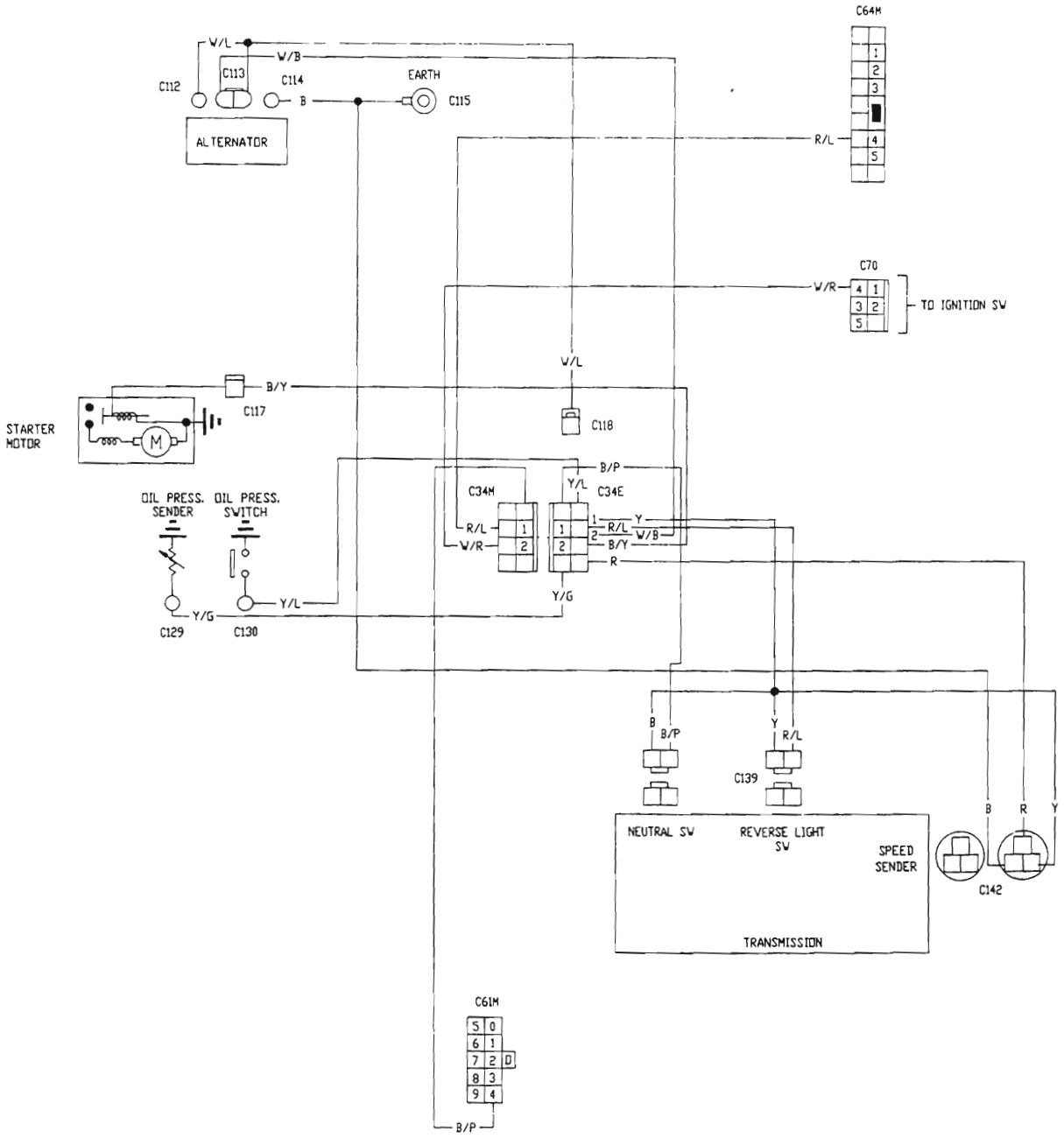
(Sedan)

Guide to Interpreting Wiring Diagrams

1. Wiring diagram for each model is shown on two separate fold out sheets (Sheet 1 and Sheet 2).
2. Wires are marked with their colour coding (see colour code table on each).
3. Connectors are labelled with an identifying number e.g.: C72
4. Connectors which form a junction between two major vehicle harnesses have a suffix added to the identifying number which indicates which harness each half of the connector is part of.
   e.g.: C56M

   Table of suffixes:
   - A — Air conditioning Harness
   - B — Body Harness
   - D — Door Harness
   - E — Engine Harness
   - I — Instrument Harness
   - M — Main Harness
5. Some connectors appear on both sheets of the diagram. If a wire is not shown at the other side of a plug, check for the plug on other sheet.
6. Diagrams show highest equipment level for each model. Other vehicles will not have all wiring items shown.

WIRE COLORS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB



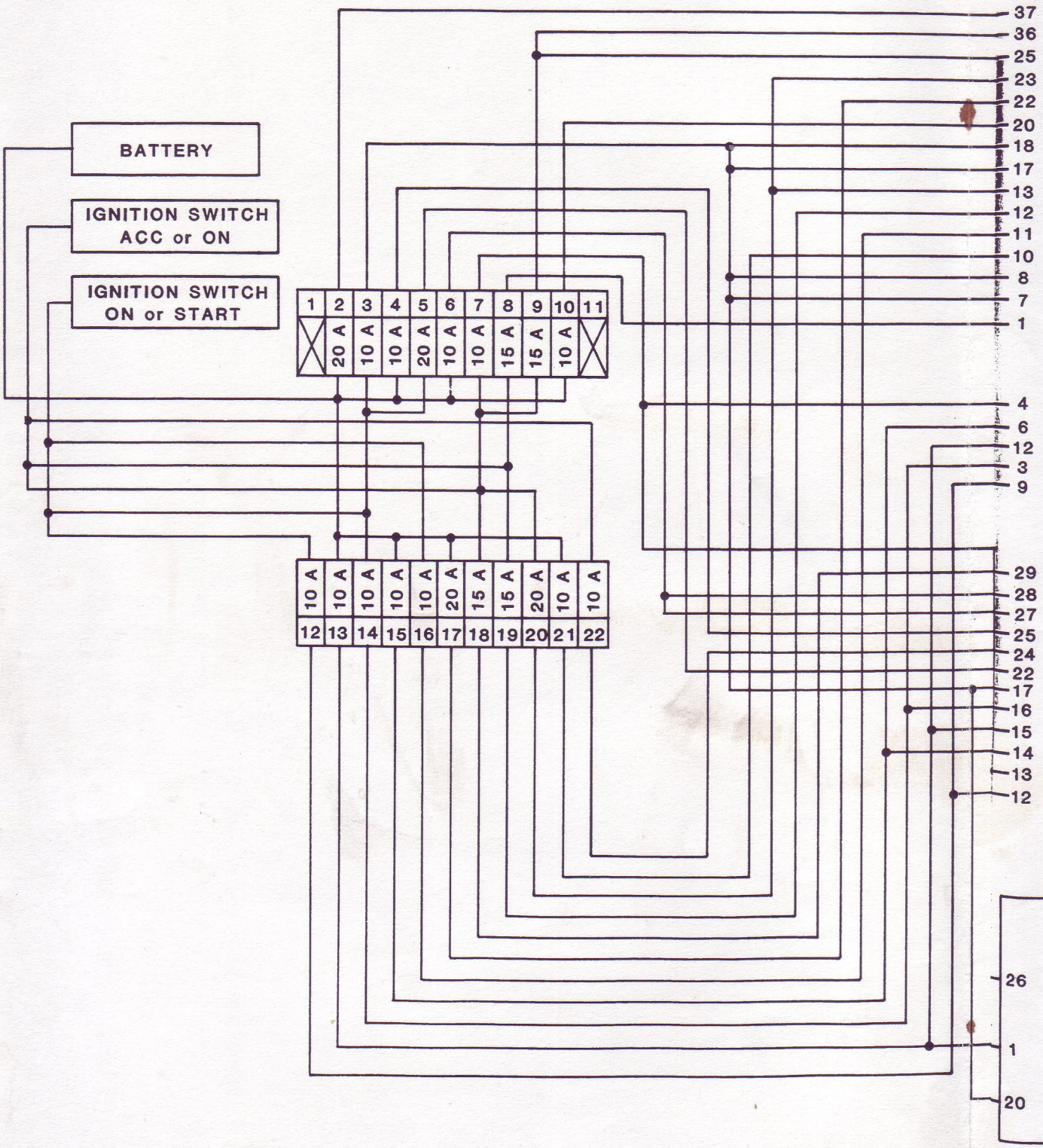
AD41 6-CYL MANUAL GEARBOX ELECTRICAL SCHEMATIC.

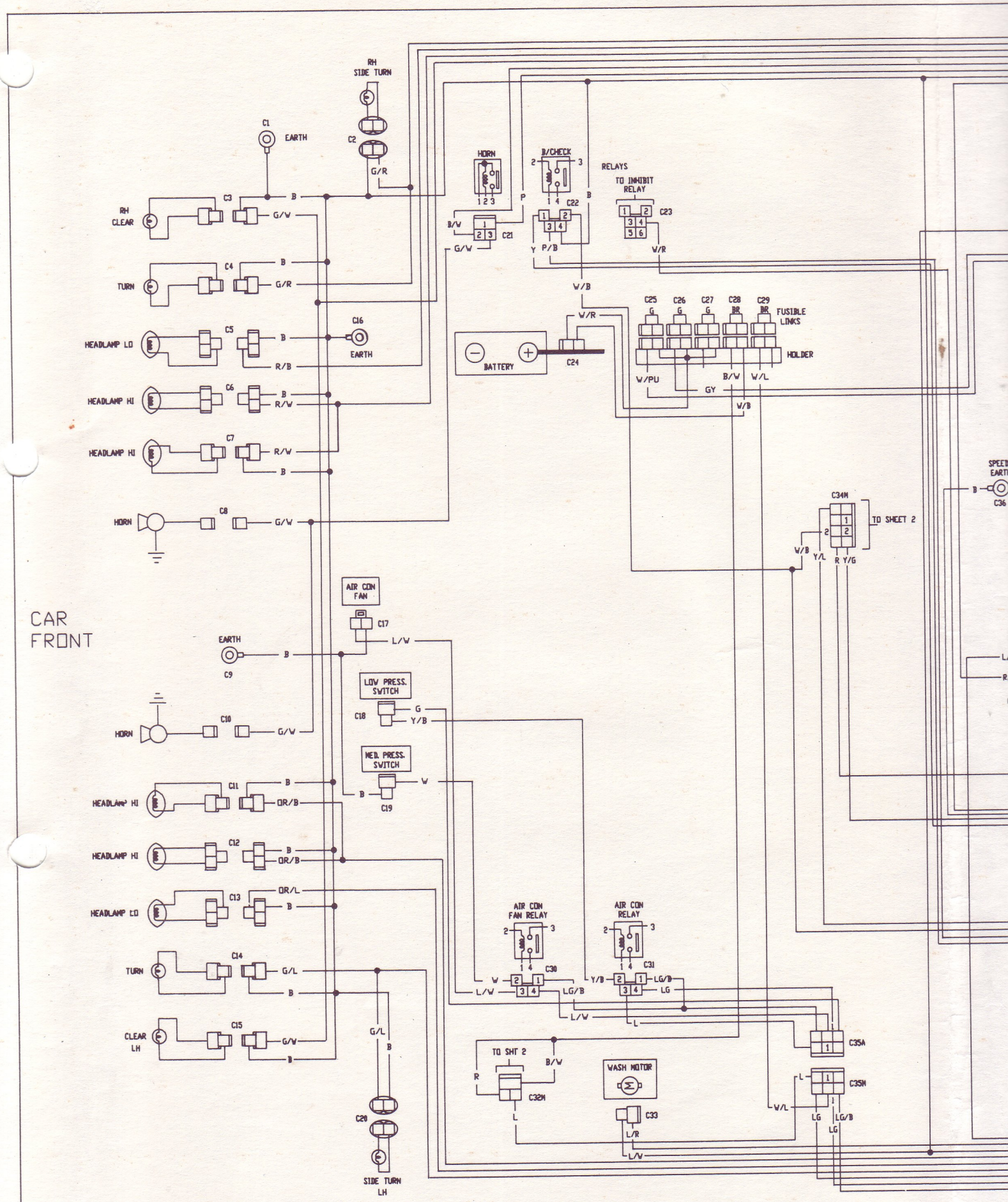
BY K.T.R.

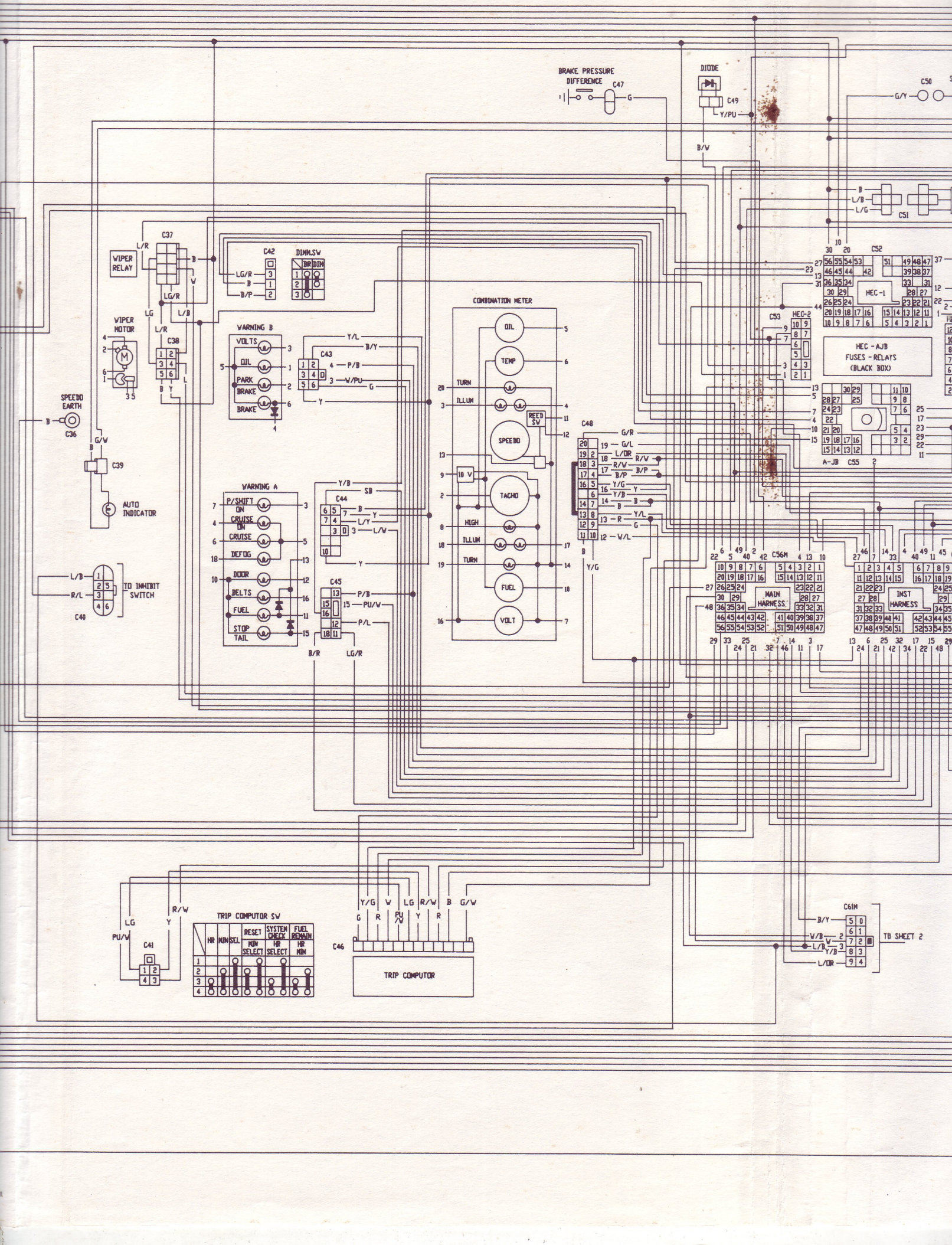
ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS)
UNLESS OTHERWISE NOTED,WIRE COLOURS ON EITHER SIDE OF CONNECTORS ARE THE SAME

