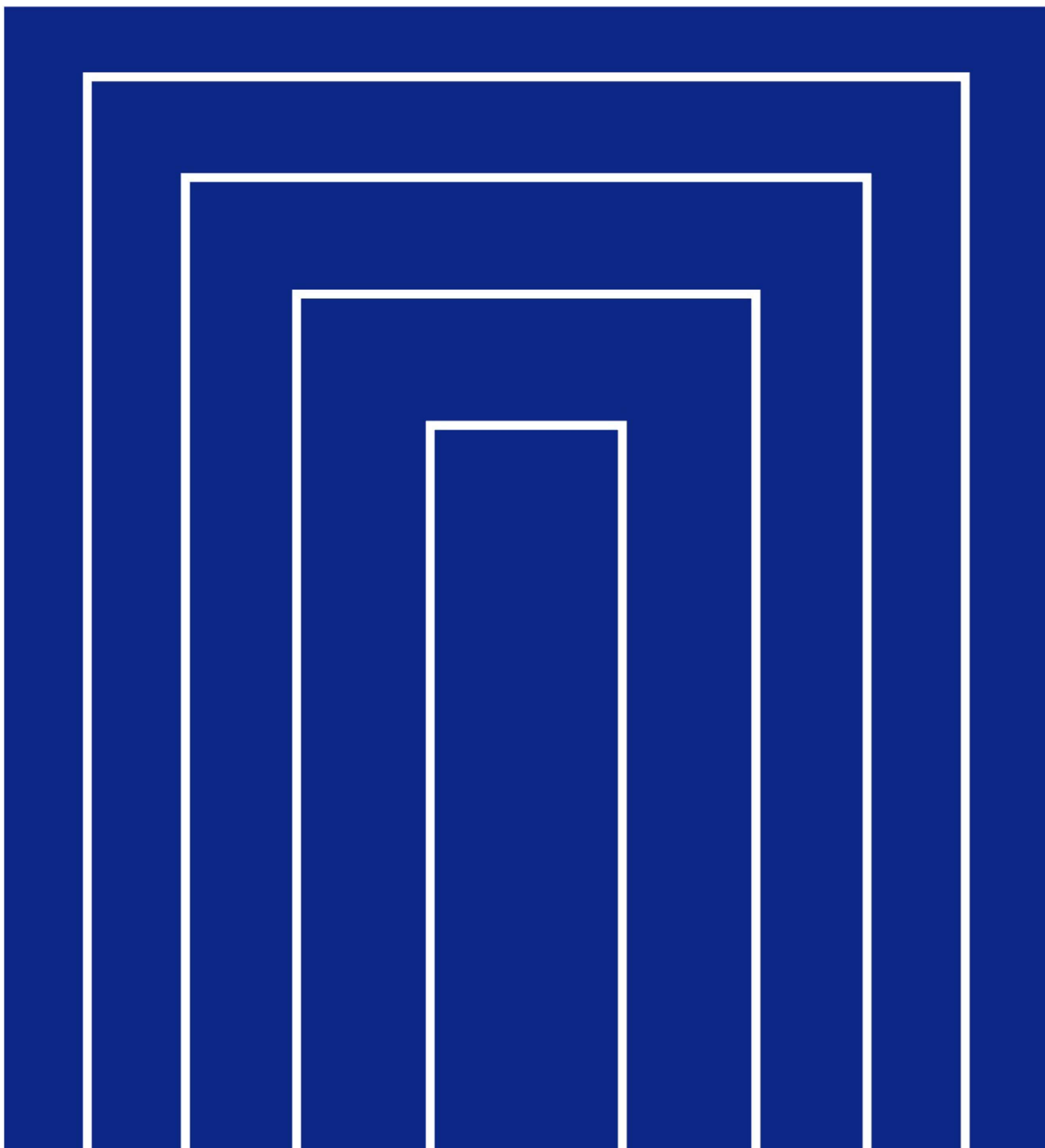


TOYOTA

1KZ-T, 1KZ-TE ENGINE

REPAIR MANUAL SUPPLEMENT

Apr., 1996



FOREWORD

This supplement has been prepared to provide information covering general service repairs for the 1KZ-T, 1KZ-TE engine mounted on the TOYOTA LAND CRUISER/LAND CRUISER PRADO.

Applicable model: KZJ90, 95 series

For basic engine service repair, refer to the following repair manual.

1KZ-T Engine Repair Manual
(Pub. No. RM353E)

Please note that the publications below have also been prepared as relevant service manuals to the components and systems in this engine.

Manual Name	Pub. No.
• 1KZ-TE Engine Emission Control Repair Manual	ERM121E
• LAND CRUISER/LAND CRUISER PRADO New Car Features	NCF131E

All information in this manual is based on the latest product information at the time of publication. However, specifications and procedures are subject to change without notice.

TOYOTA MOTOR CORPORATION

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CAUTION

This manual does not include all the necessary items about repair and service. this manual is made for the purpose of the use for the persons who have special techniques and certifications. In the cases that non-specialized or uncertified technicians perform repair or service only using this manual or without proper equipment or tool, that may cause severe injury to you or other people around and also cause damage to your customer's vehicle.

In order to prevent dangerous operation and damages to your customer's vehicle, be sure to follow the instruction shown below.

- Must read this manual thoroughly. It is especially important to have good understanding all the contents written in the PRECAUTION of "IN" section.
- The service method written in this manual is very effective to perform repair and service. When performing the operations following the procedures using this manual, be sure to use tools specified and recommended. If using non-specified or recommended tools and service method, be sure to confirm safety of the technicians and any possibility of causing personal injury or damage to the customer's vehicle before starting the operation.
- If part replacement is necessary, must replace the part with the same part number or equivalent part. Do not replace it with inferior quality.
- It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is important to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

INTRODUCTION
ENGINE
STARTING
CHARGING

IN

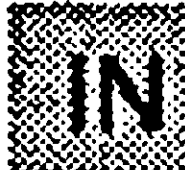
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INTRODUCTION

HOW TO USE THIS MANUAL	IN- 2
IDENTIFICATION INFORMATION	IN- 4
GENERAL REPAIR INSTRUCTIONS	IN- 4
PRECAUTION	IN- 7
ABBREVIATIONS USED IN THIS MANUAL	IN- 8
STANDARD BOLT TORQUE SPECIFICATIONS	IN- 9



HOW TO USE THIS MANUAL

INDEX

IN002-1J

An INDEX is provided on the first page of each section to guide you to the item to be repaired. To assist you in finding your way through the manual, the Section Title and major heading are given at the top of every page.

GENERAL DESCRIPTION

At the beginning of each section, a General Description (Precautions) is given that pertains to all repair operations contained in that section.

Read these precautions before starting any repair task.

TROUBLESHOOTING

TROUBLESHOOTING tables are included for each system to help you diagnose the problem and find the cause.

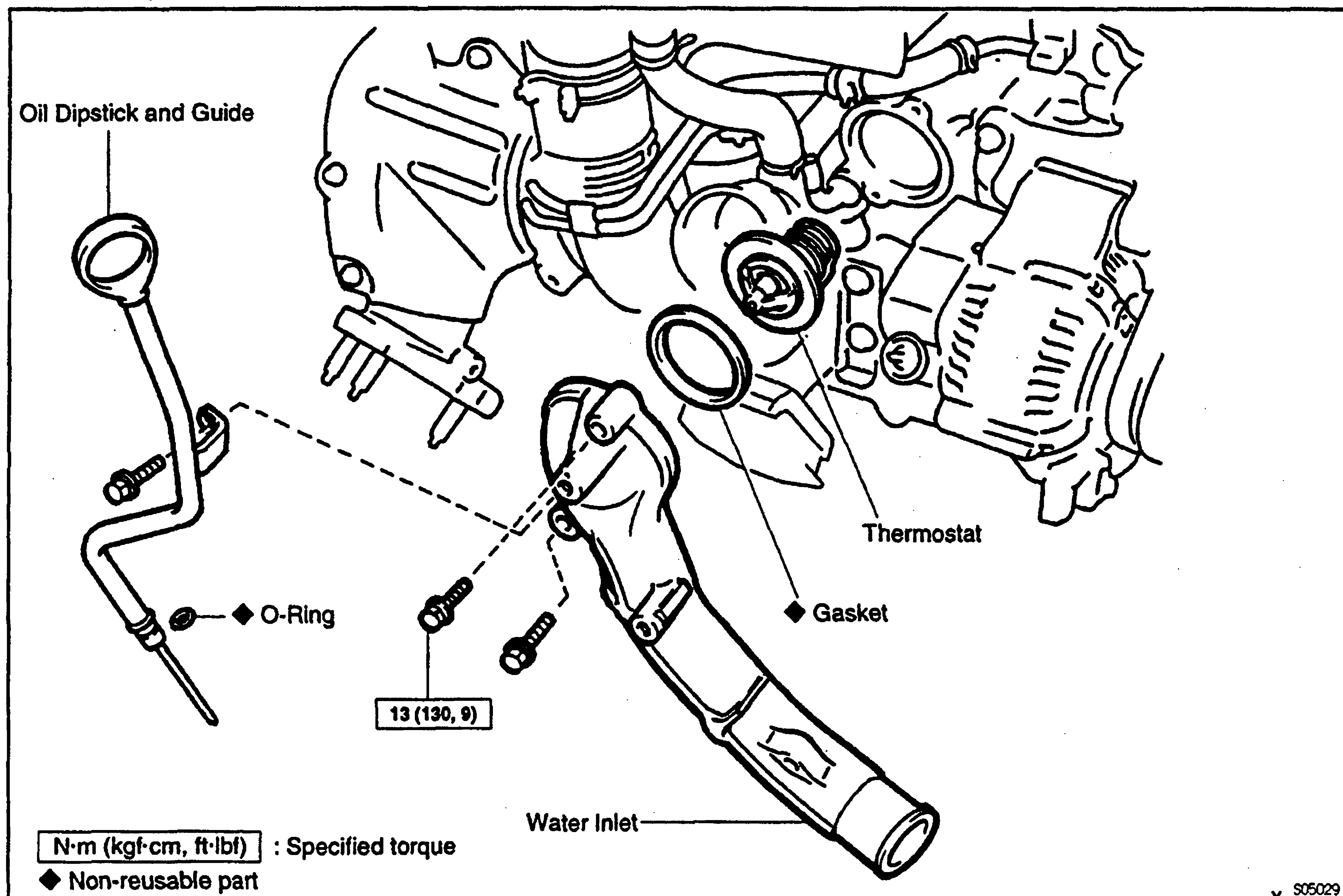
PREPARATION

Preparation lists the SST (Special Service Tools), recommended tools, equipment, lubricant and SSM (Special Service Materials) which should be prepared before beginning the operation and explains the purpose of each one.

REPAIR PROCEDURES

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

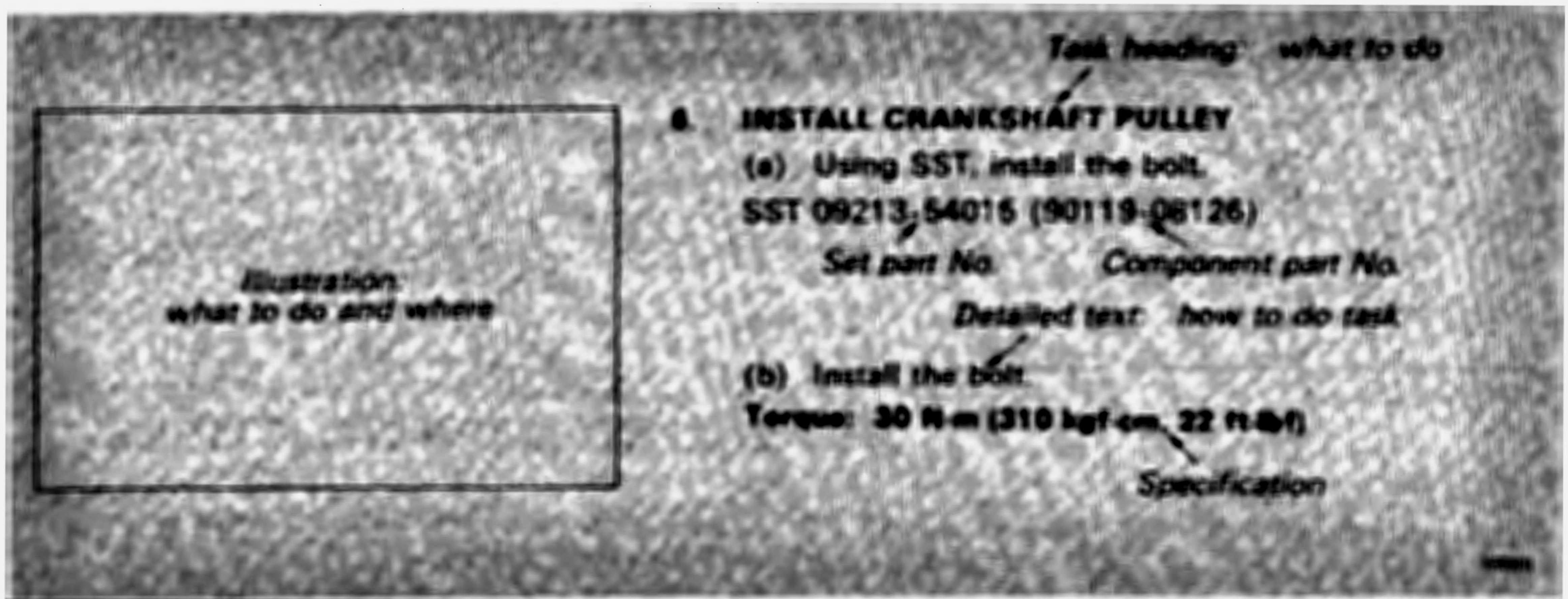
Example:



The procedures are presented in a step—by—step format:

- The illustration shows what to do and where to do it.
- The task heading tells what to do.
- The detailed text tells how to perform the task and gives other information such as specifications and warnings.

Example:



This format provides the experienced technician with a FAST TRACK to the information needed. The upper case task heading can be read at a glance when necessary, and the text below it provides detailed information. Important specifications and warnings always stand out in bold type.

REFERENCES

References have been kept to a minimum. However, when they are required you are given the page to refer to.

SPECIFICATIONS

Specifications are presented in bold type throughout the text where needed. You never have to leave the procedure to look up your specifications. They are also found at the end of each section, for quick reference.

CAUTIONS, NOTICES, HINTS:

- **CAUTIONS** are presented in bold type, and indicate there is a possibility of injury to you or other people.
- **NOTICES** are also presented in bold type, and indicate the possibility of damage to the components being repaired.
- **HINTS** are separated from the text but do not appear in bold. They provide additional information to help you efficiently perform the repair.

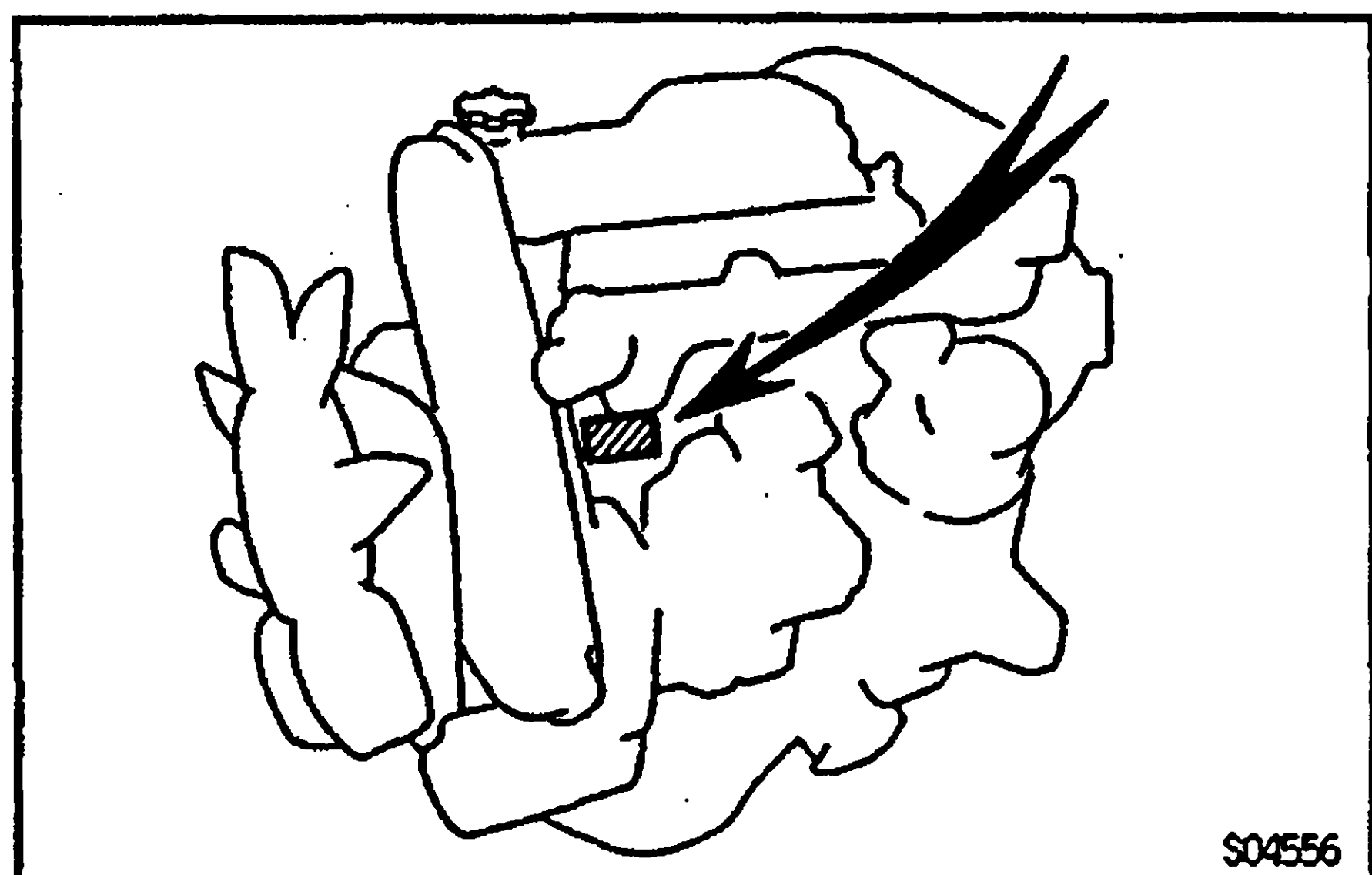
SI UNIT

The UNIT 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 yard/pound system.

Example:

Torque: 30 N·m (310 kgf·cm, 22 ft·lbf)

IN



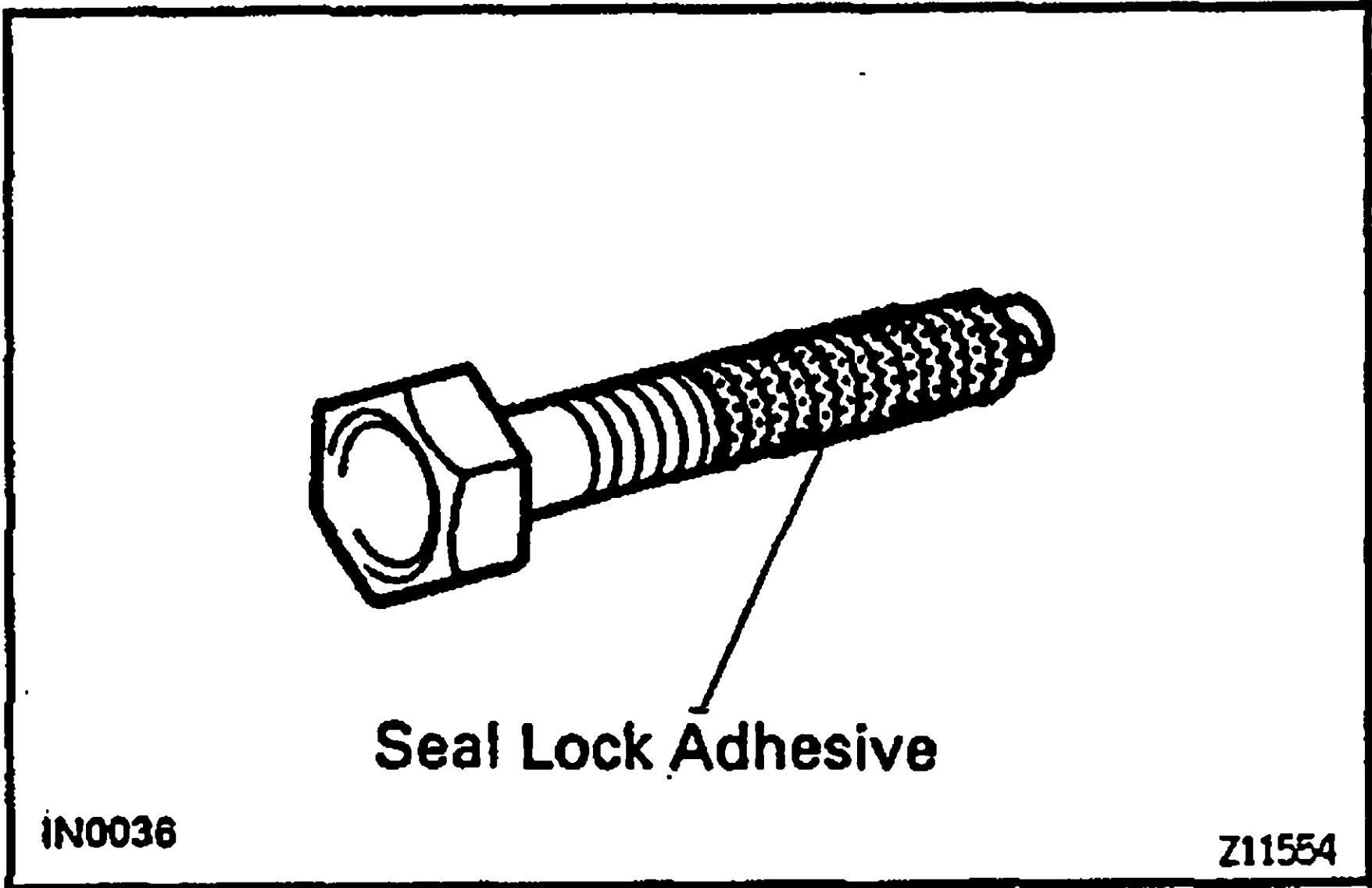
IDENTIFICATION INFORMATION ENGINE SERIAL NUMBER

IN004-07

The engine serial number is stamped on the engine block as shown.

GENERAL REPAIR INSTRUCTIONS

1. Use fender, seat and floor covers to keep the vehicle clean and prevent damage. IN05M-05
2. During disassembly, keep parts in the appropriate order to facilitate reassembly.
3. Observe the following:
 - (a) Before doing electrical work, disconnect the negative (—) terminal cable from the battery.
 - (b) If it is necessary to disconnect the battery for inspection or repair, always disconnect the cable from the negative (—) terminal which is grounded to the vehicle body.
 - (c) To prevent damage to the battery terminal post, loosen the terminal nut and raise the cable straight up without twisting or prying it.
 - (d) Clean the battery terminal posts and cable terminals with a shop rag. Do not scrape them with a file or other abrasive objects.
 - (e) Install the cable terminal to the battery post with the nut loose, and tighten the nut after installation. Do not use a hammer to tap the terminal onto the post.
 - (f) Be sure the cover for the positive (+) terminal is properly in place.
4. Check hose and wiring connectors to make sure that they are secure and correct.
5. Non—reusable parts
 - (a) Always replace cotter pins, gaskets, O—rings and oil seals etc. with new ones.



- (b) Non-reusable parts are indicated in the component illustrations by the "◆" symbol.
6. Precoated parts
- Precoated parts are bolts and nuts, etc. that are coated with a seal lock adhesive at the factory.
- (a) If a precoated part is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.
- (b) When reusing precoated parts, clean off the old adhesive and dry with compressed air. Then apply the specified seal lock adhesive to the bolt, nut or threads.
- (c) Precoated parts are indicated in the component illustrations by the "★" symbol.
7. When necessary, use a sealer on gaskets to prevent leaks.
8. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.
9. Use of special service tools (SST) and special service materials (SSM) may be required, depending on the nature of the repair. Be sure to use SST and SSM where specified and follow the proper work procedure. A list of SST and SSM can be found in the preparation part at the front of each section in this manual.
10. When replacing fuses, be sure the new fuse has the correct amperage rating. DO NOT exceed the rating or use one with a lower rating.

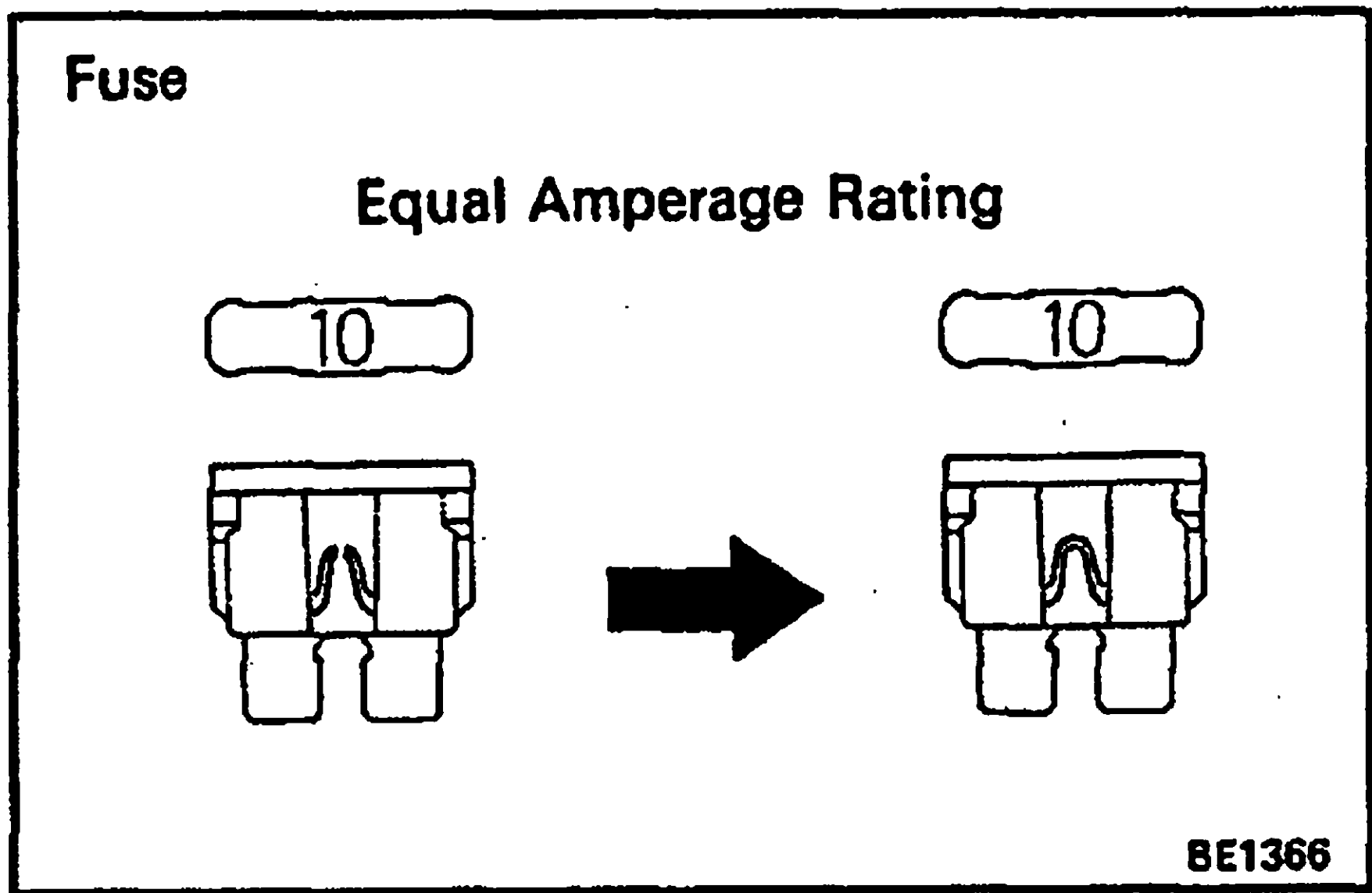
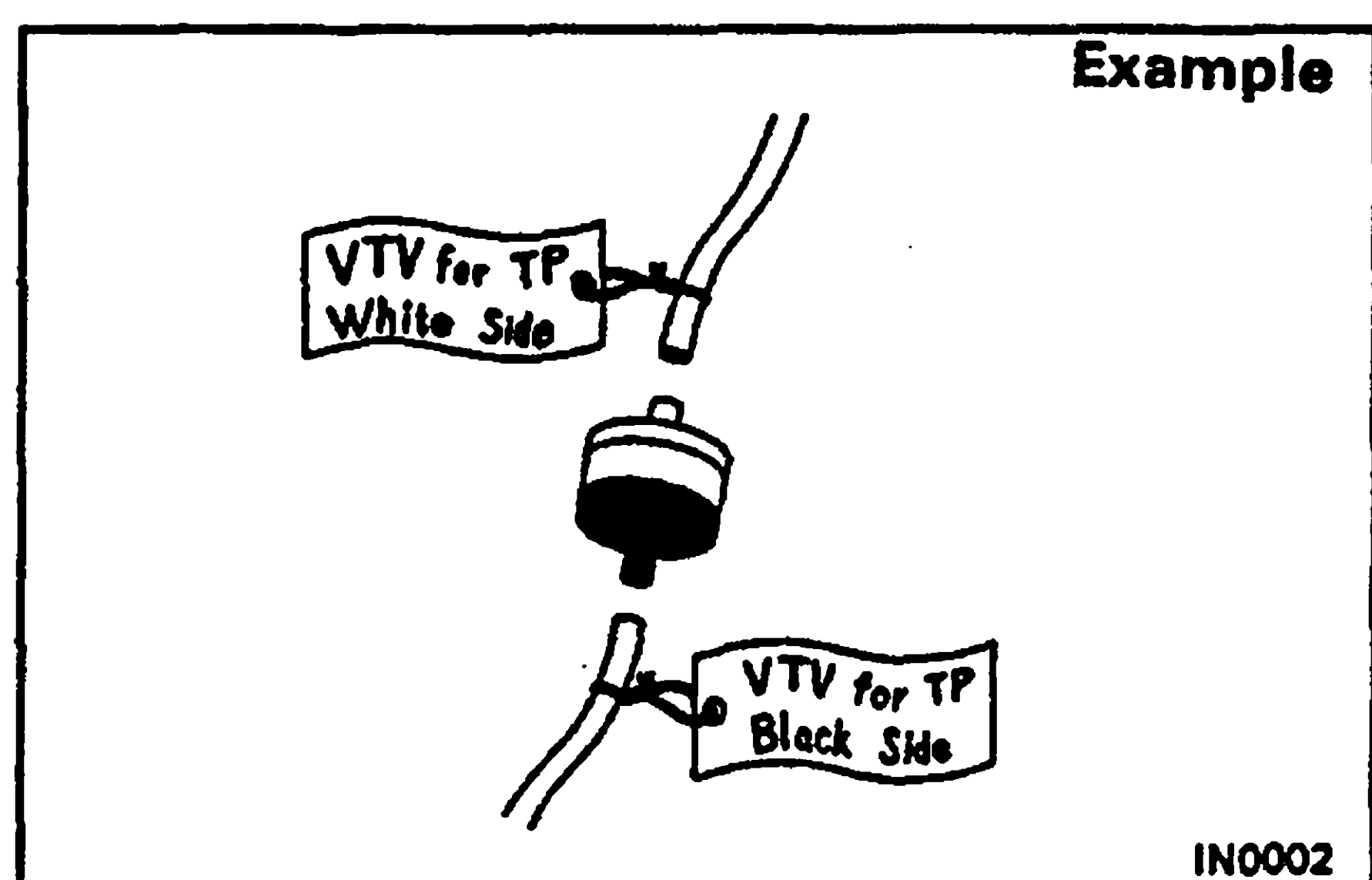
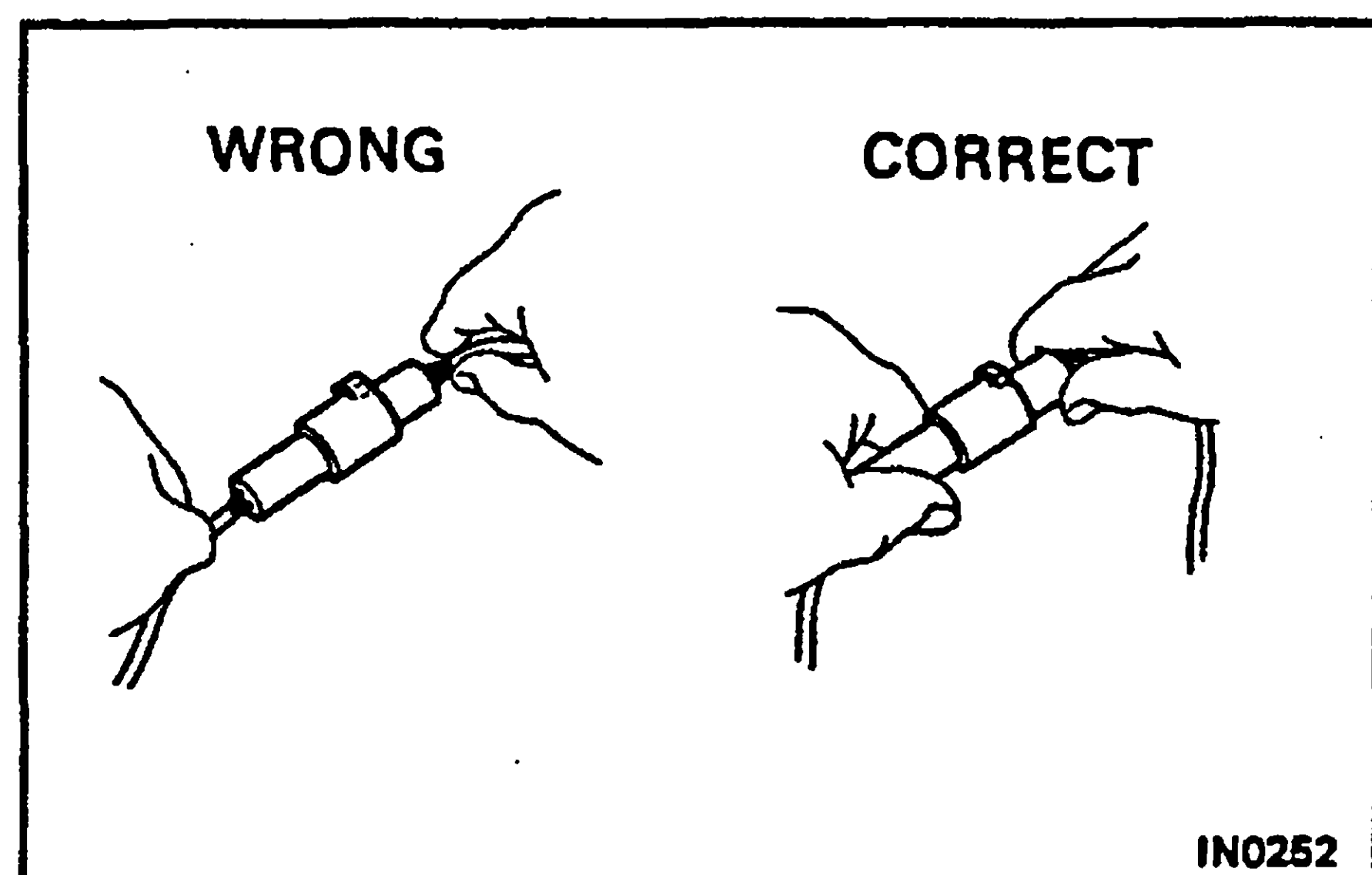
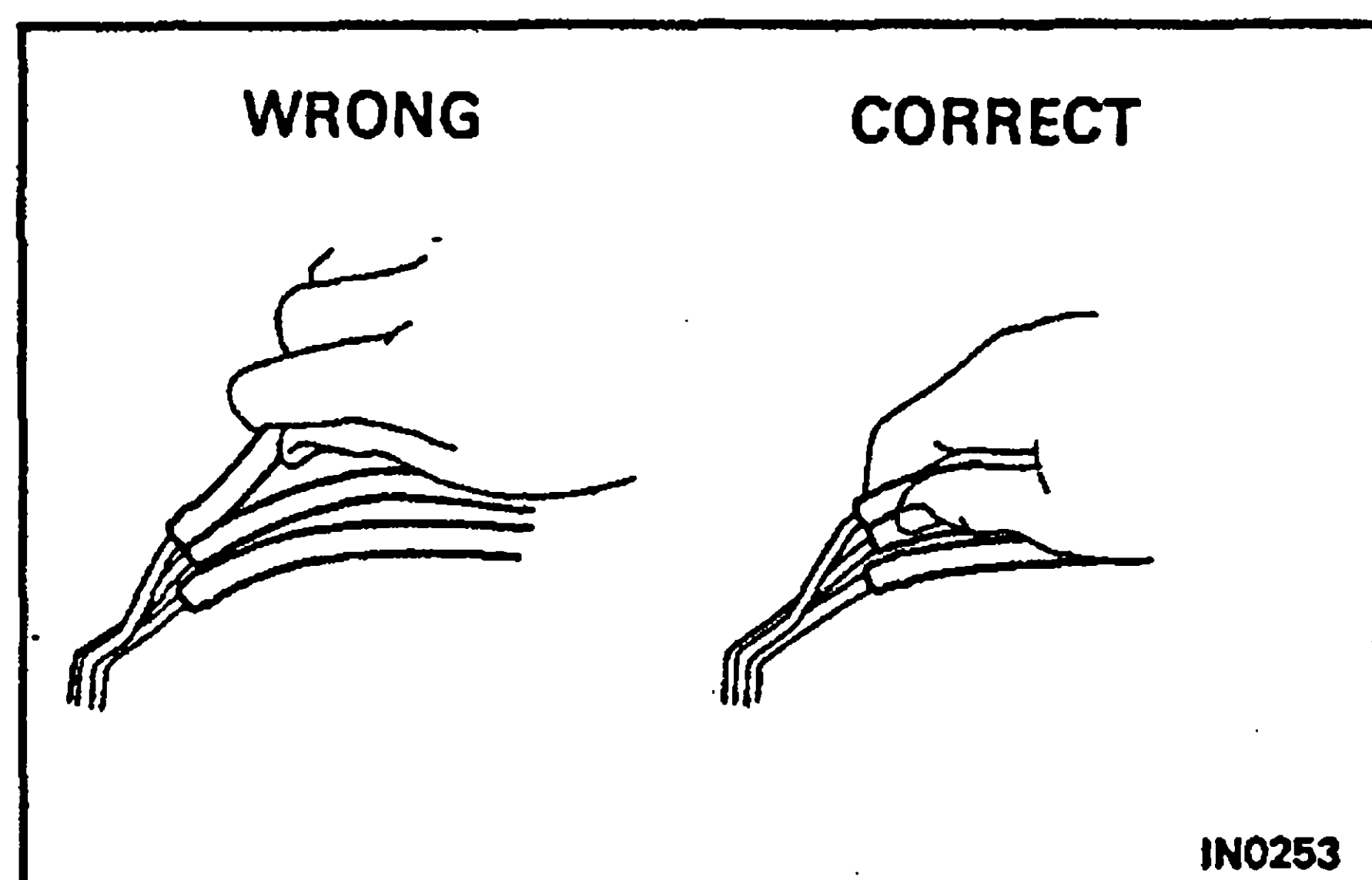


Illustration	Symbol	Part Name	Abbreviation
 BE5594	 IN0365	FUSE	FUSE
 BE5595	 IN0366	MEDIUM CURRENT FUSE	M-FUSE
 BE5596	 IN0367	HIGH CURRENT FUSE	H-FUSE
 BE5597	 IN0367	FUSIBLE LINK	FL
 BE5598	 IN0368	CIRCUIT BREAKER	CB

IN



11. Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations.
 - (a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels at the opposite end in order to ensure safety.
 - (b) After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on a vehicle raised on a jack alone, even for a small job that can be finished quickly.
12. Observe the following precautions to avoid damage to the parts:
 - (a) Do not open the cover or case of the ECU unless absolutely necessary. (If the IC terminals are touched, the IC may be destroyed by static electricity.)
 - (b) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
 - (c) To pull apart electrical connectors, pull on the connector itself, not the wires.
 - (d) Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard floor, they should be replaced and not reused.
 - (e) When steam cleaning an engine, protect the electronic components, air filter, and emissions related components from water.
 - (f) Never use an impact wrench to remove or install temperature switches or temperature sensors.
 - (g) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.
 - (h) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adapter instead. Once the hose has been stretched, it may leak.
13. Tag hoses before disconnecting them:
 - (a) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
 - (b) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.
14. Unless otherwise stated, all resistance is measured at an ambient temperature of 20°C (68°F). Because the resistance may be outside specifications if measured at high temperatures immediately after the vehicle has been running, measurements should be made when the engine has cooled down.

PRECAUTION**IF VEHICLE IS EQUIPPED WITH MOBILE COMMUNICATION SYSTEM**

INQ2M-00

For vehicles with mobile communication systems such as two-way radios and cellular telephones, observe the following precautions.

- (1) Install the antenna as far as possible away from the ECU and sensors of the vehicle's electronic system.
- (2) Install the antenna feeder at least 20 cm (7.87 in.) away from the ECU and sensors of the vehicle's electronics systems. For details about ECU and sensors locations, refer to the section on the applicable component.
- (3) Do not wind the antenna feeder together with the other wiring. As much as possible, also avoid running the antenna feeder parallel with other wire harnesses.
- (4) Confirm that the antenna and feeder are correctly adjusted.
- (5) Do not install powerful mobile communications system.

ABBREVIATIONS USED IN THIS MANUAL

M031-02

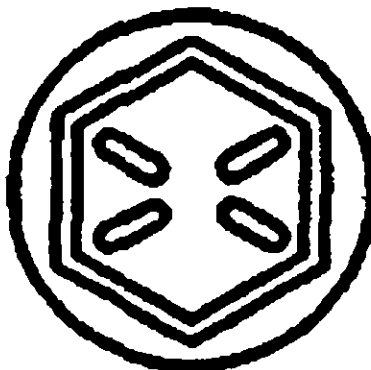
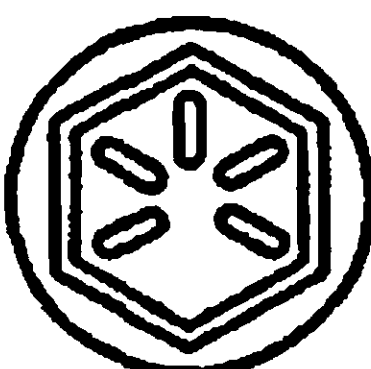
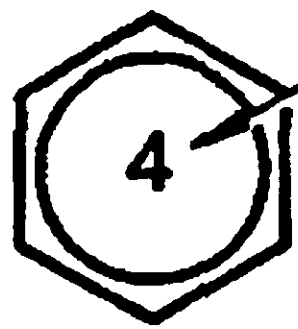
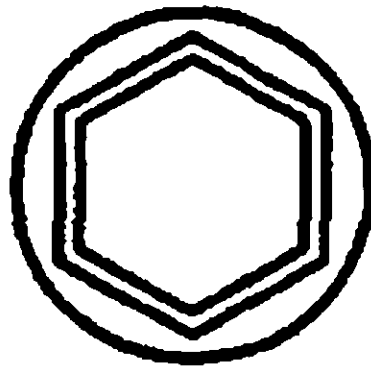
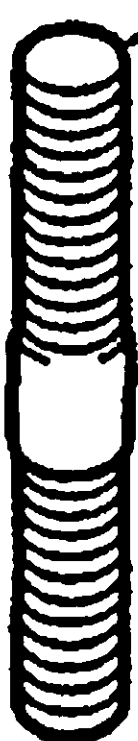
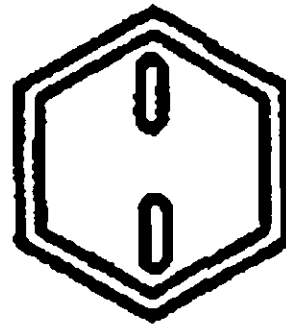
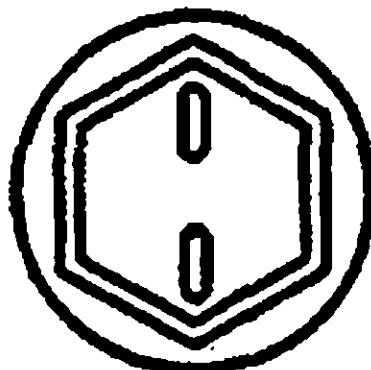
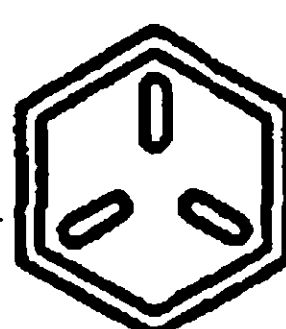
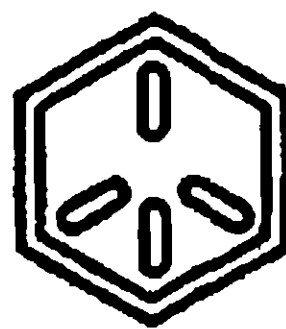
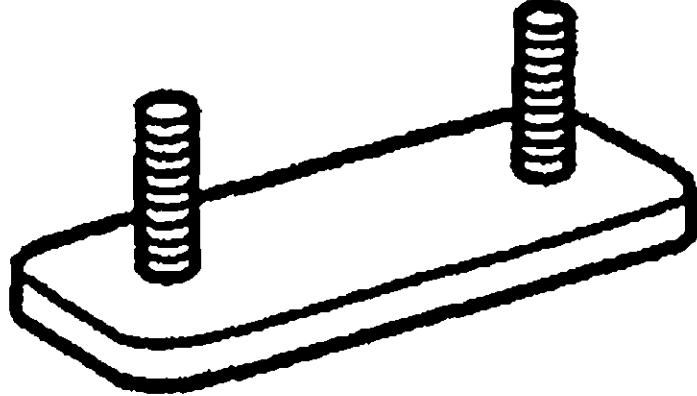
A/C	Air conditioner
A/T	Automatic Transmission
BACS	Boost Altitude Compensational Stopper
CB	Circuit Breaker
DP	Dashpot
DTC	Diagnostic Trouble Code
ECD	Electronic Control Diesel
ECT	Electronic Controlled Transmission
ECU	Electronic Control Unit
EGR	Exhaust Gas Recirculation
EVAP	Electronic Vacuum Regulating Valve
EX	Exhaust
FIPG	Formed in Place Gasket
FL	Fusible Link
H—Fuse	High Current Fuse
IG	Ignition
IN	Intake
J/B	Junction Block
M—Fuse	Medium Current Fuse
M/T	Manual Transmission
O/S	Oversize
PCV	Positive Crankcase Ventilation
R/B	Relay Block
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
SW	Switch
TDC	Top Dead Center
U/S	Undersize
VSV	Vacuum Switching Valve
w/	With
w/o	Without

W00V-08

IN

STANDARD BOLT TORQUE SPECIFICATIONS

HOW TO DETERMINE BOLT STRENGTH

	Mark	Class		Mark	Class
Hexagon head bolt	4—	4T	Hexagon flange bolt w/ washer hexagon bolt	 4 Protruding lines	9T
	5—	5T			
	6—	6T	Hexagon flange bolt w/ washer hexagon bolt	 5 Protruding lines	10T
	Bolt head No. 7—	7T			
	8—	8T			
	9—	9T			
	10—	10T			
	11—	11T			
	 No mark	4T	Hexagon flange bolt w/ washer hexagon bolt	 6 Protruding lines	11T
Hexagon flange bolt w/ washer hexagon bolt	 No mark	4T	Stud bolt	 No mark	4T
Hexagon head bolt	 2 Protruding lines	5T			
Hexagon flange bolt w/ washer hexagon bolt	 2 Protruding lines	6T		 Grooved	6T
Hexagon head bolt	 3 Protruding lines	7T			
Hexagon head bolt	 4 Protruding lines	8T	Welded bolt		4T

SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt			Hexagon flange bolt		
			N·m	kgf·cm	ft·lbf	N·m	kgf·cm	ft·lbf
4T	6	1	5	55	48 in.·lbf	6	60	52 in.·lbf
	8	1.25	12.5	130	9	14	145	10
	10	1.25	26	260	19	29	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	74	760	55	84	850	61
	16	1.5	115	1,150	83	—	—	—
5T	6	1	6.5	65	56 in.·lbf	7.5	75	65 in.·lbf
	8	1.25	15.5	160	12	17.5	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1,050	76
	16	1.5	140	1,400	101	—	—	—
6T	6	1	8	80	69 in.·lbf	9	90	78 in.·lbf
	8	1.25	19	195	14	21	210	15
	10	1.25	39	400	29	44	440	32
	12	1.25	71	730	53	80	810	59
	14	1.5	110	1,100	80	125	1,250	90
	16	1.5	170	1,750	127	—	—	—
7T	6	1	10.5	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	105	1,050	76
	14	1.5	145	1,500	108	165	1,700	123
	16	1.5	230	2,300	166	—	—	—
8T	8	1.25	29	300	22	33	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	110	1,100	80	120	1,250	90
9T	8	1.25	34	340	25	37	380	27
	10	1.25	70	710	51	78	790	57
	12	1.25	125	1,300	94	140	1,450	105
10T	8	1.25	38	390	28	42	430	31
	10	1.25	78	800	58	88	890	64
	12	1.25	140	1,450	105	155	1,600	116
11T	8	1.25	42	430	31	47	480	35
	10	1.25	87	890	64	97	990	72
	12	1.25	155	1,600	116	175	1,800	130

ENGINE

ENGINE MECHANICAL

PREPARATION	EG- 2
AIR FILTER INSPECTION AND CLEANING	EG- 3
COMPRESSION CHECK	EG- 4
VALVE CLEARANCE INSPECTION AND ADJUSTMENT.....	EG- 5
INJECTION TIMING INSPECTION AND ADJUSTMENT (1KZ-TE).....	EG- 10
IDLE SPEED AND MAXIMUM SPEED INSPECTION (1KZ-TE).....	EG- 10
HEATER IDLE-UP SPEED INSPECTION (1KZ-TE).....	EG- 11
A/C IDLE-UP SPEED INSPECTION (1KZ-TE).....	EG- 12
INTAKE SHUTTER INSPECTION (1KZ-T)	EG- 12
INTAKE CONSTRICTOR CONTROL INSPECTION (1KZ-TE).....	EG- 13
TIMING BELT	EG- 15
TIMING GEAR	EG- 17
CYLINDER HEAD	EG- 18
SERVICE SPECIFICATIONS.....	EG- 31

TURBOCHARGER SYSTEM

PREPARATION	EG- 36
TURBOCHARGER	EG- 37
SERVICE SPECIFICATIONS.....	EG- 46

ELECTRONIC CONTROL DIESEL(ECD) SYSTEM

PRECAUTION	EG- 47
PREPARATION	EG- 48
DIAGNOSIS SYSTEM	EG- 49
TROUBLESHOOTING	EG- 56
VENTURI	EG- 64
TIMING CONTROL VALVE	EG- 67
VSV FOR INTAKE CONSTRICTOR CONTROL	EG- 67
ECD MAIN RELAY	EG- 68
SPILL VALVE RELAY	EG- 69
WATER TEMPERATURE SENSOR	EG- 69
FUEL TEMPERATURE SENSOR	EG- 70
INTAKE AIR TEMPERATURE SENSOR	EG- 70
TURBO PRESSURE SENSOR	EG- 71
CRANKSHAFT POSITION SENSOR	EG- 72
ENGINE (AND ECT) ECU	EG- 73
SERVICE SPECIFICATIONS.....	EG- 75

FUEL SYSTEM

PREPARATION	EG- 78
FUEL FILTER REPLACEMENT	EG- 80
INJECTION NOZZLE	EG- 82
INJECTION PUMP (1KZ-T)	EG- 84
INJECTION PUMP (1KZ-TE).....	EG- 102
SERVICE SPECIFICATIONS.....	EG- 111

COOLING SYSTEM

PREPARATION	EG- 114
COOLANT CHECK	EG- 114
COOLANT REPLACEMENT.....	EG- 115
THERMOSTAT	EG- 116
RADIATOR	EG- 118
SERVICE SPECIFICATIONS.....	EG- 123

LUBRICATION SYSTEM

PREPARATION	EG- 124
OIL PRESSURE CHECK	EG- 124
OIL AND FILTER REPLACEMENT	EG- 125
OIL PUMP	EG- 127
OIL COOLER	EG- 128
OIL NOZZLE	EG- 129
SERVICE SPECIFICATIONS.....	EG- 130

REFER TO 1KZ-T ENGINE REPAIR MANUAL
(Pub. No. RM353E)

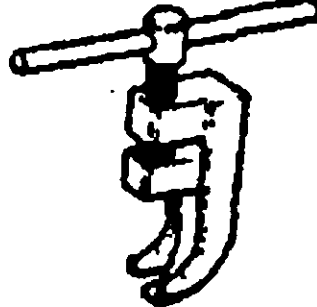
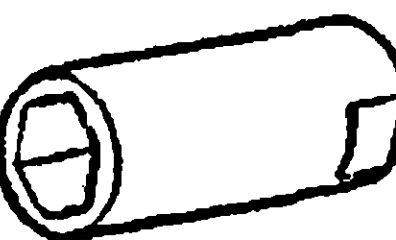
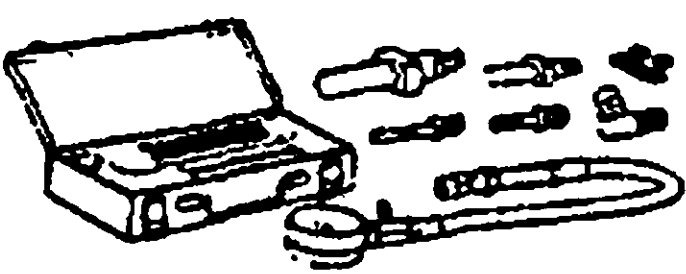
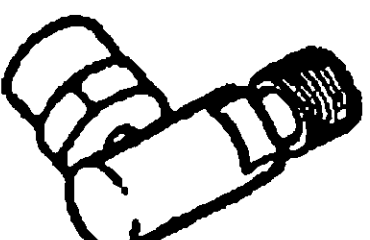
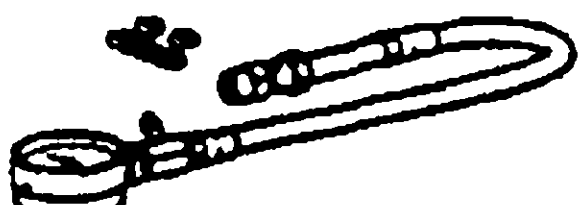
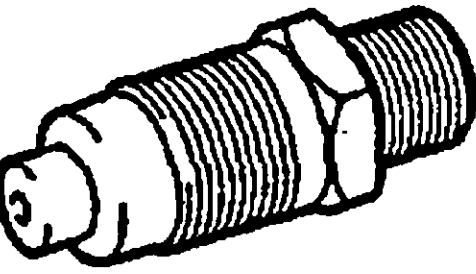
NOTE: The above pages contain only the points which differ from the above listed manual.

ENGINE MECHANICAL

PREPARATION

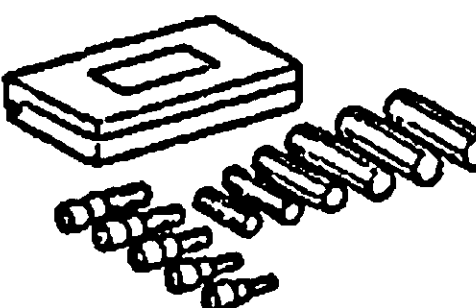
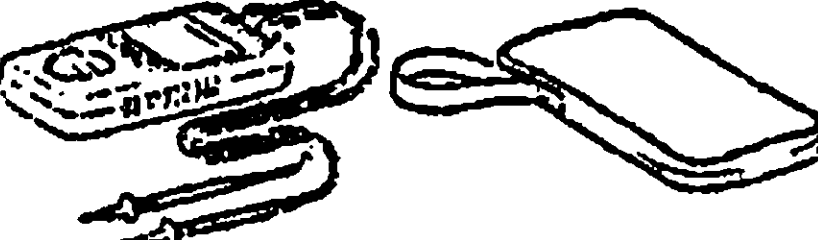
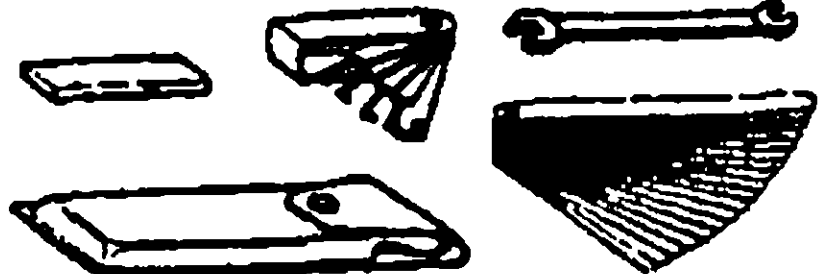
SST (SPECIAL SERVICE TOOLS)

EG04Y-2U

	09248-64011 Valve Clearance Adjusting Tool	
	09268-64010 Injection Nozzle Wrench Set	
	(09268-64020) Injection Nozzle Holder Retaining Nut Wrench	
	09992-00024 Cylinder Compression Check Gauge Set	
	(09992-00200) L Joint	
	(09992-00211) Gauge Assy	
	09992-00500 Compression Gauge Attachment	

RECOMMENDED TOOLS

EG04Z-21

	09040-00010 Hexagon Wrench Set .	Timing belt idler pulley
	09082-00040 TOYOTA Electrical Tester.	VSV for intake shutter
	09200-00010 Engine Adjust Kit .	

EG000-24

EQUIPMENT

Cylinder gauge	
Dial indicator	
Magnetic finger	
Micrometer	
Mirror	
Tachometer	
Torque wrench	
Vacuum gauge	
Vernier calipers	

EG001-23

SSM (SERVICE SPECIAL MATERIALS)

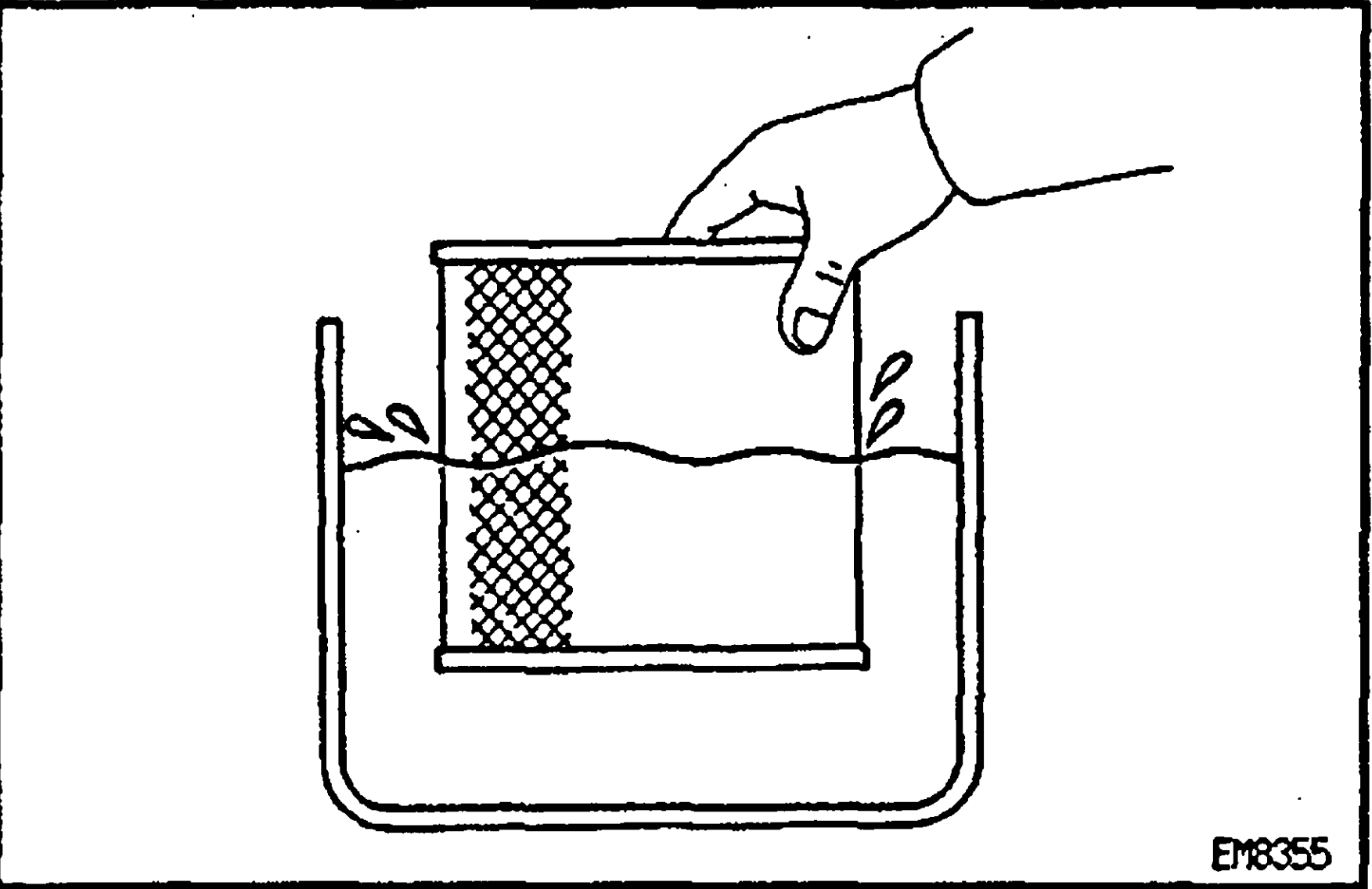
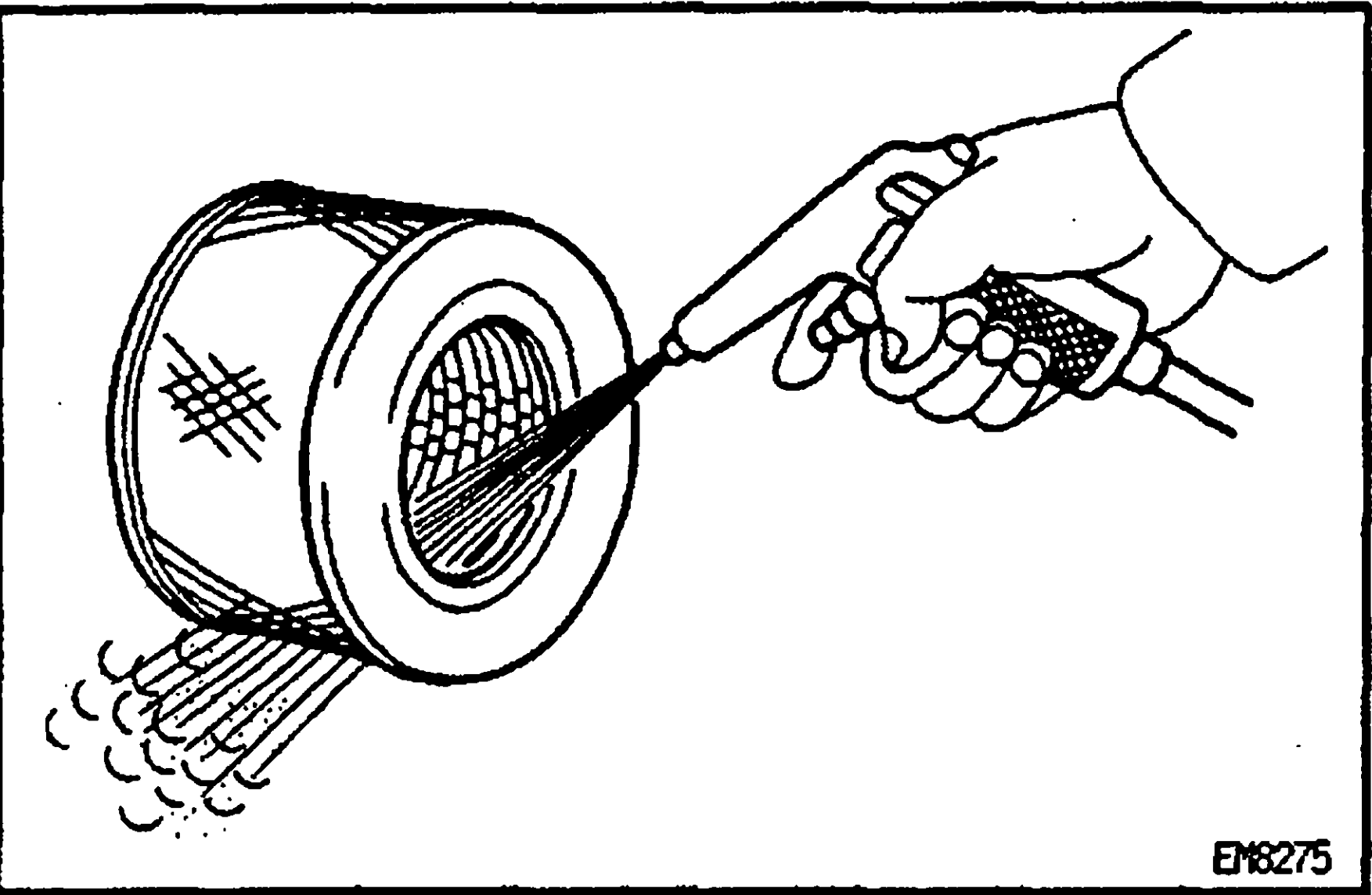
08826-00080	Seal Packing Black or equivalent (FIPG)	Timing belt cover Camshaft oil seal retainer Cylinder head
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AIR FILTER INSPECTION AND CLEANING

EG7EU-01

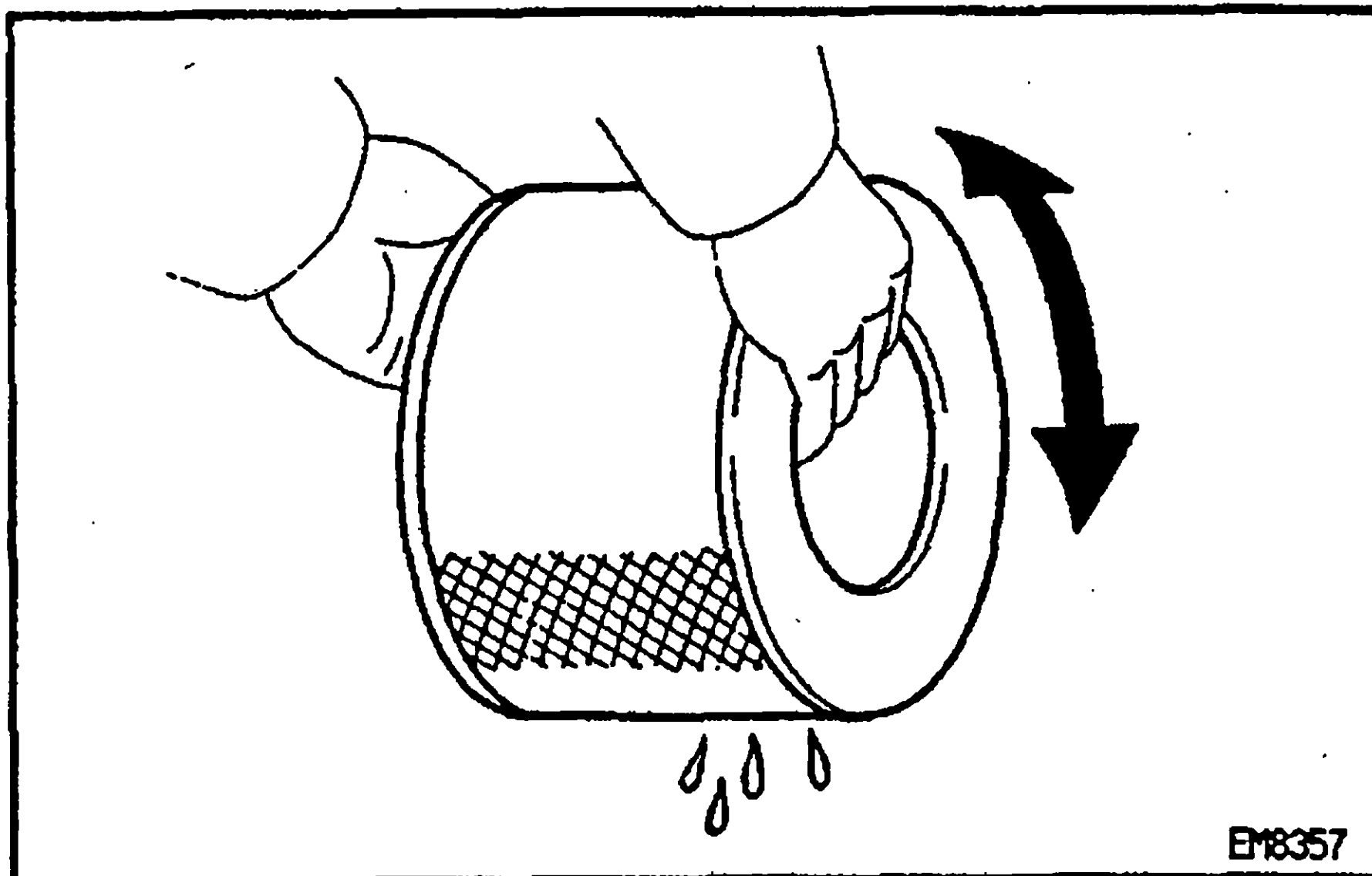
AIR FILTER INSPECTION AND CLEANING
Paper Filter Type:

- 1. INSPECT AIR FILTER**
Visually check that the filter element is not excessively dirty, damaged or oily.
- 2. CLEAN AIR FILTER**
Clean the filter element with compressed air.
First blow from the inside thoroughly. Then blow off the outside of the filter element.



Washable Type:

- 1. INSPECT AIR FILTER**
Visually check that the filter element is not excessively dirty, damaged or oily.
- 2. CLEAN AIR FILTER**
 - (a) Blow dirt off in the filter element with compressed air.
 - (b) Submerge the filter element in the water and agitate it up and down more than 10 times.
 - (c) Repeat rinsing in clean water until rinsing water is clear.



- (d) Remove excess water by shaking the filter element or blowing with compressed air.
NOTICE: Do not beat or drop filter element.
- (e) Wipe off dust on the air cleaner case interior.

COMPRESSION CHECK

HINT: If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure. EG7EV-01

1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. 1KZ-T:

DISCONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR

3. 1KZ-TE:

DISCONNECT INJECTION PUMP (SPILL CONTROL VALVE) CONNECTOR

4. DISCONNECT GLOW PLUG WIRE FROM GLOW PLUG CONNECTOR

NOTICE: In order not to short the glow plug wire, apply vinyl tape around the terminal.

5. REMOVE INTAKE PIPE

(See step 2 in cylinder head removal)

6. REMOVE INJECTION PIPES

(See step(s) 2 and 3 (1KZ-T) injection pump removal in Fuel System)

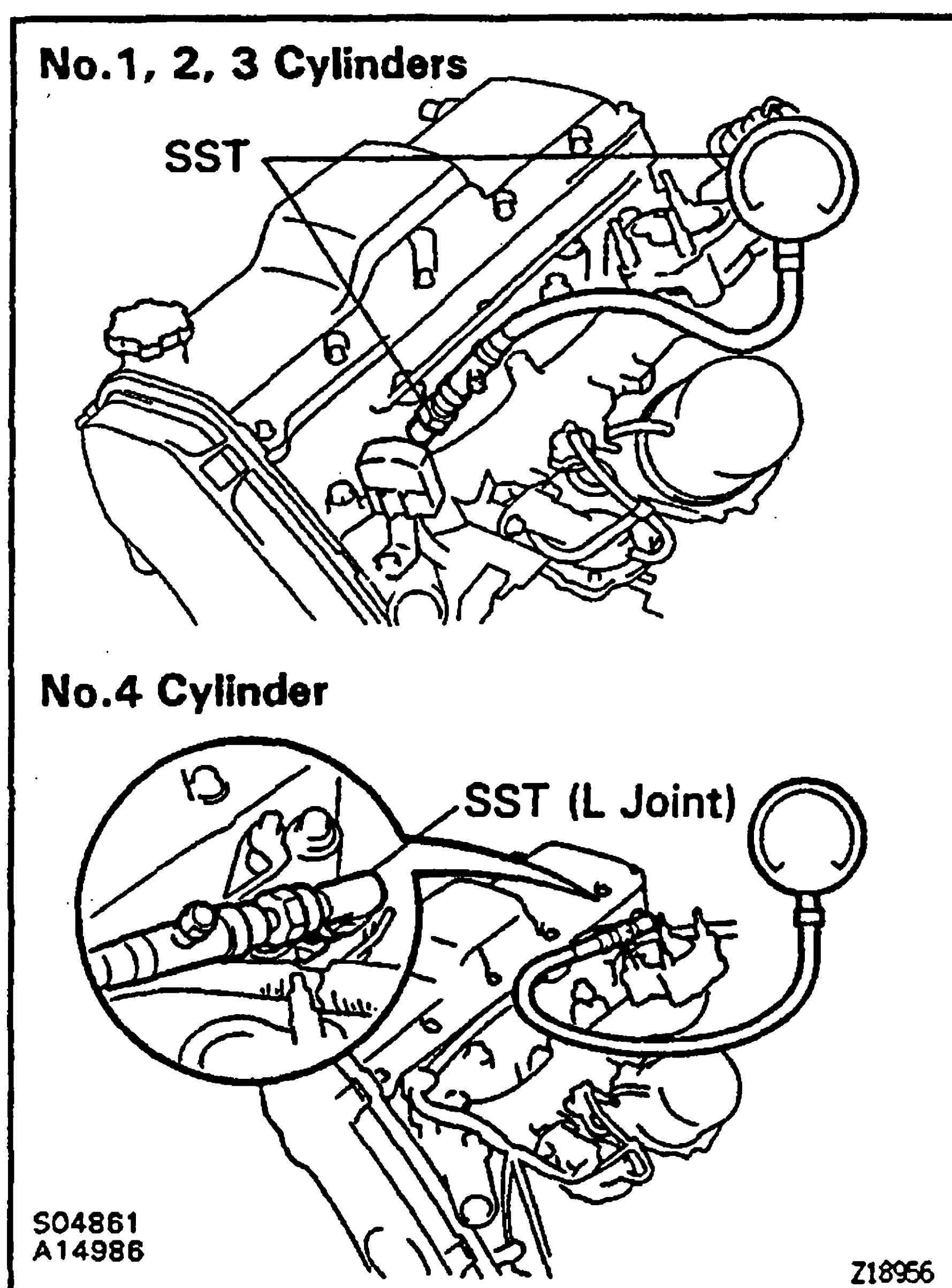
7. REMOVE INJECTION NOZZLES

(See steps 8 and 9 in cylinder head removal)

8. CHECK CYLINDER COMPRESSION PRESSURE

HINT: Turn the starter before measuring the compression and discharge the foreign objects.

- (a) Install SST (attachment) to the injection nozzle hole.
SST 09992 - 00500
- (b) Connect SST (compression gauge) to the attachment.
SST 09992 - 00024 (09992 - 00200, 09992 - 00211)
- (c) While cranking the engine, measure the compression pressure.
HINT: Always use a fully charged battery to obtain engine revolution of 250 rpm or more.
- (d) Repeat steps (a) through (c) for each cylinder.
NOTICE: This measurement must be done in as short a time as possible.



Compression pressure:3,040 kPa (31.0 kgf/cm², 441 psi) or more**Minimum pressure:**1,961 kPa (20.0 kgf/cm², 284 psi)**Difference between each cylinder:**490 kPa (5.0 kgf/cm², 71 psi) or less

- (e) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the injection nozzle hole and repeat steps (a) through (c) for the cylinder with low compression.
- If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
 - If pressure stays low, a valve may be sticking or seating improperly, or there may be leakage past the gasket.

9. REINSTALL INJECTION NOZZLES

(See steps 15 and 16 in cylinder head installation)

10. REINSTALL INJECTION PIPES

(See step(s) 5 and 6 (1KZ—T) in injection pump installation in Fuel System)

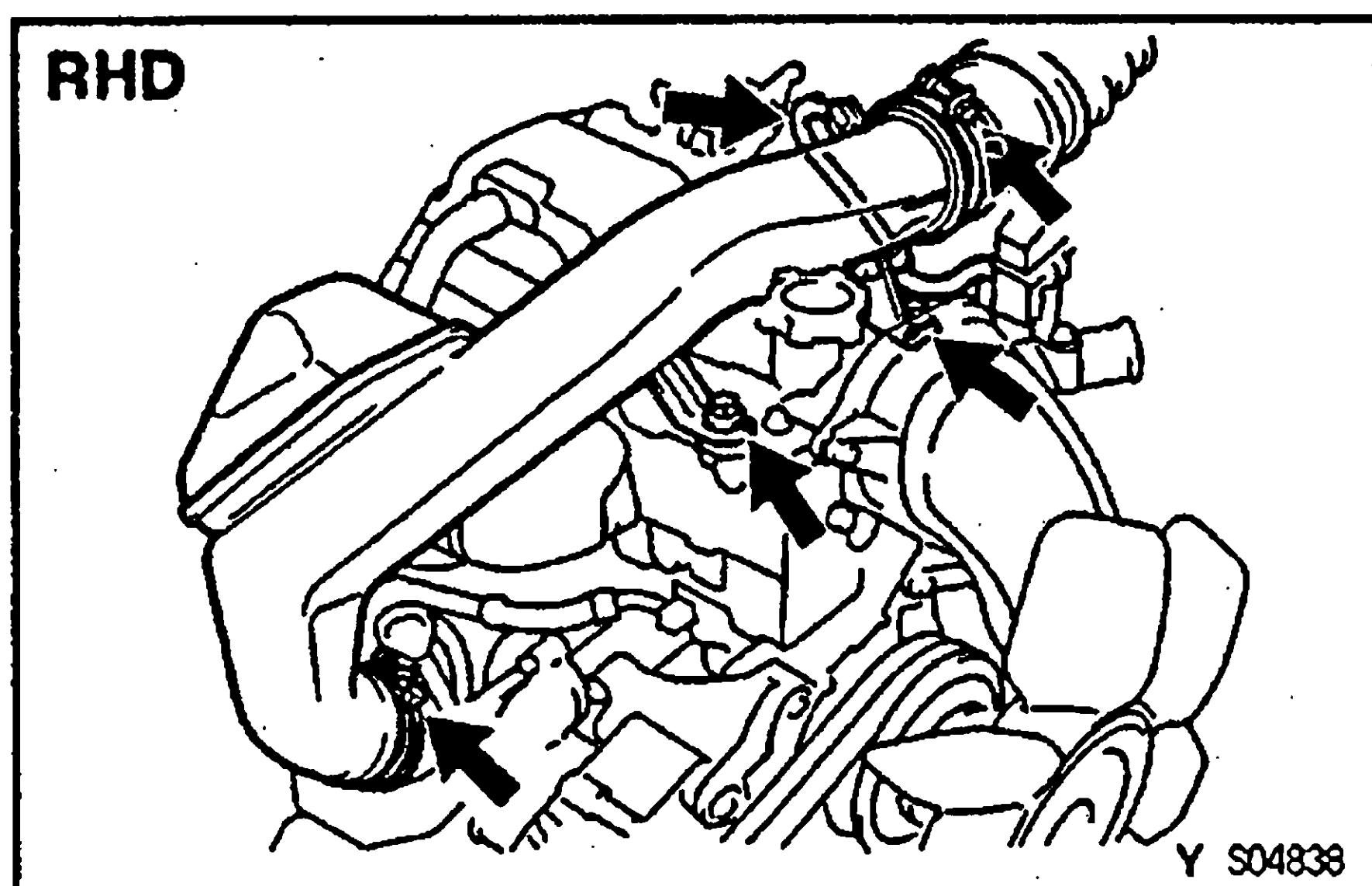
11. REINSTALL INTAKE PIPE

(See step 22 in cylinder head installation)

12. RECONNECT GLOW PLUG WIRE TO GLOW PLUG CONNECTOR**13. 1KZ—T:****RECONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR****14. 1KZ—TE:****RECONNECT INJECTION PUMP (SPILL CONTROL VALVE) CONNECTOR****15. START ENGINE AND CHECK FUEL LEAKAGE****VALVE CLEARANCE INSPECTION AND ADJUSTMENT**

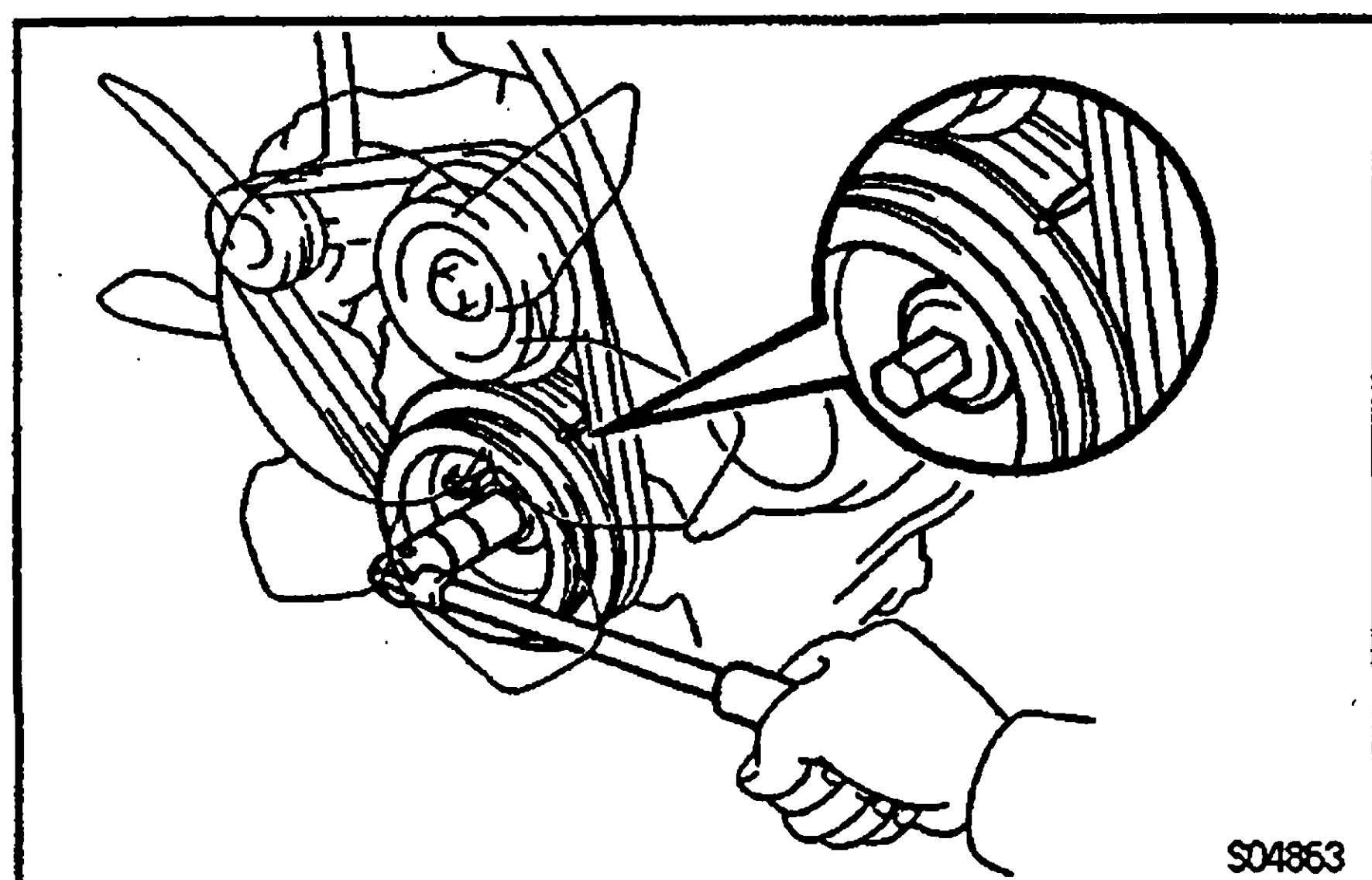
HINT: Inspect and adjust the valve clearance when the engine is cold. EG7EW-01

- 1. LHD:**
REMOVE AIR CLEANER
- 2. RHD:**
REMOVE INTAKE AIR PIPE
 - (a) Disconnect the intake air temperature sensor connector and wire harness clip.
 - (b) Remove the 2 bolts and loosen the 2 hose clamps.
 - (c) Disconnect the intake air pipe from the air cleaner hose and air inlet elbow.

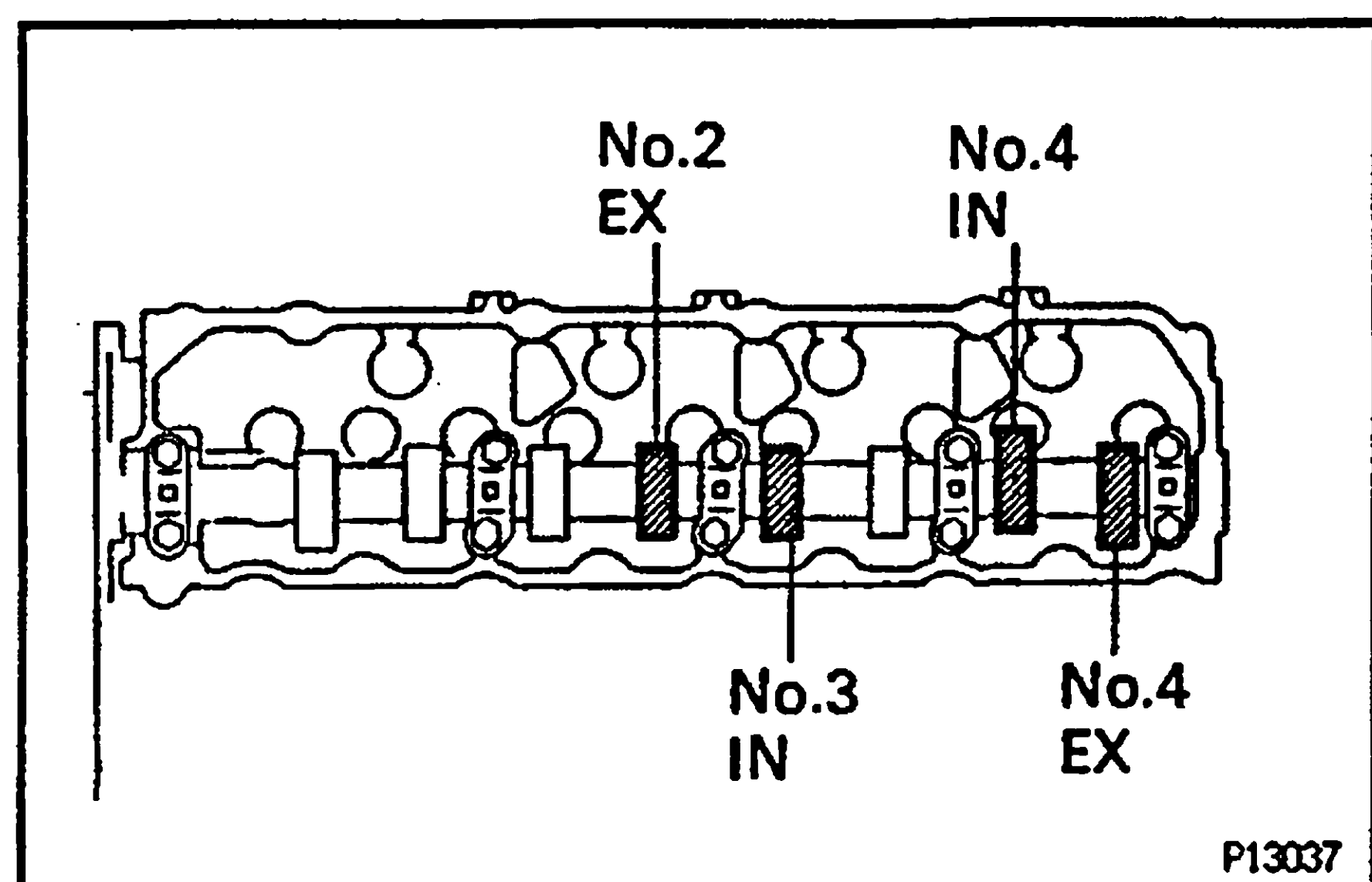


3. **REMOVE INTAKE PIPE**
(See step 2 in cylinder head removal)
4. **REMOVE CYLINDER HEAD COVER**
(See step 16 in cylinder head removal)

EG



5. **SET NO.4 CYLINDER TO TDC/COMPRESSION**
 - (a) Turn the crankshaft pulley clockwise, and align its groove with the timing pointer.
 - (b) Check that the valve lifters on the No.4 cylinder are loose and valve lifters on the No.1 cylinder are tight. If not, turn the crankshaft one revolution (360°) and align the mark as above.