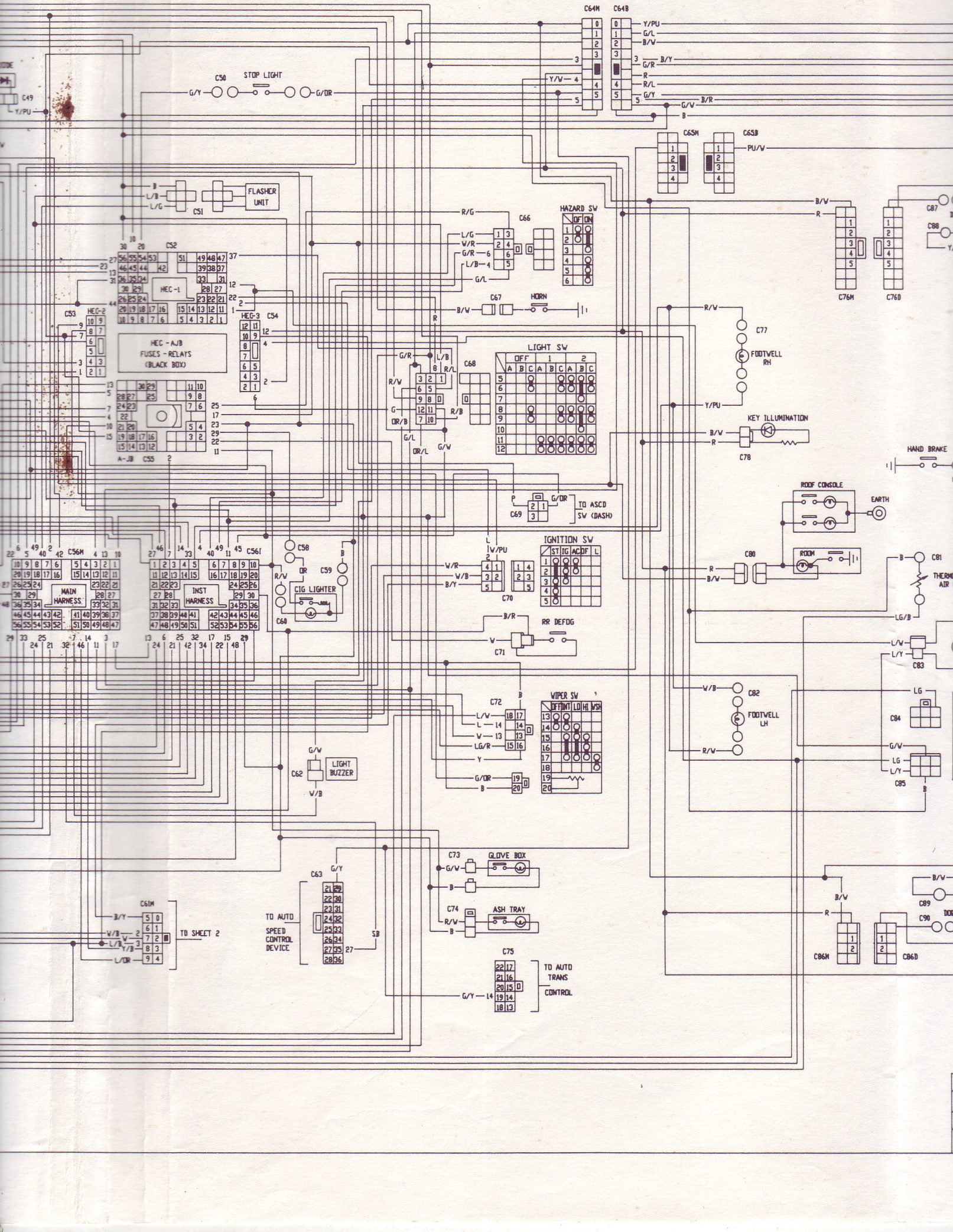
DWG/No. 24005-J7101- N

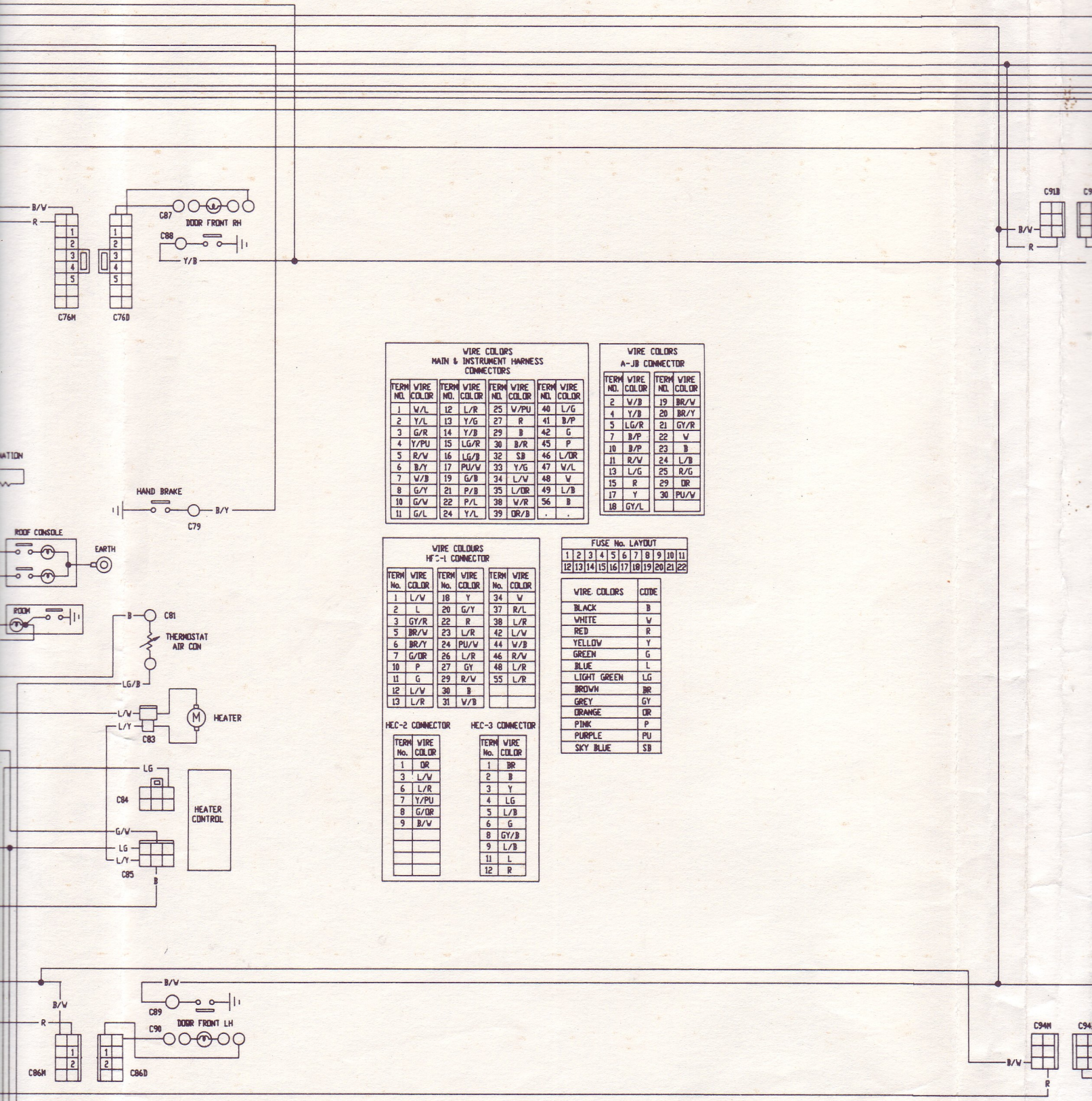
HYBRID ELECTRIC CONTROL UNIT




RH SIDE TURN
C1
EARTH
C2
G/R
HORN
B/CHECK
RELAYS
TO INHIBIT RELAY
C23
C22
C21
RH CLEAR
C3
B
G/W
TURN
C4
G/R
HEADLAMP LO
C5
R/B
C16
EARTH
HEADLAMP HI
C6
R/W
HEADLAMP HI
C7
HORN
C8
BATTERY
C24
W/R
W/B
C25
C26
C27
C28
C29
FUSIBLE LINKS
HOLDER
W/PU
B/W
W/L
GY
C34M
TO SHEET 2
W/B
Y/L
R Y/G
CAR FRONT
AIR CON FAN
C17
L/W
EARTH
C9
LOW PRESS. SWITCH
C18
G
Y/B
HORN
C10
MED. PRESS. SWITCH
C19
W
HEADLAMP HI
C11
OR/B
HEADLAMP HI
C12
HEADLAMP LO
C13
OR/L
TURN
C14
G/L
CLEAR LH
C15
AIR CON FAN RELAY
AIR CON RELAY
C30
C31
LG/B
LG
TO SHT 2
C32M
WASH MOTOR
C33
C35A
C35M
L/R
C20
SIDE TURN LH


BRAKE PRESSURE DIFFERENCE
C47
G
DIODE
C49
Y/PU
B/W
C50
G/Y
B
L/B
L/G
C51
C52
HEC-1
HEC-2
C53
HEC - AJB
FUSES - RELAYS
(BLACK BOX)
A-JB C55
C37
WIPER RELAY
L/R
B
W
LG/R
LG
L/B
C42
DIMM.SW
BR
DIM
LG/R
B
B/P
WIPER MOTOR
C38
L
B
Y
WARNING B
VOLTS
OIL
PARK BRAKE
BRAKE
Y/L
B/Y
C43
P/B
W/PU
G
Y
COMBINATION METER
OIL
TEMP
TURN
ILLUM
REED SW
SPEEDO
10 V
TACHO
HIGH
ILLUM
TURN
FUEL
VOLT
SPEEDO EARTH
C36
G/W
C39
AUTO INDICATOR
WARNING A
P/SHIFT ON
CRUISE ON
CRUISE
DEFOG
DOOR
BELTS
FUEL
STOP TAIL
Y/B
SB
C44
B
Y
L/Y
L/W
Y
C45
P/B
PU/W
P/L
B/R
LG/R
C48
G/R
G/L
L/OR
R/W
R/W
B/P
Y/G
Y
Y/B
B
R
Y/L
G
W/L
B
Y/G
L/B
R/L
TO INHIBIT SWITCH
C40
C56M
MAIN HARNESS
INST HARNESS
C61M
B/Y
W/B
L/B
Y/B
L/OR
TO SHEET 2
TRIP COMPUTOR SW
HR
MIN
SEL
RESET
MIN SELECT
SYSTEM CHECK
HR SELECT
FUEL REMAIN
HR
MIN
C41
PU/W
LG
R/W
Y
C46
Y/G
G
W
R
LG
PU/W
R/W
Y
B
R
G/W
TRIP COMPUTOR


C64M
C64B
Y/PU
G/L
B/W
B/Y
G/R
R
R/L
G/Y
B/R
G/W
B
C65M
C65B
PU/W
C50
STOP LIGHT
G/Y
G/OR
C49
Y/PU
FLASHER UNIT
C51
B
L/B
L/G
C52
HEC-1
HEC-2
HEC-3
C53
C54
HEC - AJB
FUSES - RELAYS
(BLACK BOX)
A-JB
C55
C66
HAZARD SW
OFF
ON
R/G
L/G
W/R
G/R
L/B
G/L
C67
HORN
B/W
C68
LIGHT SW
OFF
1
2
R/W
G/R
L/B
R/L
R/B
G
OR/B
G/L
OR/L
G/W
C69
P
G/OR
TO ASCD SW (DASH)
C76M
C76D
C87
C88
C77
FOOTWELL RH
Y/PU
KEY ILLUMINATION
C78
HAND BRAKE
ROOF CONSOLE
EARTH
ROOM
C80
C81
THERM AIR
LG/B
C83
L/W
L/Y
C82
FOOTWELL LH
W/B
R/W
C84
LG
C85
G/W
L/Y
C56M
C56I
MAIN HARNESS
INST HARNESS
C58
C59
C60
CIG LIGHTER
R/W
OR
B
C70
IGNITION SW
ST
IG
ACC
OFF
L
L/W
W/PU
W/R
W/B
B/Y
C71
RR DEFOG
B/R
W
C72
L/W
L
W
LG/R
Y
G/OR
B
WIPER SW
OFF
INT
LO
HI
WSH
C62
LIGHT BUZZER
G/W
W/B
C73
GLOVE BOX
G/W
B
C74
ASH TRAY
R/W
B
C75
G/Y
TO AUTO TRANS CONTROL
C63
G/Y
TO AUTO SPEED CONTROL DEVICE
SB
C61M
B/Y
W/B
L/B
Y/B
L/OR
TO SHEET 2
C86M
C86D
C89
C90



WIRE COLORS
MAIN & INSTRUMENT HARNESS CONNECTORS

TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR
1	W/L	12	L/R	25	W/PU	40	L/G
2	Y/L	13	Y/G	27	R	41	B/P
3	G/R	14	Y/B	29	B	42	G
4	Y/PU	15	LG/R	30	B/R	45	P
5	R/W	16	LG/B	32	SB	46	L/OR
6	B/Y	17	PU/W	33	Y/G	47	W/L
7	W/B	19	G/B	34	L/W	48	W
8	G/Y	21	P/B	35	L/OR	49	L/B
10	G/W	22	P/L	38	W/R	56	B
11	G/L	24	Y/L	39	OR/B	.	.

WIRE COLORS
A-JB CONNECTOR

TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR
2	W/B	19	BR/W
4	Y/B	20	BR/Y
5	LG/R	21	GY/R
7	B/P	22	W
10	B/P	23	B
11	R/W	24	L/B
13	L/G	25	R/G
15	R	29	OR
17	Y	30	PU/W
18	GY/L		

WIRE COLOURS
HEC-1 CONNECTOR

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
1	L/W	18	Y	34	W
2	L	20	G/Y	37	R/L
3	GY/R	22	R	38	L/R
5	BR/W	23	L/R	42	L/W
6	BR/Y	24	PU/W	44	W/B
7	G/OR	26	L/R	46	R/W
10	P	27	GY	48	L/R
11	G	29	R/W	55	L/R
12	L/W	30	B		
13	L/R	31	W/B		

HEC-2 CONNECTOR

TERM No.	WIRE COLOR
1	OR
3	L/W
6	L/R
7	Y/PU
8	G/OR
9	B/W

HEC-3 CONNECTOR

TERM No.	WIRE COLOR
1	BR
2	B
3	Y
4	LG
5	L/B
6	G
8	GY/B
9	L/B
11	L
12	R

FUSE No. LAYOUT

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22

WIRE COLORS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB

SYMBOL	DESCRIPTION
	EARTH
	SWITCH
	BULB

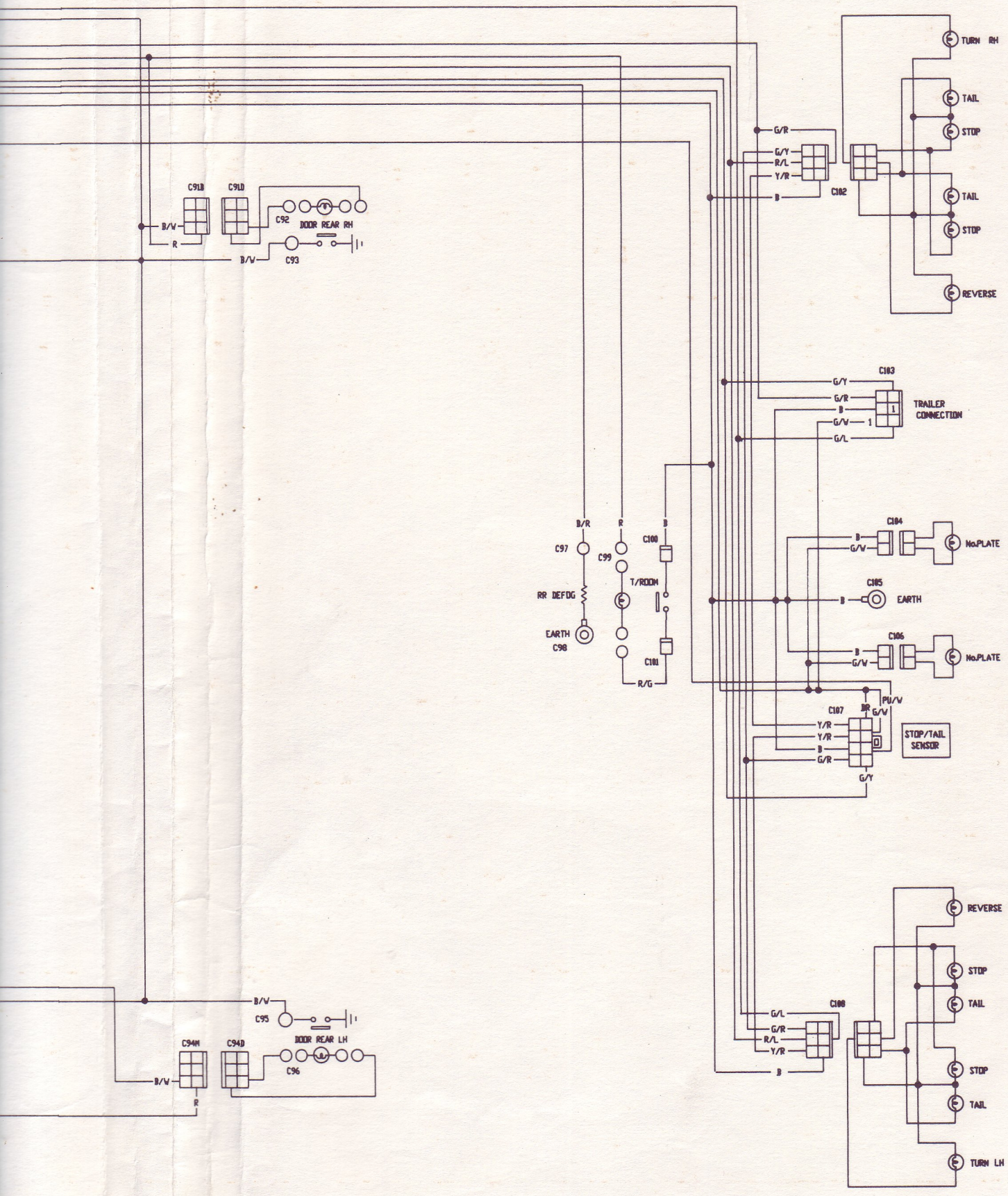
AD41-TI 6-CYL AUTO SEDAN ELECTRICAL SCHEMATIC SHEET 1

BY K.T.R.

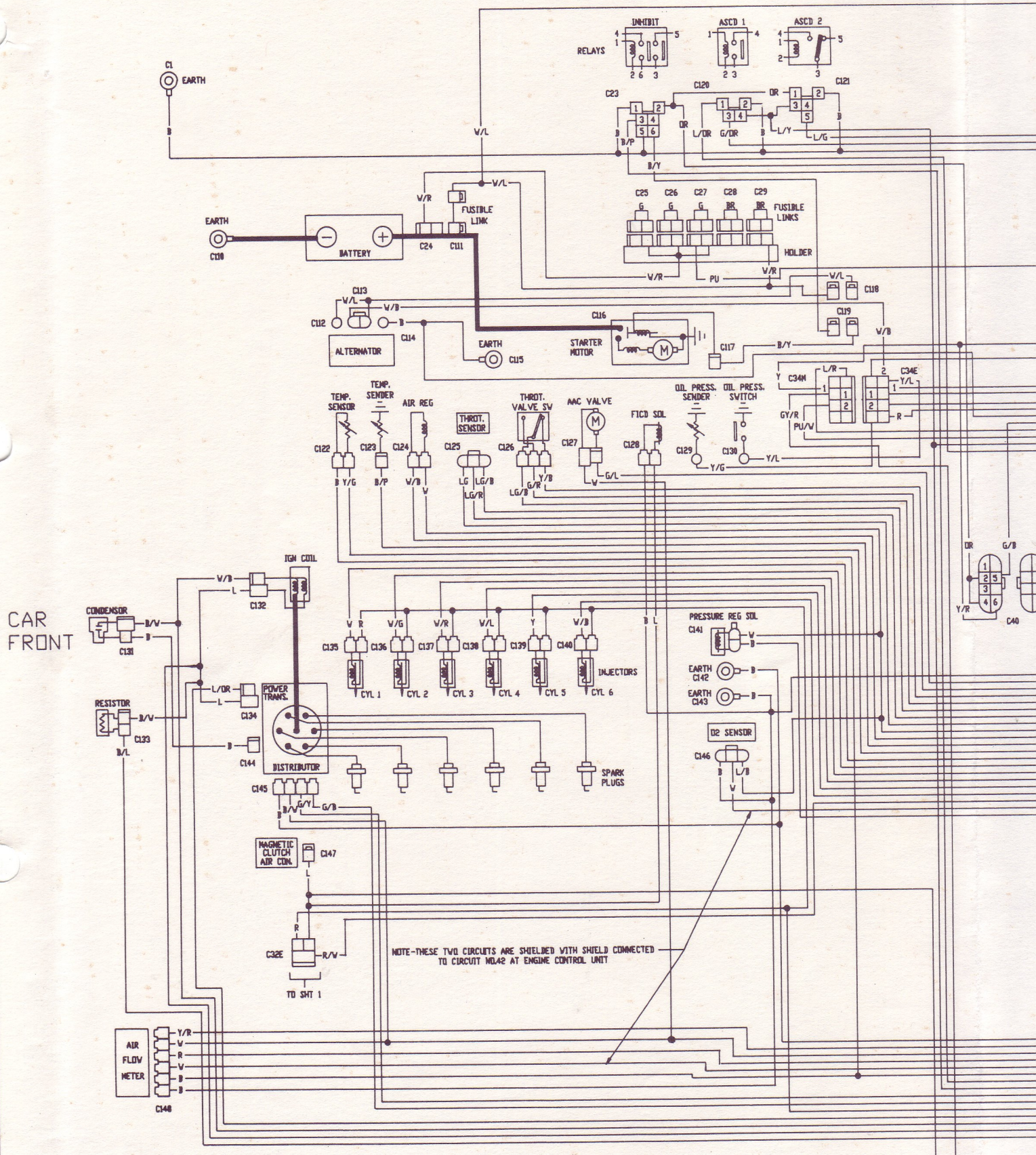
FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 2.