6. **CHECK VALVE CLEARANCE**
 - (a) Check only the valves indicated in the illustration.
 - Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
 - Record the out — of — specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold):

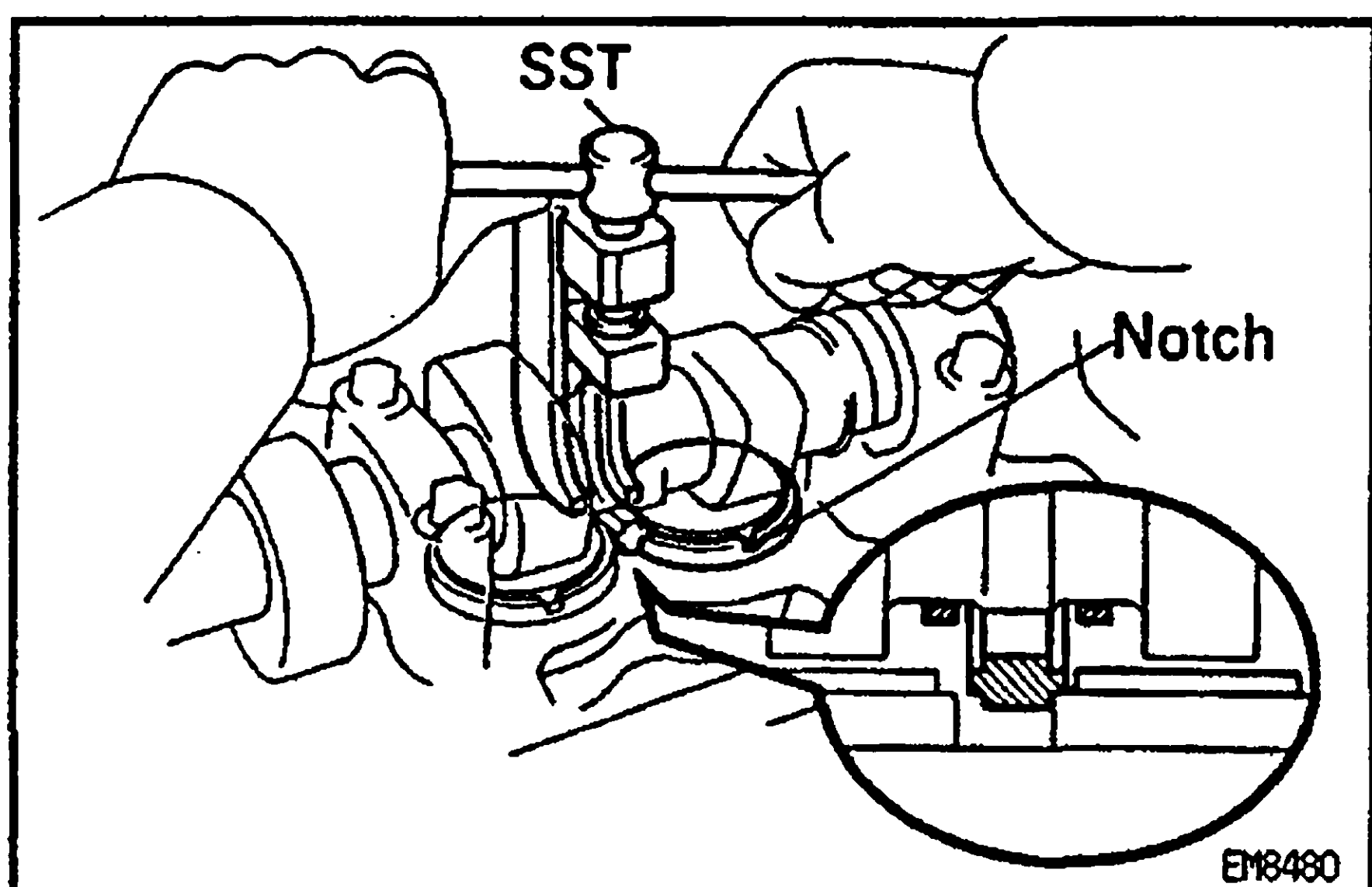
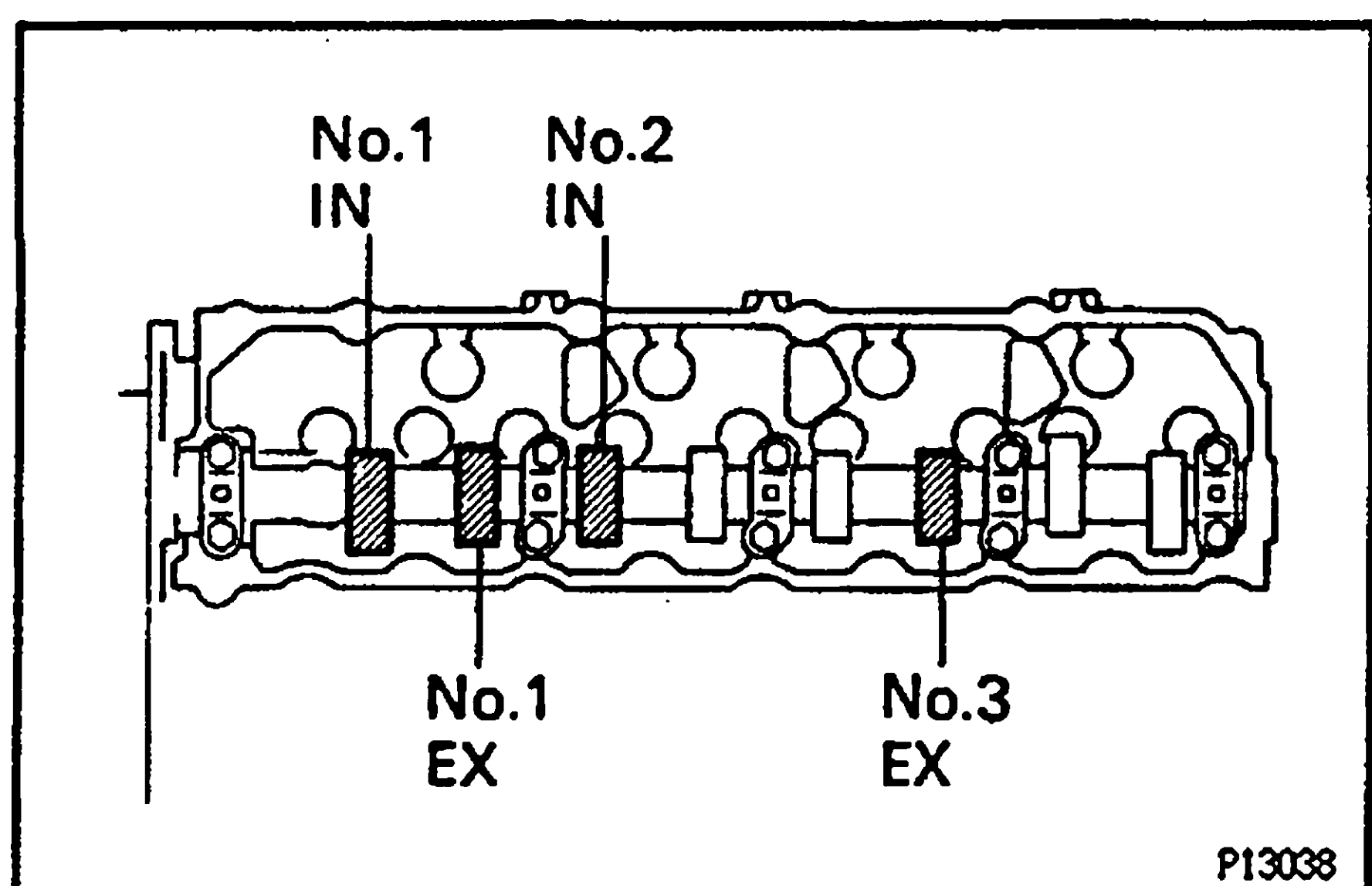
Intake

0.20 — 0.30 mm (0.008 — 0.012 in.)

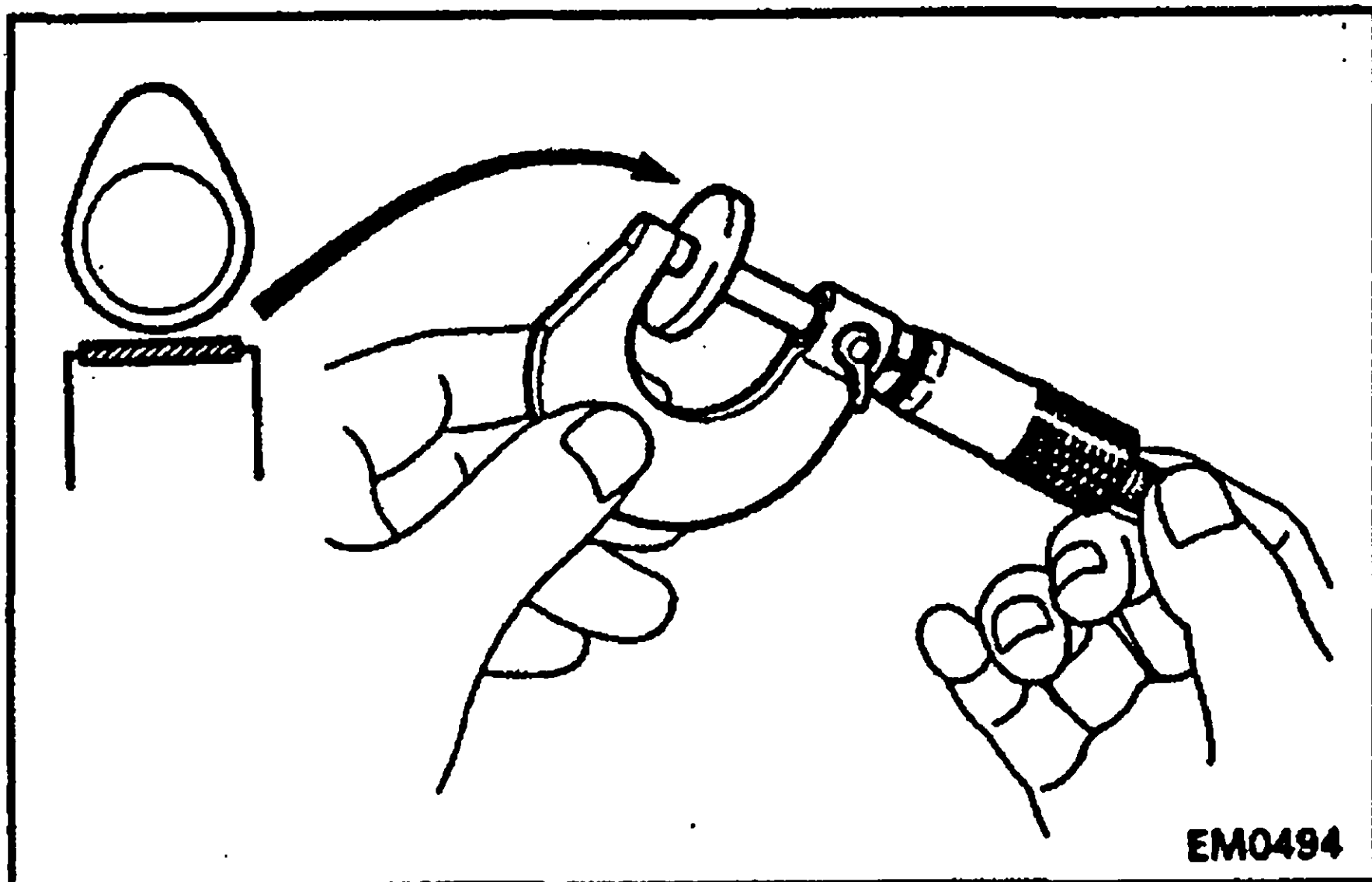
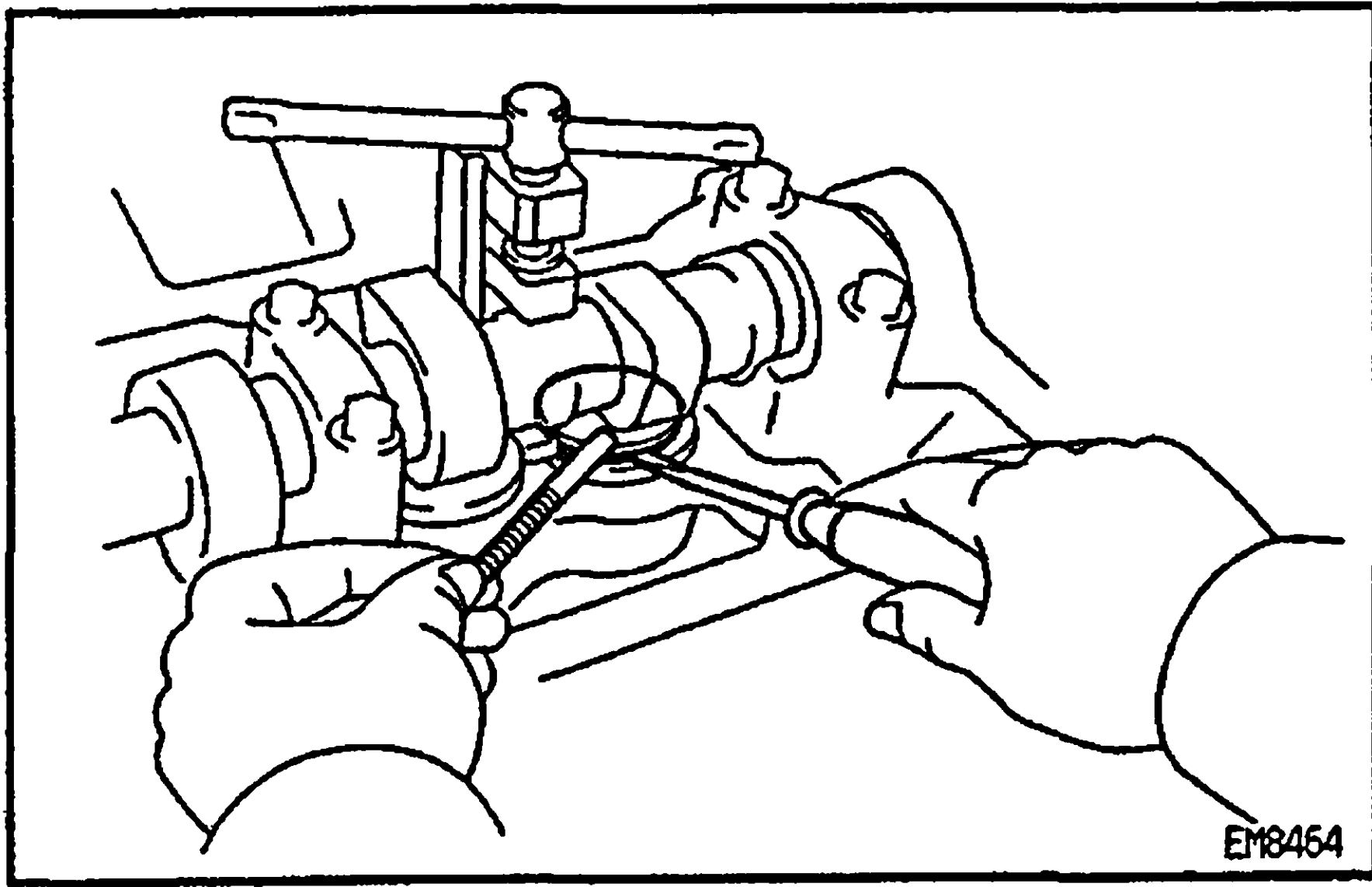
Exhaust

0.25 — 0.35 mm (0.010 — 0.014 in.)

- (b) Turn the crankshaft pulley one revolution (360°) and align the mark as above (See procedure step 5).
- (c) Check only the valves indicated as shown. Measure the valve clearance. (See procedure in step (a))



7. **ADJUST VALVE CLEARANCE**
 - (a) Remove the adjusting shim.
 - Turn the crankshaft to position the cam lobe of the camshaft on the adjusting valve upward.
 - Using SST, press down the valve lifter.
- SST 09248—64011**
- HINT:** Before pressing down the valve lifter, position the notch on the exhaust manifold side.



- (b) Determine the replacement adjusting shim size by using following the formula or charts:

- Using a micrometer, measure the thickness of the shim which was removed.
- Calculate the thickness of the new shim so the valve clearance comes within specified value.

T Thickness of removed shim

A Measured valve clearance

N Thickness of new shim

Intake:

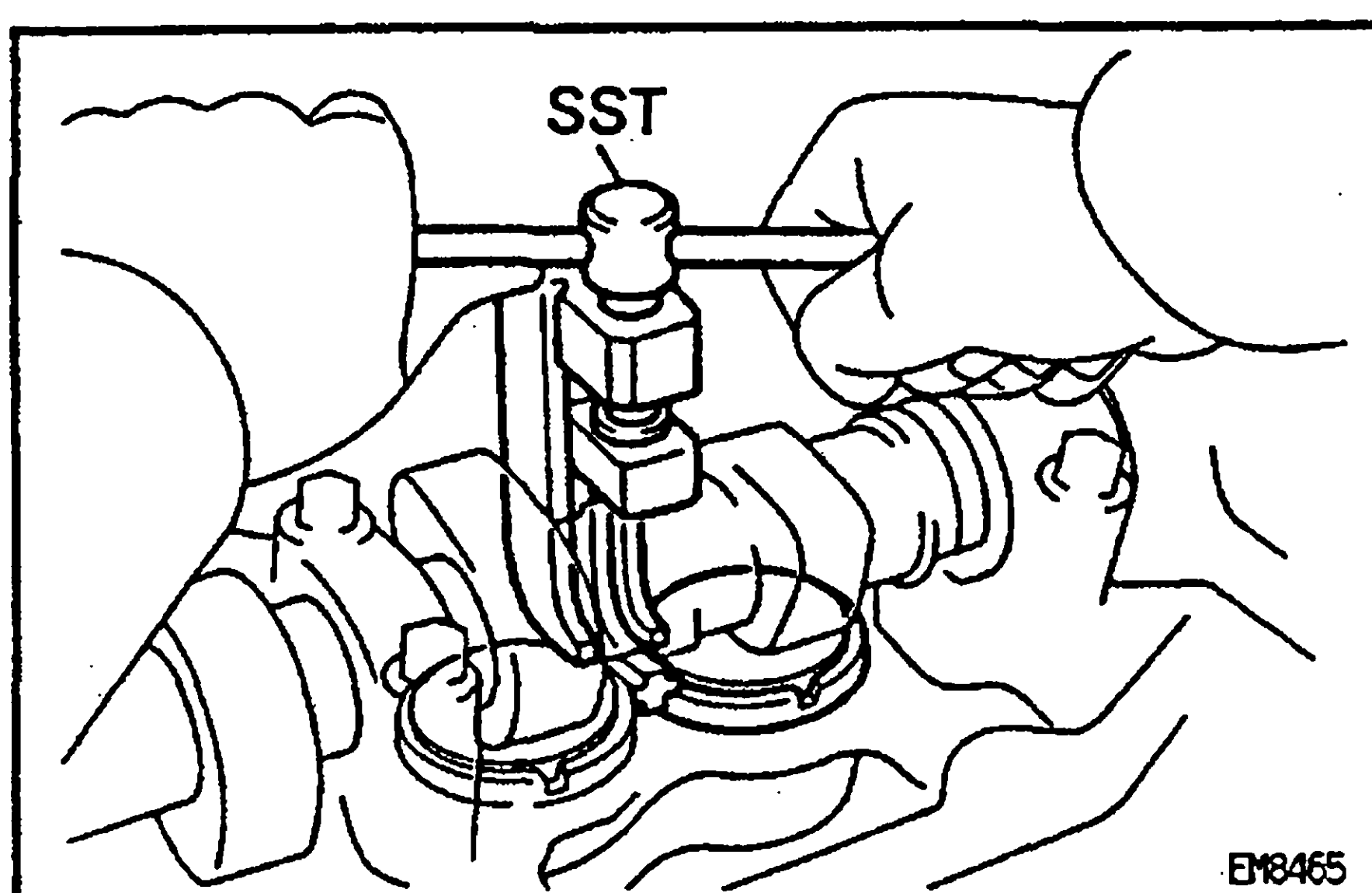
$$N = T + (A - 0.25 \text{ mm (0.010 in.)})$$

Exhaust:

$$N = T + (A - 0.30 \text{ mm (0.012 in.)})$$

- Select a new shim with a thickness as close as possible to the calculated values.

HINT: Shims are available in 17 sized in increments of 0.050 mm (0.0020 in.), from 2.500 mm (0.0984 in.) to 3.300 mm (0.1299 in.).



- (c) Install a new adjusting shim.

- Place a new adjusting shim on the valve lifter.
- Remove the SST.

SST 09248-64011

- (d) Recheck the valve clearance.

8. REINSTALL CYLINDER HEAD COVER

(See step 14 in cylinder head installation)

9. REINSTALL INTAKE PIPE

(See step 22 in cylinder head installation)

10. LHD:

REINSTALL AIR CLEANER

11. RHD:

REINSTALL INTAKE AIR PIPE

- Connect the intake air pipe to the air inlet elbow and air cleaner hose with the 2 hose clamps.
- Install the intake air pipe with the 2 bolts.
- Connect the intake air temperature sensor connector and wire harness clip.

Adjusting Shim Selection Using Chart

INTAKE

[illegible]

New shim thickness		mm (in.)	
Shim No.	Thickness	Shim No.	Thickness
01	2.50 (0.0984)	46	2.95 (0.1161)
42	2.55 (0.1004)	26	3.00 (0.1181)
06	2.60 (0.1024)	47	3.05 (0.1201)
43	2.65 (0.1043)	31	3.10 (0.1220)
11	2.70 (0.1063)	48	3.15 (0.1240)
44	2.75 (0.1083)	36	3.20 (0.1260)
16	2.80 (0.1102)	49	3.25 (0.1280)
45	2.85 (0.1122)	41	3.30 (0.1299)
21	2.90 (0.1142)		

Intake valve clearance (Cold):

0.20 – 0.30 mm (0.008 – 0.012 in.)

EXAMPLE: The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.350 mm (0.0138 in.). Replace the 2.800 mm (0.1102 in.) shim with a No.21 shim.

Adjusting Shim Selection Using Chart

EXHAUST

Measured clearance mm (in.)	Installed shim thickness mm (in.)																							
	2.50 (0.0984)	2.52 (0.0992)	2.54 (0.1000)	2.55 (0.1004)	2.56 (0.1008)	2.58 (0.1016)	2.60 (0.1024)	2.62 (0.1031)	2.64 (0.1039)	2.65 (0.1043)	2.66 (0.1047)	2.68 (0.1055)	2.70 (0.1063)	2.72 (0.1071)	2.74 (0.1079)	2.75 (0.1083)	2.76 (0.1087)	2.78 (0.1094)	2.80 (0.1102)	2.82 (0.1110)	2.84 (0.1118)	2.85 (0.1122)	2.86 (0.1126)	2.88 (0.1134)
0.000 - 0.020 (0.0000 - 0.0008)																								
0.021 - 0.040 (0.0008 - 0.0016)																								
0.041 - 0.060 (0.0016 - 0.0024)																								
0.061 - 0.080 (0.0024 - 0.0031)																								
0.081 - 0.100 (0.0032 - 0.0039)																								
0.101 - 0.120 (0.0040 - 0.0047)																								
0.121 - 0.140 (0.0048 - 0.0055)																								
0.141 - 0.160 (0.0056 - 0.0063)																								
0.161 - 0.180 (0.0063 - 0.0071)																								
0.181 - 0.200 (0.0071 - 0.0079)																								
0.201 - 0.220 (0.0079 - 0.0087)																								
0.221 - 0.240 (0.0087 - 0.0094)																								
0.241 - 0.249 (0.0095 - 0.0098)																								
0.250 - 0.350 (0.0098 - 0.0138)																								
0.351 - 0.360 (0.0138 - 0.0142)																								
0.361 - 0.380 (0.0142 - 0.0150)																								
0.381 - 0.400 (0.0150 - 0.0157)																								
0.401 - 0.420 (0.0158 - 0.0165)																								
0.421 - 0.440 (0.0166 - 0.0173)																								
0.441 - 0.460 (0.0174 - 0.0181)																								
0.461 - 0.480 (0.0181 - 0.0189)																								
0.481 - 0.500 (0.0189 - 0.0197)																								
0.501 - 0.520 (0.0197 - 0.0205)																								
0.521 - 0.540 (0.0205 - 0.0213)																								
0.541 - 0.560 (0.0213 - 0.0220)																								
0.561 - 0.580 (0.0221 - 0.0228)																								
0.581 - 0.600 (0.0229 - 0.0236)																								
0.601 - 0.620 (0.0237 - 0.0244)																								
0.621 - 0.640 (0.0244 - 0.0252)																								
0.641 - 0.660 (0.0252 - 0.0260)																								
0.661 - 0.680 (0.0260 - 0.0268)																								
0.681 - 0.700 (0.0268 - 0.0276)																								
0.701 - 0.720 (0.0276 - 0.0283)																								
0.721 - 0.740 (0.0284 - 0.0291)																								
0.741 - 0.760 (0.0292 - 0.0299)																								
0.761 - 0.780 (0.0300 - 0.0307)																								
0.781 - 0.800 (0.0307 - 0.0315)																								
0.801 - 0.820 (0.0315 - 0.0323)																								
0.821 - 0.840 (0.0323 - 0.0331)																								
0.841 - 0.860 (0.0331 - 0.0339)																								
0.861 - 0.880 (0.0339 - 0.0346)																								
0.881 - 0.900 (0.0347 - 0.0354)																								
0.901 - 0.920 (0.0355 - 0.0362)																								
0.921 - 0.940 (0.0363 - 0.0370)																								
0.941 - 0.960 (0.0370 - 0.0378)																								
0.961 - 0.980 (0.0378 - 0.0386)																								
0.981 - 1.000 (0.0386 - 0.0394)																								
1.001 - 1.020 (0.0394 - 0.0402)																								
1.021 - 1.040 (0.0402 - 0.0409)																								
1.041 - 1.060 (0.0410 - 0.0417)																								
1.061 - 1.080 (0.0418 - 0.0425)																								
1.081 - 1.100 (0.0426 - 0.0433)																								
1.101 - 1.120 (0.0433 - 0.0441)																								
1.121 - 1.140 (0.0441 - 0.0449)																								
1.141 - 1.150 (0.0449 - 0.0453)																								

New shim thickness mm (in.)			
Shim No.	Thickness	Shim No.	Thickness
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44	2.75 (0.1083)	36	3.20 (0.1260)
16	2.80 (0.1102)	49	3.25 (0.1280)
45	2.85 (0.1122)	41	3.30 (0.1299)
21	2.90 (0.1142)		

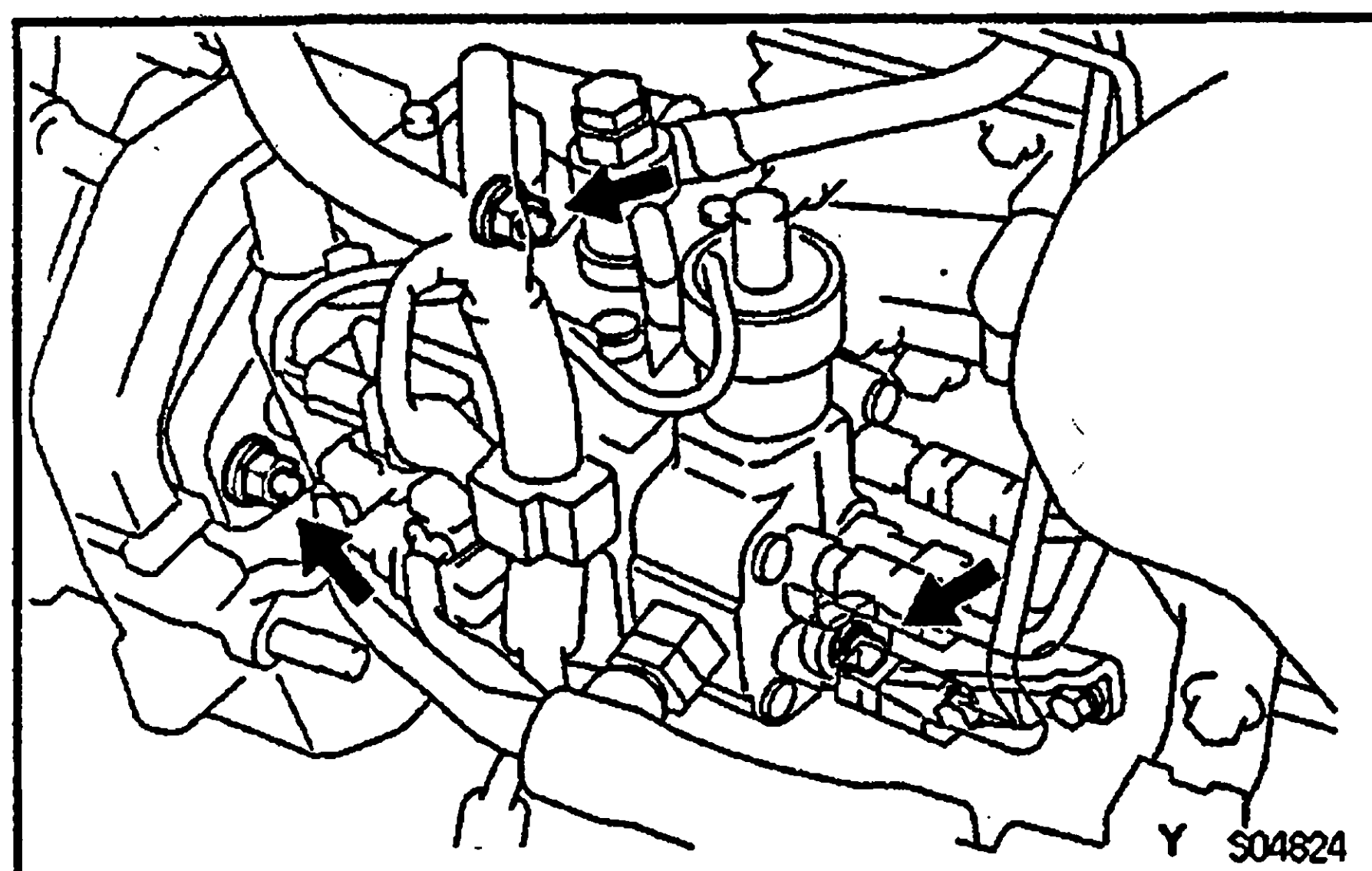
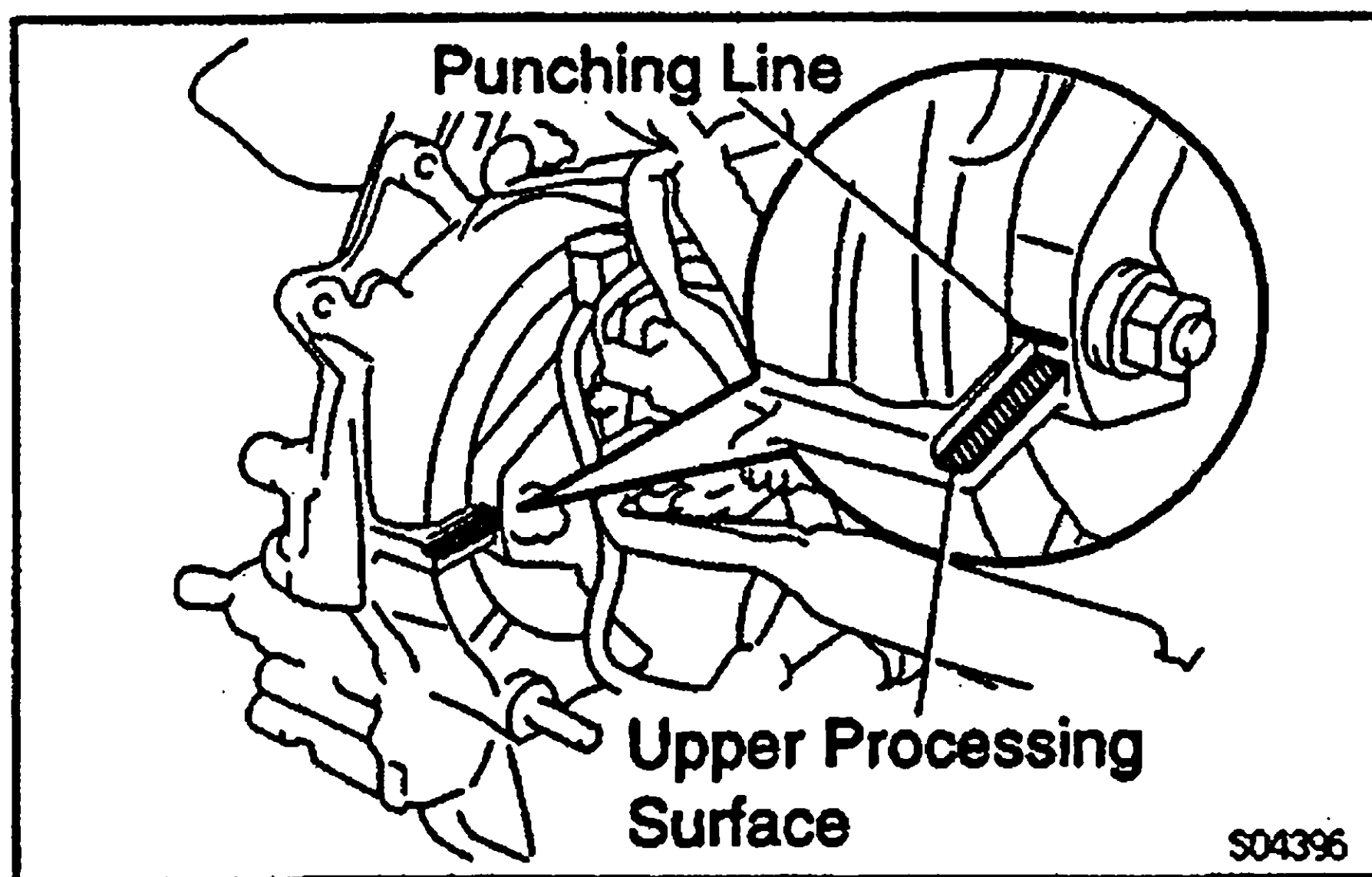
Exhaust valve clearance (Cold):

0.25 - 0.35 mm (0.010 - 0.014 in.)

EXAMPLE: The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.390 mm (0.0154 in.).

Replace the 2.900 mm (0.1142 in.) shim with a No.11 shim.

EG



INJECTION TIMING INSPECTION AND ADJUSTMENT (1KZ—TE)

887EX-01

1. INSPECT INJECTION TIMING

Using mirror, check that the punching line of the injection pump flange and the upper processing surface of the timing gear case aligned.

2. ADJUST INJECTION TIMING

(a) Loosen these nuts and bolt:

- Bolt holding injection pump to injection pump stay
- 2 nuts holding injection pump to timing gear case

(b) Align the punching line and upper processing surface by slightly tilting the injection pump.

(c) Tighten these nuts and bolt:

- 2 nuts holding injection pump to timing gear case
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)
- Bolt holding injection pump to injection pump stay

Torque: 32 N·m (330 kgf·cm, 24 ft·lbf)

IDLE SPEED AND MAXIMUM SPEED INSPECTION (1KZ—TE)

887EY-01

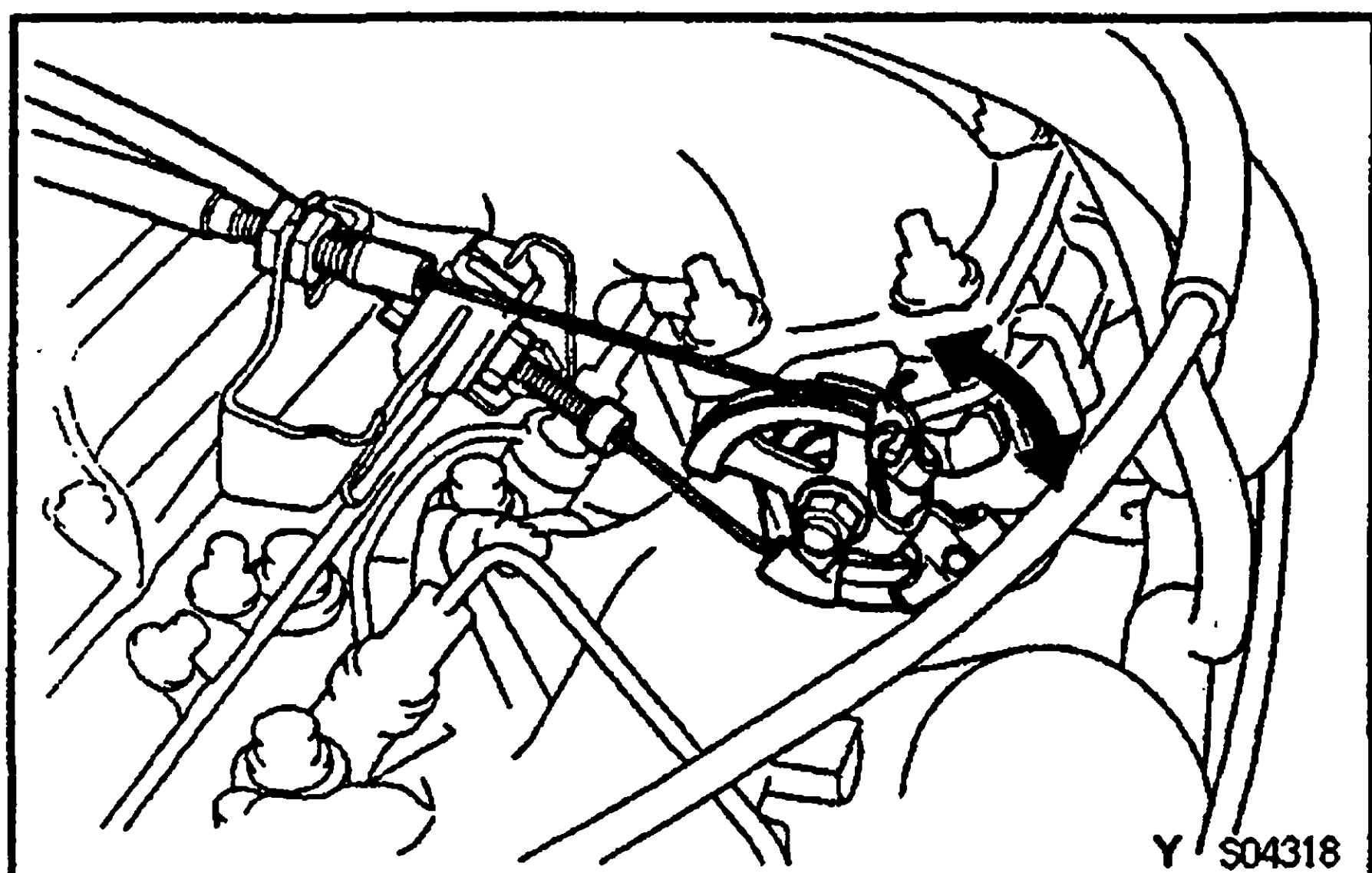
1. INITIAL CONDITIONS

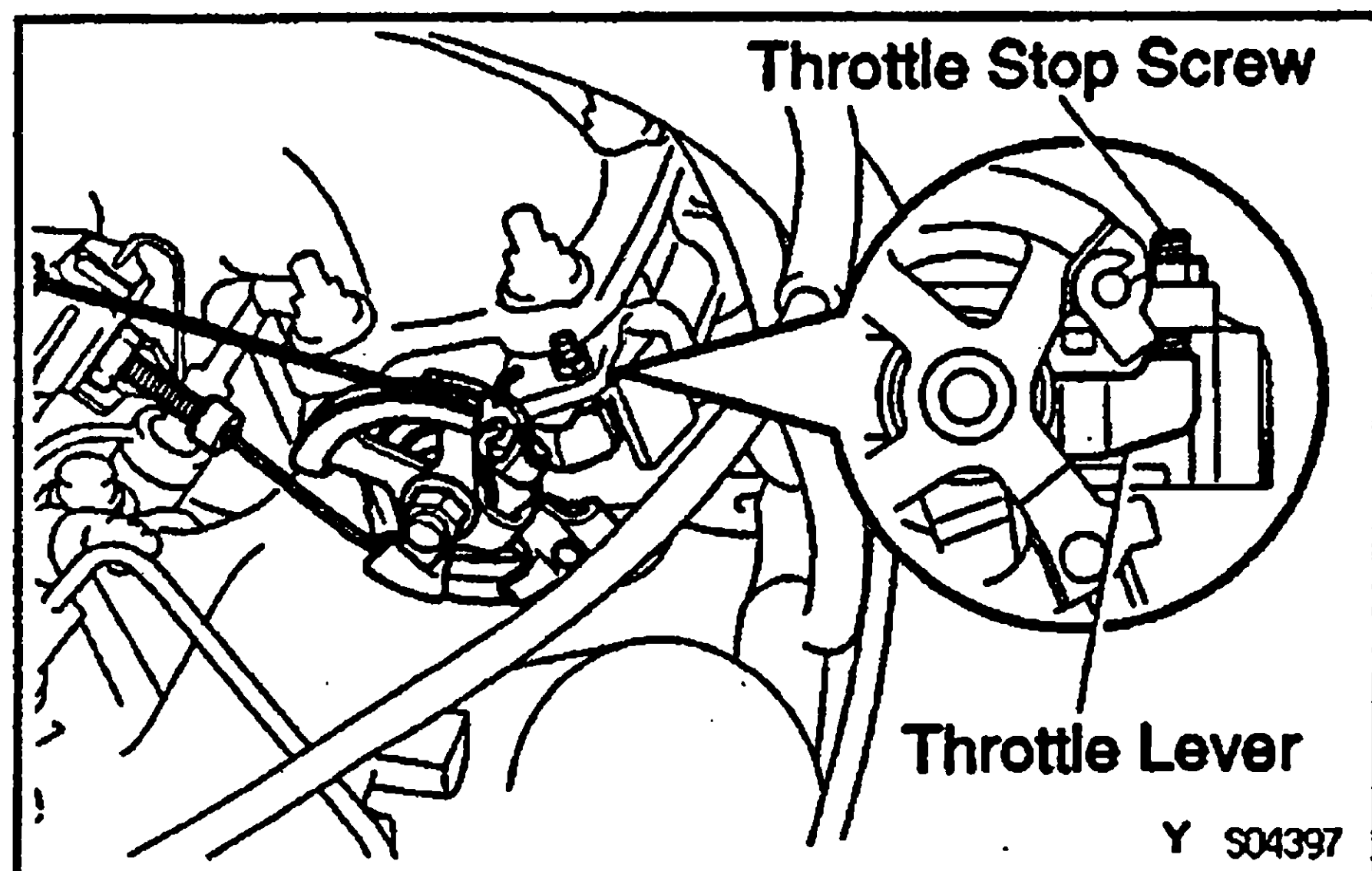
- Engine at normal operating temperature
- Air cleaner installed
- All pipes and hoses of air induction system connected
- All accessories switched OFF
- All vacuum lines properly connected
- ECD system wiring connectors fully plugged
- Valve clearance set correctly
- Injection timing set correctly
- A/T:
Transmission is neutral position

2. CONNECT TACHOMETER

3. INSPECT IDLE SPEED

- Check that the throttle linkage move smoothly.





- (b) Check that the throttle lever touches throttle stop screw when the accelerator pedal is released.
- (c) Start the engine.
- (d) Check the idle speed.

Idle speed:

650 — 750 rpm

If the idle speed is not as specified, check the troubleshooting in ECD System.

4. INSPECT MAXIMUM SPEED

- (a) Depress the accelerator pedal all the way.
- (b) Check the maximum speed.

Maximum speed:

4,500 — 4,700 rpm

If the maximum speed is not as specified, replace the injection pump.

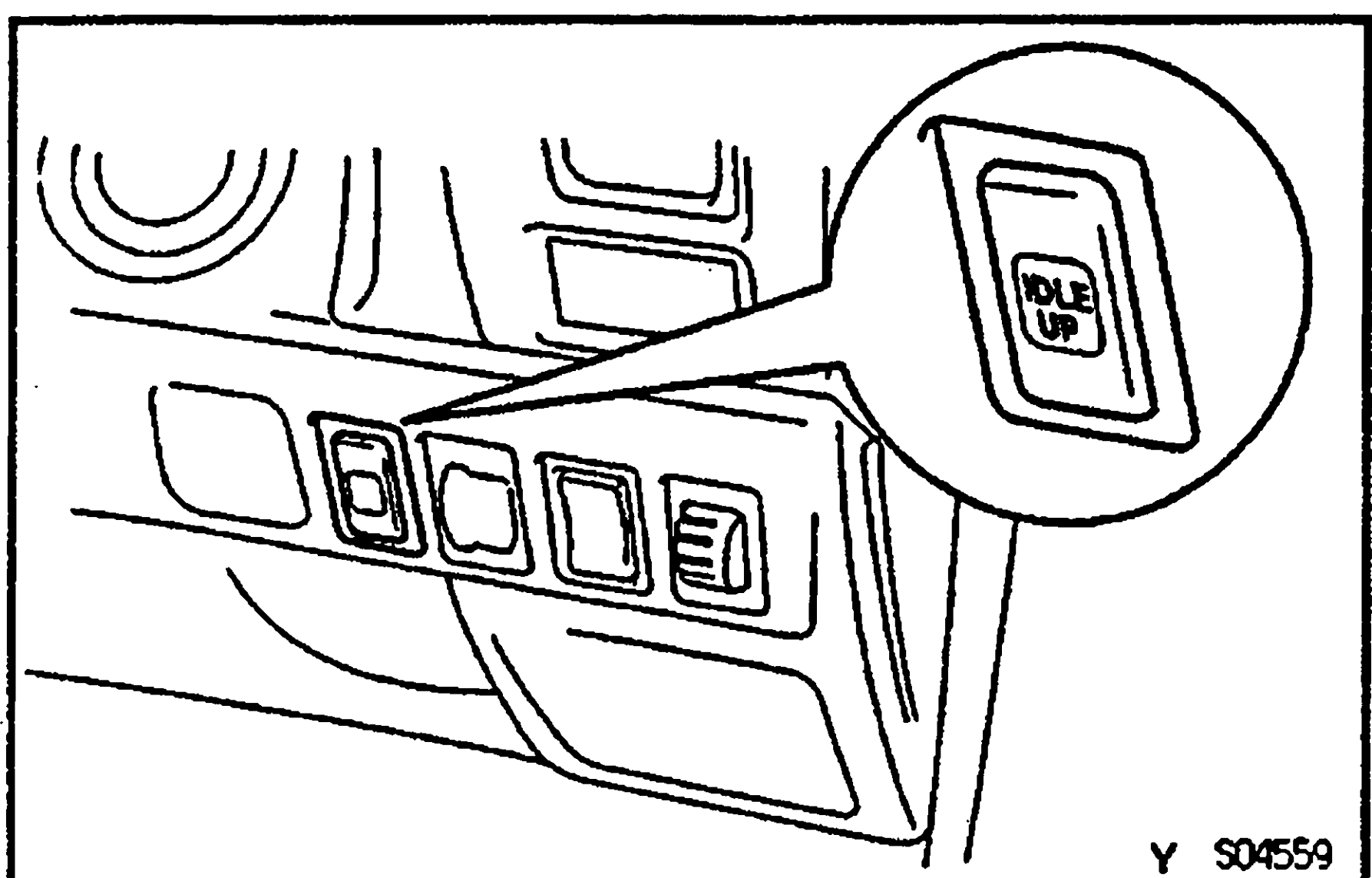
HEATER IDLE—UP SPEED INSPECTION (1KZ—TE)

EG7KZ-01

1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All pipes and hoses of air induction system connected
- (d) All accessories switched OFF
- (e) All vacuum lines properly connected
- (f) ECD system wiring connectors fully plugged
- (g) Valve clearance set correctly
- (h) Injection timing set correctly
- (i) Idle speed set correctly
- (j) A/T:
Transmission is neutral position

2. CONNECT TACHOMETER



3. INSPECT HEATER IDLE—UP SPEED

- (a) Start the engine.
- (b) Push on the heater idle—up switch.
- (c) Check the heater idle—up speed.

Heater idle—up speed:

1,150 — 1,250 rpm

If the heater idle—up speed is not specified, check the troubleshooting in ECD System.

A/C IDLE—UP SPEED INSPECTION (1KZ—TE)

88778-01

1. INITIAL CONDITIONS

(See heater idle—up speed inspection (1KZ—TE))

2. CONNECT TACHOMETER

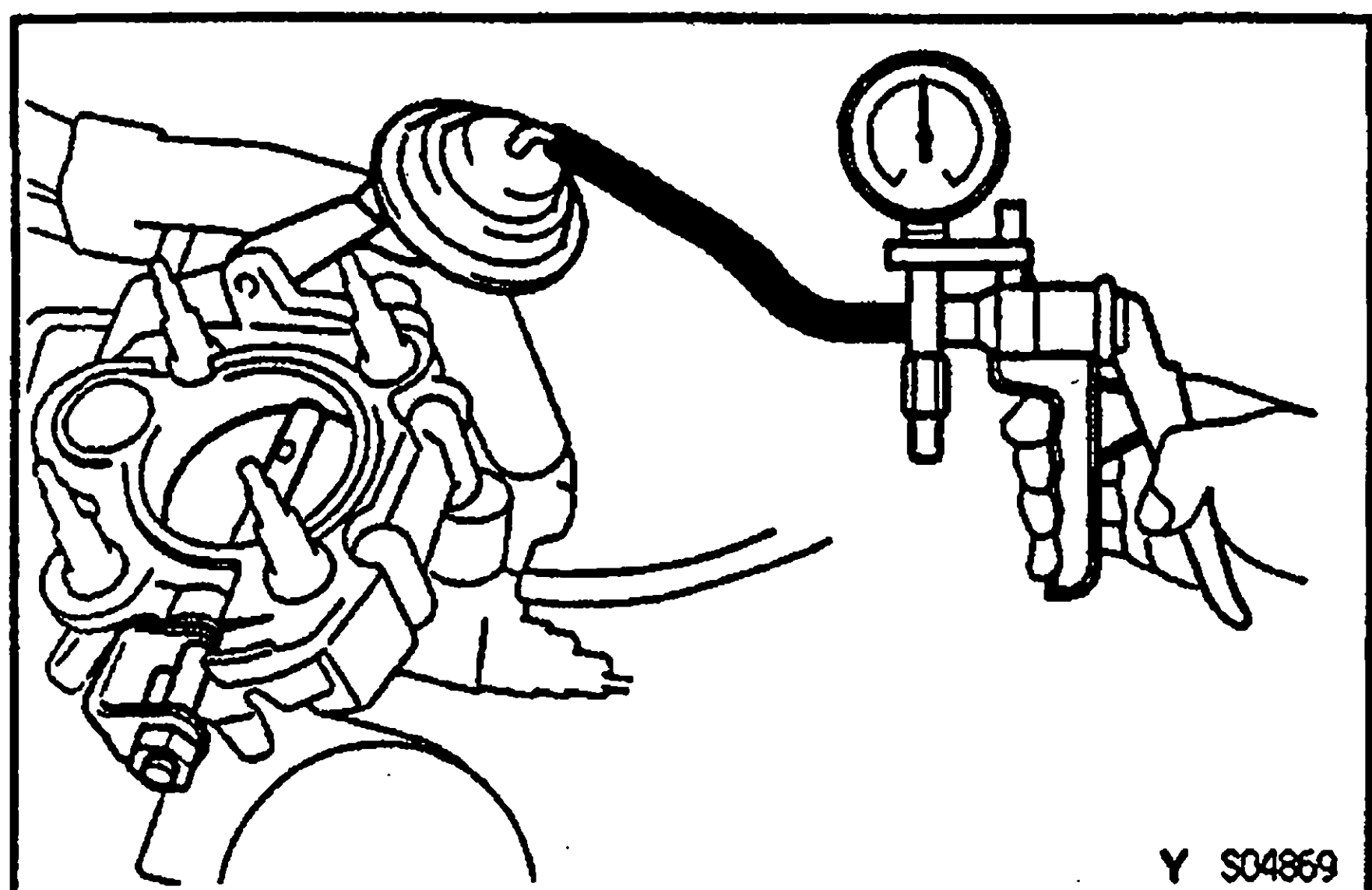
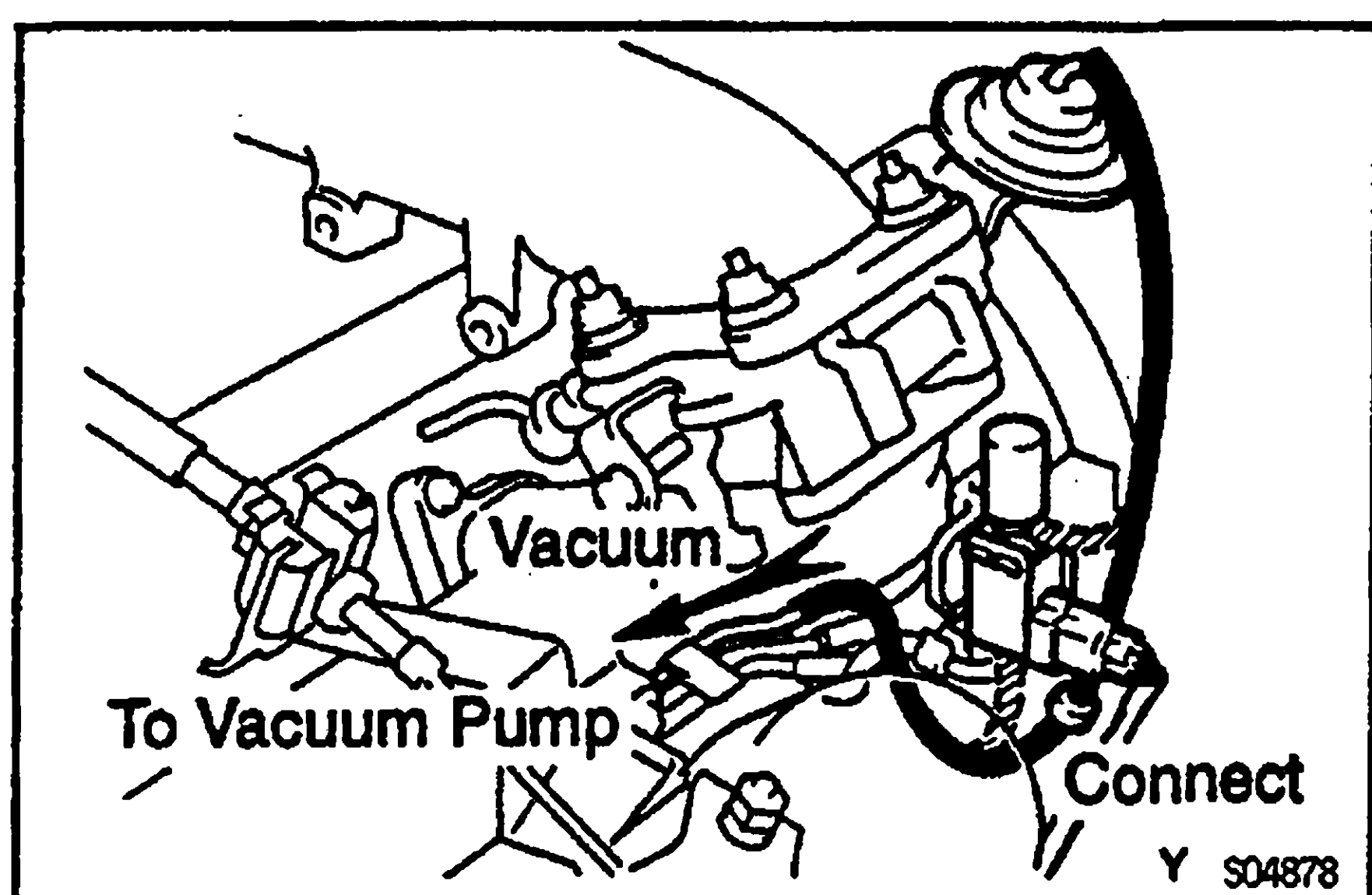
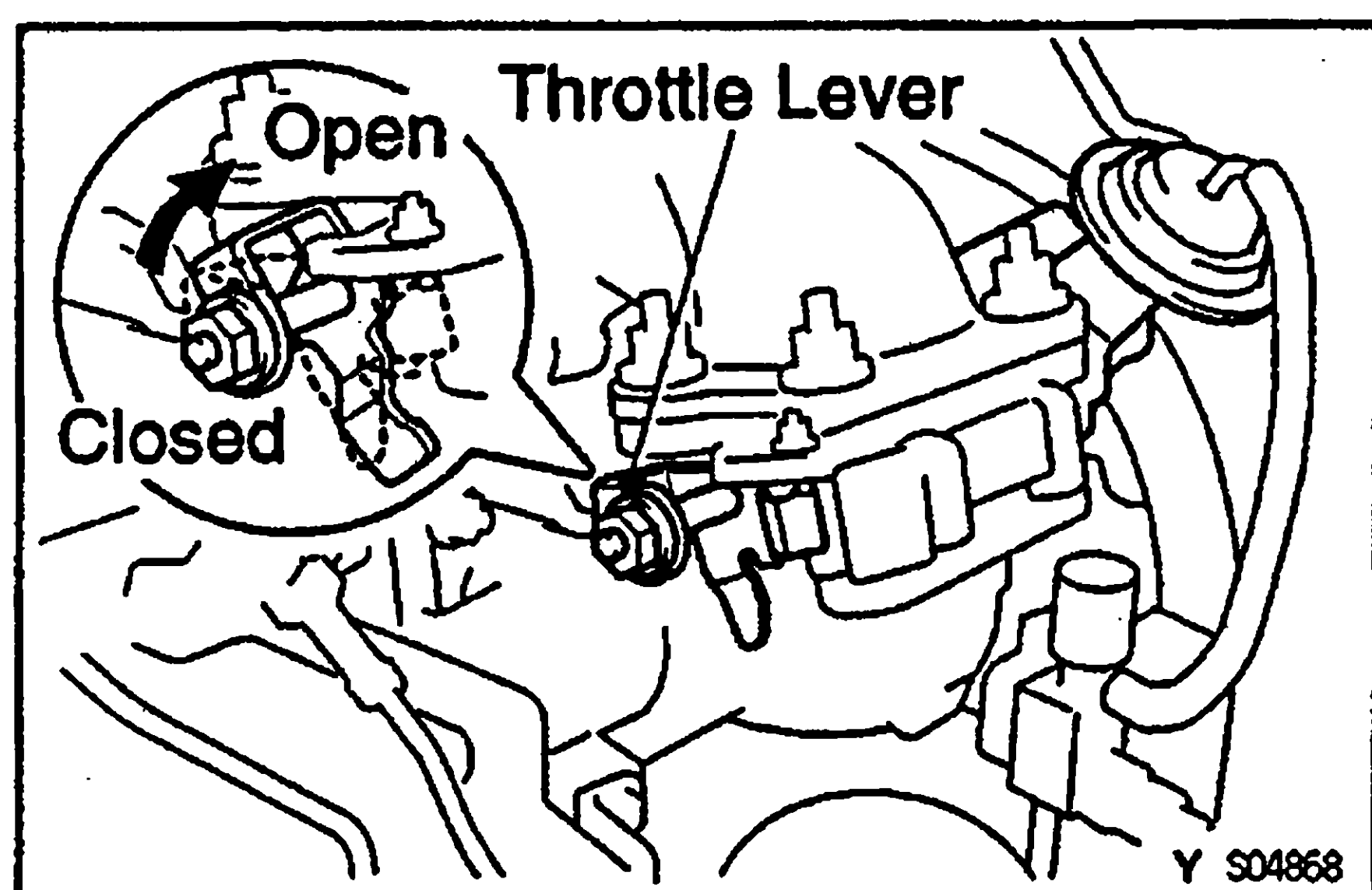
3. INSPECT A/C IDLE—UP SPEED

- Start the engine.
- Push on the A/C switch.
- Check the A/C idle—up speed.

A/C idle—up speed:

750 — 850 rpm

If the A/C idle—up speed is not specified, check the troubleshooting in ECD System.



INTAKE SHUTTER INSPECTION (1KZ—T)

88771-01

INTAKE SHUTTER INSPECTION

1. INSPECT INTAKE SHUTTER OPERATION

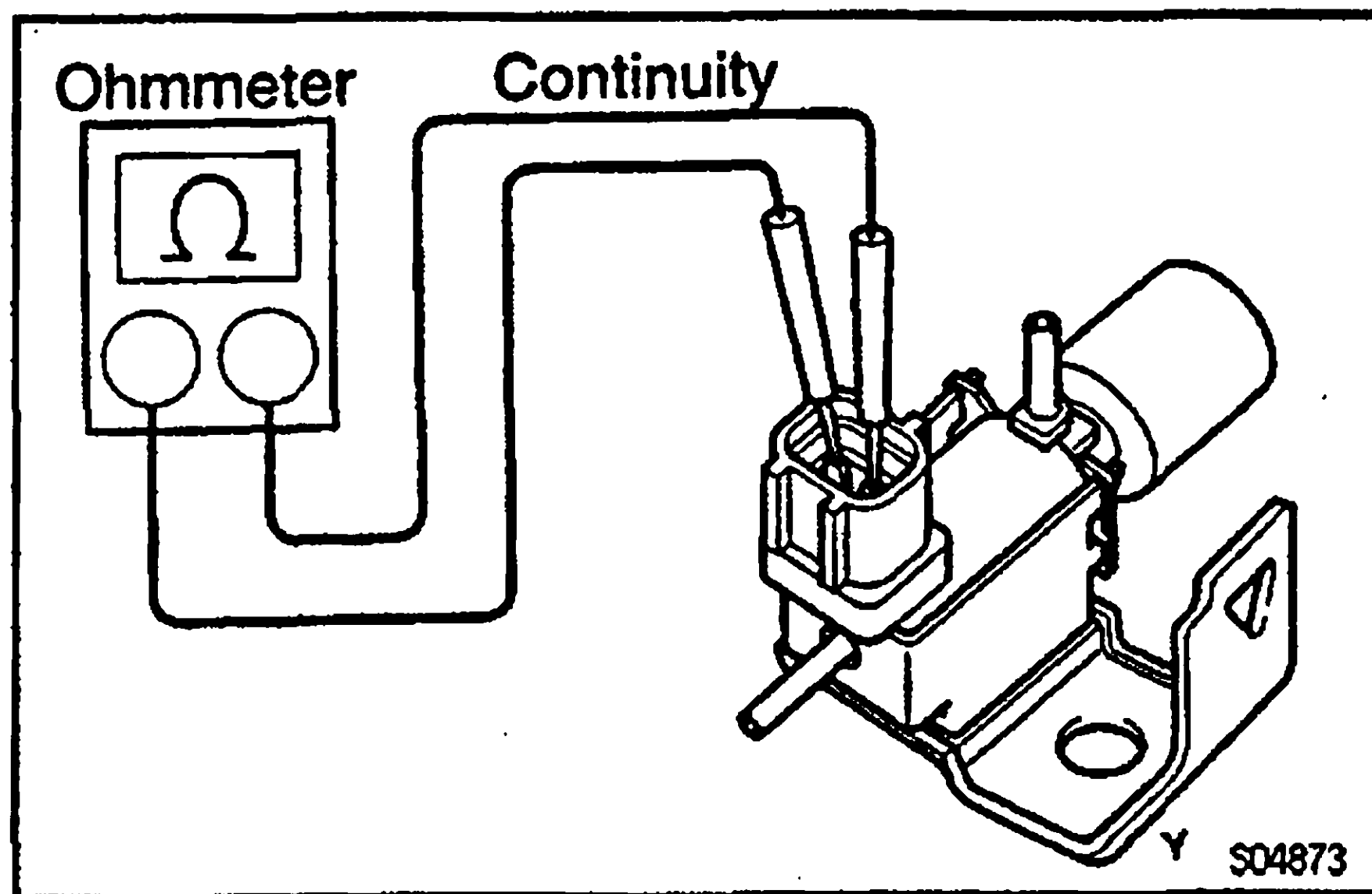
- Start the engine.
- When running the engine, check the throttle lever is fully open position.
- When the engine stops (IG OFF), check that the throttle lever is fully closed position.
- A few seconds after the engine stops (IG OFF), check that the throttle lever is fully open position.

2. INSPECT VENTURI

- Start the engine.
- Disconnect the vacuum hoses from the VSV.
- Apply vacuum directly to the actuator with the engine idling.
- Check that the engine runs rough or dies.
- Reconnect the vacuum hoses to the proper locations.

3. INSPECT THROTTLE VALVE

- Remove the intake pipe.
(See step 2 in cylinder head removal)
- Fully close the throttle valve, and check that it return smoothly.
- Apply at least 29.3 kPa (220 mmHg, 8.66 in.Hg) of vacuum to the actuator.
- Check that the vacuum does not drop immediately.
- Install the intake pipe.
(See step 22 in cylinder head installation)

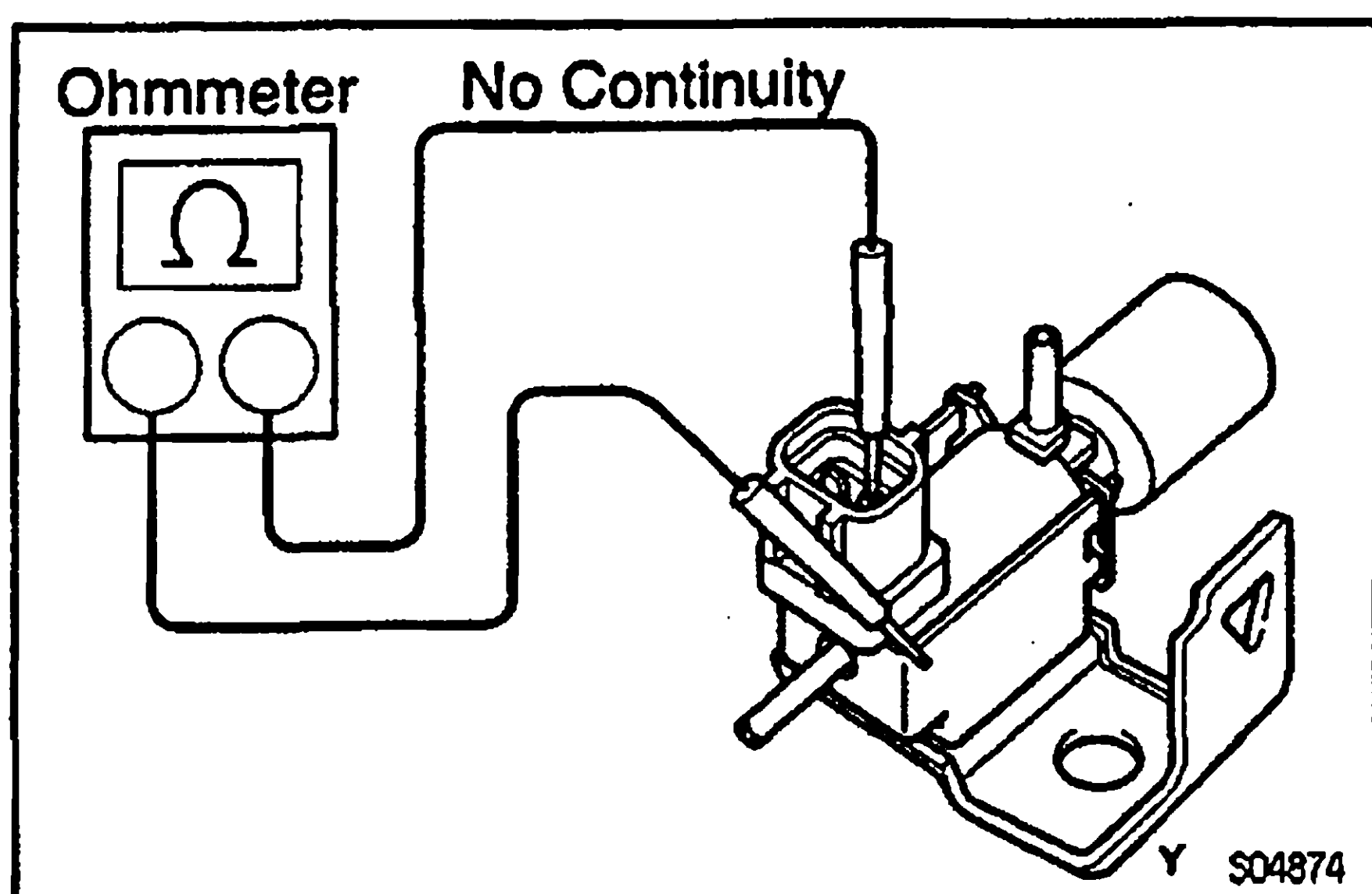
**4. INSPECT VSV****A. Inspect VSV for open circuit**

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

Resistance:

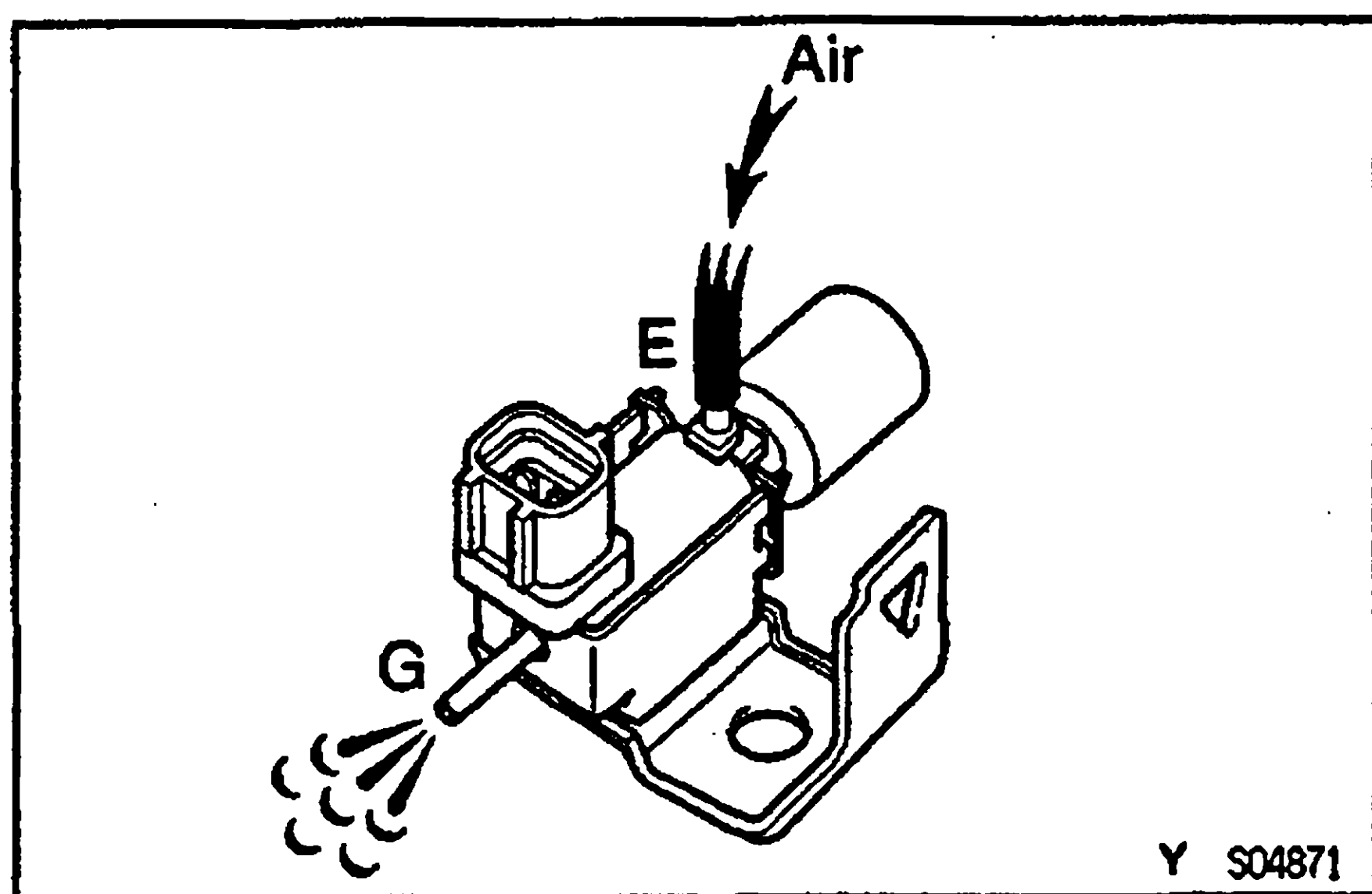
37 — 44 Ω at 20°C (68°F)

If there is no continuity, replace the VSV.

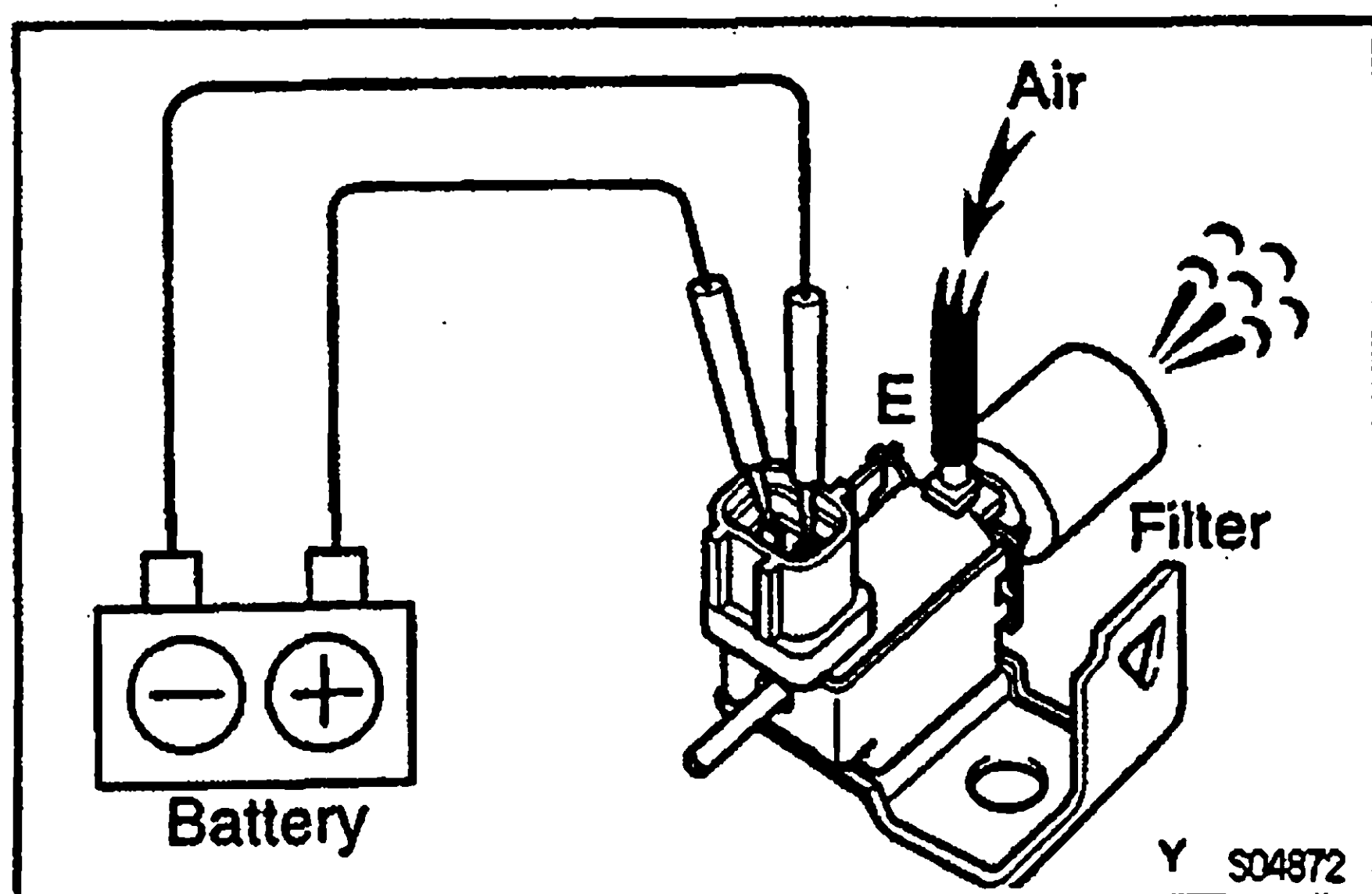
**B. Inspect VSV for ground**

Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.

**C. Inspect VSV operation**

(a) Check that air flows from port E to port G.



(b) Apply battery positive voltage across the terminals.

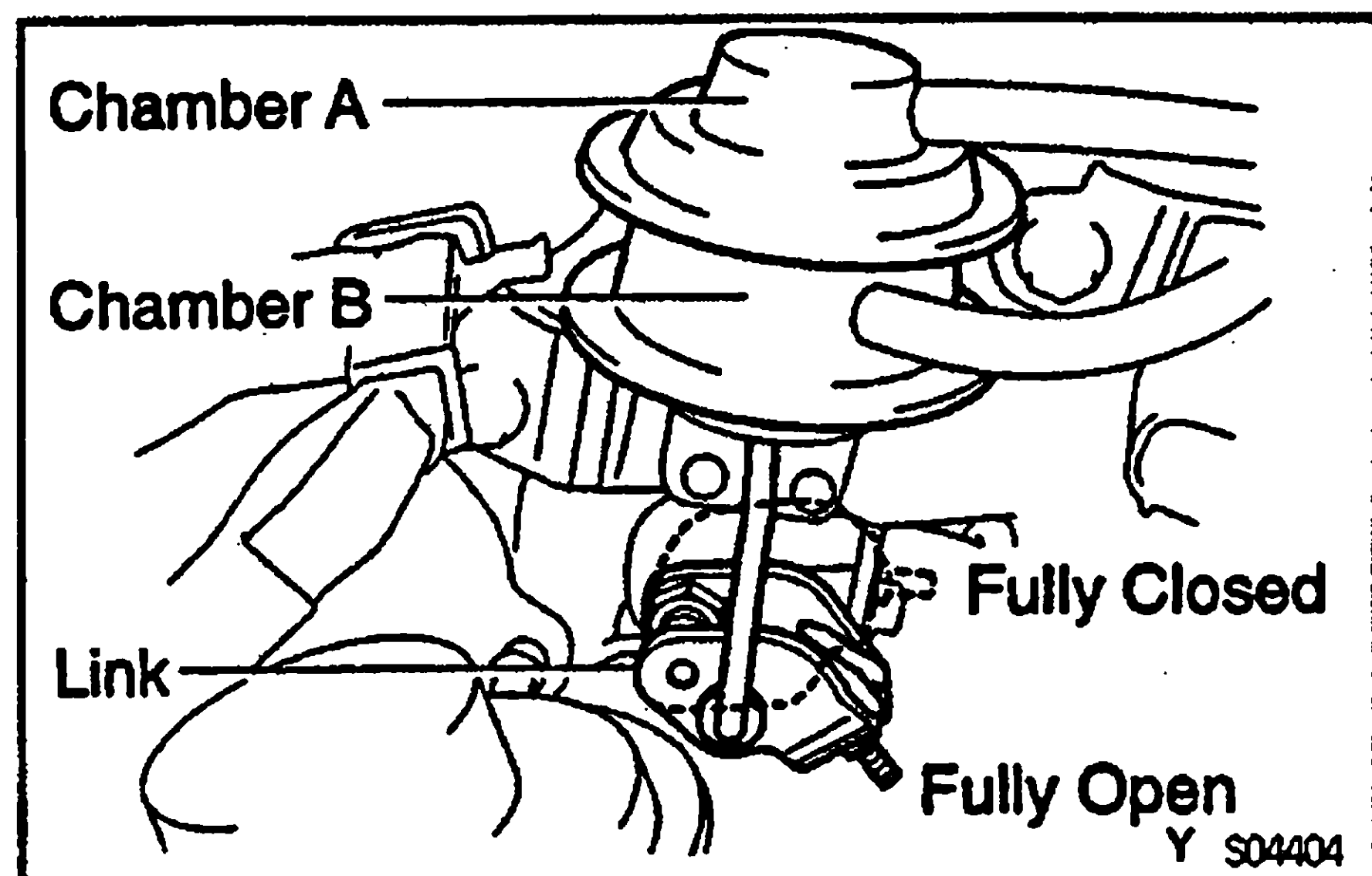
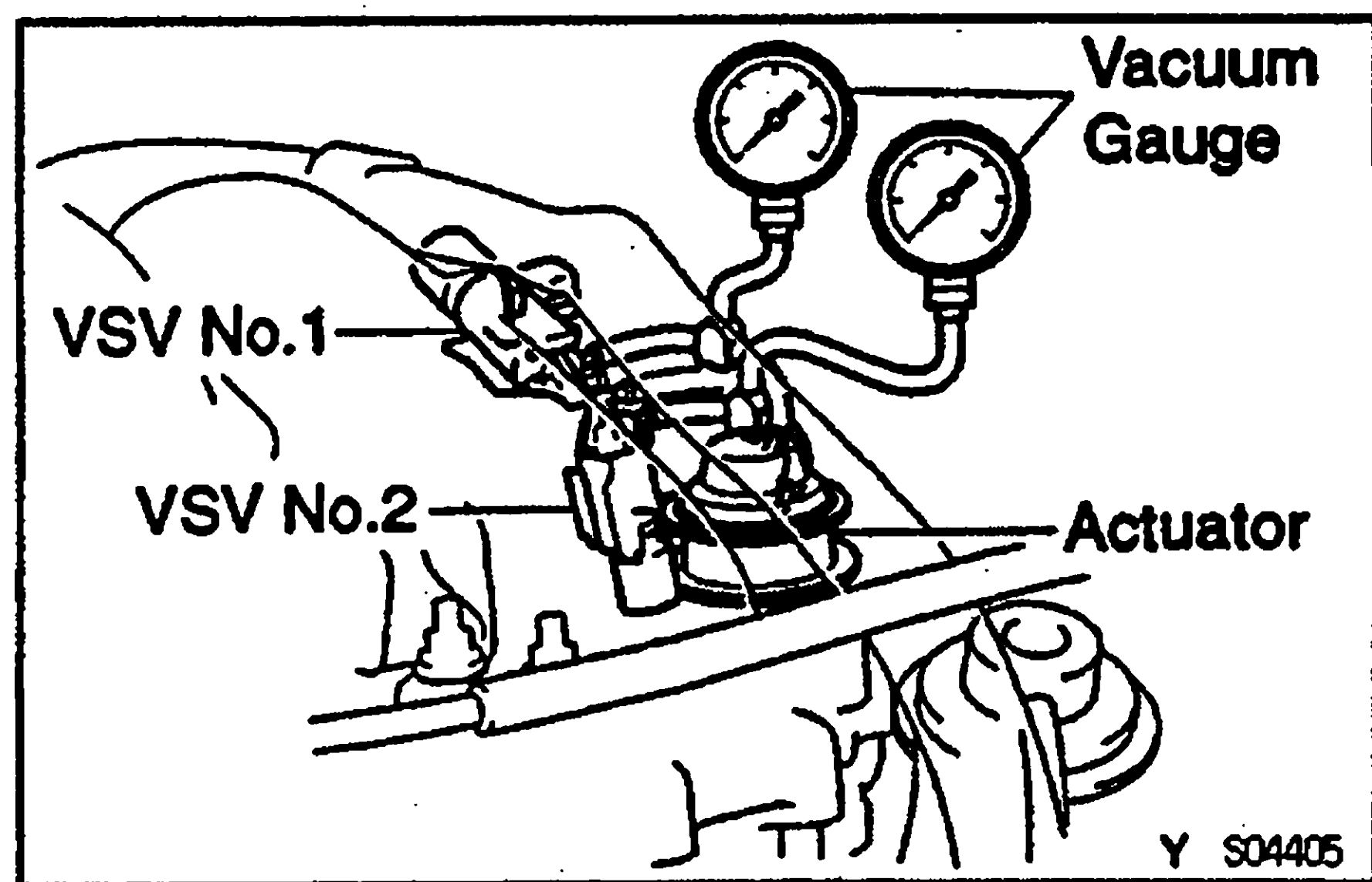
(c) Check that air flows from port E to the filter.

If operation is not as specified, replace the VSV.

INTAKE CONSTRICTOR CONTROL INSPECTION (1KZ—TE)

1. INITIAL CONDITIONS

(See heater idle—up speed inspection (1KZ—TE))



2. CONNECT VACUUM GAUGES

Using a 3-way connector, connect a vacuum gauge to the hose between the actuator and VSV.

NOTICE: Always stop the engine when installing or removing the vacuum gauges, or removing the vacuum hoses.

3. INSPECT COLD ENGINE CONDITION

- (a) Start the engine.
- (b) Check that the vacuum gauge in the chambers A and B will not move.

HINT: As no vacuum is loaded in the chamber, sub-throttle valve is fully open.

- (c) Check the lever link position of the illustration.

Standard:

Link is levered lowest position.

(Same position as that before starting)

4. INSPECT HOT ENGINE CONDITION

- (a) Check that the vacuum gauge in the chambers A and B will not move during idling.

HINT: As no vacuum is loaded in the chamber, sub-throttle valve is fully open.

- (b) When opening the throttle valve from idling condition, check that the vacuum gauges of chambers A and B will raise.

- (c) Check the link position of the lower diaphragm.

Standard:

Link is lowered to lowest position.

(Same position as that before starting)

- (d) When the engine stops (IG OFF) from idling condition, check that the vacuum gauges in chambers A and B will rise.

- (e) Check the link position of the lower diaphragm.

Standard:

Link is raised to highest position.

HINT: Vacuum is loaded in the chambers A and B of the diaphragm and sub-throttle valve will fully closed.

- (f) A few seconds after the engine stops (IG OFF), check that the vacuum gauges in the chambers A and B is at zero.

- (g) Check the link position of the lower diaphragm.

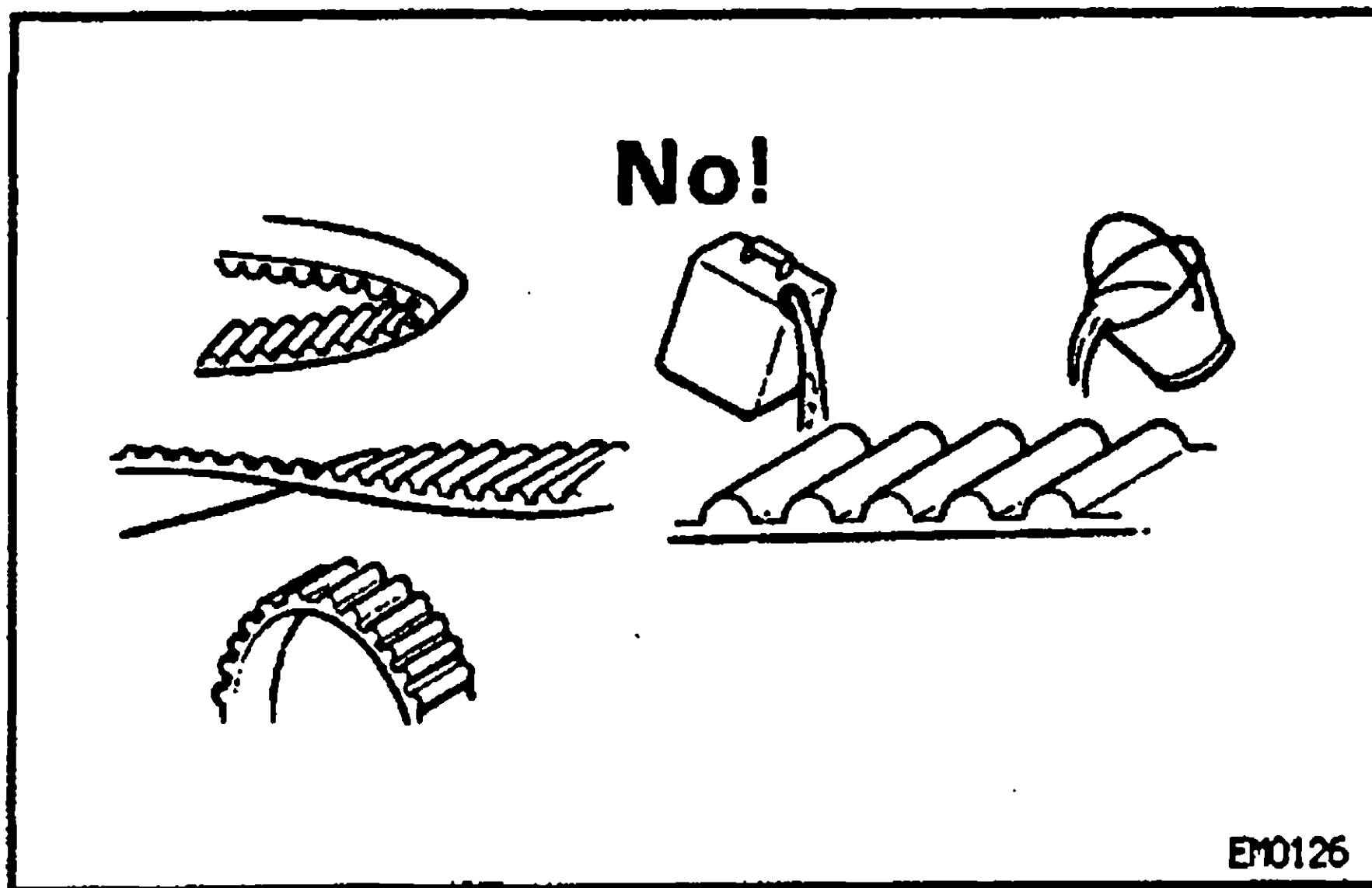
Standard:

Link is lowered to lowest position.

HINT: As the vacuum does not act in the chamber, sub-throttle valve is fully open.

5. REMOVE VACUUM GAUGE

Remove the vacuum gauge, and reconnect the vacuum hoses to the proper locations.



TIMING BELT

TIMING BELT COMPONENTS INSPECTION ^{EG773-01}

1. INSPECT TIMING BELT

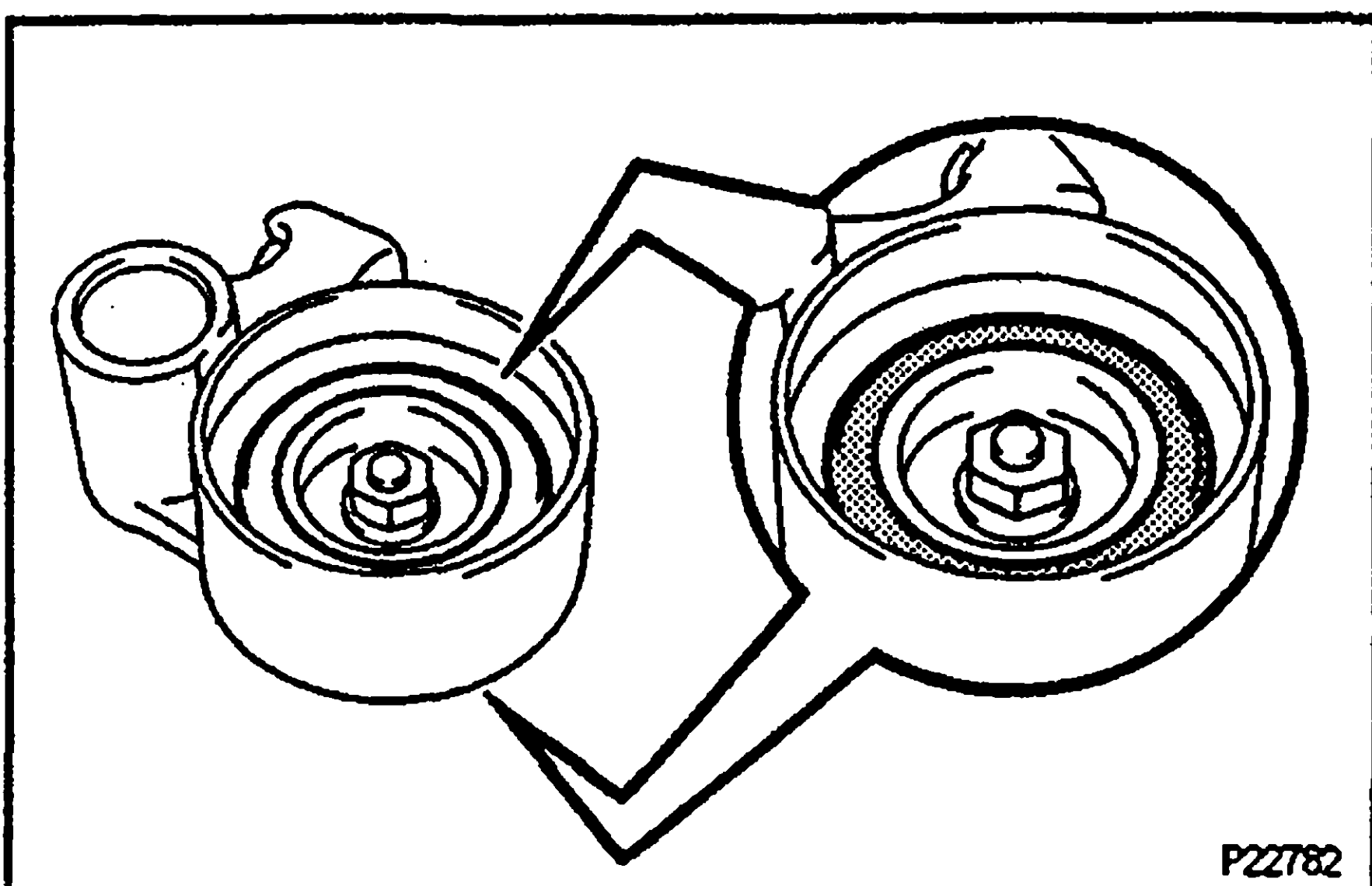
NOTICE:

- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water or steam.
- Do not utilize timing belt tension when installing or removing the mount bolt of the camshaft timing pulley.

If there are any defects, check these points:

- Premature parting**
 - Check for proper installation.
 - Check the timing cover gasket for damage and proper installation.
- If the belt teeth are cracked or damaged, check to see if the camshaft is locked.
- If there is noticeable wear or cracks on the belt face, check to see if there are nicks on the side of the idler pulley lock.
- If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.
- If there is noticeable wear on the belt teeth, check timing cover for damage and check gasket has been installed correctly and for foreign material on the pulley teeth.

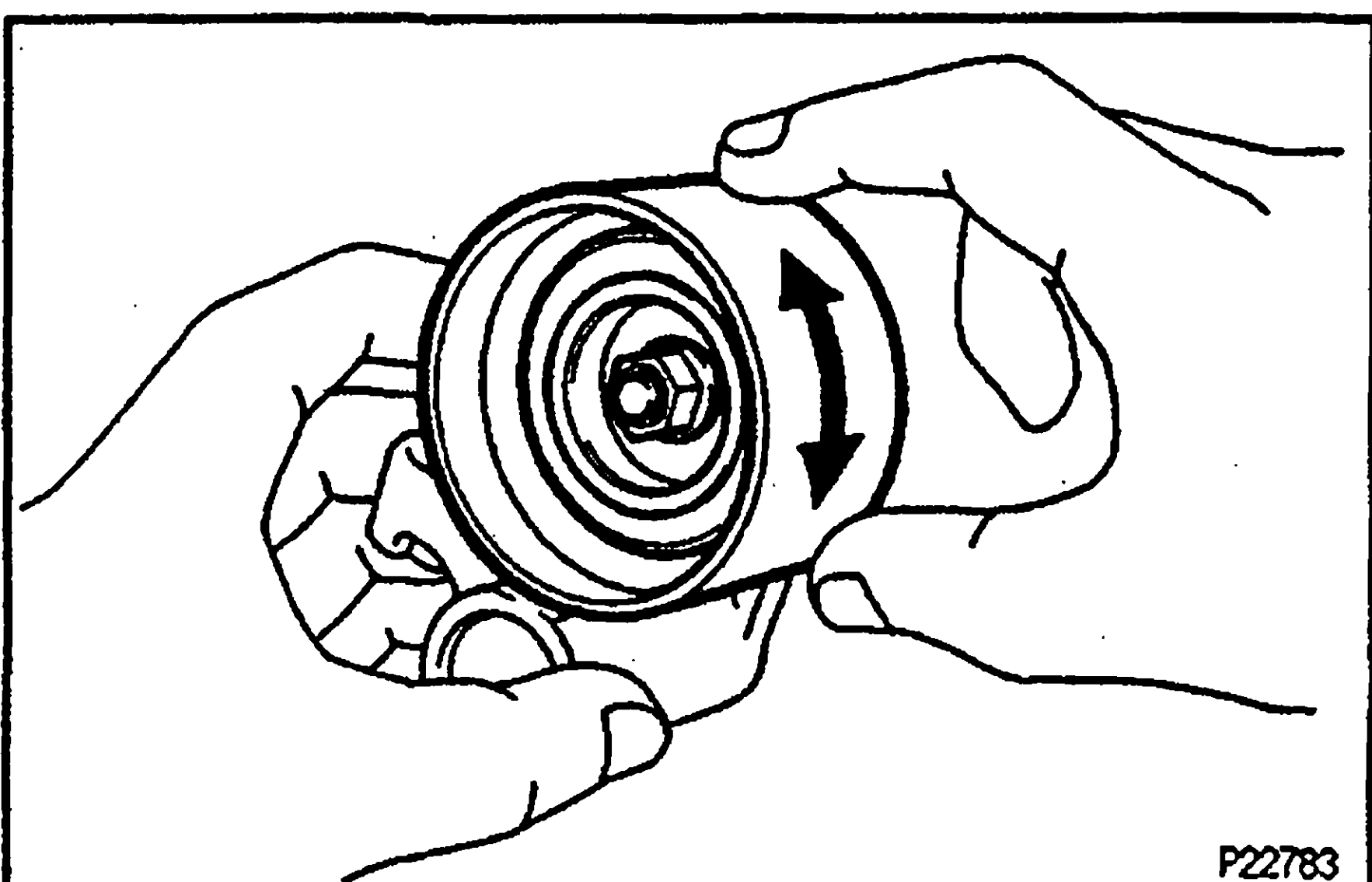
If necessary, replace the timing belt.



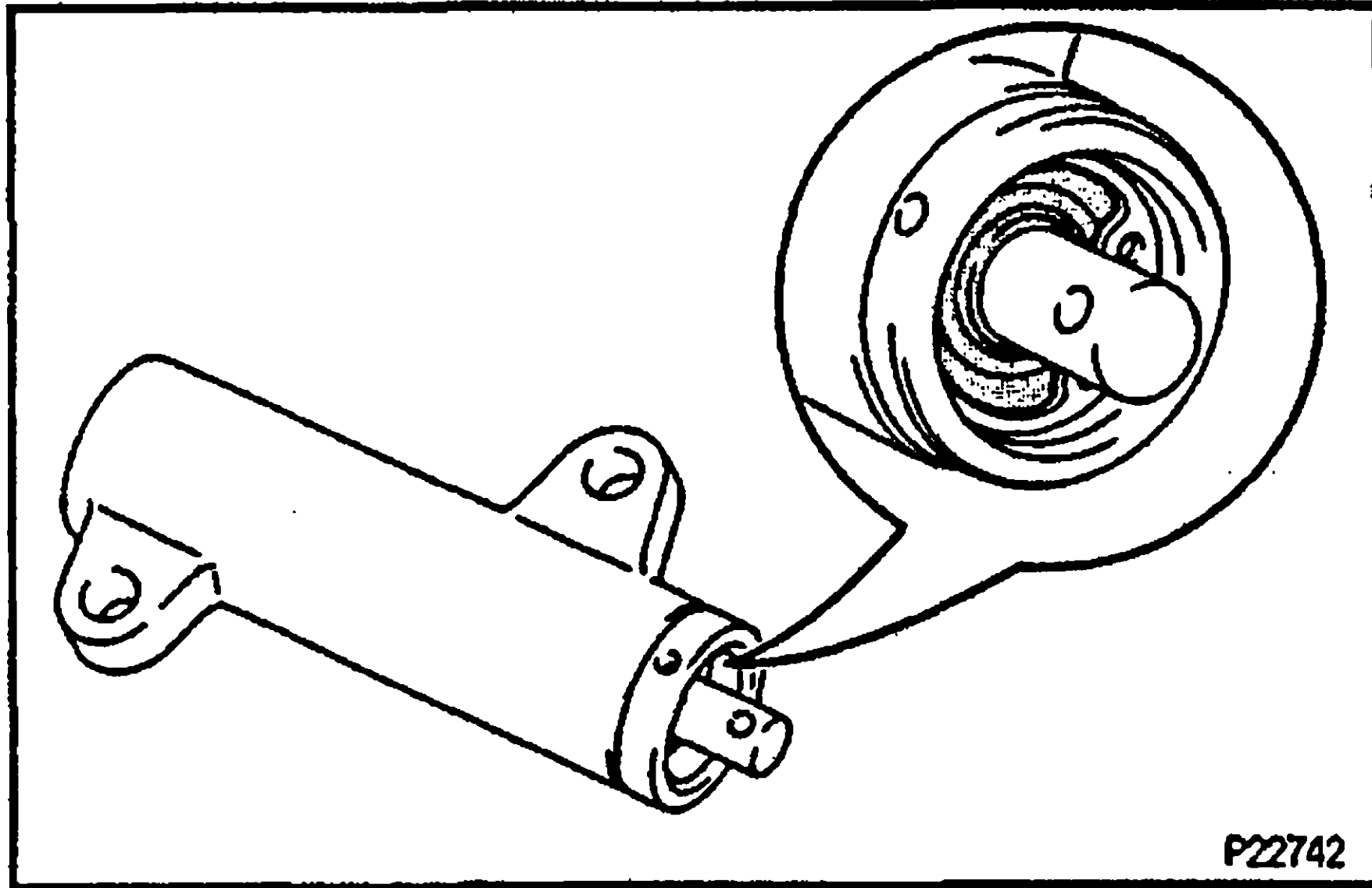
2. INSPECT IDLER PULLEY

- Visually check the seal portion of the idler pulley for oil leakage.

If leakage is found, replace the idler pulley.



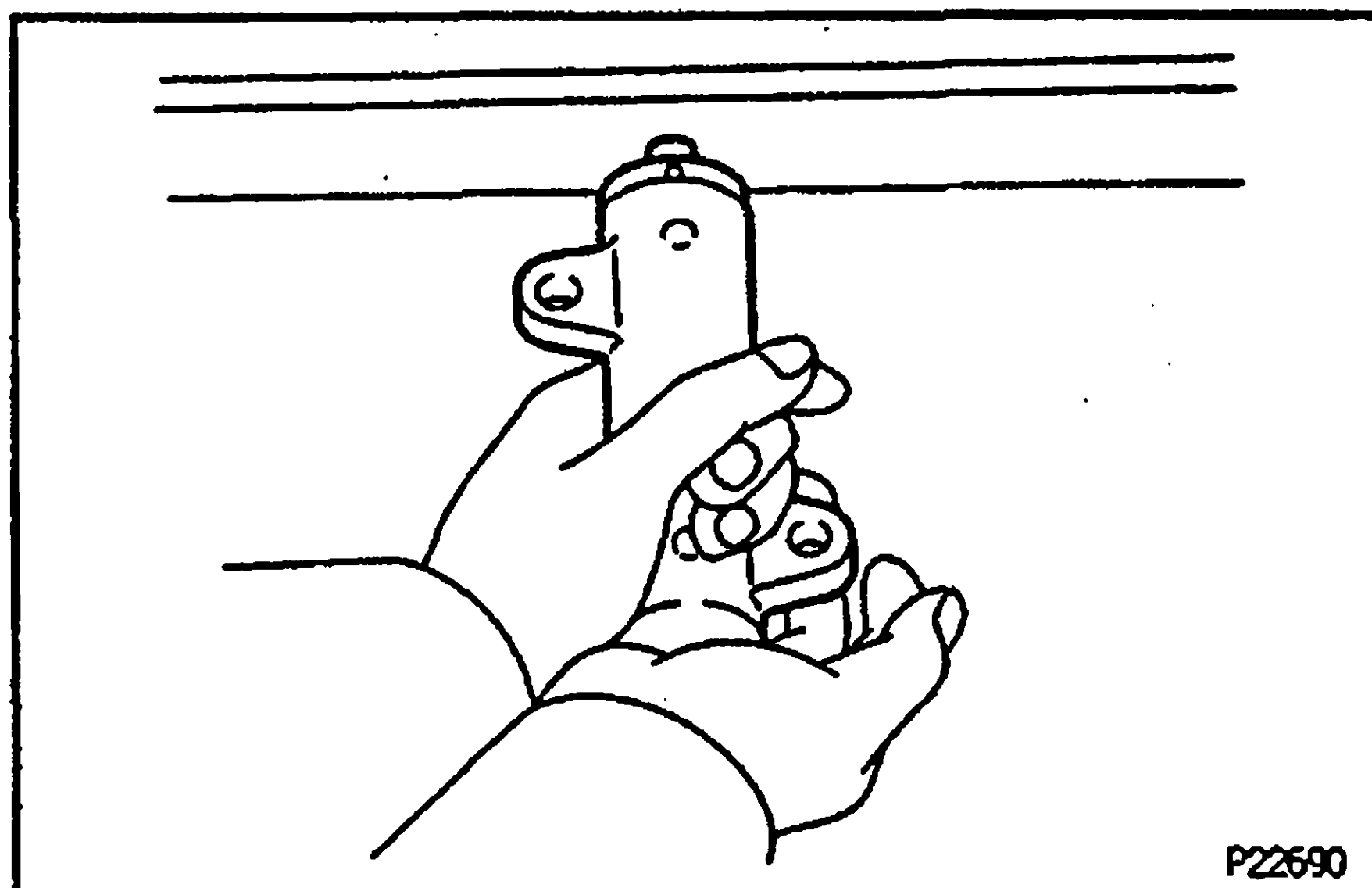
- Check that the idler pulley turns smoothly. If necessary, replace the idler pulley.



3. INSPECT TIMING BELT TENSIONER

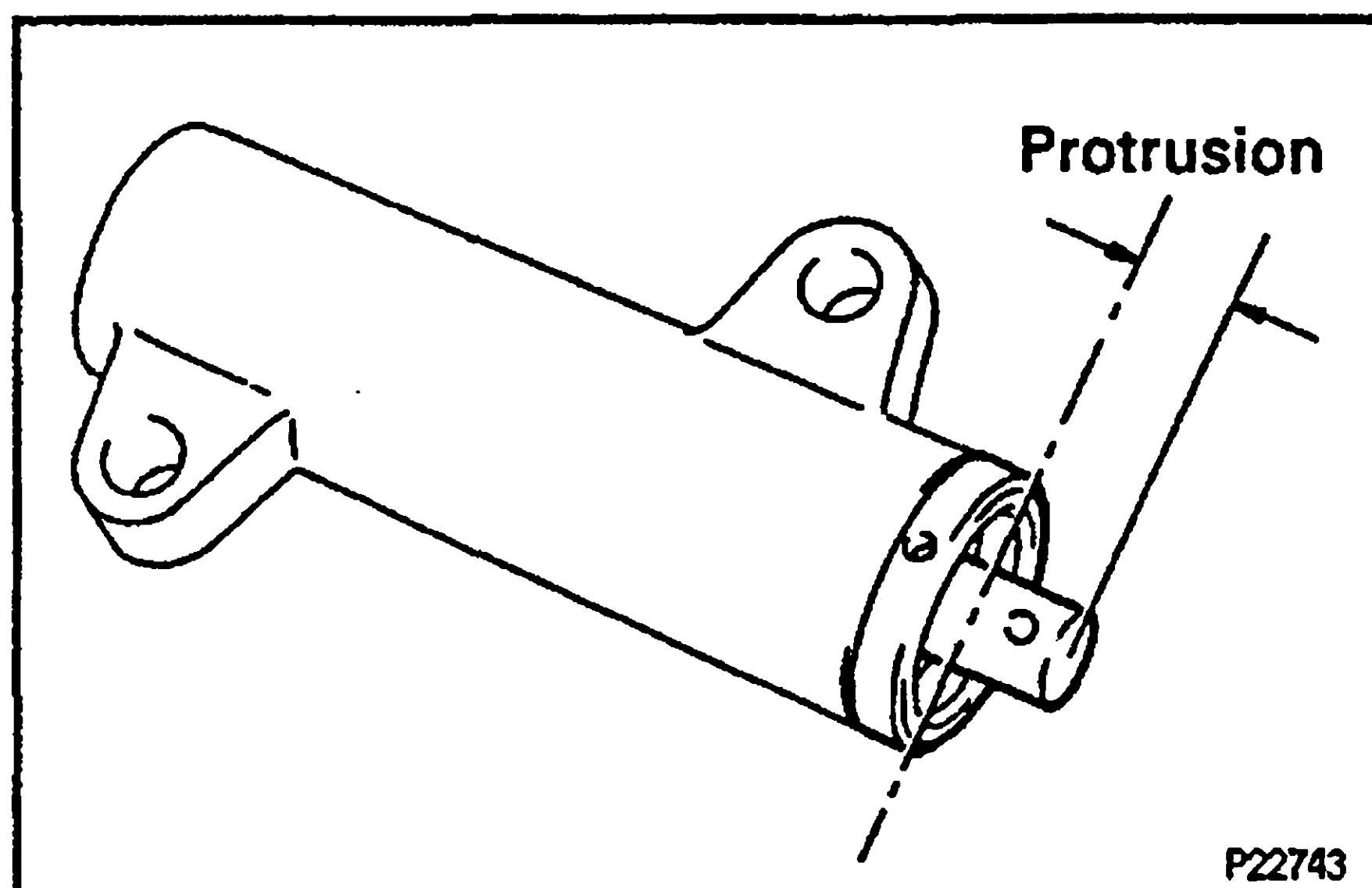
- (a) Visually check the seal portion of the tensioner for oil leakage.

HINT: If there is only the faintest trace of oil on the seal on the push rod side, the tensioner is all right. If leakage is found, replace the tensioner.



- (b) Hold the tensioner with both hands and push the push rod strongly as shown to check that it doesn't move. If the push rod moves, replace the tensioner.

NOTICE: Never hold the tensioner push rod facing downward.



- (c) Measure the protrusion of the push rod from the housing end.

Protrusion:

8.1 – 8.9 mm (0.319 – 0.350 in.)

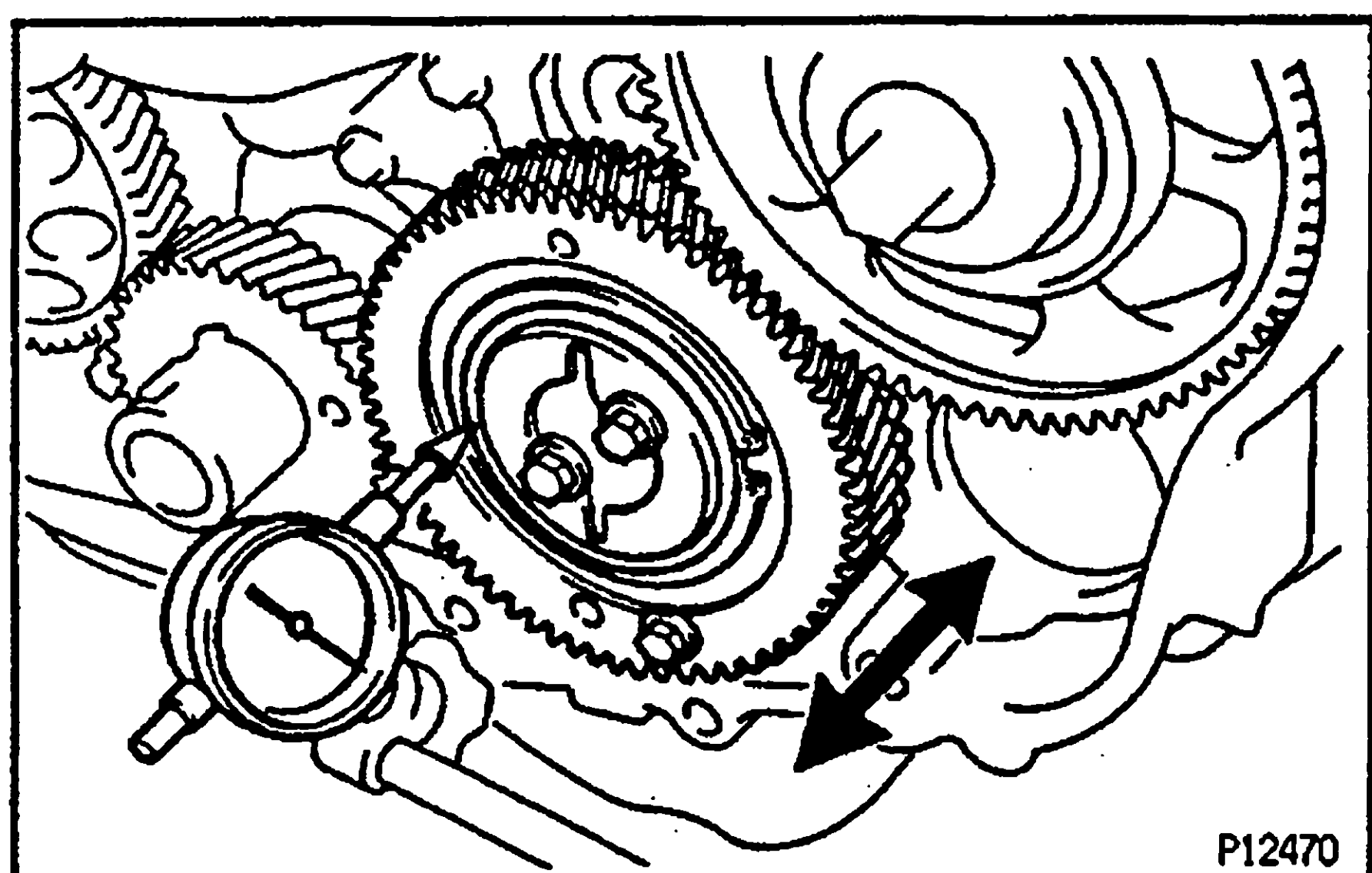
If the protrusion is not as specified, replace the tensioner.

TIMING GEAR

TIMING GEARS REMOVAL

907F4-01

NOTICE: When removing the crankshaft pulley and timing gear as the timing belt is off and the valve interferes with the piston, never turn the crankshaft to the right beyond the dead point above the No.4 cylinder.



P12470

CHECK THRUST CLEARANCE OF IDLER GEAR

Using a dial indicator, measure the thrust clearance.

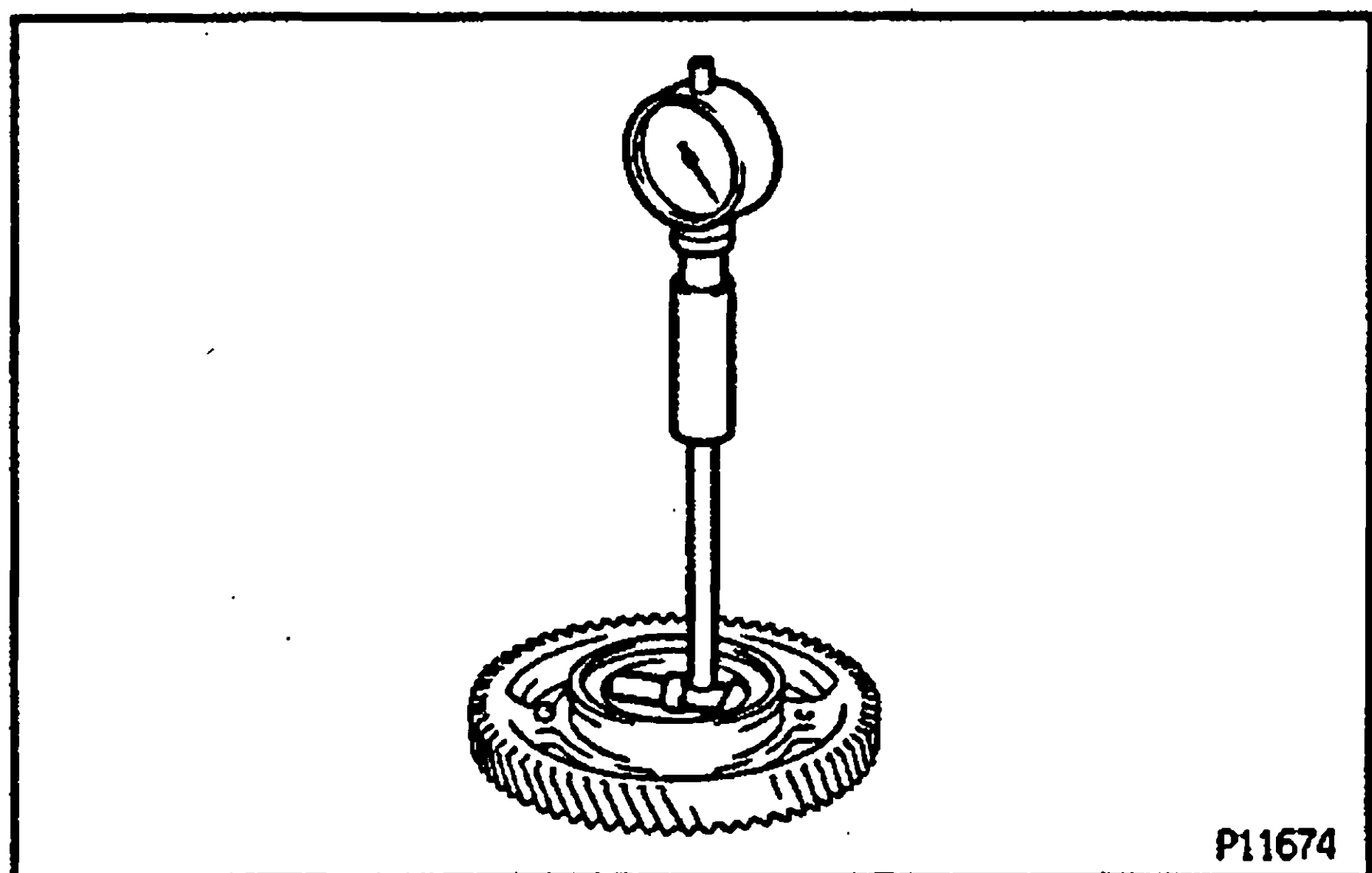
Standard thrust clearance:

0.06 — 0.11 mm (0.0024 — 0.0043 in.)

Maximum thrust clearance:

0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust plate. If necessary, replace the idler gear and/or idler gear shaft.



P11674

TIMING GEARS INSPECTION

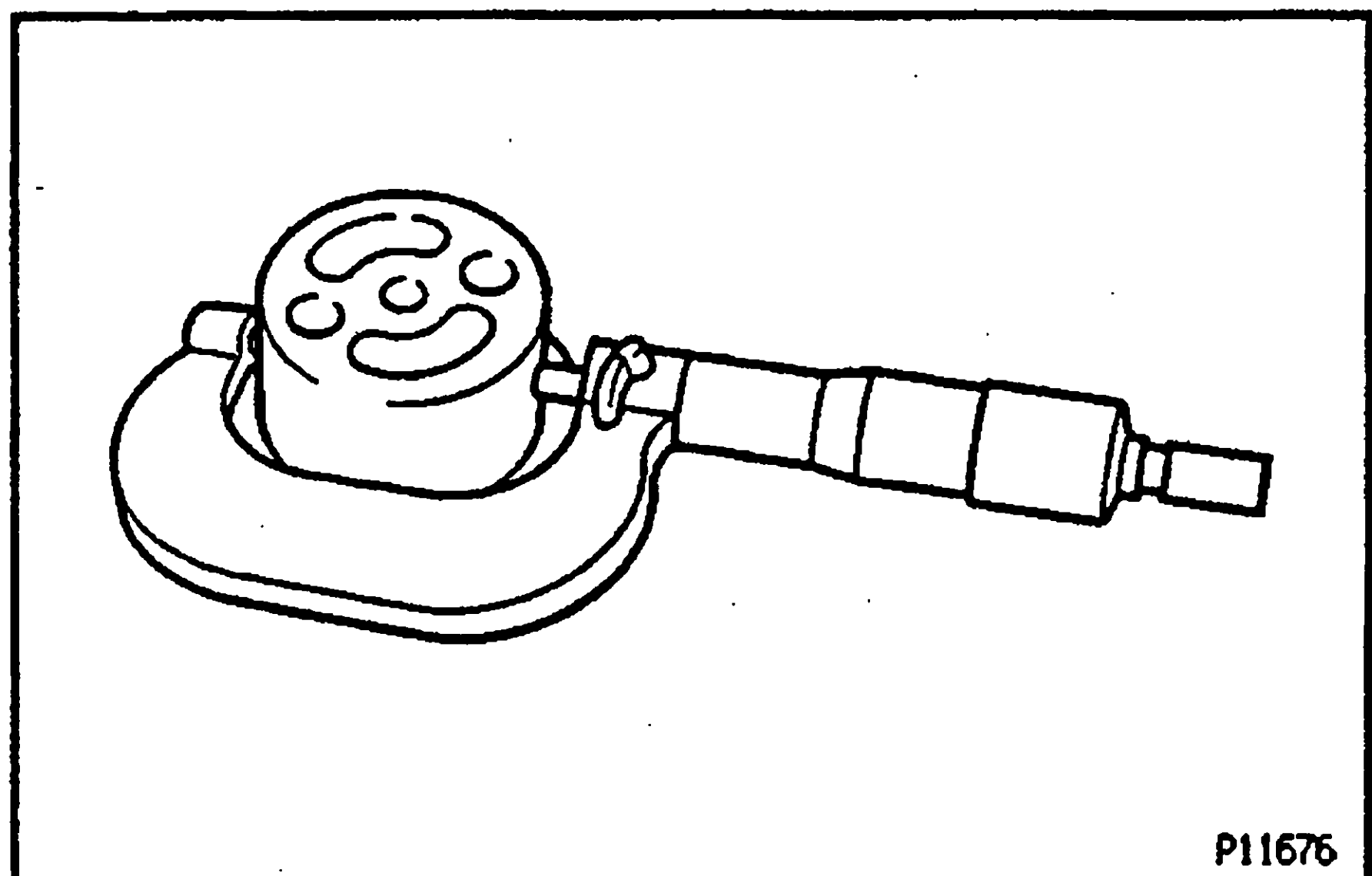
907F5-01

INSPECT IDLER GEAR

- (a) Using a cylinder gauge, measure the inside diameter of the idler gear.

Idler gear inside diameter:

44.000 — 44.025 mm (1.7323 — 1.7333 in.)



P11676

- (b) Using a micrometer, measure the diameter of the idler gear shaft.

Idler gear shaft diameter:

43.955 — 43.990 mm (1.7305 — 1.7319 in.)

- (c) Subtract the idler gear shaft diameter measurement from the idler gear inside diameter measurement.

Standard oil clearance:

0.010 — 0.070 mm (0.0004 — 0.0028 in.)

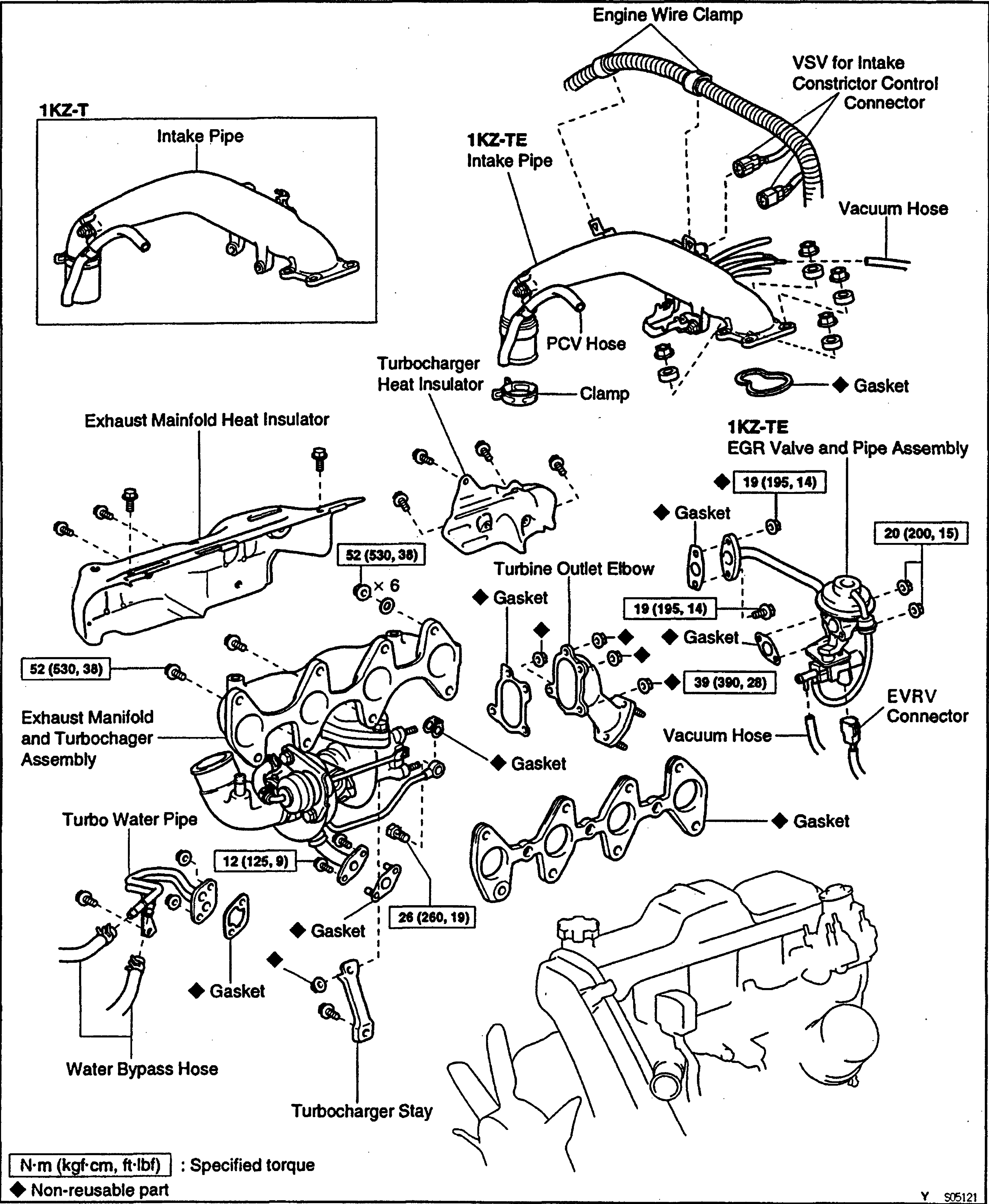
Maximum oil clearance:

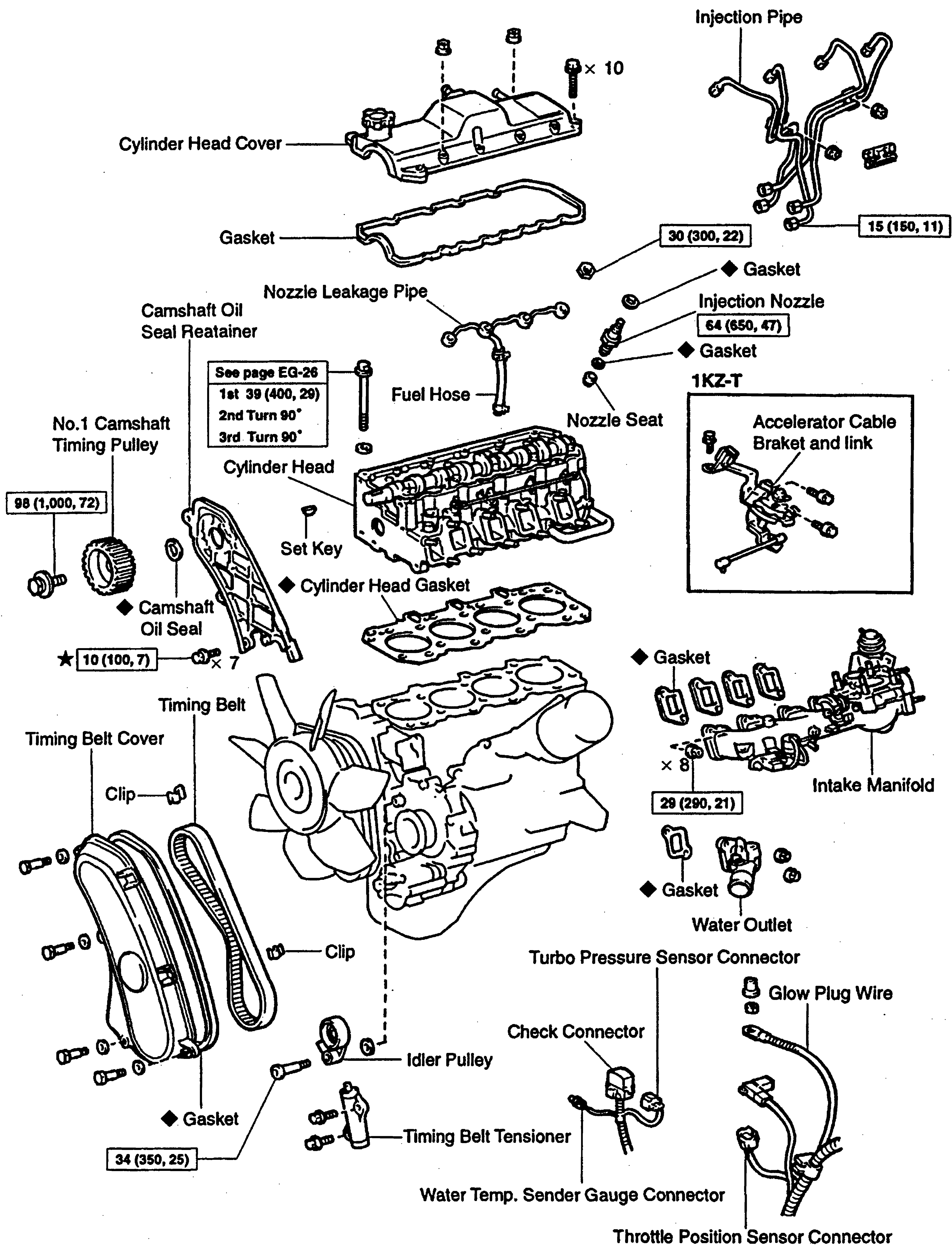
0.20 mm (0.0079 in.)

If the clearance is greater than maximum, replace the gear and shaft.

CYLINDER HEAD
COMPONENTS FOR REMOVAL AND
INSTALLATION

EG764-02





N·m (kgf·cm, ft·lbf) : Specified torque

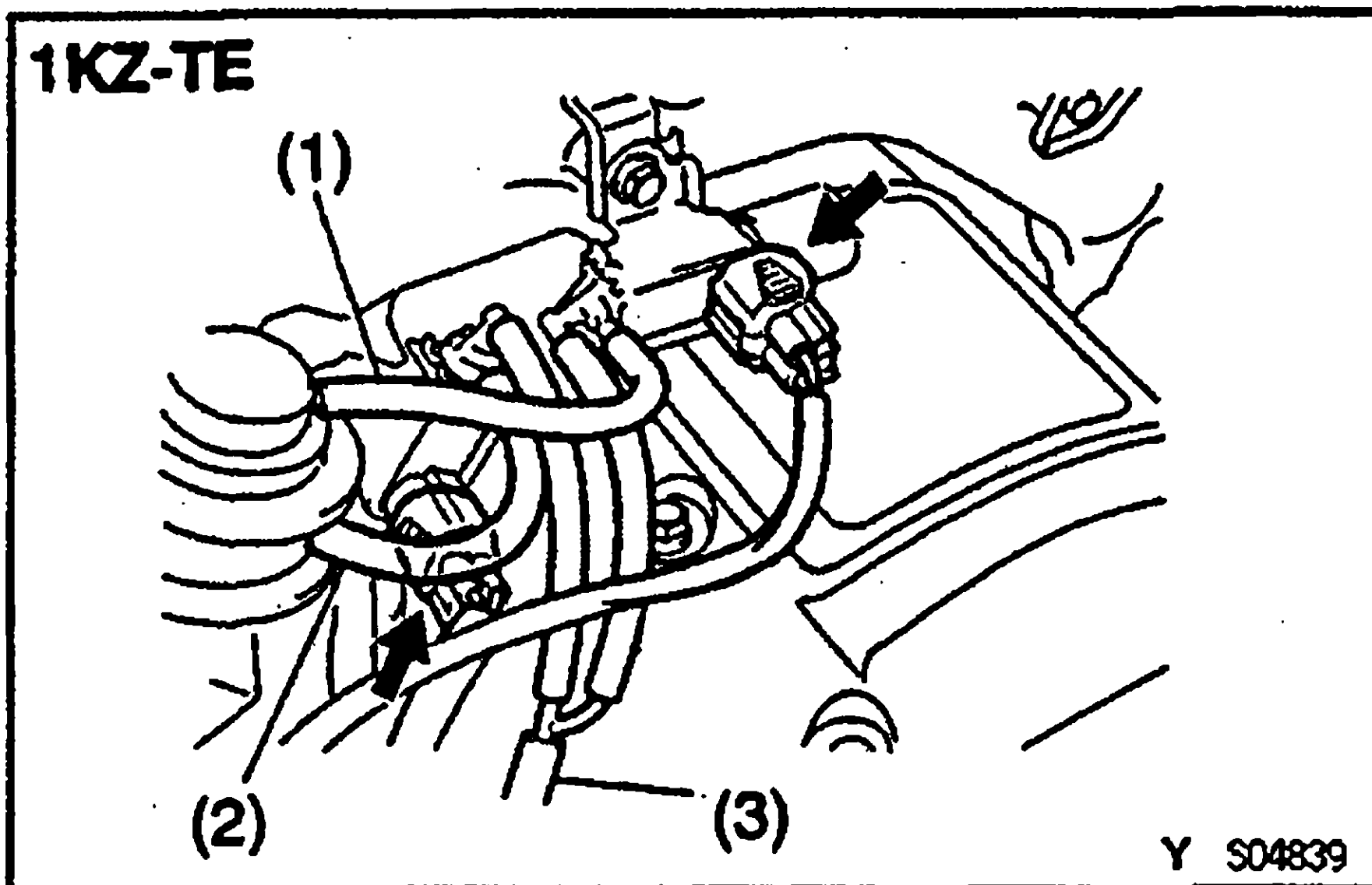
◆ Non-reusable part

★ Precoated part

CYLINDER HEAD REMOVAL

NOTICE: This engine uses ceramic glow plugs. To prevent damage to the glow plugs, do not remove them unless necessary.

1. DRAIN ENGINE COOLANT



2. REMOVE INTAKE PIPE

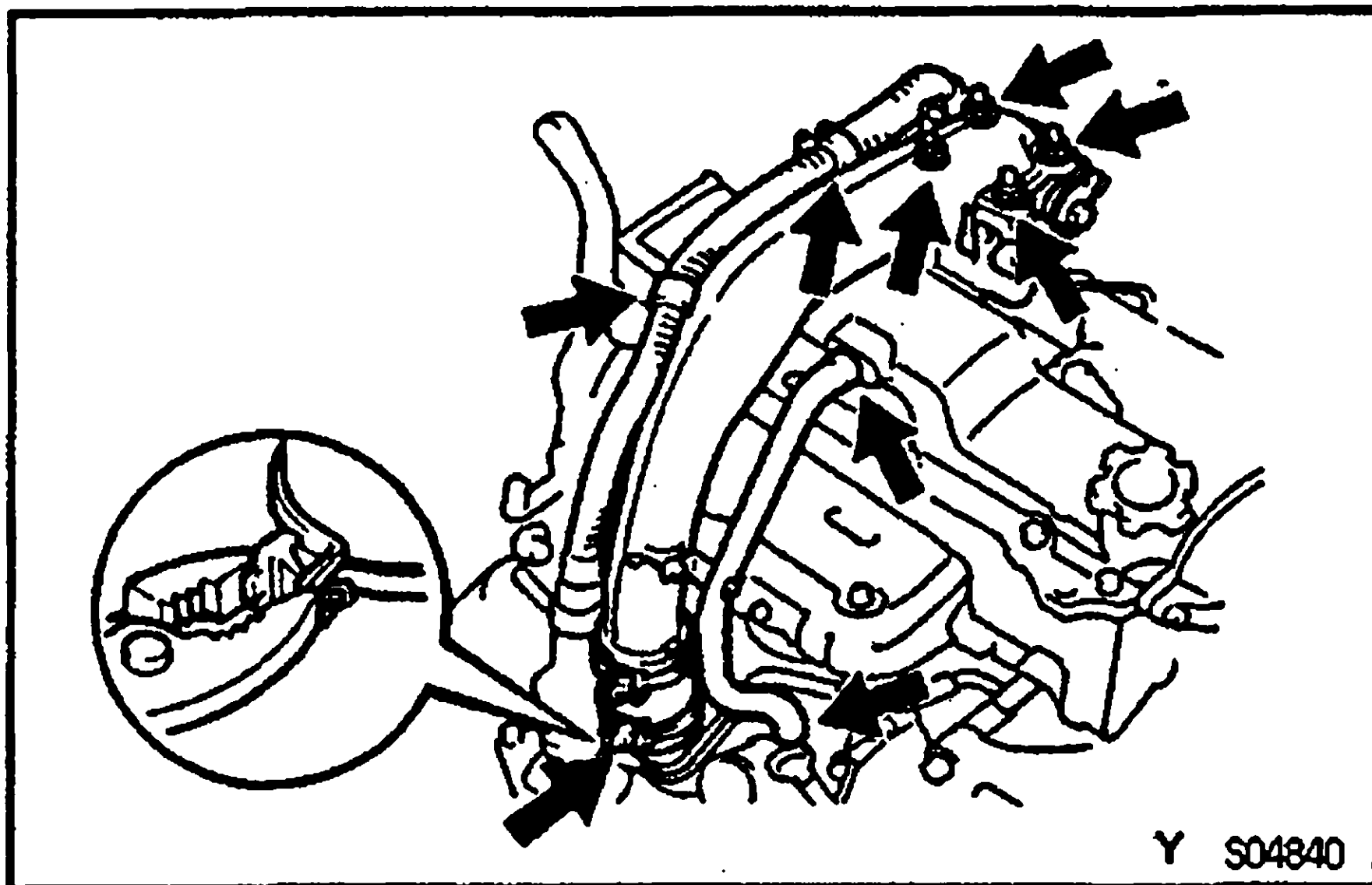
(a) 1KZ-TE:

Disconnect the VSV connectors.

(b) 1KZ-TE:

Disconnect these vacuum hoses:

- (1) Vacuum hose from actuator of chamber A
- (2) Vacuum hose from actuator of chamber B
- (3) Vacuum hose from 3-way (from vacuum pump)



(c) LHD:

Disconnect the clamp (1KZ-T) or 2 clamps (1KZ-TE) of the engine wire.

(d) Remove the 4 nuts and seal washers.

(e) Use pliers to pinch the ends of the clamp together until the lock plate engages the catch. Make sure the lock plate and catch are engaged securely.

(f) Remove the intake pipe, PCV hose and gasket.

3. REMOVE TURBOCHARGER

(See steps 3 to 9 in turbocharger removal in Turbocharger System)

4. 1KZ-T:

REMOVE ACCELERATOR CABLE BRACKET AND LINK

(See step 2 in injection pump removal in Fuel System)

5. REMOVE INJECTION PIPES

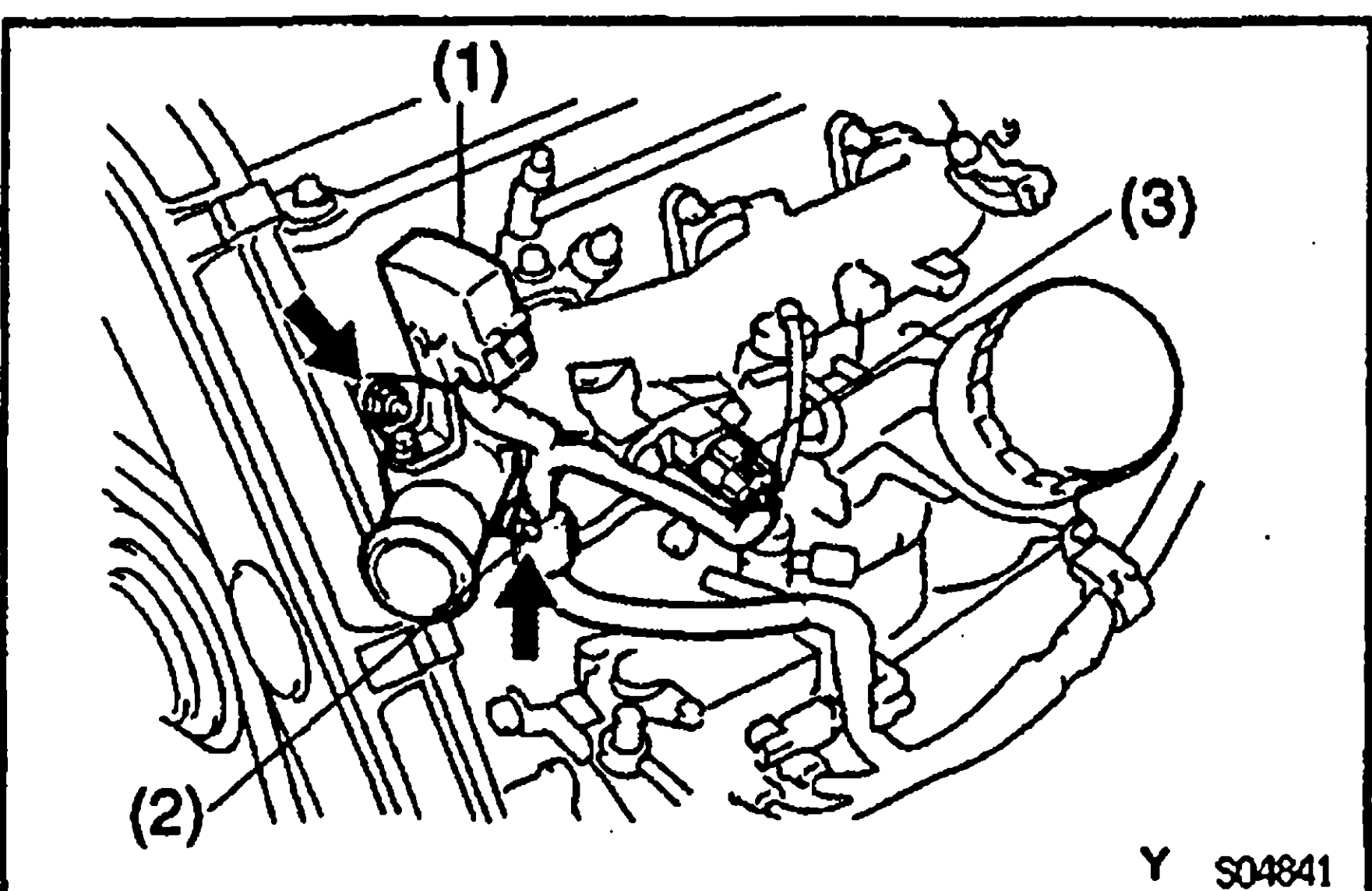
(See step 3 in injection pump removal in Fuel System)

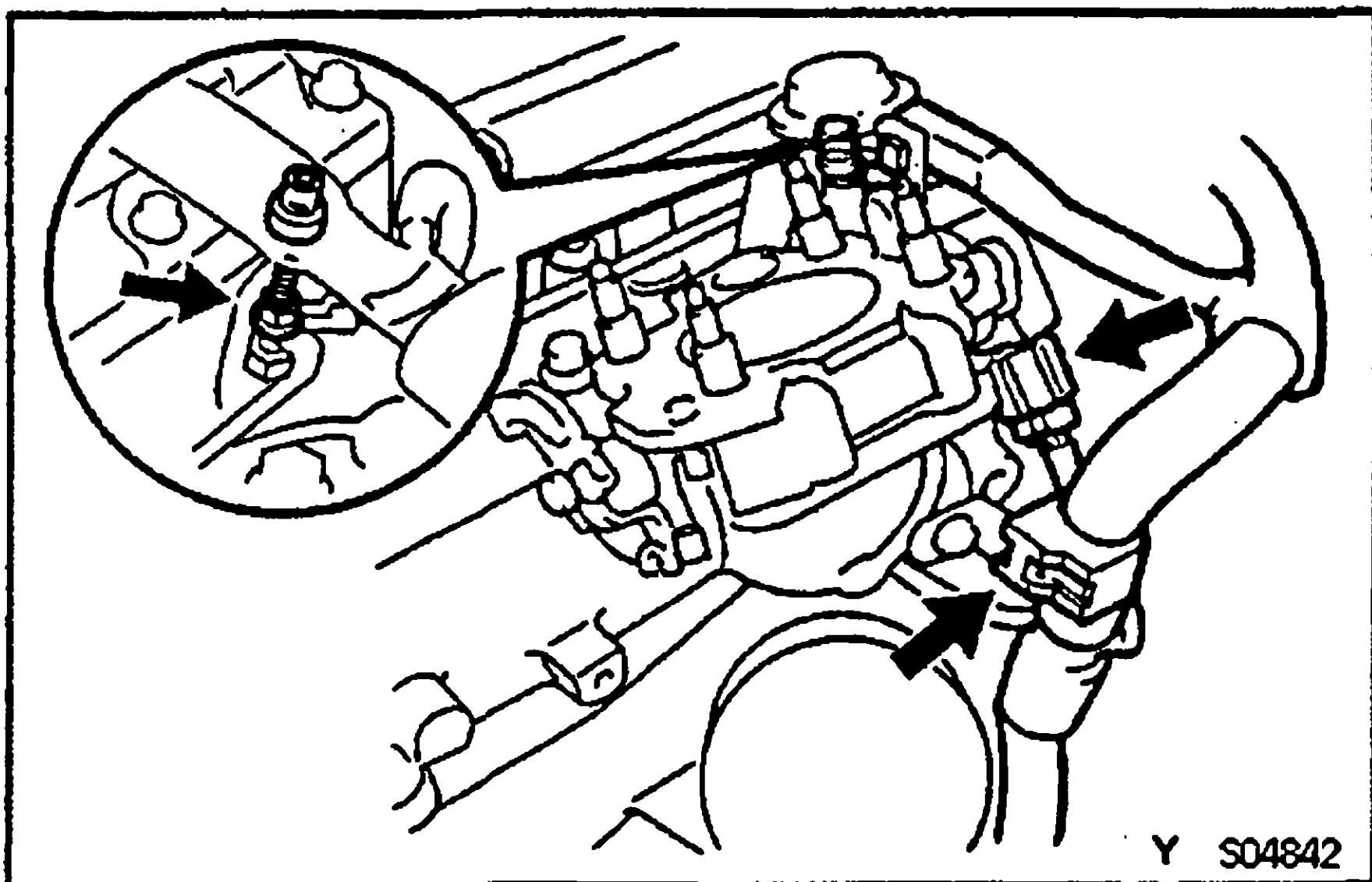
6. REMOVE WATER OUTLET

(a) Disconnect these connectors and clamp:

- (1) Check connector
- (2) Engine wire clamp
- (3) Turbo pressure sensor connector
- (4) Water temperature sender gauge connector

(b) Remove the 2 nuts, water outlet and gasket.



**7. REMOVE INTAKE MANIFOLD****(a) 1KZ-T:**

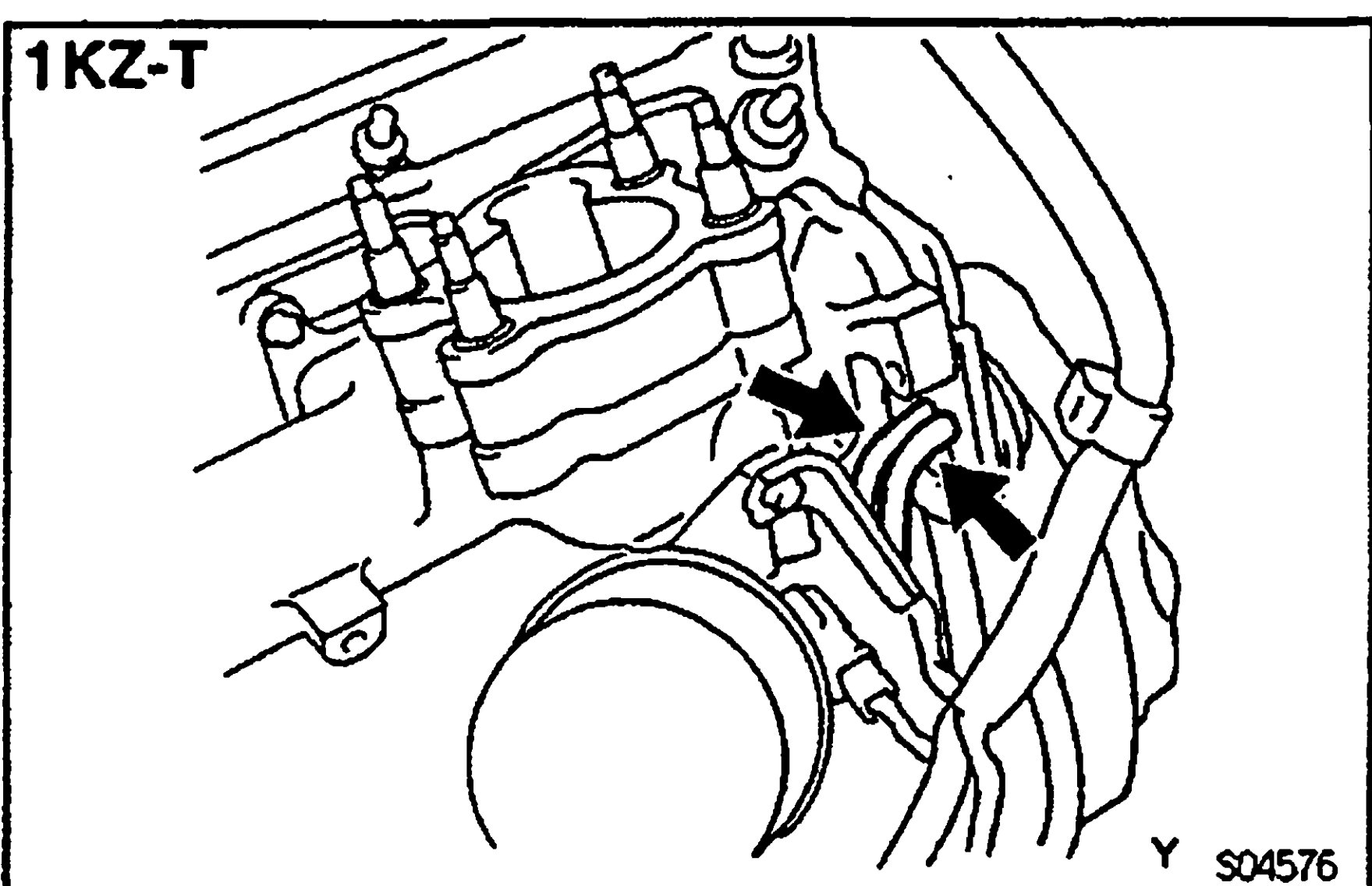
Disconnect the vacuum hose from the injection pump.

(b) 1KZ-TE:

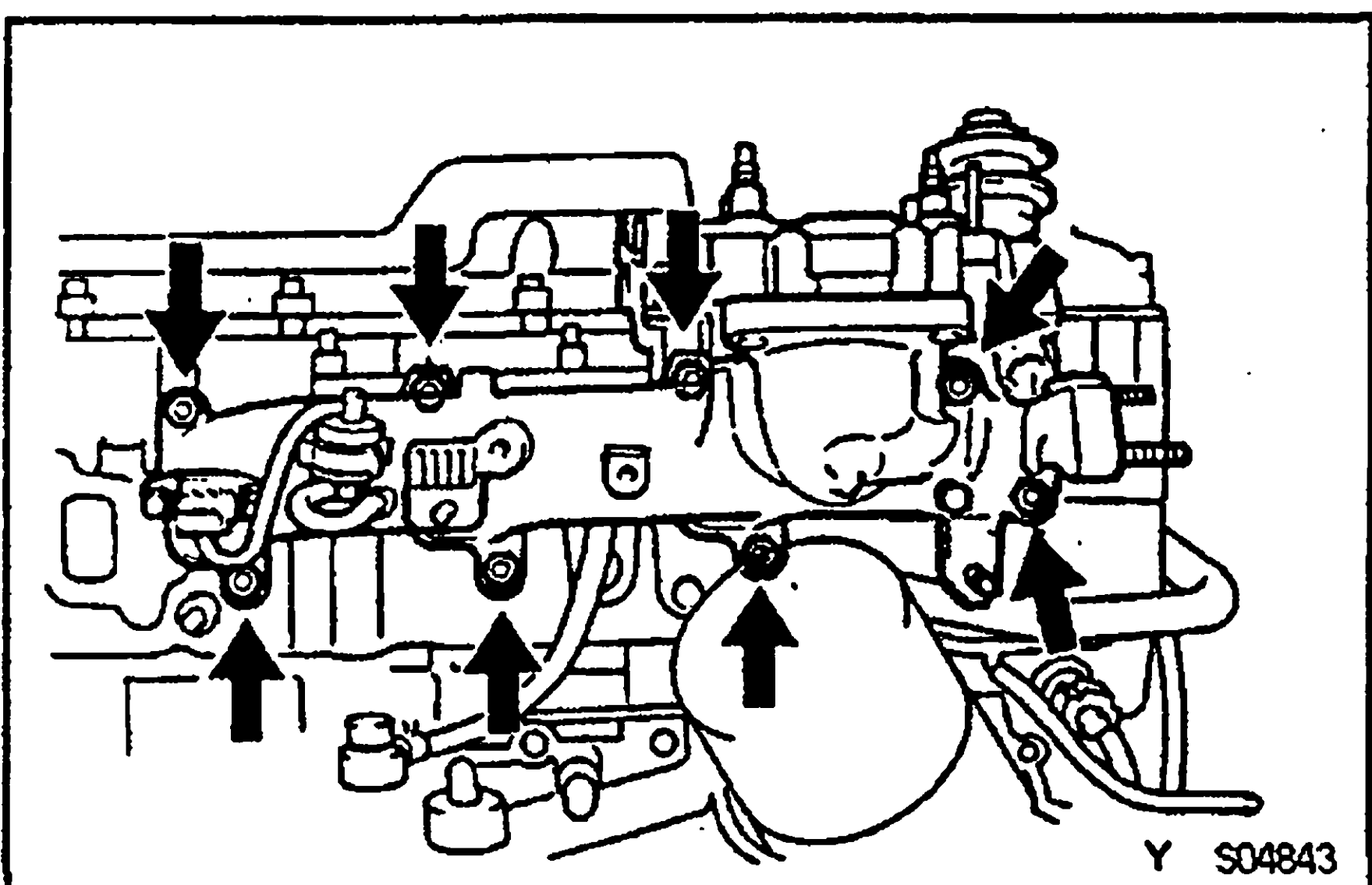
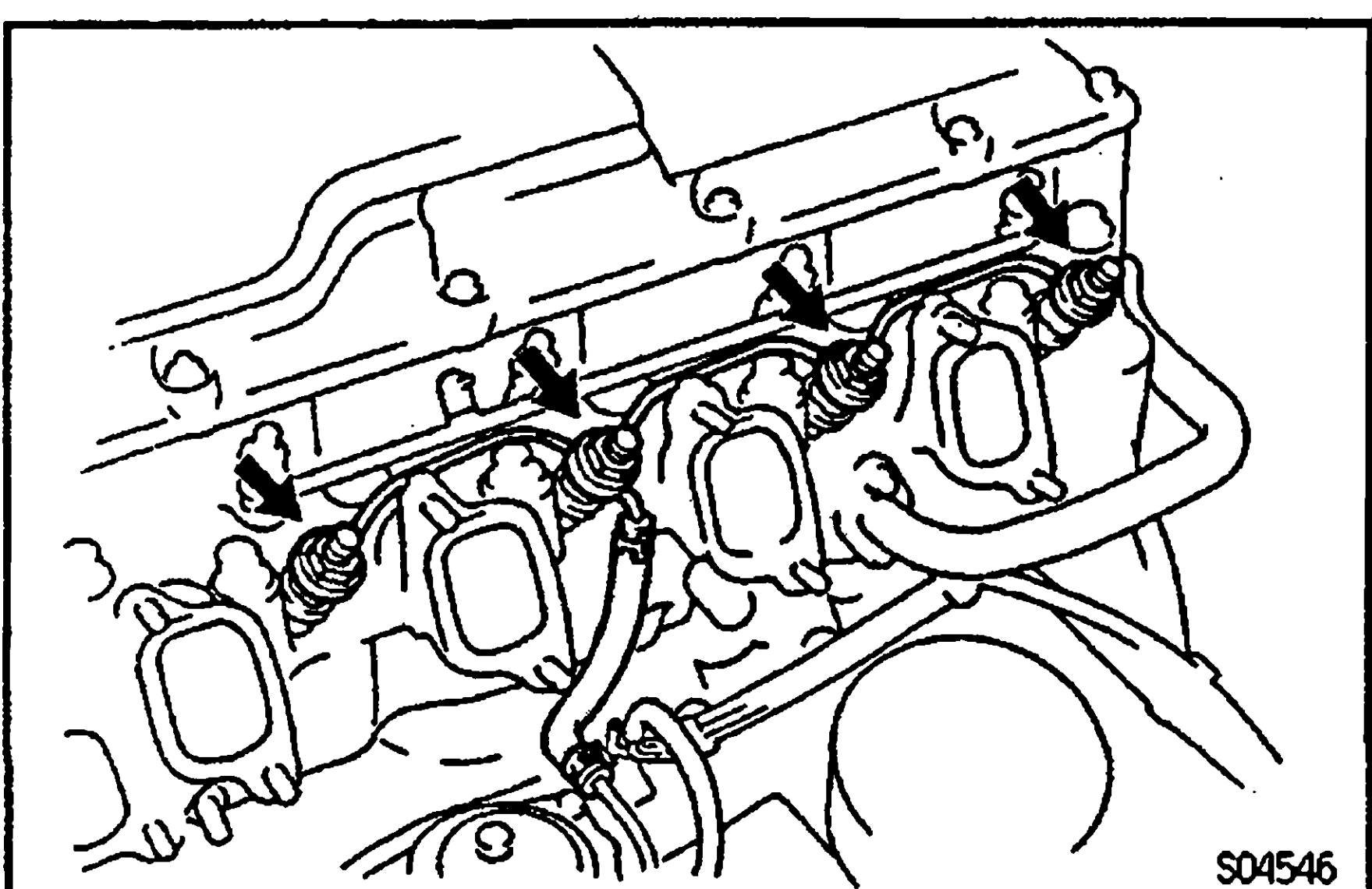
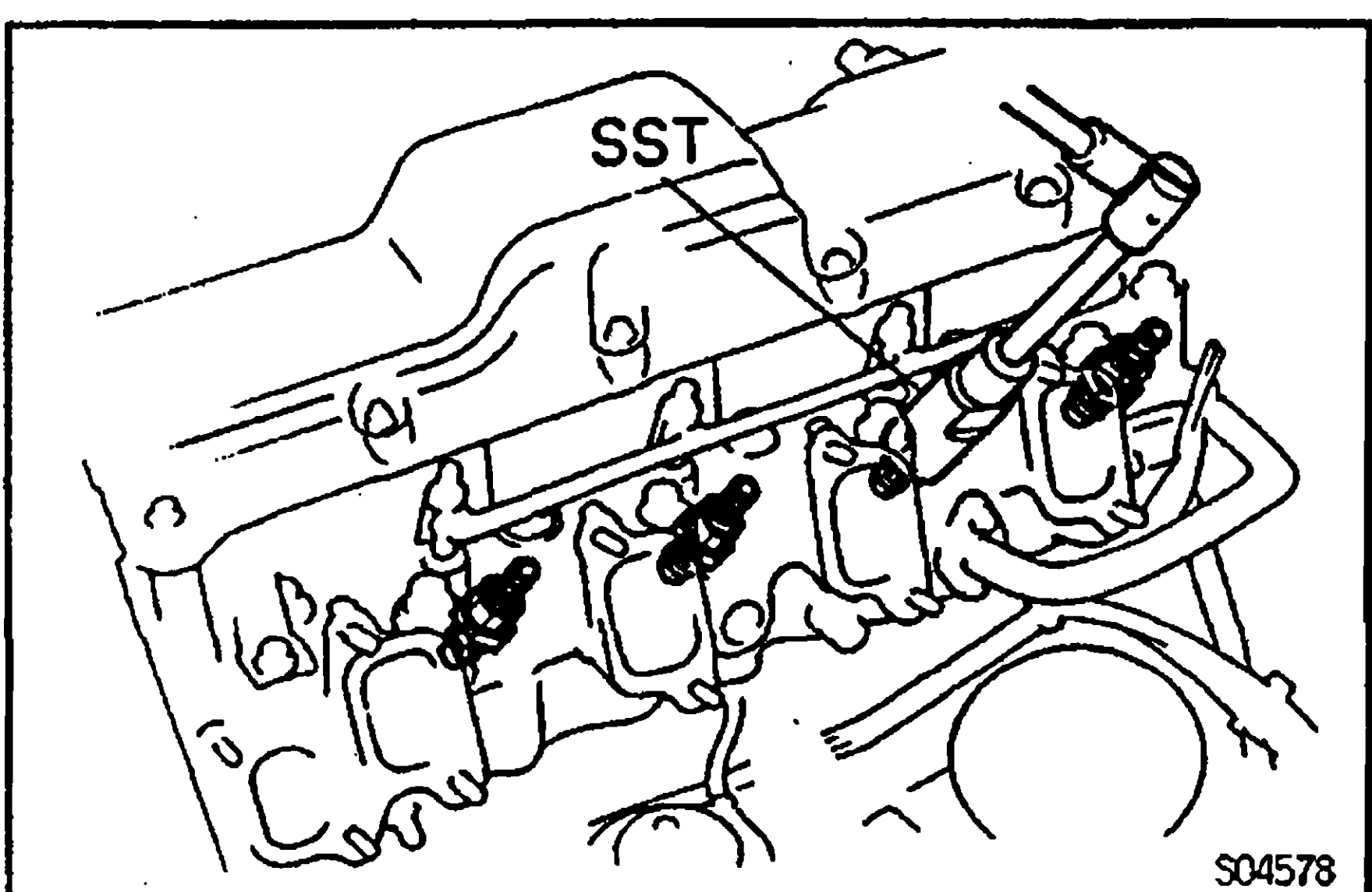
Disconnect the throttle position sensor connector.

(c) Remove the grommet and nut, disconnect the glow plug wire.**(d) Disconnect the engine wire clamp from the venturi.**

EG

**(e) 1KZ-T:**

Disconnect the 2 vacuum hoses from the altitude compensator.

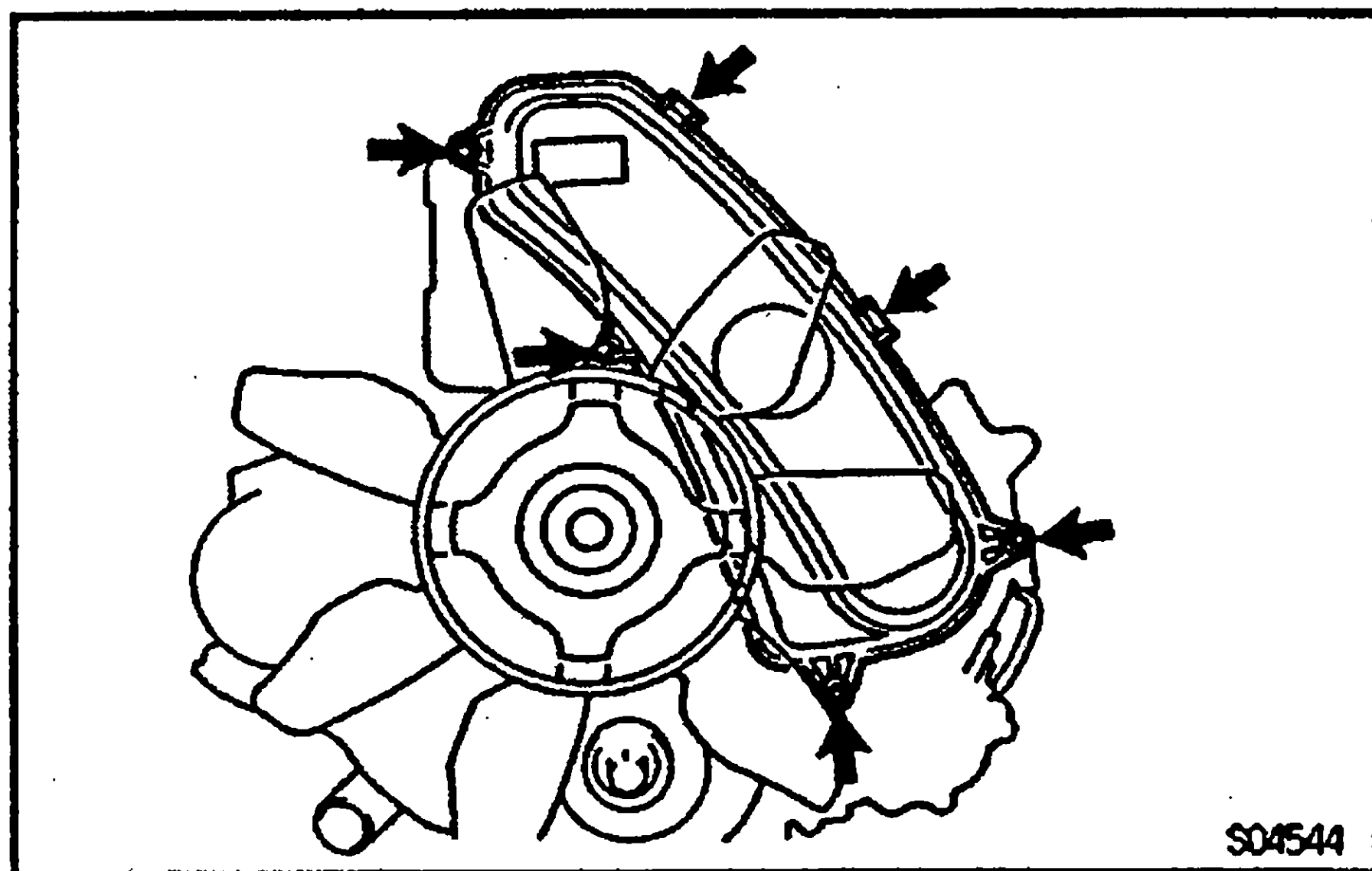
**(f) Remove the 8 nuts, intake manifold and 4 gaskets.****8. REMOVE NOZZLE LEAKAGE PIPE****(a) Disconnect the fuel hose from the return pipe.****(b) Remove the 4 nuts, nozzle leakage pipe and 4 gaskets.****9. REMOVE INJECTION NOZZLES**

Using SST, remove the 4 injection nozzles, gaskets and seats.

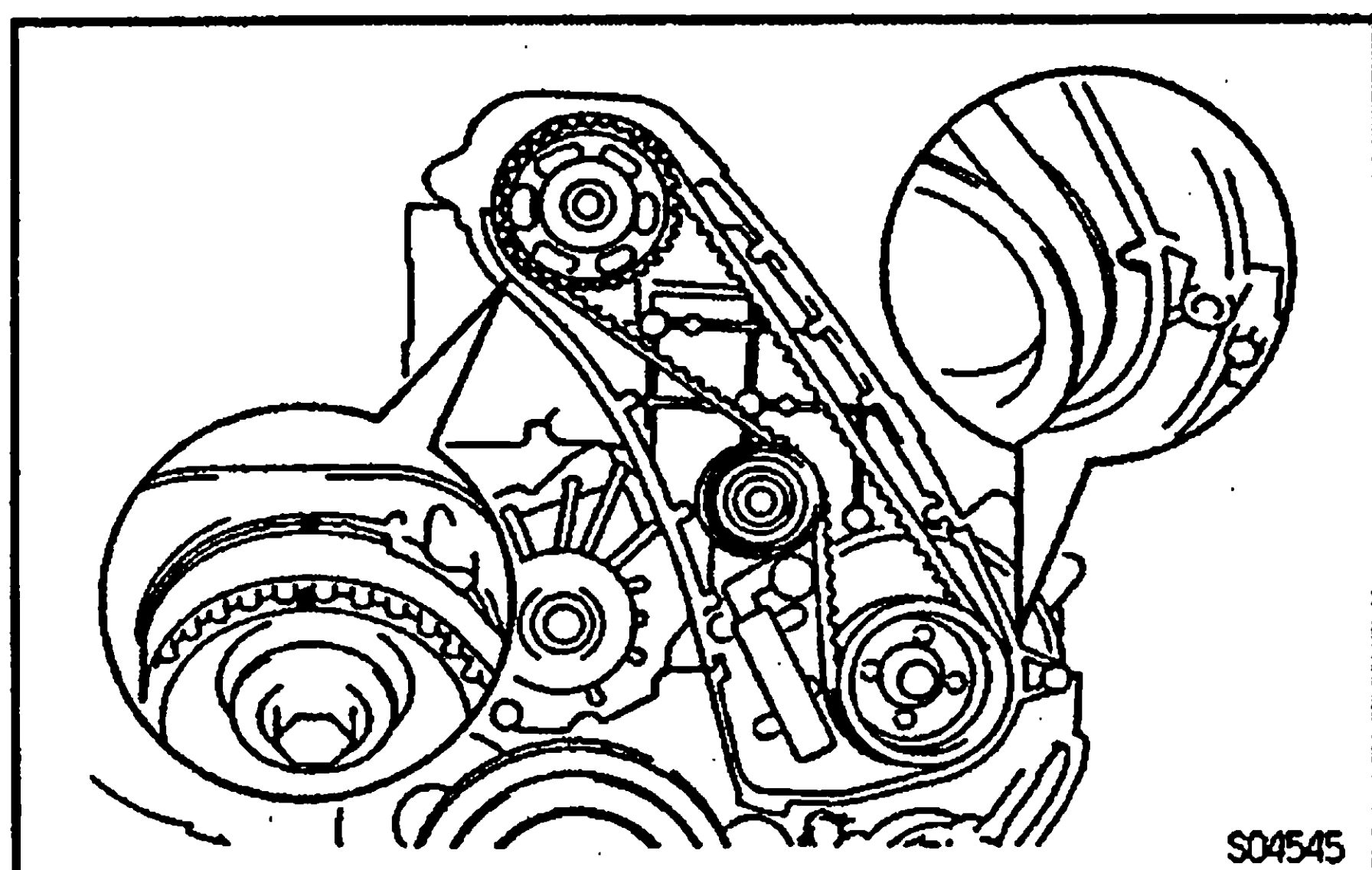
SST 09268-64010 (09268-64020)

HINT: Arrange the injection nozzles in correct order.

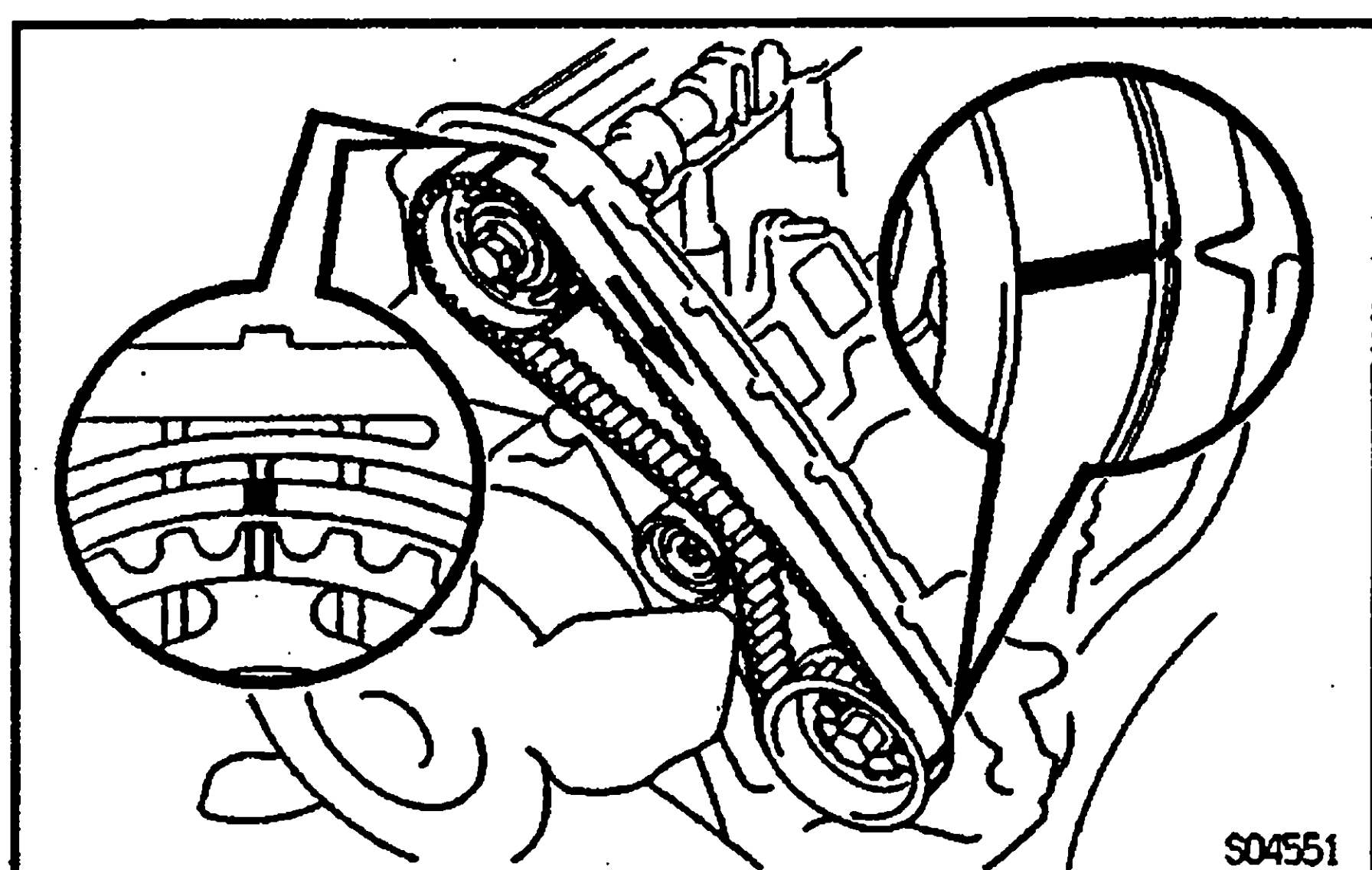
EG

**10. REMOVE TIMING BELT COVER**

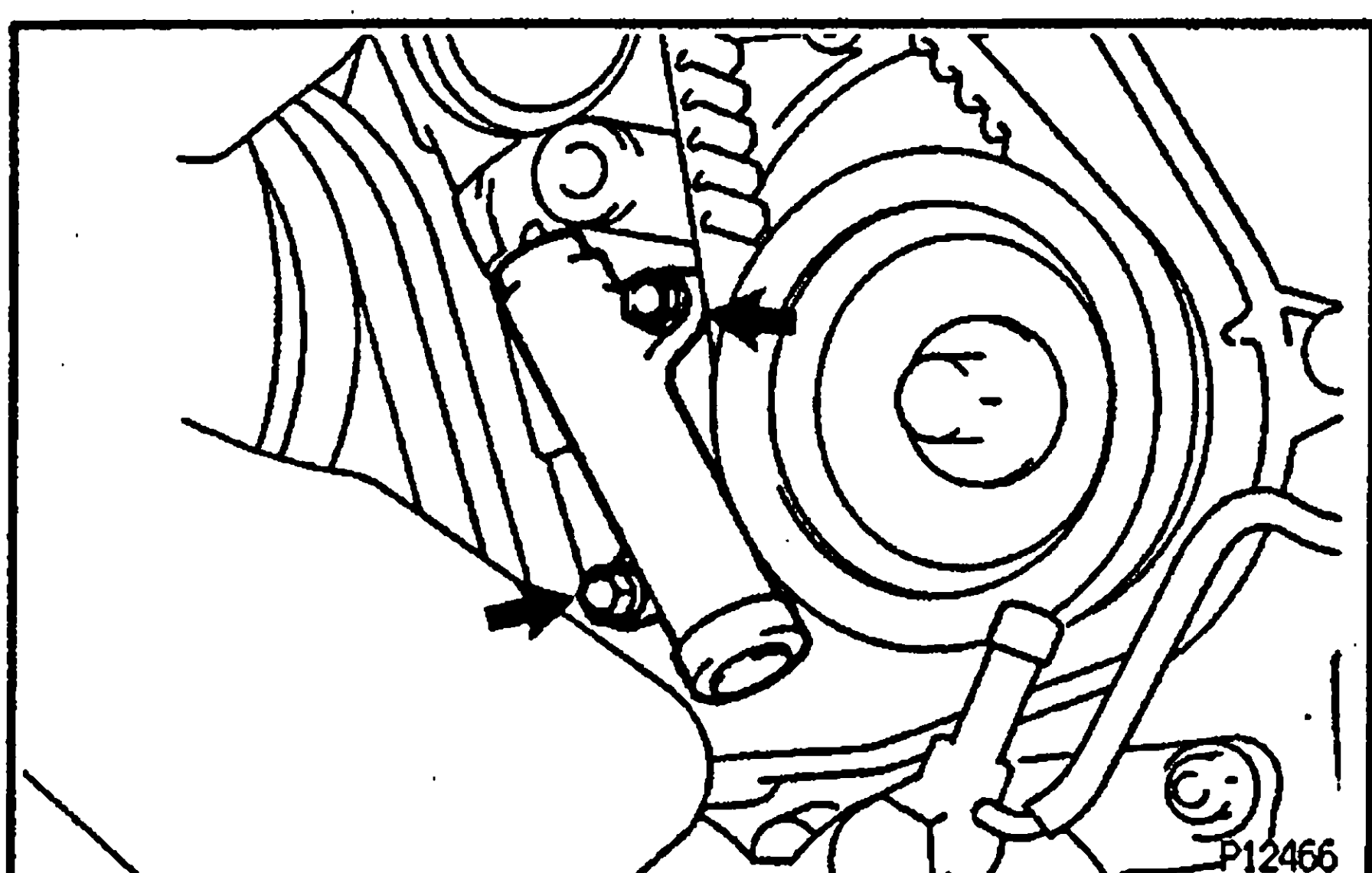
Remove the 4 bolts, seal washers, 2 clips, timing belt cover and gasket.