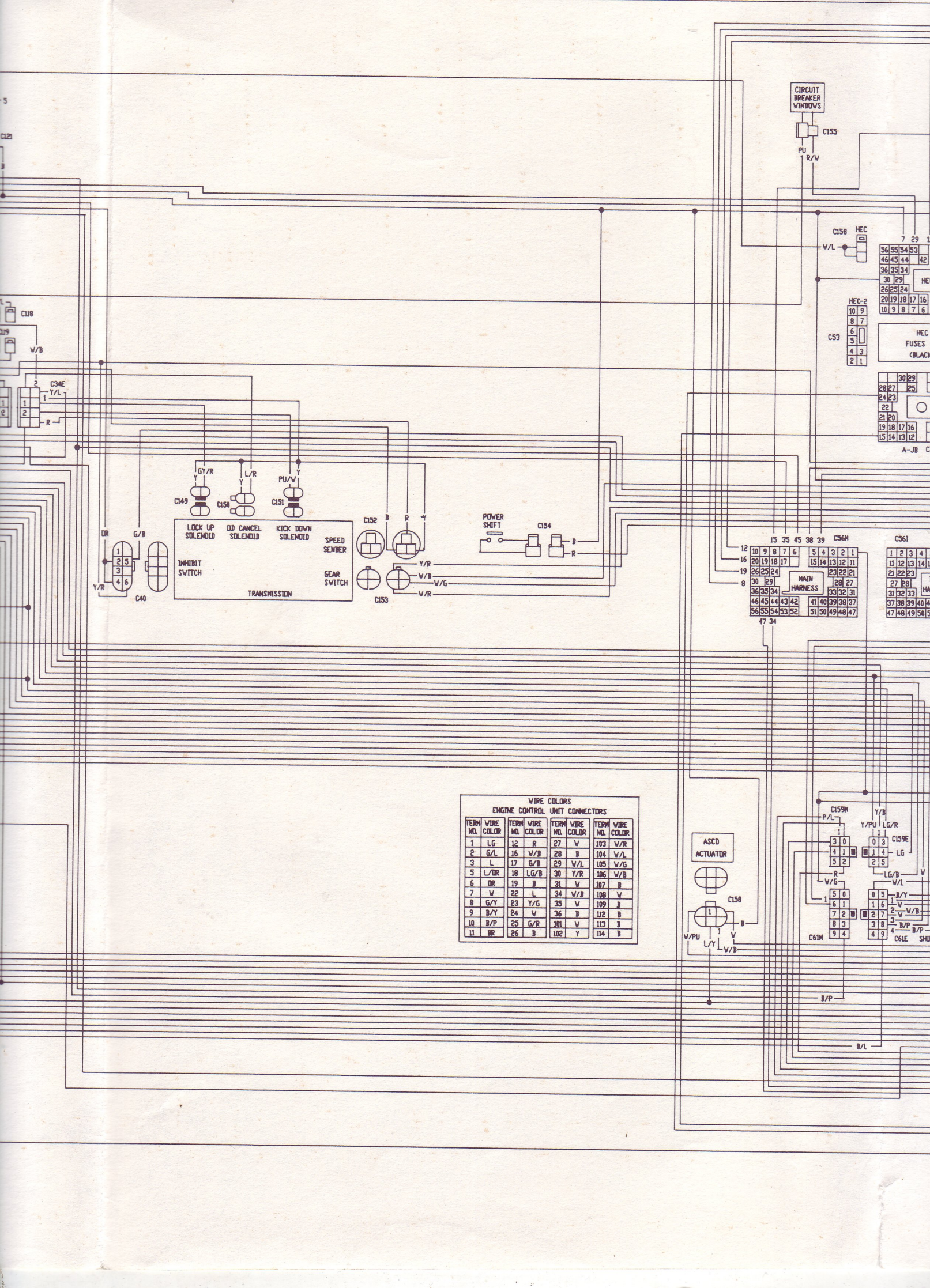
UNLESS OTHERVISE NOTED, WIRE COLOURS ON EITHER SIDE OF CONNECTOR JUNCTION ARE THE SAME

ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS)



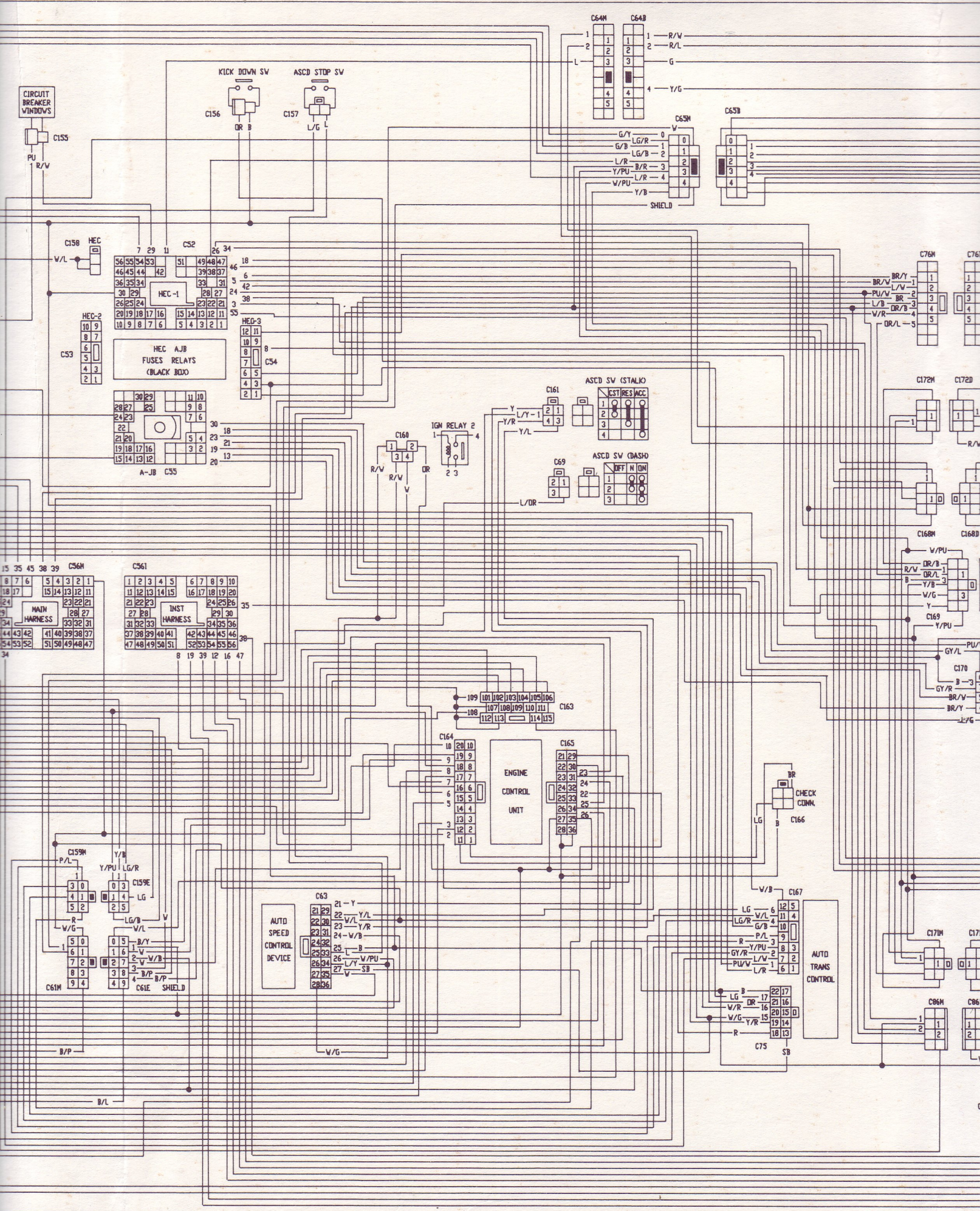
DWG/No. 24005-J7100-21-[M][1][2]

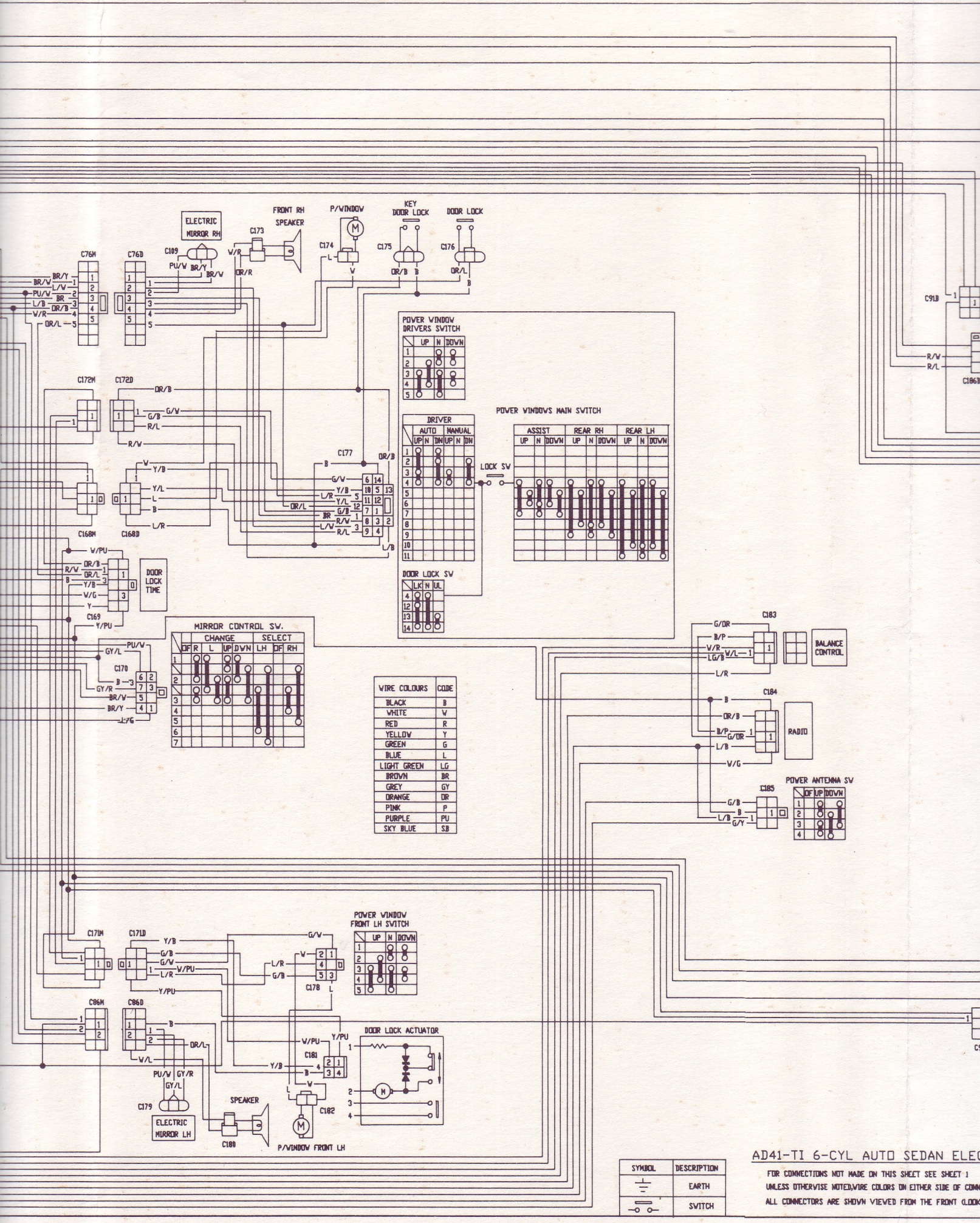

CAR FRONT
INHIBIT RELAYS
ASCD 1
ASCD 2
C1 EARTH
EARTH C110
BATTERY
FUSIBLE LINK
C24
C111
C25 C26 C27 C28 C29
FUSIBLE LINKS
HOLDER
C113
C112
ALTERNATOR
C114
EARTH C115
C116
STARTER MOTOR
C117
C118
C119
C120
C121
C23
C34M
C34E
TEMP. SENSOR
TEMP. SENDER
AIR REG
THROT. SENSOR
THROT. VALVE SW
AAC VALVE
FICD SOL
OIL PRESS. SENDER
OIL PRESS. SWITCH
C122
C123
C124
C125
C126
C127
C128
C129
C130
IGN COIL
C132
CONDENSOR
C131
RESISTOR
C133
C134
POWER TRANS.
DISTRIBUTOR
C144
C145
C135
C136
C137
C138
C139
C140
CYL 1
CYL 2
CYL 3
CYL 4
CYL 5
CYL 6
INJECTORS
SPARK PLUGS
PRESSURE REG SOL
C141
EARTH C142
EARTH C143
O2 SENSOR
C146
MAGNETIC CLUTCH AIR CON.
C147
C32E
TO SHT 1
NOTE-THESE TWO CIRCUITS ARE SHIELDED WITH SHIELD CONNECTED TO CIRCUIT NO.42 AT ENGINE CONTROL UNIT
AIR FLOW METER
C148
C40

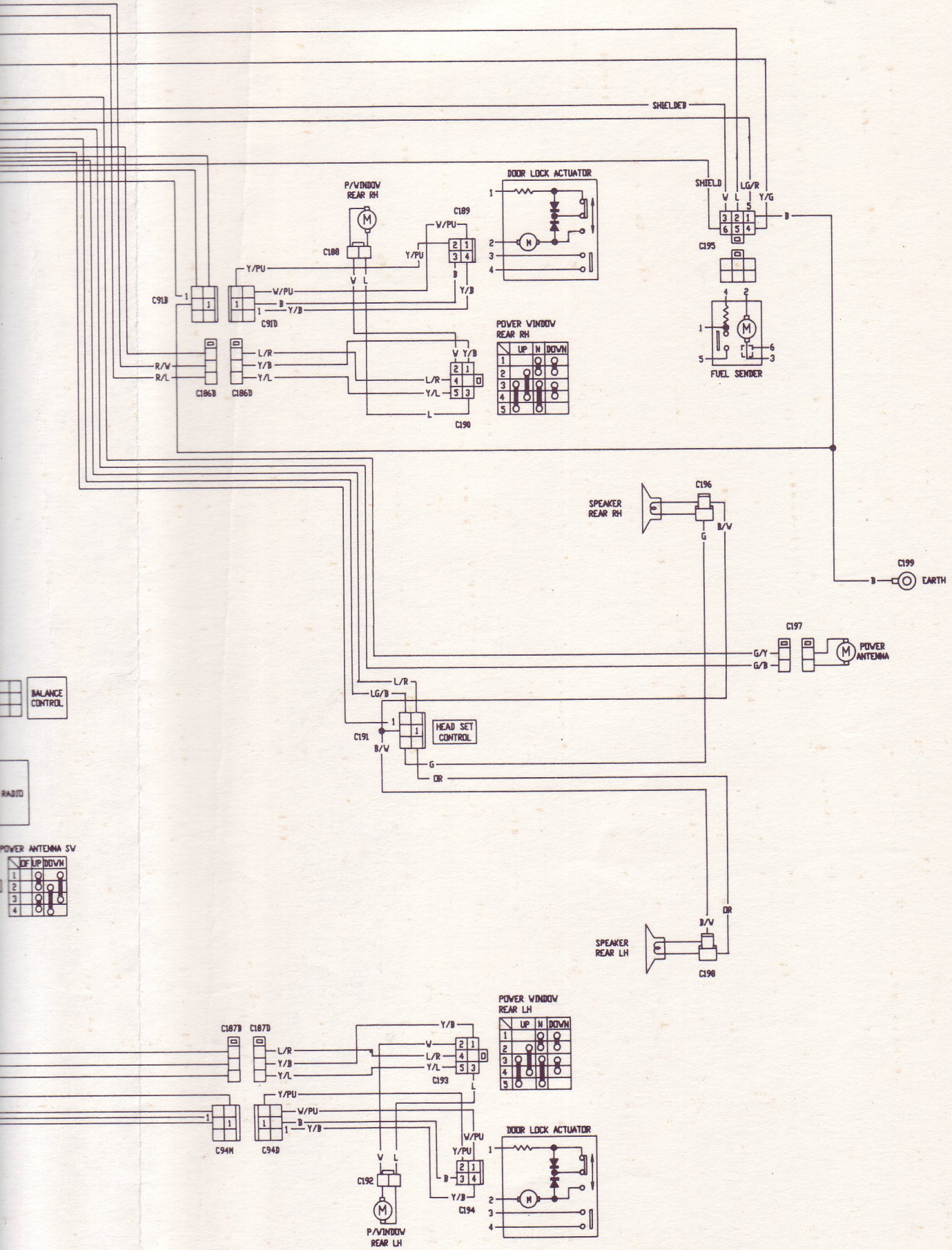


WIRE COLORS
ENGINE CONTROL UNIT CONNECTORS

TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR	TERM NO.	WIRE COLOR
1	LG	12	R	27	V	103	W/R
2	G/L	16	W/B	28	B	104	W/L
3	L	17	G/B	29	W/L	105	W/G
5	L/OR	18	LG/B	30	Y/R	106	W/B
6	OR	19	B	31	V	107	B
7	W	22	L	34	W/B	108	V
8	G/Y	23	Y/G	35	V	109	B
9	B/Y	24	W	36	B	112	B
10	B/P	25	G/R	101	W	113	B
11	BR	26	B	102	Y	114	B


CIRCUIT BREAKER WINDOWS
C155
PU
R/W
KICK DOWN SW
C156
OR B
ASCD STOP SW
C157
L/G L
C64M
C64B
L
R/W
R/L
G
Y/G
C65M
C65B
G/Y
G/B
L/R
Y/PU
W/PU
LG/R
LG/B
B/R
L/R
Y/B
SHIELD
C158 HEC
W/L
C52
HEC-1
HEC-2
C53
HEC-3
C54
HEC AJB
FUSES RELAYS
(BLACK BOX)
A-JB C55
C161
ASCD SW (STALK)
CST RES ACC
Y
L/Y
Y/R
Y/L
C69
ASCD SW (DASH)
OFF N ON
L/DR
C160
IGN RELAY 2
R/W
DR
W
C76M
C76I
BR/Y
L/W
PU/W
BR
L/B
DR/B
W/R
DR/L
C172M
C172D
R/W
C168M
C168D
W/PU
DR/B
R/W
DR/L
B
Y/B
W/G
Y
C169
Y/PU
PU/
GY/L
C170
B
GY/R
BR/W
BR/Y
L/G
C56M
MAIN HARNESS
C56I
INST HARNESS
C163
C164
ENGINE CONTROL UNIT
C165
BR
CHECK CONN.
C166
LG
B
C159M
C159E
C61M
C61E
SHIELD
P/L
Y/B
Y/PU
LG/R
LG
R
W/G
W/L
LG/B
B/Y
B/P
C63
AUTO SPEED CONTROL DEVICE
W/B
C167
AUTO TRANS CONTROL
C75
C171M
C171I
C86M
C86I
B/P
B/L
W/G
SB