**11. SET NO.4 CYLINDER TO TDC/COMPRESSION**

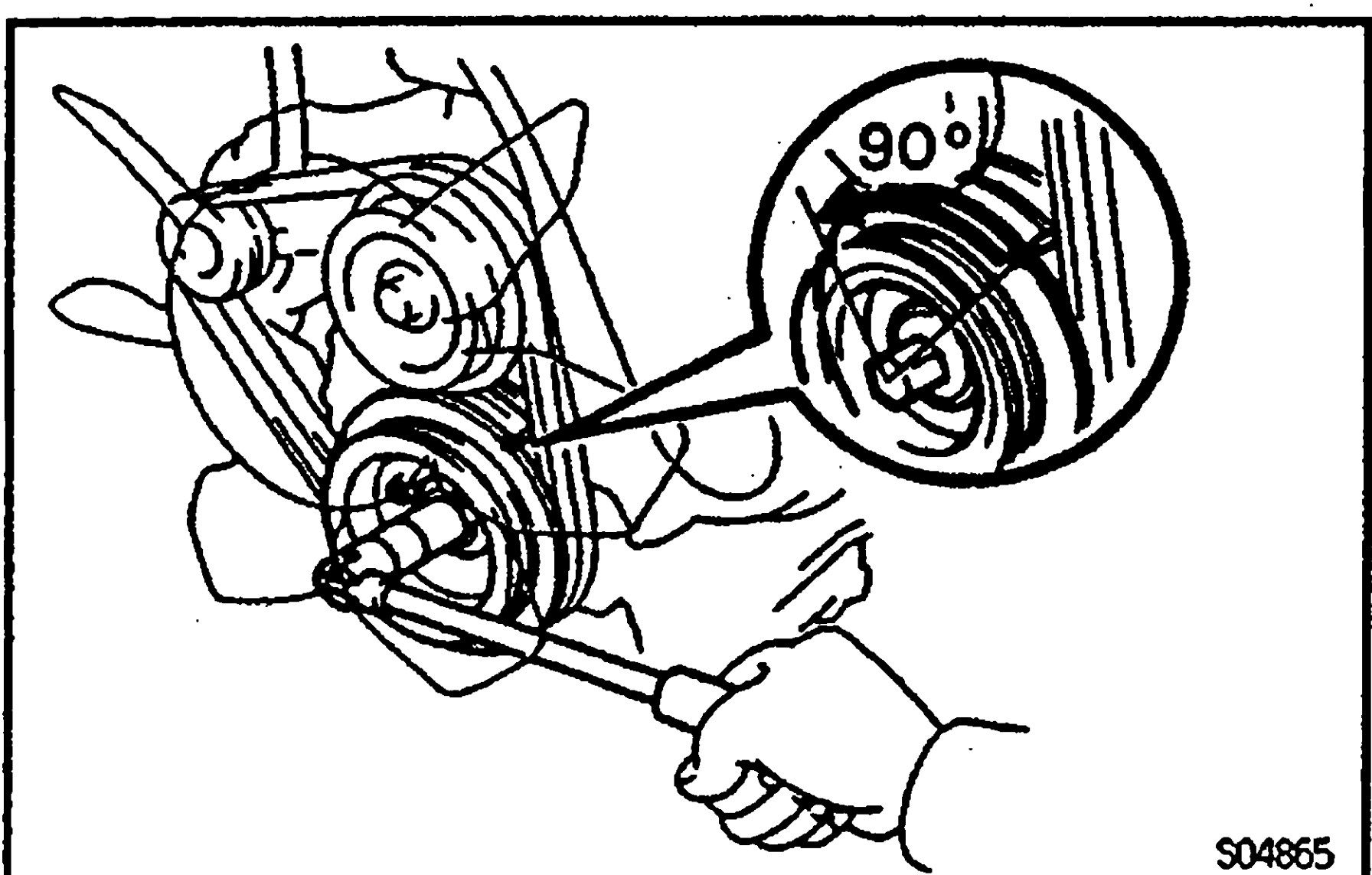
Turn the crankshaft pulley clockwise, set both No.1 and No.2 camshaft pulley grooves at TDC marks.

**12. IF RE-USING TIMING BELT, MARK TIMING BELT**

HINT: If reusing the timing belt, draw a direction arrow on the belt (in the direction of engine revolution), and place matchmarks on the pulleys and belt as shown in the illustration.

**13. REMOVE TIMING BELT TENSIONER**

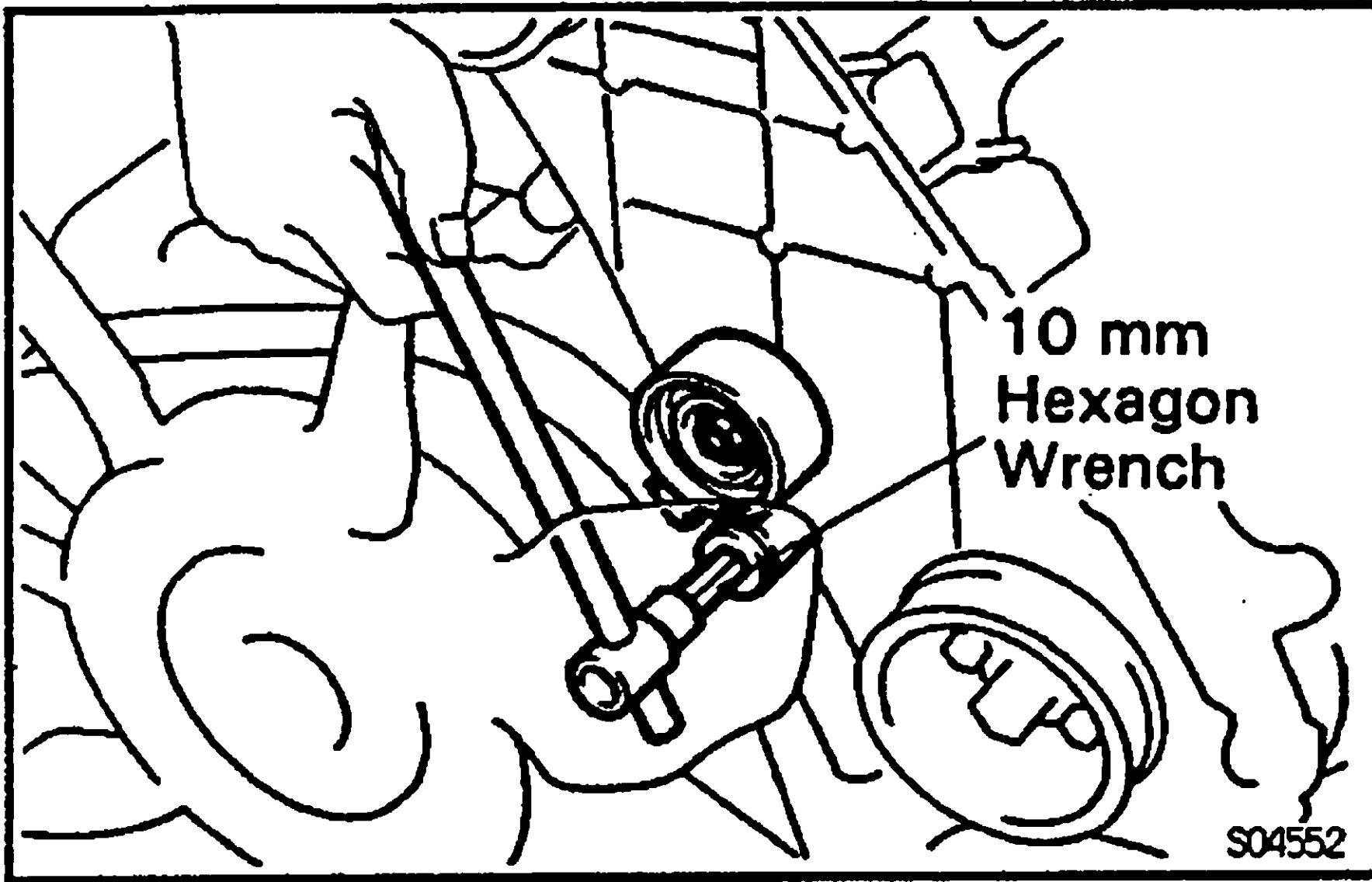
Alternately loosen the 2 bolts, remove them and timing belt tensioner.

**14. REMOVE TIMING BELT**

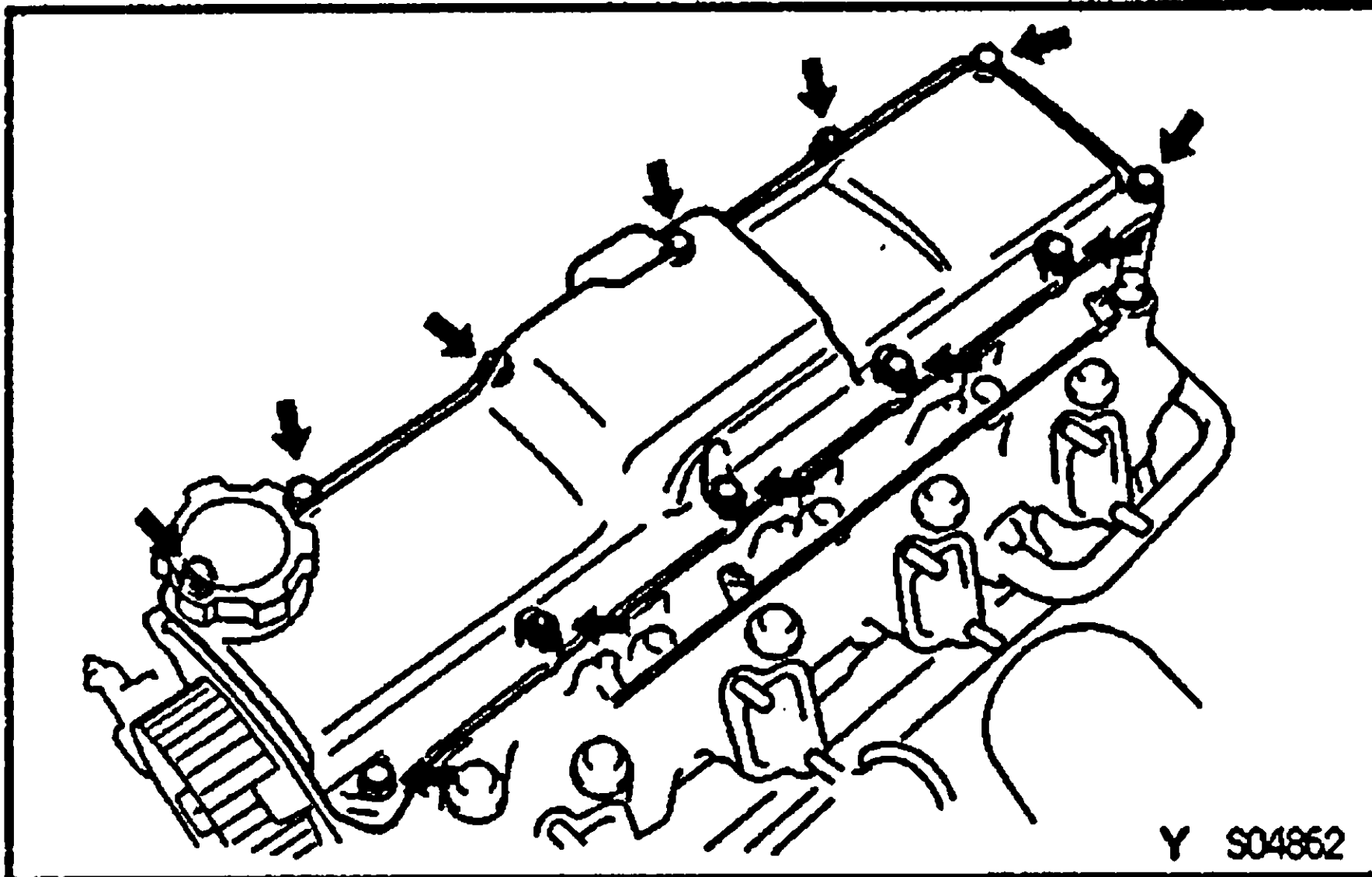
- (a) Turn the crankshaft 90° counterclockwise.

NOTICE: If the timing belt is disengaged, having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you remove the No.1 camshaft timing pulley (step 17), causing damage. So always set the crankshaft pulley at the correct angle.

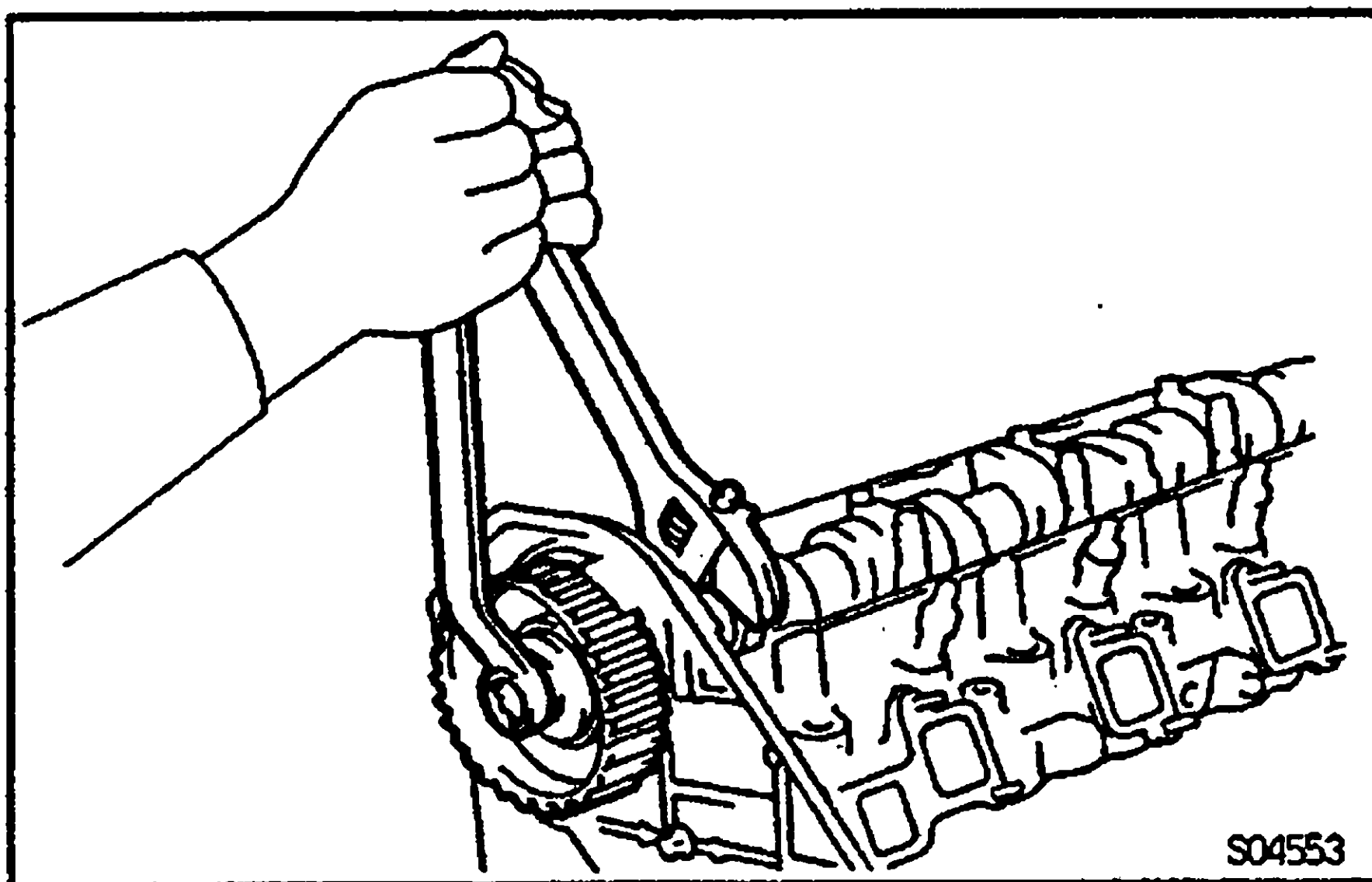
- (b) Remove the timing belt.

**15. REMOVE TIMING BELT IDLER PULLEY**

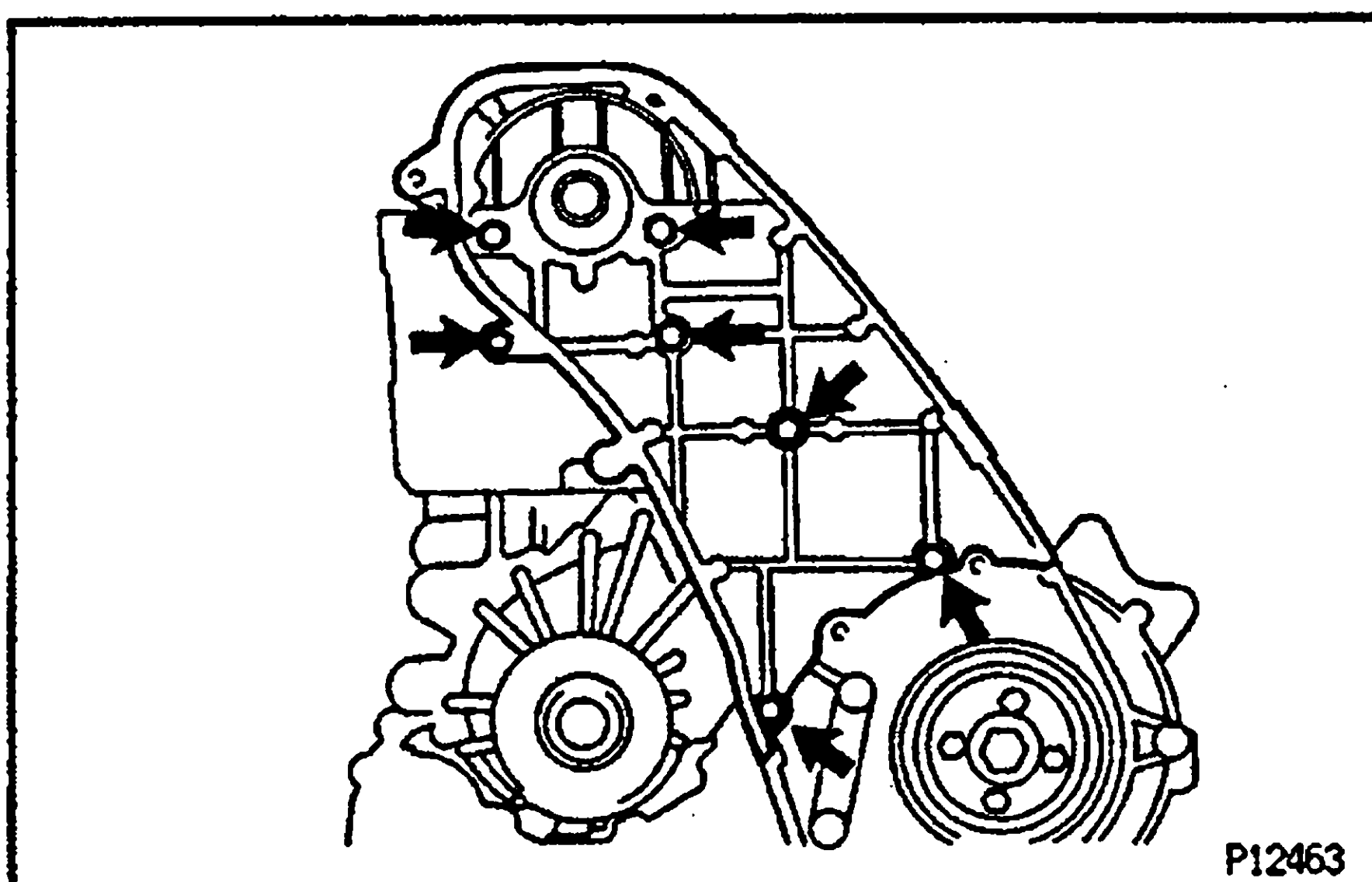
Using a 10 mm hexagon wrench, remove the bolt, timing belt idler pulley and washer.

**16. REMOVE CYLINDER HEAD COVER**

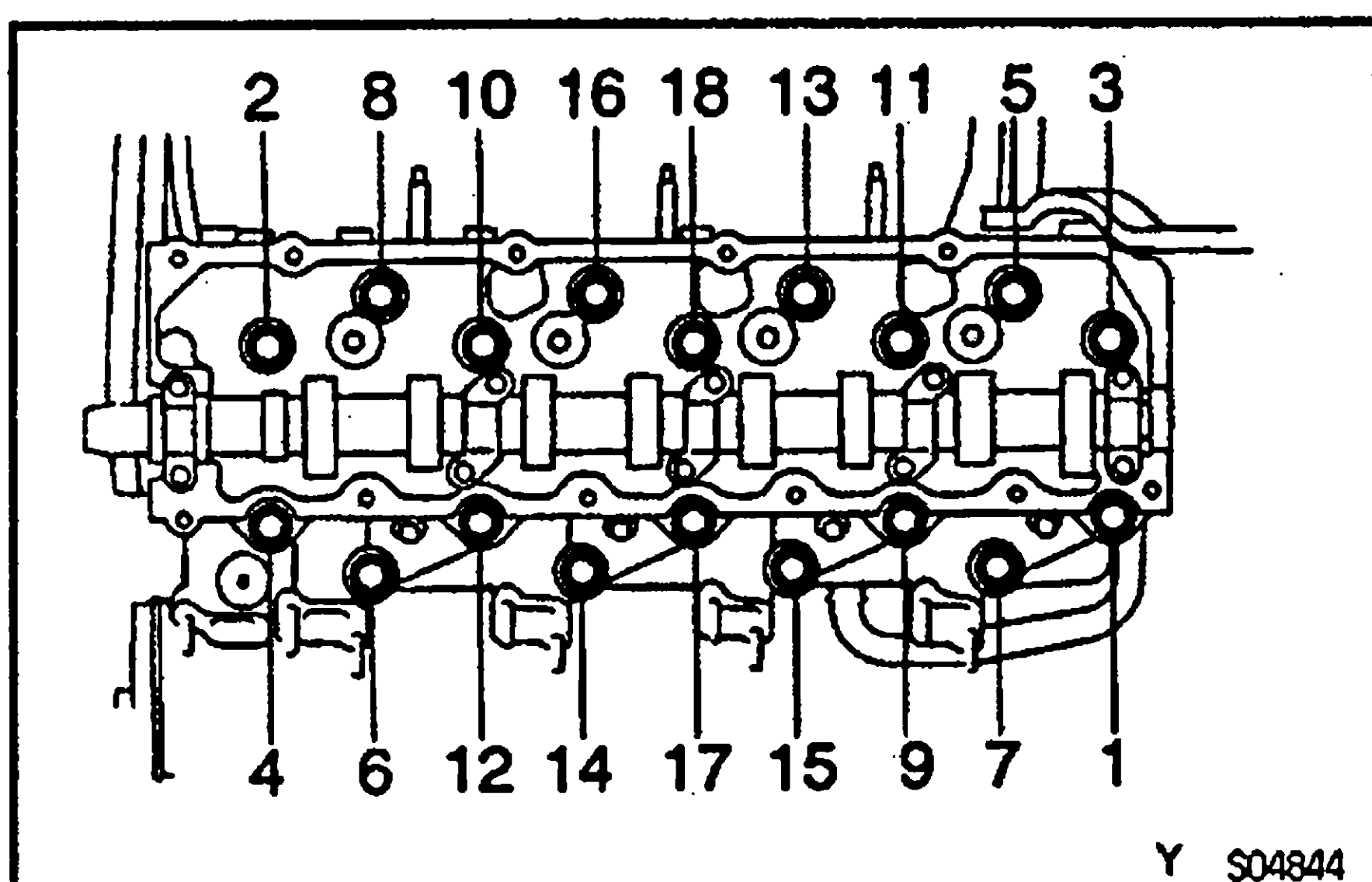
Remove the 10 bolts, 2 nuts, cylinder head cover and gasket.

**17. REMOVE NO.1 CAMSHAFT TIMING PULLEY**

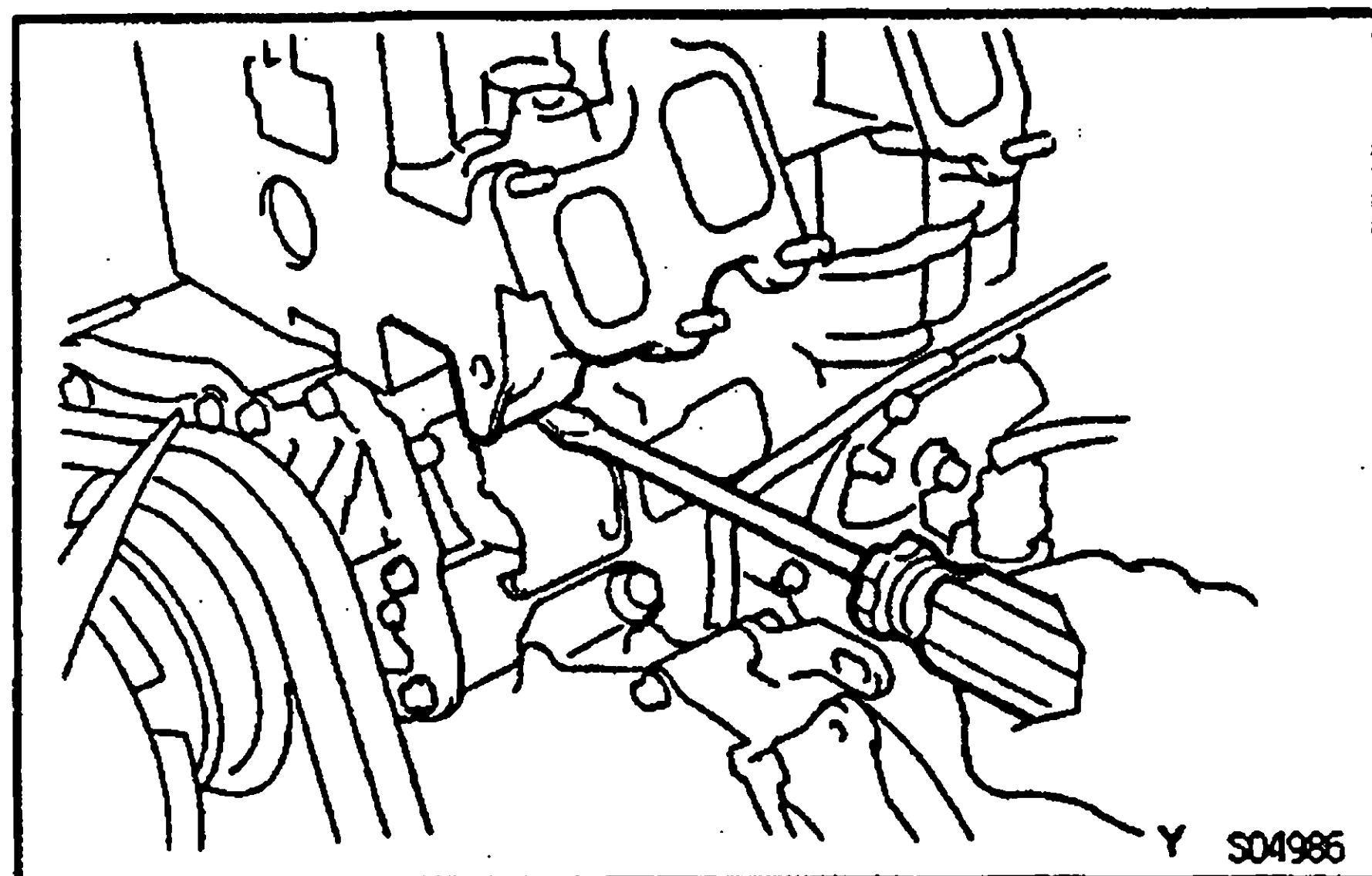
- (a) Hold the hexagonal wrench head portion of the camshaft with a wrench, and remove the camshaft timing pulley bolt and camshaft timing pulley.
- (b) Remove the set key.

**18. REMOVE CAMSHAFT OIL SEAL RETAINER**

- (a) Remove the 7 bolts holding the camshaft oil seal retainer to the cylinder head.
- (b) Pry out the camshaft oil seal retainer.

**19. REMOVE CYLINDER HEAD**

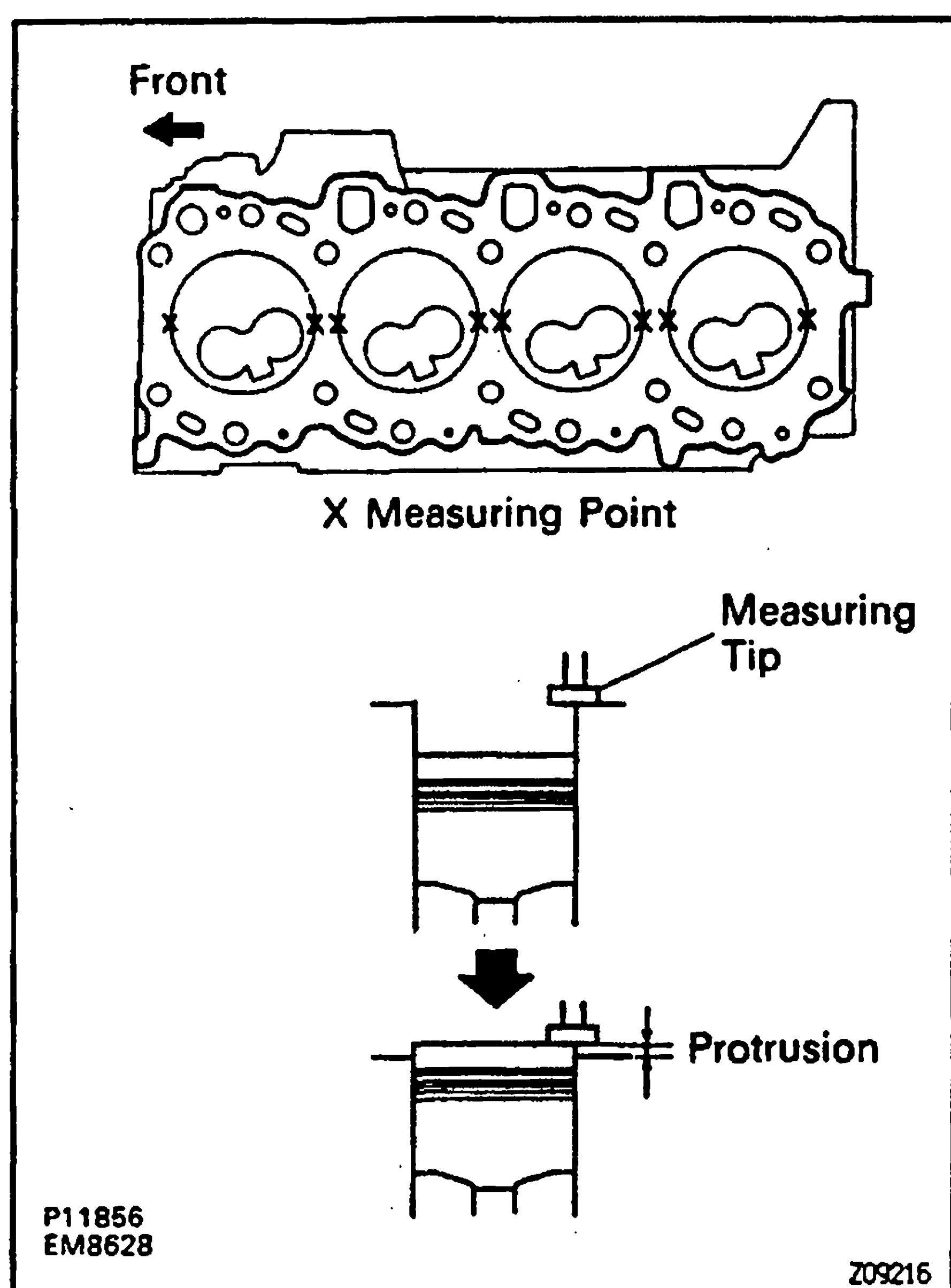
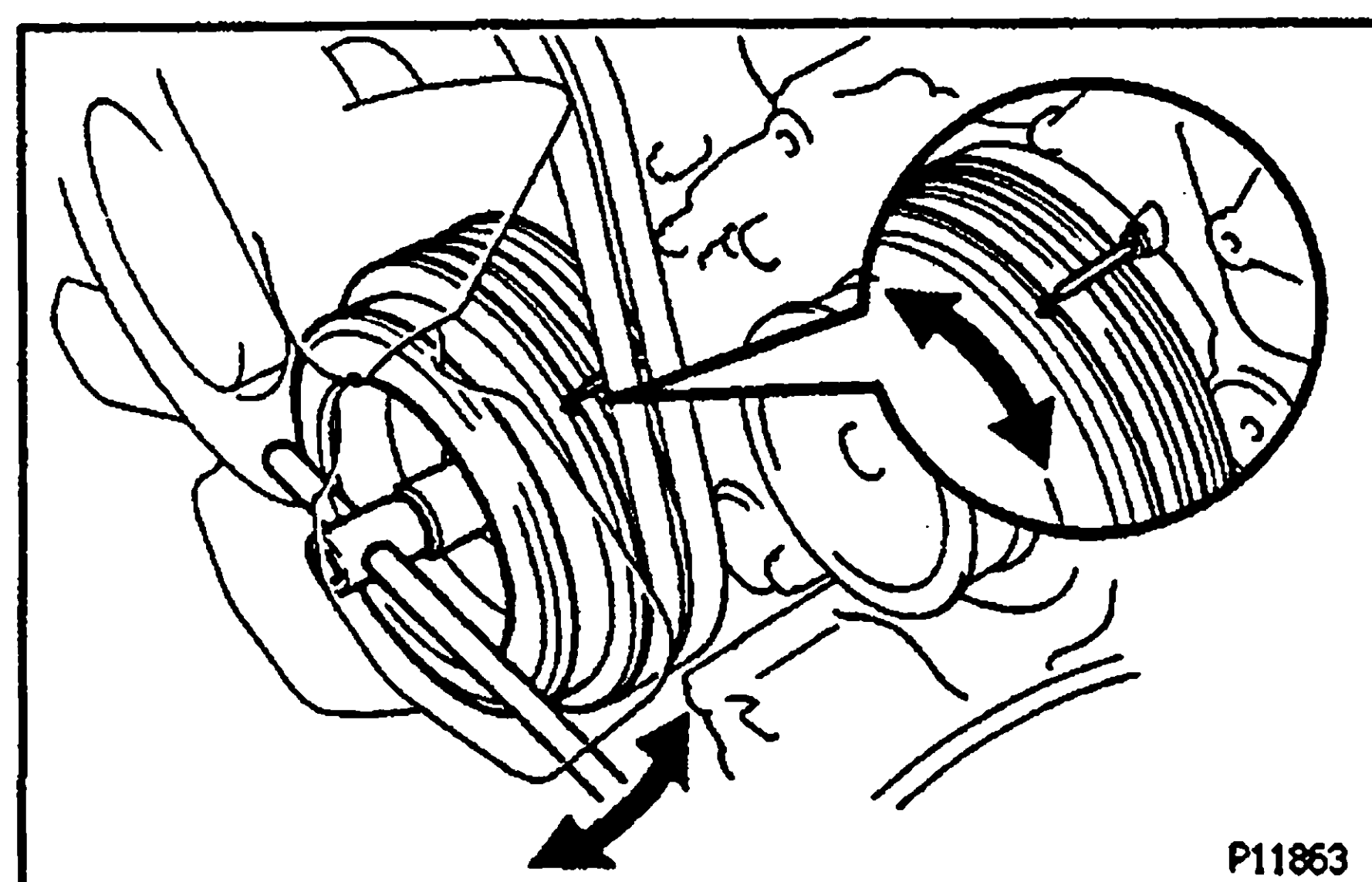
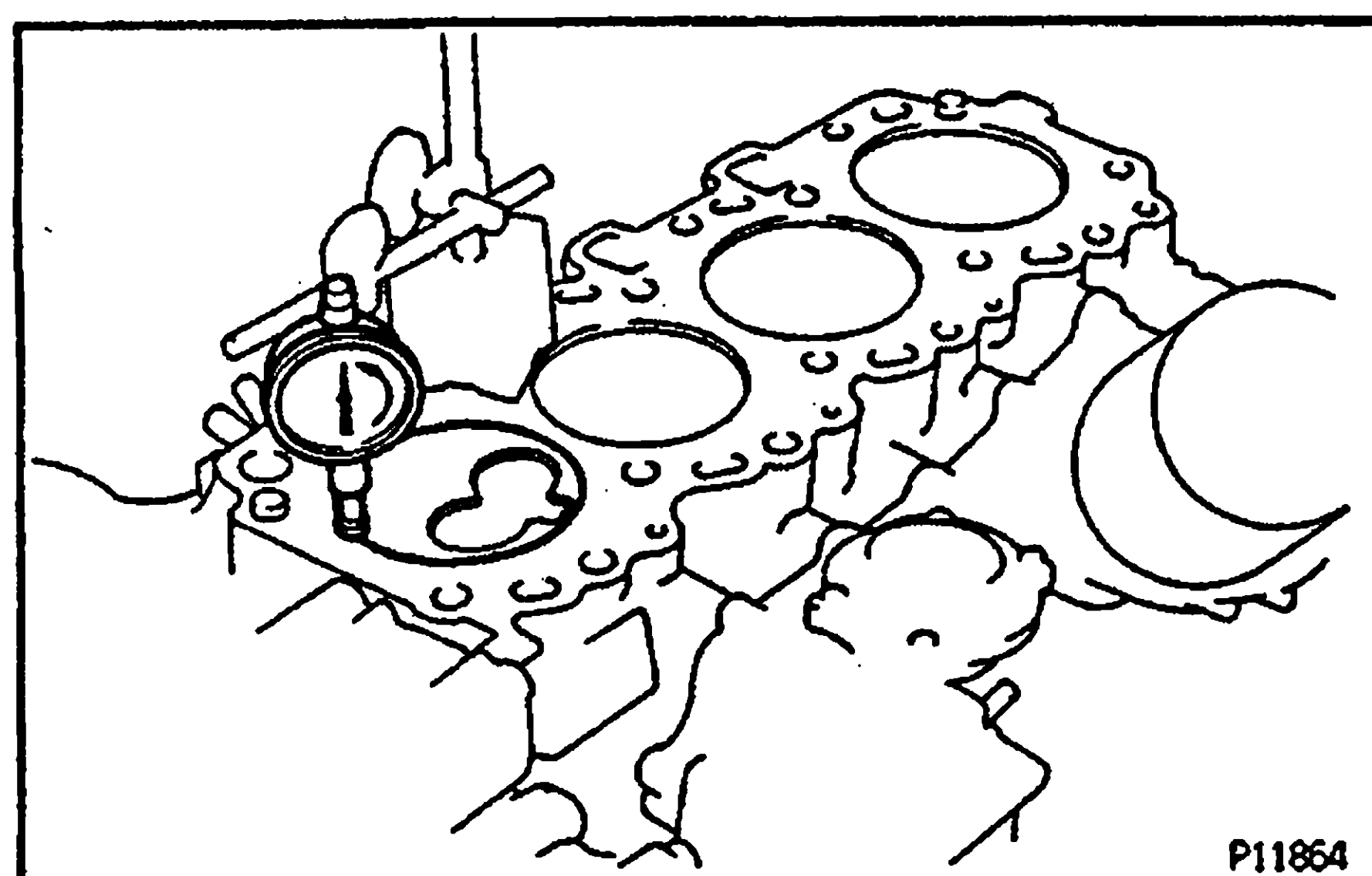
- (a) Uniformly loosen and remove the 18 cylinder head bolts, in several passes, in the sequence shown.
NOTICE: Head warpage or cracking could result from removing bolts in incorrect order.



- (b) Lift the cylinder head from the dowels on the cylinder block, and place the head on wooden blocks on a bench.

HINT: If the cylinder head is difficult to lift off, pry with a screwdriver between the cylinder head and block.

NOTICE: Be careful not to damage the contact surfaces of cylinder head and block.



CYLINDER HEAD INSTALLATION

1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET

A. Check piston protrusions for each cylinder.

- Clean the cylinder block with solvent.
- Set the piston of the cylinder to be measured to slightly before TDC.
- Place a dial indicator on the cylinder block, and set the dial indicator at 0 mm (0 in.).

HINT:

- Use a dial indicator measuring tip as shown in the illustration.
- Make sure that the measuring tip is square to the cylinder block gasket surface and piston head when taking the measurements.

- Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.

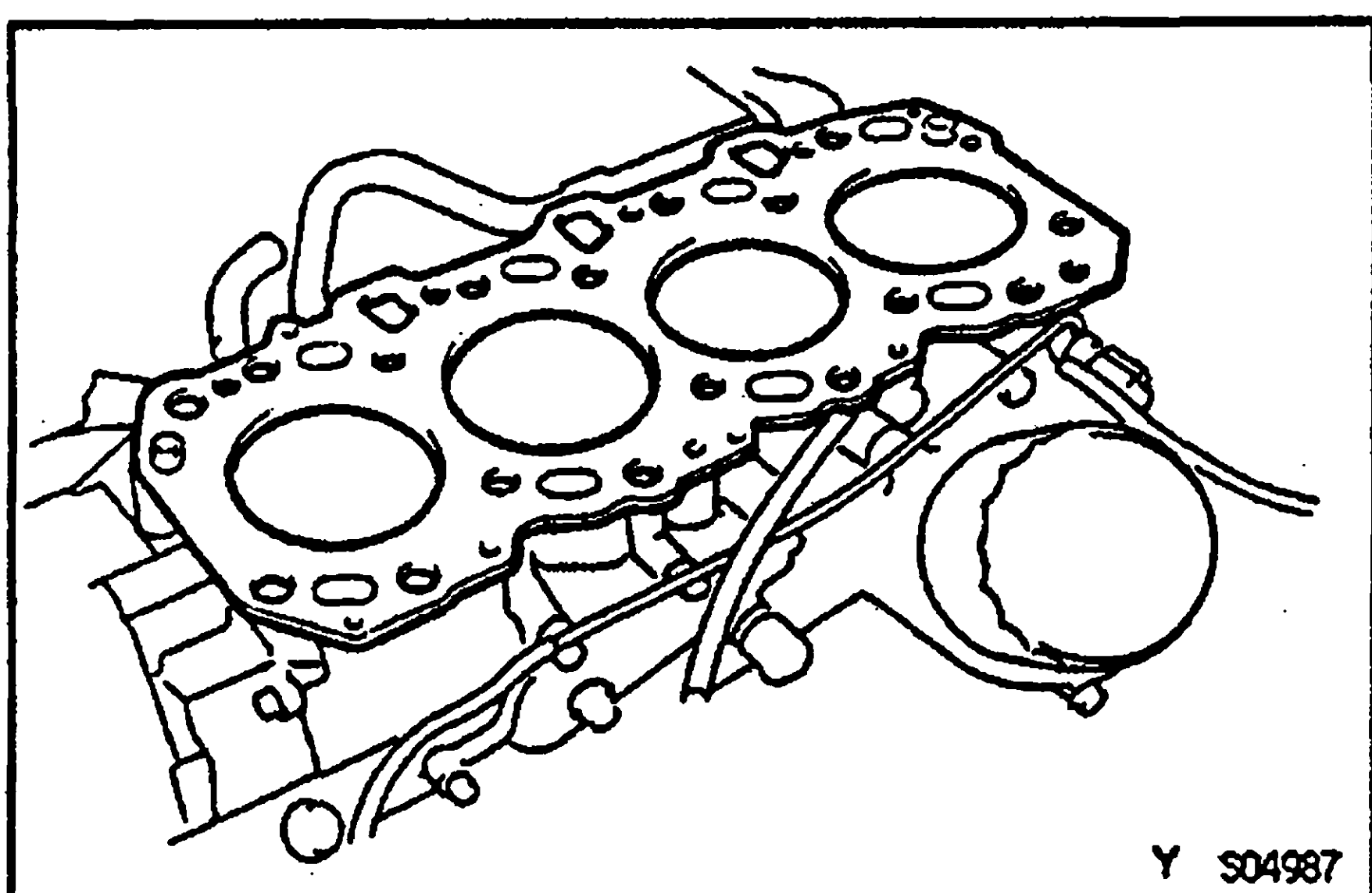
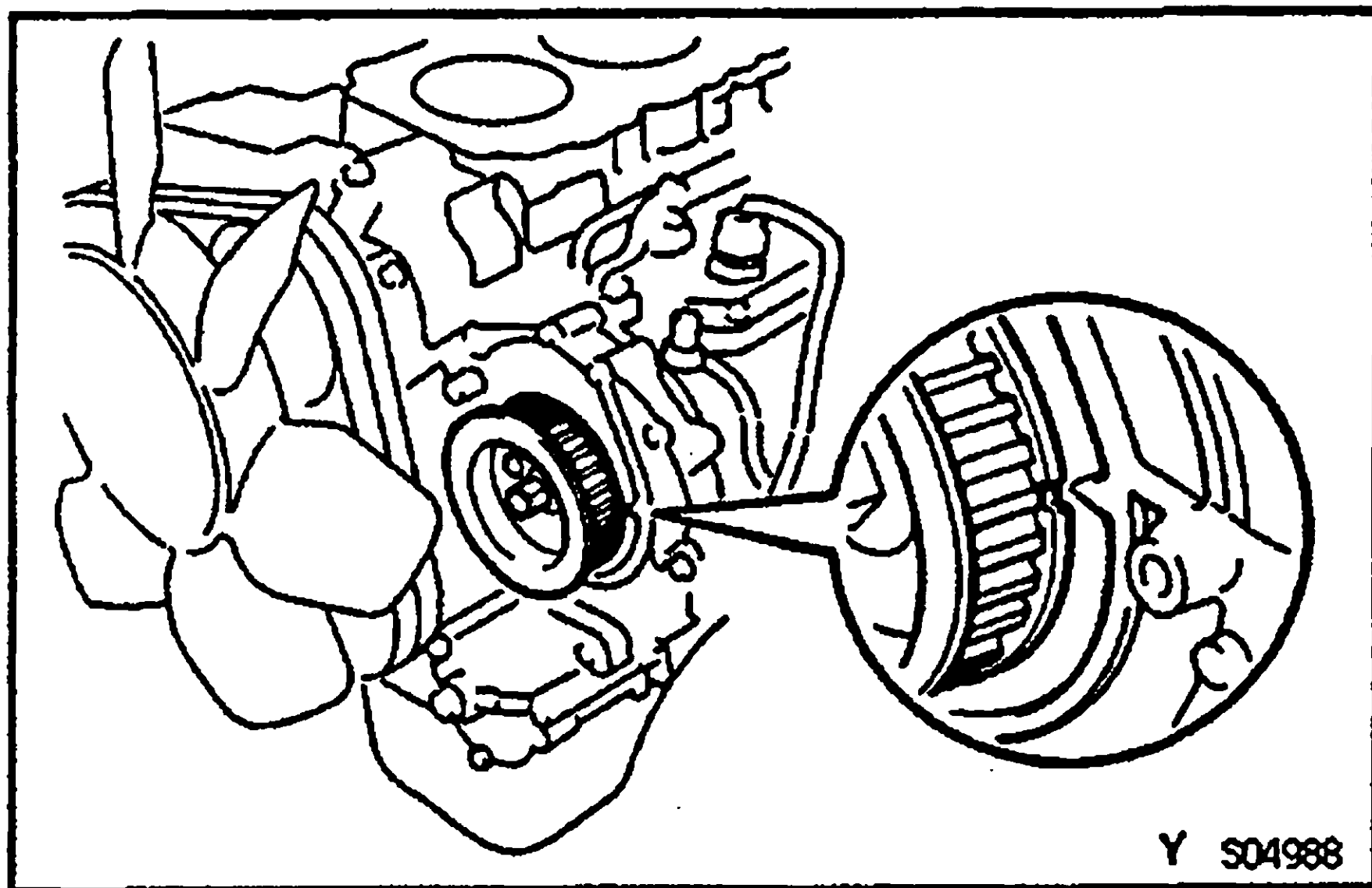
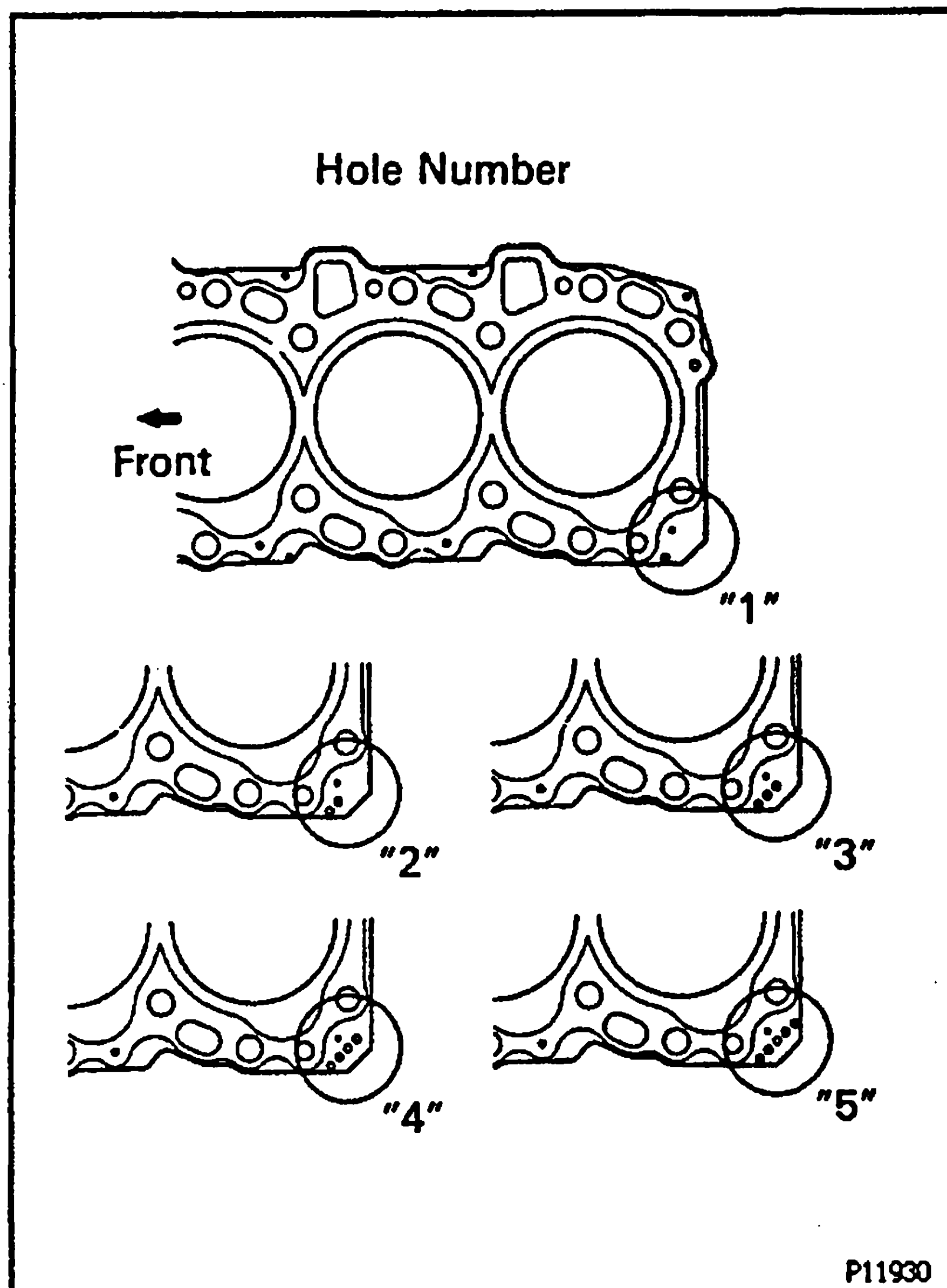
- Measure each cylinder at 2 places as shown in the illustration, making a total of 8 measurements.

- For the piston protrusion value of each cylinder, use the average of the 2 measurements of each cylinder.

Protrusion:

0.08 — 0.33 mm (0.0031 — 0.0130 in.)

(When removing piston and connecting rod assembly)
If the protrusion is not as specified, remove the piston and connecting rod assembly and reinstall it.



B. Select new cylinder head gasket

HINT: There are 5 types of cylinder head gasket (hole number 1 to 5) installed at factory, but only 3 types for supply parts (hole number "1", "3" and "5"), so when replacing the gasket select from one of 3 types above.

Installed cylinder head gasket thickness:

Hole number "1"

0.80 — 0.90 mm (0.0315 — 0.0354 in.)

Hole number "3"

0.90 — 1.00 mm (0.0354 — 0.0394 in.)

Hole number "5"

1.00 — 1.10 mm (0.0394 — 0.0433 in.)

Select the largest piston protrusion value from the measurements made, then select the appropriate cylinder head gasket according to the table below.

Piston protrusion mm (in.)	Gasket size
0.08 — 0.12 (0.0031 — 0.0047)	Use "1"
0.13 — 0.22 (0.0051 — 0.0087)	Use "3"
0.23 — 0.33 (0.0091 — 0.0130)	Use "5"

2. SET NO.4 CYLINDER TO TDC/COMPRESSION

Turn the crankshaft pulley, and align the TDC mark of the timing gear cover with the No.2 camshaft timing pulley.

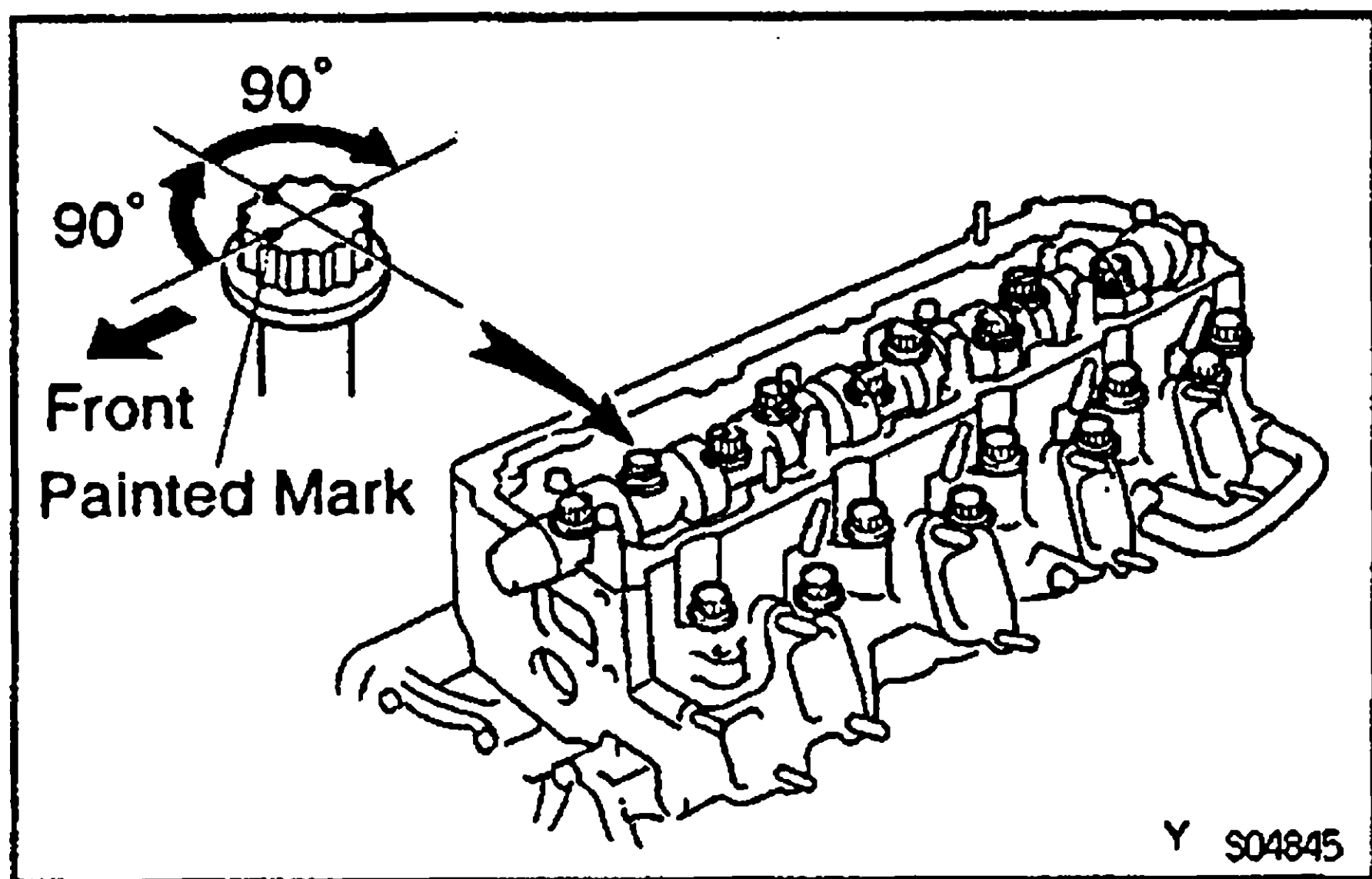
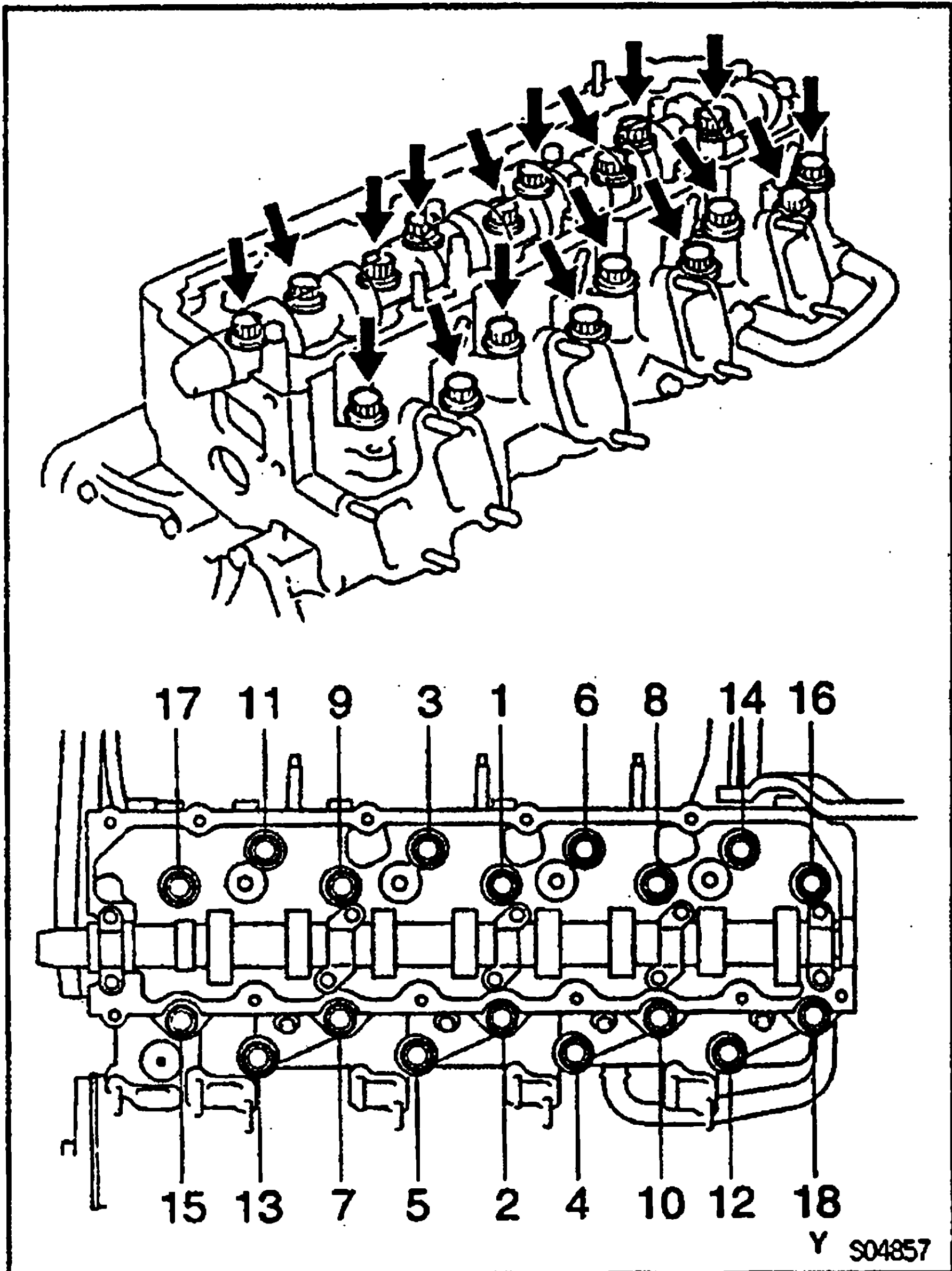
3. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block

- (a) Place a new cylinder head gasket in position on the cylinder block.

NOTICE: Be careful of the installation direction.

- (b) Place the cylinder head in position on the cylinder head gasket.



B. Install cylinder head bolts

HINT:

- The cylinder head bolts are tightened in 3 progressive steps (steps (b), (d) and (e)).
- If any bolts is broken or deformed, replace it.

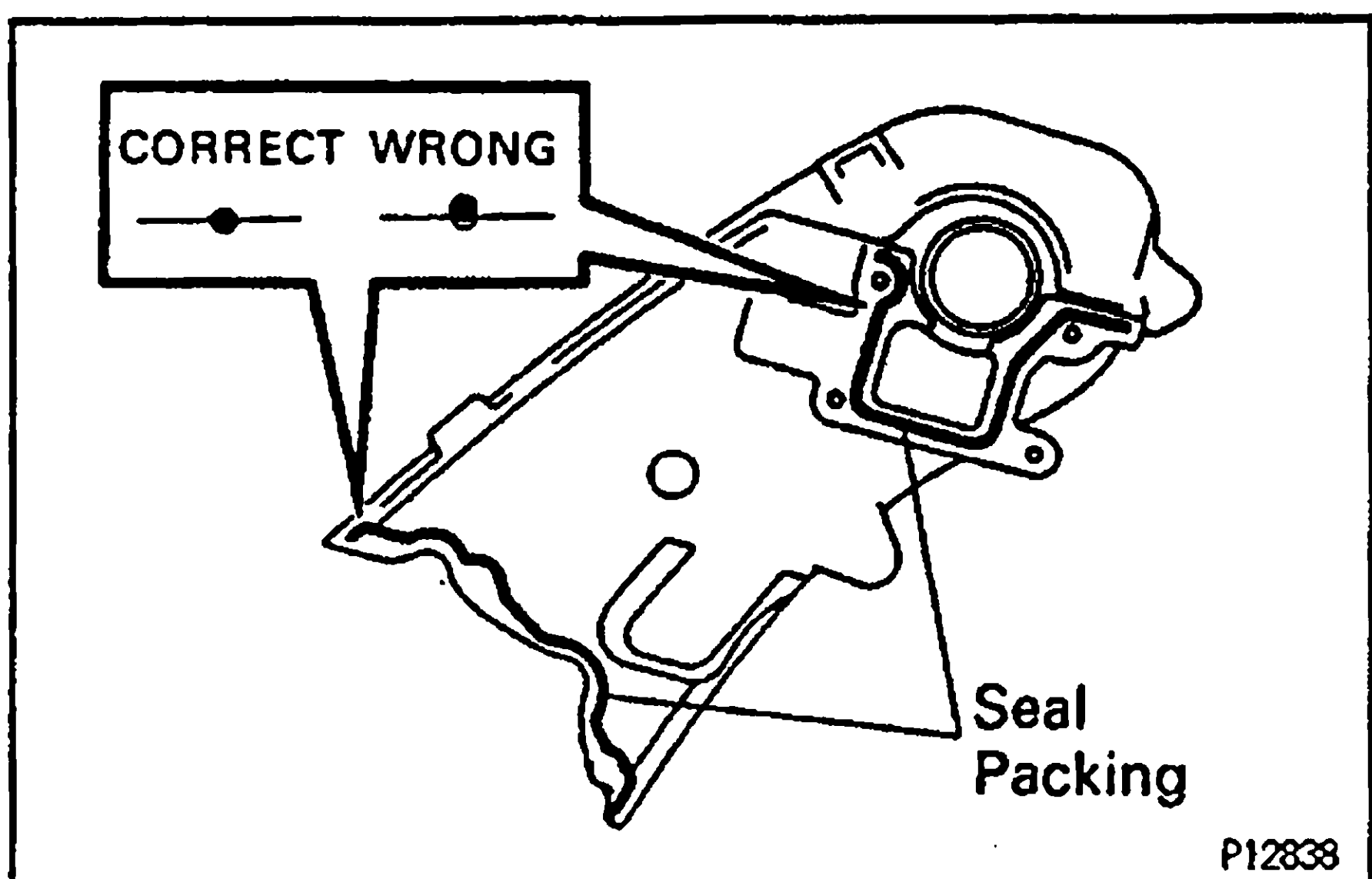
- Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- Install and uniformly tighten the 18 cylinder head bolts, in several passes, in the sequence shown.

Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

- Mark the front of the cylinder head bolt with paint.
- Retighten the cylinder head bolts 90° in the numerical order shown.
- Retighten cylinder head bolts by an additional 90°.
- Check that the painted mark is now facing rearward.

4. INSTALL CAMSHAFT OIL SEAL RETAINER

- Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the camshaft oil seal retainer and cylinder head.
 - Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non—residue solvent, clean both sealing surfaces.



- Apply seal packing to the camshaft oil seal retainer as shown in the illustration.

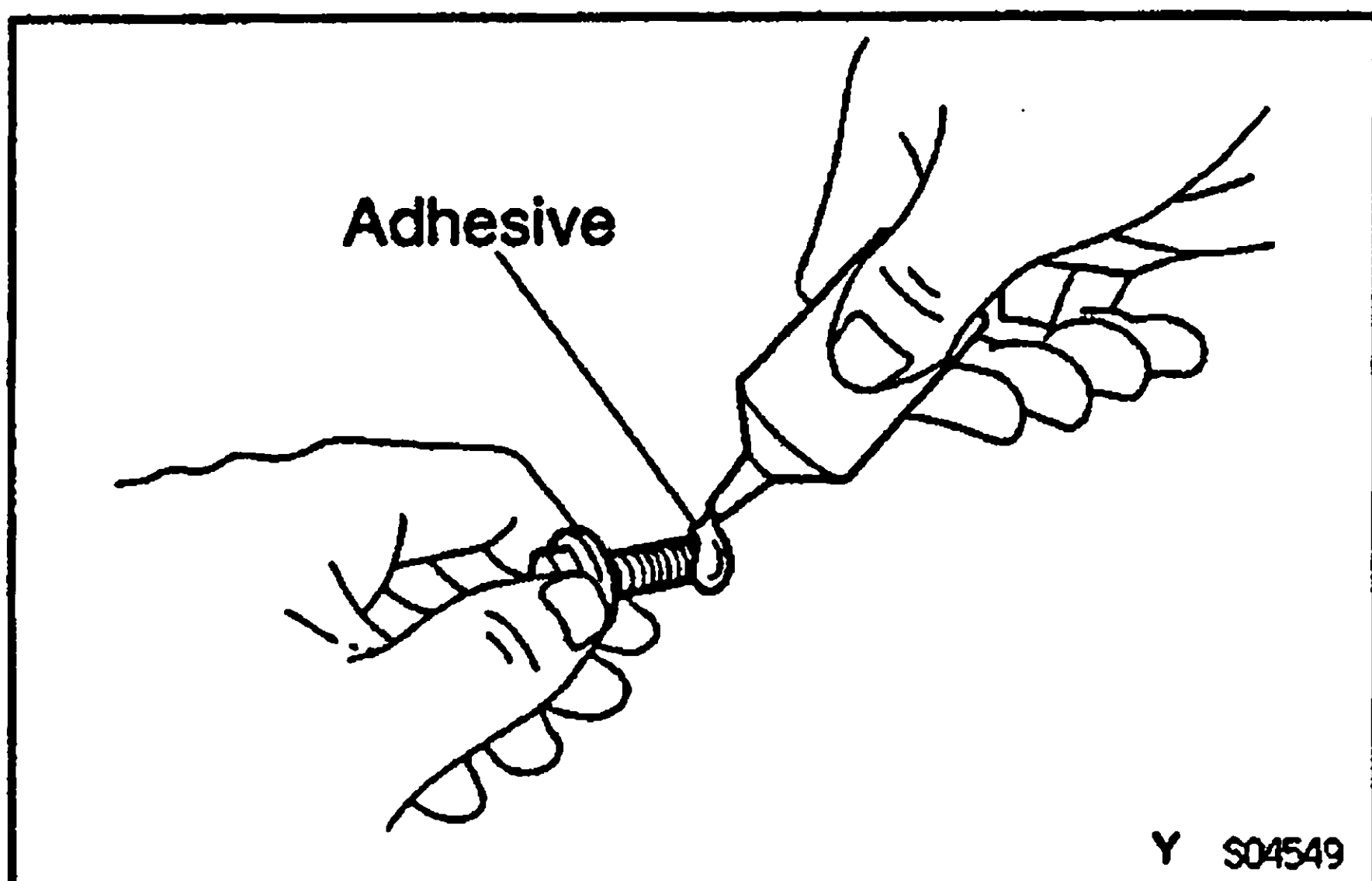
Seal packing:

Part No. 08826—00080 or equivalent

- Install a nozzle that has been cut to a 2 — 3 mm (0.08 — 0.12 in.) opening.

HINT: Avoid applying an excessive amount to the surface.

- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

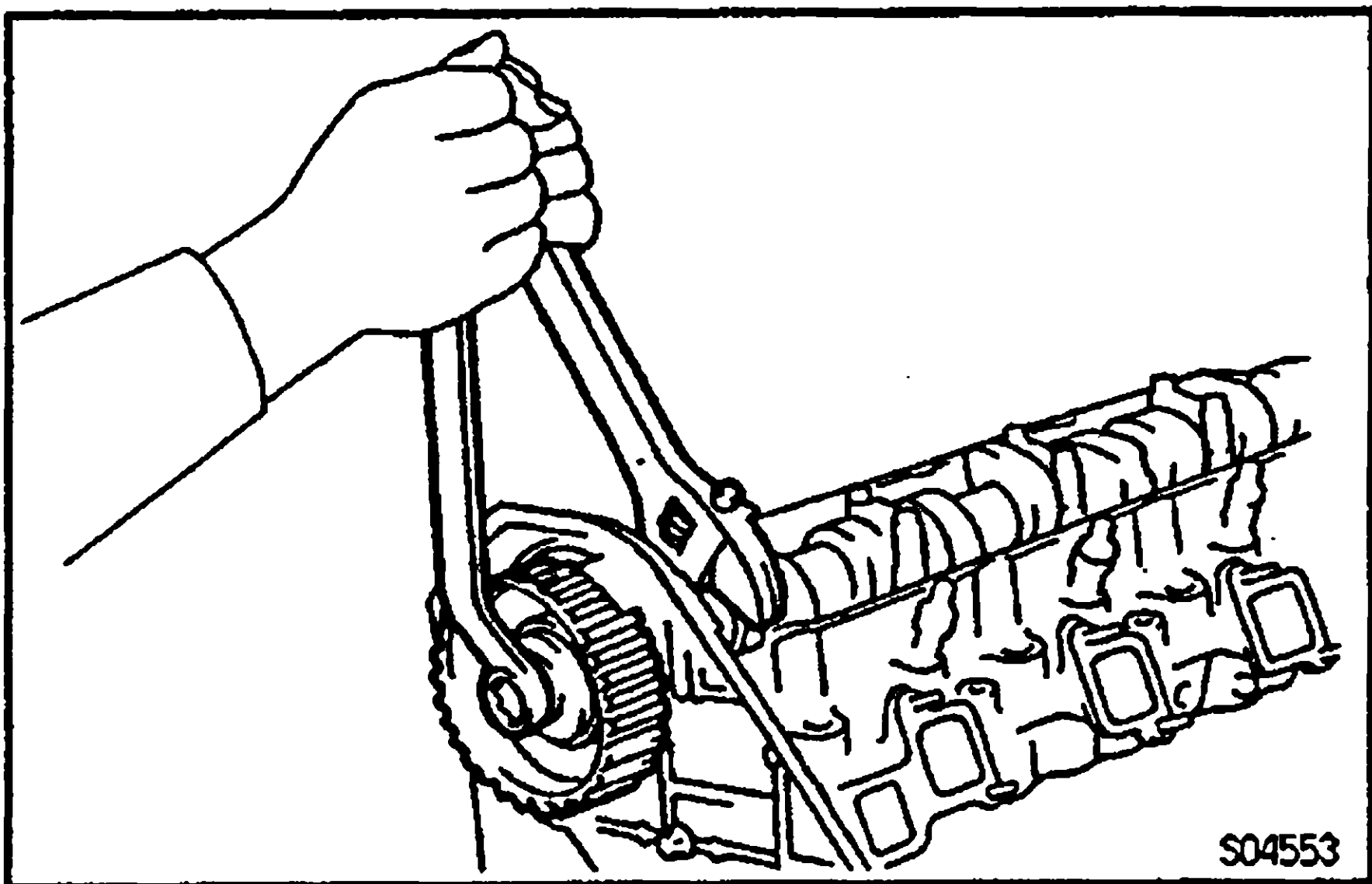


- (c) Apply adhesive to 2 or 3 threads of the mounting bolt end.

Adhesive:

Part No. 08833-00070, THREE BOND 1324, or equivalent

- (d) Install the retainer with the 7 bolts.
Torque: 10 N·m (100 kgf·cm, 7 ft·lbf)



5. INSTALL NO.1 CAMSHAFT TIMING PULLEY

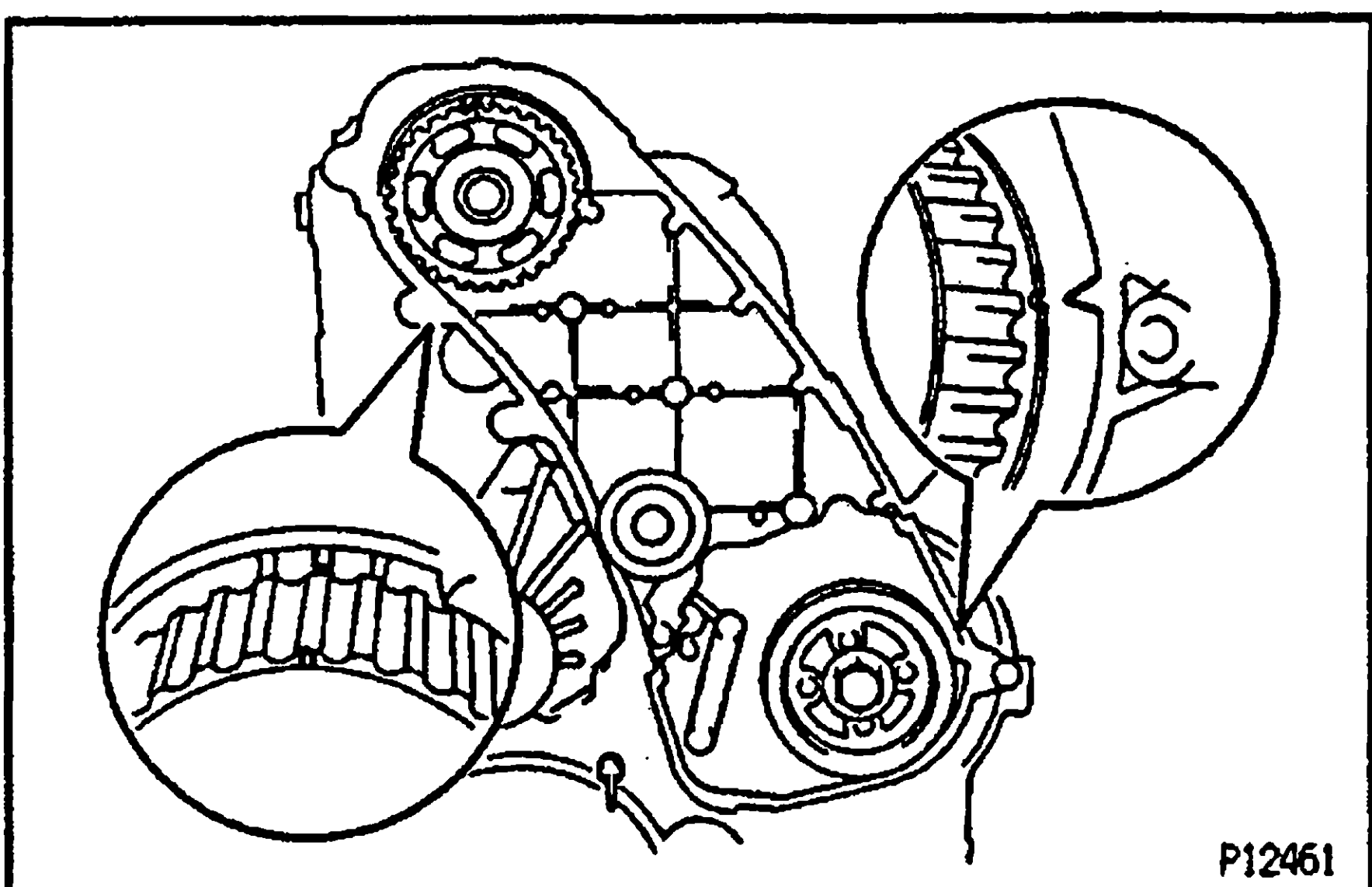
- Install the set key to the key groove of the camshaft.
- Align the pulley set key with the key groove of the camshaft timing pulley, slide the camshaft timing pulley.
- Temporarily install the timing pulley bolt.
- Hold the hexagon wrench head portion of the camshaft with a wrench, and tighten the camshaft timing pulley bolt.

Torque: 98 N·m (1,000 kgf·cm, 72 ft·lbf)

6. SET NO.4 CYLINDER TO TDC/COMPRESSION

Set the timing pulley at each position.

NOTICE: When turning the crankshaft, the valve heads will hit against the piston top. So do not turn it more than necessary.



7. INSTALL TIMING BELT IDLER PULLEY

- Using a 10 mm hexagon wrench, install the washer and timing belt idler pulley with the bolt.

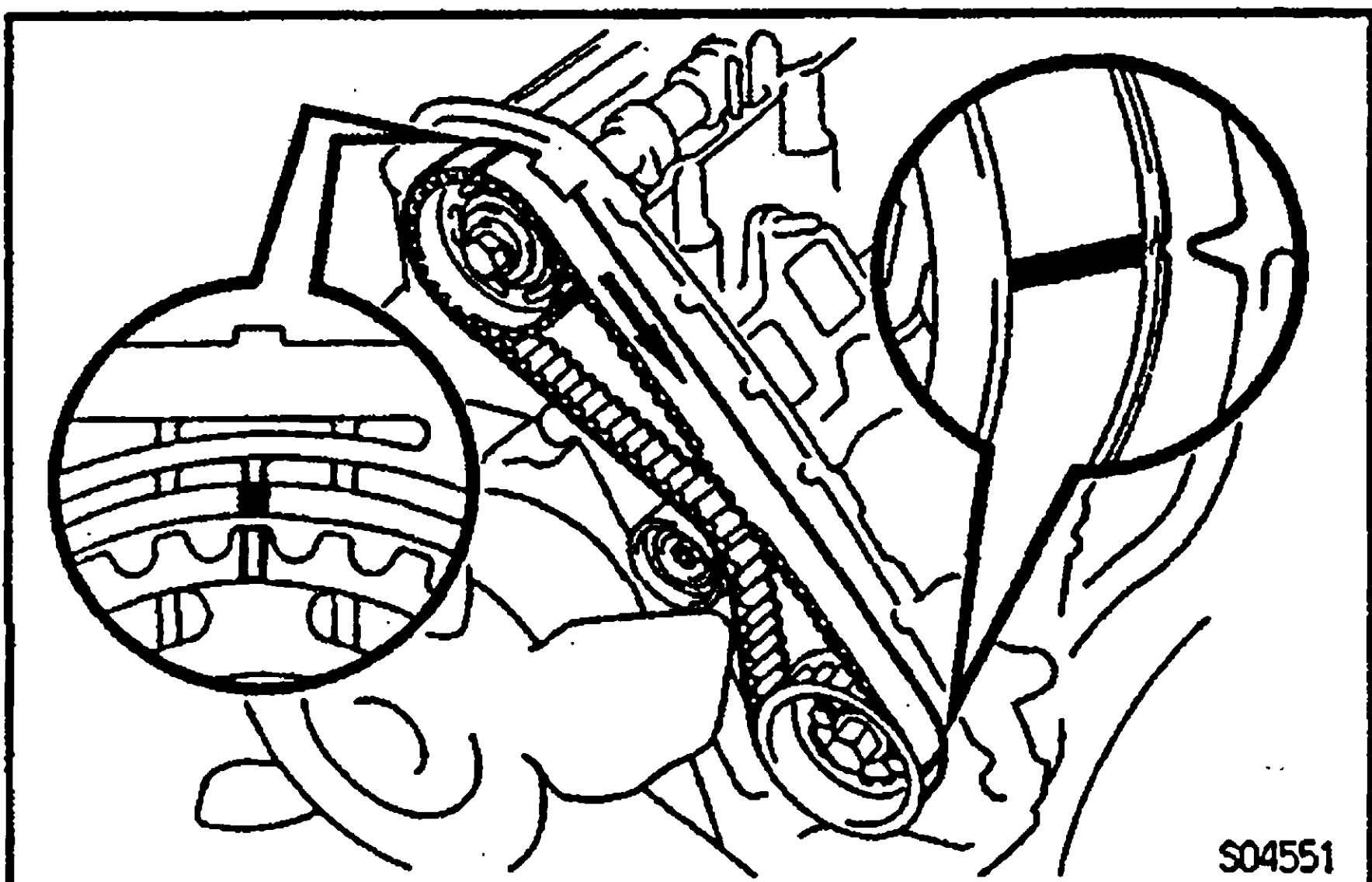
Torque: 34 N·m (350 kgf·cm, 25 ft·lbf)

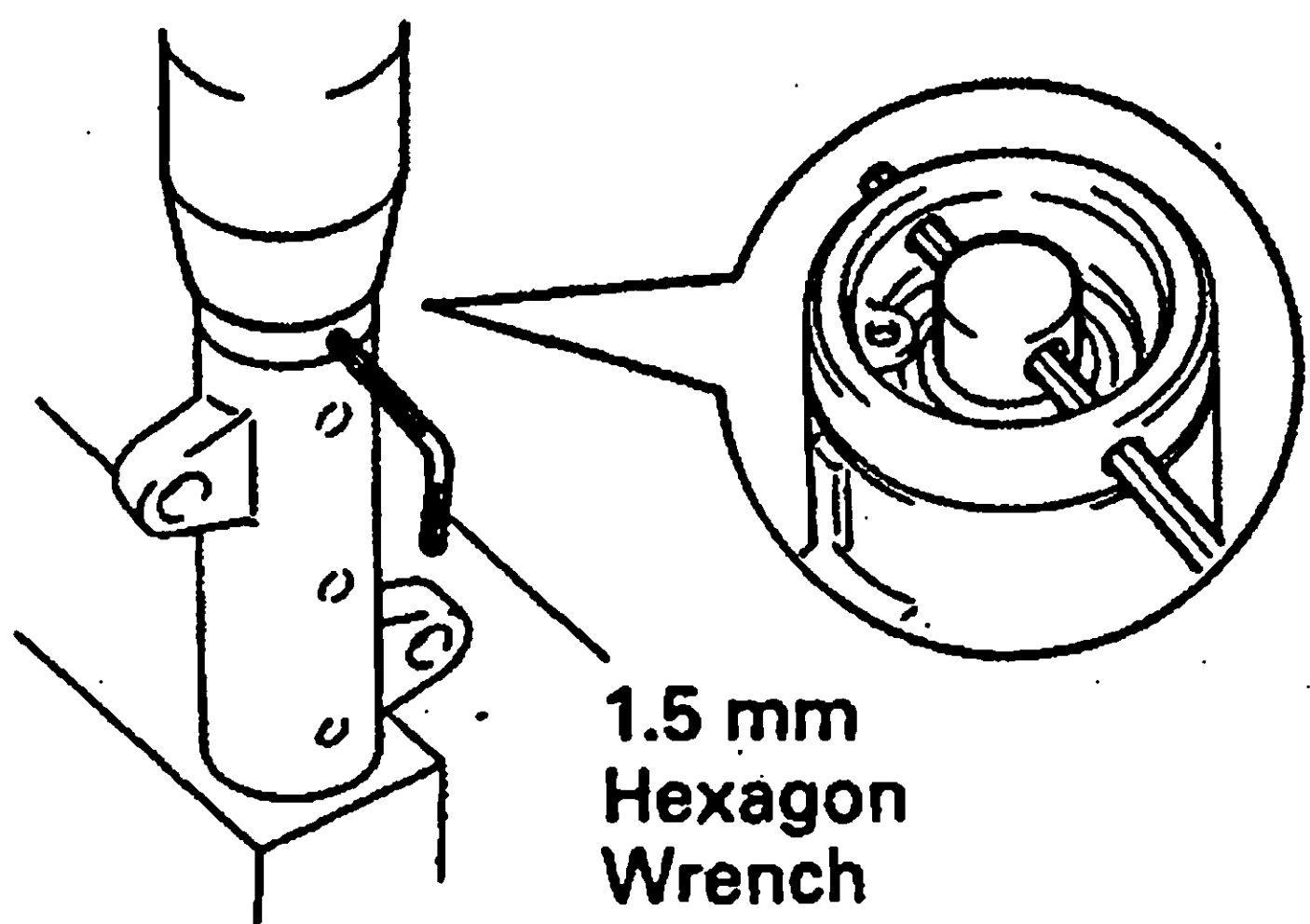
- Check that the idler pulley moves smoothly. If it doesn't move smoothly, check the idler pulley and washer.

8. INSTALL TIMING BELT

NOTICE: The engine should be cold.

HINT: If re-using the timing belt, align the points marked during removal, and install the belt with the arrow pointing in the direction of engine revolution.

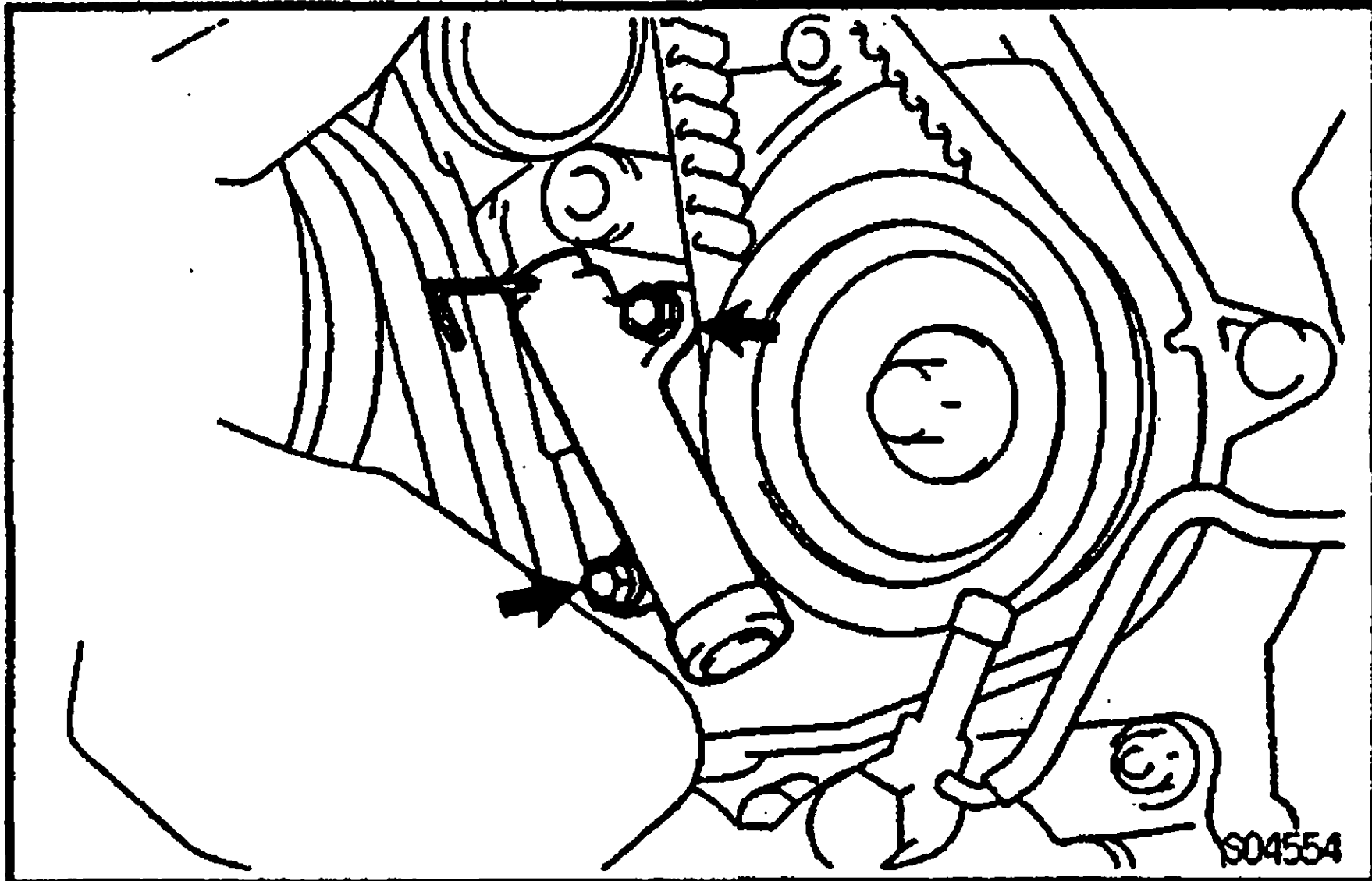




P22744

9. SET TIMING BELT TENSIONER

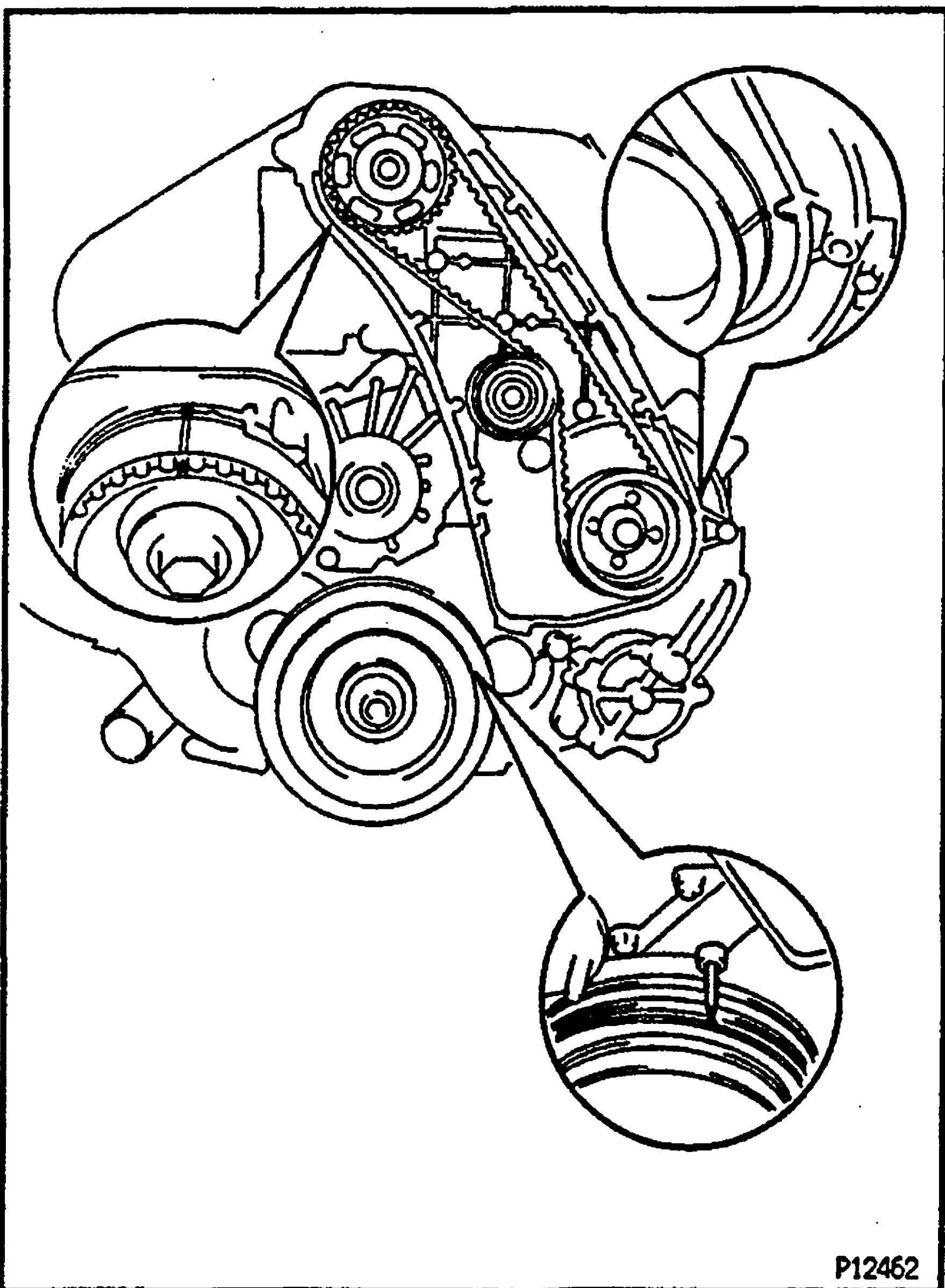
- Using a press, slowly press in the push rod using 981 — 9,807 N (100 — 1,000 kgf, 220 — 2,205 lbf) of force.
- Align the holes of the push rod and housing, pass a 1.5 mm hexagon wrench through the holes to keep the setting position of the push rod.
- Release the press.



S04554

10. INSTALL TIMING BELT TENSIONER

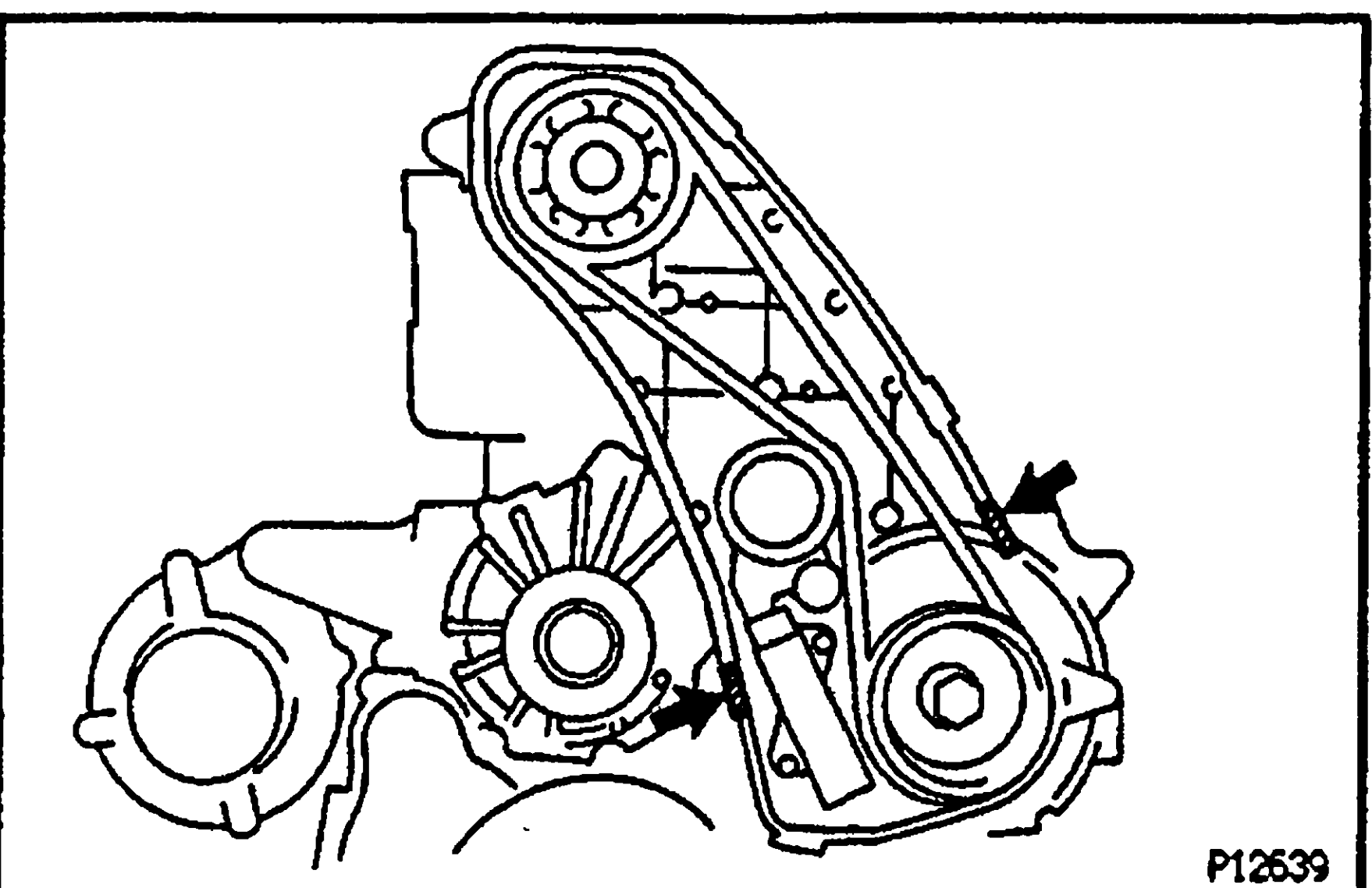
- Temporarily install the timing belt tensioner with the 2 bolts while pushing the idler pulley toward the timing belt.
- Tighten the 2 bolts.
Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)
- Remove the 1.5 mm hexagon wrench from the tensioner.



P12462

11. CHECK VALVE TIMING

Turn the crankshaft pulley clockwise and check that each pulley aligns with the timing marks (TDC mark) as shown in the illustration.
If the marks do not align, remove the timing belt and reinstall it.



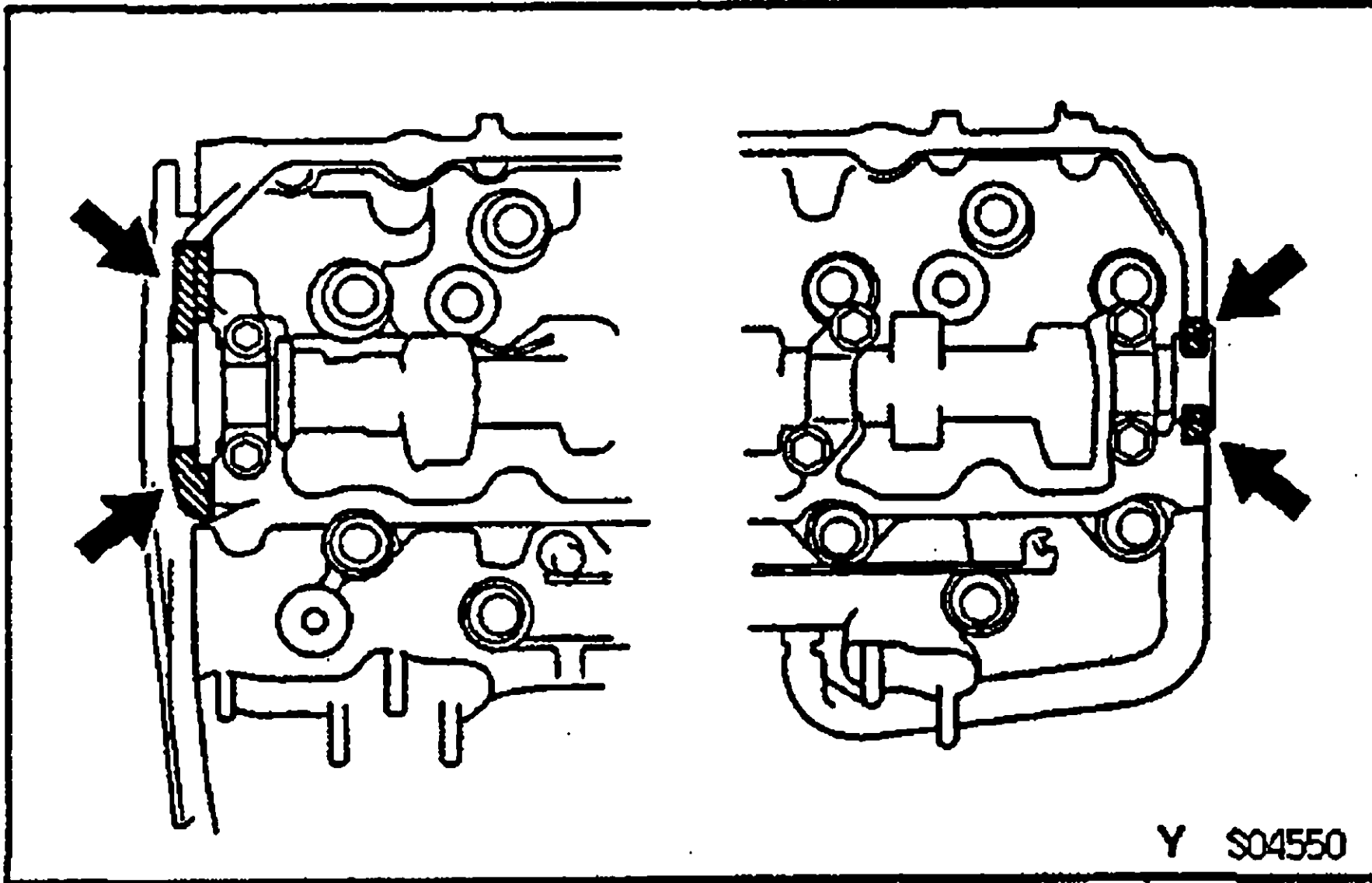
P12639

12. INSTALL TIMING BELT COVER

- Remove any old packing (FIPG) material.
- Apply seal packing to the camshaft oil seal retainer and timing gear cover as shown in the illustration.
Seal packing:
Part No.08826—00080 or equivalent
- Install the gasket to the timing belt cover.
- Install the timing belt cover with the 4 seal washers, bolts and 2 clips.

13. CHECK AND ADJUST VALVE CLEARANCE

(See steps 6 and 7 in valve clearance inspection and adjustment)

**14. INSTALL CYLINDER HEAD COVER**

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the cylinder head as shown in the illustration.

Seal packing:

Part No. 08826-00080 or equivalent

- (c) Install the gasket to the cylinder head cover.
- (d) Install the cylinder head cover with the 10 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 8.8 N·m (90 kgf·cm, 78 in.-lbf)

15. INSTALL INJECTION NOZZLES

- (a) Place the nozzle seats and new gaskets into the injection nozzle holes of the cylinder head.
- (b) Using SST, install the injection nozzles.

SST 09268-64010 (09268-64020)

Torque: 64 N·m (650 kgf·cm, 47 ft-lbf)

NOTICE: Over torquing could cause nozzle deformation and needle adhesion or other defects.

16. INSTALL NOZZLE LEAKAGE PIPE

- (a) Install 4 new gaskets and the leakage pipe with the 4 nuts.

Torque: 30 N·m (300 kgf·cm, 22 ft-lbf)

- (b) Connect the fuel hose to the return pipe.

17. INSTALL INTAKE MANIFOLD

- (a) Place 4 new gaskets in position on the cylinder head.
- NOTICE:** Be careful of the installation direction.

- (b) Install the intake manifold with the 8 nuts. Uniformly tighten the nuts in several passes.

Torque: 29 N·m (290 kgf·cm, 21 ft-lbf)

- (c) **1KZ-T:**

Connect the 2 vacuum hoses to the altitude compensator.

- (d) Connect the engine wire clamp to the venturi.

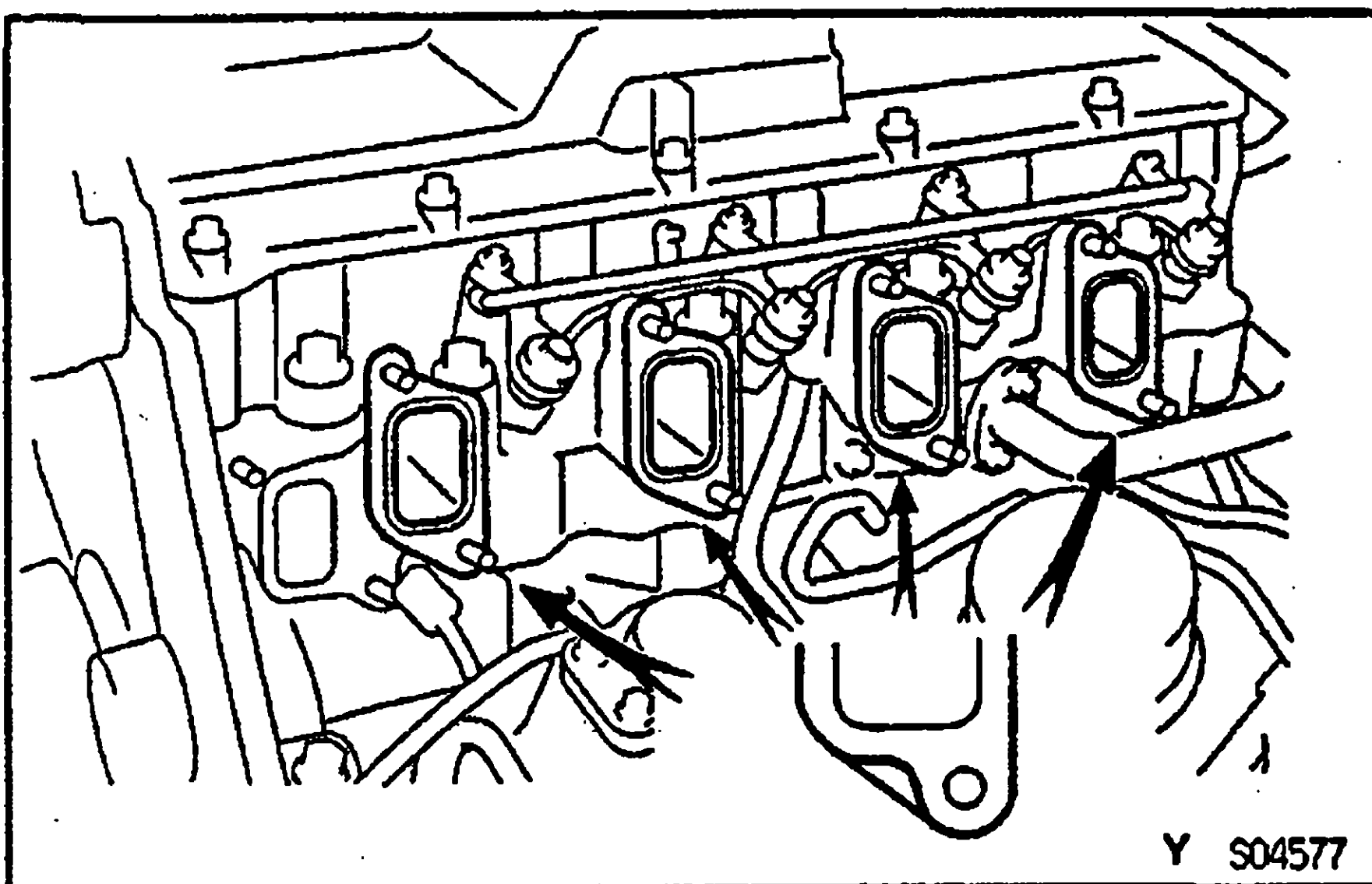
- (e) Install the glow plug wire with the nut and grommet.

- (f) **1KZ-T:**

Connect the vacuum hose to the injection pump.

- (g) **1KZ-TE:**

Connect the throttle position sensor connector.



18. INSTALL WATER OUTLET

- (a) Install a new gasket and the water outlet with the 2 nuts.

Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

- (b) Connect these connectors and clamp:

- Water temperature sender gauge connector
- Turbo pressure sensor connector
- Check connector
- Engine wire clamp

19. INSTALL INJECTION PIPES

(See step 5 in injection pump installation in Fuel System)

20. 1KZ—T:**INSTALL ACCELERATOR CABLE BRACKET AND LINK**

(See step 6 in injection pump installation in Fuel System)

21. INSTALL TURBOCHARGER

(See steps 5 to 11 in turbocharger installation in Turbocharger System)

22. INSTALL INTAKE PIPE

- (a) Place a new gasket on the venturi.
- (b) Connect the intake pipe and PCV hose.
- (c) Place the clamp lock together with pliers and press down the tip of the lock plate. Carefully let the lock spread apart. Take care not to let the pliers slip.
- (d) Install the 4 seal washers and nuts.

Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)

- (e) LHD:

Connect the clamp (1KZ—T) or 2 clamps (1KZ—TE) of the engine wire.

- (f) 1KZ—TE:

Connect these vacuum hoses:

- Vacuum hose to actuator of chamber A
- Vacuum hose to actuator of chamber B
- Vacuum hose to 3—way (from vacuum pump)

- (g) 1KZ—TE:

Connect the VSV connectors.

23. FILL WITH ENGINE COOLANT**24. START ENGINE AND CHECK FOR LEAKS****25. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL**

SERVICE SPECIFICATIONS

SERVICE DATA

B0005-24

Compression pressure	at 250 rpm	STD Minimum	3,040 kPa (31.0 kgf/cm ² , 441 psi) or more 1,961 kPa (20.0 kgf/cm ² , 284 psi) 490 kPa (5.0 kgf/cm ² , 71 psi) or less
Valve clearance	at cold	Intake Exhaust Adjusting shim thickness	0.20 — 0.30 mm (0.008 — 0.012 in.) 0.25 — 0.35 mm (0.010 — 0.014 in.) No.01 2.50 mm (0.0984 in.) No.42 2.55 mm (0.1004 in.) No.06 2.60 mm (0.1024 in.) No.43 2.65 mm (0.1043 in.) No.11 2.70 mm (0.1063 in.) No.44 2.75 mm (0.1083 in.) No.16 2.80 mm (0.1102 in.) No.45 2.85 mm (0.1122 in.) No.21 2.90 mm (0.1142 in.) No.46 2.95 mm (0.1161 in.) No.26 3.00 mm (0.1181 in.) No.47 3.05 mm (0.1201 in.) No.31 3.10 mm (0.1220 in.) No.48 3.15 mm (0.1240 in.) No.36 3.20 mm (0.1260 in.) No.49 3.25 mm (0.1280 in.) No.41 3.30 mm (0.1299 in.)
Injection timing (1KZ-T)	Plunger stroke		0.58 — 0.62 mm (0.0228 — 0.0244 in.)
Idle speed	—		650 — 750 rpm
Maximum speed		1KZ-T 1KZ-TE	4,470 — 4,730 rpm 4,500 — 4,700 rpm
Heater idle-up speed (1KZ-TE)	—		1,150 — 1,250 rpm
A/C idle-up speed		1KZ-T 1KZ-TE	900 — 1,000 rpm 750 — 850 rpm
VSV for intake shutter (1KZ-T)	Resistance	at 20°C (68°F)	37 — 44 Ω
Timing belt tensioner	Protrusion (from housing end)		8.1 — 8.9 mm (0.319 — 0.350 in.)
Timing gear	Idler gear inside diameter Idler gear shaft diameter Idler gear oil clearance Gear backlash Idler gear thrust clearance	STD Maximum STD Maximum STD Maximum	44.000 — 44.025 mm (1.7323 — 1.7333 in.) 43.955 — 43.990 mm (1.7305 — 1.7319 in.) 0.010 — 0.070 mm (0.0004 — 0.0028 in.) 0.20 mm (0.0079 in.) 0.02 — 0.15 mm (0.0008 — 0.0060 in.) 0.20 mm (0.0079 in.) 0.06 — 0.11 mm (0.0024 — 0.0043 in.) 0.30 mm (0.0118 in.)

Cylinder head	Warpage	Maximum	0.15 mm (0.0059 in.)
	Valve seat		
	Refacing angle		30°, 45°, 60°
	Contacting angle		45°
	Contacting width	Intake	1.5 — 1.9 mm (0.059 — 0.075 in.)
		Exhaust	1.8 — 2.2 mm (0.071 — 0.087 in.)
	Valve guide bushing bore diameter	STD	13.000 — 13.027 mm (0.5118 — 0.5129 in.)
		O/S 0.05	13.050 — 13.077 mm (0.5134 — 0.5148 in.)
	Cylinder head bolt outer diameter	STD	11.8 — 12.0 mm (0.465 — 0.472 in.)
		Minimum	11.6 mm (0.457 in.)
Valve guide bushing	Installed cylinder head gasket thickness		
	Hole number "1"		0.80 — 0.90 mm (0.0315 — 0.0354 in.)
	Hole number "3"		0.90 — 1.00 mm (0.0354 — 0.0394 in.)
	Hole number "5"		1.00 — 1.10 mm (0.0394 — 0.0433 in.)
Valve	Inside diameter		8.010 — 8.030 mm (0.3154 — 0.3161 in.)
	Outside diameter (for repair part)	STD	13.040 — 13.051 mm (0.5134 — 0.5138 in.)
		O/S 0.05	13.090 — 13.101 mm (0.5154 — 0.5158 in.)
Valve	Valve overall length	STD	103.29 — 103.69 mm (4.0665 — 4.0823 in.)
		Minimum	102.79 mm (4.0468 in.)
	Valve face angle		44.5°
	Stem diameter	Intake	7.975 — 7.990 mm (0.3140 — 0.3146 in.)
		Exhaust	7.960 — 7.975 mm (0.3134 — 0.3140 in.)
	Stem oil clearance	STD Intake	0.020 — 0.055 mm (0.0008 — 0.0022 in.)
		Exhaust	0.035 — 0.070 mm (0.0014 — 0.0028 in.)
		Maximum Intake	0.08 mm (0.0031 in.)
		Exhaust	0.10 mm (0.0039 in.)
	Margin thickness	STD Intake	1.6 mm (0.063 in.)
		Exhaust	1.7 mm (0.067 in.)
		Minimum Intake	1.1 mm (0.043 in.)
		Exhaust	1.2 mm (0.047 in.)
Valve spring	Deviation	Maximum	2.0 mm (0.079 in.)
	Free length		48.54 mm (1.9110 in.)
	Installed tension at 37.0 mm (1.457 in.)		301 — 332 N (30.7 — 33.9 kgf, 67.7 — 74.7 lbf)
Valve lifter	Lifter diameter		40.892 — 40.902 mm (1.6099 — 1.6103 in.)
	Lifter bore diameter		40.930 — 40.950 mm (1.6114 — 1.6122 in.)
	Oil clearance	STD	0.028 — 0.058 mm (0.0011 — 0.0023 in.)
		Maximum	0.10 mm (0.0039 in.)
Manifold	Warpage	Maximum	0.40 mm (0.0157 in.)
Camshaft	Thrust clearance	STD	0.08 — 0.18 mm (0.0031 — 0.0071 in.)
		Maximum	0.25 mm (0.0098 in.)
	Journal oil clearance	STD	0.025 — 0.062 mm (0.0010 — 0.0024 in.)
		Maximum	0.10 mm (0.0039 in.)
	Journal diameter		27.969 — 27.985 mm (1.1011 — 1.1018 in.)
	Circle runout	Maximum	0.06 mm (0.0024 in.)
	Cam lobe height	STD Intake	54.810 — 54.910 mm (2.1579 — 2.1618 in.)
		Exhaust	56.140 — 56.240 mm (2.2102 — 2.2142 in.)
		Minimum Intake	54.39 mm (2.1413 in.)
		Exhaust	55.72 mm (2.1937 in.)

Combustion chamber	Protrusion	Minus 0.03 — Plus 0.02 mm (Minus 0.0012 — Plus 0.0008 in.)
	Shim thickness	0.05 mm (0.0020 in.) 0.10 mm (0.0039 in.)
Cylinder block	Cylinder head surface warpage	Maximum 0.10 mm (0.0039 in.)
	Cylinder bore diameter	STD Mark 1 96.000 — 96.010 mm (3.7795 — 3.7799 in.) Mark 2 96.010 — 96.020 mm (3.7799 — 3.7803 in.) Mark 3 96.020 — 96.030 mm (3.7803 — 3.7807 in.) Maximum STD 96.23 mm (3.7886 in.)
	Main journal bore diameter	STD Mark 1 75.000 — 75.006 mm (2.9528 — 2.9530 in.) Mark 2 75.006 — 75.012 mm (2.9530 — 2.9532 in.) Mark 3 75.012 — 75.018 mm (2.9532 — 2.9535 in.)
Piston and piston ring	Piston diameter	STD Mark 1 95.940 — 95.950 mm (3.7772 — 3.7776 in.) Mark 2 95.950 — 95.960 mm (3.7776 — 3.7779 in.) Mark 3 95.960 — 95.970 mm (3.7779 — 3.7783 in.) O/S 0.50 96.440 — 96.470 mm (3.7968 — 3.7980 in.) O/S 0.75 96.690 — 96.720 mm (3.8067 — 3.8079 in.) O/S 1.00 96.940 — 96.970 mm (3.8165 — 3.8177 in.)
	Piston oil clearance	STD 0.050 — 0.070 mm (0.0020 — 0.0028 in.) Maximum 0.14 mm (0.0055 in.)
	Piston ring groove clearance	No.1 0.060 — 0.110 mm (0.0024 — 0.0043 in.) No.2 0.060 — 0.100 mm (0.0024 — 0.0039 in.) Oil 0.020 — 0.060 mm (0.0009 — 0.0024 in.)
	Piston ring end gap	STD No.1 0.350 — 0.570 mm (0.0138 — 0.0224 in.) No.2 0.400 — 0.600 mm (0.0157 — 0.0236 in.) Oil 0.200 — 0.500 mm (0.0079 — 0.0197 in.) Maximum No.1 1.03 mm (0.0406 in.) No.2 1.10 mm (0.0433 in.) Oil 0.87 mm (0.0343 in.)
Connecting rod	Thrust clearance	STD 0.10 — 0.30 mm (0.0039 — 0.0118 in.) Maximum 0.40 mm (0.0157 in.)
	Connecting rod bearing center wall thickness	
	Reference	STD Mark 2 1.486 — 1.489 mm (0.0585 — 0.0586 in.) Mark 3 1.489 — 1.492 mm (0.0586 — 0.0587 in.) Mark 4 1.492 — 1.495 mm (0.0587 — 0.0589 in.) Mark 5 1.495 — 1.498 mm (0.0589 — 0.0590 in.) Mark 6 1.498 — 1.501 mm (0.0590 — 0.0591 in.)
	Connecting rod oil clearance	STD STD 0.036 — 0.054 mm (0.0014 — 0.0021 in.) U/S 0.25 and U/S 0.50 0.037 — 0.077 mm (0.0015 — 0.0030 in.) Maximum 0.10 mm (0.0039 in.)

Connecting rod (cont'd)	Rod out—of alignment		
	Maximum per 100 mm (3.94 in.)		0.03 mm (0.0012 in.)
	Rod twist	Maximum per 100 mm (3.94 in.)	0.15 mm (0.0059 in.)
	Connecting rod bolt outside diameter	STD	8.400 — 8.600 mm (0.3307 — 0.3385 in.)
		Maximum	8.20 mm (0.3228 in.)
	Bushing inside diameter		34.012 — 34.024 mm (1.3391 — 1.3395 in.)
	Piston pin diameter		34.000 — 34.012 mm (1.3386 — 1.3391 in.)
	Piston pin oil clearance	STD	0.008 — 0.016 mm (0.0003 — 0.0006 in.)
		Maximum	0.03 mm (0.0012 in.)
	Big end inner diameter		
Crankshaft	Reference	STD Mark 1	62.014 — 62.020 mm (2.4415 — 2.4417 in.)
		Mark 2	62.020 — 62.026 mm (2.4417 — 2.4420 in.)
		Mark 3	62.026 — 62.032 mm (2.4420 — 2.4422 in.)
	Thrust clearance		
		STD	0.040 — 0.240 mm (0.0016 — 0.0094 in.)
		Maximum	0.30 mm (0.0118 in.)
	Thrust washer thickness		
		STD	2.430 — 2.480 mm (0.0957 — 0.0976 in.)
		U/S 0.25	2.555 — 2.605 mm (0.1006 — 0.1026 in.)
		U/S 0.125	2.493 — 2.543 mm (0.0981 — 0.1001 in.)
	Main journal oil clearance	STD	0.036 — 0.054 mm (0.0014 — 0.0021 in.)
		U/S 0.25 and U/S 0.50	0.037 — 0.077 mm (0.0015 — 0.0030 in.)
		Maximum	0.10 mm (0.0039 in.)
	Main journal diameter	STD Mark 1	69.994 — 70.000 mm (2.7557 — 2.7559 in.)
		Mark 2	69.988 — 69.994 mm (2.7554 — 2.7557 in.)
		Mark 3	69.982 — 69.988 mm (2.7552 — 2.7554 in.)
		U/S 0.25	69.745 — 69.755 mm (2.7459 — 2.7463 in.)
		U/S 0.50	69.495 — 69.505 mm (2.7360 — 2.7364 in.)
	Main bearing center wall thickness		
	Reference	STD Mark 2	2.479 — 2.482 mm (0.0976 — 0.0977 in.)
		Mark 3	2.482 — 2.485 mm (0.0977 — 0.0978 in.)
		Mark 4	2.485 — 2.488 mm (0.0978 — 0.0980 in.)
		Mark 5	2.488 — 2.491 mm (0.0980 — 0.0981 in.)
		Mark 6	2.491 — 2.494 mm (0.0981 — 0.0982 in.)
	Crank pin diameter	STD Mark 1	58.994 — 59.000 mm (2.3226 — 2.3228 in.)
		Mark 2	58.988 — 58.994 mm (2.3224 — 2.3226 in.)
		Mark 3	58.982 — 58.988 mm (2.3221 — 2.3224 in.)
		U/S 0.25	58.745 — 58.755 mm (2.3128 — 2.3132 in.)
		U/S 0.50	58.495 — 58.505 mm (2.3028 — 2.3132 in.)
	Circle runout		Maximum 0.06 mm (0.0024 in.)
	Main journal taper and out—of—round		Maximum 0.020 mm (0.0008 in.)
	Crank pin taper and out—of—round		Maximum 0.020 mm (0.0008 in.)
	Main bearing cap bolt outer diameter	STD	13.500 — 14.000 mm (0.5315 — 0.5512 in.)
		Minimum	12.60 mm (0.4961 in.)

Balance shaft	Thrust clearance	STD	0.065 — 0.140 mm (0.0026 — 0.0055 in.)
		Maximum	0.25 mm (0.0098 in.)
	No.1 journal oil clearance	STD	0.040 — 0.079 mm (0.0016 — 0.0031 in.)
		Maximum	0.18 mm (0.0071 in.)
	No.2 journal oil clearance	STD	0.040 — 0.079 mm (0.0016 — 0.0031 in.)
		Maximum	0.19 mm (0.0075 in.)
	No.3 journal oil clearance	STD	0.050 — 0.089 mm (0.0020 — 0.0035 in.)
		Maximum	0.18 mm (0.0071 in.)
	No.1 bearing inside diameter		42.000 — 42.020 mm (1.6535 — 1.6543 in.)
	No.2 bearing inside diameter		41.000 — 41.020 mm (1.6142 — 1.6150 in.)
	No.3 bearing inside diameter		32.000 — 31.020 mm (1.2598 — 1.2606 in.)
	No.1 journal diameter		41.941 — 41.960 mm (1.6512 — 1.6520 in.)
	No.2 journal diameter		40.931 — 40.950 mm (1.6115 — 1.6122 in.)
	No.3 journal diameter		31.941 — 31.960 mm (1.2575 — 1.2583 in.)

EG

B6778-01

TORQUE SPECIFICATIONS

Part tightened	N·m	kgf·cm	ft·lbf
Injection pump x Timing gear case	21	210	15
Injection pump stay x Injection pump	32	330	24
Cylinder head x Cylinder block	1st	39	400
	2nd	Turn 90°	Turn 90°
	3rd	Turn 90°	Turn 90°
Camshaft oil seal retainer x Cylinder head	10	100	7
No.1 camshaft timing pulley x Camshaft	98	1,000	72
Timing belt tensioner x Timing gear case	13	130	9
Injection nozzle x Cylinder head	64	650	47
Nozzle leakage pipe x Injection nozzle	30	300	22
Intake manifold x Cylinder head	29	290	21
Intake pipe x Venturi	12	120	9

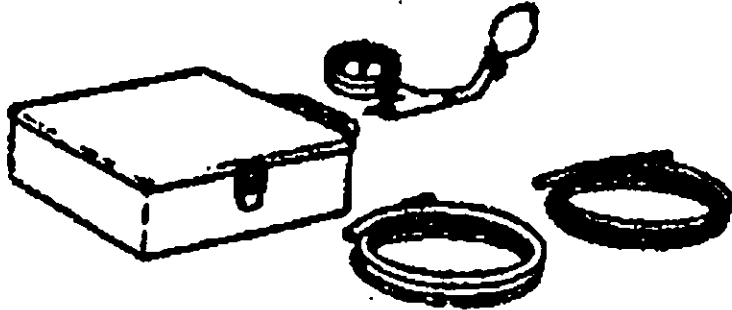
TURBOCHARGER SYSTEM

PREPARATION

SST (SPECIAL SERVICE TOOLS)

1000R-0P

EG

	09992-00241 Turbocharger Pressure Gauge	
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EQUIPMENT

1000T-10

Dial indicator	
Torque wrench	

TURBOCHARGER ON-VEHICLE INSPECTION

EG779-01

1. INSPECT INTAKE AIR SYSTEM

Check for leakage or clogging between the air cleaner housing and turbocharger inlet and between the turbocharger outlet and cylinder head.

- Clogged air cleaner Clean or replace element
- Hoses collapsed or deformed Repair or replace
- Leakage from connections Check each connection and repair
- Cracks in components Check and replace

2. INSPECT EXHAUST SYSTEM

Check for leakage or clogging between the cylinder head and turbocharger inlet and between the turbocharger outlet and exhaust pipe.

- Deformed components Repair or replace
- Foreign material in passages Remove
- Leakage from components Repair or replace
- Cracks in components Check and replace

3. CHECK TURBOCHARGING PRESSURE

- (a) Warm up engine.
- (b) Using a 3-way connector, connect SST (turbocharger pressure gauge) to the hose leading to the intake manifold.

SST 09992-00241

- (c) Press in the clutch pedal, then press the accelerator pedal down as far as it will go. Measure the turbocharging pressure at maximum speed (approx. 4,600 rpm).

Standard pressure:

51 — 67 kPa

(0.52 — 0.68 kgf/cm², 7.4 — 9.7 psi)

If the pressure is less than specified, check the intake air and exhaust systems for leakage.

If there is no leakage, replace the turbocharger.

If the pressure is above specification, check if the actuator hose is disconnected or cracked. If not, replace the turbocharger.

4. INSPECT IMPELLER WHEEL ROTATION

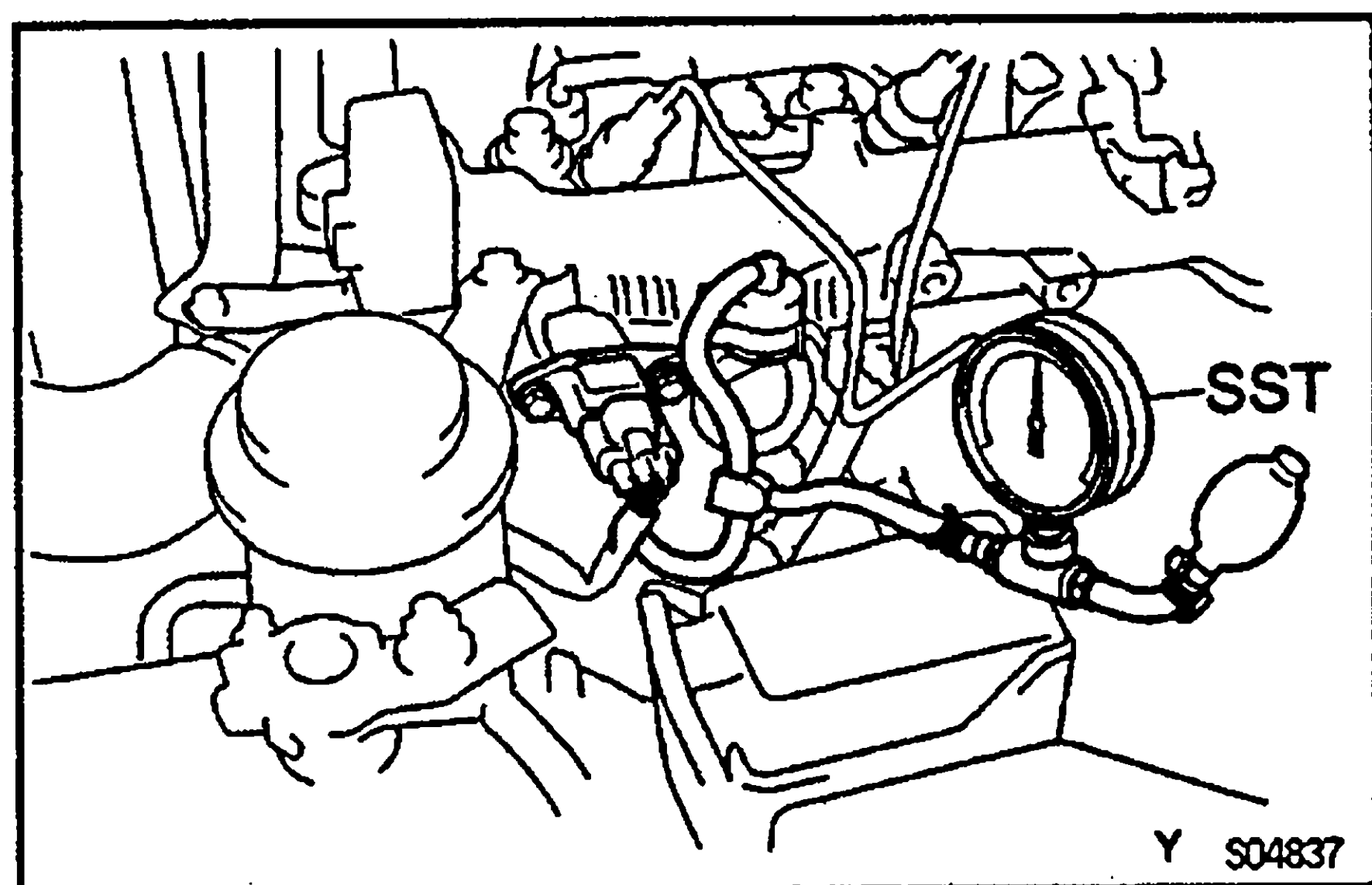
(See step 1 in turbocharger inspection)

5. INSPECT ACTUATOR OPERATION

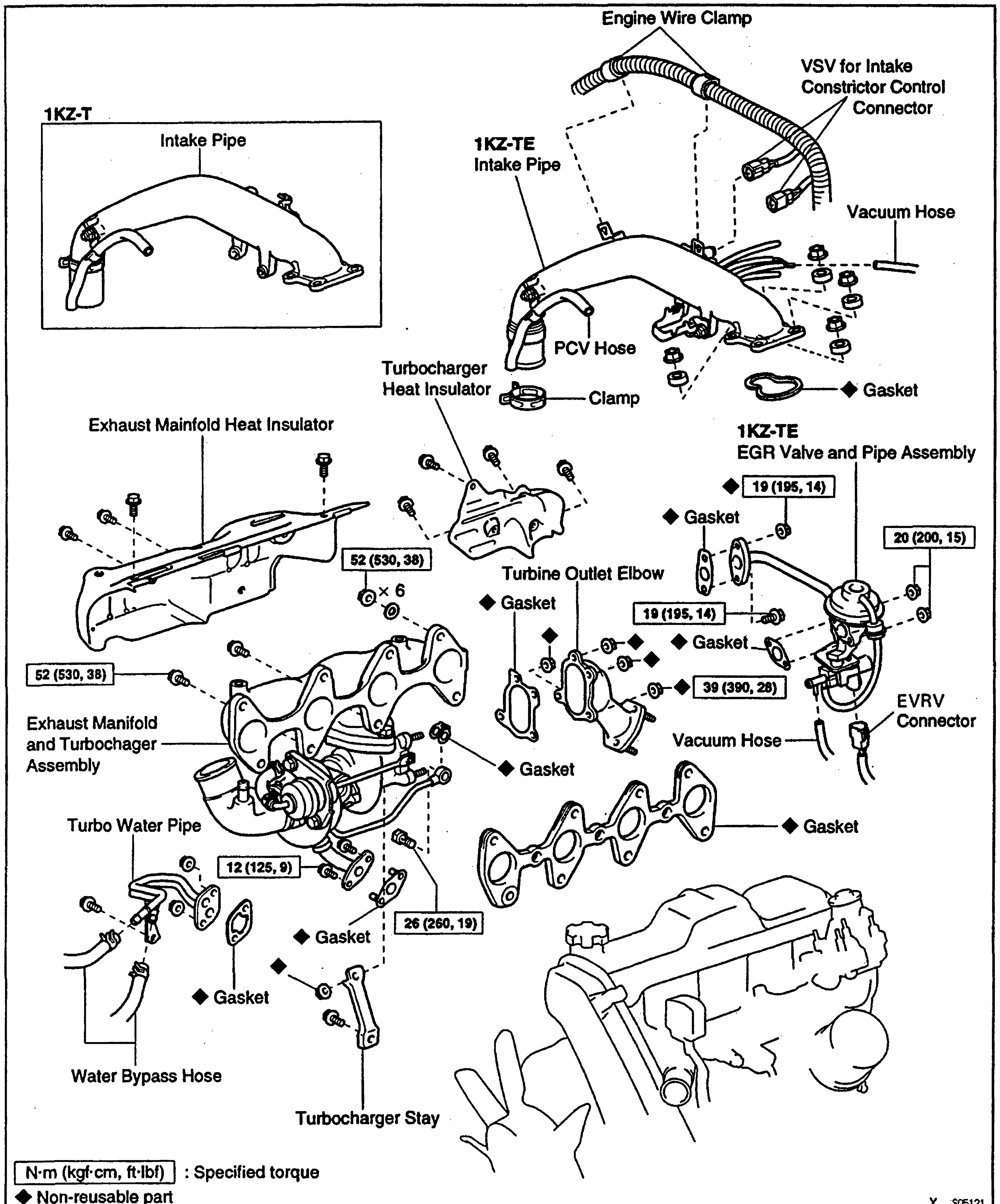
(See step 4 in turbocharger inspection)

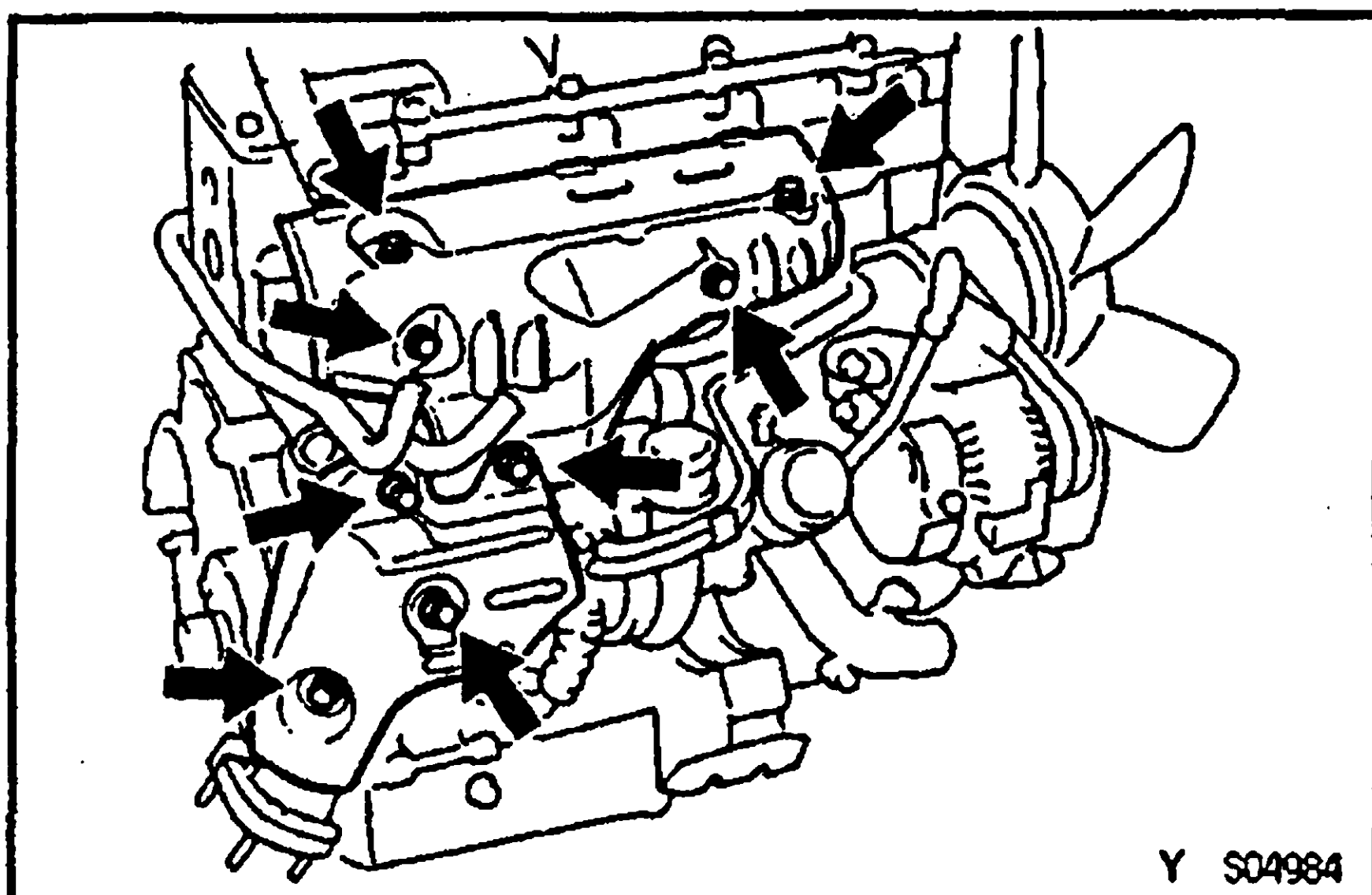
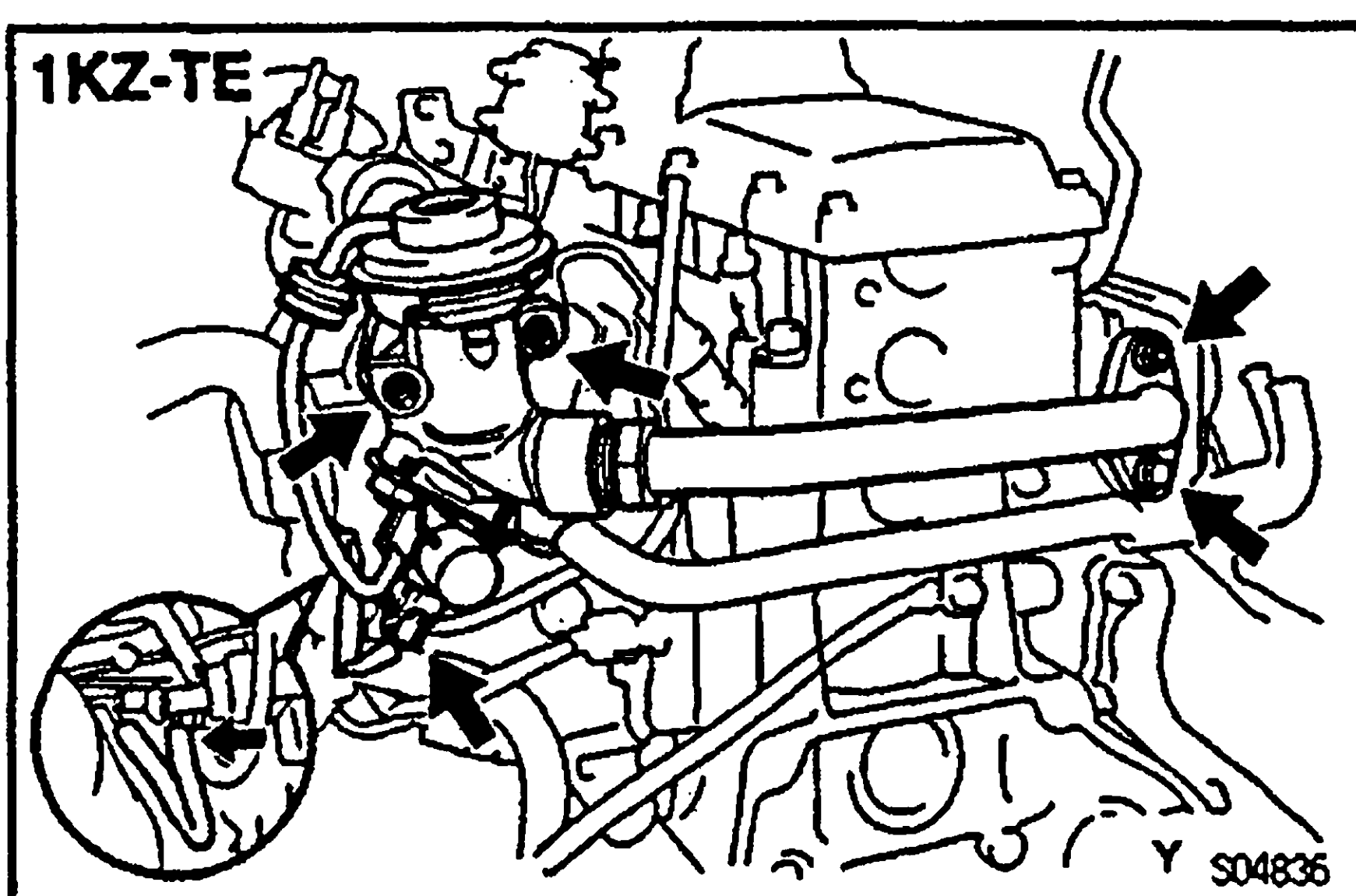
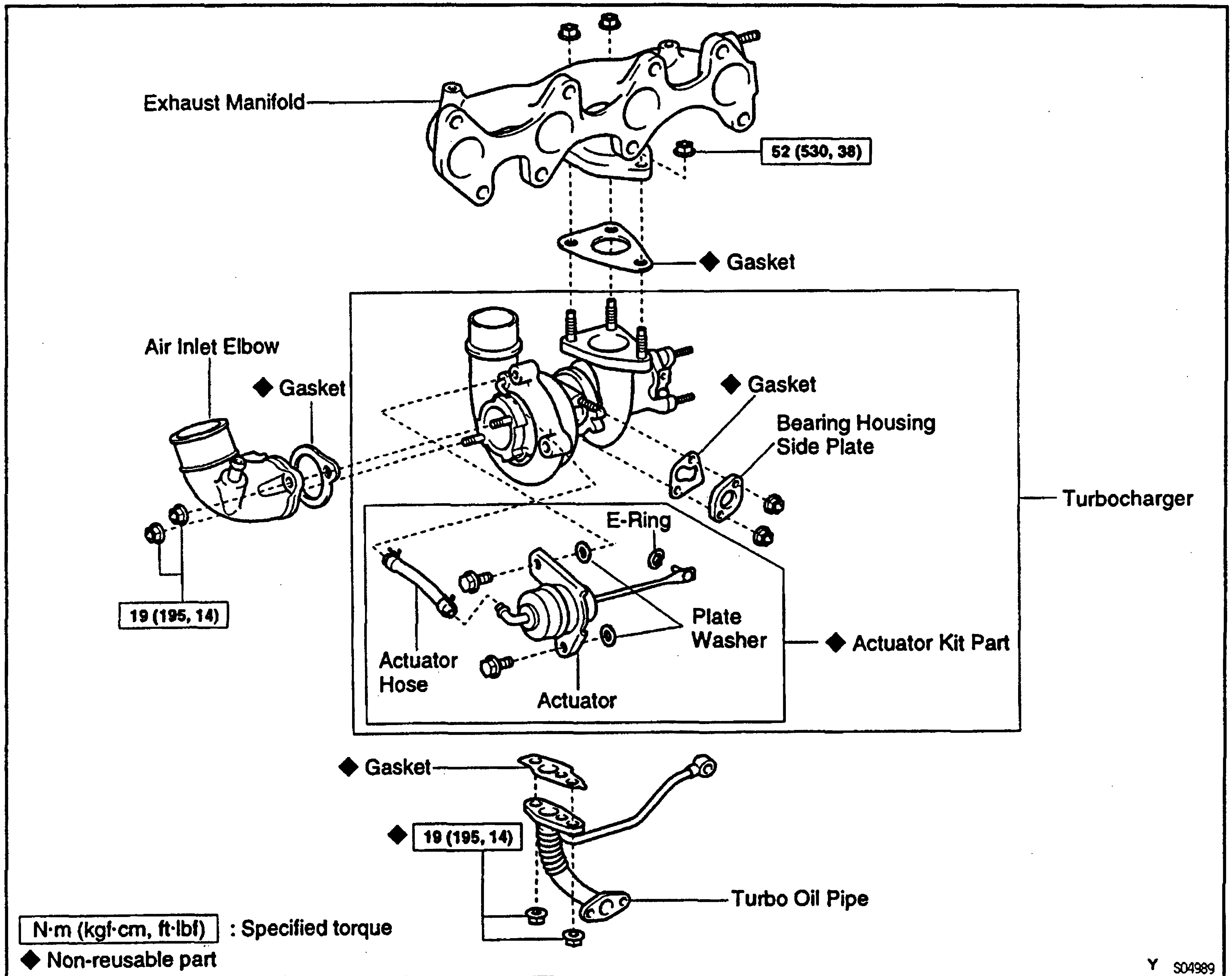
6. INSPECT TURBO PRESSURE SENSOR

(See turbo pressure sensor inspection in ECD System)



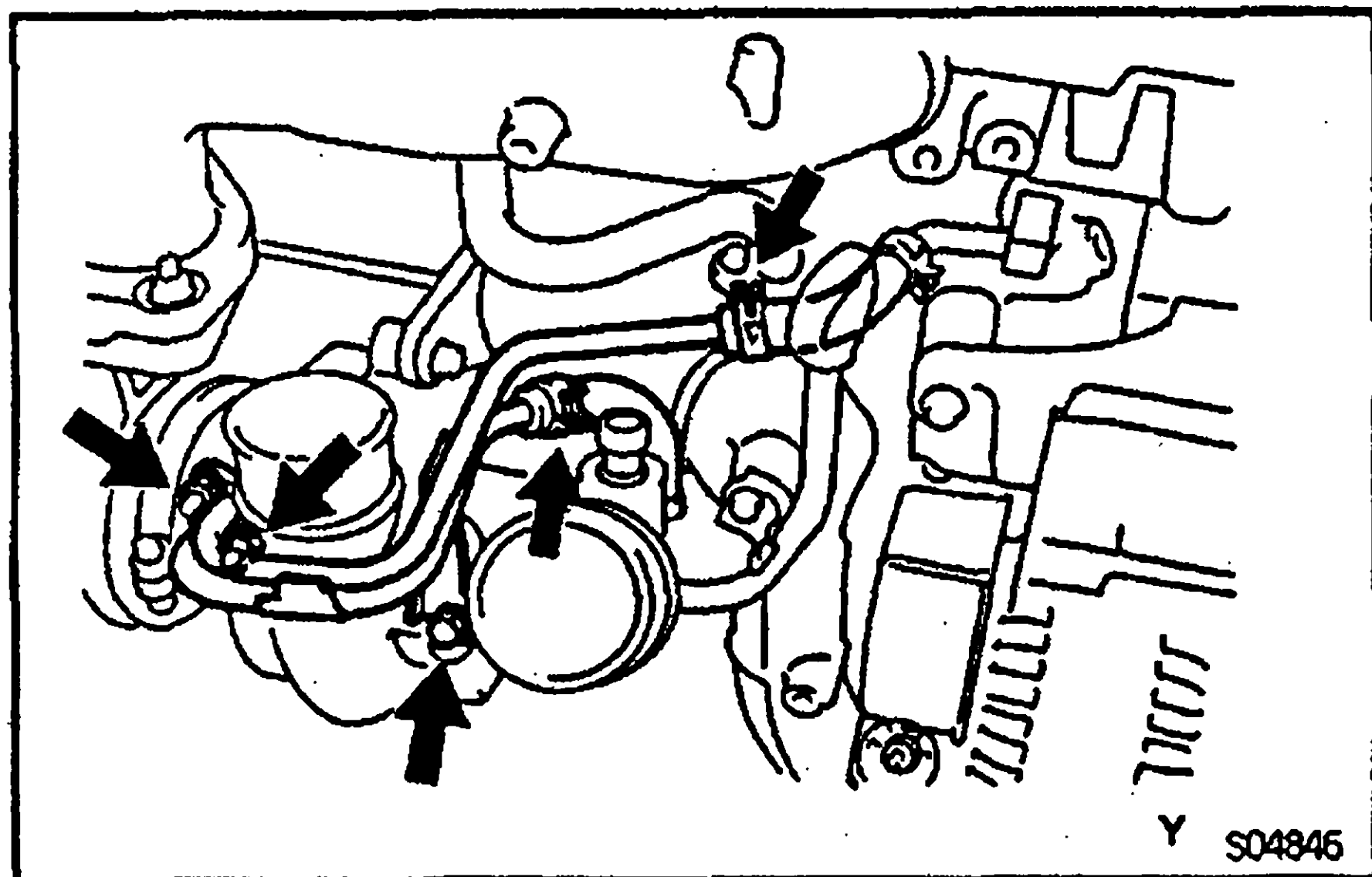
COMPONENTS FOR REMOVAL AND INSTALLATION



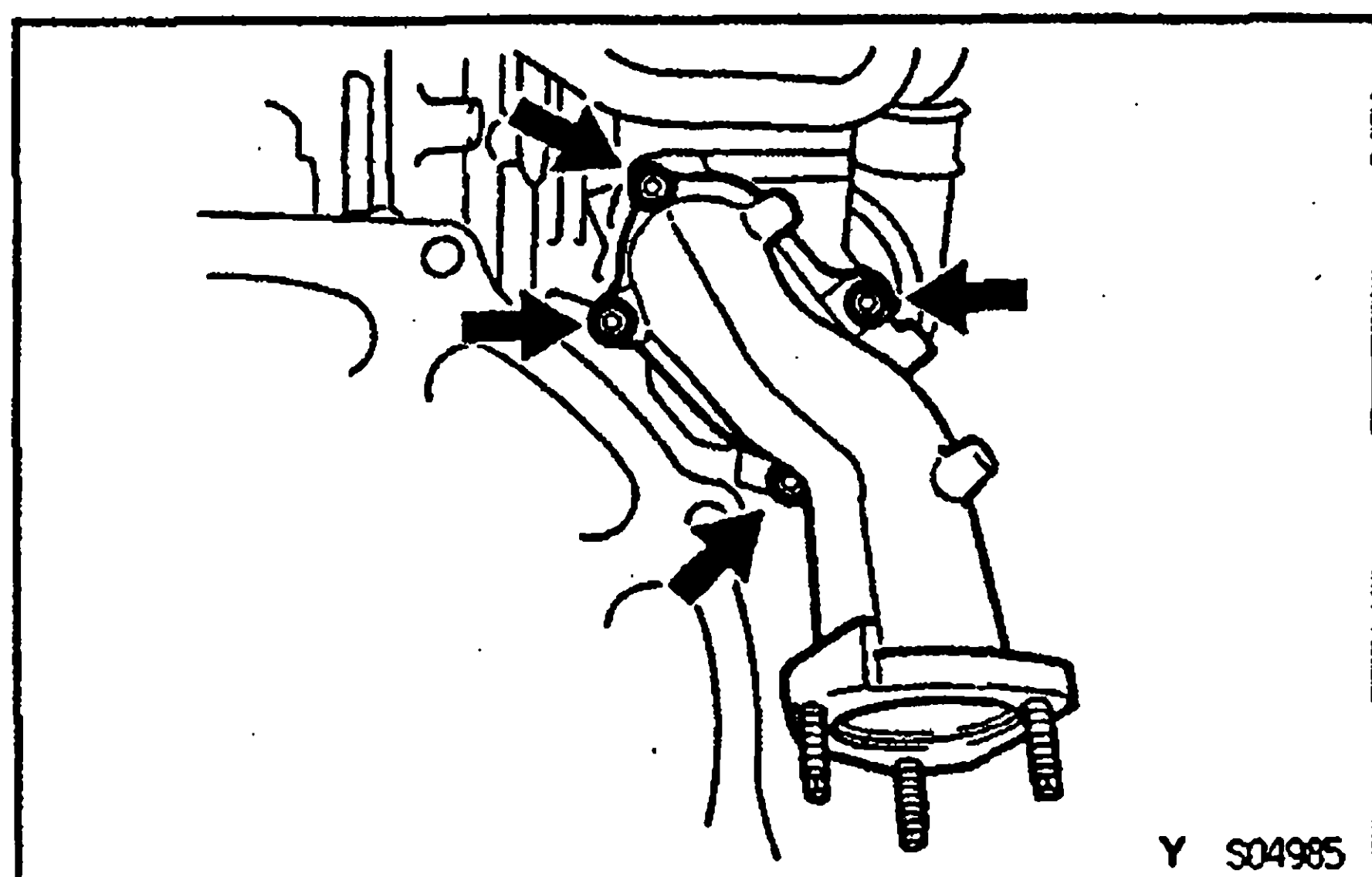


TURBOCHARGER REMOVAL

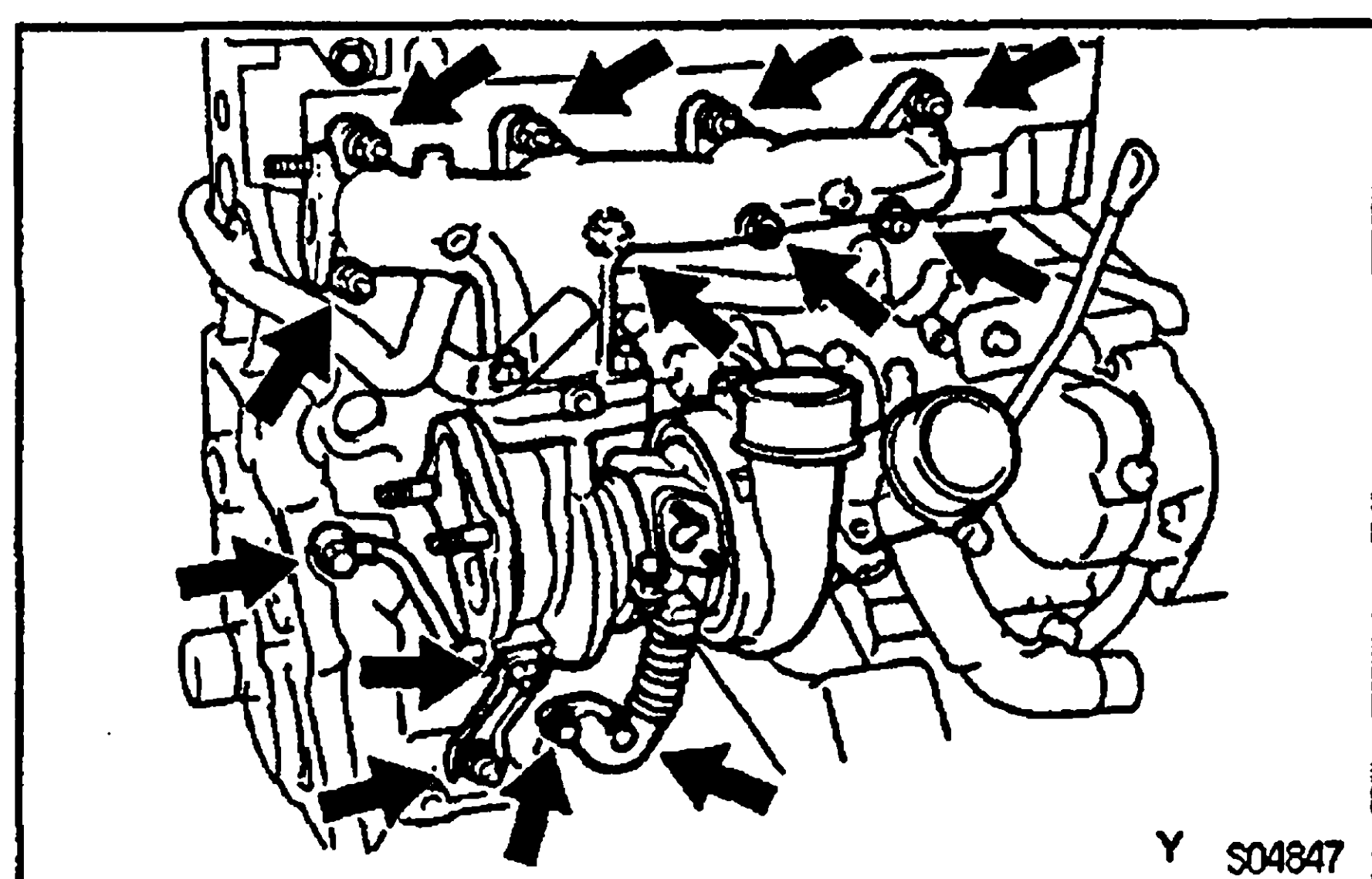
1. DRAIN ENGINE COOLANT
2. REMOVE INTAKE PIPE
(See step 2 in cylinder head removal in Engine Mechanical)
3. 1KZ-TE:
REMOVE EGR VALVE AND PIPE ASSEMBLY
 - (a) Disconnect the vacuum hose and EVRV connector.
 - (b) Remove the 3 nuts, bolt, the EGR valve, pipe assembly and 2 gaskets.
4. REMOVE TURBOCHARGER HEAT INSULATOR
Remove the 4 bolts and heat insulator.
5. REMOVE EXHAUST MANIFOLD HEAT INSULATOR
Remove the 4 bolts and heat insulator.

**6. REMOVE TURBO WATER PIPE**

- (a) Disconnect the 2 water bypass hoses from the turbo water pipe.
- (b) Remove the 2 nuts, bolt, water pipe and gasket.

**7. REMOVE TURBINE OUTLET ELBOW**

Remove the 4 nuts, turbine outlet elbow and gasket.

**8. REMOVE TURBOCHARGER STAY**

Remove the bolt, nut and turbocharger stay.

9. REMOVE TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY

- (a) Remove the 2 bolts and union bolt from the turbo oil pipe.
- (b) Remove the 6 nuts, plate washers, 2 bolts, the turbocharger, exhaust manifold assembly and 3 gaskets.

10. REMOVE TURBO OIL PIPE FROM TURBOCHARGER

Remove the 2 nuts, oil pipe and gasket.

11. REMOVE EXHAUST MANIFOLD FROM TURBOCHARGER

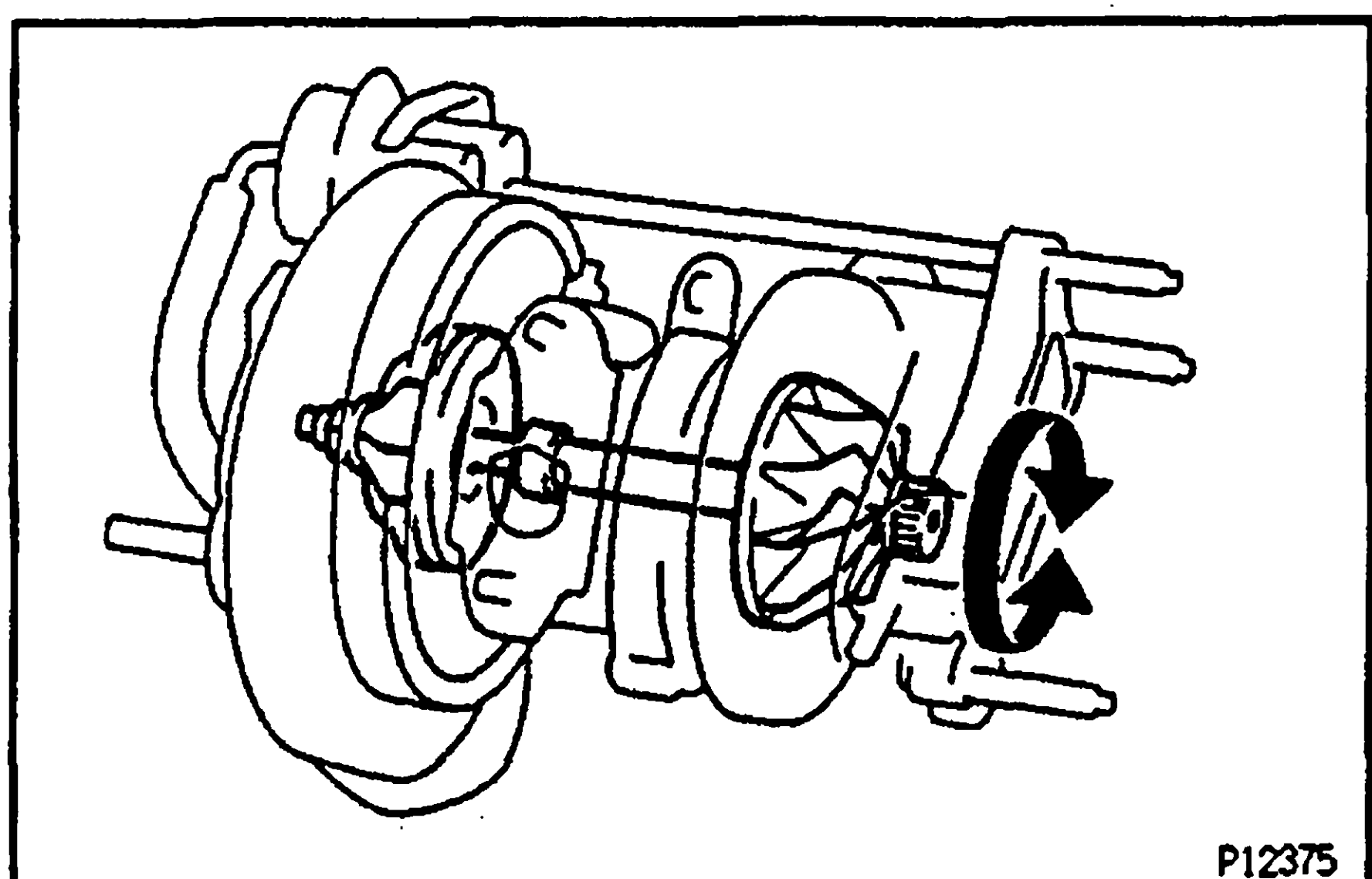
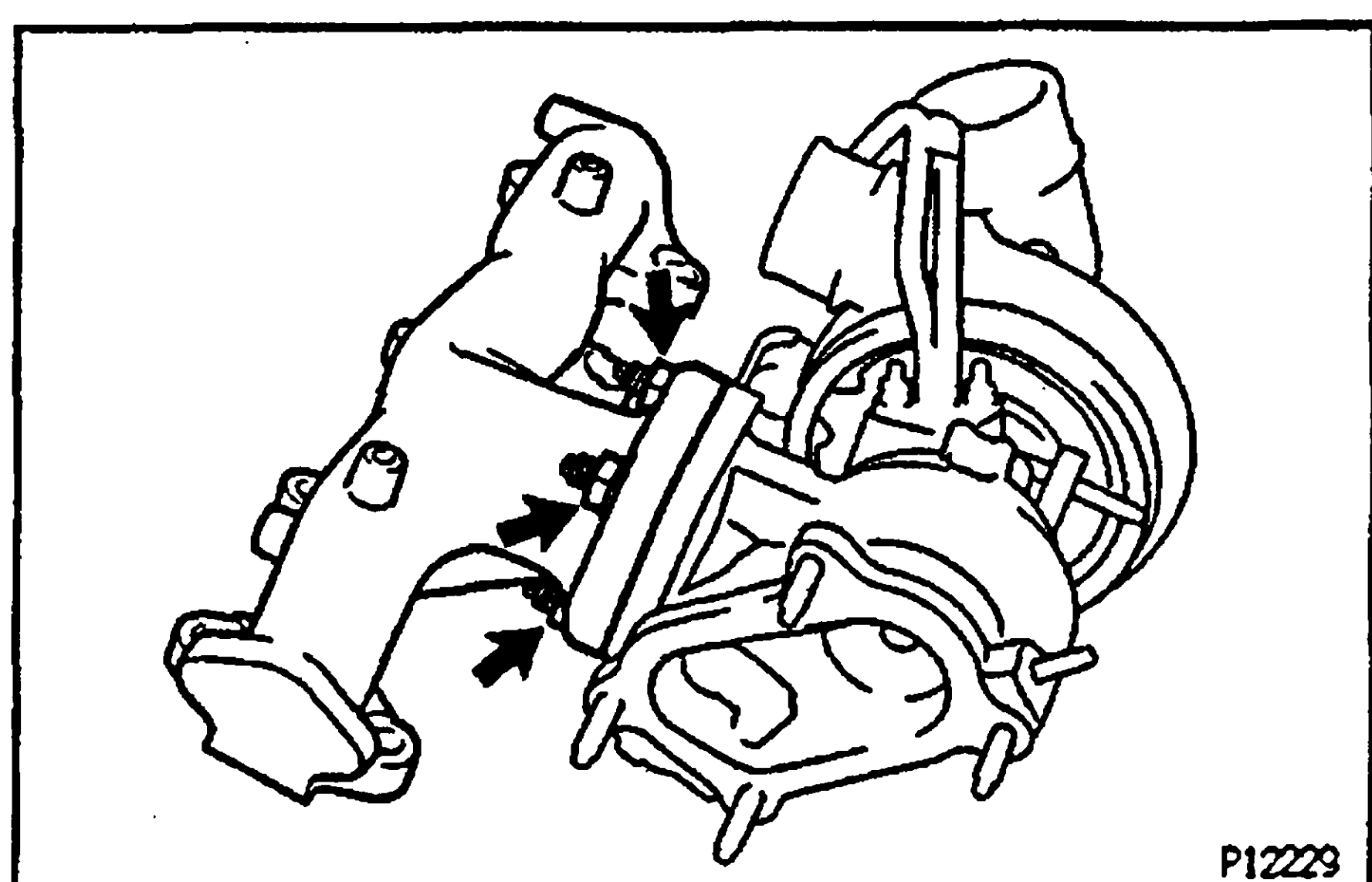
Remove the 3 nuts, exhaust manifold and gasket.

12. REMOVE TURBINE AIR INLET ELBOW FROM TURBOCHARGER

Remove the 2 nuts, inlet elbow and gasket.

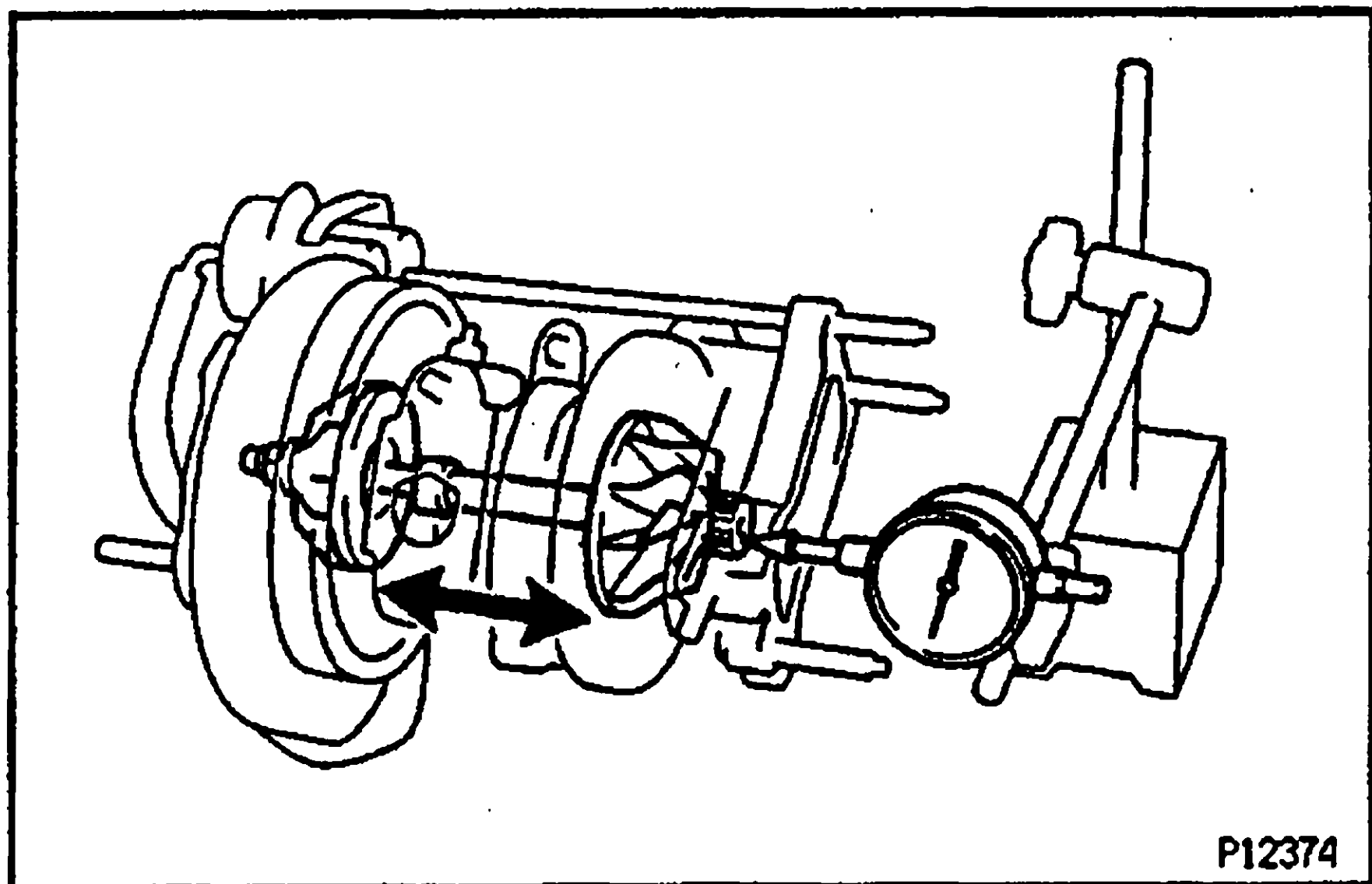
13. REMOVE BEARING HOUSING SIDE PLATE FROM TURBOCHARGER

Remove the 2 bolts, side plate and gasket.

**TURBOCHARGER INSPECTION****1. INSPECT TURBINE SHAFT ROTATION**

Grasp the edge of the turbine shaft, and turn it. Check that the turbine shaft turns smoothly.

If the turbine shaft does not turn or if it turns with a heavy drag, replace the turbocharger.



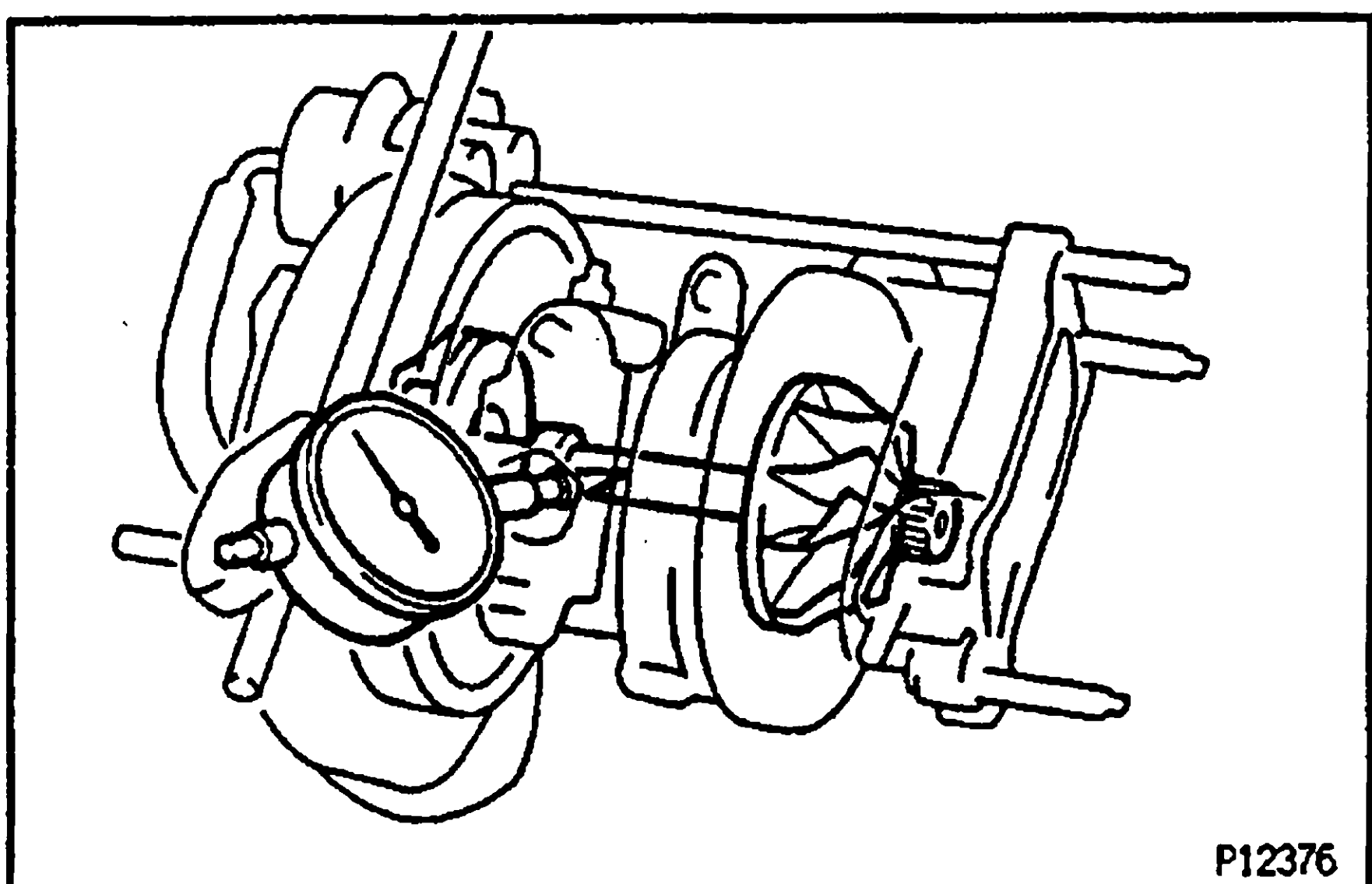
2. INSPECT AXIAL PLAY OF TURBINE SHAFT

- Using a dial indicator, insert the needle of the dial indicator into the exhaust side.
- Move the turbine shaft in an axial direction, measure the axial play of the turbine shaft.

Maximum oil clearance:

0.16 mm (0.0063 in.)

If the axial play is greater than maximum, replace the turbocharger.



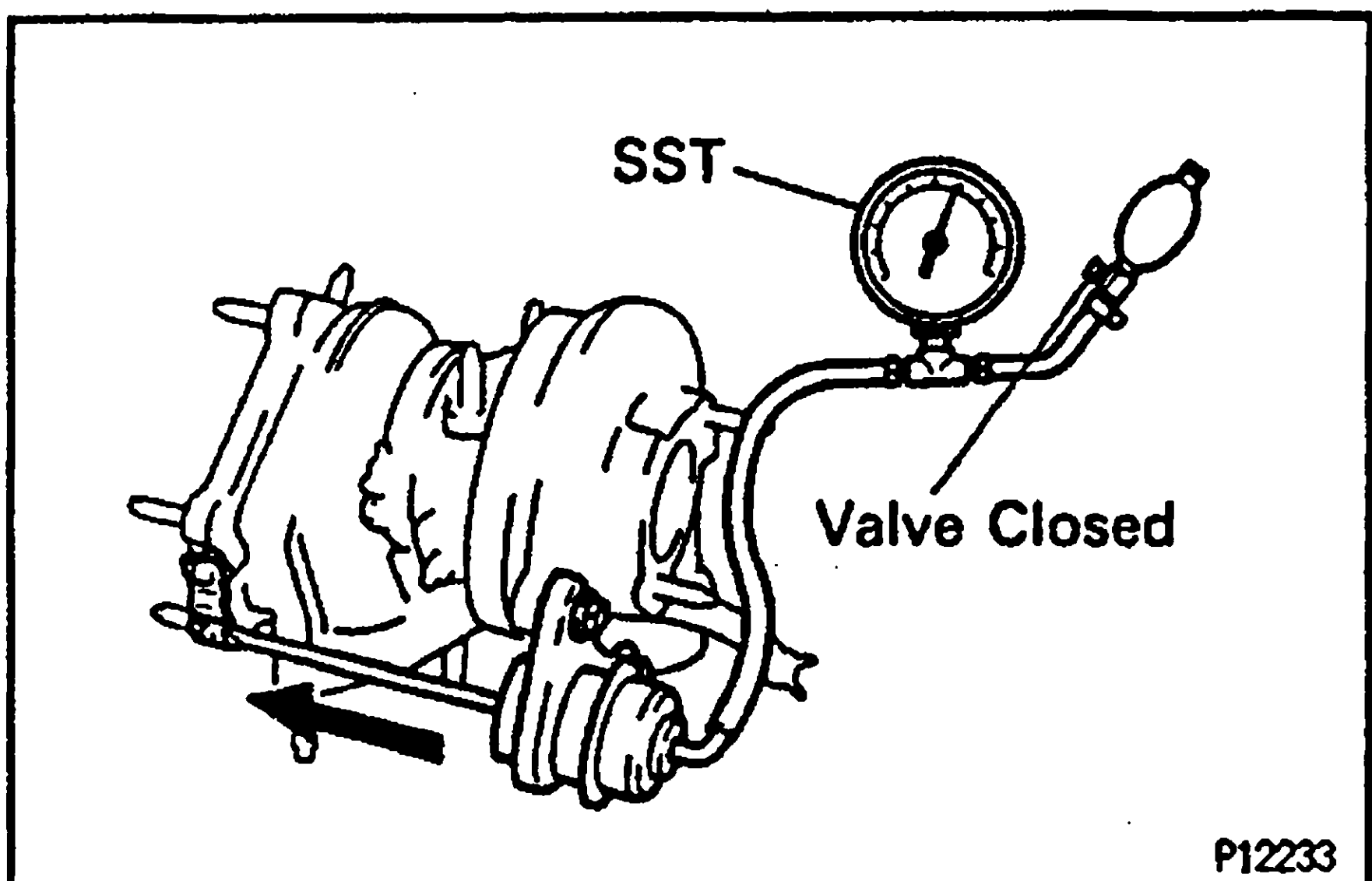
3. INSPECT RADIAL PLAY OF TURBINE SHAFT

- Using a dial indicator, insert the needle of the dial indicator into the oil outlet hole, and set it in the center of the turbine shaft.
- Move the turbine shaft in a radial direction, measure the radial play of the turbine shaft.