ELECTRIC MIRROR RH
FRONT RH SPEAKER
P/WINDOW
KEY DOOR LOCK
DOOR LOCK
C109
C173
C174
C175
C176
C76M
C76D
POWER WINDOW DRIVERS SWITCH
UP N DOWN
POWER WINDOWS MAIN SWITCH
DRIVER
AUTO
MANUAL
ASSIST
REAR RH
REAR LH
LOCK SW
C177
C172M
C172D
C168M
C168D
DOOR LOCK SW
LK N UL
DOOR LOCK TIME
C169
MIRROR CONTROL SW.
CHANGE
SELECT
OF R L UP DWN LH OF RH
C170
C183
BALANCE CONTROL
C184
RADIO
POWER ANTENNA SW
OF UP DOWN
C185
WIRE COLOURS
CODE
BLACK B
WHITE W
RED R
YELLOW Y
GREEN G
BLUE L
LIGHT GREEN LG
BROWN BR
GREY GY
ORANGE OR
PINK P
PURPLE PU
SKY BLUE SB
POWER WINDOW FRONT LH SWITCH
C171M
C171D
C178
C86M
C86D
C181
C182
DOOR LOCK ACTUATOR
C179
ELECTRIC MIRROR LH
SPEAKER
C180
P/WINDOW FRONT LH
C91B
C186B
SYMBOL
DESCRIPTION
EARTH
SWITCH
AD41-TI 6-CYL AUTO SEDAN ELEC
FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 1
UNLESS OTHERWISE NOTED,WIRE COLORS ON EITHER SIDE OF CONN
ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOK



-TI 6-CYL AUTO SEDAN ELECTRICAL SCHEMATIC SHEET 2

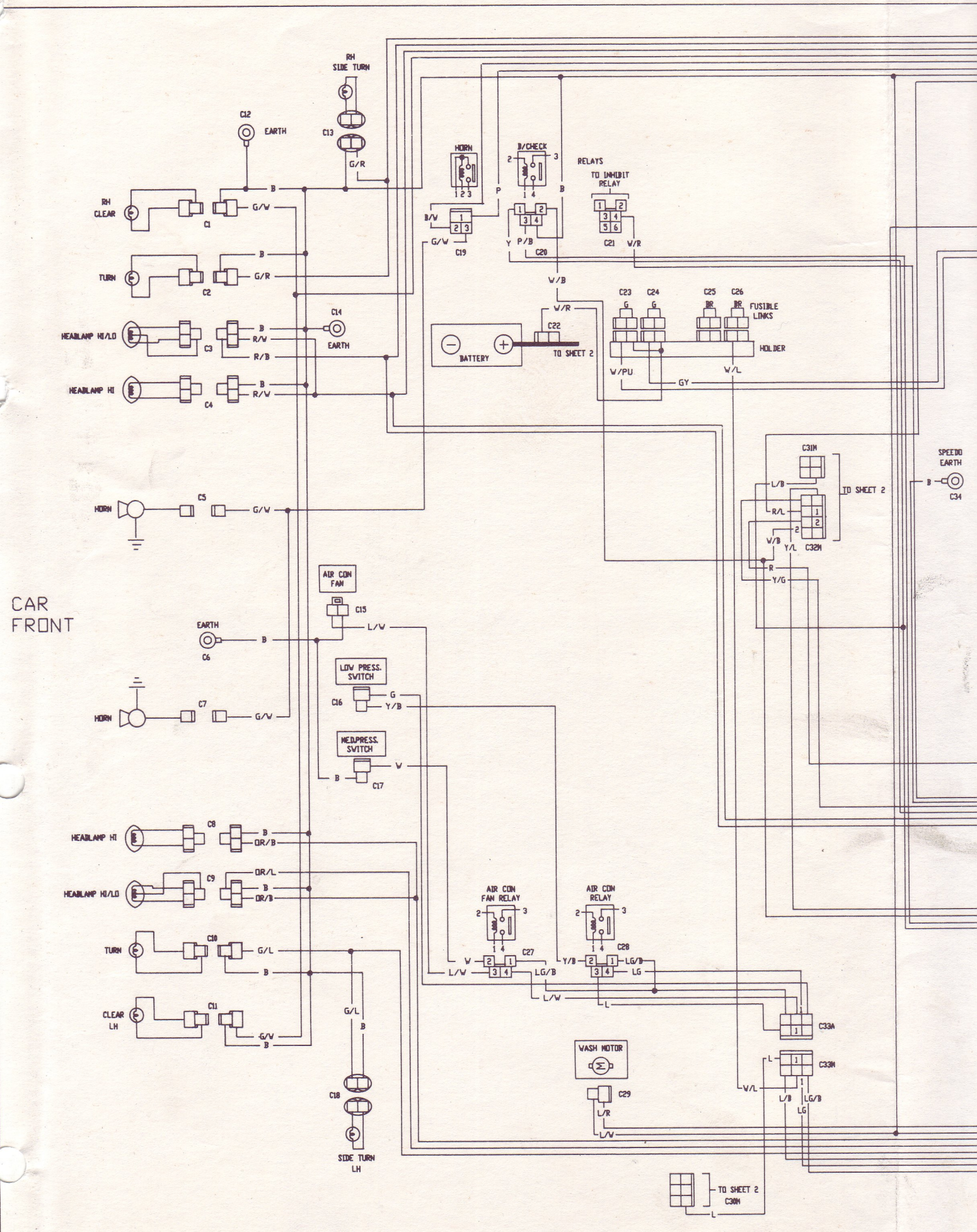
BY K.T.R.

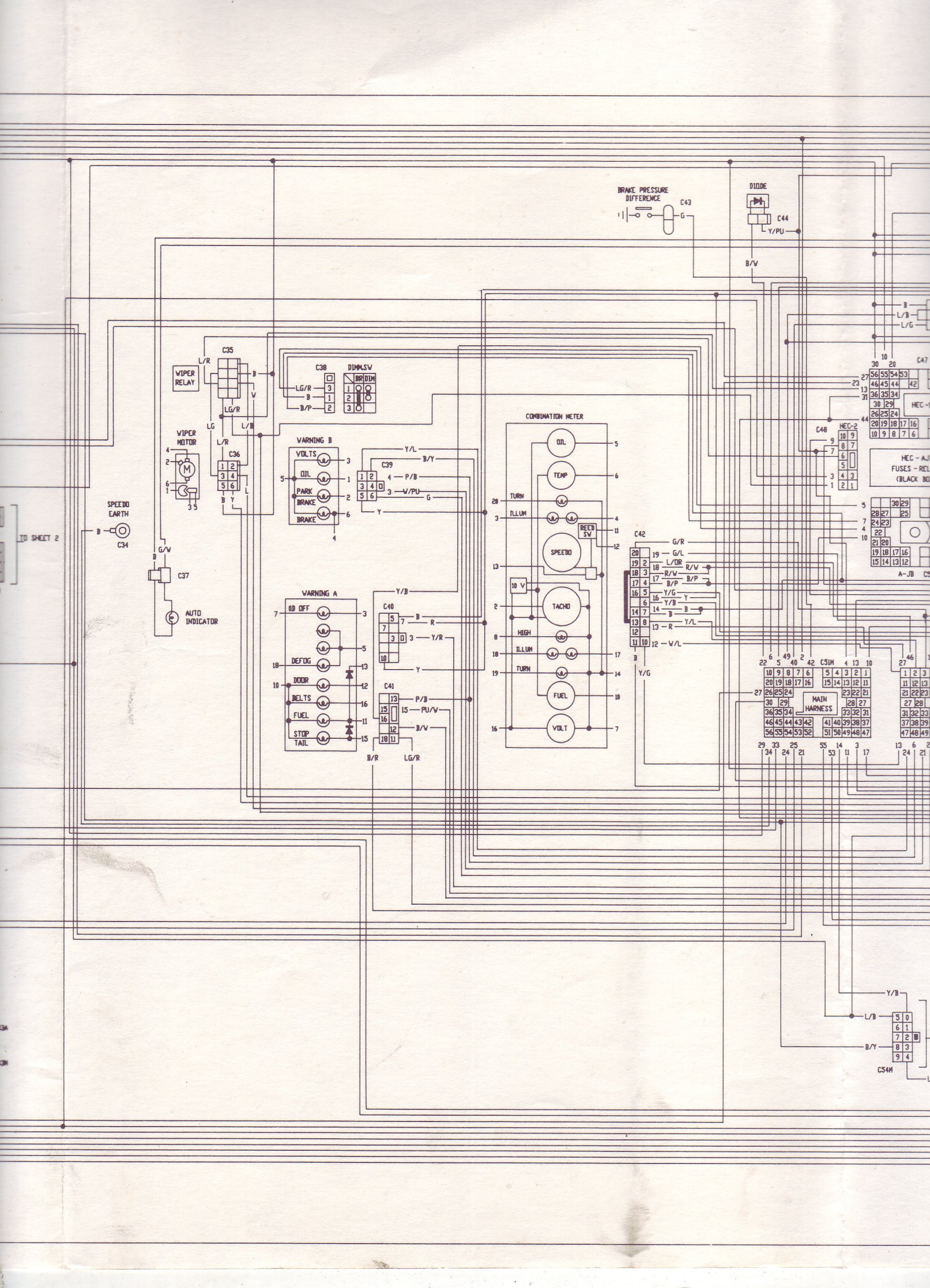
CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 1

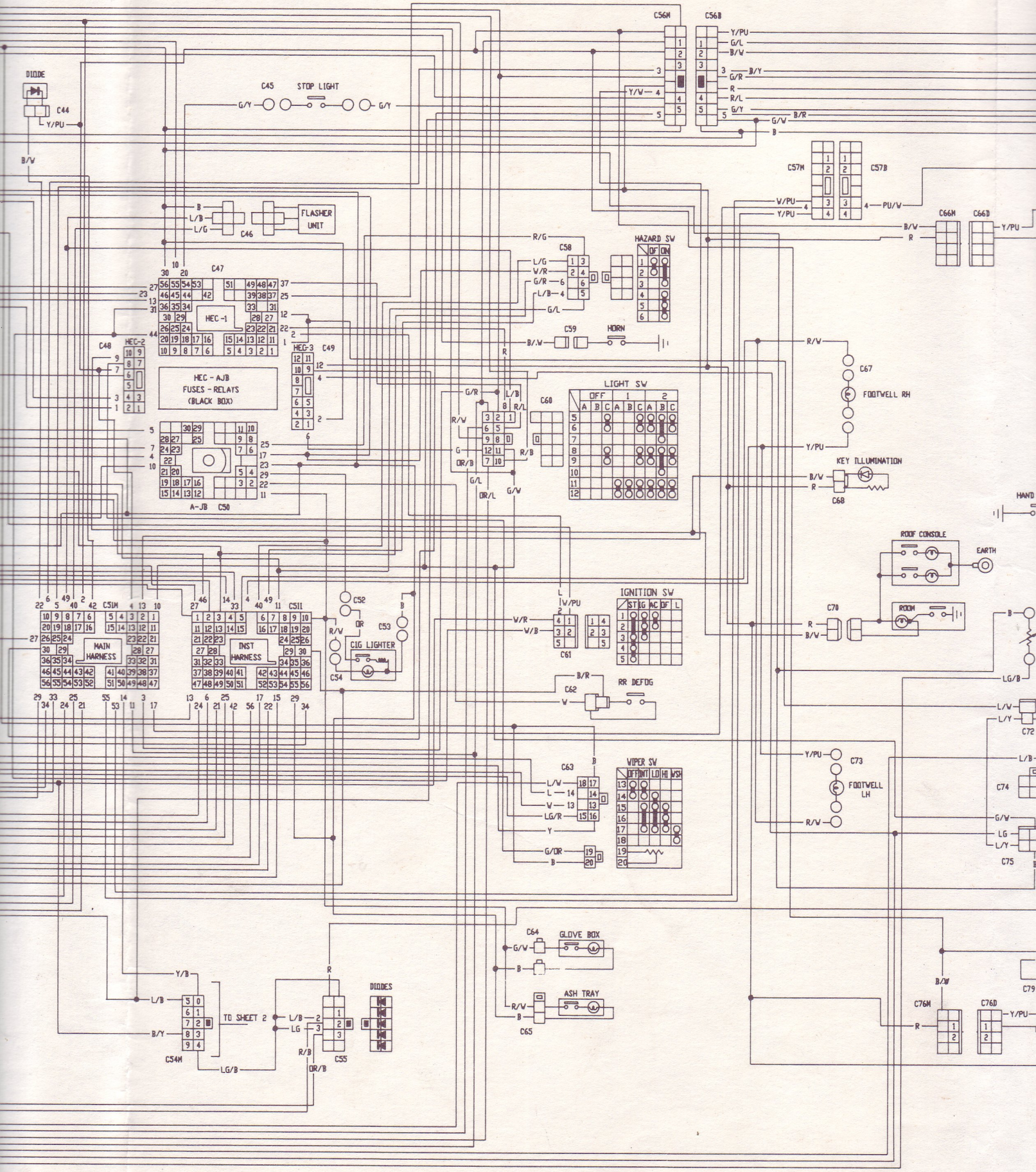
SS OTHERVISE NOTED,WIRE COLORS ON EITHER SIDE OF CONNECTOR JUNCTIONS ARE THE SAME

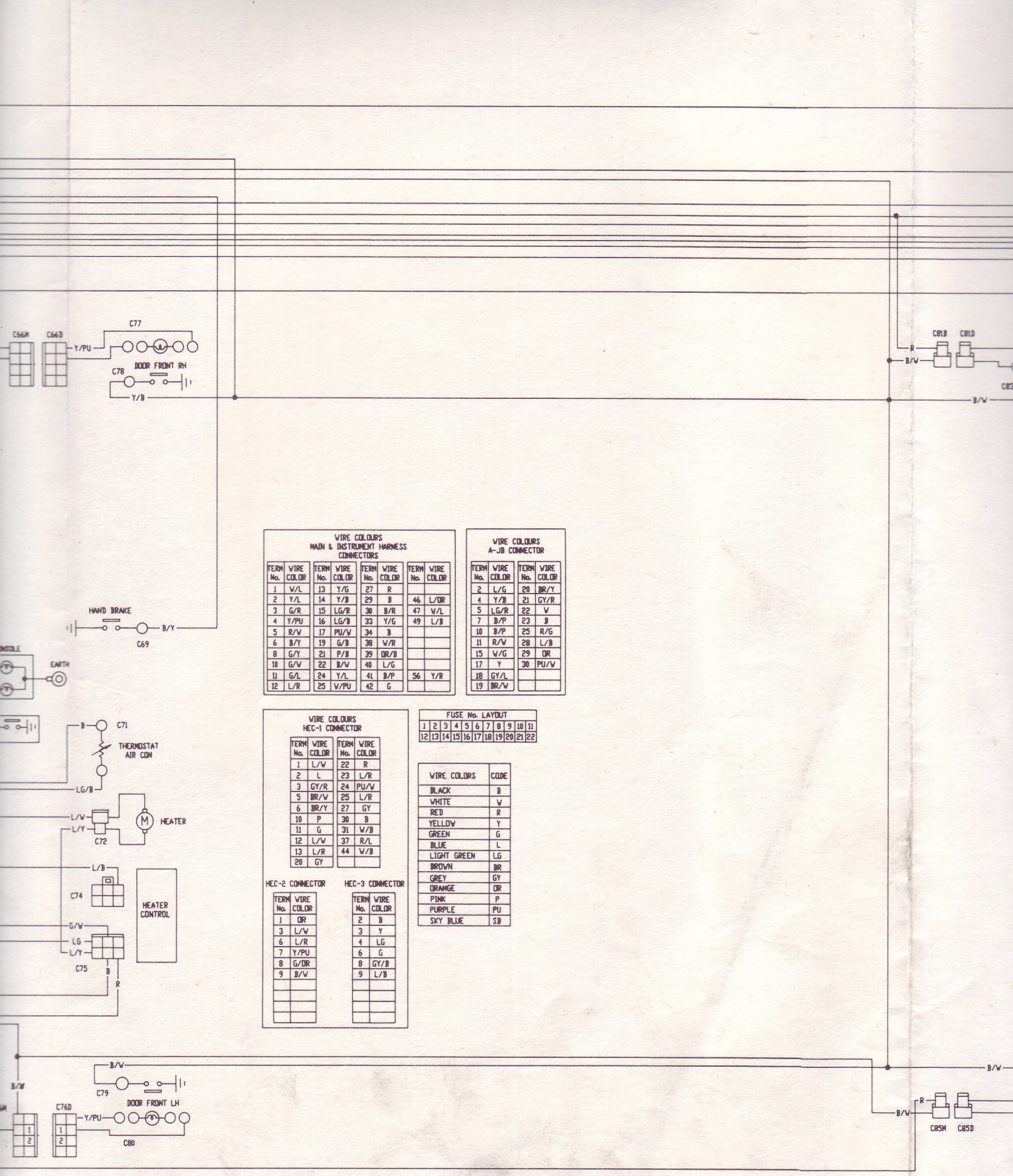
CONNECTORS ARE SHOVN VIEVED FROM THE FRONT (LOOKING AT TERMINALS).