Maximum oil clearance:

0.11 mm (0.0043 in.)

If the radial play is greater than maximum, replace the turbocharger.



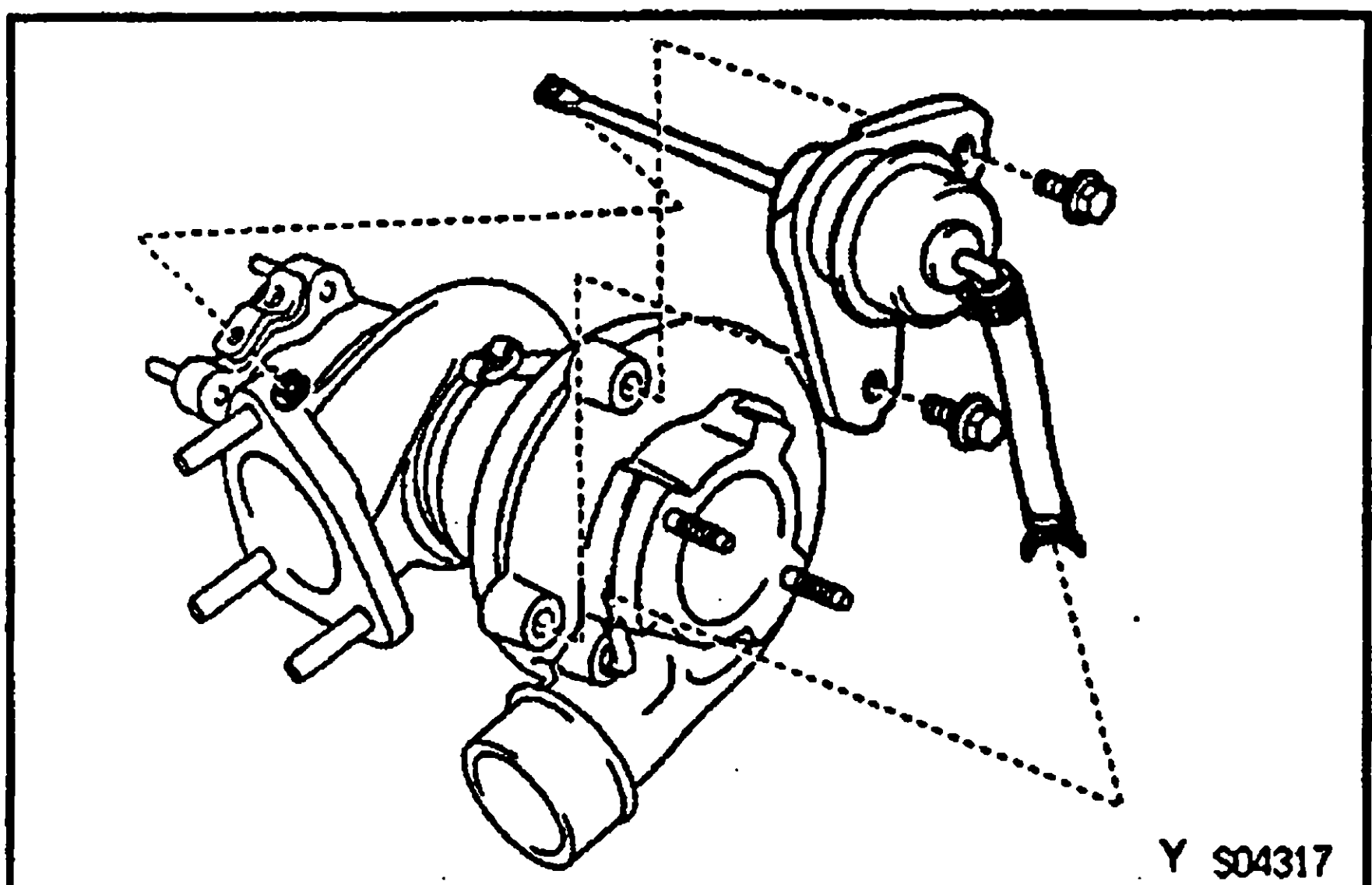
4. INSPECT ACTUATOR AND WASTE GATE VALVE OPERATION

- Disconnect the actuator hose from the compressor housing.
- Using SST, apply approx. 116 kPa (1.18 kgf/cm², 16.7 psi) of pressure to the actuator.
SST 09992-00241
- Move the actuator push rod, and check that the waste gate valve is open.

If the rod does not move, replace the actuator or turbocharger.

NOTICE: Never apply more than 156 kPa (1.59 kgf/cm², 22.6 psi) of pressure to the actuator.

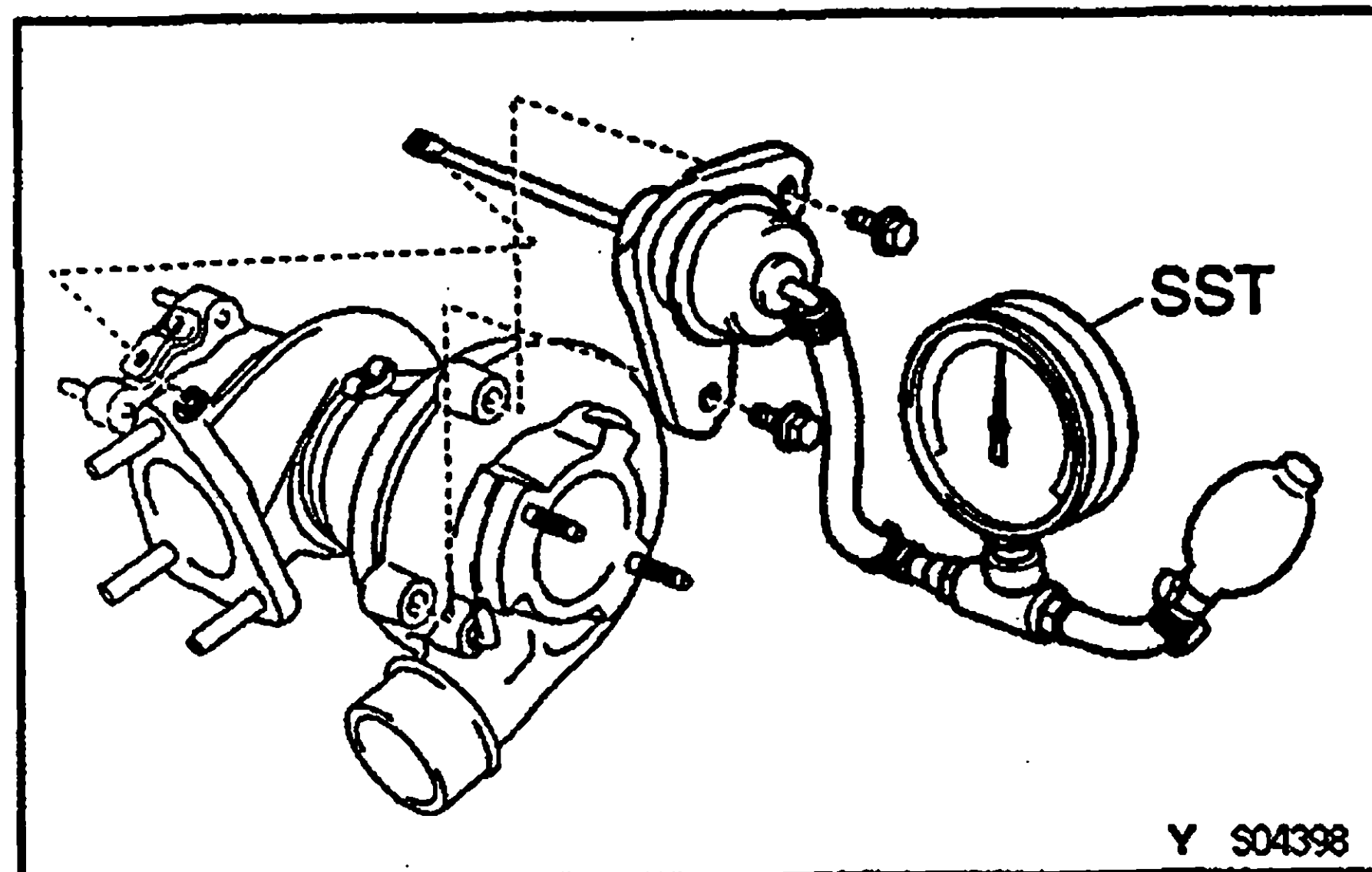
- Reconnect the actuator hose to the compressor housing.



ACTUATOR REPLACEMENT

1. REMOVE ACTUATOR

- Disconnect the actuator hose from the compressor housing.
- Remove the 2 bolts holding the actuator to the compressor housing.
- Remove the E-ring holding the actuator push rod to the waste gate valve link, and remove the actuator.



2. INSTALL ACTUATOR

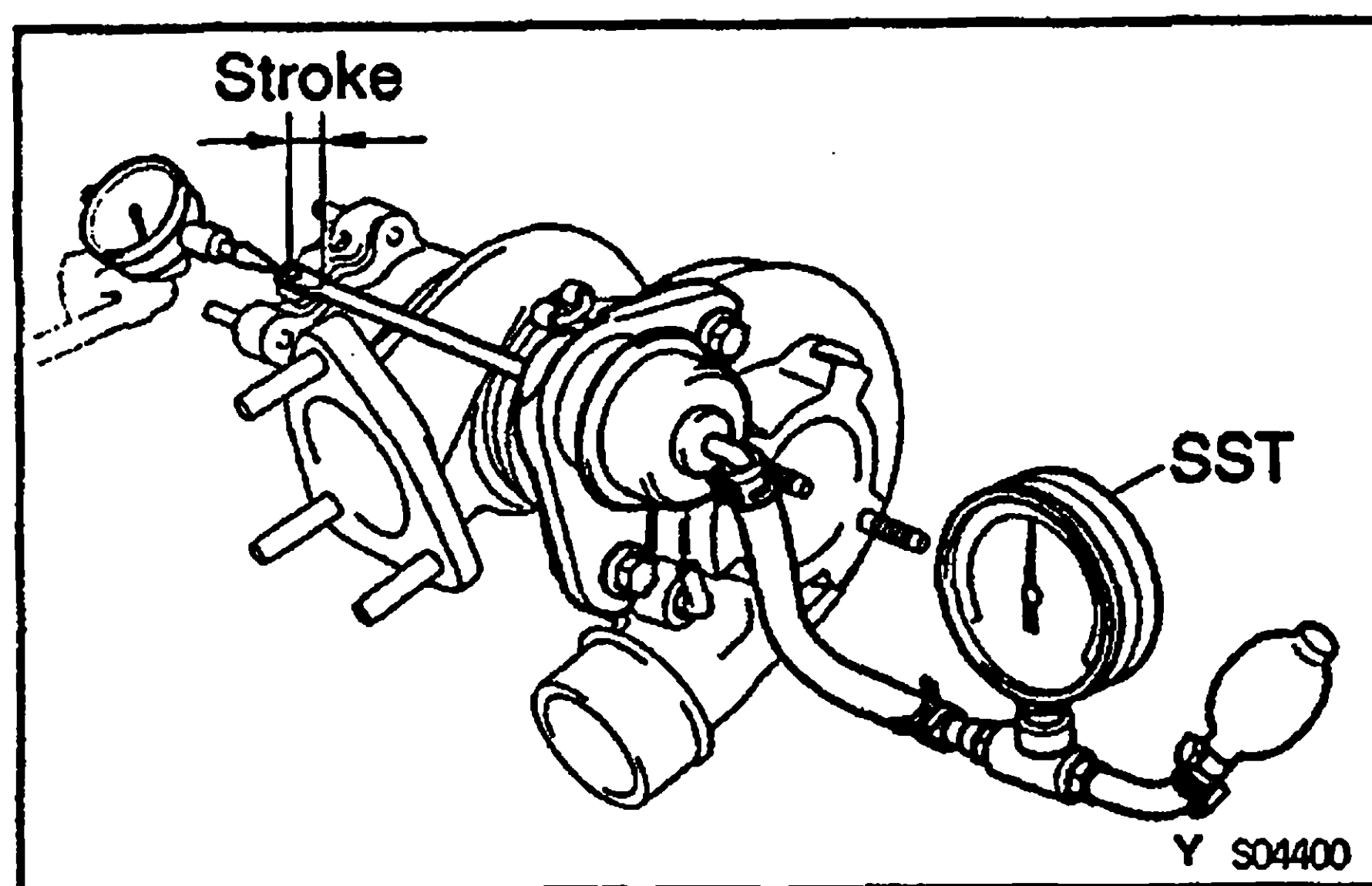
- Using SST, apply pressure to a new actuator.
SST 09992-00241
- Connect the actuator push rod to the waste gate valve link with a new E-ring.
- Install the actuator to the compressor housing with the 2 bolts.

Torque: 19 N·m (195 kgf·cm, 14 ft·lbf)

- Remove the SST.

NOTICE:

- Never apply more than 156 kPa (1.59 kgf/cm², 22.6 psi) of pressure to the actuator.
- Do not use a hammer, etc. to force the actuator push rod onto the waste gate valve link.



3. ADJUST ACTUATOR ROD STROKE

NOTICE: Never apply more than 156 kPa (1.59 kgf/cm², 22.6 psi) of pressure to the actuator.

- Using a dial indicator, set the dial indicator in a straight line with the actuator push rod.
- Using SST, apply 119 kPa (1.21 kgf/cm², 17.2 psi) of pressure to the actuator, and measure the actuator push rod stroke.

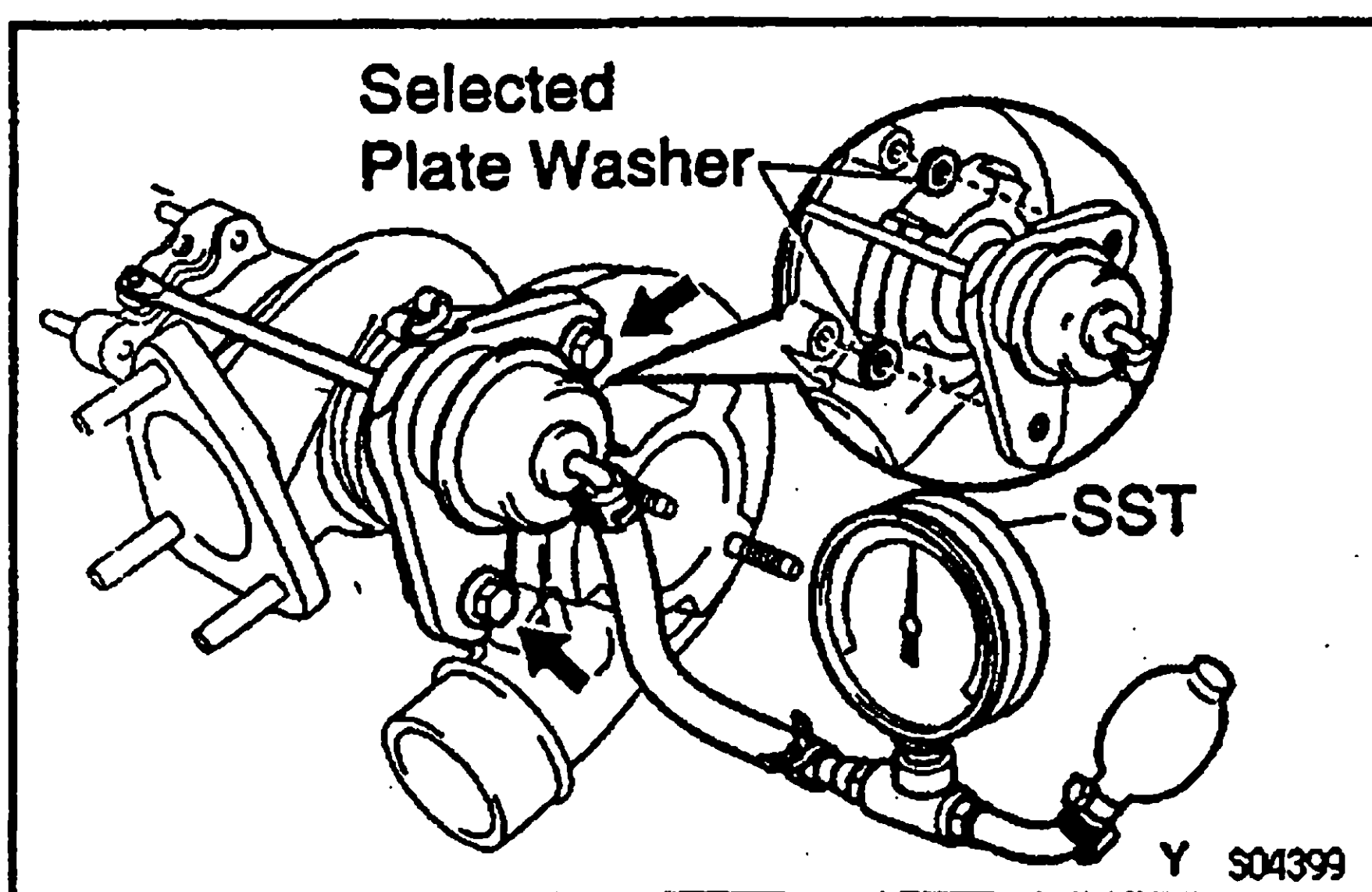
SST 09992-00241

- From the table below select the plate washer thickness to match the stroke measured in (b) above.

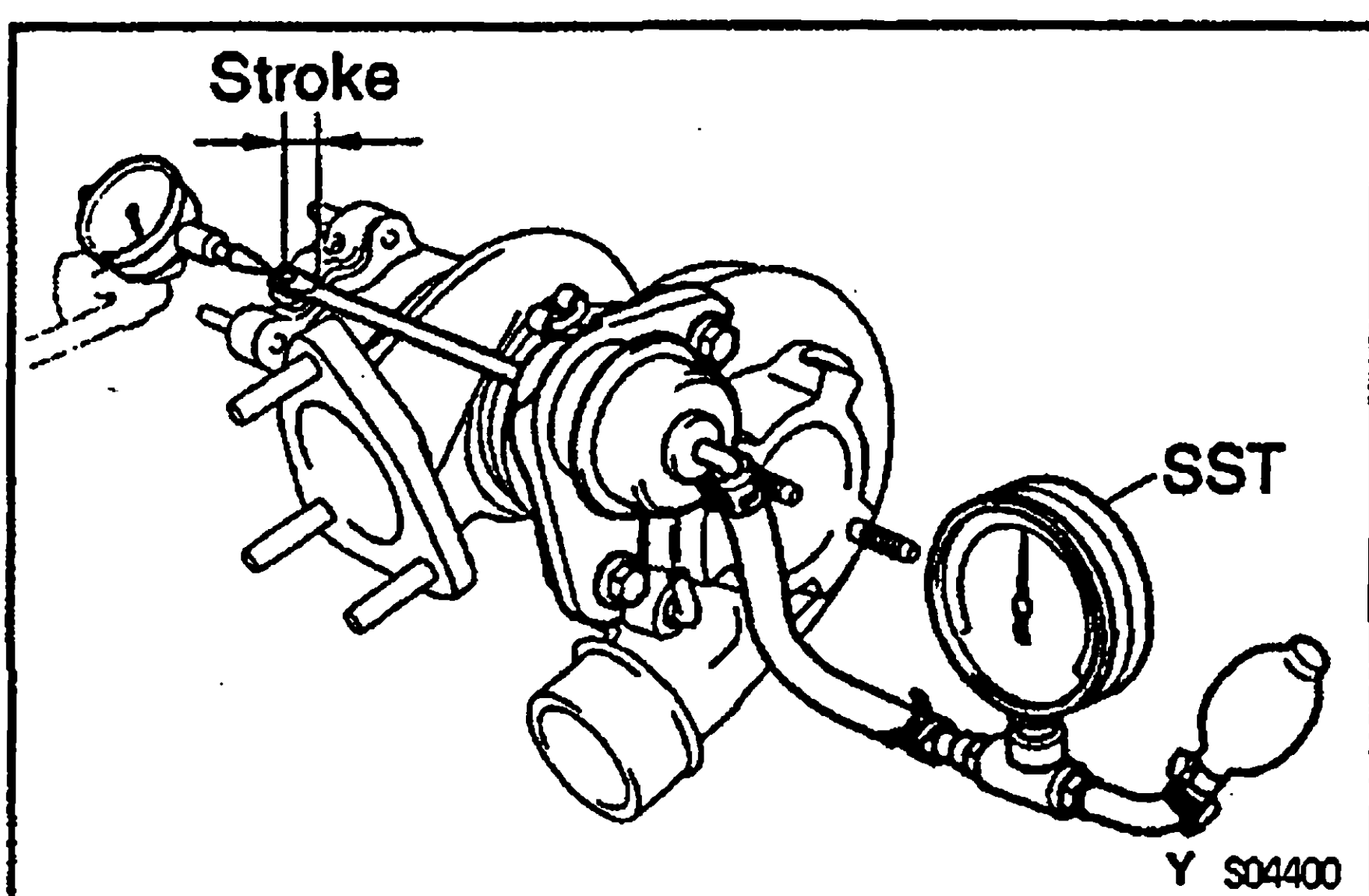
Stroke measurement mm (in.)	Required plate washer thickness mm (in.)
1.20 – 1.70 (0.0472 – 0.0669)	None required
1.71 – 2.20 (0.0673 – 0.0866)	0.5 (0.020)
2.21 – 2.70 (0.0870 – 0.1063)	1.0 (0.039)
2.71 – 3.20 (0.1067 – 0.1260)	1.5 (0.059)
3.21 – 3.70 (0.1264 – 0.1457)	2.0 (0.079)
3.71 – 4.20 (0.1461 – 0.1654)	2.5 (0.098)
4.21 – 4.70 (0.1657 – 0.1850)	3.0 (0.118)
4.71 – 5.20 (0.1854 – 0.2047)	3.5 (0.138)
5.21 – 5.70 (0.2051 – 0.2244)	4.0 (0.157)
5.71 – 6.20 (0.2248 – 0.2441)	4.5 (0.177)
6.21 – 6.70 (0.2445 – 0.2638)	5.0 (0.197)
6.71 – 7.20 (0.2642 – 0.2827)	5.5 (0.217)
7.21 – 7.70 (0.2839 – 0.3031)	6.0 (0.236)
7.71 – 8.20 (0.3035 – 0.3228)	6.5 (0.256)

NOTICE:

- Use a combination of plate washers of 0.5 mm (0.020 in.), 1.0 mm (0.039 in.), 2.0 mm (0.079 in.) and 3.0 mm (0.118 in.) thickness to achieve the required thickness.
- Use the same thickness of plate washer for the 2 locations between the actuator and compressor housing.
- If the plate washer thickness exceeds 3.5 mm (0.138 in.), replace the actuator installation bolts with the bolts from the kit part.



- (d) Using SST, apply approx. 119 kPa (1.21 kgf/cm², 17.2 psi) of pressure to the actuator, and install the selected plate washers between the actuator and compressor housing with the 2 bolts.
Torque: 19 N·m (195 kgf·cm, 14 ft·lbf)



- (e) Using SST, apply approx. 119 kPa (1.21 kgf/cm², 17.2 psi) of pressure to the actuator, and measure the actuator push rod stroke.
SST 09992-00241

Standard stroke:

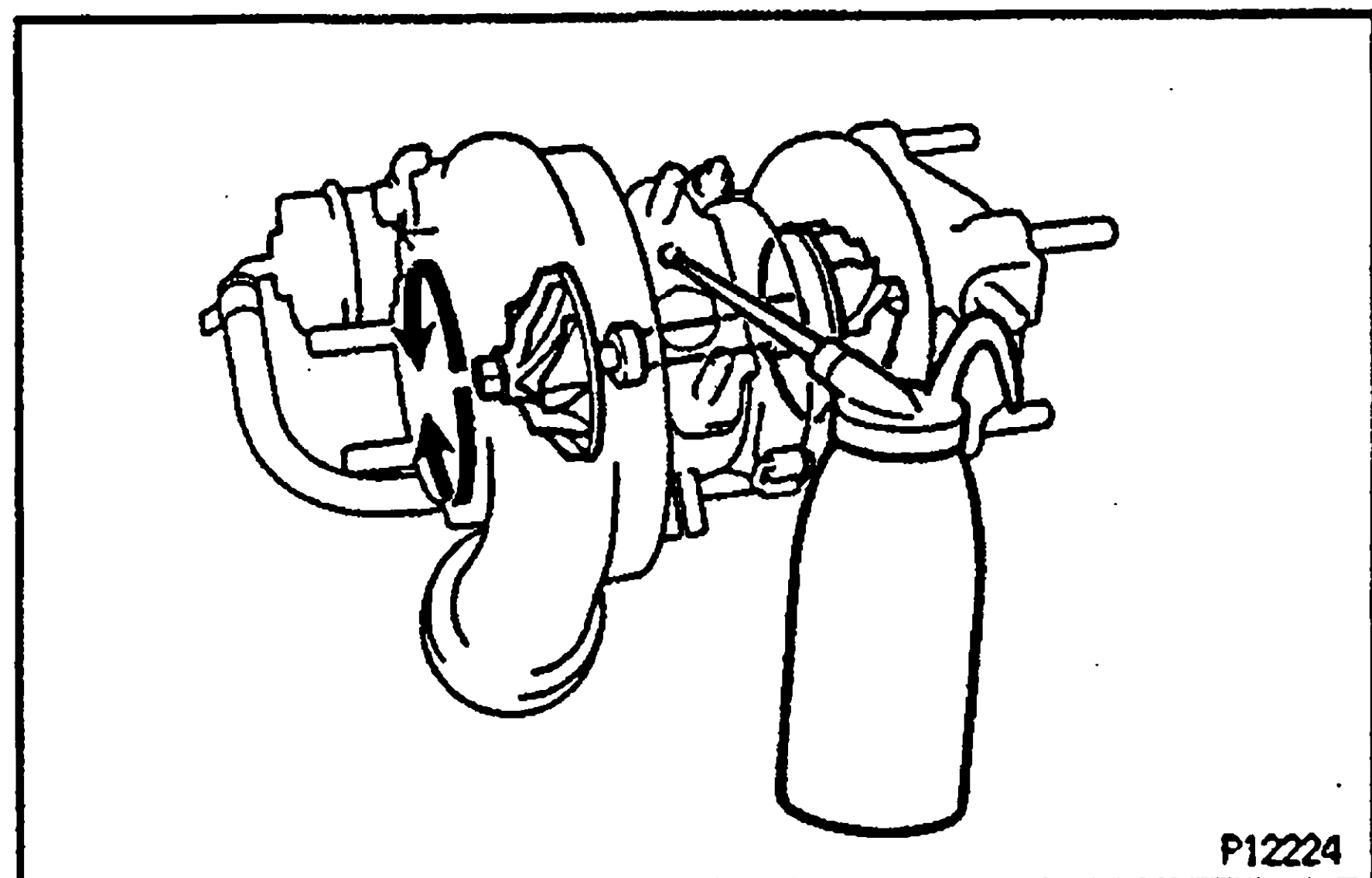
1.20 – 1.70 mm (0.0472 – 0.0669 in.)

If the stroke is outside specifications, reselect the plate washers.

4. **INSTALL ACTUATOR HOSE**
5. **APPLY YELLOW PAINT**

Apply yellow paint from the actuator bolts to the actuator bracket to indicate that they have been correctly installed.

6. **CHECK TURBOCHARGING PRESSURE**
(See step 3 in on—vehicle inspection)



TURBOCHARGER INSTALLATION

NOTICE: After replacing the turbocharger assembly, pour approx. 20 cm³ (1.2 cu in.) of fresh oil into the oil inlet hole and turn the turbine wheel by hand to splash oil on the bearing.

1. INSTALL BEARING HOUSING SIDE PLATE TO TURBOCHARGER

Install a new gasket and the side plate with the 2 bolts.

Torque: 7.8 N·m (80 kgf·cm, 69 in.-lbf)

2. INSTALL TURBINE AIR INLET ELBOW TO TURBOCHARGER

Install a new gasket and the inlet elbow with the 2 nuts.

Torque: 19 N·m (195 kgf·cm, 14 ft·lbf)

3. INSTALL EXHAUST MANIFOLD TO TURBOCHARGER

Install a new gasket and the exhaust manifold with the 3 nuts.

Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

4. INSTALL TURBO OIL PIPE TO TURBOCHARGER

Install a new gasket and the oil pipe with 2 new nuts.

Torque: 19 N·m (195 kgf·cm, 14 ft·lbf)

5. INSTALL TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY

- Install 2 new gaskets to the turbo oil pipe.
- Install a new gasket to the cylinder head.
- Uniformly install and tighten the 6 plate washers, nuts and 2 bolts holding the exhaust manifold to the cylinder head in several passes.
- Install the union bolt and 2 bolts holding the oil pipe to the cylinder block.

Torque:

Union bolt

26 N·m (260 kgf·cm, 19 ft·lbf)

Bolt

12 N·m (125 kgf·cm, 9 ft·lbf)

6. INSTALL TURBOCHARGER STAY

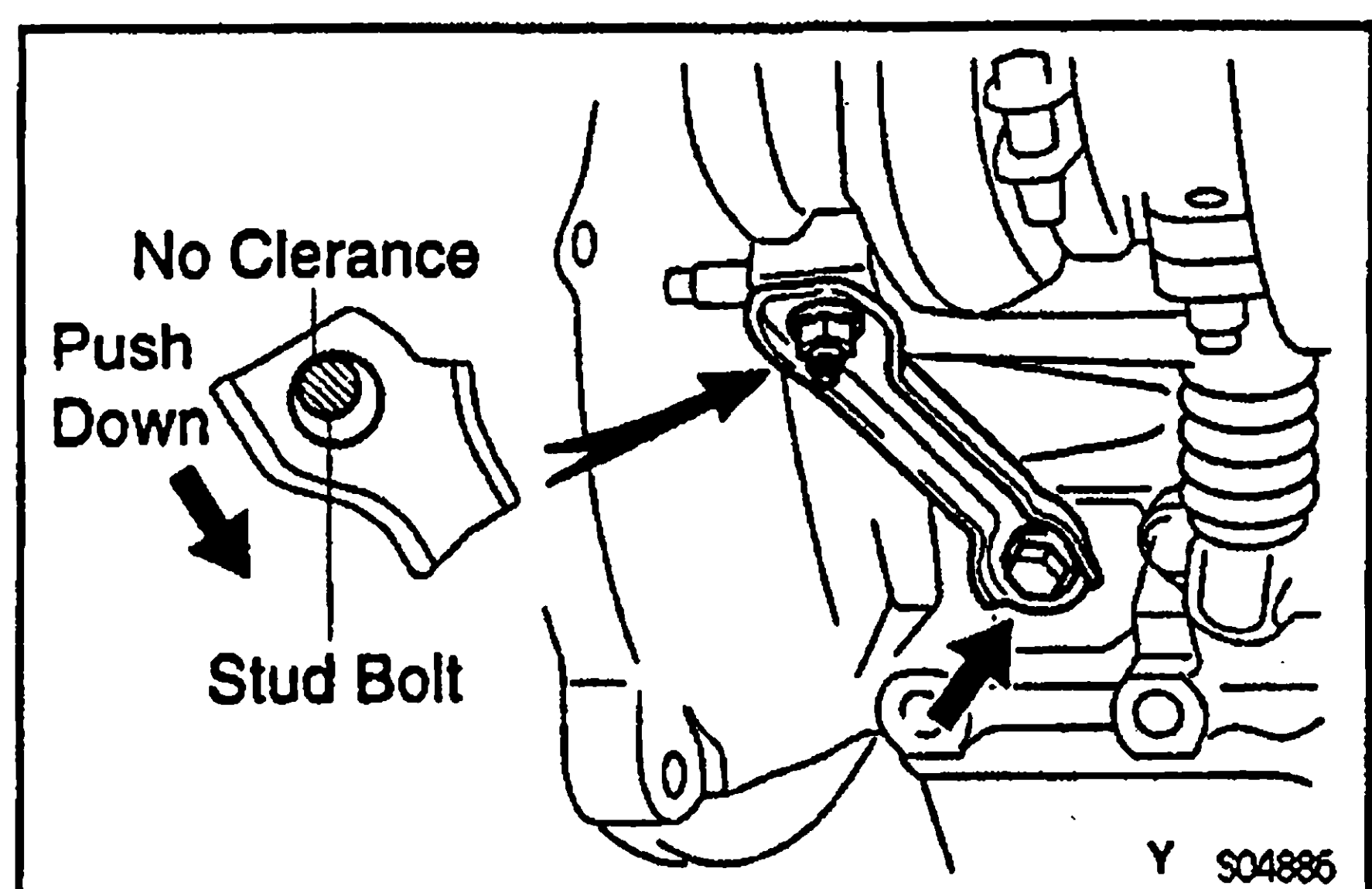
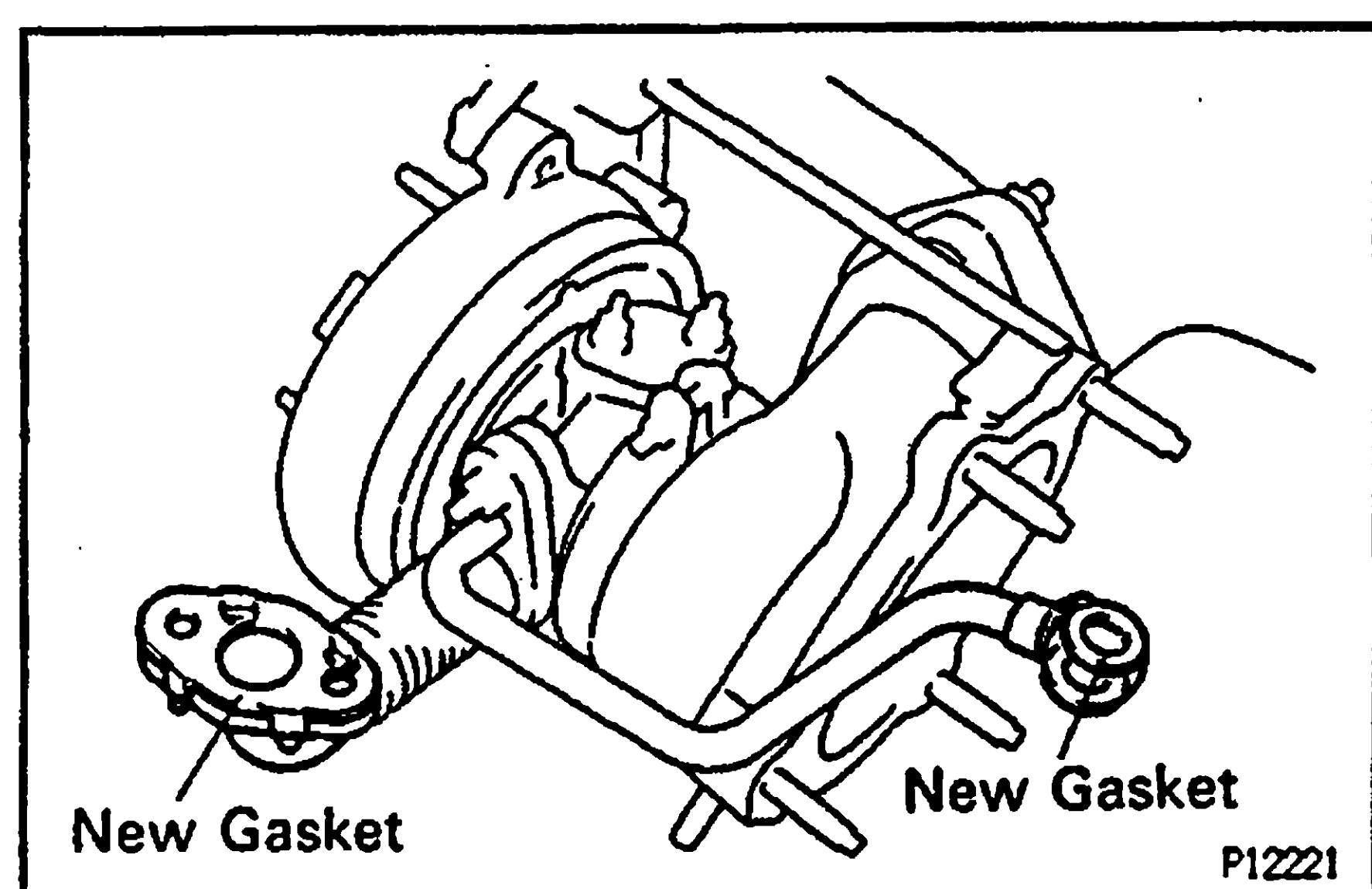
- Temporarily install the turbocharger stay with the bolt and a new nut.
- Push down the turbocharger stay and tighten the bolt and nut.

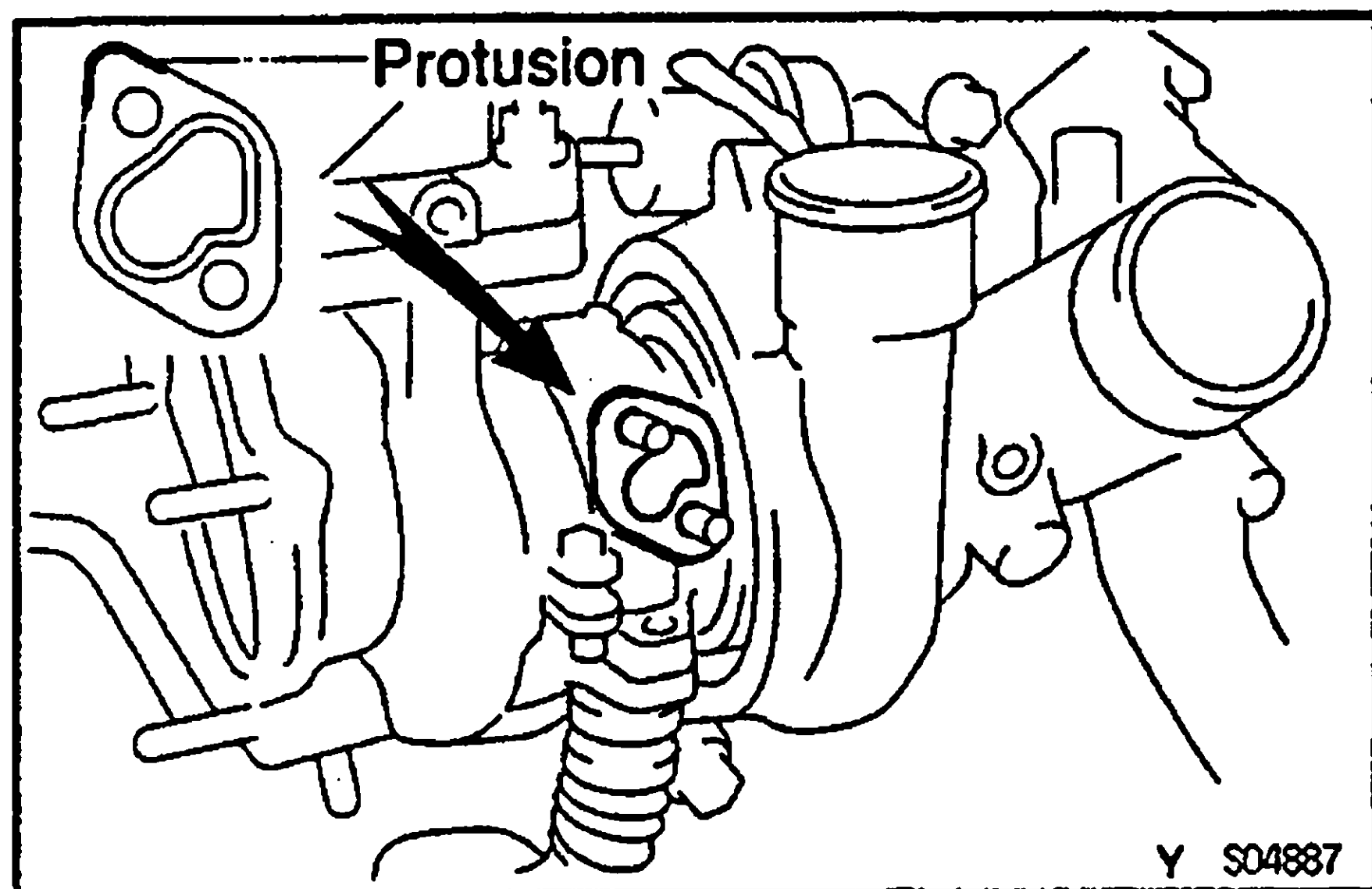
Torque: 19 N·m (195 kgf·cm, 14 ft·lbf)

7. INSTALL TURBINE OUTLET ELBOW

Install a new gasket and the outlet elbow with 4 new nuts. Alternately tighten the nuts.

Torque: 39 N·m (390 kgf·cm, 28 ft·lbf)



**8. INSTALL TURBO WATER PIPE**

- (a) Place a new gasket on the turbochager with the pro-
trusion facing upward.

NOTICE: Be careful of the gasket installation direction.

- (b) Install the water pipe with the 2 nuts and bolt.

Torque:

Nut

12 N·m (120 kgf·cm, 9 ft·lbf)

Bolt

8 N·m (80 kgf·cm, 69 in·lbf)

- (c) Connect the 2 water bypass hoses to the turbo water
pipe.

9. INSTALL EXHAUST MANIFOLD HEAT INSULATOR

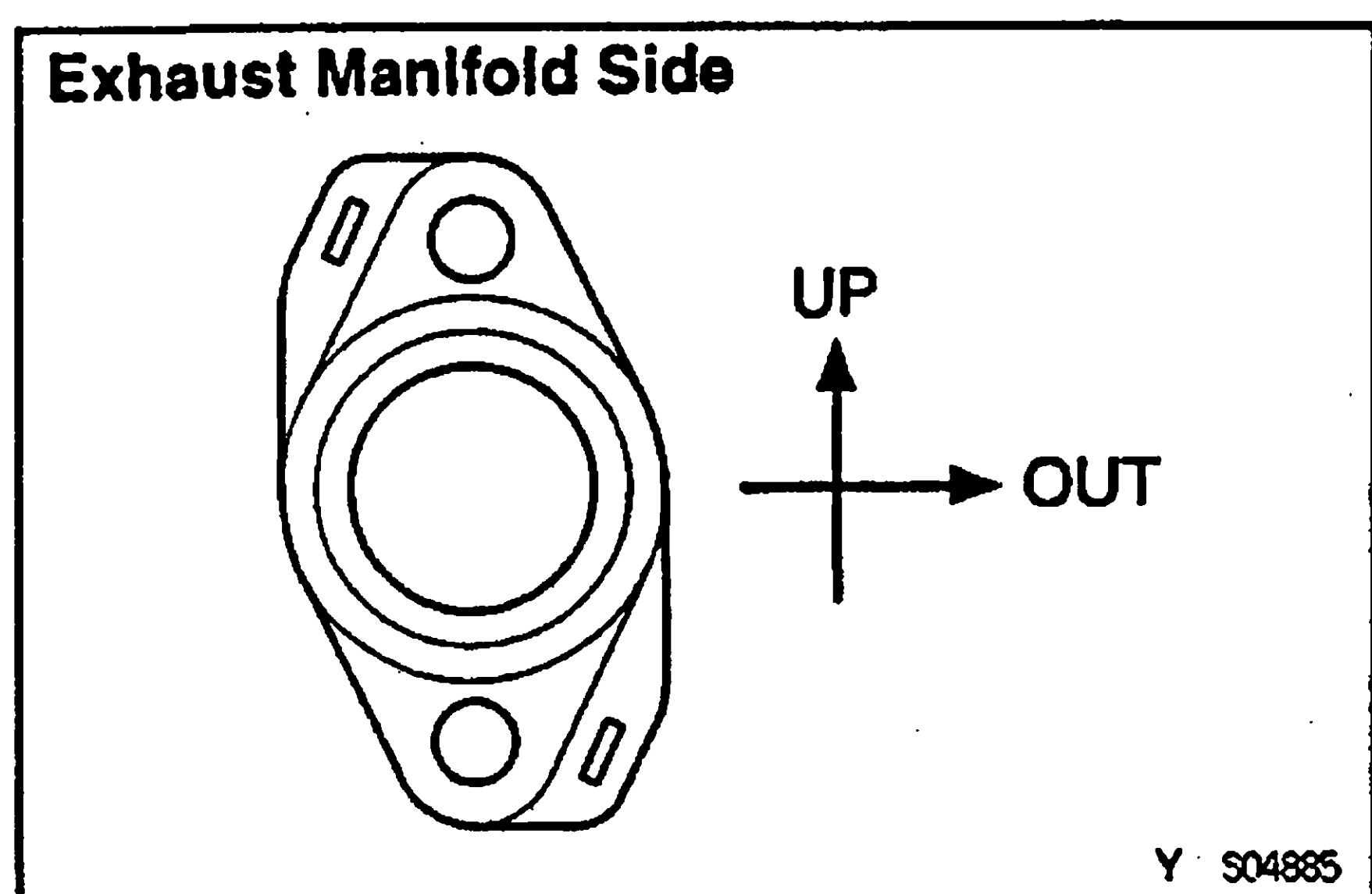
Install the heat insulator with the 4 bolts.

Torque: 6 N·m (65 kgf·cm, 53 in·lbf)

10. INSTALL TURBOCHARGER HEAT INSULATOR

Install the heat insulator with the 4 bolts.

Torque: 6 N·m (65 kgf·cm, 53 in·lbf)

**11. 1KZ-TE:****INSTALL EGR VALVE AND PIPE ASSEMBLY**

- (a) Place 2 new gaskets on the intake and exhaust mani-
folds.

NOTICE: Be careful of the exhaust manifold side gasket
installation direction.

- (b) Install the EGR valve and pipe assembly with the bolt,
2 nuts and a new nut. Alternately tighten the bolt and
nuts.

Torque:

EGR valve side

20 N·m (200 kgf·cm, 15 ft·lbf)

EGR pipe side

19 N·m (195 kgf·cm, 14 in·lbf)

- (c) Connect the vacuum hose and EVRV connector.

12. INSTALL INTAKE PIPE

(See step 22 in cylinder head installation in Engine
Mechanical)

13. FILL WITH ENGINE COOLANT**14. START ENGINE AND CHECK FOR LEAKS****15. CHECK ENGINE OIL LEVEL**

SERVICE SPECIFICATIONS
SERVICE DATA

880303-04

Turbocharger	Turbocharging pressure		51 — 67 kPa (0.52 — 0.68 kgf/cm ² , 7.7 — 9.8 psi)
	Turbine wheel axial play	Maximum	0.16 mm (0.0063 in.)
	Turbine wheel radial play	Maximum	0.11 mm (0.0043 in.)
	Actuator push rod stroke		1.20 — 1.70 mm (0.0472 — 0.0669 in.)
	Adjusting plate washer		0.5 mm (0.020 in.)
			1.0 mm (0.039 in.)
			2.0 mm (0.079 in.) 3.0 mm (0.118 in.)

TORQUE SPECIFICATIONS

880303-07

Part tightened		N·m	kgf·cm	ft·lbf
Turbocharger actuator x Compressor housing		19	195	14
Bearing housing side plate x Turbocharger		7.8	80	69 in·lbf
Turbine inlet elbow x Turbocharger		19	195	14
Turbocharger x Exhaust manifold		52	530	38
Turbo oil pipe x Turbocharger		19	195	14
Exhaust manifold x Cylinder block		52	530	38
Turbo oil pipe x Cylinder block	Union bolt	26	260	19
	Bolt	12	125	9
Turbocharger stay x Turbocharger		19	195	14
Turbocharger stay x Cylinder block		19	195	14
Turbine outlet elbow x Turbocharger		39	390	28
Turbo water pipe x Turbocharger	Nut	12	120	9
	Bolt	8	80	69 in·lbf
Exhaust manifold heat insulator x Exhaust manifold		6	65	53 in·lbf
Turbocharger heat insulator x Turbocharger		6	65	53 in·lbf
EGR valve x Intake manifold	1KZ—TE	20	200	15
EGR pipe x Exhaust manifold	1KZ—TE	19	195	14

ELECTRONIC CONTROL DIESEL(ECD) SYSTEM

PRECAUTION

1. Before working on the fuel system, disconnect the negative (—) terminal cable from the battery. DS150-06

HINT: Any diagnostic trouble code retained by the computer will be erased when the negative (—) terminal cable is removed from the battery.

Therefore, if necessary, read the diagnosis before removing the negative (—) terminal cable from the battery.

2. Do not smoke or work near an open flame when working on the fuel system.
3. Keep diesel fuel away from rubber or leather parts.

AIR INDUCTION SYSTEM

DS00CM-0K

1. Separation of the engine oil dipstick, oil filler cap, PCV hose, etc. may cause the engine to run out of tune.
2. Disconnection, looseness or cracks in the parts of the air induction system between the venturi and cylinder head will allow air suction and cause the engine to run out of tune.

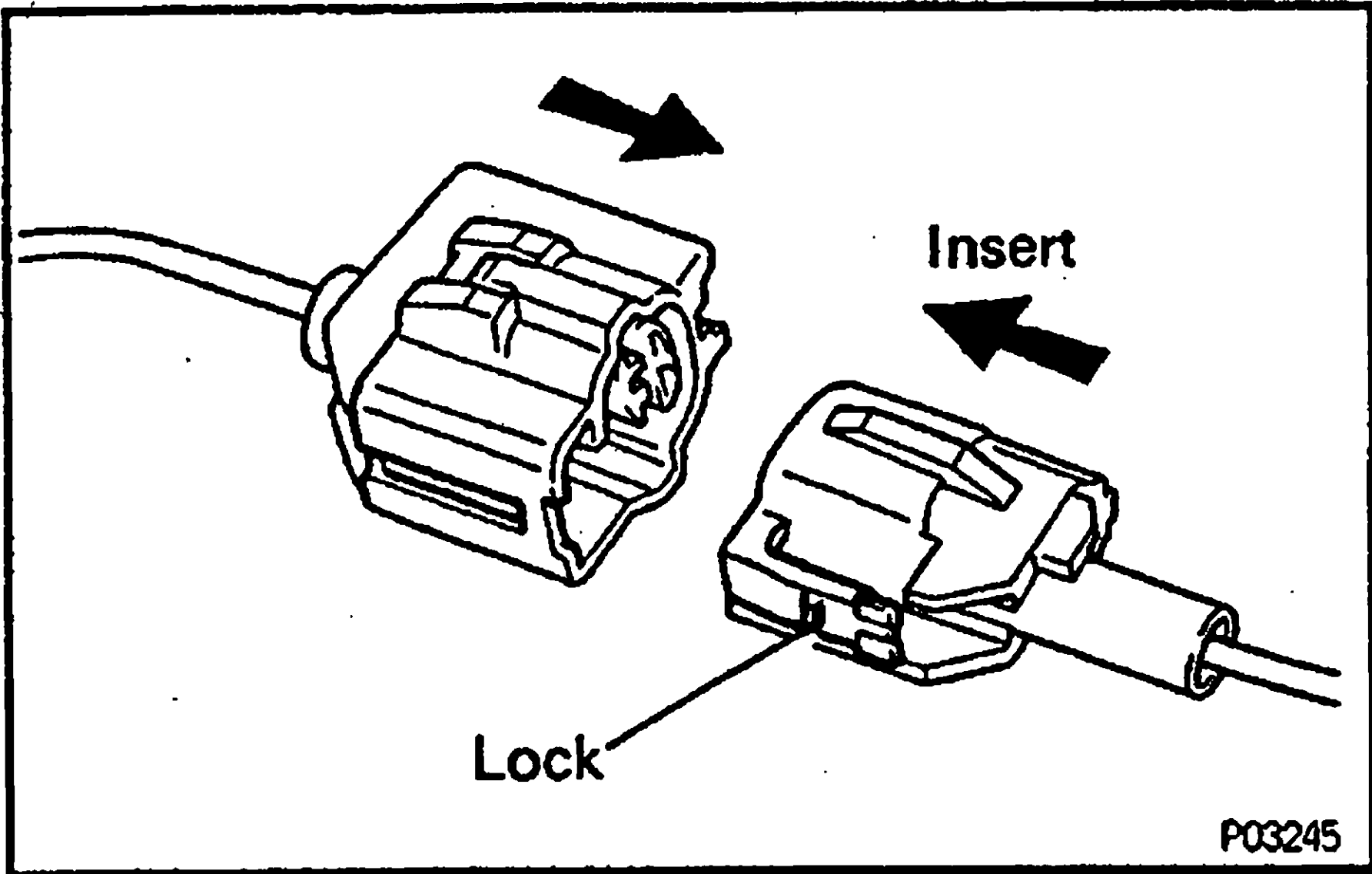
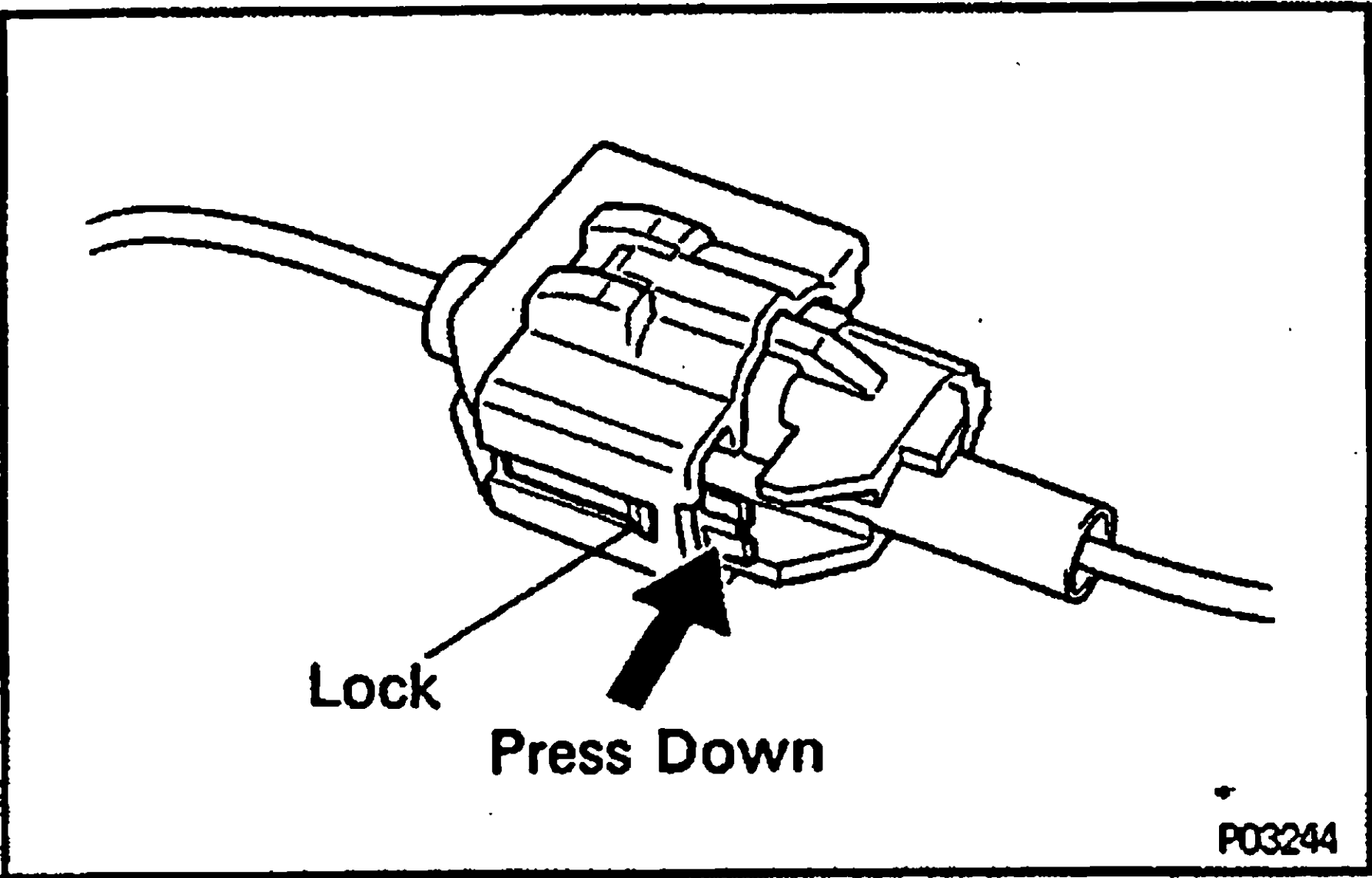
ELECTRONIC CONTROL SYSTEM

DS07F3-01

1. Before removing ECD wiring connectors, terminals, etc., first disconnect the power by either turning the ignition switch OFF or disconnecting the negative (—) terminal cable from the battery.

HINT: Always check the diagnostic trouble code before disconnecting the negative (—) terminal cable from the battery.

2. When installing the battery, be especially careful not to incorrectly connect the positive (+) and negative (—) cables.
3. Do not permit parts to receive a severe impact during removal or installation. Handle all ECD parts carefully, especially the ECU.
4. Do not be careless during troubleshooting as there are numerous transistor circuits and even slight terminal contact can further troubles.
5. Do not open the ECU cover.



6. When inspecting during rainy weather, take care to prevent entry of water. Also, when washing the engine compartment, prevent water from getting on the ECD parts and wiring connectors.
7. Parts should be replaced as an assembly.
8. Care is required when pulling out and inserting wiring connectors.

(a) Release the lock and pull out the connector, pulling on the connectors.

(b) Fully insert the connector and check that it is locked.
9. When inspecting a connector with a volt/ohmmeter

(a) Carefully take out the water—proofing rubber if it is a water—proof type connector.

(b) Insert the test probe into the connector from the wiring side when checking the continuity, amperage or voltage.

(c) Do not apply unnecessary force to the terminal.

(d) After checking, install the water—proofing rubber on the connector securely.

PREPARATION

SST (SPECIAL SERVICE TOOLS)

880C7-27

	09843-18020 Diagnosis Check Wire	
	09992-00241 Turbocharger Pressure Gauge	

RECOMMENDED TOOLS

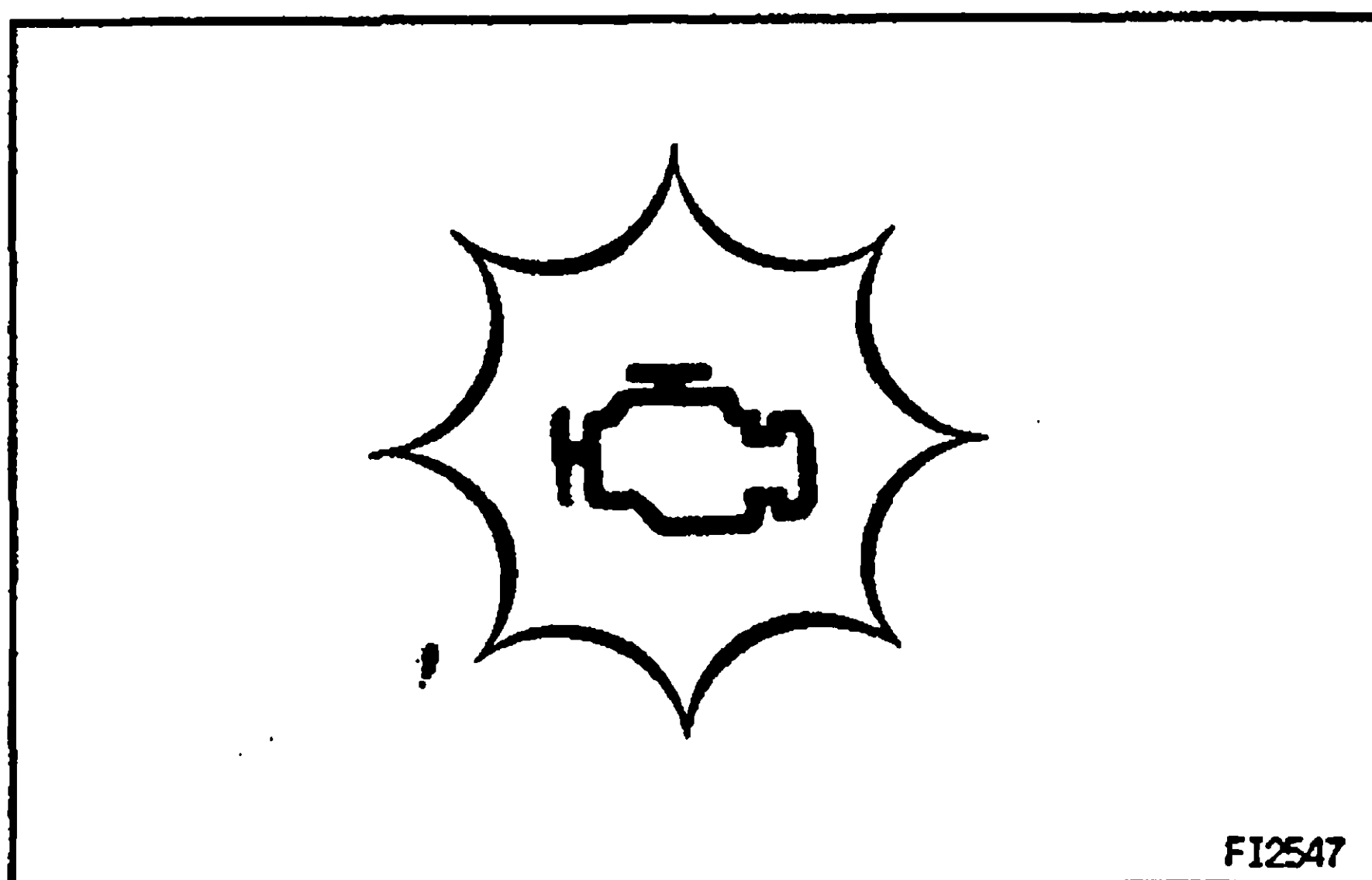
880C8-18

	09082-00040 TOYOTA Electrical Tester.	
	09200-00010 Engine Adjust Kit .	

EQUIPMENT

880C9-25

19 mm diam. deep socket wrench	Water temp. sensor
Tachometer	
Thermometer	
Torque wrench	
Vacuum gauge	



DIAGNOSIS SYSTEM

CHECK ENGINE WARNING LIGHT CHECK ^{EG4JE-03}

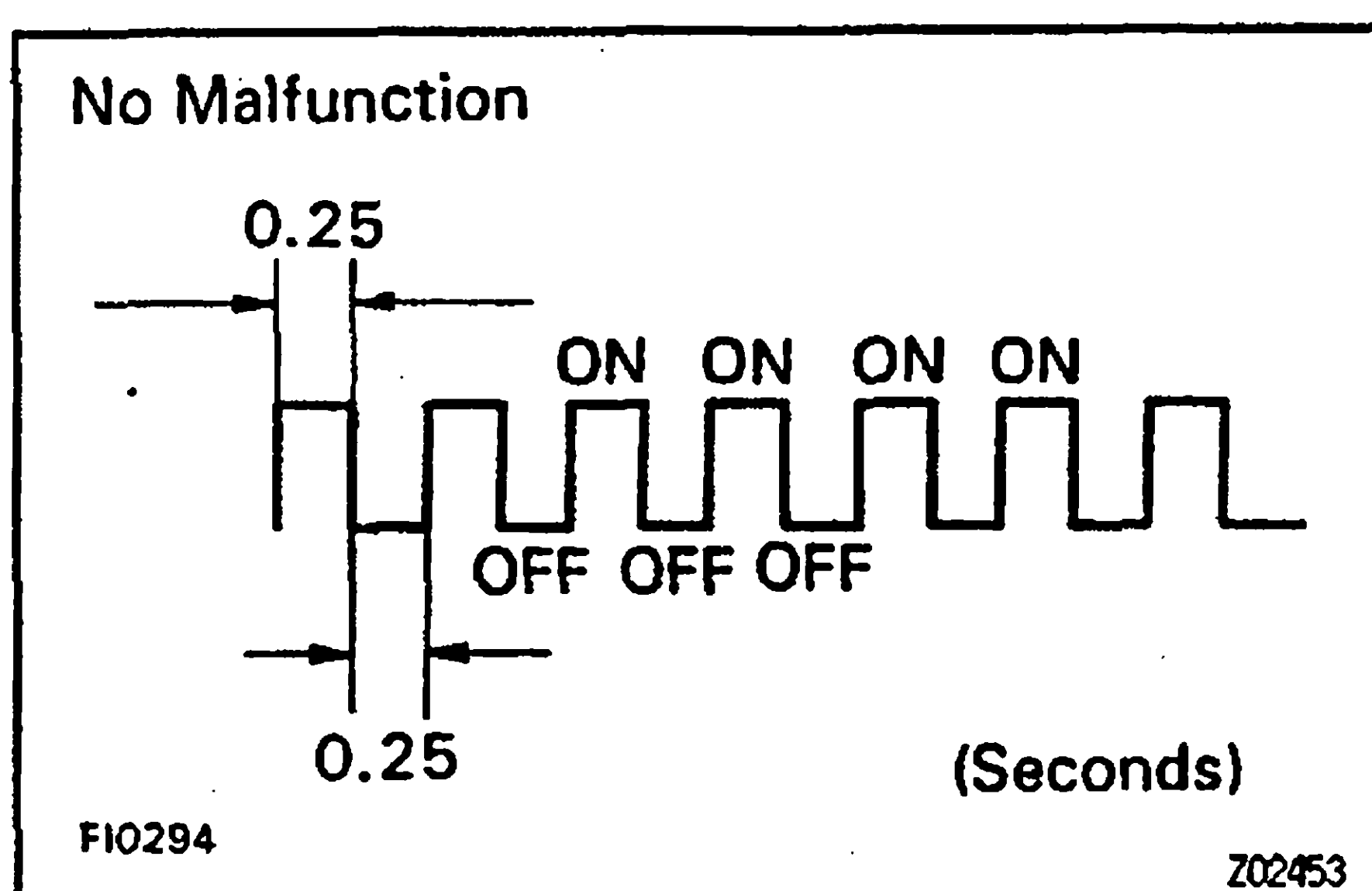
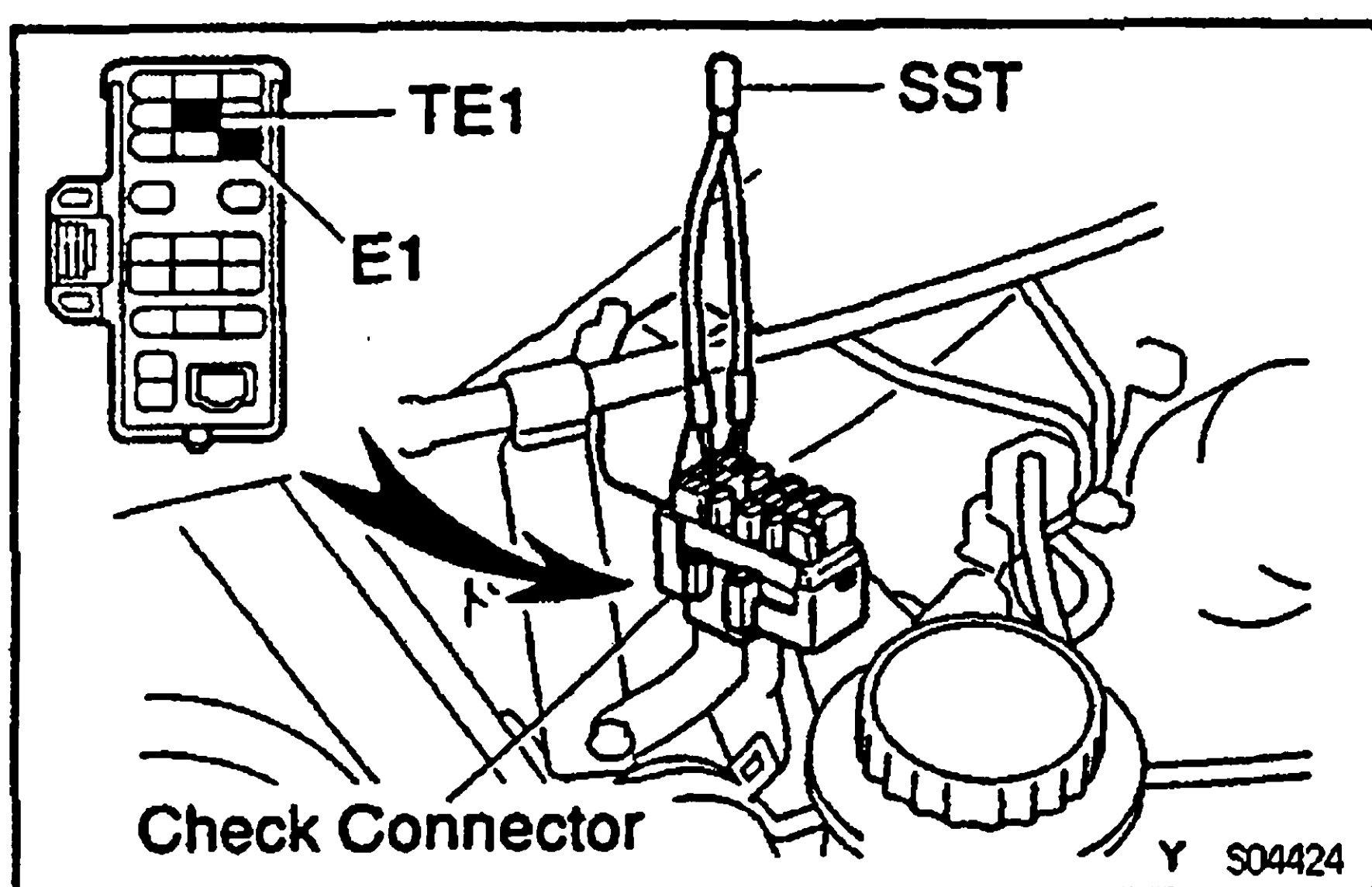
1. The check engine warning light will come on when the ignition switch is at ON and the engine is not running.
2. When the engine is started, the check engine warning light should go off. If the light remains on, the diagnosis system has detected a malfunction or abnormality in the system.

DIAGNOSTIC TROUBLE CODES OUTPUT ^{EG77C-01}

Normal mode:

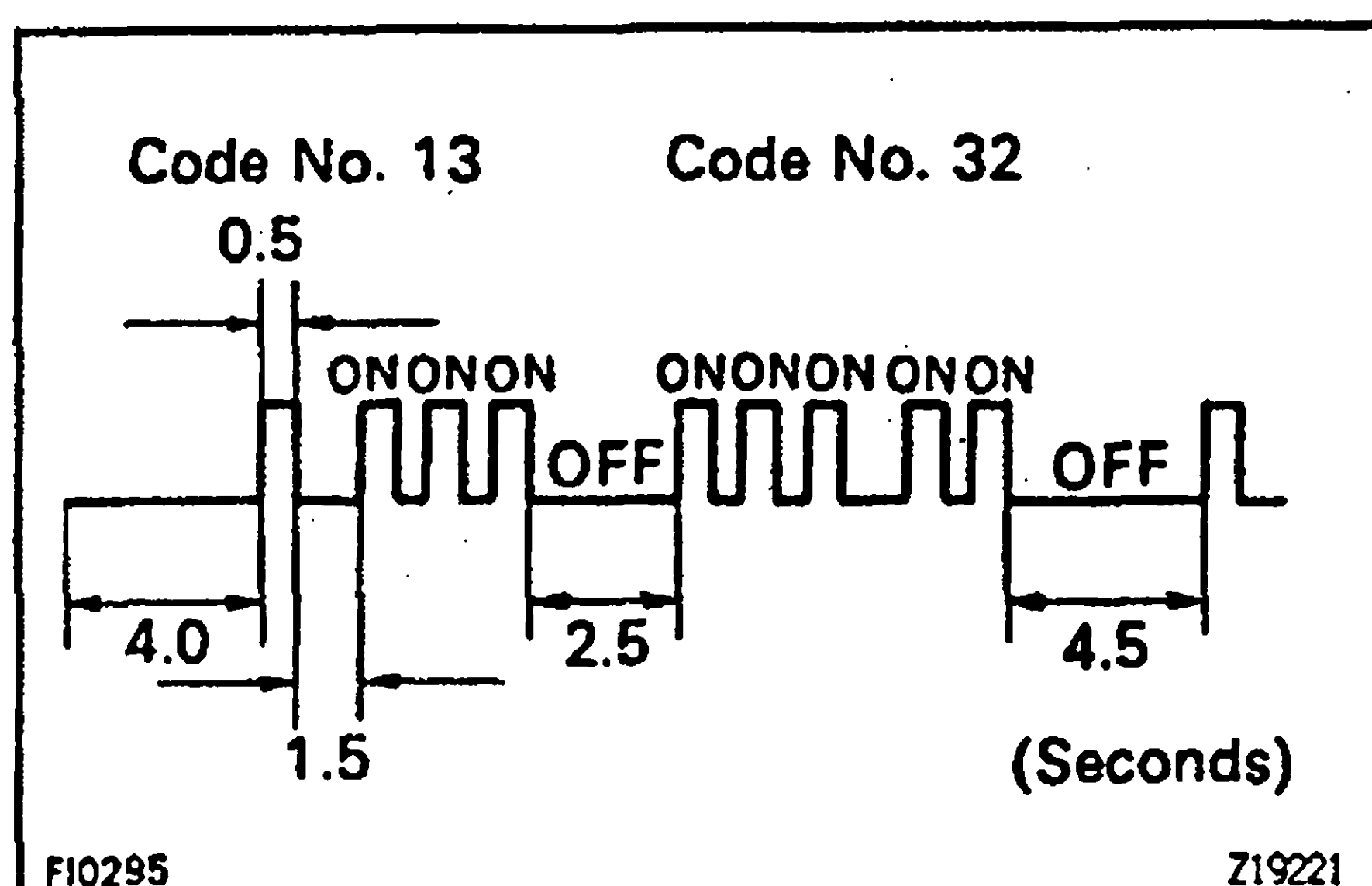
To obtain an output of diagnostic trouble codes, proceed as follows:

1. Initial conditions
 - (a) Battery positive voltage 11 V or more
 - (b) Throttle valve fully closed
(Throttle position sensor IDL points closed)
 - (c) Accessories switched OFF
 - (d) Engine at normal operating temperature
2. Turn the ignition switch ON.
NOTICE: Do not start the engine.
3. Using SST, connect terminals TE1 and E1 of the check connector.
SST 09843-18020
4. Read the diagnostic trouble code as indicated by the number of flashes of the check engine warning light.



Diagnostic Trouble Codes

- (a) Normal System Operation (no malfunction)
 - The light will alternately blink ON and OFF at 0.25 second intervals.
- (b) Malfunction Code Indication
 - In the event of a malfunction, the light will blink every 0.5 seconds. The 1st number of blinks will equal the 1st digit of a 2 digit diagnostic trouble code, and after a 1.5 second pause, the 2nd number of blinks will equal the second digit. If there are 2 or more codes, there will be a 2.5 second pause between each code.



- After all the codes have been output, there will be a 4.5 second pause and they will all be repeated as long the terminals TE1 and E1 of the check connector are connected.

HINT: In the event of a number of trouble codes, indication will begin from the smaller value and continue to the larger.

5. After the diagnosis check, remove the SST from the check connector.

SST 09843—18020

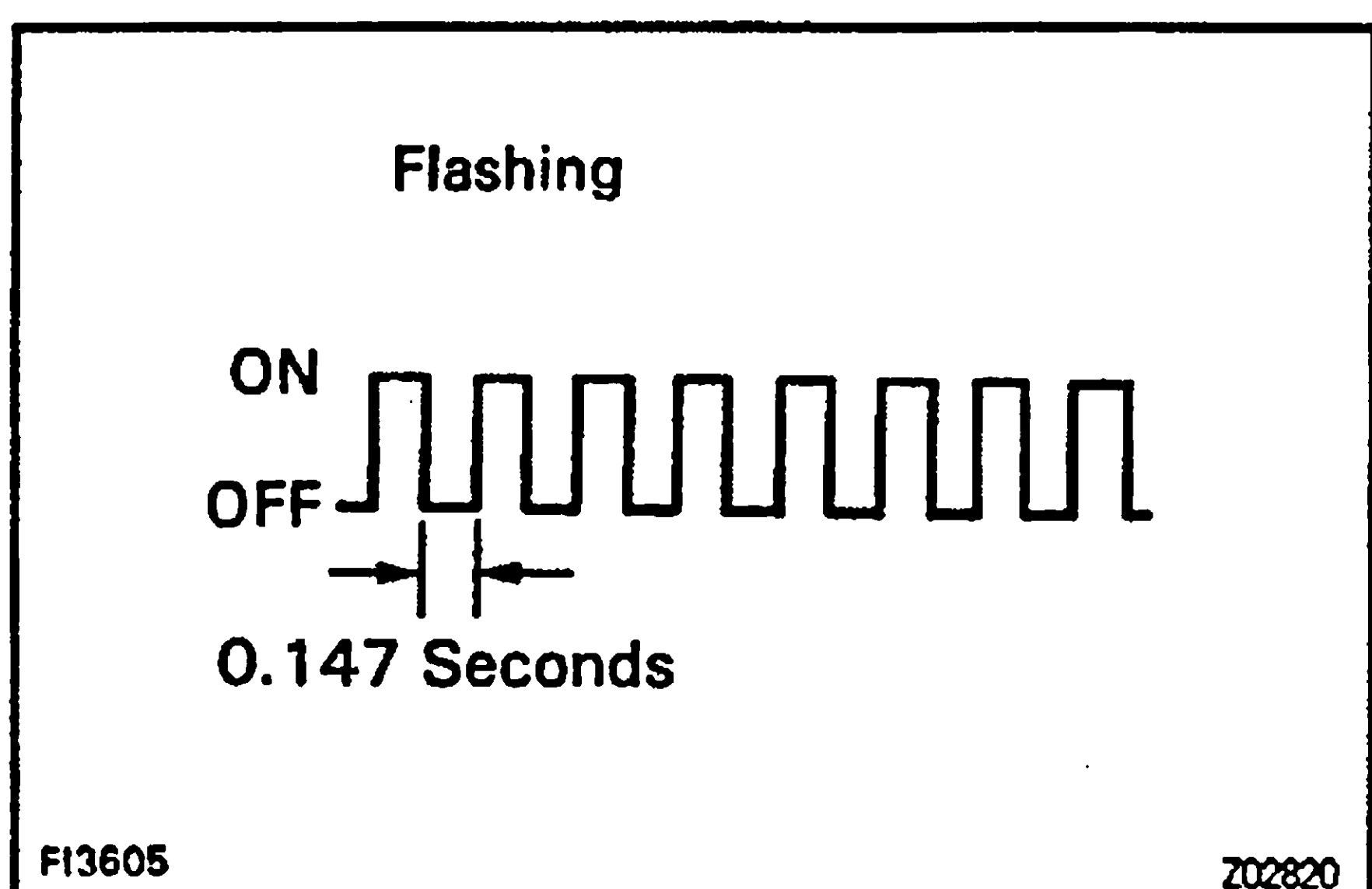
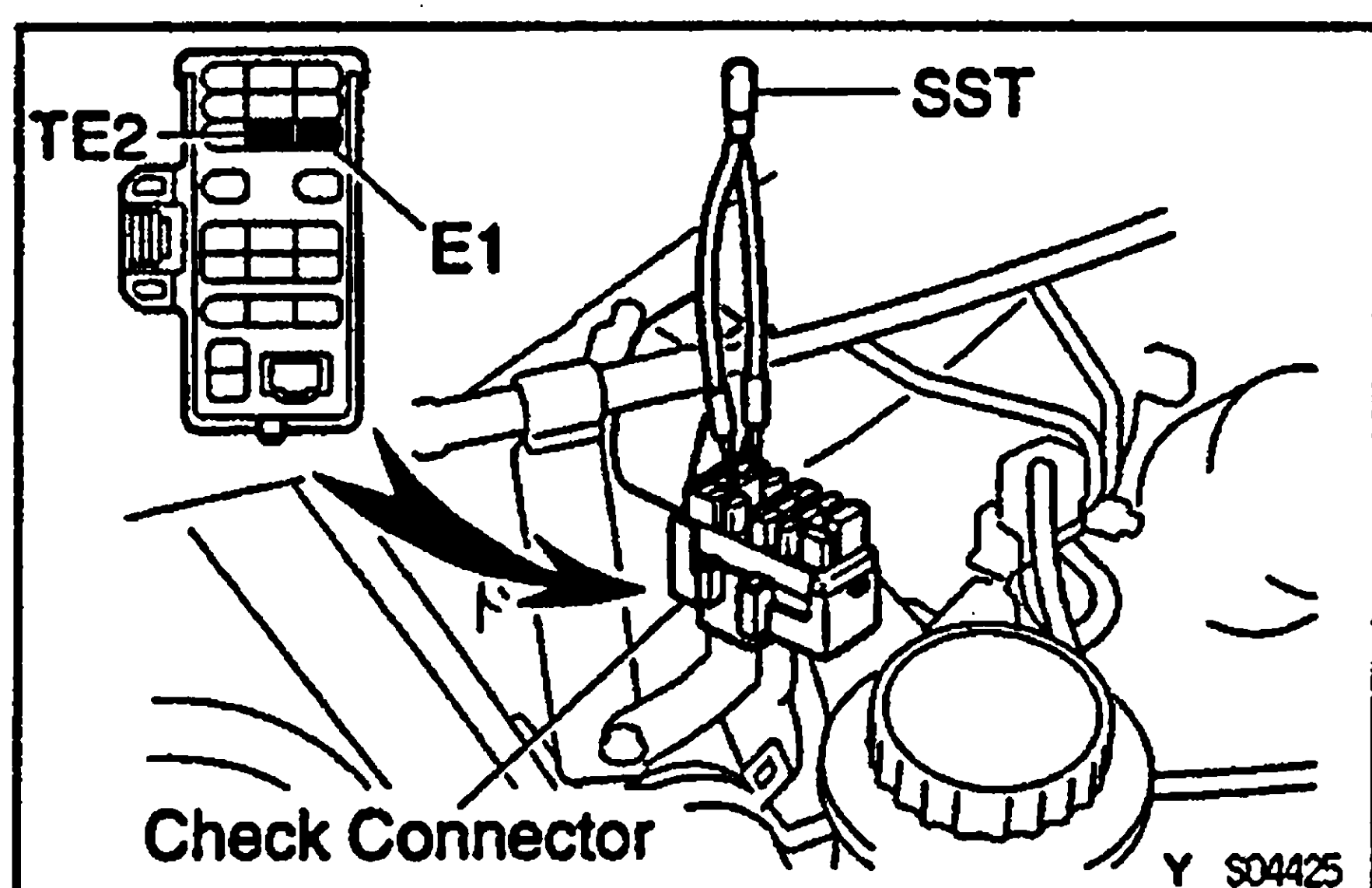
Test mode:

HINT:

- Compared to the normal mode, the test mode has an increased sensing ability to detect malfunctions.
- It can also detect malfunctions in the starter signal circuit, air conditioning signal.
- Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the test mode.

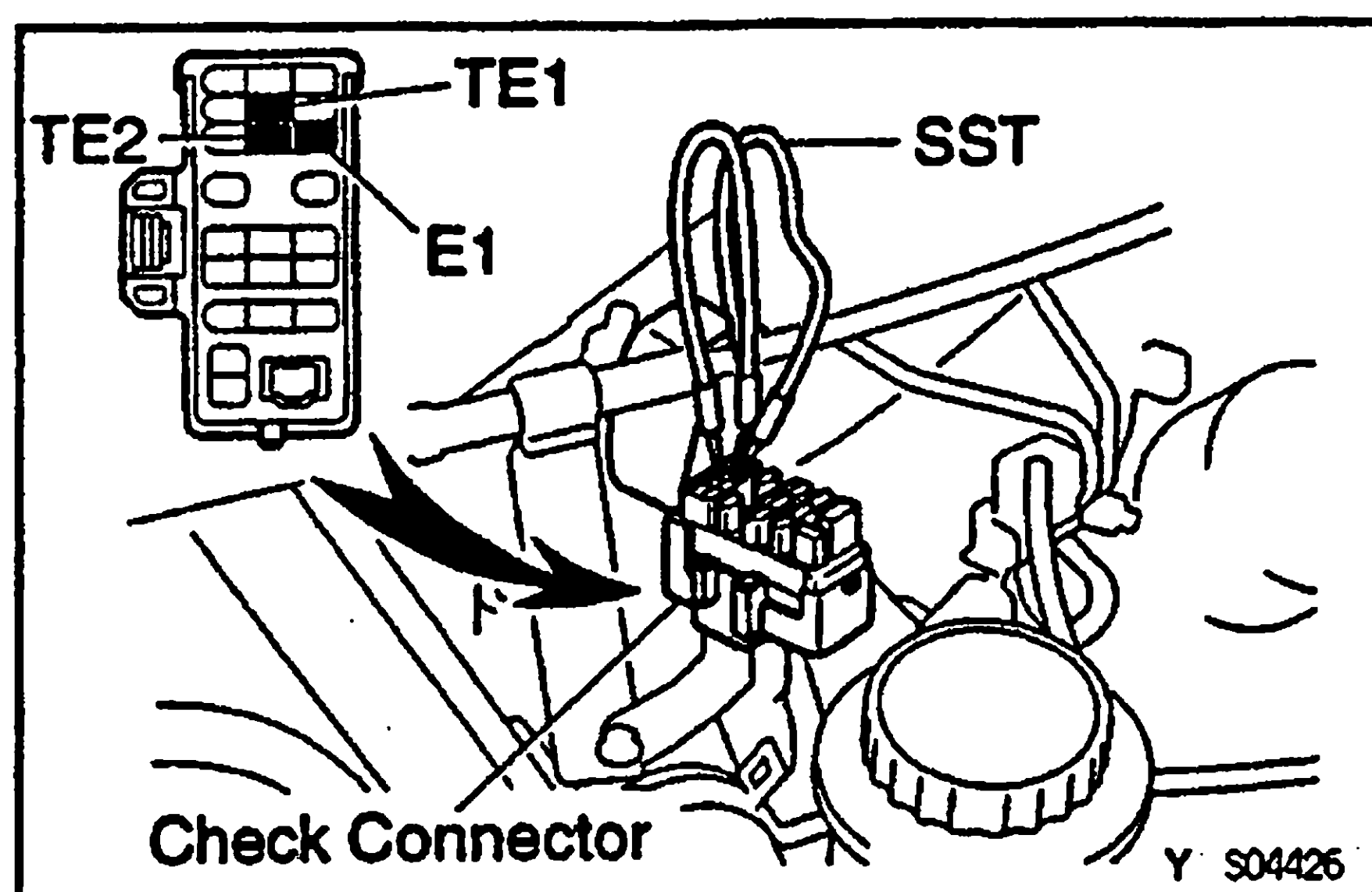
To obtain an output of diagnostic trouble codes, proceed as follows:

1. Initial conditions
 - (a) Battery positive voltage 11 V or more
 - (b) Throttle valve fully closed
(Throttle position sensor IDL points closed)
 - (c) Accessories switched OFF
2. Turn the ignition switch OFF.
3. Using SST, connect terminals TE2 and E1 of the check connector.
SST 09843—18020
4. Turn the ignition switch ON to begin the diagnosis in the test mode.



HINT: To confirm that the test mode is operating, check that the check engine warning light flashes when the ignition switch is turned ON.