DWG/No. 24005-J7100-22 - M 1


CAR FRONT
RH SIDE TURN
C12
EARTH
C13
G/R
RH CLEAR
C1
G/W
B
TURN
C2
G/R
HEADLAMP HI/LO
C3
R/W
R/B
C14
EARTH
HEADLAMP HI
C4
HORN
C5
HORN
C7
EARTH
C6
AIR CON FAN
C15
L/W
LOW PRESS. SWITCH
C16
G
Y/B
MED.PRESS. SWITCH
C17
W
HEADLAMP HI
C8
OR/B
HEADLAMP HI/LO
C9
OR/L
TURN
C10
G/L
CLEAR LH
C11
SIDE TURN LH
C18
HORN
B/V
C19
G/W
B/CHECK
RELAYS
TO INHIBIT RELAY
P
B
Y
P/B
C20
C21
W/R
W/B
BATTERY
C22
TO SHEET 2
C23
C24
C25
C26
G
BR
FUSIBLE LINKS
HOLDER
W/PU
GY
W/L
C31M
L/B
R/L
W/B
Y/L
C32M
TO SHEET 2
R
Y/G
SPEEDO EARTH
B
C34
AIR CON FAN RELAY
C27
AIR CON RELAY
C28
LG/B
LG
L/W
L
C33A
C33M
WASH MOTOR
C29
L/R
L/W
TO SHEET 2
C30M


BRAKE PRESSURE DIFFERENCE
C43
G
DIODE
C44
Y/PU
B/W
WIPER RELAY
C35
L/R
B
W
LG/R
LG
L/B
WIPER MOTOR
C36
L/R
B
Y
L
C38
DIMM SW
LG/R
B
B/P
BR
DIM
WARNING B
VOLTS
OIL
PARK BRAKE
BRAKE
C39
Y/L
B/Y
P/B
W/PU
G
Y
COMBINATION METER
OIL
TEMP
TURN
ILLUM
REED SW
SPEEDO
10 V
TACHO
HIGH
ILLUM
TURN
FUEL
VOLT
C42
G/R
G/L
L/DR
R/W
R/W
B/P
Y/G
Y
Y/B
B
Y/L
R
W/L
B
Y/G
SPEEDO EARTH
B
C34
G/W
B
C37
AUTO INDICATOR
WARNING A
OD OFF
DEFOG
DOOR
BELTS
FUEL
STOP TAIL
Y/B
C40
B
R
Y/R
Y
C41
P/B
PU/W
B/W
B/R
LG/R
HEC-2
C48
C47
MAIN HARNESS
C51M
C54M
Y/B
L/B
B/Y
TO SHEET 2


DIODE
C44
Y/PU
B/W
C45
STOP LIGHT
G/Y
G/Y
C56M
C56B
Y/PU
G/L
B/W
B/Y
G/R
R
R/L
G/Y
B/R
G/W
B
C57M
C57B
W/PU
Y/PU
PU/W
C66M
C66D
B/W
R
Y/PU
B
L/B
L/G
C46
FLASHER UNIT
C47
HEC-1
HEC-2
HEC-3
C48
C49
HEC - AJB
FUSES - RELAYS
(BLACK BOX)
A-JB C50
R/G
C58
L/G
W/R
G/R
L/B
G/L
HAZARD SW
OFF
ON
B/W
C59
HORN
R
R/W
C67
FOOTWELL RH
Y/PU
LIGHT SW
OFF
1
2
A B C A B C A B C
G/R
L/B
R/L
R/W
G
DR/B
G/L
DR/L
G/W
R/B
C60
KEY ILLUMINATION
B/W
R
C68
HAND
ROOF CONSOLE
EARTH
ROOM
C70
R
B/W
B
LG/B
C52
DR
C53
R/W
C54
CIG LIGHTER
IGNITION SW
ST IG AC DF L
L
W/PU
W/R
W/B
C61
B/R
C62
W
RR DEFOG
L/W
L/Y
C72
L/B
C74
G/W
LG
L/Y
C75
C63
L/W
L
W
LG/R
Y
G/OR
B
WIPER SW
OFF INT LO HI WSH
Y/PU
C73
FOOTWELL LH
R/W
MAIN HARNESS
C51M
INST HARNESS
C51I
C64
GLOVE BOX
G/W
B
R/W
B
ASH TRAY
C65
Y/B
L/B
B/Y
LG/B
C54M
TO SHEET 2
L/B
LG
R/B
DR/B
C55
R
DIODES
C79
B/W
C76M
R
C76D
Y/PU



WIRE COLOURS
MAIN & INSTRUMENT HARNESS CONNECTORS

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR	TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
1	W/L	13	Y/G	27	R		
2	Y/L	14	Y/B	29	B	46	L/OR
3	G/R	15	LG/R	30	B/R	47	W/L
4	Y/PU	16	LG/B	33	Y/G	49	L/B
5	R/W	17	PU/W	34	B		
6	B/Y	19	G/B	38	W/R		
8	G/Y	21	P/B	39	OR/B		
10	G/W	22	B/W	40	L/G		
11	G/L	24	Y/L	41	B/P	56	Y/R
12	L/R	25	W/PU	42	G		

WIRE COLOURS
A-JB CONNECTOR

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
2	L/G	20	BR/Y
4	Y/B	21	GY/R
5	LG/R	22	W
7	B/P	23	B
10	B/P	25	R/G
11	R/W	28	L/B
15	W/G	29	OR
17	Y	30	PU/W
18	GY/L		
19	BR/W		

WIRE COLOURS
HEC-1 CONNECTOR

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
1	L/W	22	R
2	L	23	L/R
3	GY/R	24	PU/W
5	BR/W	25	L/R
6	BR/Y	27	GY
10	P	30	B
11	G	31	W/B
12	L/W	37	R/L
13	L/R	44	W/B
20	GY		

HEC-2 CONNECTOR

TERM No.	WIRE COLOR
1	OR
3	L/W
6	L/R
7	Y/PU
8	G/OR
9	B/W

HEC-3 CONNECTOR

TERM No.	WIRE COLOR
2	B
3	Y
4	LG
6	G
8	GY/B
9	L/B

FUSE No. LAYOUT

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22

WIRE COLORS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB

SYMBOL	DESCRIPTION
	EARTH
	SWITCH
	BULB

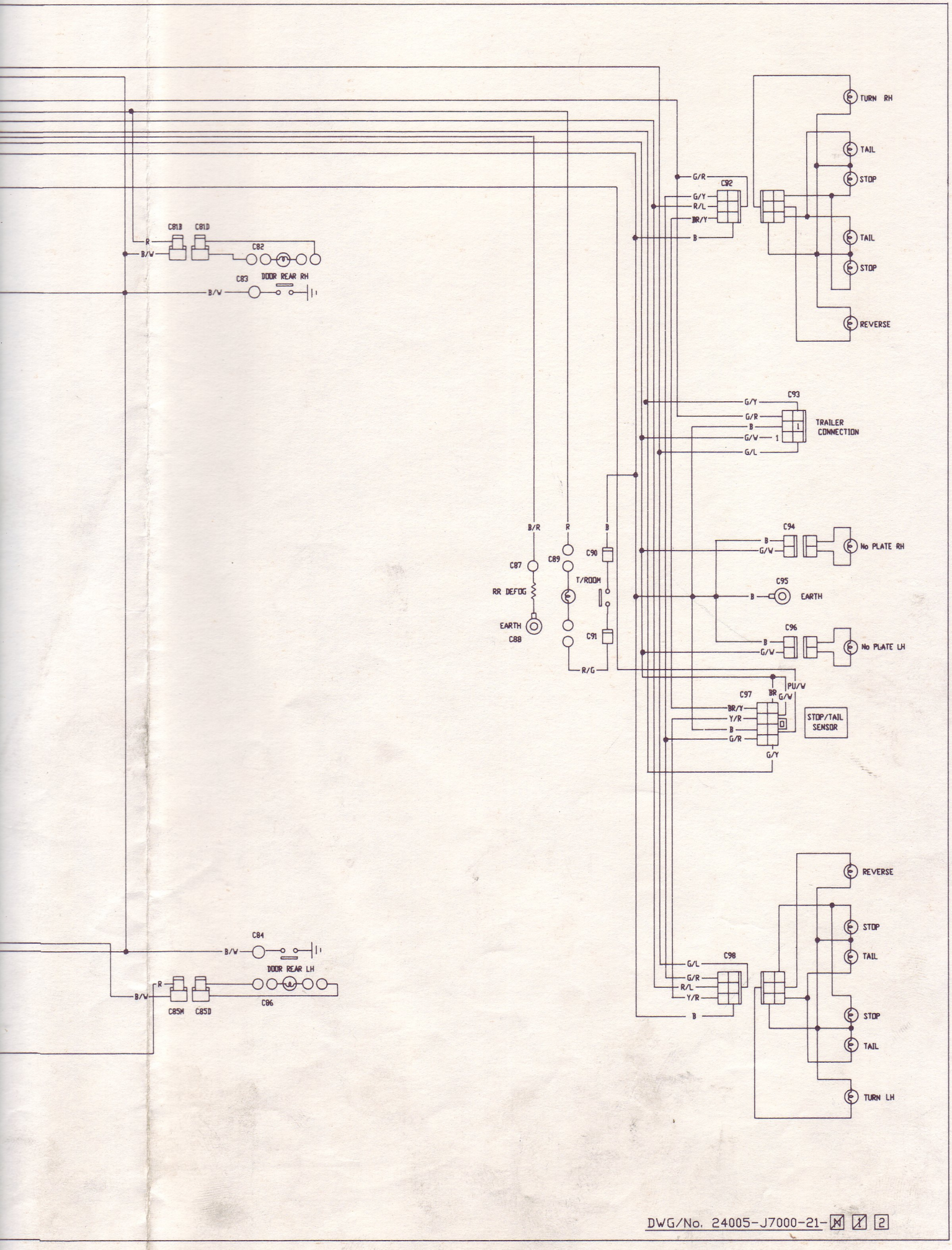
AD41 4-CYL AUTO SEDAN ELECTRICAL SCHEMATIC SHEET 1

BY K.T.R.

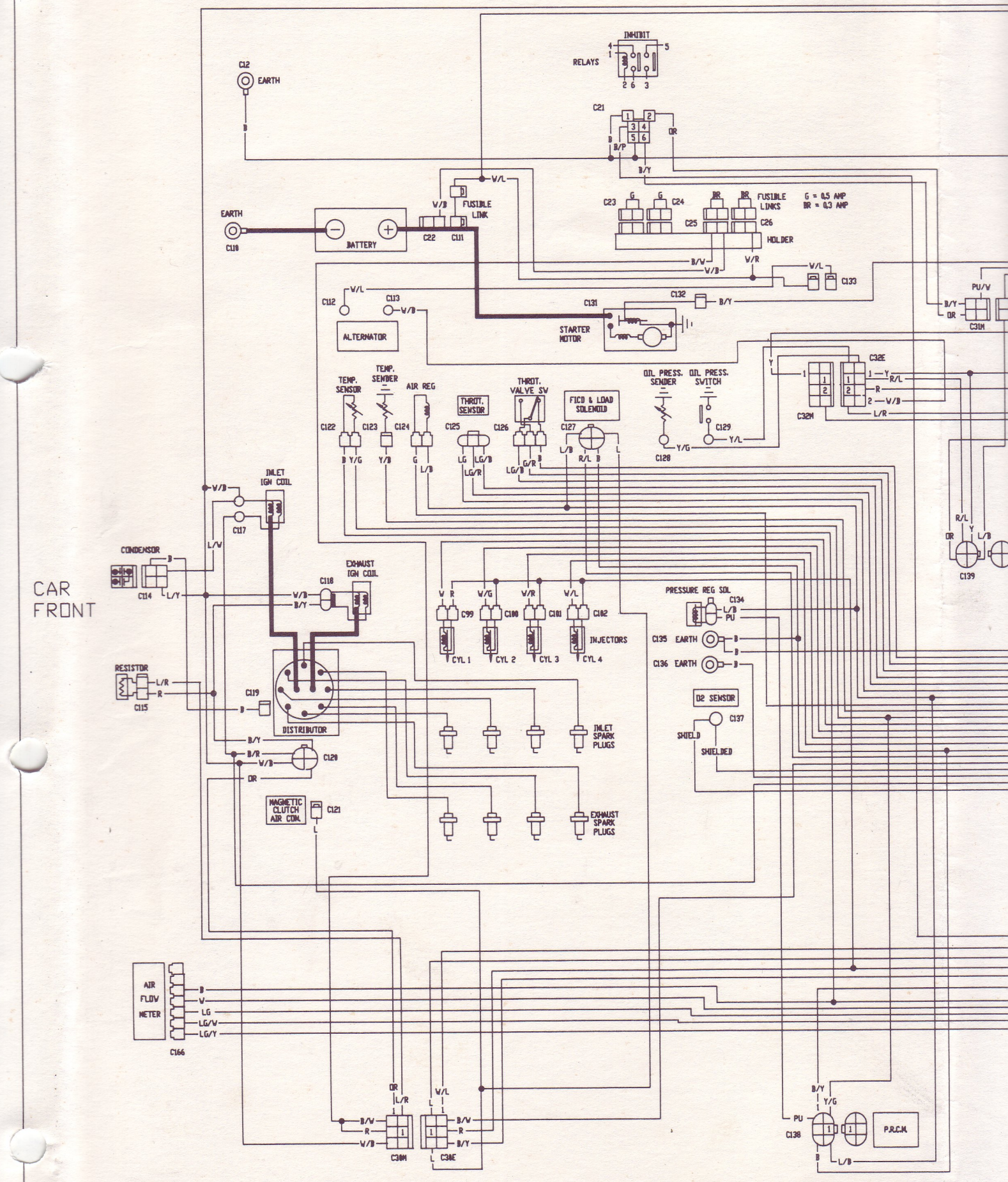
FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 2.

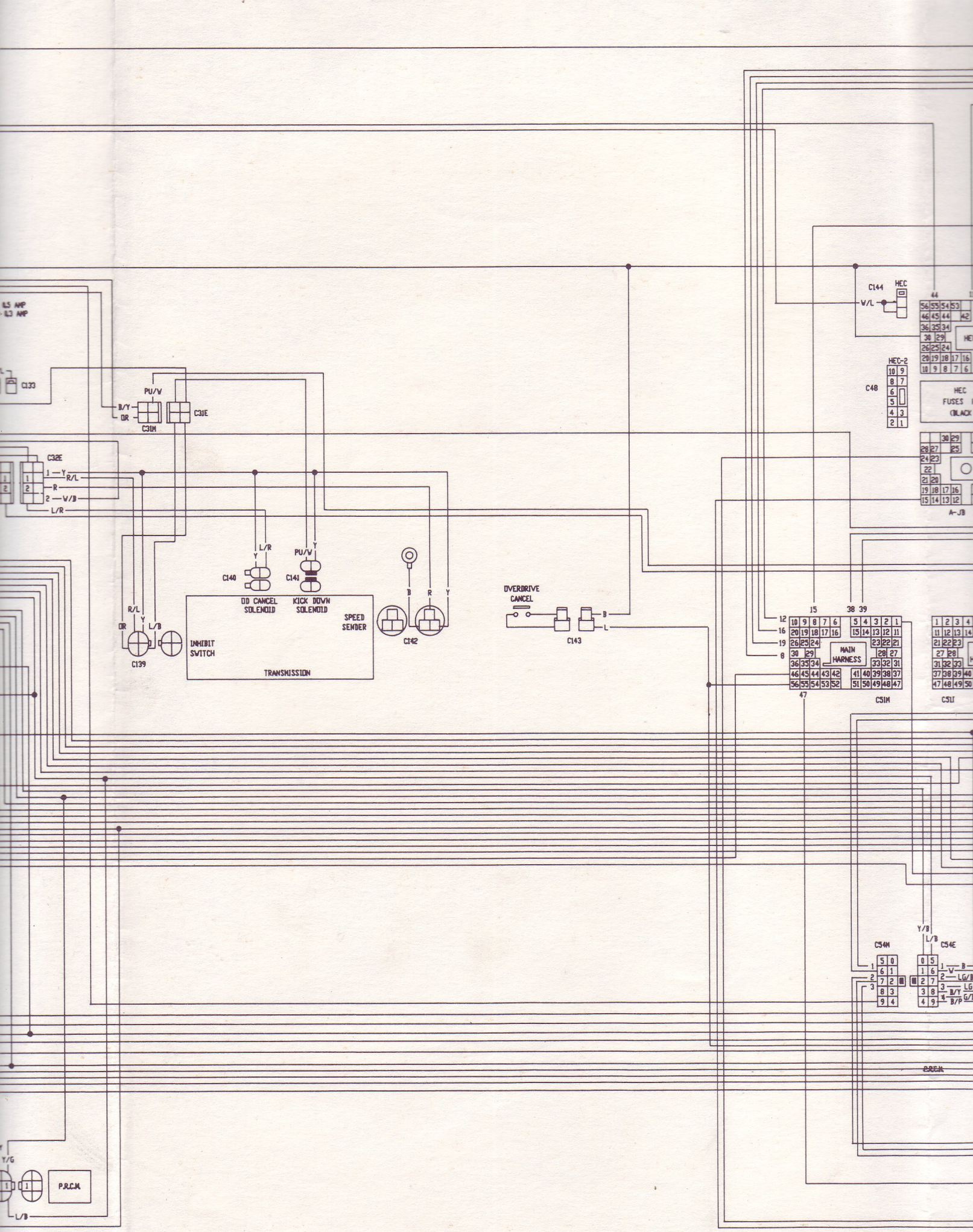
UNLESS OTHERWISE NOTED WIRE COLOURS ON EITHER SIDE OF CONNECTOR ARE THE SAME

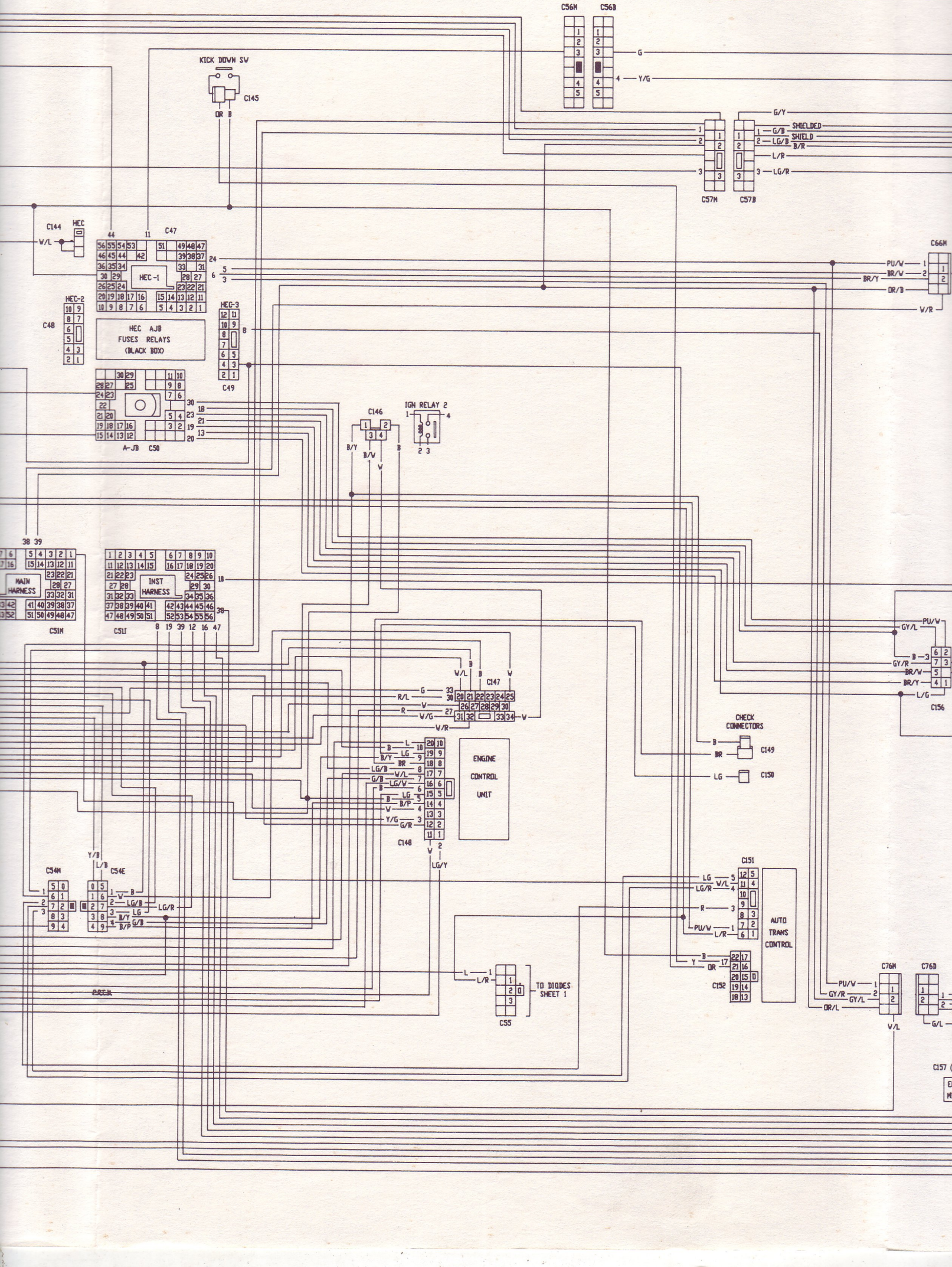
ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS)

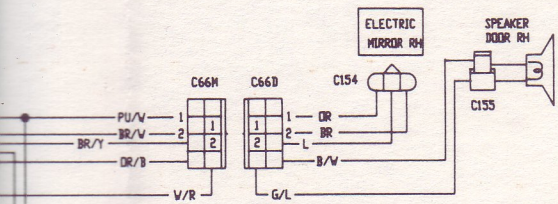


DWG/No. 24005-J7000-21-M 1 2

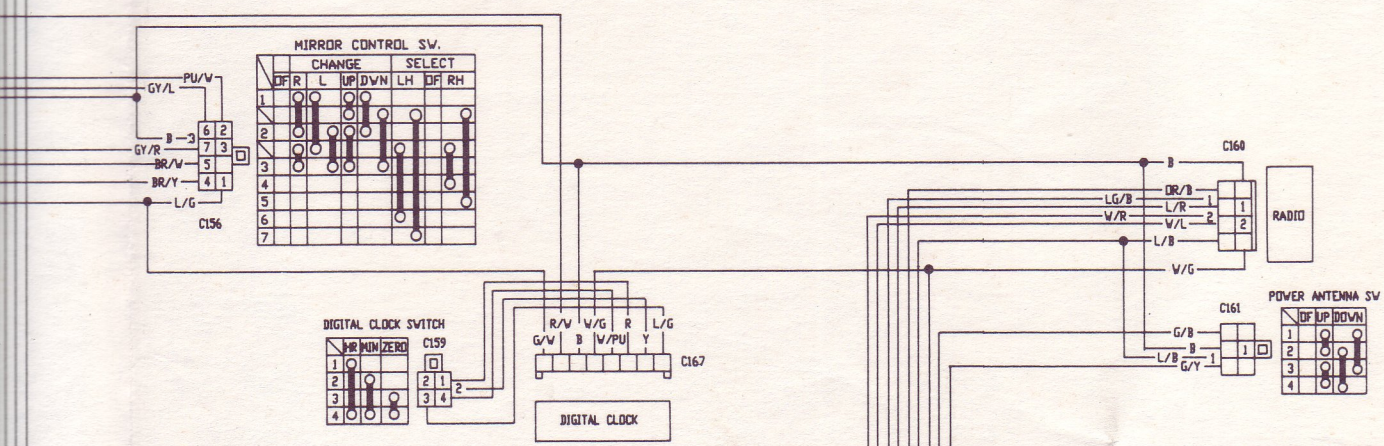

CAR FRONT
INHIBIT RELAYS
C12 EARTH
C21
EARTH C10
BATTERY
C22 C11
FUSIBLE LINK
FUSIBLE LINKS
G = 0.5 AMP
BR = 0.3 AMP
C23 C24 C25 C26
HOLDER
C133
C112 C113
ALTERNATOR
C131 C132
STARTER MOTOR
C31M
C32E C32M
TEMP. SENSOR
TEMP. SENDER
AIR REG
THROT. SENSOR
THROT. VALVE SW
FICD & LOAD SOLENOID
OIL PRESS. SENDER
OIL PRESS. SWITCH
C122 C123 C124 C125 C126 C127 C128 C129
C139
INLET IGN COIL
C117
CONDENSOR C114
EXHAUST IGN COIL
C118
C99 C100 C101 C102
INJECTORS
CYL 1 CYL 2 CYL 3 CYL 4
PRESSURE REG SOL
C134
C135 EARTH
C136 EARTH
RESISTOR C115
C119
DISTRIBUTOR
INLET SPARK PLUGS
EXHAUST SPARK PLUGS
O2 SENSOR
C137
SHIELD
SHIELDED
C120
MAGNETIC CLUTCH AIR CON.
C121
AIR FLOW METER
C166
C30M C30E
C138
P.R.C.M.

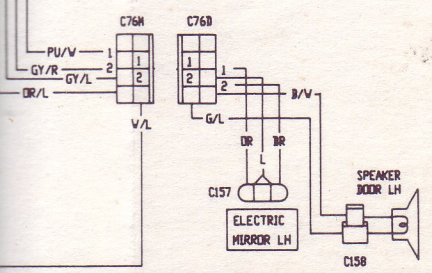

C144
HEC
W/L
HEC-2
C48
HEC FUSES (BLACK
A-JB
C133
PU/V
B/Y
DR
C31M
C31E
C32E
1 — Y
R/L
R
2 — V/B
L/R
C140
C141
L/R
Y
PU/V
Y
OD CANCEL SOLENOID
KICK DOWN SOLENOID
SPEED SENDER
INHIBIT SWITCH
TRANSMISSION
C139
R/L
Y
L/B
DR
B
R
Y
C142
OVERDRIVE CANCEL
B
L
C143
MAIN HARNESS
C51M
C51L
C54M
C54E
Y/B
L/B
1 — V — B
2 — LG/B
3 — B/Y LG/
4 — B/P
P.R.C.M.
Y/G
L/B
P.R.C.M.


C56M
C56B
G
Y/G
KICK DOWN SW
C145
DR
B
C57M
C57B
G/Y
SHIELDED
G/B
SHIELD
LG/B
B/R
L/R
LG/R
C144
HEC
W/L
C47
HEC-1
HEC-2
C48
HEC-3
C49
HEC AJB
FUSES RELAYS
(BLACK BOX)
A-JB C50
C66M
PU/W
BR/W
BR/Y
DR/B
W/R
C146
IGN RELAY 2
B/Y
B/W
W
B
C147
G
R/L
V
R
W/G
W/R
ENGINE
CONTROL
UNIT
C148
CHECK
CONNECTORS
C149
C150
C151
AUTO
TRANS
CONTROL
C152
C54M
C54E
Y/B
L/B
LG/R
C55
TO DIODES
SHEET 1
MAIN
HARNESS
C51M
INST
HARNESS
C51I
C156
GY/L
GY/R
L/G
C76M
C76B
PU/W
GY/R
GY/L
DR/L
W/L
G/L
C157



WIRE COLOURS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB

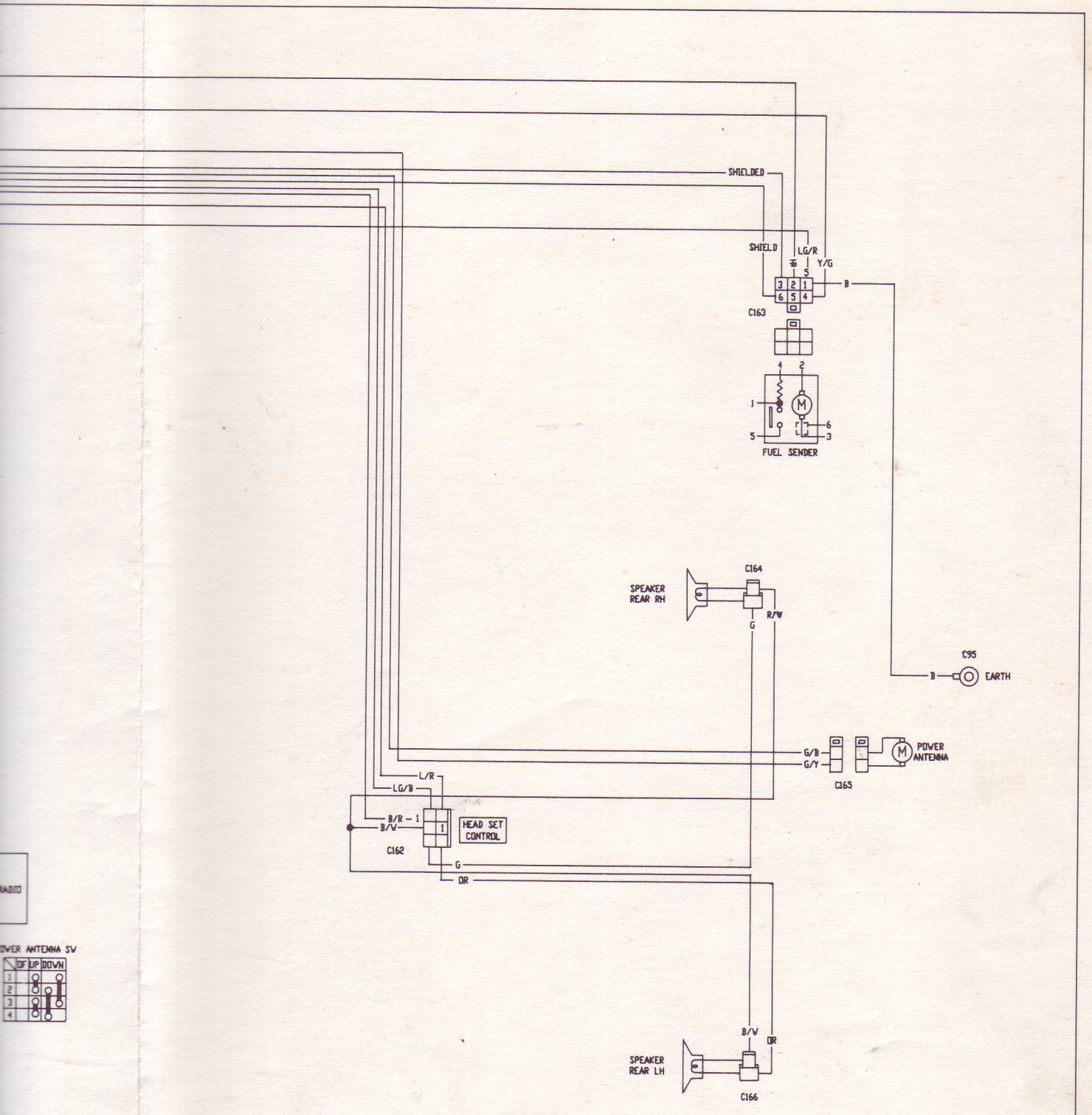




SYMBOL	DESCRIPTION
	EARTH
	SWITCH

AD41 4-CYL AUTO SEDAN ELECTRIC

FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 1
UNLESS OTHERWISE NOTED,WIRE COLORS ON EITHER SIDE OF CONNECTO
ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING



RADIO

OWER ANTENNA SW

	OFF	UP	DOWN
1			
2			
3			
4			

4-CYL AUTO SEDAN ELECTRICAL SCHEMATIC SHEET 2

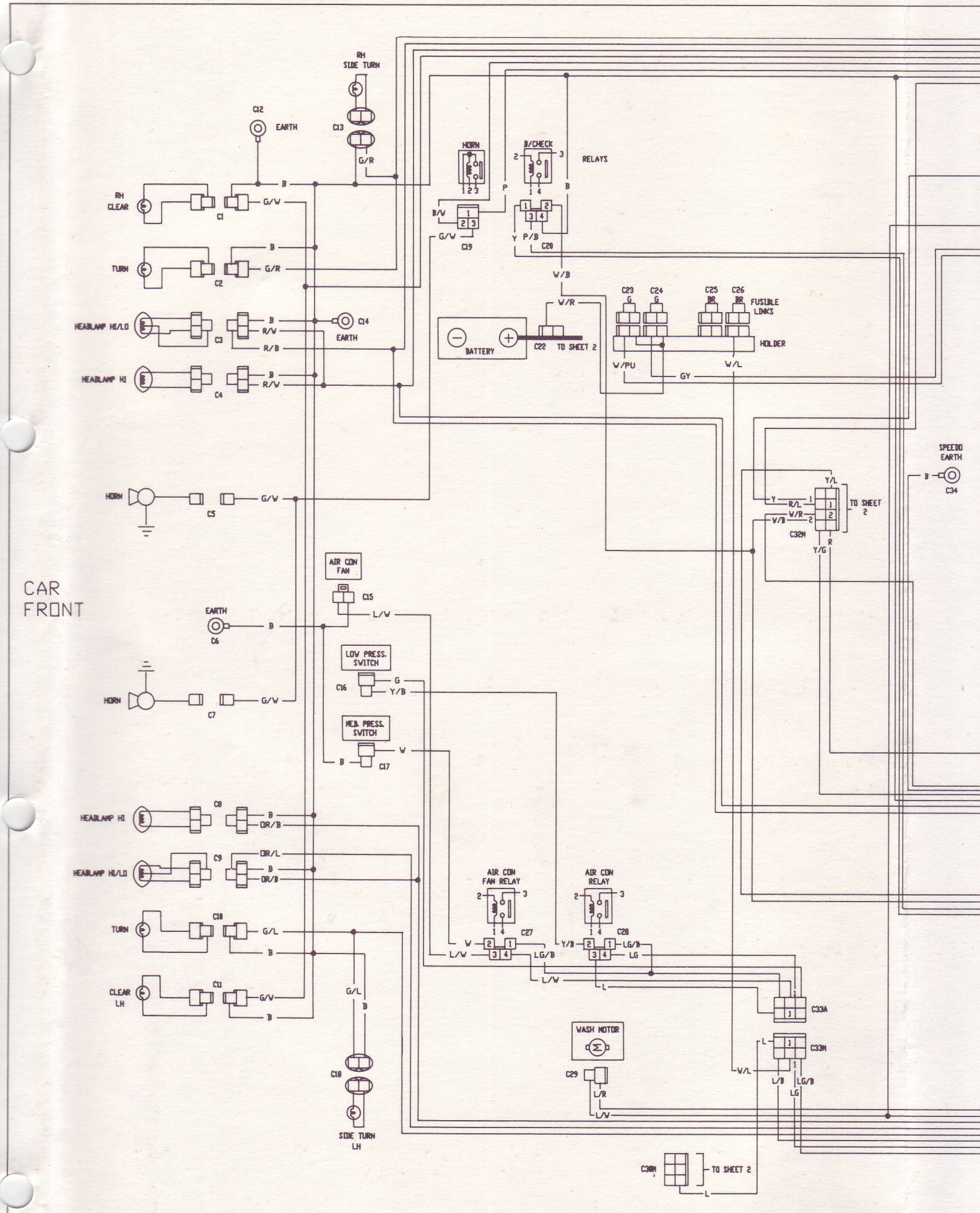
BY K.T.R.

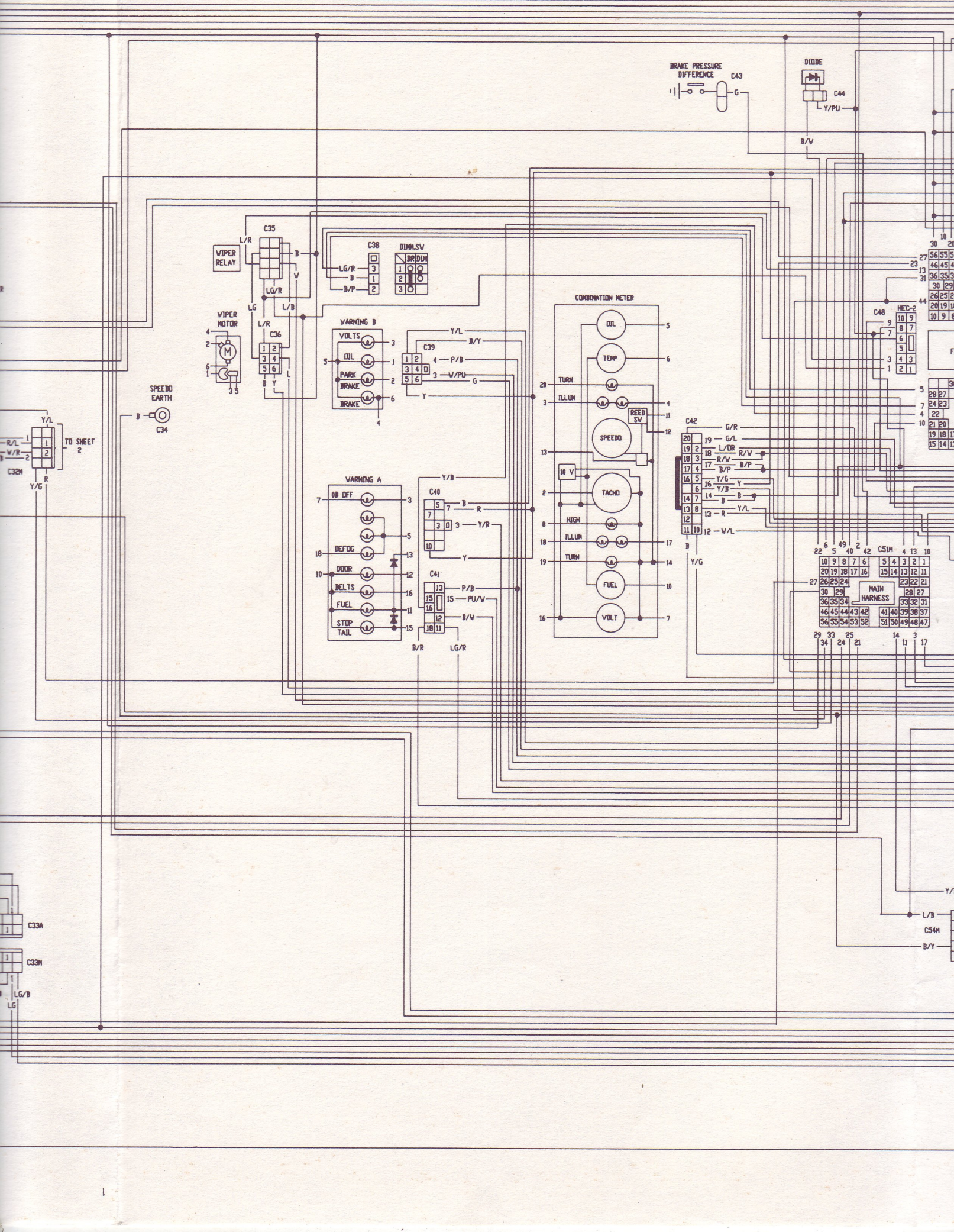
NNECTIONS NOT MADE ON THIS SHEET SEE SHEET 1