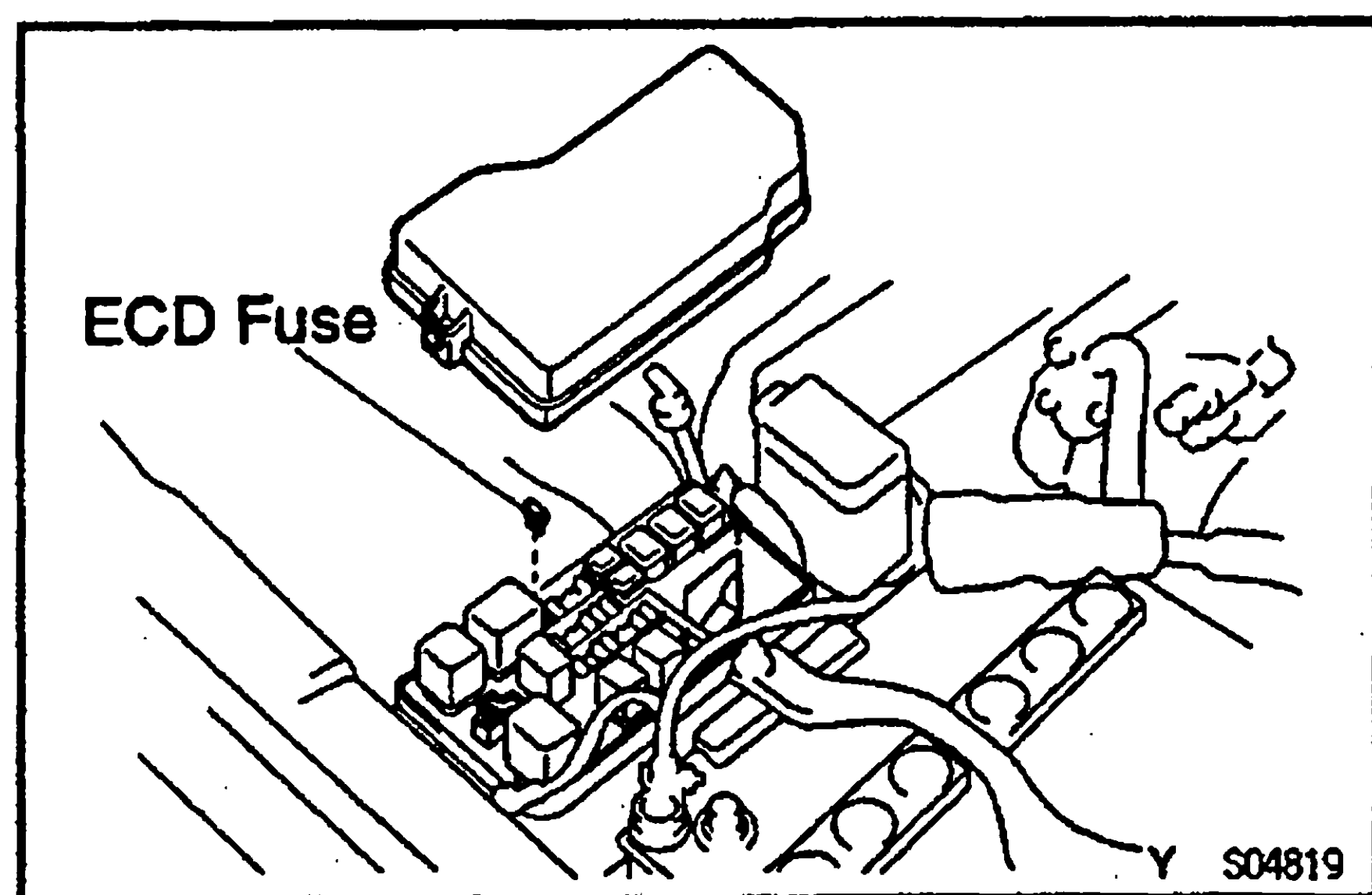
5. Start the engine and drive the vehicle at a speed of 5 km/h (3 mph) or higher.
6. Simulate the conditions of the malfunction described by the customer.



7. Using SST, connect terminals TE1 and E1 of the check connector.
SST 09843-18020
8. Read the diagnostic trouble code as indicated by the number of flashes of the check engine warning light.
9. Remove the SST from the check connector.
SST 09843-18020

HINT:

- The test mode will not start if terminals TE2 and E1 are connected after the ignition switch is turned ON.
- The starter signal and vehicle speed signal will be diagnosed by the ECU as malfunctions, and code Nos. 42 and 43 will be output, if the operation in step 5 is not done.
- When the air conditioning is on or when the accelerator pedal is depressed, code "51" (Switch condition signal) is output, but this is not abnormal.



DIAGNOSTIC TROUBLE CODE CANCELLATION

B042T-0F

1. After repair of the trouble area, the diagnostic trouble code retained in memory by the ECU must be cancelled out by removing the ECD fuse (15A) for 60 seconds or more, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out) with the ignition switch OFF.

HINT:

- Cancellation can also be done by removing the negative (—) terminal cable from the battery, but in this case, other memory systems (clock, etc.) will also be cancelled out.
 - If the diagnostic trouble code is not cancelled out, it will be retained by the ECU and appear along with a new code in the event of future trouble.
 - If it is necessary to work on engine components requiring removal of the battery terminal, a check must first be made to see if a diagnostic trouble code has been recorded.
2. After cancellation, road test the vehicle to check that a normal code is now read on the check engine warning light.
If the same diagnostic trouble code appears, it indicates that the trouble area has not been repaired thoroughly.

DIAGNOSIS INDICATION

1. When 2 or more codes are indicated, the lowest number (code) will appear first.
2. All detected diagnostic trouble codes, except code No. 51 under the test mode will be retained in memory by the ECU from the time of detection until cancelled out.
3. Once malfunction is cleared, the check engine warning light in the combination meter will go off but the diagnostic trouble code (s) remains stored in ECU memory (except for code No.51 under the test mode).

EG

DIAGNOSTIC TROUBLE CODES

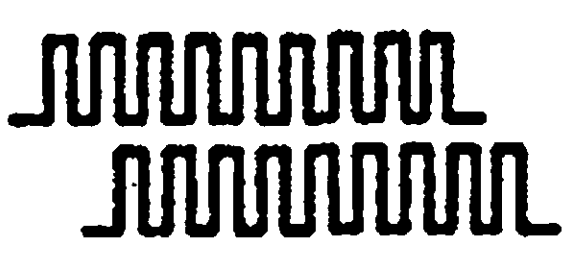
80770-01

HINT:

- If a malfunction is detected during the diagnostic trouble code check, refer to the circuit indicated in the table, and turn to the corresponding page.
- Your readings may vary from the parameters listed in the table, depending on the instruments used.

DTC No.	Number of Blinks of Check Engine Warning Light	System	Check Engine*1 Warking Light		Diagnosis	Trouble Area	Memory*2	See page
			Normal Mode	Test Mode				
—	 FI1401	Normal	—	—	Output when no other code is recorded.	—	—	—
12	 FI1606	RPM Signal 1	ON	ON	No crankshaft position angle signal (TDC signal) to ECU with engine speed 400 rpm or more.	• Open or short in TDC circuit • Crankshaft position sensor • ECU	○	EG-72 EG-73
13	 FI1607	RPM Signal 2	ON	ON	• No NE signal to ECU for 0.5 sec. or more with engine speed 680 rpm or more. • No NE signal to ECU for 2 sec. or more with during cranking.	• Open or short in NE circuit • Engine speed sensor • ECU	○	EG-73 EG-102
14	 FI1608	Timing Control Signal	ON	N.A.	After warming up engine and during idling, crankshaft angle is deviated 7° or more from target for 10 sec. or more.	• Open or short TCV circuit • Fuel filter (Clogging) • Injection pump (Internal pressure and TCV) • ECU	○	EG-67 EG-73 EG-80 EG-102

DTC No.	Number of Blinks of Check Engine Warning Light	System	Check Engine*1 Working Light		Diagnosis	Trouble Area	Memory*2	See page
			Normal Mode	Test Mode				
*3 16	 FI3600	A/T Control Signal	ON	N.A.	Fault in communications between the engine CPU and A/T CPU in the ECU.	• ECU	×	—
17	 BE3932	Interior IC Signal	ON	N.A.	Normal signal is not output from ECD CPU.	• ECU	○	—
22	 FI1610	Water Temp. Sensor Signal	ON	ON	Open or short in water temp. sensor circuit for 0.5 sec. or more. (THW)	• Open or short in water temp. sensor circuit • Water temp. sensor • ECU	○	EG-69 EG-73
24	 FI1611	Intake Air Temp. Sensor Signal	OFF	ON	Open or short in intake air temp. sensor circuit for 0.5 sec. or more. (THA)	• Open or short in intake air temp. sensor circuit • Intake air temp. sensor • ECU	○	EG-70 EG-73
32	 BE3933	Correction Resistors Signal	OFF	ON	Open or short in correction circuit for 0.5 sec. or more. (VRP, VRT)	• Open or short in correction resistors circuit • Correction resistor • ECU	○	EG-73 EG-102
33	 BE3933	Intake Constrictor Control Signal	ON	N.A.	Open or short in intake constrictor control for 0.5 sec. or more. (S/TH1, S/TH2)	• Open or short in intake constrictor control circuit • VSV for intake constrictor control • ECU	○	EG-13 EG-67 EG-73
35	 BE3933	Turbo Pressure Sensor Signal	ON	ON	• When engine speed is 2,400 rpm or more and acceleration is 52 % or more, intake manifold pressure signal shows abnormally low value for 2 sec. or more. • Intake manifold pressure shows abnormally high value for 2 sec. or more.	• Open or short in turbo pressure sensor circuit • Turbo pressure circuit • ECU	○	EG-71 EG-73
39	 S02130	Fuel Temp. Sensor Signal	ON	ON	Open or short in fuel temp. sensor circuit for 0.5 sec. or more. (THF)	• Open or short in fuel temp. sensor circuit • Fuel temp. sensor • ECU	○	EG-70 EG-73
41	 FI1614	Throttle Position Sensor Signal	ON	ON	Open or short throttle position sensor circuit for 0.1 sec. or more.	• Open or short in throttle position sensor circuit • Throttle position sensor • ECU	○	EG-66 EG-73
42	 FI1615	Vehicle Speed Sensor Signal	OFF	OFF	M/T: No speed sensor signal to ECU for 8 sec. or more during heavy load driving with engine speed between 1,800 rpm and 3,200 rpm. A/T: No speed sensor signal to ECU for 8 sec. or more when shift position in "R", "D", "2" or "L" range with engine speed 2,800 rpm or more.	• Open or short in vehicle speed sensor circuit • Vehicle speed sensor • ECU	○	EG-73
43	 FI1616	Starter Signal	OFF	OFF	Starter signal to ECU for 10 sec. or more with engine speed 1,200 rpm or more. (STA)	• Open or short in starter signal circuit • Ignition switch • ECU	○	EG-73

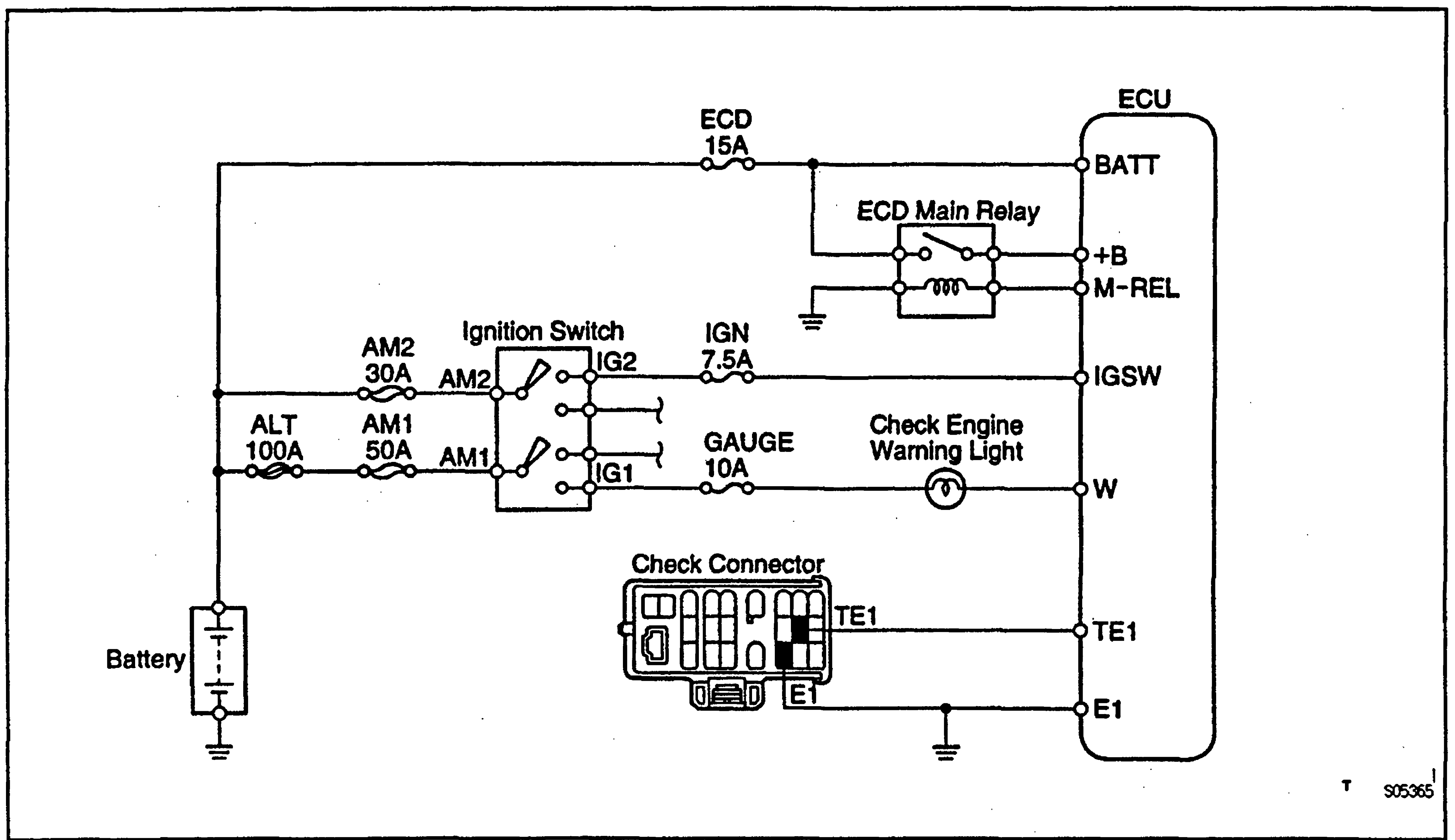
DTC No.	Number of Blinks of Check Engine Warning Light	System	Check Engine ^{*1} Warning Light		Diagnosis	Trouble Area	Memory ^{*2}	See page
			Normal Mode	Test Mode				
*4 99	 P25117	Engine Immobiliser System	ON	N.A.	Open or short detected in engine immobiliser system circuit. (IMO, IMI)	• Open or short in engine immobiliser system circuit • Transponder key amplifier • Transponder key coil • Transponder key computer • ECU	○	EG-73 *5
51	 FI1617	Switch Condition Signal	N.A.	N.A.	Displayed when A/C is ON, IDL contact OFF or shift position in "R", "D", "2" or "L" range with STA is OFF and check terminals TE1 and E1 connected in Test mode.	• A/C switch system • Neutral start switch circuit • Throttle position sensor IDL circuit • ECU	×	EG-66 EG-73

V08156

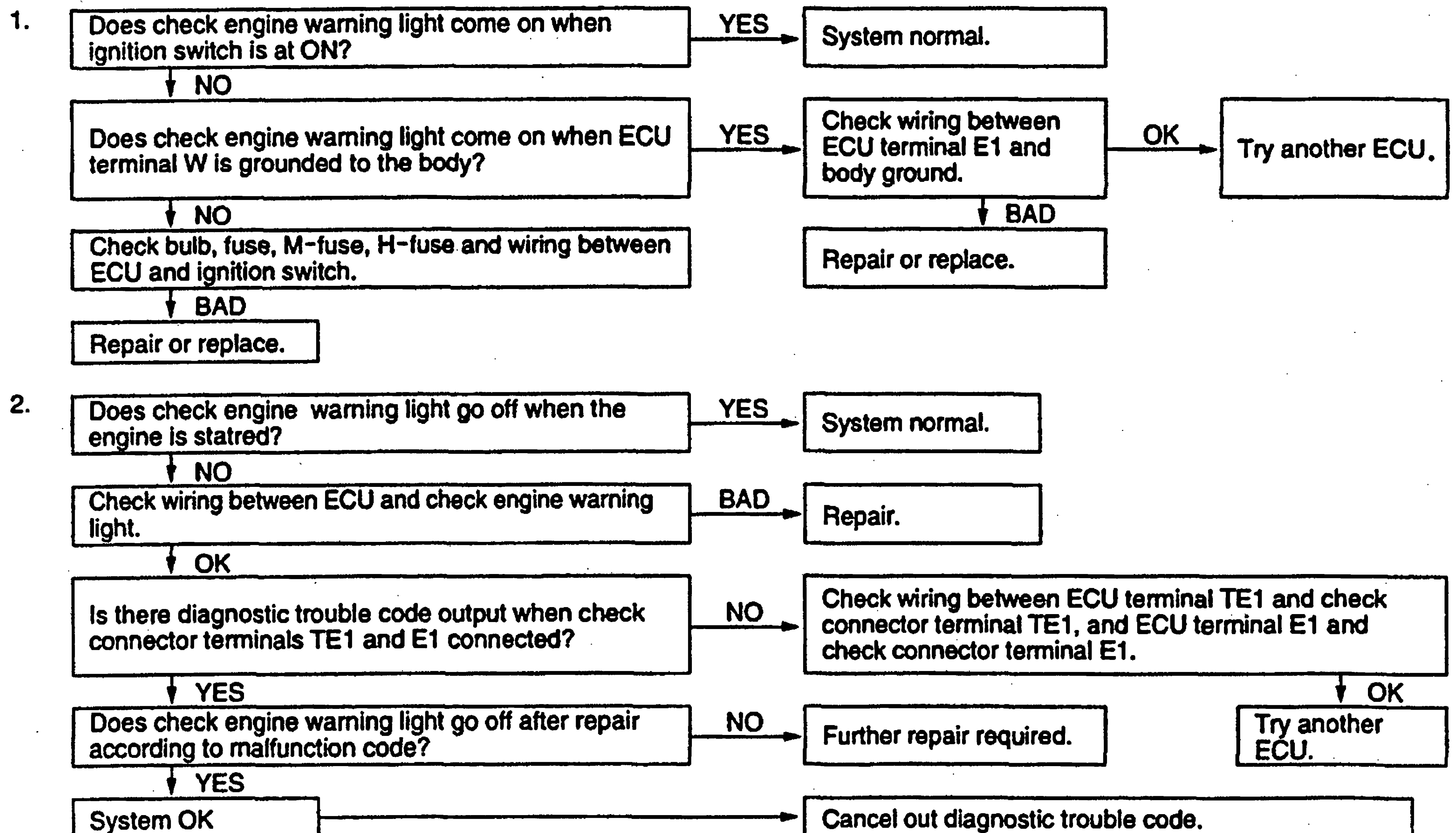
REMARKS:

- *1: "ON" displayed in the diagnosis mode column indicates that the check engine warning light is lighted up when a malfunction is detected. "OFF" indicates that the check engine warning light does not light up during malfunction diagnosis, even if a malfunction is detected. "N.A." indicates that the item is not included in malfunction diagnosis.
- *2: "○" in the memory column indicates that a diagnostic trouble code is recorded in the ECU memory when a malfunction occurs. "X" indicates that a diagnostic trouble code is not recorded in the ECU memory even if a malfunction occurs. Accordingly, output of diagnostic results in normal or test mode is performed with the ignition switch ON.
- *3: A/T only
- *4: w/ Engine Immobiliser System only
- *5: See BE section of Repair Manual of Chassis and Body of applicable model.

ECD CIRCUIT INSPECTION



T S05365



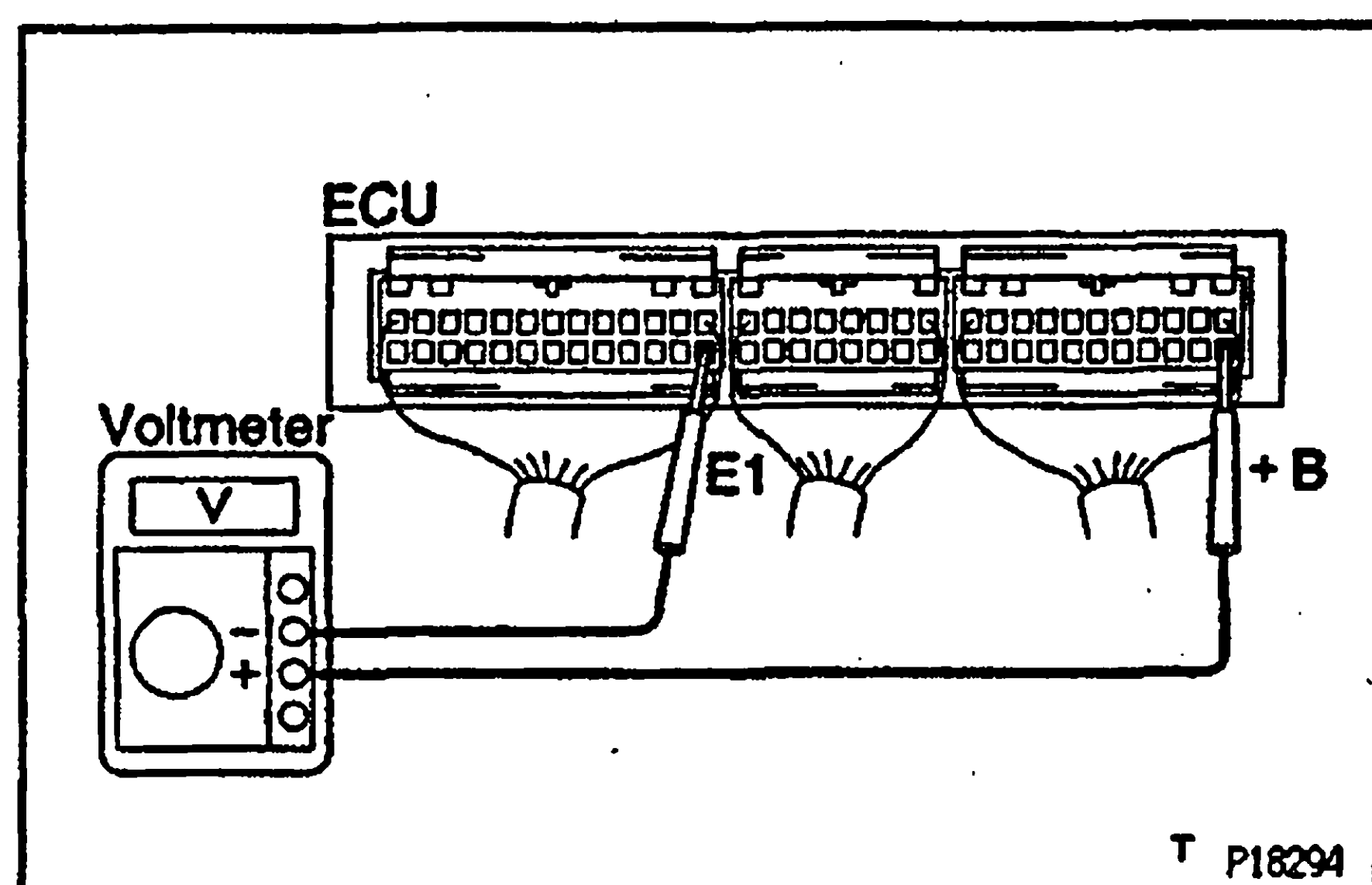
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TROUBLESHOOTING

EG00V-07

HINT:

- The following troubleshooting procedures are designed for inspection of each separate system, and therefore the actual procedure may vary somewhat. However, troubleshooting should be performed while referring to the inspection methods described in this manual.
- Before beginning inspection, it is best to first make a simple check of the fuses, M—fuses, H—fuse and the condition of the connectors.
- The following troubleshooting procedures are based on the supposition that the trouble lies in either a short or open circuit within the computer.
- If engine trouble occurs even though proper operating voltage is detected in the computer connector, then it can be assumed that the ECU is faulty and should be replaced.



ECD SYSTEM CHECK PROCEDURE

B042M-04

PREPARATION

Disconnect the ECU from the vehicle body.
(See engine (& ECT) ECU)

HINT:

- Do all voltage measurements with the connectors connected.
- Verify that the battery positive voltage is 11 V or more when the ignition switch is in the "ON" position.

Using a voltmeter with high impedance (10 k Ω /V minimum), measure the voltage at each terminal of the wiring connectors.

Engine (& ECT) ECU Terminals

Symbol	Terminal Name	Symbol	Terminal Name	Symbol	Terminal Name
E01	POWER GROUND	S1*1	ECT SOLENOID	A/C	A/C MAGNETIC CLUTCH
E02	POWER GROUND	S2*1	ECT SOLENOID	OD1*1	CRUISE CONTROL ECU
TCV	TIMING CONTROL VALVE	SL*1	ECT SOLENOID	SP1	VEHICLE SPEED SENSOR (METER)
	—	E1	ENGINE GROUND	HSW	HEATER IDLE - UP SWITCH
SPV	SPILL CONTROL VALVE	VF	CHECK CONNECTOR	IMO*2	TRANSPONDER KEY COMPUTER
EGR	EVRV	TT*1	CHECK CONNECTOR	ACT	A/C AMPLIFIER
S/TH1	VSV (INTAKE CONSTRICTOR CONTROL, NO.1)	TE2	CHECK CONNECTOR	G-IND	GLOW INDICATOR LIGHT
SNW*1	SNOW MODE SWITCH	TE1	CHECK CONNECTOR	TAC	TACHOMETER
S/TH2	VSV (INTAKE CONSTRICTOR CONTROL, NO.2)	VRP	CORRECTION RESISTOR B	OIL-W*1	A/T OIL TEMP. WARNING LIGHT
SNWL*1	SNOW MODE LIGHT	VRT	CORRECTION RESISTOR A	IMI*2	TRANSPONDER KEY COMPUTER
TFN*1	TRANSFER SHIFT POSITION DETECTION SWITCH	THF	FUEL TEMP. SENSOR	W	CHECK ENGINE WARNING LIGHT
2*1	NEUTRAL START SWITCH	THO*1	A/T FLUID TEMP. SENSOR	OD2*1	O/D MAIN RELAY
L4*1	TRANSFER SHIFT POSITION DETECTION SWITCH	THW	WATER TEMP. SENSOR	STP*1	STOP LIGHT SWITCH
L*1	NEUTRAL START SWITCH	IDL	THROTTLE POSITION SENSOR	P*1	ECT PATTERN SELECT SWITCH
	—	THA	INTAKE AIR TEMP. SENSOR	M - REL	ECD MAIN RELAY
	—	VA	THROTTLE POSITION SENSOR	IGSW	IGNITION SWITCH
TDC+	CRANKSHAFT POSITION SENSOR	PIM	TURBO PRESSURE SENSOR	S - REL	GLOW PLUG RELAY
TDC-	CRANKSHAFT POSITION SENSOR		—	SVR	SPILL VALVE RELAY
NE+	ENGINE SPEED SENSOR	VC	TURBO PRESSURE SENSOR, THROTTLE POSITION SENSOR	BATT	BATTERY
NE-	ENGINE SPEED SENSOR	E2	SENSOR GROUND	+B	ECD MAIN RELAY
SP2+*1	VEHICLE SPEED SENSOR (ECT)	STA	STARTER RELAY		
SP2-*1	VEHICLE SPEED SENSOR (ECT)	NSW*1	NEUTRAL START SWITCH		

ECU Terminals

E01	TCV	SPV	S/TH1	S/TH2	TFN	L4		TDC+	NE+	SP2+	S1	SL	VF	TE2	VRP	THF	THW	THA	PIM	VC	STA	A/C	SP1	IMO	G-IND	OIL-W	W	STP	M-REL	S-REL	BATT
E02		EGR	SNW	SNWL	2	L		TDC-	NE-	SP2-	S2	E1	TT	TE1	VRT	THO	IDL	VA		E2	NSW	OD1	HSW	ACT	TAC	IMI	OD2	P	IGSW	SVR	+B

*1: A/T only *2: w/ Engine Immobiliser System

BASIC INSPECTION

When the malfunction code is not confirmed in the diagnostic trouble code check, troubleshooting should be performed in the order for all possible circuits to be considered as the causes of the problems.

In many cases, by carrying out the basic engine check shown in the table, the location causing the problem can be found quickly and efficiently. Therefore, use of this check is essential in engine troubleshooting.

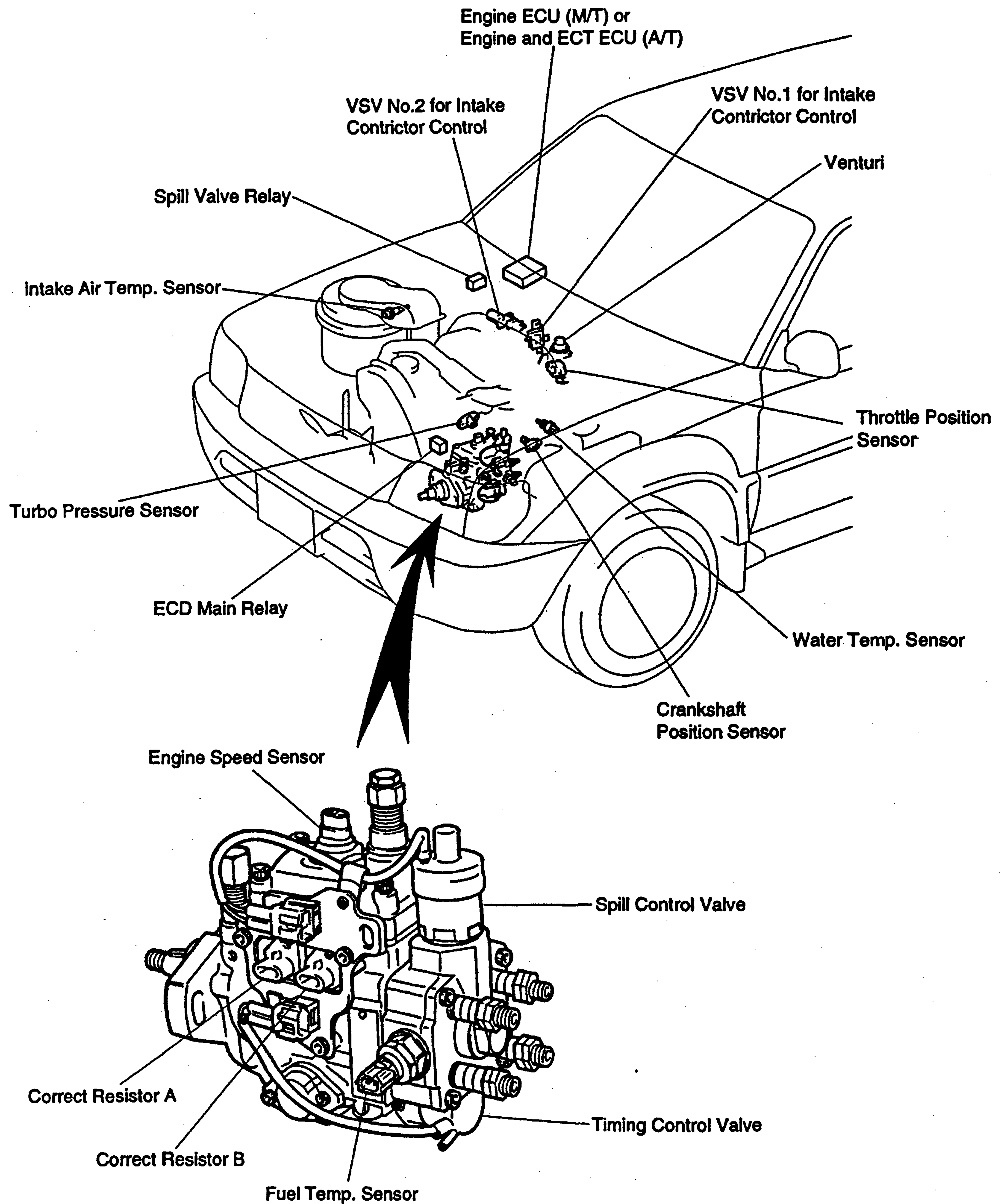
EG

	Check Item	Check Method	Standard
Fuel System	Leakage from fuel pipe	Touch piping with hands and check if there is any leakage.	No leakage
	Volume of water of segmenter	Check whether filter warning light comes on or not.	No lighting
	Volume of fuel in main body of pump	Remove overflow screw and check fuel volume in main body of pump.	Must have fuel above governor cover.
	Injection timing	See injection timing inspection and adjustment.	
Power Sorce	Battery	Check between (+) and (-) terminals with tester.	11 V or more
	Power sorce flow	Check connection conditions of fuses, fusible link, grounding and wire hamess connectors.	Must been connected correctly.
Others	Check of accelerator wiring	See idle speed and maximam speed inspection.	
	Clogging of air filter	See air filter inspection and cleaning.	

V08154

NOTICE: If usual summer grade fuel is used in cold districts, the engine may not start because the fuel is congealed at the at the extremely low temperature. In case of using winter grade fuel.

PARTS LOCATON



PROBLEM SYMPTOMS MATRIX CHART

EG7FG-01

The problem still can be confirmed in the basic inspection, then proceed to this step and perform troubleshooting according to the numbered order given in the table below.

See page		Suspect area																
		Symptom	A/C Switch	Air Filter	Battery and Battery Terminal	Compression	Correction Resistor A	Correction Resistor B	Cylinder Head (Cracks)	Crankshaft Position Sensor	Diagnostic Trouble Code	ECD Main Relay	ECU	EGR Valve	Engine Oil	Engine Speed Sensor	Fuel Filter	Fuel Line (Air Beed)
Difficult to start	Engine cranks normally				2	10					1	5	9			8		11
	Cold engine												9		10	5	2	11
	Hot engine					8							7			1	5	9
Engine stall	Soon after starting										1		7			4	2	
	Others										1	3	9			5		2
Poor idling	Incorrect first idle										1		4				3	
	High engine idle speed	5									1		8					
	Lower engine idle speed	4									1		5					
	Rough idling					4			14	12	1		13			10		2
	Hunting at hot engine					4			11		1		10			7		2
	Hunting at cold engine					4			12	9	1		11			10		2
Poor driveability	Hesitation/Poor acceleration					3	13	8		10	1		14	12			9	16
	Knocking						6			3	1		5					
	Black smoke		2					7			1		11	15		5		
	White smoke						9			8	1		12	11				
	Surging/Hunting												3					

		See page		Suspect area		Symptom		EG - 82	EG - 102	EG - 10	EG - 70	—	ST - 3	—	EG - 102	EG - 69	EG - 66	EG - 67	EG - 37	EG - 71	EG - 5	—	EG - 64	EG - 67	EG - 69	—
Difficult to start	Engine cranks normally		12					4	7	6																
	Cold engine	7	12					1	8								4						6		3	
	Hot engine	4	10														3						6			
Engine stall	Soon after starting		9												3								6	5		8
	Others		11												6	4							7	8		10
Poor idling	Incorrect first idle		5																						2	
	High engine idle speed		9			4		6							2							7			3	
	Lower engine idle speed	7	8			2																3			6	
	Rough idling	8	15	3		11	5										9				6		7			
	Hunting at hot engine	6	12	3		9										8					5					
	Hunting at cold engine		13	3			7										6				5				8	
Poor driveability	Hesitation/Poor acceleration	15	17	2	11											7		6	5	4						
	Knocking	8	10	2						9							4								7	
	Black smoke	12	16		9					10						6			14	13			3	4	8	
	White smoke	6	13				(3)											7	5				4	2	(10)	
	Surging/Hunting	1	5														2									4

() : During warm-up

Engine (& ECT) ECU Wiring Connectors Voltage

EG

Terminals	Condition	STD Voltage (V)
BATT – E1	—	9 – 14
+B – E1	IG SW ON	9 – 14
IGSW – E1		
VC – E1	IG SW ON	4.5 – 5.5
PIM – E1	IG SW ON and apply vacuum 40 kPa (300 mmHg, 11.8 in.Hg)	0.2 – 0.8
	IG SW ON	1.3 – 1.9
	IG SW ON and apply pressure 69 kPa (0.7 kgf/cm², 10 psi)	3.2 – 3.8
VA – E1	Accelerator fully closed	0.3 – 0.8
	Accelerator fully open	3.2 – 4.9
IDL – E1	Accelerator fully closed	0 – 3
	Accelerator fully open	9 – 14
TDC+ – TDC-	Idling after warming up	Pulse generation
NE+ – NE-	Idling after warming up	Pulse generation
SP1 – E1	IG SW ON and rotate driving wheel slowly	Pulse generation
SP2+ – SP2-	IG SW ON and rotate driving wheel slowly	Pulse generation
THW – E1	Idling, Engine coolant temp. 60°C (140°F) to 120°C (248°F)	0.2 – 1.0
THA – E1	Idling, Intake air temp. 0°C (32°F) to 80°C (176°F)	0.5 – 3.4
THF – E1	IG SW ON (When engine is cold)	0.5 – 3.4
VRP – E1	IG SW ON	0.2 – 4.5
VRT – E1	IG SW ON	0.2 – 4.5

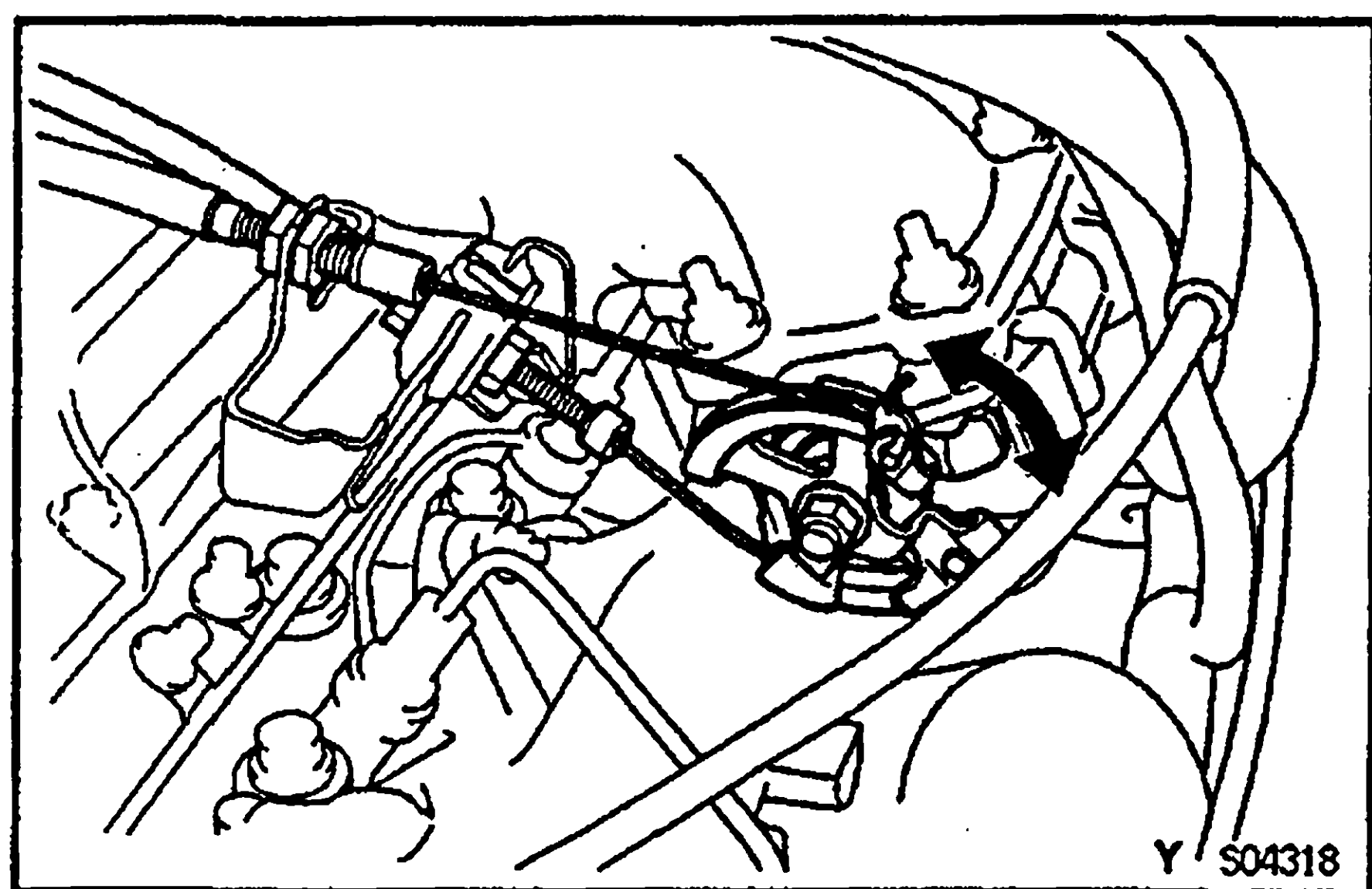
ECU Terminals

E01	TCV	SPV	S/TH1	S/TH2	TFN	L4	/	TDC+	NE+	SP2+	S1	SL	VF	TE2	VRP	THF	THW	THA	PIM	VC	STA	A/C	SP1	IMO	G-IND	OIL-W	W	STP	M-REL	S-REL	BATT
E02	/	EGR	SNW	SNWL	2	L	/	TDC-	NE-	SP2-	S2	E1	TT	TE1	VRT	THO	IDL	VA	/	E2	NSW	OD1	HSW	ACT	TAC	IMI	OD2	P	IGSW	SVR	+B

Terminals	Condition	STD Voltage (V)
SPV – E1	IG SW ON	9 – 14
	Idling after warming up	Pulse generation
TCV – E1	IG SW ON	Pulse generation
	Idling after warming up	Pulse generation
S/TH1 – E1	VSV for intake constrictor control, No.1 is OFF (IG SW ON)	9 – 14
	VSV for intake constrictor control, No.1 is ON (For 2 sec. after IG SW ON to OFF)	0 – 3
S/TH2 – E1	VSV for intake constrictor control, No.2 is OFF (Cranking)	9 – 14
	VSV for intake constrictor control, No.2 is ON (For 2 sec. after IG SW ON to OFF)	0 – 3
EGR – E1	IG SW ON	9 – 14
	EGR system is ON (Maintain engine speed at 1,500 rpm after warming up)	Pulse generation
S-REL – E1	Cranking	6 or more
	Idling after warming up (Pass 2 min. after engine start)	0 – 1.5
G-IND – E1	IG SW OFF to ON	0 – 3
	Idling after warming up	9 – 14
W – E1	Check engine warning light on (Disconnect water temp. sensor connector)	0 – 3
	No trouble (Check engine warning light off) and idling	9 – 14
STA – E1	Cranking	6 or more
NSW – E1	IG SW ON and shift position in "P" or "N" position	0 – 3
	IG SW ON and other shift position in "P" or "N" position	9 – 14
IMI – E1	Idling	Pulse generation
IMO – E1	A few seconds after engine starting	Pulse generation
A/C – E1	A/C ON (Magnitic clutch ON)	9 – 14
	A/C OFF	0 – 3

Terminals	Condition	STD Voltage (V)
ACT - E1	IG SW ON	9 - 14
	At A/C cut control (Driving at 30 km / h (48 mph) or less, For 5 sec. after accelerator fully open)	0 - 3
M-REL - E1	IG SW ON	9 - 14
	Pass 2 sec. or more after IG SW ON to OFF	0 - 1.5
SVR - E1	IG SW ON	0 - 1.5
TAC - E1	Idling after warming up	Pulse generation
VF - E1	Connect terminals TE1 and E1 of check connector (Diagnosis is no trouble)	4.5 - 5.5
	Disconnect water temp. sensor connector and terminals TE1 and E1 of check connector (Diagnosis is abnormal)	0 - 1
HSW - E1	Maintain heater idle - up switch ON	0 - 3
	Others	9 - 14
STP - E1	Stop light switch ON	7.5 - 14
	Stop light switch OFF	0 - 1.5
OIL-W - E1	When engine is cold	9 - 14
THO - E1	During warming up	0.2 - 4.5
TE1 TE2 - E1	IG SW ON	9 - 14
	Connect terminals TE1, TE2 and E1 of check connector (Test mode)	0 - 3

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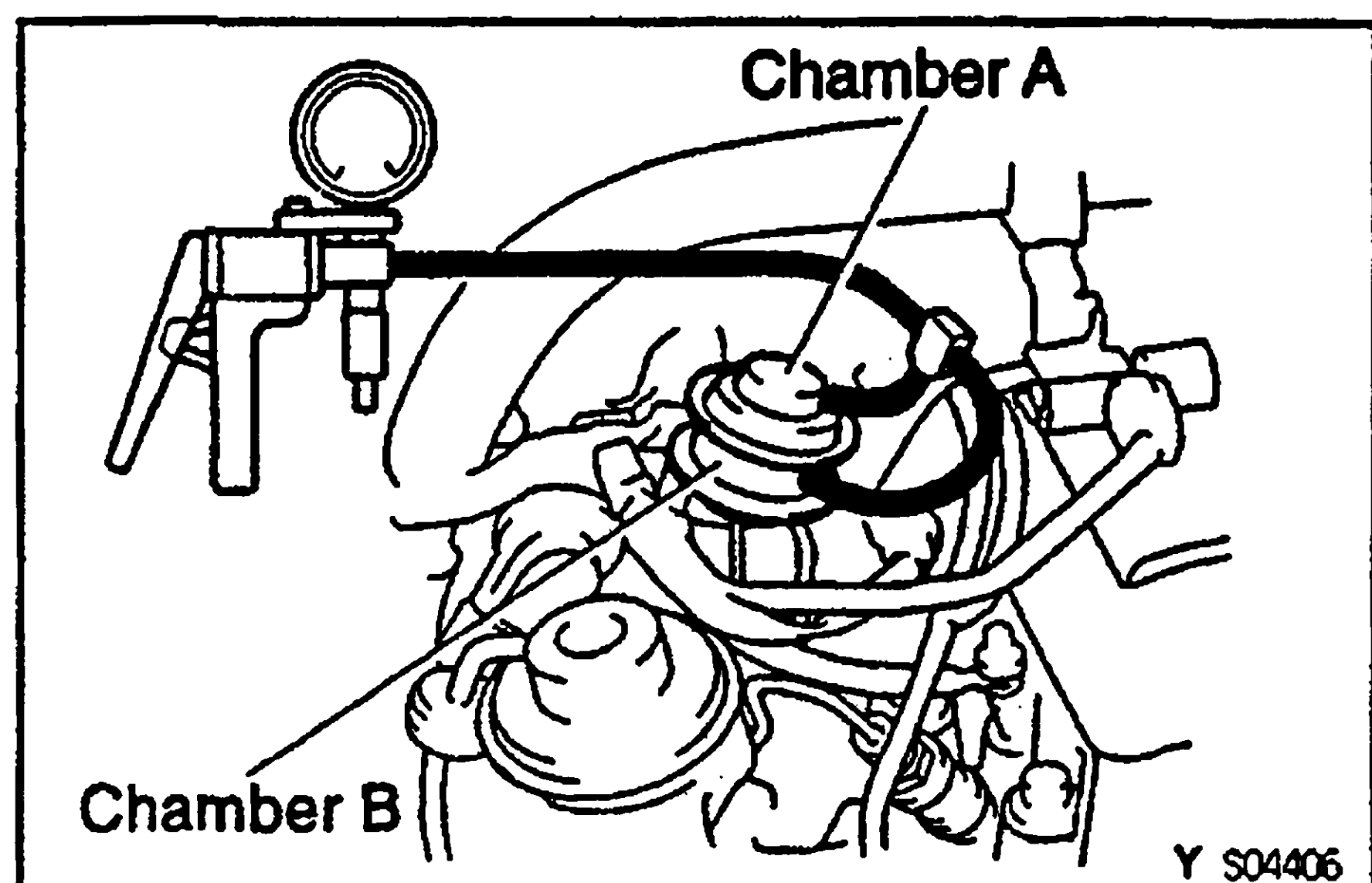


VENTURI ON—VEHICLE INSPECTION

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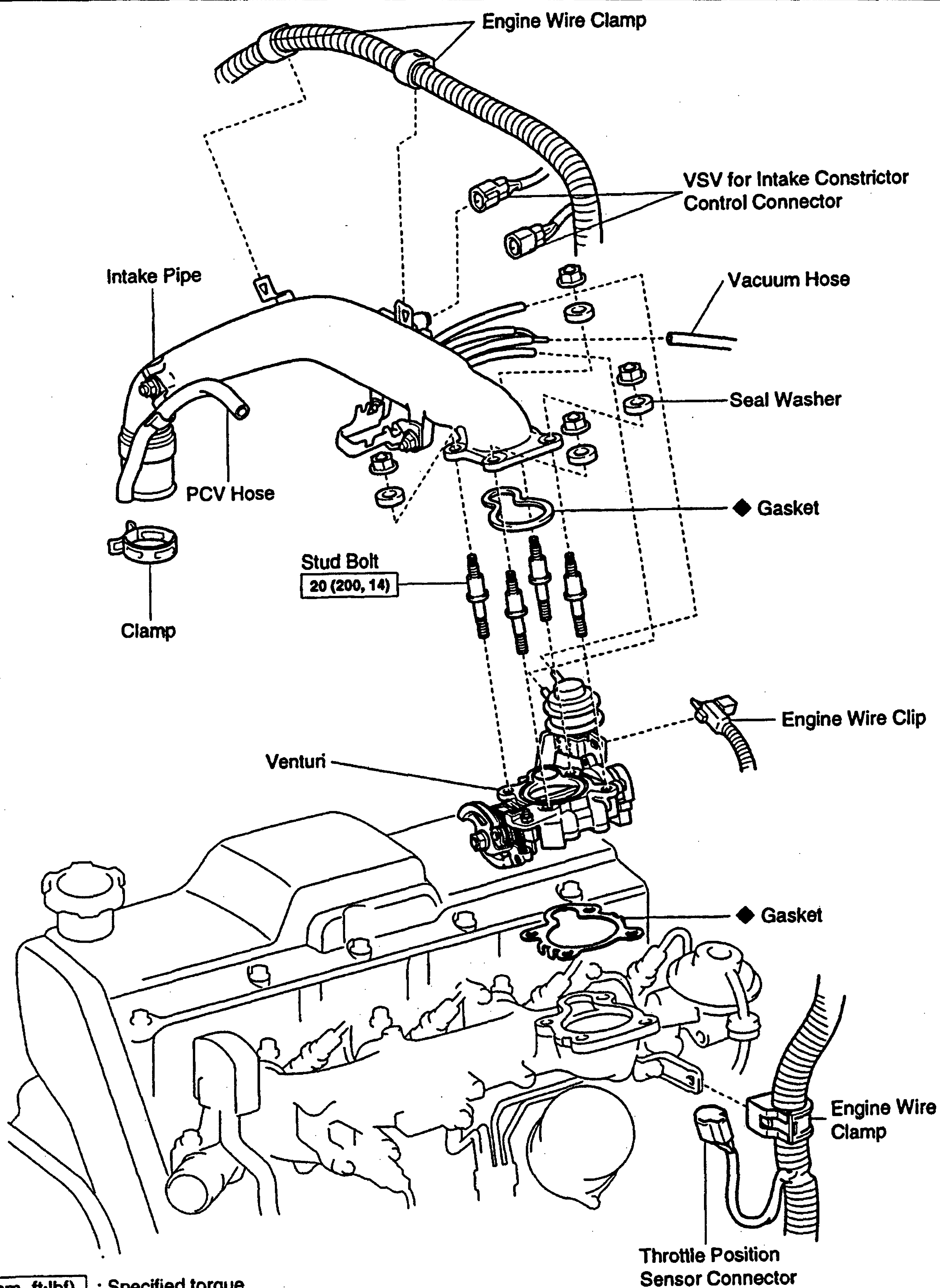
INSPECT VENTURI OPERATION

- (a) Check that the throttle linkage moves smoothly.



- (b) Check that the diaphragm rod is pulled up when a vacuum of approx. 60 kPa (450 mmHg, 17.72 in. Hg) is applied to the actuator B.
- (c) Start the engine.
- (d) Using a 3-way connector, apply approx. 60 kPa (450 mmHg, 17.72 in.Hg) of vacuum directly to the chambers A and B with the engine idling.
- (e) Check that the engine runs rough or dies.
- (f) Reconnect the vacuum hoses to the proper locations.

COMPONENTS FOR REMOVAL AND INSTALLATION

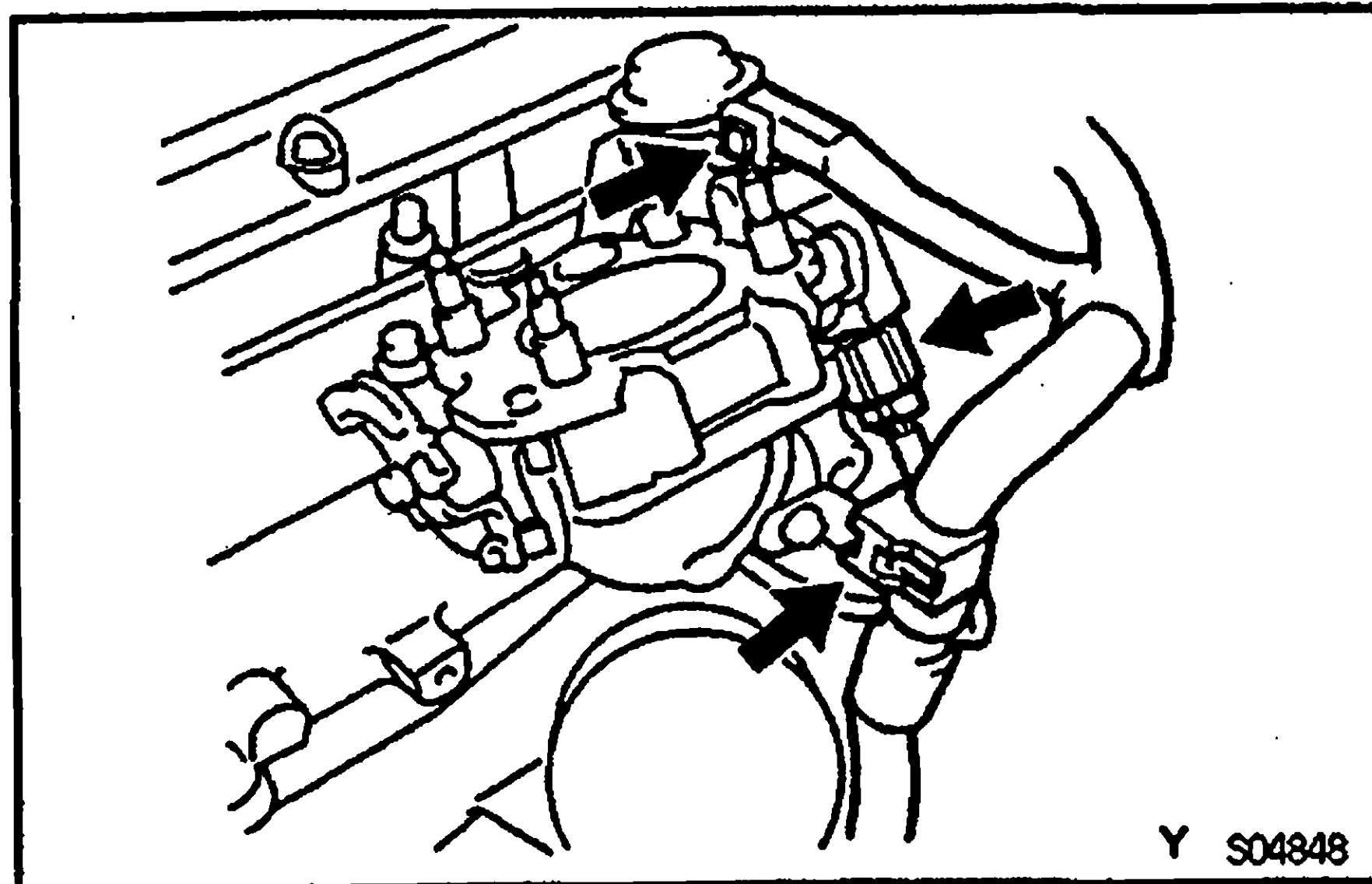


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

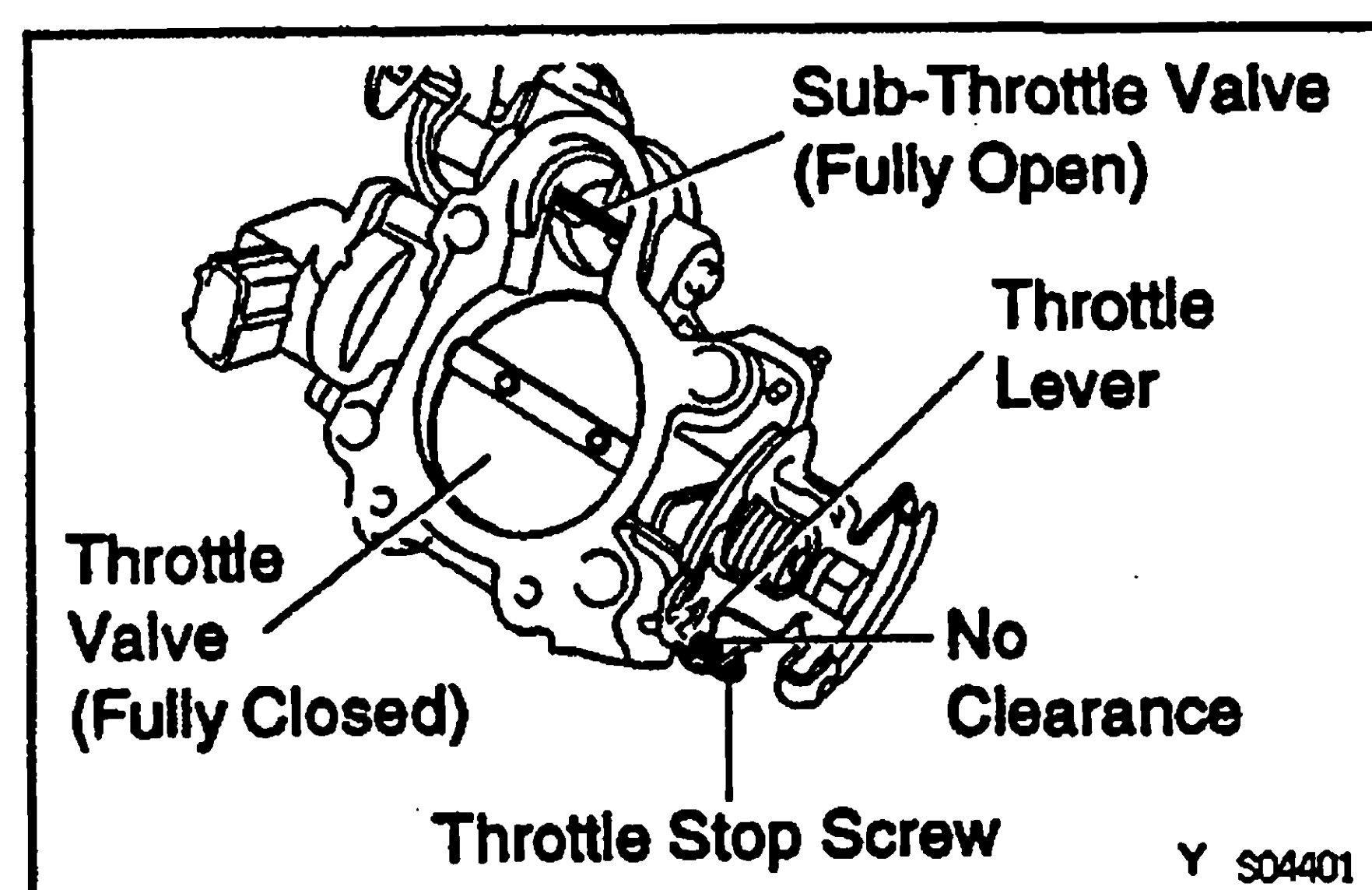
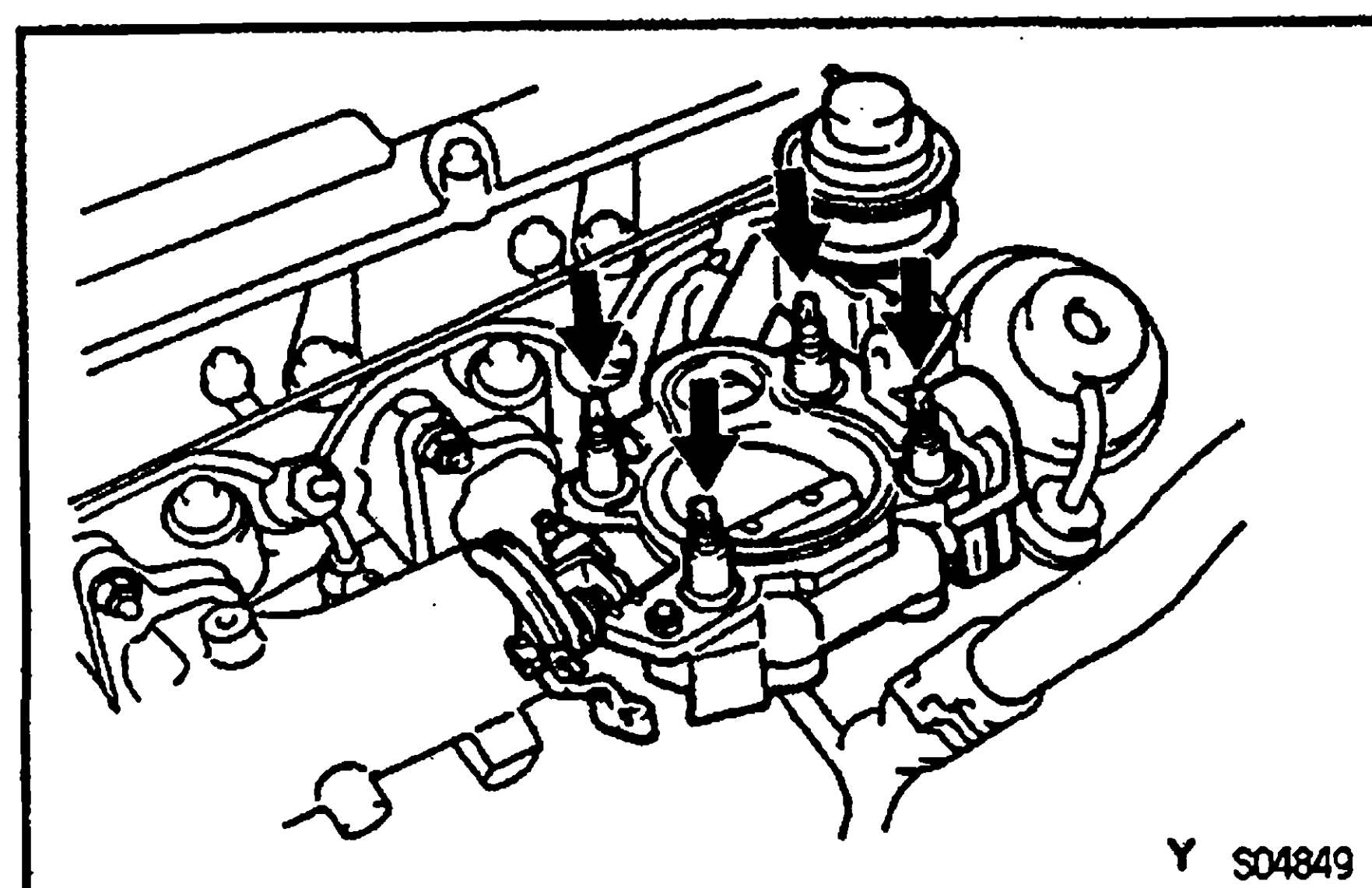
Y

S05386



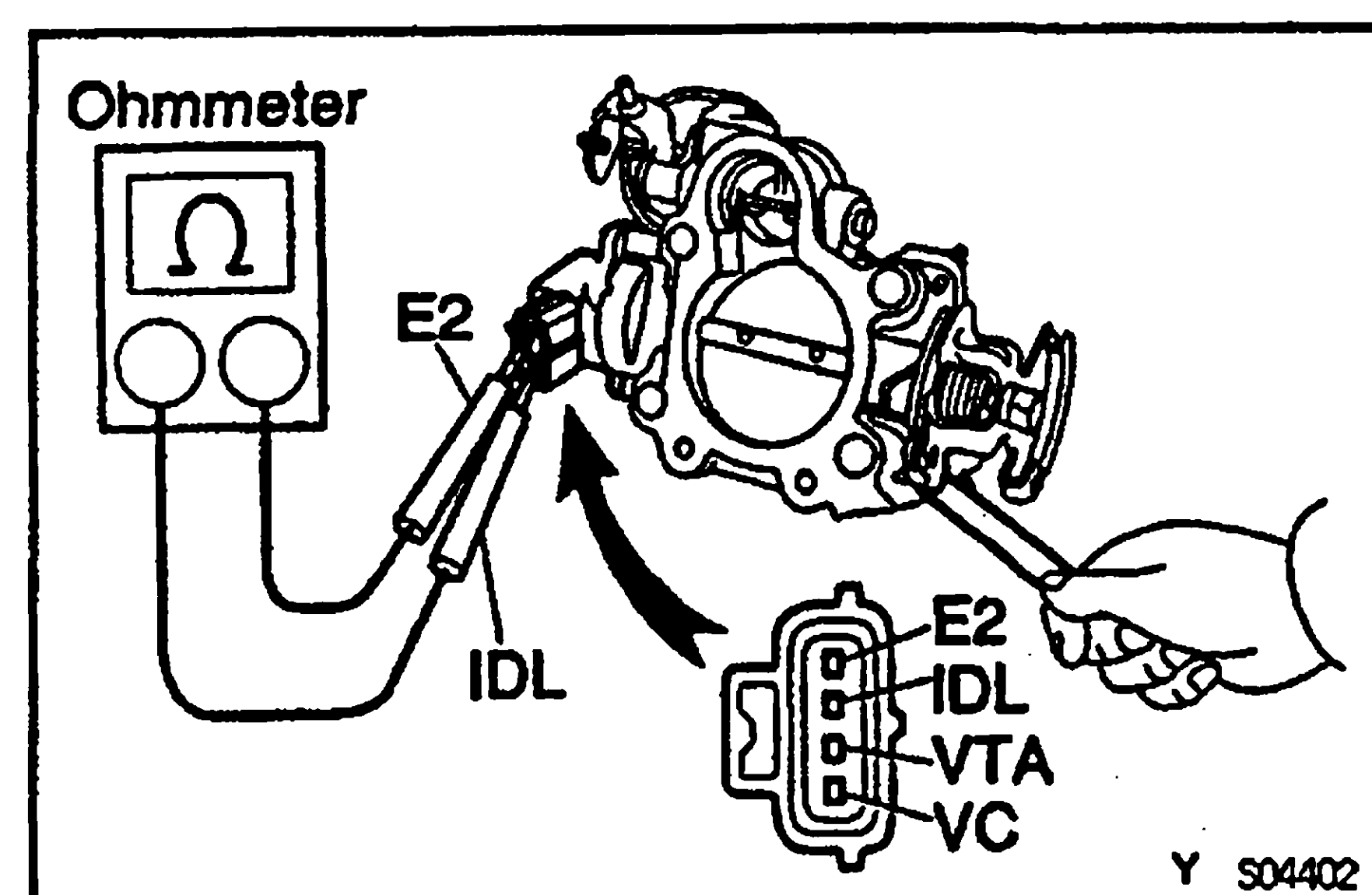
VENTURI REMOVAL

1. **REMOVE INTAKE PIPE**
(See step 2 in cylinder head removal in Engine Mechanical)
 2. **REMOVE VENTURI**
 - (a) Disconnect the throttle position sensor connector.
 - (b) Disconnect the engine wire clamp and clip from the venturi.
 - (c) Remove the 4 stud bolts, venturi and gasket.
- INSTALLATION HINT:** Place a new gasket on the intake manifold.
Torque: 20 N·m (200 kgf·cm, 14 ft·lbf)



VENTURI INSPECTION

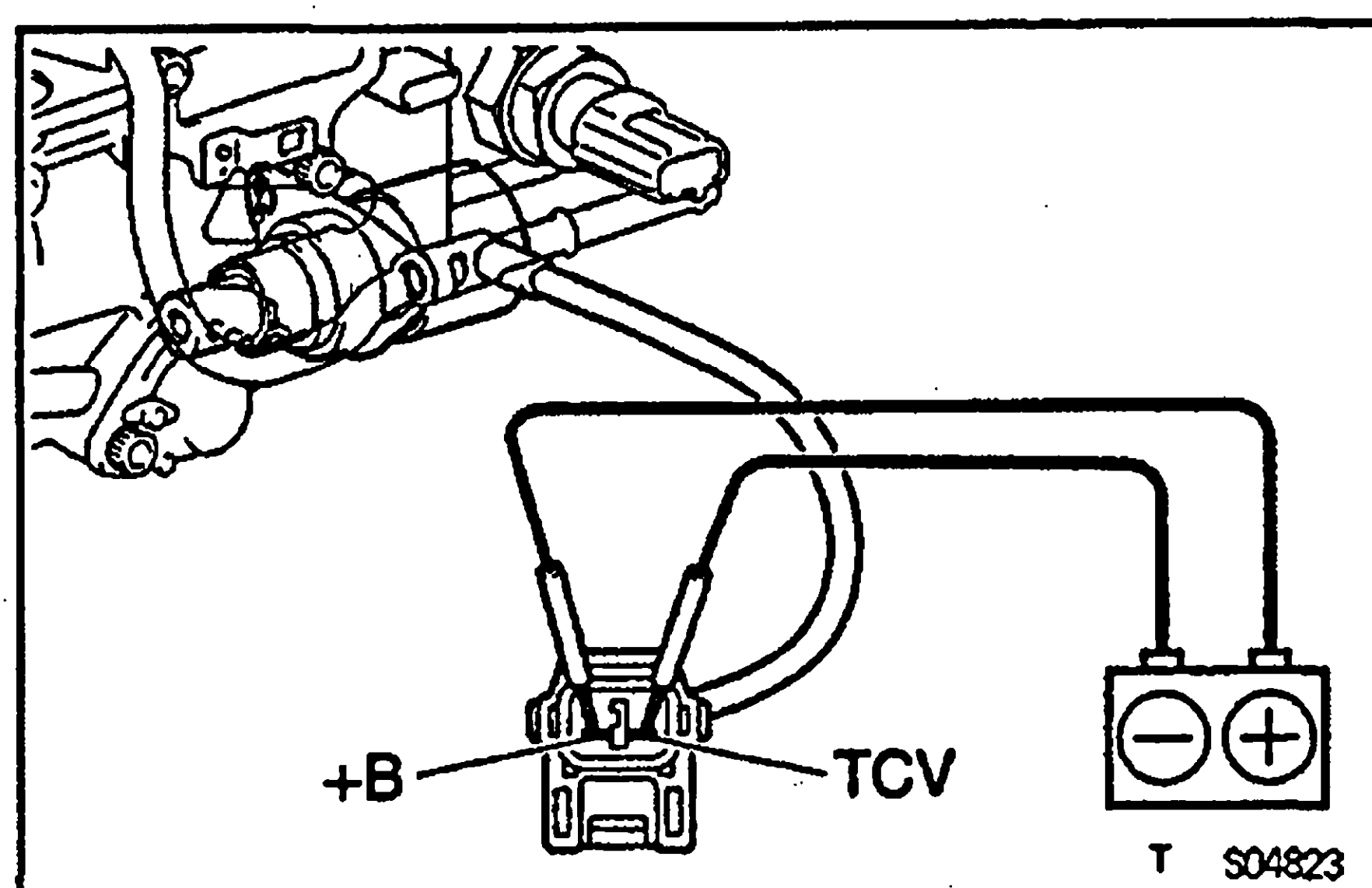
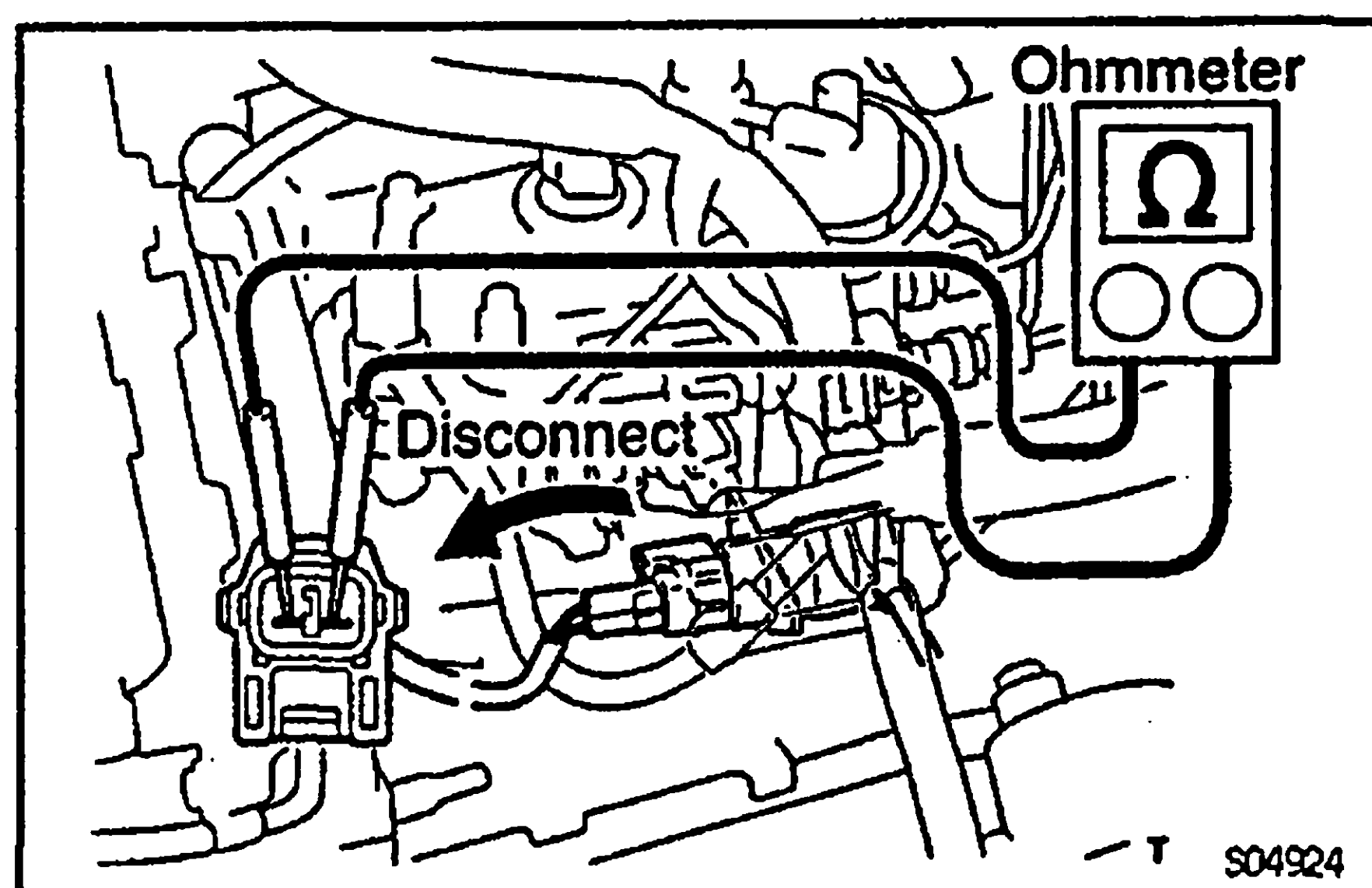
1. **INSPECT VENTURI VALVE**
 - (a) Check that there is no clearance between the throttle stop screw and throttle lever when the throttle valve is fully closed.
 - (b) Check that the sub-throttle valve is fully open.
2. **INSPECT THROTTLE POSITION SENSOR**
 - (a) Insert a feeler gauge between the throttle stop screw and stop lever.
 - (b) Using an ohmmeter, measure the resistance between each terminal.



Clearance between lever and stop screw	Between terminals	Resistance
0 mm (0 in.)	VTA — E2	0.2 — 5.8 kΩ
0 mm (0 in.)	IDL — E2	2.3 kΩ or less
1.6 mm (0.06 in.)	IDL — E2	Infinity
Throttle valve fully open	VTA — E2	1.4 — 9.5 kΩ
—	VC — E2	2.5 — 5.9 kΩ

VENTURI INSTALLATION

Installation is in the reverse order removal.



TIMING CONTROL VALVE ON-VEHICLE INSPECTION

EG64T-08

1. **DISCONNECT TIMING CONTROL VALVE CONNECTOR**
2. **INSPECT TIMING CONTROL VALVE RESISTANCE**
Using an ohmmeter, measure the resistance between terminals.

Resistance:

10 – 14 Ω at 20°C (68°F)

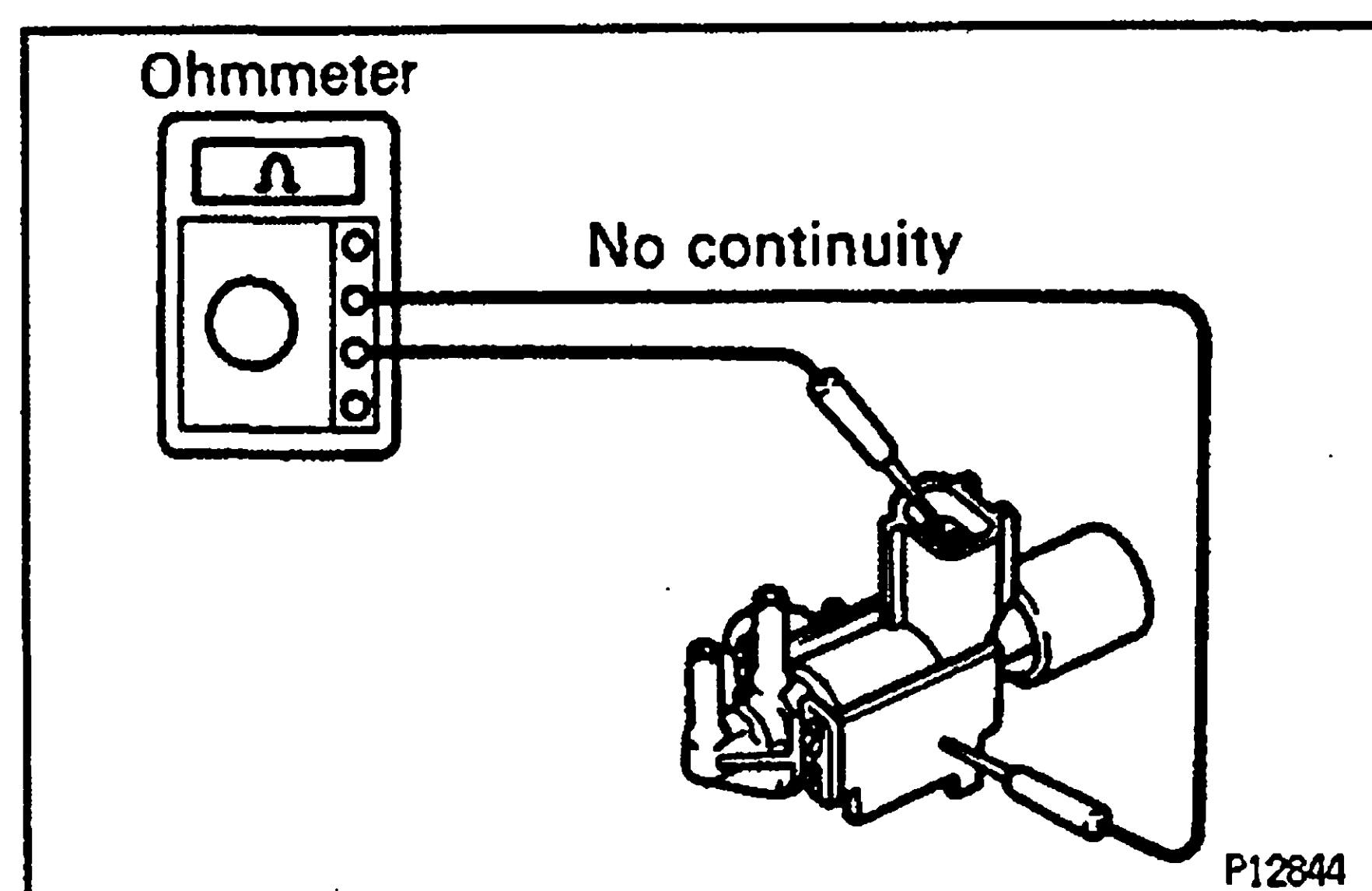
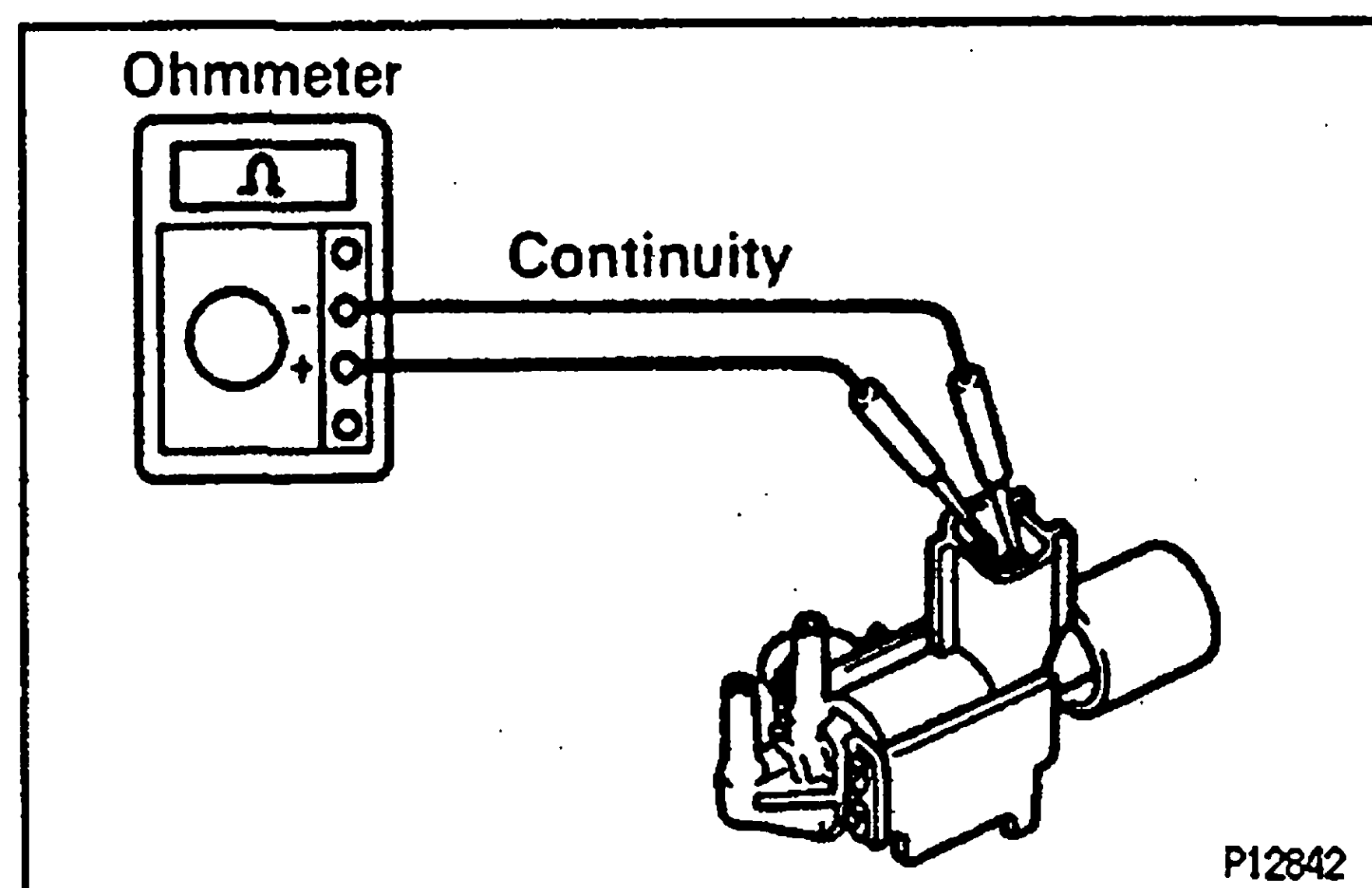
If the resistance is not as specified, replace the timing control valve.

3. **INSPECT VALVE SOLENOID OPERATION**
 - (a) Connect the battery positive terminal to the valve terminal +B.
 - (b) Connect the battery negative terminal to the valve terminal TCV.
 - (c) Check that the solenoid makes a 'clicks' sound.
If operation is not as specified, replace the timing control valve.

NOTICE:

- Do not apply voltage for more than 30 seconds to avoid burning out the solenoid.
- If repeating this step, wait until the solenoid coils down enough that it can be touched by hand.

4. **RECONNECT TIMING CONTROL VALVE CONNECTOR**



VSV FOR INTAKE CONSTRICTOR CONTROL VSV INSPECTION

EG7FM-01

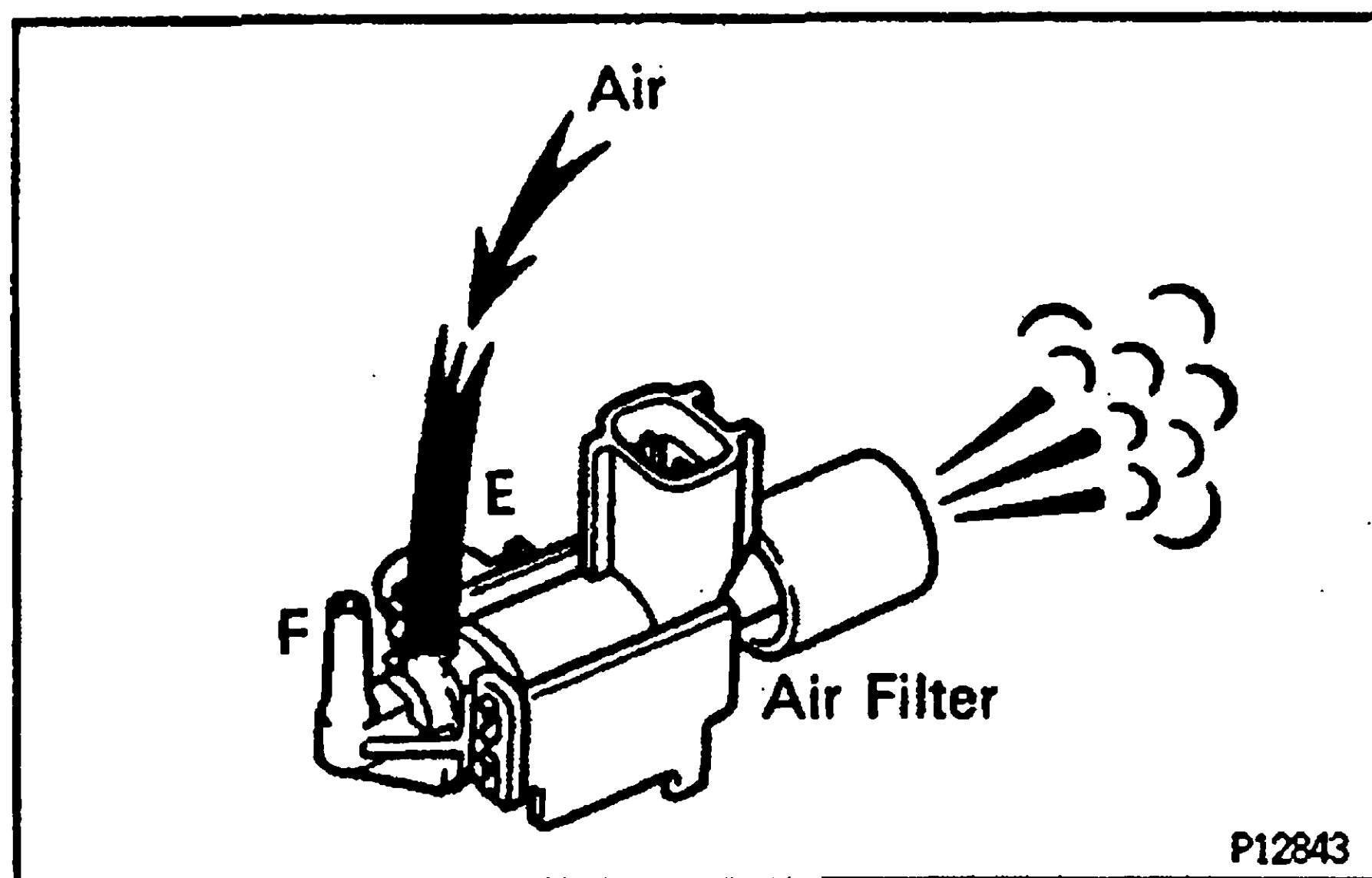
1. **REMOVE VSV**
2. **INSPECT VSV**
 - A. **Inspect VSV for open circuit**
Using an ohmmeter, check that there is continuity between the terminals.