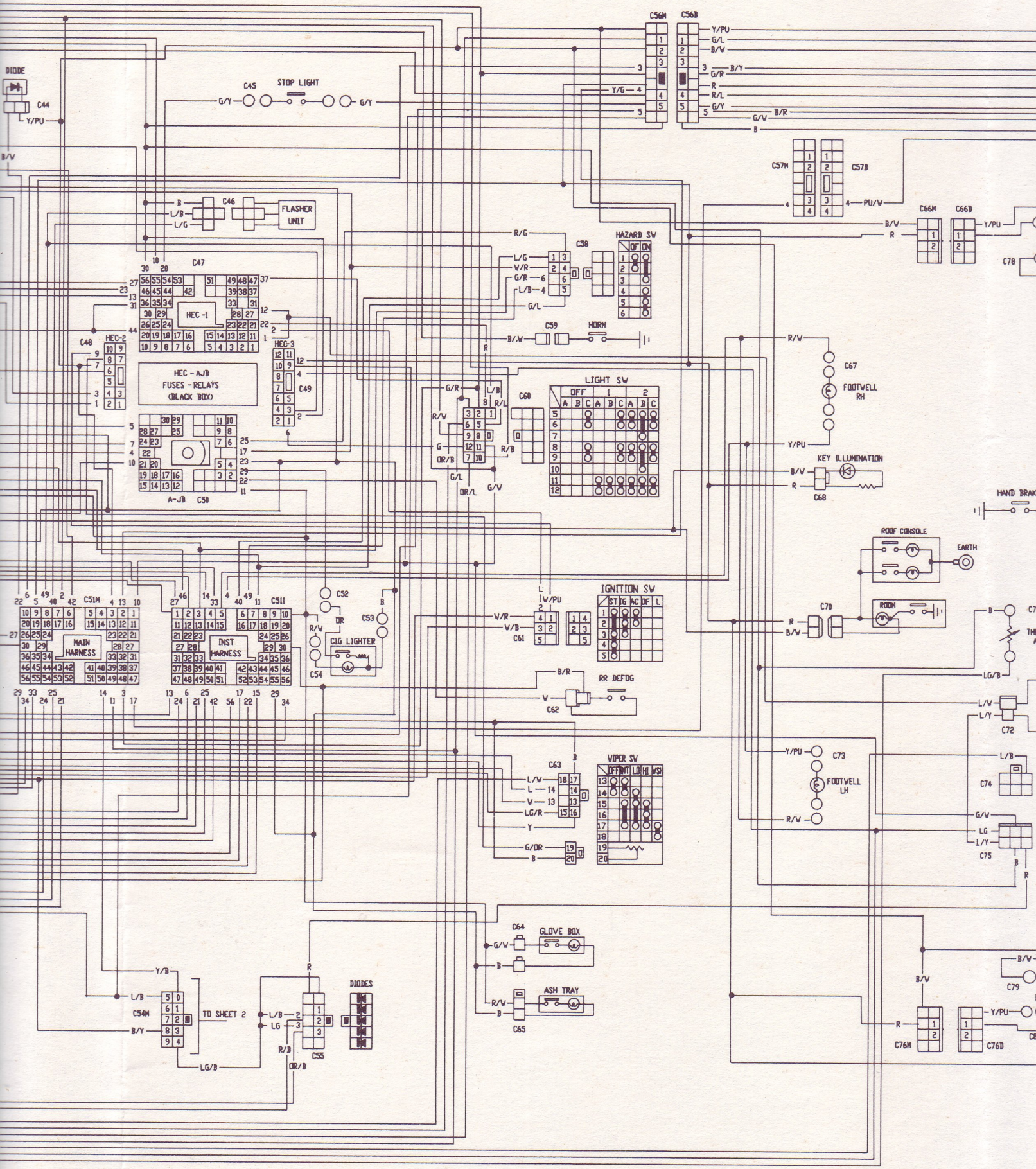
OTHERWISE NOTED,WIRE COLORS ON EITHER SIDE OF CONNECTOR JUNCTIONS ARE THE SAME

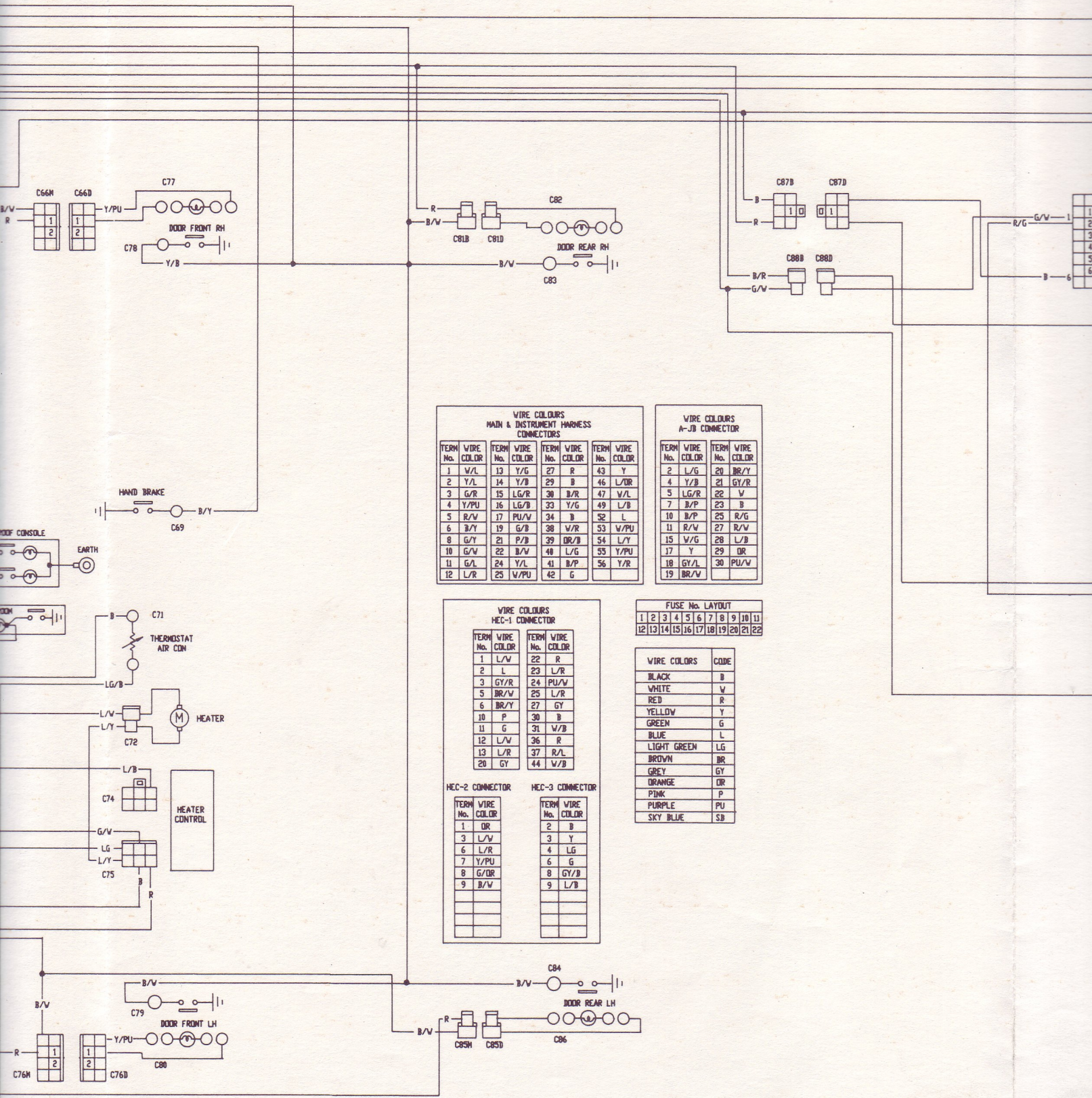
NECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS).

DWG/No. 24005-J7000-22- M 1


CAR FRONT
RH SIDE TURN
C13
G/R
C12
EARTH
B
RH CLEAR
C1
G/W
TURN
C2
HEADLAMP HI/LO
C3
R/W
R/B
C14
EARTH
HEADLAMP HI
C4
HORN
C5
HORN
C7
EARTH
C6
AIR CON FAN
C15
L/W
LOW PRESS. SWITCH
C16
G
Y/B
HIGH PRESS. SWITCH
C17
W
HEADLAMP HI
C8
OR/B
HEADLAMP HI/LO
C9
OR/L
TURN
C10
G/L
CLEAR LH
C11
G/W
C18
SIDE TURN LH
HORN
B/W
C19
B/CHECK
RELAYS
P
Y
P/B
C20
W/B
W/R
BATTERY
C22
TO SHEET 2
C23
C24
C25
C26
FUSIBLE LINKS
HOLDER
W/PU
GY
W/L
SPEEDO EARTH
C34
Y/L
R/L
W/B
C32M
TO SHEET 2
R
Y/G
AIR CON FAN RELAY
C27
AIR CON RELAY
C28
LG/B
LG
C33A
C33M
L/B
WASH MOTOR
C29
L/R
C30M
TO SHEET 2


BRAKE PRESSURE DIFFERENCE
C43
G
DIODE
C44
Y/PU
B/V
C35
WIPER RELAY
L/R
B
W
LG/R
LG
L/B
C38
DIM.SW
BR
DIM
LG/R
B
B/P
WIPER MOTOR
C36
L/R
B
Y
L
WARNING B
VOLTS
OIL
PARK BRAKE
BRAKE
C39
Y/L
B/Y
P/B
W/PU
G
Y
SPEEDO EARTH
B
C34
COMBINATION METER
OIL
TEMP
TURN
ILLUM
SPEEDO
REED SW
TACHO
HIGH
ILLUM
TURN
FUEL
VOLT
10 V
WARNING A
OD OFF
DEFOG
DOOR
BELTS
FUEL
STOP TAIL
C40
B
R
Y/R
Y
C41
P/B
PU/W
B/W
B/R
LG/R
C42
G/R
G/L
L/OR
R/W
R/W
B/P
B/P
Y/G
Y
Y/B
B
B
R
Y/L
W/L
B
Y/G
C48
HEC-2
C51M
MAIN HARNESS
C32M
Y/L
R/L
W/R
R
Y/G
TO SHEET 2
C33A
C33M
LG/B
LG
L/B
C54M
B/Y


DIODE
C44
Y/PU
B/W
C45
STOP LIGHT
G/Y
G/Y
C46
FLASHER UNIT
B
L/B
L/G
C47
HEC-1
HEC-2
HEC-3
C48
C49
HEC - AJB
FUSES - RELAYS
(BLACK BOX)
A-JB
C50
C51M
MAIN HARNESS
C51I
INST HARNESS
C52
C53
CIG LIGHTER
C54
C54M
TO SHEET 2
LG/B
C55
DIODES
C56M
C56I
Y/PU
G/L
B/W
B/Y
G/R
R
R/L
G/Y
B/R
G/W
B
C57M
C57I
PU/W
C58
HAZARD SW
OFF
ON
C59
HORN
C60
LIGHT SW
OFF
1
2
C61
IGNITION SW
ST
IG
AC
DF
L
C62
RR DEFOG
C63
WIPER SW
OFF
INT
LO
HI
WSH
C64
GLOVE BOX
C65
ASH TRAY
C66M
C66I
C67
FOOTWELL RH
KEY ILLUMINATION
C68
HAND BRAKE
ROOF CONSOLE
EARTH
C70
ROOM
C72
C73
FOOTWELL LH
C74
C75
C76M
C76I
C78
C79



WIRE COLOURS
MAIN & INSTRUMENT HARNESS CONNECTORS

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR	TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
1	W/L	13	Y/G	27	R	43	Y
2	Y/L	14	Y/B	29	B	46	L/OR
3	G/R	15	LG/R	30	B/R	47	W/L
4	Y/PU	16	LG/B	33	Y/G	49	L/B
5	R/W	17	PU/W	34	B	52	L
6	B/Y	19	G/B	38	W/R	53	W/PU
8	G/Y	21	P/B	39	OR/B	54	L/Y
10	G/W	22	B/W	40	L/G	55	Y/PU
11	G/L	24	Y/L	41	B/P	56	Y/R
12	L/R	25	W/PU	42	G		

WIRE COLOURS
A-JB CONNECTOR

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
2	L/G	20	BR/Y
4	Y/B	21	GY/R
5	LG/R	22	W
7	B/P	23	B
10	B/P	25	R/G
11	R/W	27	R/W
15	W/G	28	L/B
17	Y	29	OR
18	GY/L	30	PU/W
19	BR/W		

WIRE COLOURS
HEC-1 CONNECTOR

TERM No.	WIRE COLOR	TERM No.	WIRE COLOR
1	L/W	22	R
2	L	23	L/R
3	GY/R	24	PU/W
5	BR/W	25	L/R
6	BR/Y	27	GY
10	P	30	B
11	G	31	W/B
12	L/W	36	R
13	L/R	37	R/L
20	GY	44	W/B

HEC-2 CONNECTOR

TERM No.	WIRE COLOR
1	OR
3	L/W
6	L/R
7	Y/PU
8	G/OR
9	B/W

HEC-3 CONNECTOR

TERM No.	WIRE COLOR
2	B
3	Y
4	LG
6	G
8	GY/B
9	L/B

FUSE No. LAYOUT

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22

WIRE COLORS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB

SYMBOL	DESCRIPTION
	EARTH
	SWITCH
	BULB

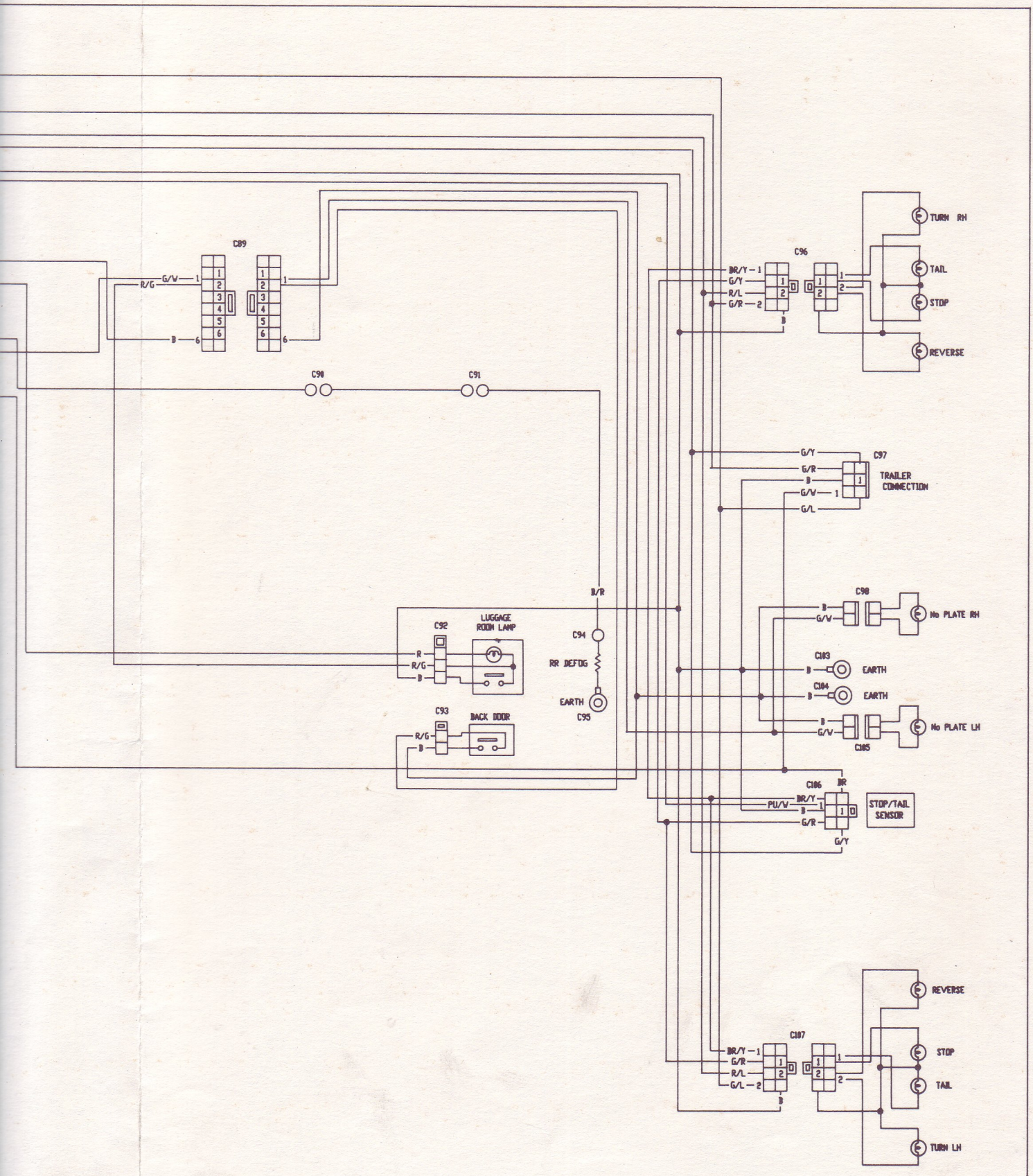
AD41 4-CYL MANUAL WAGON ELECTRICAL SCHEMATIC SHEET 1

BY K.T.R.

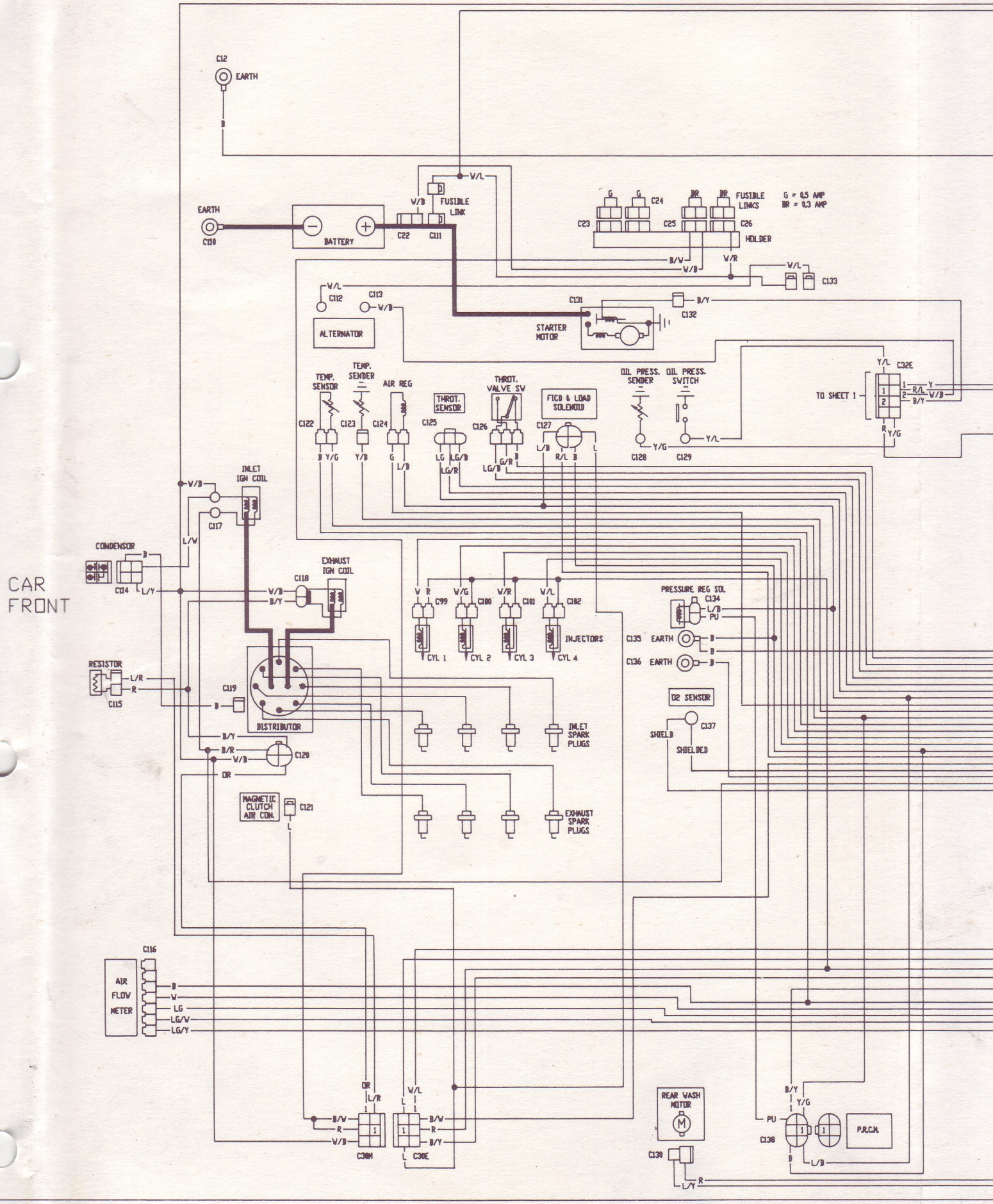
FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 2.

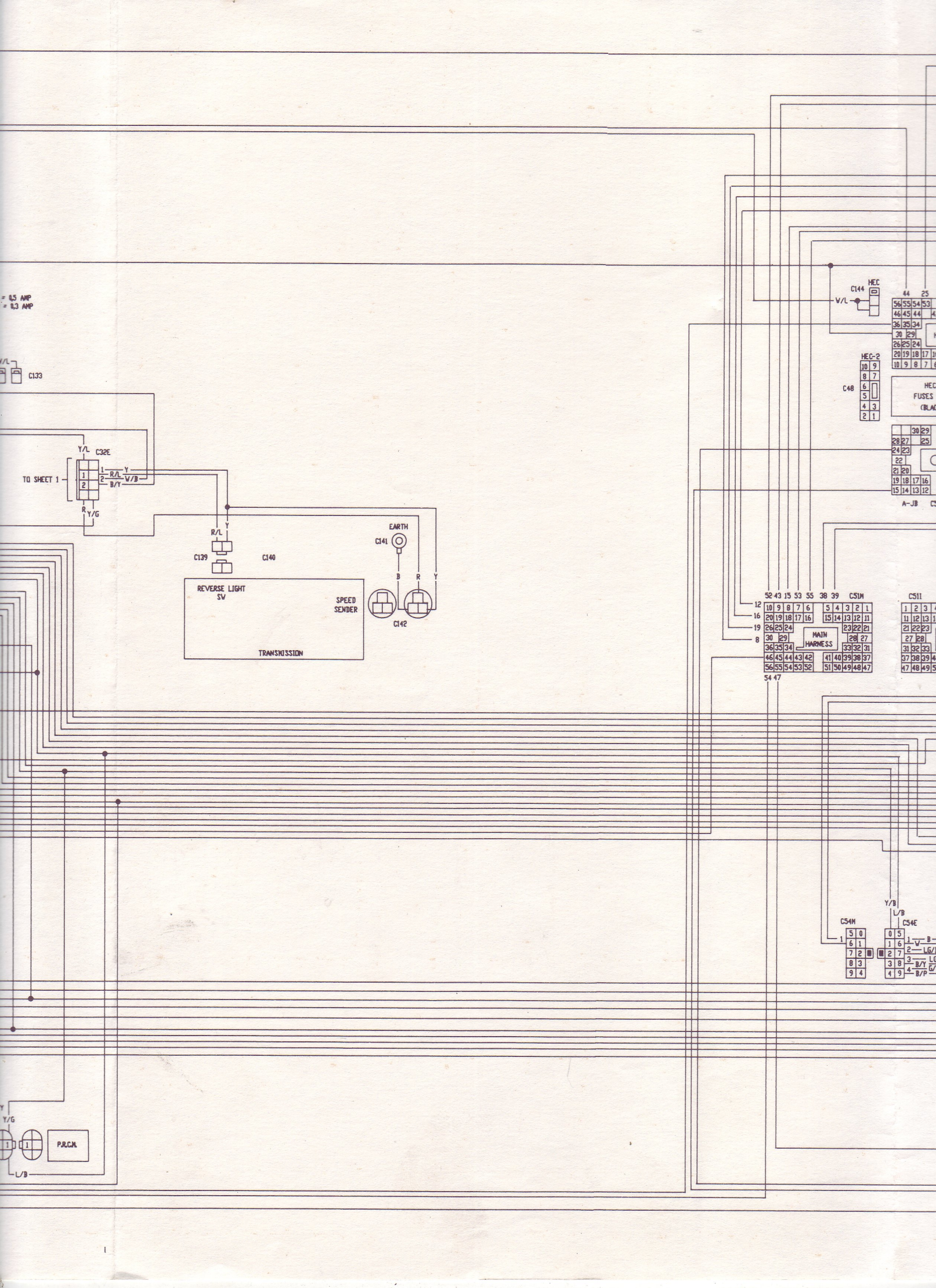
UNLESS OTHERVISE NOTED WIRE COLOURS ON EITHER SIDE OF CONNECTOR JUNCTIONS ARE THE SAME

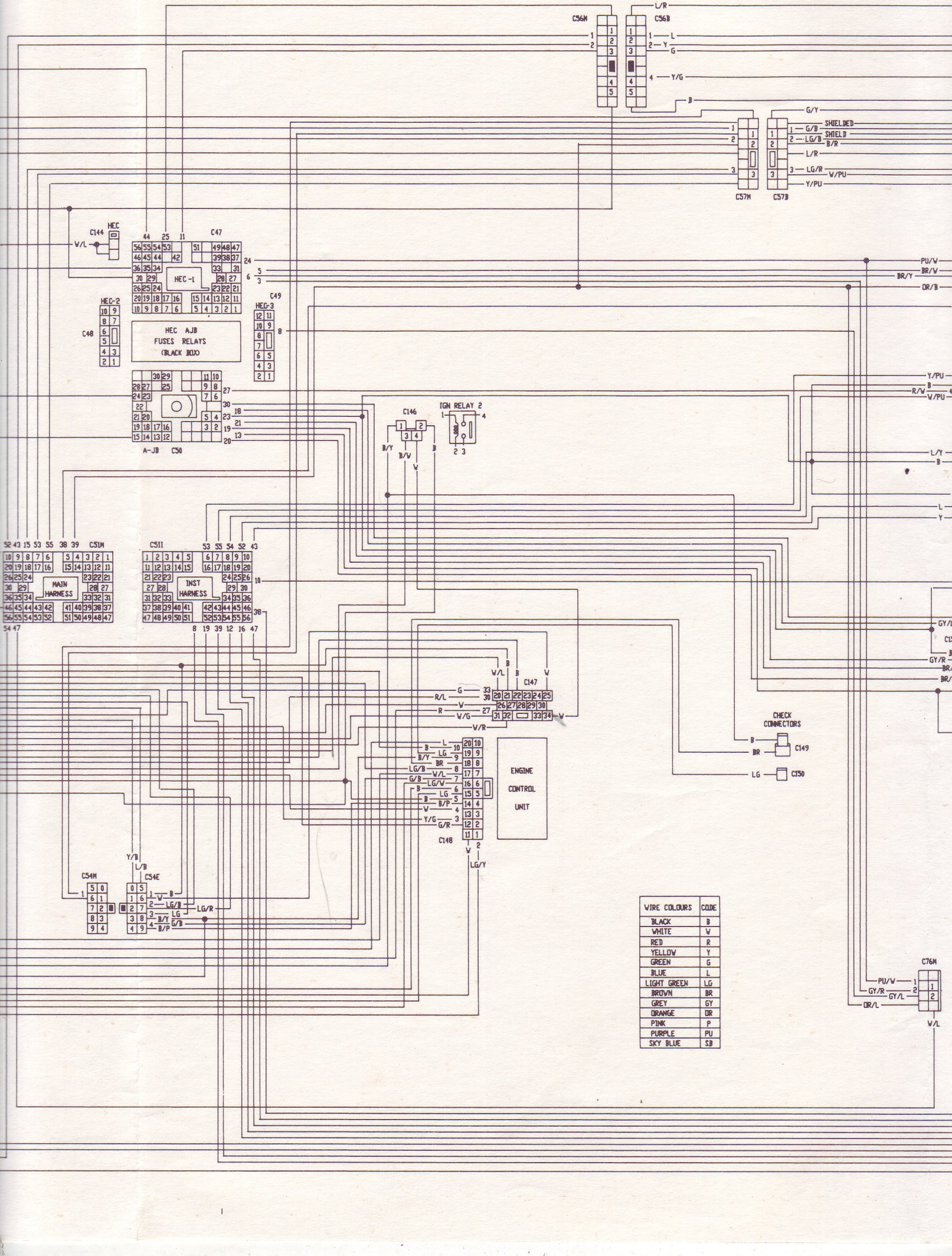
ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS).



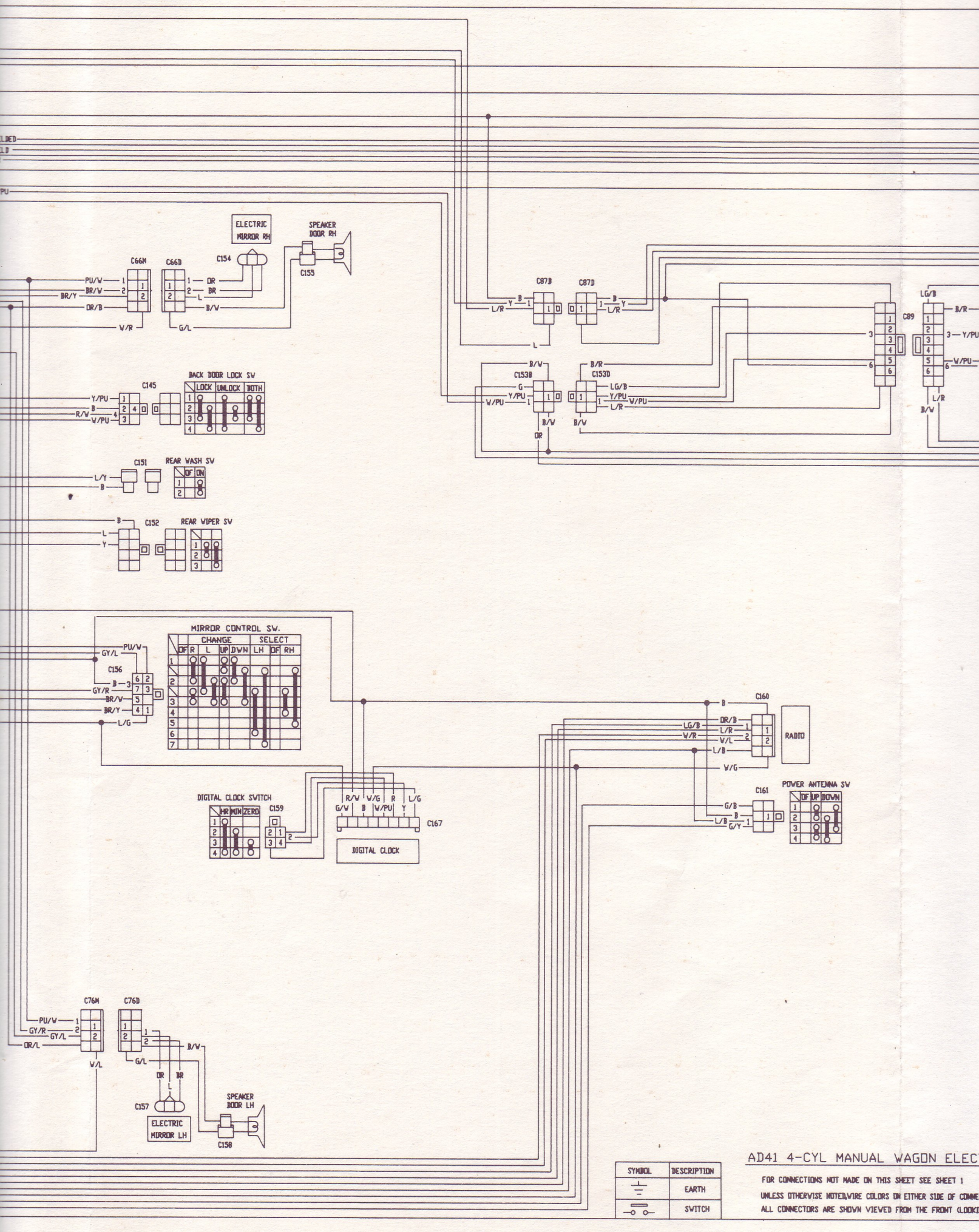
DWG/No. 24005-J7001-21-M 2


CAR FRONT
C12
EARTH
B
EARTH
C10
BATTERY
W/L
W/B
FUSIBLE LINK
C22
C11
G
G
C24
BR
BR
FUSIBLE LINKS
G = 0,5 AMP
BR = 0,3 AMP
C23
C25
C26
HOLDER
B/W
W/B
W/R
W/L
C133
W/L
C112
C113
W/B
ALTERNATOR
C131
B/Y
C132
STARTER MOTOR
Y/L
C32E
TO SHEET 1
1
2
R/L
W/B
B/Y
R
Y/G
TEMP. SENSOR
TEMP. SENDER
AIR REG
THROT. SENSOR
THROT. VALVE SW
FICD & LOAD SOLENOID
OIL PRESS. SENDER
OIL PRESS. SWITCH
C122
C123
C124
C125
C126
C127
C128
C129
B Y/G
Y/B
G
L/B
LG
LG/B
LG/R
G/R
B
LG/B
L/B
R/L
B
L
Y/G
Y/L
INLET IGN COIL
W/B
C117
L/W
CONDENSOR
B
C114
L/Y
EXHAUST IGN COIL
C118
W/B
B/Y
W R
W/G
W/R
W/L
C99
C100
C101
C102
CYL 1
CYL 2
CYL 3
CYL 4
INJECTORS
PRESSURE REG SOL
C134
L/B
PU
C135
EARTH
B
B
C136
EARTH
B
RESISTOR
L/R
R
C115
C119
B
DISTRIBUTOR
B/Y
B/R
W/B
C120
DR
MAGNETIC CLUTCH AIR CON.
C121
L
INLET SPARK PLUGS
EXHAUST SPARK PLUGS
O2 SENSOR
C137
SHIELD
SHIELDED
C116
AIR FLOW METER
B
W
LG
LG/W
LG/Y
DR
L/R
W/L
B/W
R
W/B
B/Y
C30M
C30E
REAR WASH MOTOR
M
C130
R
L/Y
B/Y
Y/G
PU
C138
P.R.C.M.
B
L/B


= 0,5 AMP
= 0,3 AMP
C133
Y/L
C32E
TO SHEET 1
1
2
R/L
B/Y
Y
V/B
R
Y/G
R/L
Y
C139
C140
REVERSE LIGHT SW
SPEED SENDER
TRANSMISSION
EARTH
C141
B
R
Y
C142
P.R.C.M.
L/B
C144
HEC
V/L
HEC-2
C48
FUSES
A-JB
52 43 15 53 55 38 39
C51M
MAIN HARNESS
54 47
C511
Y/B
L/B
C54M
C54E



WIRE COLOURS	CODE
BLACK	B
WHITE	W
RED	R
YELLOW	Y
GREEN	G
BLUE	L
LIGHT GREEN	LG
BROWN	BR
GREY	GY
ORANGE	OR
PINK	P
PURPLE	PU
SKY BLUE	SB



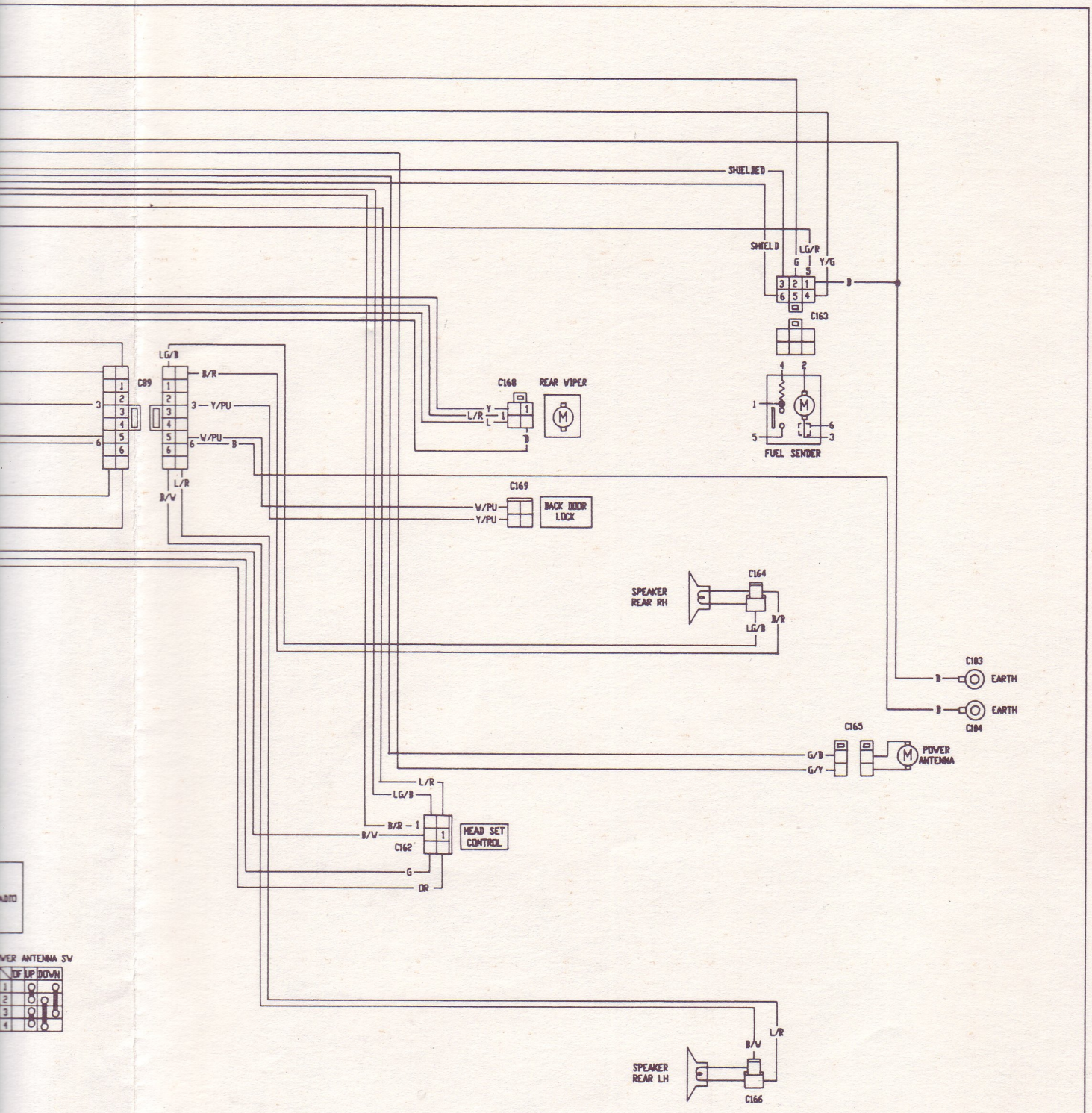
SYMBOL	DESCRIPTION
	EARTH
	SWITCH

AD41 4-CYL MANUAL WAGON ELEC

FOR CONNECTIONS NOT MADE ON THIS SHEET SEE SHEET 1

UNLESS OTHERVISE NOTED,WIRE COLORS ON EITHER SIDE OF CONNE

ALL CONNECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKI



4-CYL MANUAL WAGON ELECTRICAL SCHEMATIC SHEET 2

BY K.T.R.

NECTIONS NOT MADE ON THIS SHEET SEE SHEET 1

ITHERWISE NOTED,WIRE COLORS ON EITHER SIDE OF CONNECTOR JUNCTIONS ARE THE SAME

NECTORS ARE SHOWN VIEWED FROM THE FRONT (LOOKING AT TERMINALS).

DWG/No. 24005-J7001-22 -M2