Resistance :

38.5 – 44.5 Ω at 20°C (68°F)

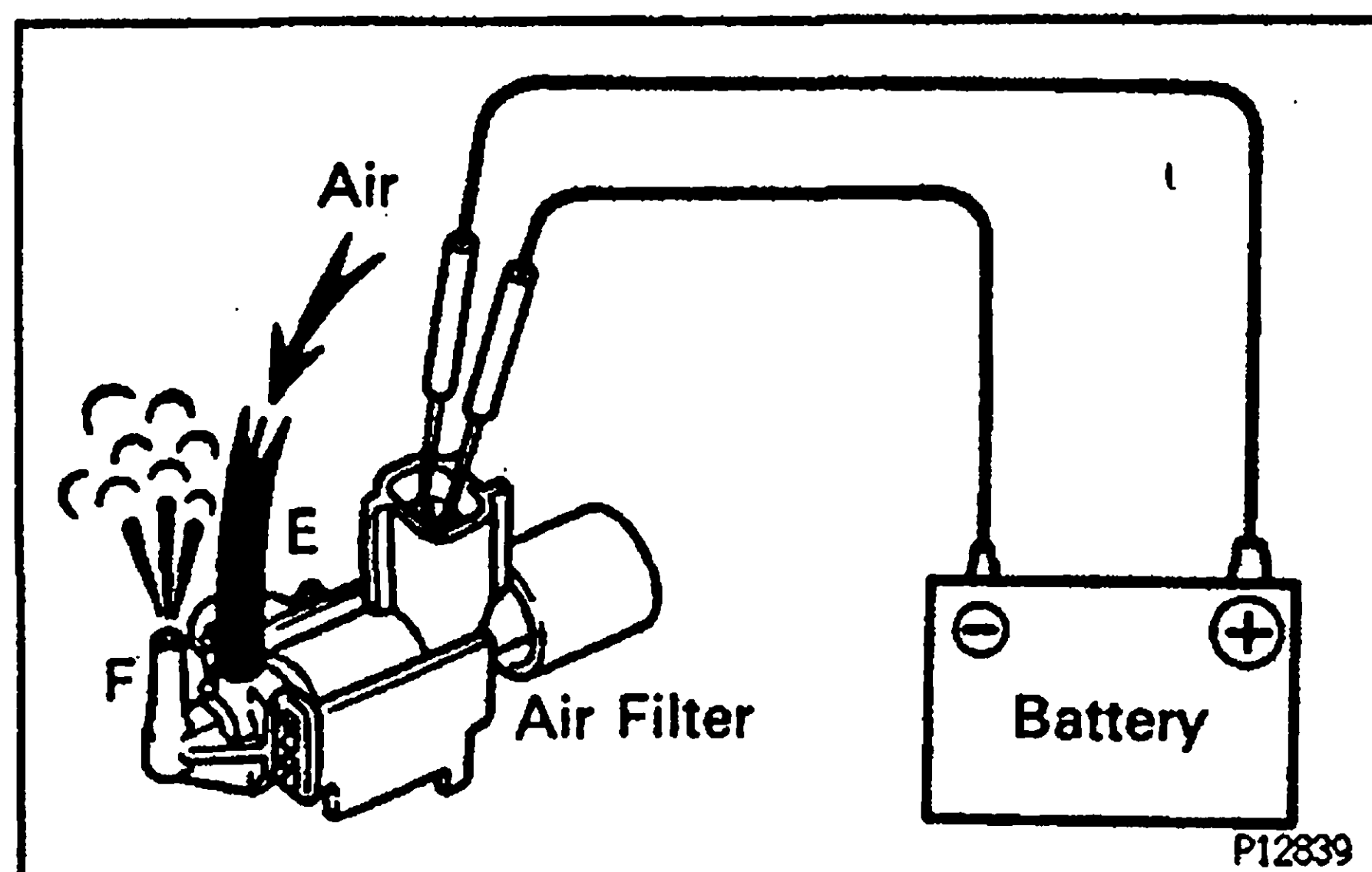
If there is no continuity, replace the VSV.

- B. **Inspect VSV for ground**
Using an ohmmeter, check that there is no continuity between each terminal and the body.
If there is continuity, replace the VSV.



C. Inspect VSV operation

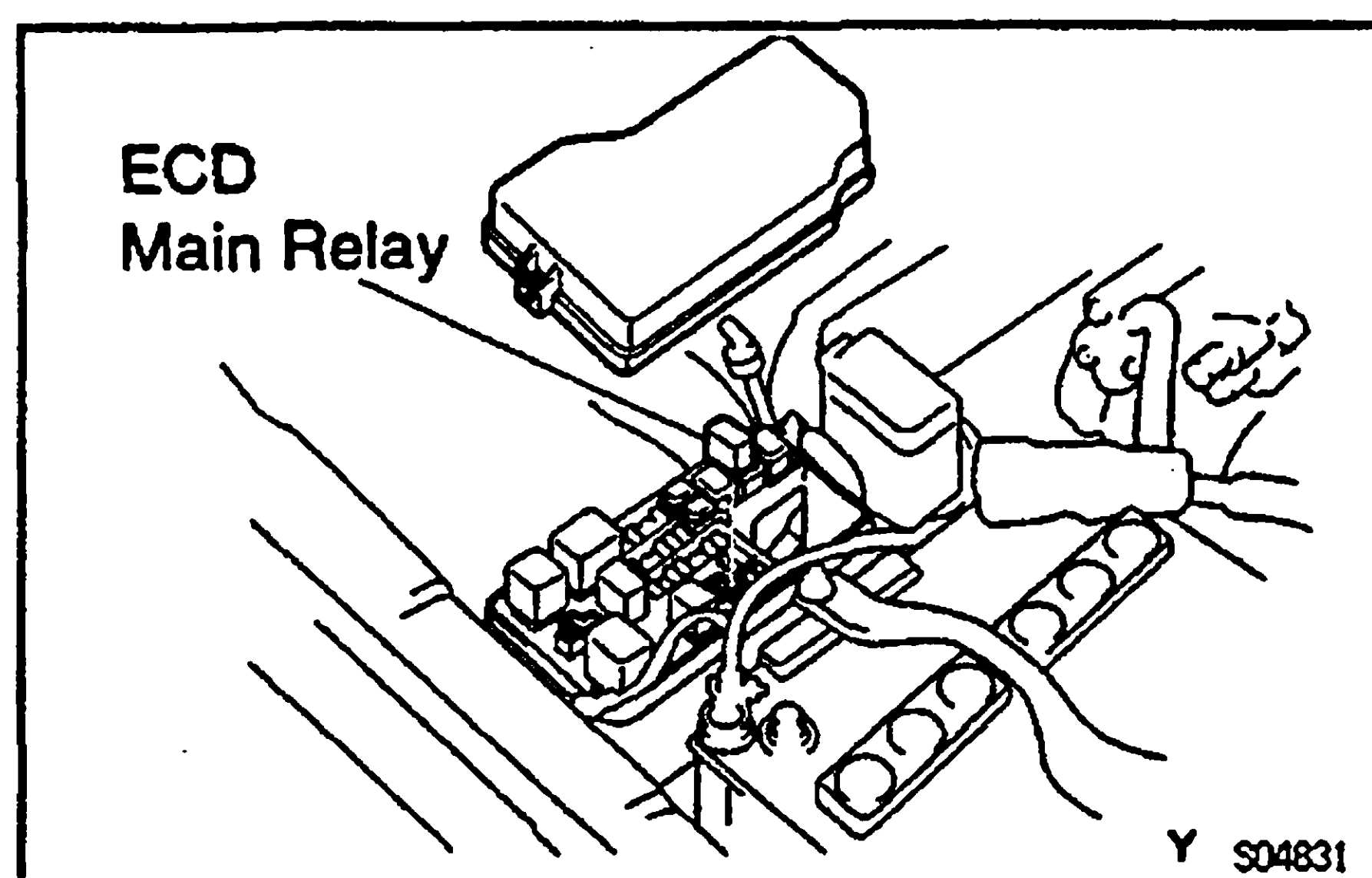
- (a) Check that air flows from pipe E to the filter.



- (b) Apply battery positive voltage across the terminals.

- (c) Check that air flows from pipe E to F.
If operation is not as specified, replace the VSV.

3. REINSTALL VSV

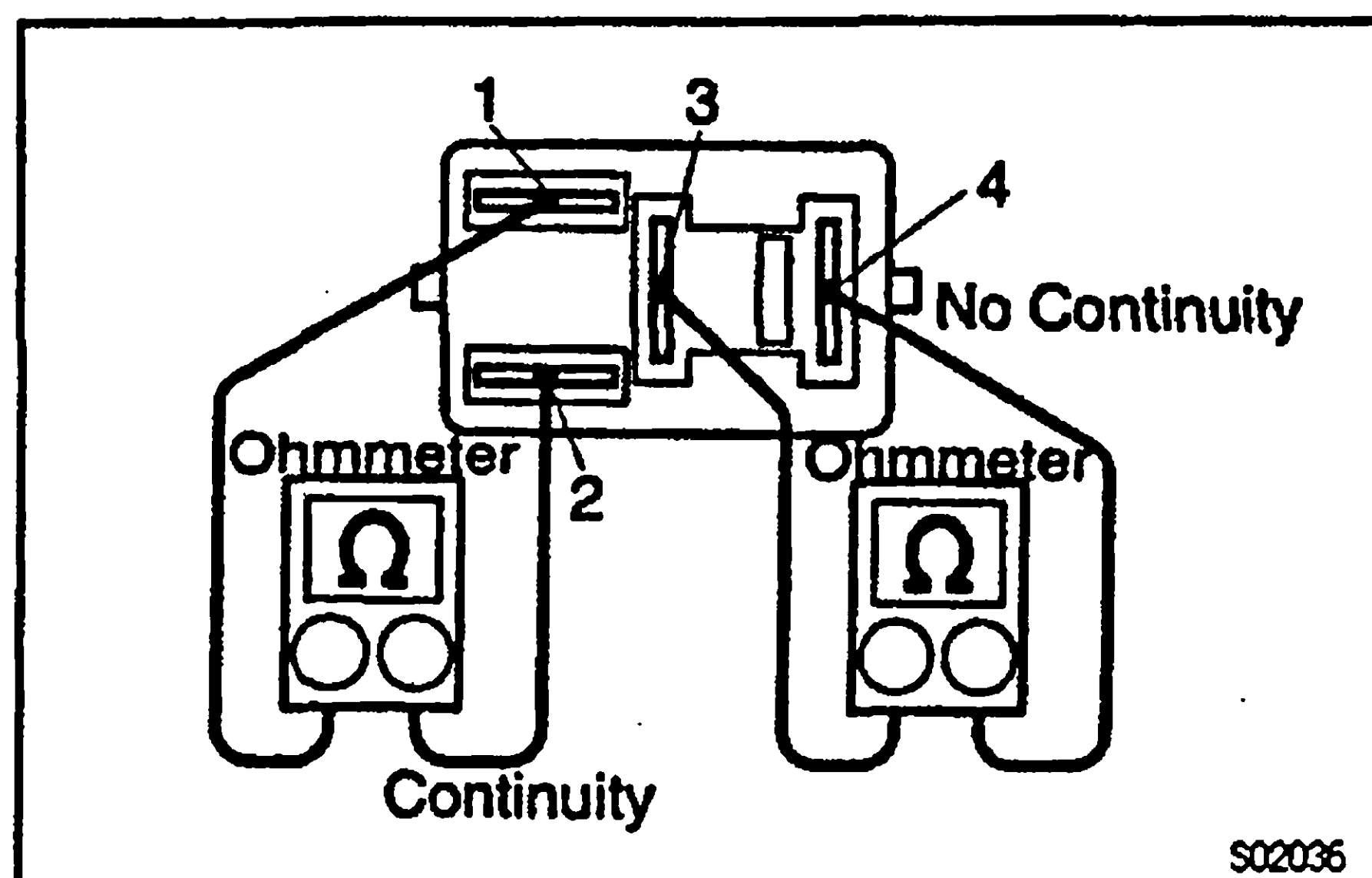


ECD MAIN RELAY

ECD MAIN RELAY INSPECTION

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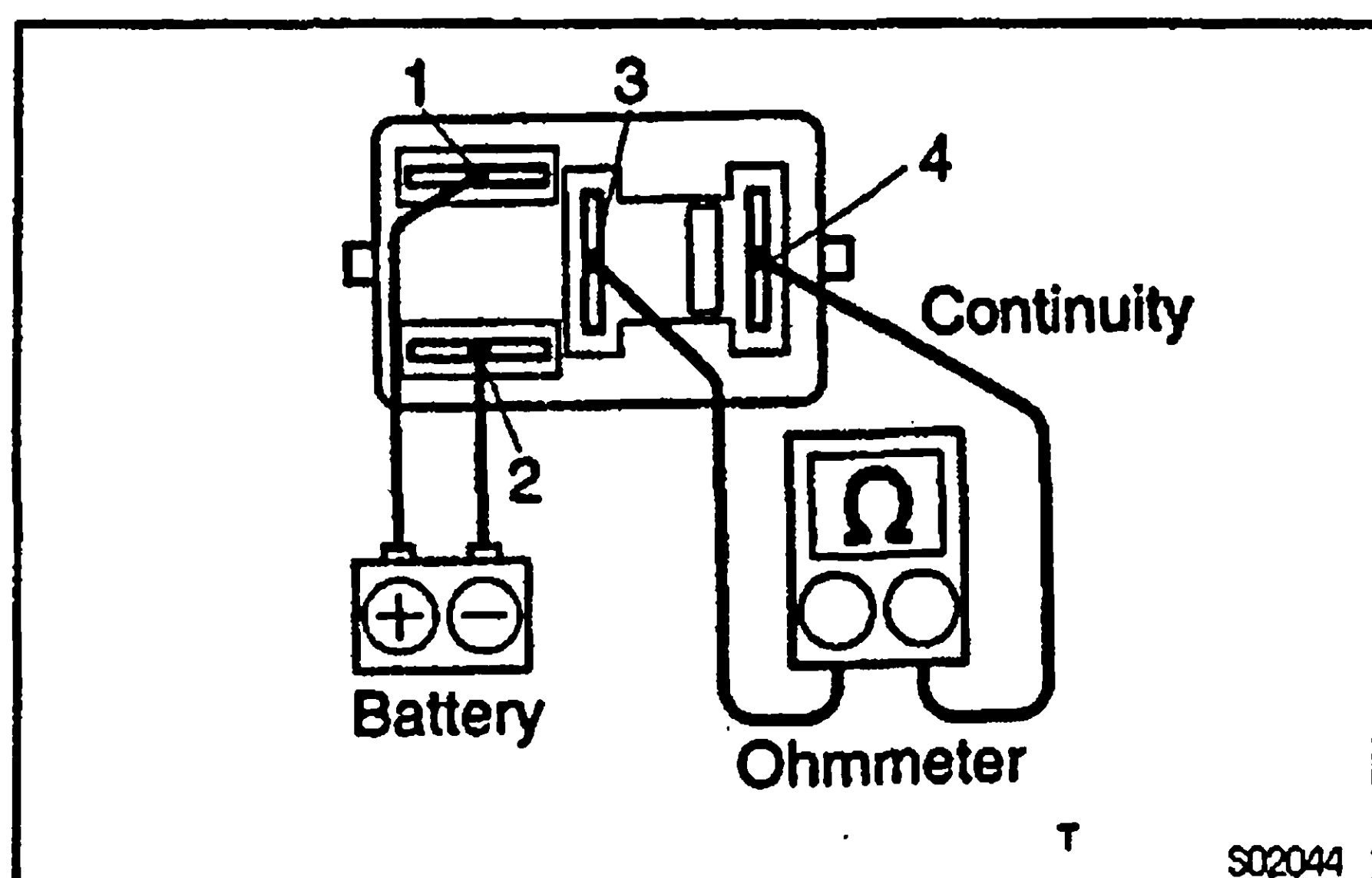
1. REMOVE ENGINE ROOM R/B COVER
2. REMOVE ECD MAIN RELAY



3. INSPECT ECD MAIN RELAY

A. Inspect relay continuity

- (a) Using an ohmmeter, check that there is continuity between terminals 1 and 2.
If there is no continuity, replace the relay.
- (b) Check that there is no continuity between terminals 3 and 4.
If there is continuity, replace the relay.

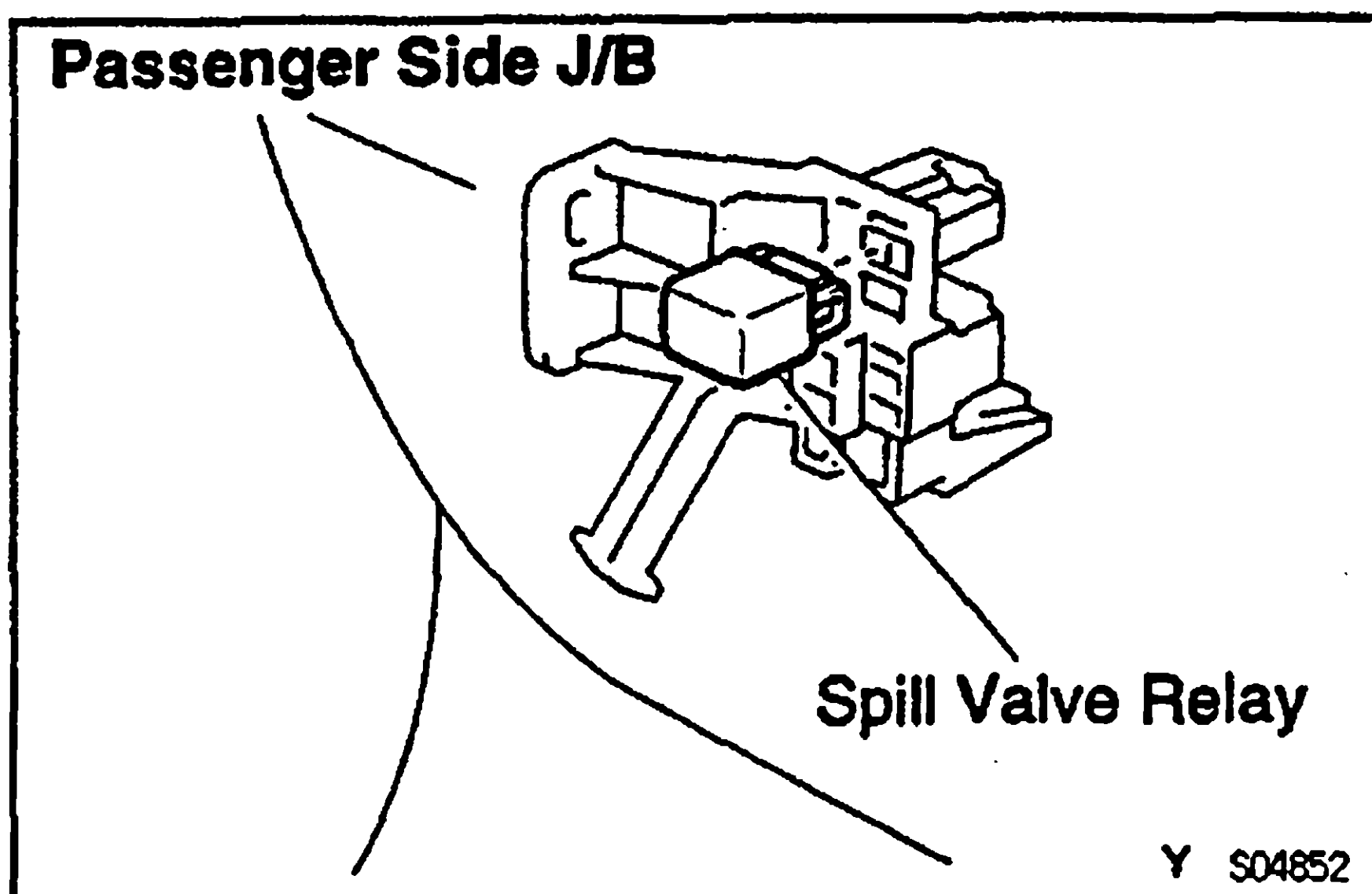


B. Inspect relay operation

- (a) Apply battery positive voltage across terminals 1 and 2.
- (b) Using an ohmmeter, check that there is continuity between terminals 3 and 4.
If there is no continuity, replace the relay.

4. REINSTALL ECD MAIN RELAY

5. REINSTALL ENGINE ROOM R/B COVER



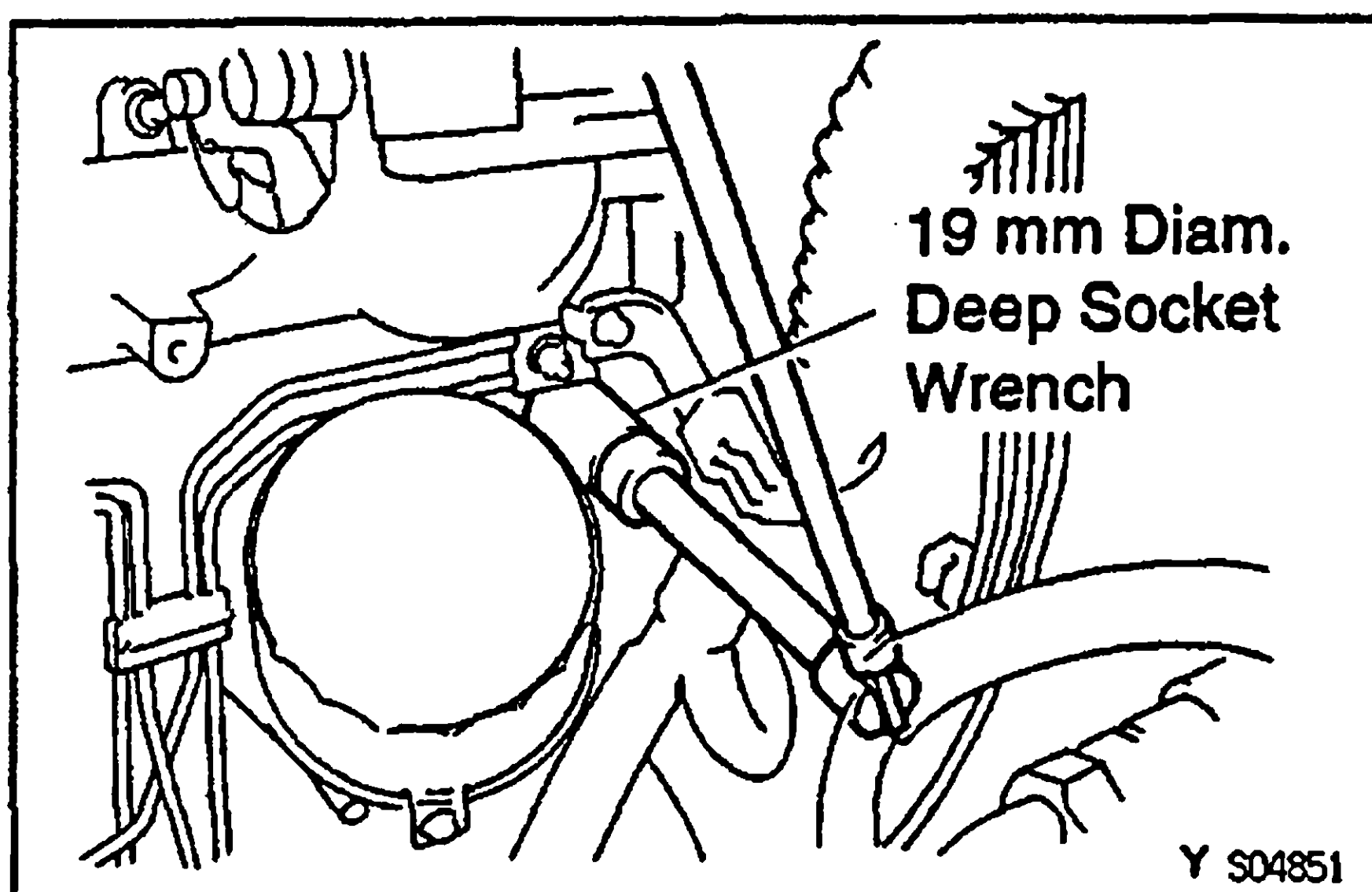
SPILL VALVE RELAY

SPILL VALVE RELAY INSPECTION

EG7FM-01

1. REMOVE PASSENGER SIDE TRIM
2. REMOVE SPILL VALVE RELAY
3. INSPECT SPILL VALVE RELAY
(See ECD main relay inspection)
4. REINSTALL SPILL VALVE RELAY
5. REINSTALL PASSENGER SIDE TRIM

EG



WATER TEMPERATURE SENSOR

WATER TEMPERATURE SENSOR INSPECTION

EG16L-03

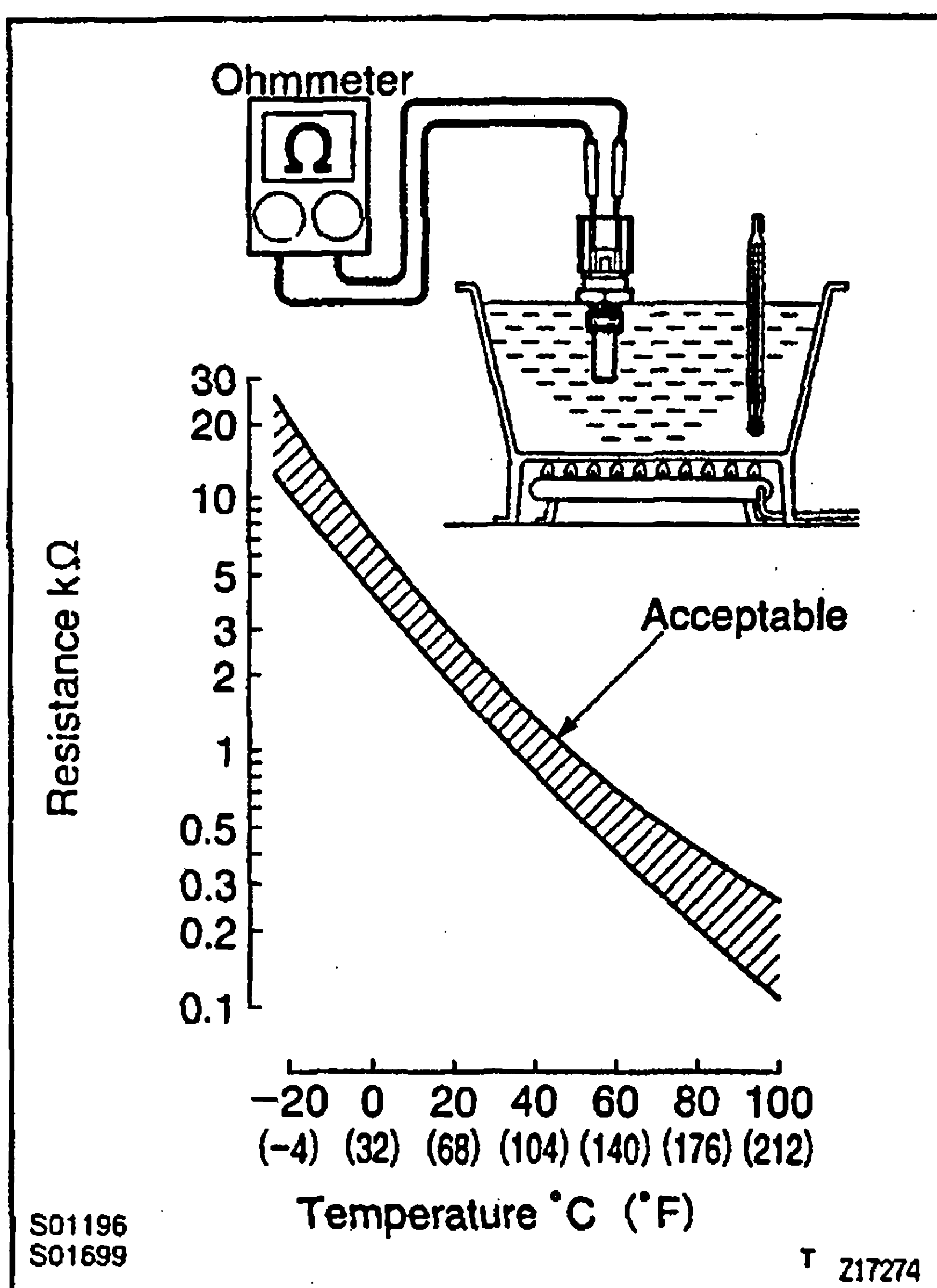
1. DRAIN ENGINE COOLANT
2. REMOVE WATER TEMPERATURE SENSOR
 - (a) Disconnect the sensor connector.
 - (b) Using a 19 mm diam. deep socket wrench, remove the sensor and gasket.
3. INSPECT WATER TEMPERATURE SENSOR

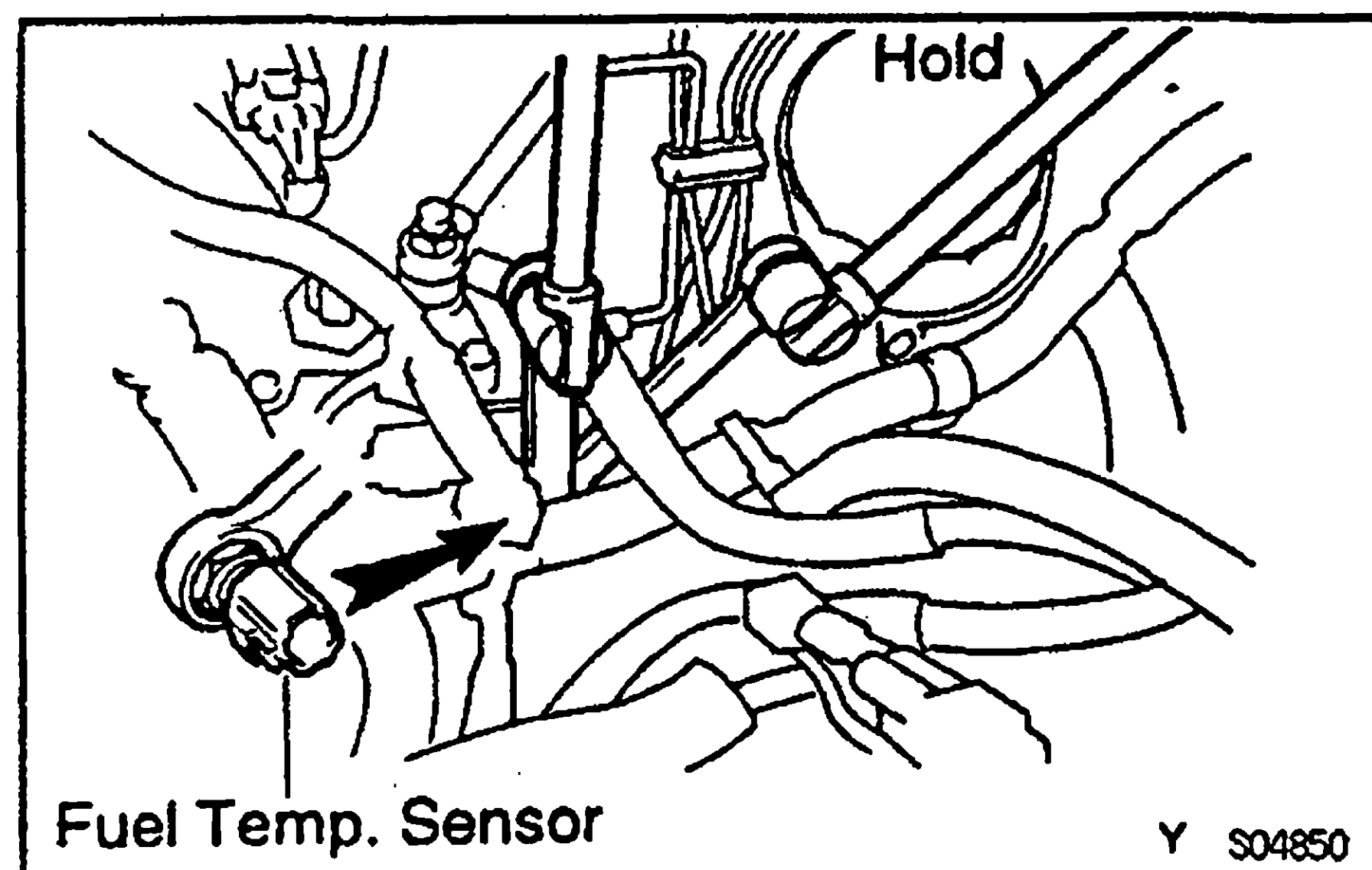
Using an ohmmeter, measure the resistance between the terminals.

Resistance:

Refer to the chart graph

If the resistance is not as specified, replace the water temperature sensor.
4. REINSTALL WATER TEMPERATURE SENSOR
 - (a) Using a 19 mm diam. deep socket wrench, install a new gasket and the sensor
Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)
 - (b) Connect the sensor connector.
5. REFILL WITH ENGINE COOLANT

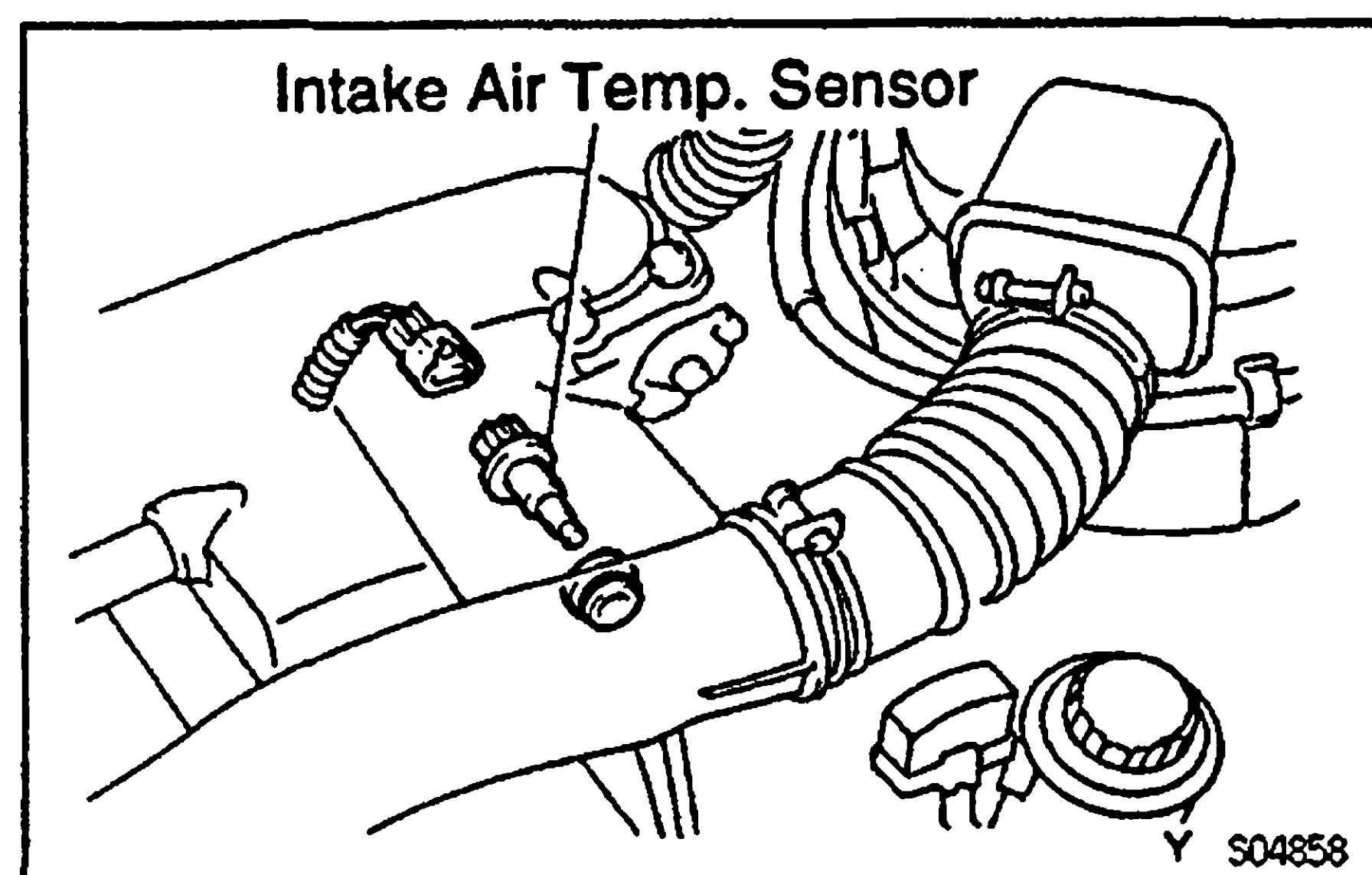




FUEL TEMPERATURE SENSOR FUEL TEMPERATURE SENSOR INSPECTION

EG7FP-01

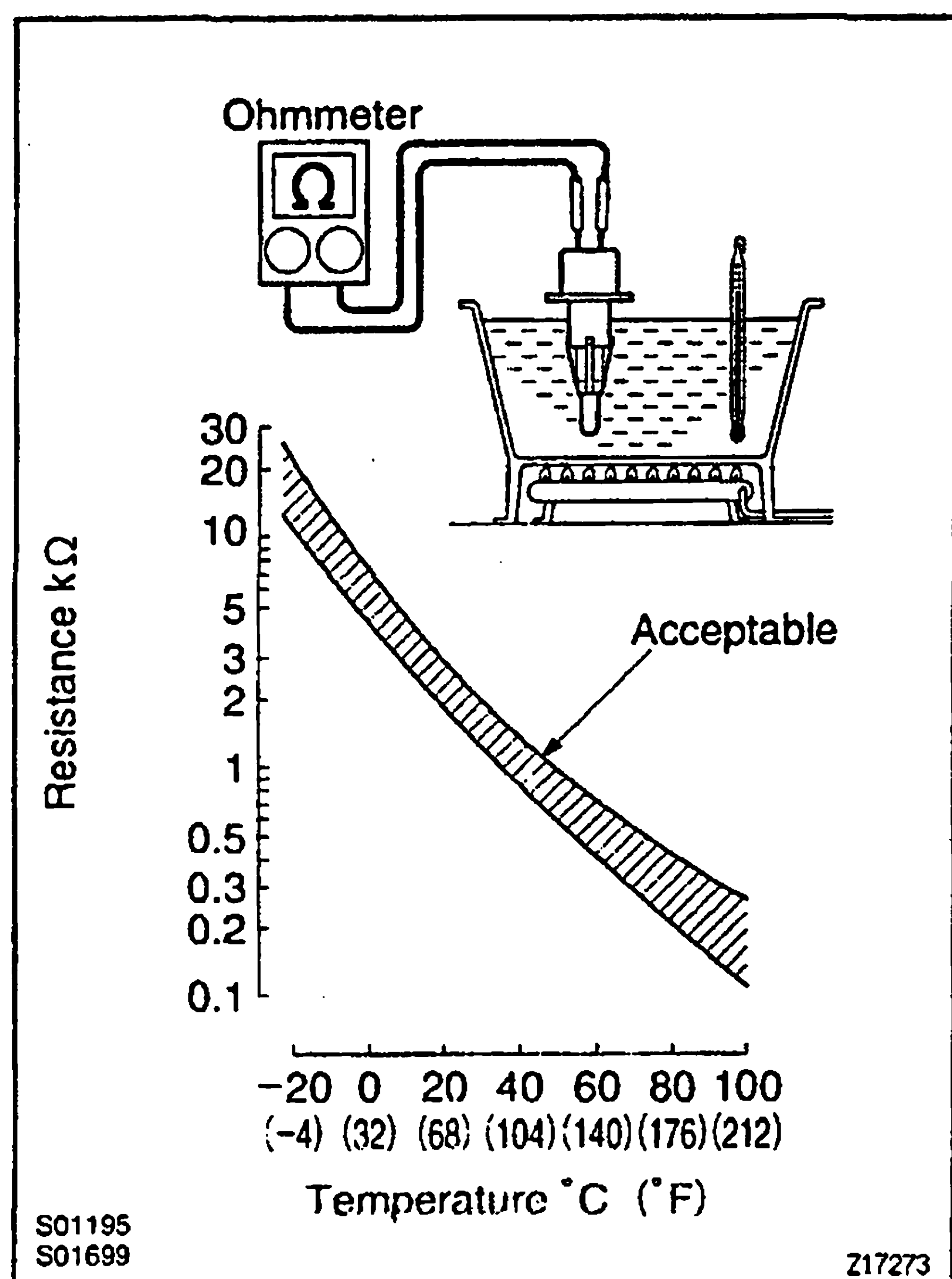
1. REMOVE FUEL TEMPERATURE SENSOR
 - (a) Put a suitable container or shop towel under the injection pump.
 - (b) Hold the distributive head plug, remove the sensor.
2. INSPECT FUEL TEMPERATURE SENSOR
(See water temperature sensor inspection)
3. REINSTALL FUEL TEMPERATURE SENSOR
Torque: 21.6 N·m (220 kgf·cm, 16.5 ft·lbf)

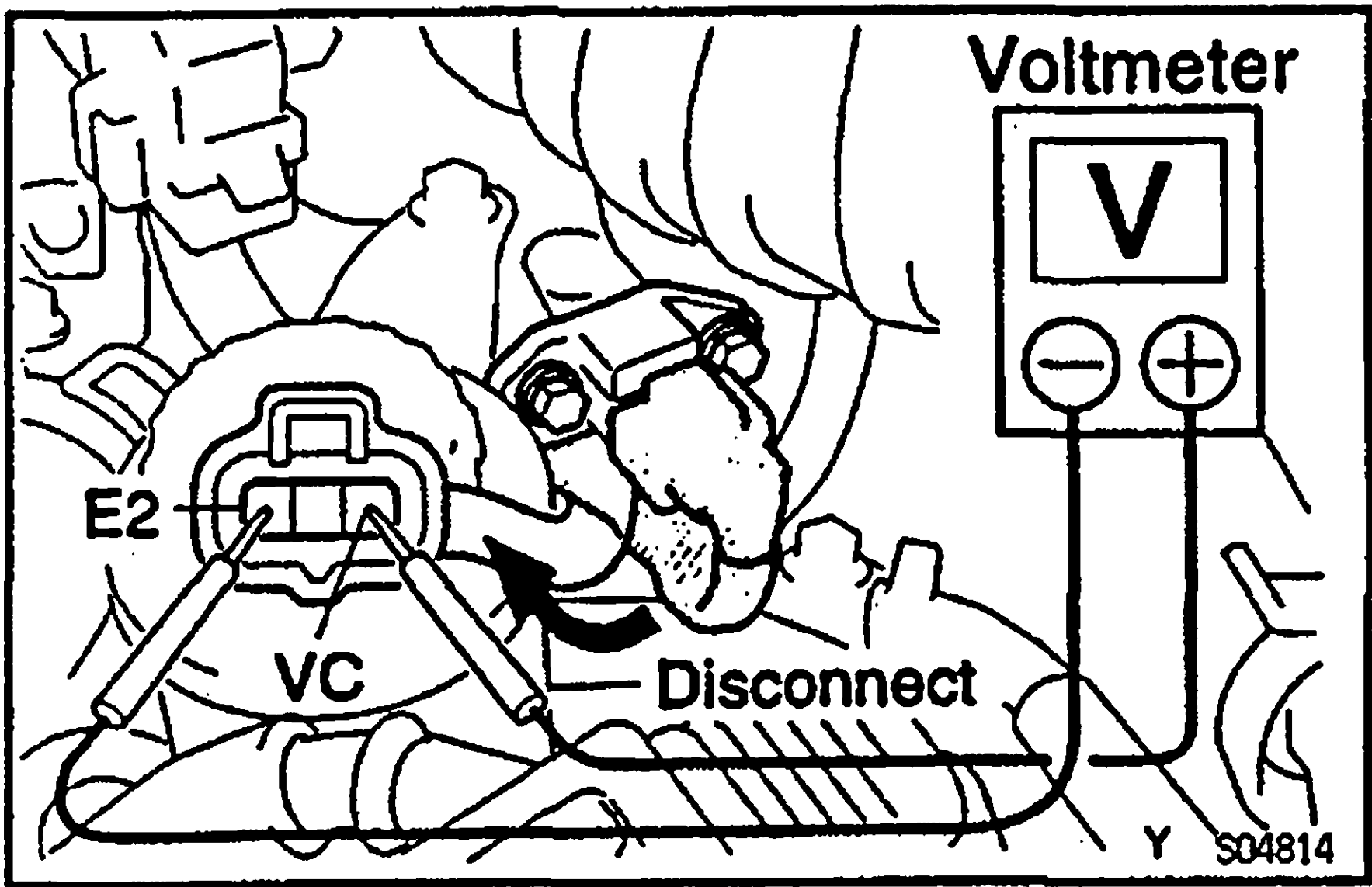


INTAKE AIR TEMPERATURE SENSOR INTAKE AIR TEMPERATURE SENSOR INSPECTION

EG7FQ-01

1. REMOVE INTAKE AIR TEMPERATURE SENSOR
2. INSPECT INTAKE AIR TEMPERATURE SENSOR
Using an ohmmeter, measure the resistance between the terminals.
Resistance:
Refer to the chart graph
If the resistance is not as specified, replace the sensor.
3. REINSTALL INTAKE AIR TEMPERATURE SENSOR

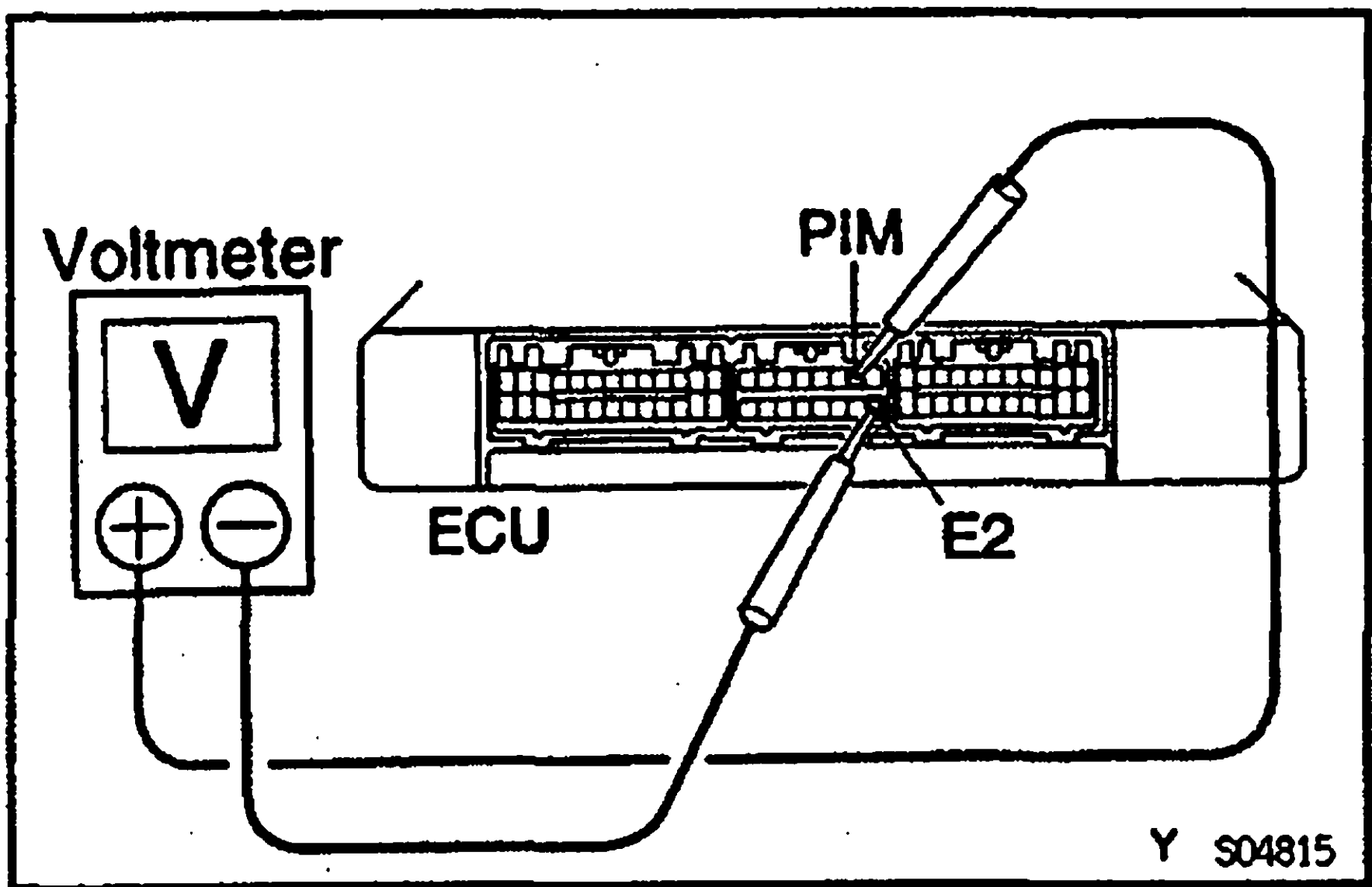




TURBO PRESSURE SENSOR

TURBO PRESSURE SENSOR INSPECTION

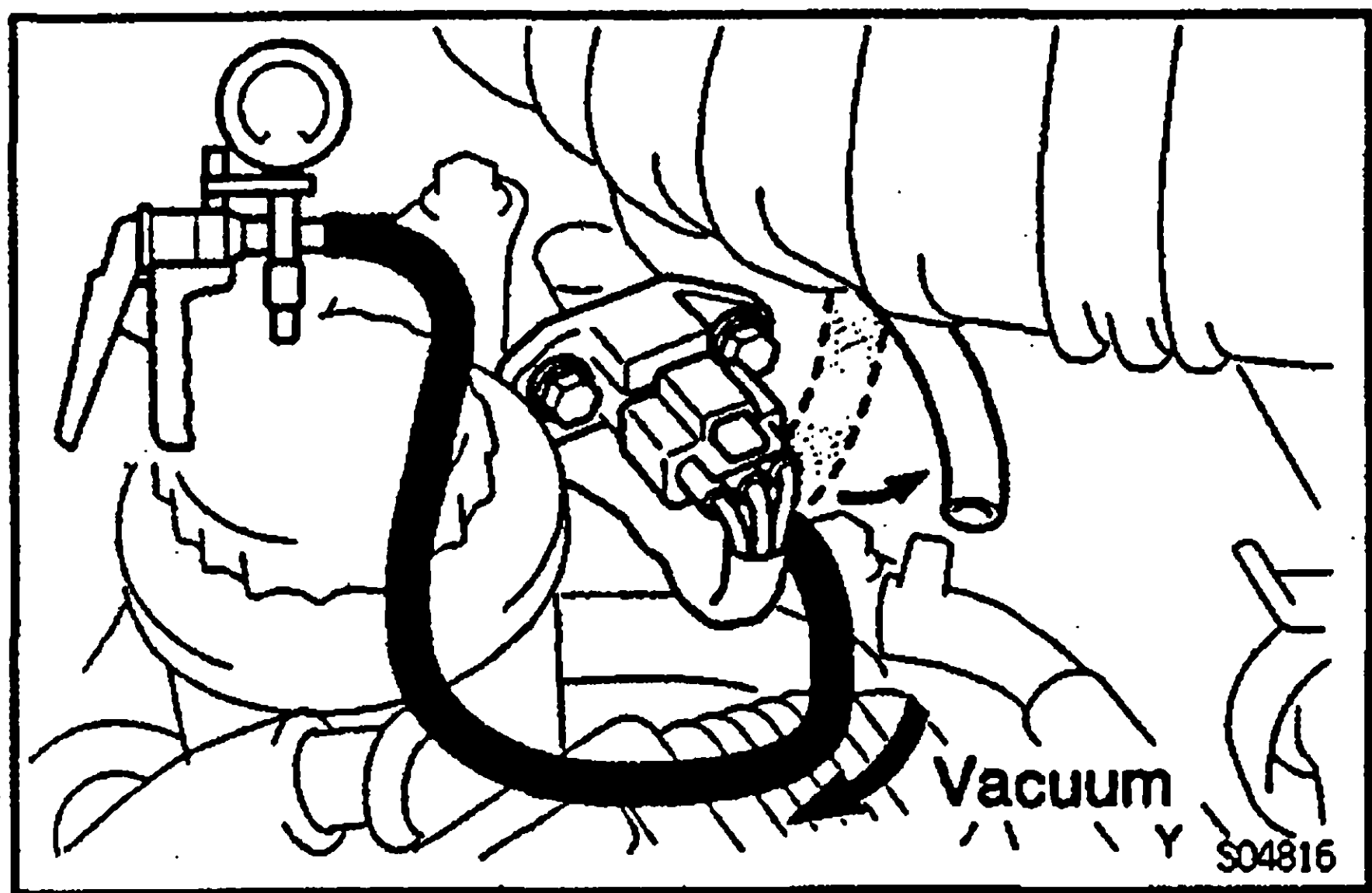
1. **INSPECT POWER SOURCE VOLTAGE OF TURBO PRESSURE SENSOR**
 - (a) Disconnect the turbo pressure sensor connector.
 - (b) Turn the ignition switch ON.
 - (c) Using a voltmeter, measure the voltage between connector terminals VC and E2 of the wiring harness side.
Voltage:
4.5 – 5.5 V
 - (d) Turn the ignition switch OFF.
 - (e) Reconnect the turbo pressure sensor connector.

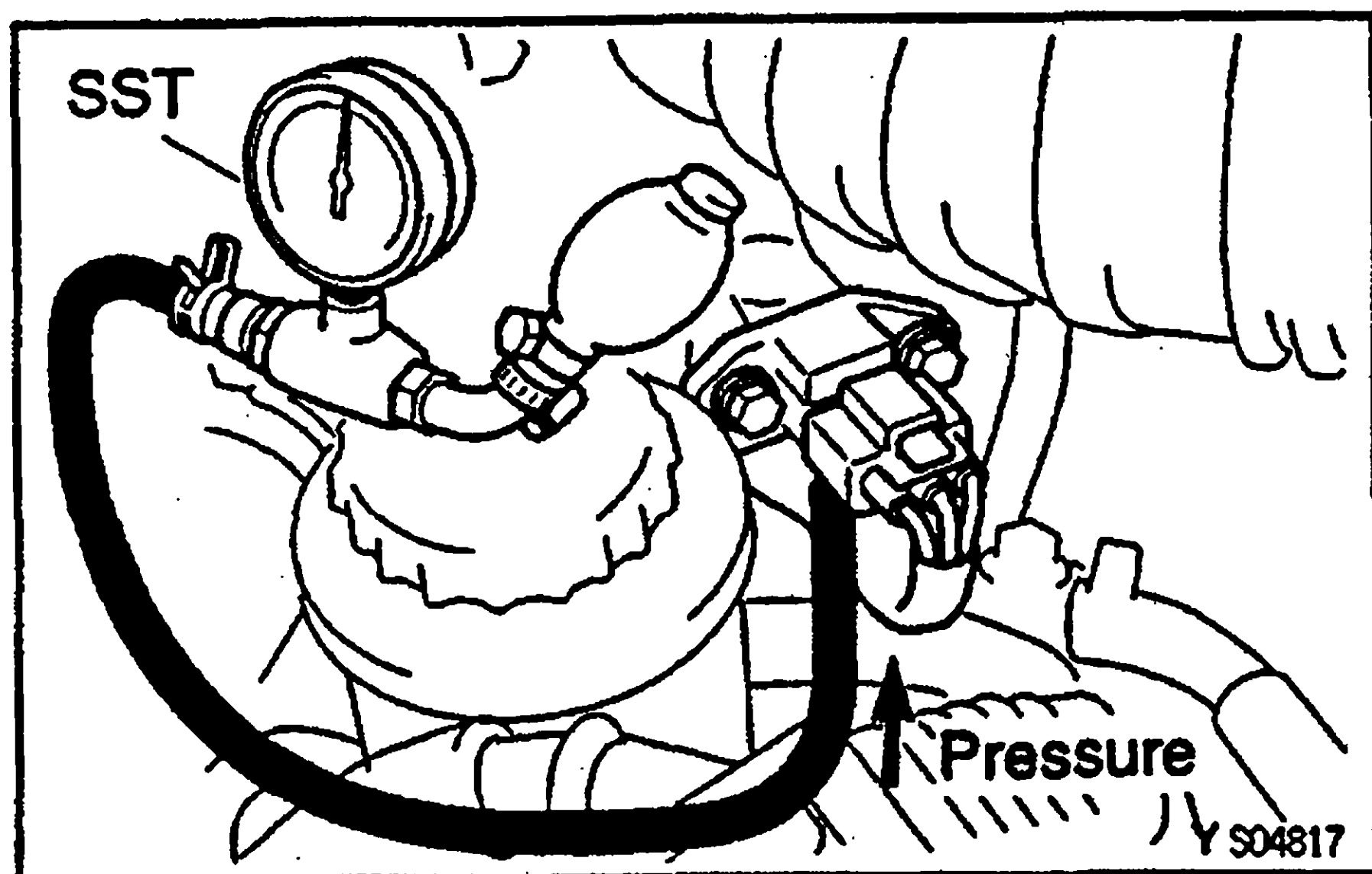


2. **INSPECT SUPPLY POWER OF TURBO PRESSURE SENSOR**
 - (a) Turn the ignition switch ON.
 - (b) Disconnect the vacuum hose from the turbo pressure sensor.
 - (c) Connect a voltmeter to terminals PIM and E2 of the ECU, and measure the output voltage under ambient atmospheric pressure.
 - (d) Apply vacuum to the turbo pressure sensor in 13.3 kPa (100 mmHg, 3.94 in.Hg) segments to 40.0 kPa (300 mmHg, 11.81 in.Hg).
 - (e) Measure the voltage drop from step (c) above for each segment.

Voltage drop:

Applied vacuum kPa (mmHg) in.Hg)	13.3 (100) (3.94)	26.7 (200) (7.87)	40.0 (300) (11.81)
Voltage drop V	0.3 - 0.5	0.6 - 0.8	0.95 - 1.15





- (f) Using SST (turbocharger pressure gauge), apply pressure to the turbo pressure sensor in 19.6 kPa (0.20 kgf/cm², 2.84 psi) segments to 98.0 kPa (1.00 kgf/cm², 14.2 psi). SST 09992-00241

- (g) Measure the voltage up from step (c) above for each segment.

Voltage up:

Applied pressure kPa (kgf/cm ² psi)	19.6 (0.20 2.84)	39.2 (0.40 5.69)	58.8 (0.60 8.53)	78.5 (0.80 11.4)	98.0 (1.00 14.2)
Voltage up V	0.4 - 0.7	0.9 - 1.2	1.4 - 1.7	2.0 - 2.3	2.5 - 2.8

T V07861

- (h) Reconnect the vacuum hose to the turbo pressure sensor.

CRANKSHAFT POSITION SENSOR CRANKSHAFT POSITION SENSOR INSPECTION

B377R-01

NOTICE: "Cold" and "Hot" in the following sentences express the temperature of the sensors themselves. "Cold" is from -10°C (14°F) to 50°C (122°F) and "Hot" is from 50°C (122°F) to 100°C (212°F).

1. DISCONNECT CRANKSHAFT POSITION SENSOR CONNECTOR
2. INSPECT CRANKSHAFT POSITION SENSOR RESISTANCE

Using an ohmmeter, measure the resistance between terminals.

Resistance:

Cold	19 - 32 Ω
Hot	24 - 37 Ω

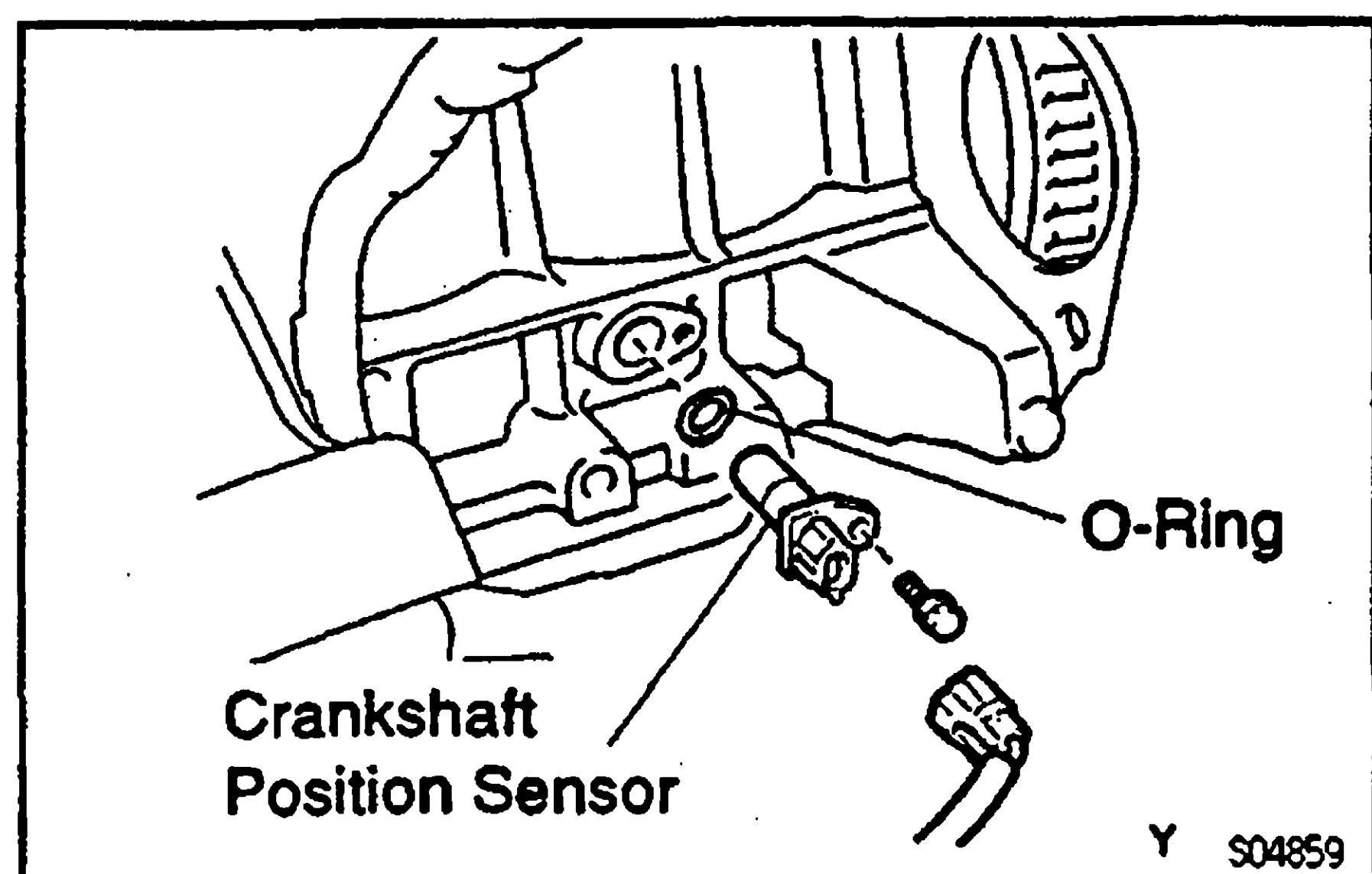
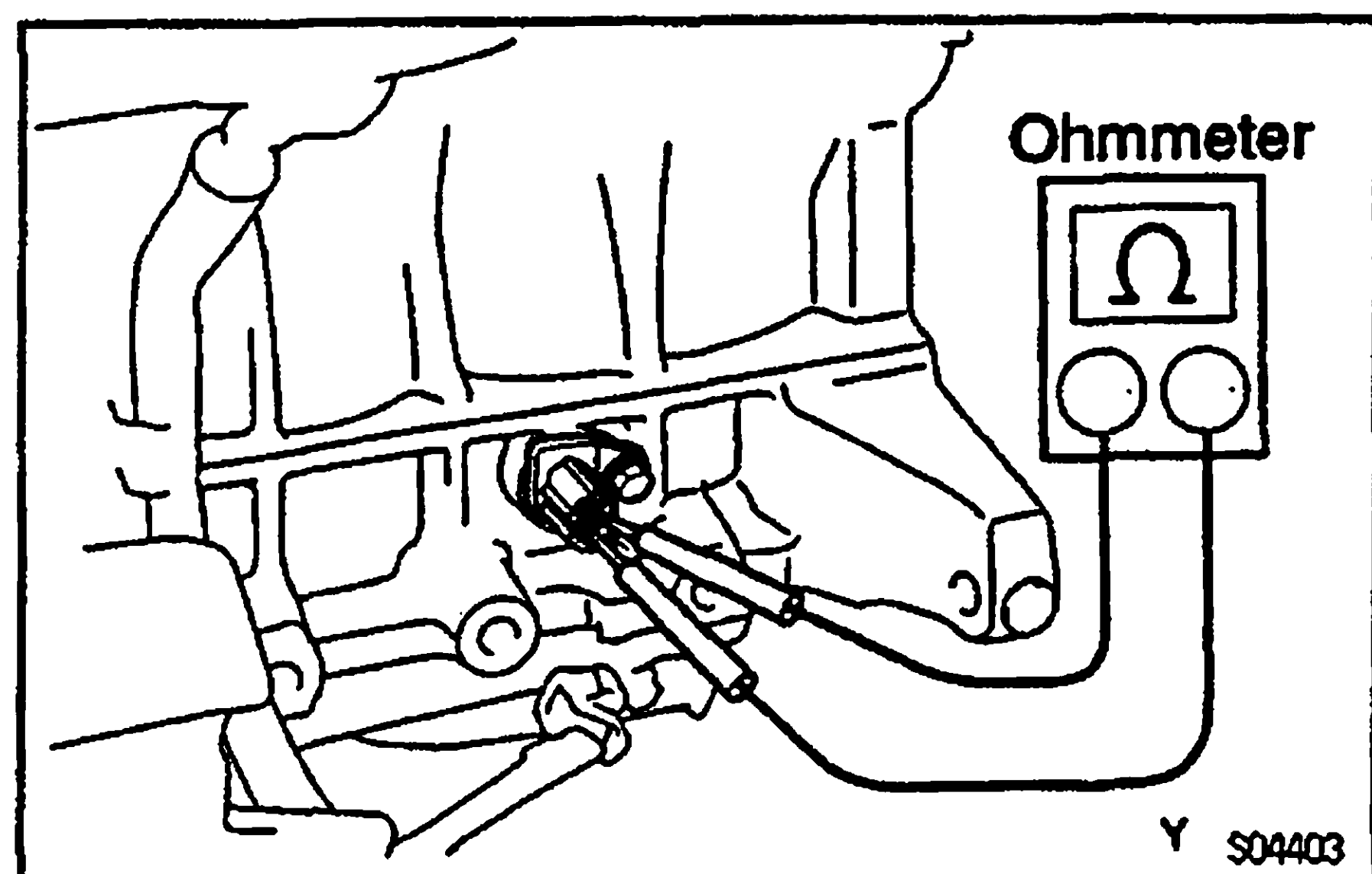
If the resistance is not as specified, replace the crankshaft position sensor.

NOTICE: Be careful not drop and shock the sensor.

HINT: Apply engine oil to the O-ring.

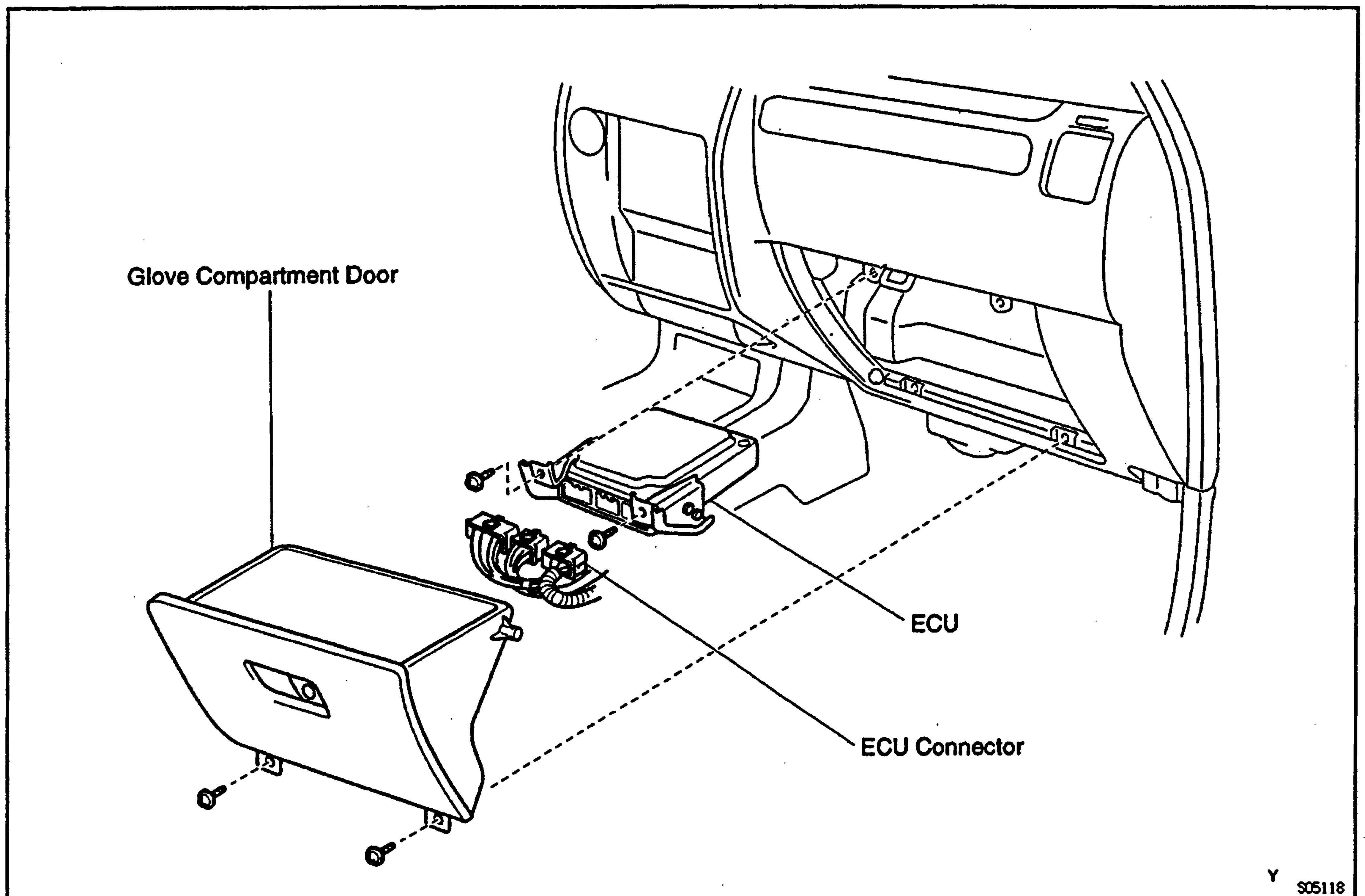
Torque: 5 N·m (50 kgf·cm, 44 in·lbf)

3. RECONNECT CRANKSHAFT POSITION SENSOR



ENGINE (AND ECT) ECU COMPONENT FOR ECU REMOVAL AND INSTALLATION

E0005-00



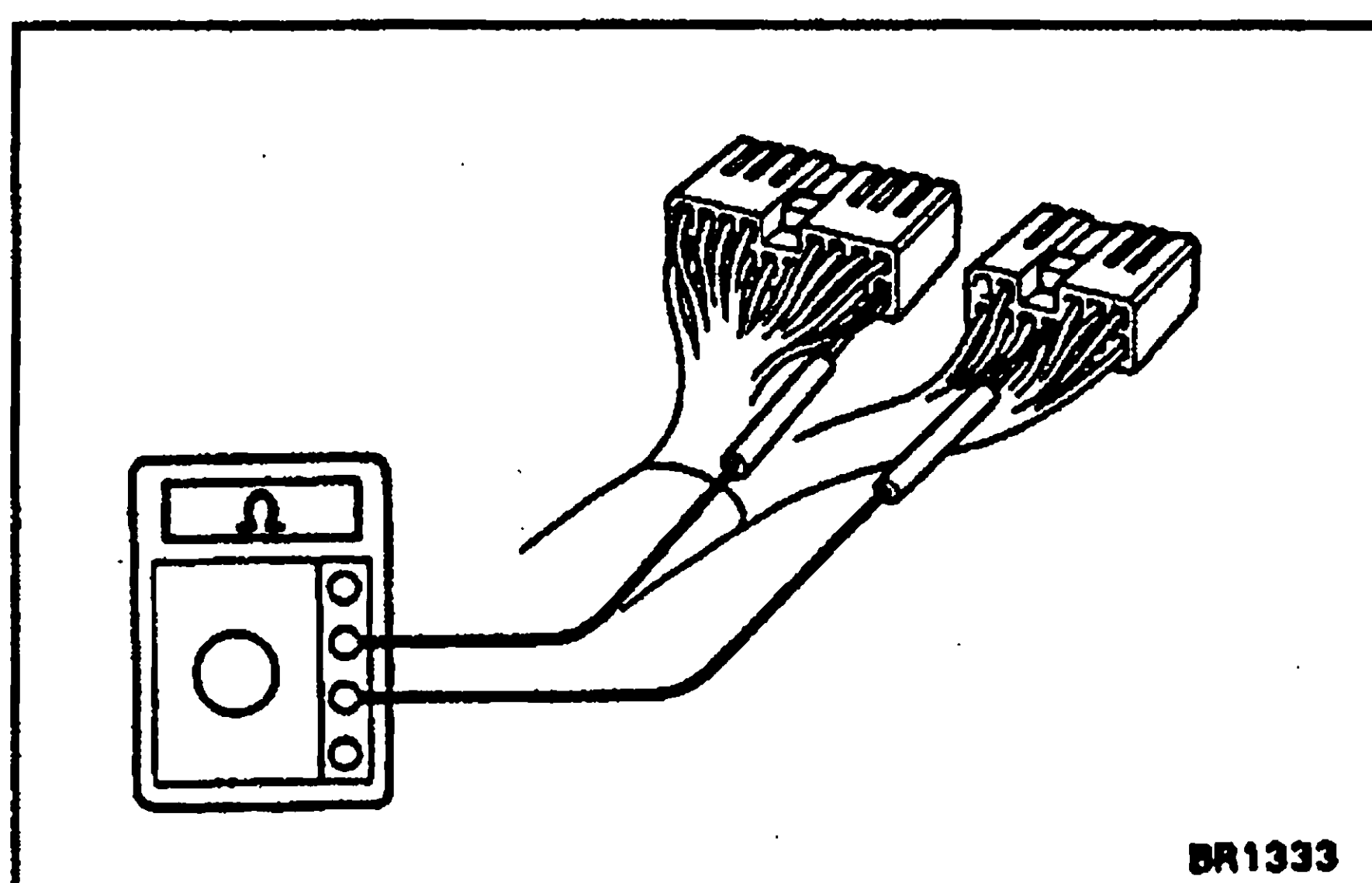
Y S05118

ECU INSPECTION

B0778-01

HINT: The ECD circuit can be checked by measuring the resistance and voltage at the wiring connectors of the ECU.

1. **DISCONNECT ECU FROM VEHICLE BODY**
2. **INSPECT VOLTAGE OF ECU**
(See troubleshooting)



3. **INSPECT RESISTANCE OF ECU**
 - (a) Turn the ignition switch OFF.
 - (b) Disconnect the 3 connectors from the ECU.
 - (c) Measure the resistance between each terminal of the wiring connectors.

NOTICE:

- Do not touch the ECU terminals.
- The tester probe should be inserted in the wiring connector from the wiring side.

ECU Wiring Connectors Resistance

Terminals	Condition	STD resistance (Ω)
IDL — E2	Throttle valve fully open	Infinity
IDL — E2	Throttle valve fully closed	2,300 or less
VTA — E2	Throttle valve fully open	1,400 — 9,500
VTA — E2	Throttle valve fully closed	200 — 5,800
VC — E2	—	2,500 — 5,900
THA — E2	Intake air temp. 20°C (68°F)	2,000 — 3,000
THF — E2	Fuel temp. 20°C (68°F)	2,000 — 3,000
THW — E2	Coolant temp. 80°C (176°F)	200 — 400
VRT — E2	—	100 — 2,500
VRP — E2	—	100 — 2,500
TDC+ — TDC—	Cold (−10°C (14°F) to 50°C (122°F))	19 — 32
TDC+ — TDC—	Hot (50°C (122°F) to 100°C (212°F))	24 — 37
NE+ — NE—	—	205 — 255
SPV — +B	—	1 — 3
TCV — +B	—	10 — 16
EGR — +B	—	11 — 18
S/TH1 — +B	—	38.5 — 46
S/TH2 — +B	—	38.5 — 46

ECU Terminals

E01	TCV	SPV	S/TH1	S/TH2	TFN	L4	/	TDC+	NE+	SP2+	S1	SL	VF	TE2	VRP	THF	THW	THA	PIM	VC	STA	AC	SP1	IMO	G-IND	OIL W	W	STP	M-REL	S-REL	BATT
E02	/	EGR	SNW	SNWL	2	L	/	TDC-	NE-	SP2-	S2	E1	TT	TE1	VRT	THO	IDL	VA	/	E2	NSW	OD1	HSW	ACT	TAC	IMI	OD2	P	IGSW	SVR	+B

SERVICE SPECIFICATIONS

SERVICE DATA

EG153-14

ECU	Condition	Terminals	Voltage
	—	BATT — E1	9 — 14 V
	IG SW ON	+B — E1	9 — 14 V
	IG SW ON	IGSW — E1	9 — 14 V
	IG SW ON	VC — E1	4.5 — 5.5 V
	IG SW ON and apply vacuum 40 kPa (300 mmHg, 11.8 in.Hg)	PIM — E1	0.2 — 0.8 V
	IG SW ON	PIM — E1	1.3 — 1.9 V
	IG SW ON and apply pressure 69 kPa (0.7 kgf/cm ² , 10 psi)	PIM — E1	3.2 — 3.8 V
	Accelerator fully closed	VA — E1	0.3 — 0.8 V
	Accelerator fully open	VA — E1	3.2 — 4.9 V
	Accelerator fully closed	IDL—E1	0 — 3 V
	Accelerator fully open	IDL—E1	9 — 14 V
	Idling after warming up	TDC+ — TDC—	Pulse generation
	Idling after warming up	NE+ — NE—	Pulse generation
	IG SW ON and rotate driving wheel slowly	SP1 — E1	Pulse generation
	IG SW ON and rotate driving wheel slowly	SP2+ — SP2—	Pulse generation
	Idling, Engine coolant temp. 60°C (140°F) to 120°C (248°F)	THW — E1	0.2 — 1.0 V
	Idling, Intake air temp. 0°C (32°F) to 80°C (176°F)	THA — E1	0.5 — 3.4 V
	IG SW ON (When engine is cold)	THF — E1	0.5 — 3.4 V
	IG SW ON	VRP — E1	0.2 — 4.5 V
	IG SW ON	VRT — E1	0.2 — 4.5 V
	IG SW ON	SPV — E1	9 — 14 V
	Idling after warming up	SPV — E1	Pulse generation
	IG SW ON	TCV — E1	Pulse generation
	Idling after warming up	TCV — E1	Pulse generation
	VSV for intake constrictor control, No.1 is OFF (IG SW ON)	S/TH1 — E1	9 — 14 V
	VSV for intake constrictor control, No.1 is ON (For 2 sec. after IG SW ON to OFF)	S/TH1 — E1	0 — 3 V
	VSV for intake constrictor control, No.2 is OFF (Cranking)	S/TH2 — E1	9 — 14 V
	VSV for intake constrictor control, No.2 is ON (For 2 sec. after IG SW ON to OFF)	S/TH2 — E1	0 — 3 V
	IG SW ON	EGR — E1	9 — 14 V
	EGR system is ON (Maintain engine speed at 1,500 rpm after warming up)	EGR — E1	Pulse generation
	Cranking	S—REL — E1	6 V or more
	Idling after warming up (Pass 2 min. or more after engine start)	S—REL — E1	0 — 1.5 V
	IG SW OFF to ON	G—IND — E1	0 — 3 V
	Idling after warming up	G—IND — E1	9 — 14 V
	Check engine warning light on (Disconnect water temp. sensor connector)	W — E1	0 — 3 V
	No trouble (Check engine warning light off) and idling	W — E1	9 — 14 V
	Cranking	STA — E1	6 V or more
	IG SW ON and shift position in "P" or "N" position	NSW — E1	0 — 3 V

ECU	Condition	Terminals	Voltage
EG	IG SW ON and other shift position in "P" or "N" position	NSW — E1	9 — 14 V
	Idling	IMI — E1	Pulse generation
	A few seconds after engine starting	IMO — E1	Pulse generation
	A/C ON (Magnetic clutch ON)	A/C — E1	9 — 14 V
	A/C OFF	A/C — E1	0 — 3 V
	IG SW ON	ACT — E1	9 — 14 V
	At A/C cut control (Driving at 30 km/h (48 mph) or less, For 5 sec. after accelerator fully open)	ACT — E1	0 — 3 V
	IG SW ON	M—REL — E1	9 — 14 V
	Pass 2 sec. or more after IG SW ON to OFF	M—REL — E1	0 — 1.5 V
	IG SW ON	SVR — E1	0 — 1.5 V
	Idling after warming up	TAC — E1	Pulse generation
	Connect terminals TE1 and E1 of check connector (Diagnosis is no trouble)	VF — E1	4.5 — 5.5 V
	Disconnect water temp. sensor connector and terminals TE1 and E1 of check connector (Diagnosis is abnormal)	VF — E1	0 — 1 V
	Maintain heater idle—up switch ON	HSW — E1	0 — 3 V
	Others	HSW — E1	9 — 14 V
	Stop light switch ON	STP — E1	7.5 — 14 V
	Stop light switch OFF	STP — E1	0 — 1.5 V
	When engine is cold	OIL—W — E1	9 — 14 V
	During warming up	THO — E1	0.2 — 4.5 V
	IG SW ON	TE1, TE2 — E1	9 — 14 V
	Connect terminals TE1, TE2 and E1 of check connector (Test mode)	TE1, TE2 — E1	0 — 3 V

Throttle position sensor	Clearance between stop screw and lever		
	0 mm (0 in.)	VTA — E2	0.2 — 5.8 kΩ
	0 mm (0 in.)	IDL — E2	2.3 kΩ or less
	0.60 mm (0.06 in.)	IDL — E2	Infinity
	Throttle valve fully open	VTA — E2	1.4 — 9.5 kΩ
Timing control valve	Resistance	at 20°C (68°F)	VC — E2
			2.5 — 5.9 kΩ
			10 — 14 Ω
VSV for intake constrictor control	Resistance	at 20°C (68°F)	38.5 — 44.5 Ω
Water temp. sensor, Fuel temp. sensor and Intake air temp. sensor	Resistance	at -20°C (-4°F)	10 — 20 kΩ
		at 0°C (32°F)	4 — 7 kΩ
		at 20°C (68°F)	2 — 3 kΩ
		at 40°C (104°F)	0.9 — 1.3 kΩ
		at 60°C (140°F)	0.4 — 0.7 kΩ
		at 80°C (176°F)	0.2 — 0.4 kΩ
Crankshaft position sensor	Resistance	Cold	19 — 32 Ω
		Hot	24 — 37 Ω

ECU	Condition	Terminals	Resistance
	Throttle valve fully open	IDL — E2	Infinity
	Throttle valve fully closed	IDL — E2	2,300 Ω or less
	Throttle valve fully open	VTA — E2	1,400 — 9,500 Ω
	Throttle valve fully closed	VTA — E2	200 — 5,800 Ω
	—	VC — E2	2,500 — 5,900 Ω
	Intake air temperature 20°C (68°F)	THA — E2	2,000 — 3,000 Ω
	Fuel temperature 20°C (68°F)	THF — E2	2,000 — 3,000 Ω
	Coolant temperature 80°C (176°F)	THW — E2	200 — 400 Ω
	—	VRT — E2	100 — 2,500 Ω
	—	VRP — E2	100 — 2,500 Ω
	Cold	TDC+ — TDC—	19 — 32 Ω
	Hot	TDC+ — TDC—	24 — 37 Ω
	—	NE+ — NE—	205 — 255 Ω
	—	SPV — +B	1 — 3 Ω
	—	TCV — +B	10 — 16 Ω
	—	EGR — +B	11 — 18 Ω
	—	S/TH1 — +B	38.5 — 46 Ω
	—	S/TH2 — +B	38.5 — 46 Ω

TORQUE SPECIFICATIONS

E30U9-04

Part tightened	N·m	kgf·cm	ft·lbf
Venturi x Intake manifold	20	200	14
Water temp. sensor x Cylinder block	25	250	18
Fuel temp. sensor x Distributive head plug (No.2)	21.6	220	16.5
Crankshaft position sensor x Cylinder block	5	50	44 in·lbf

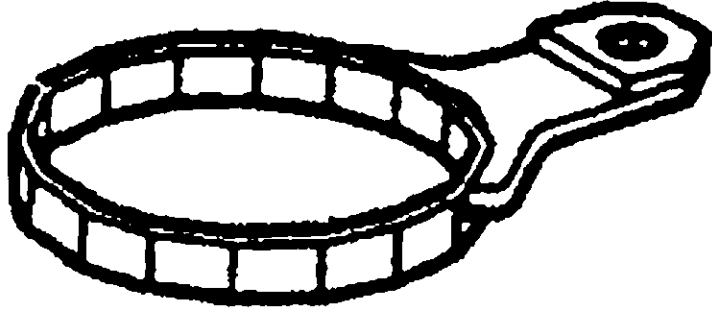
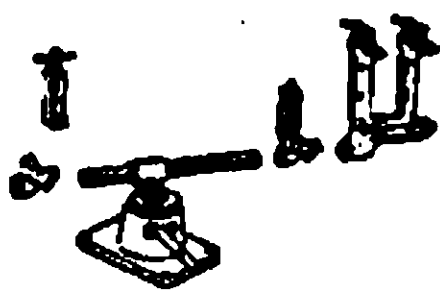
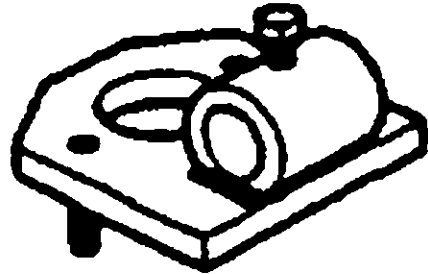
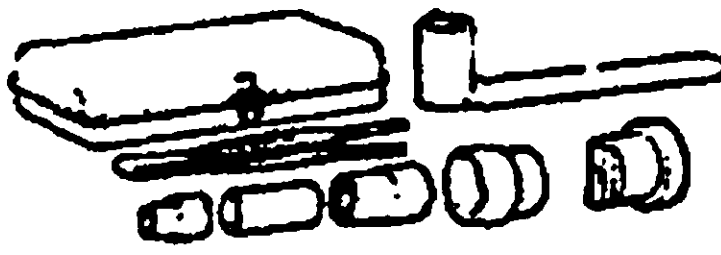
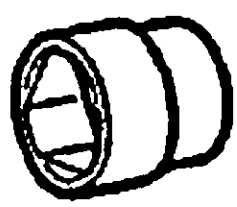
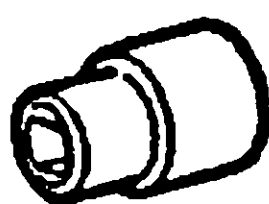
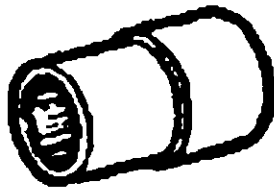
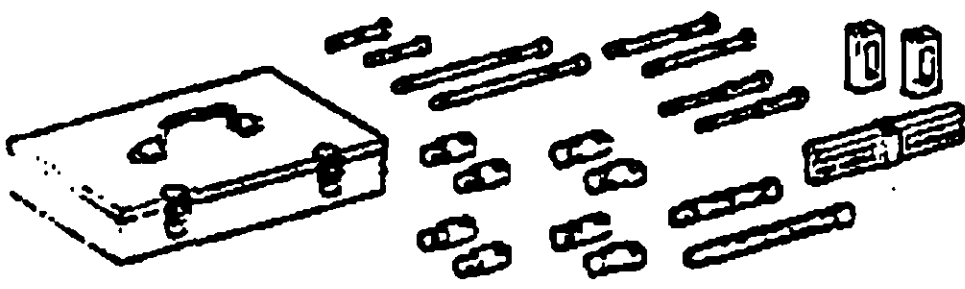
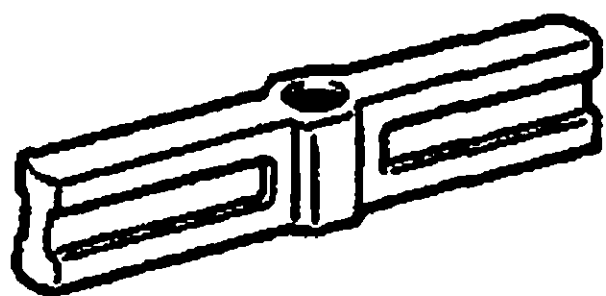
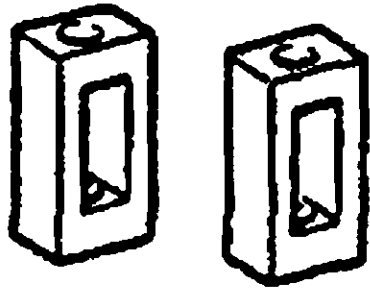
FUEL SYSTEM

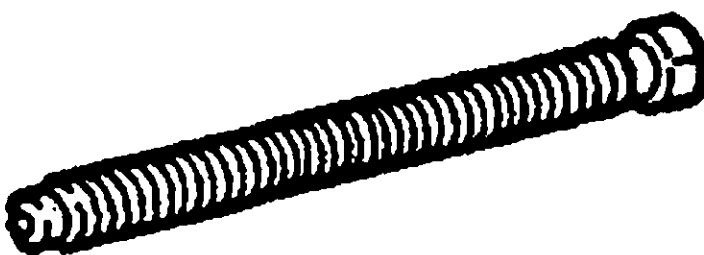
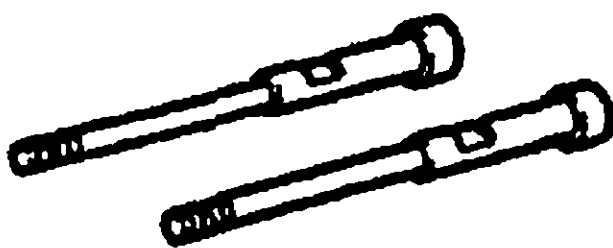
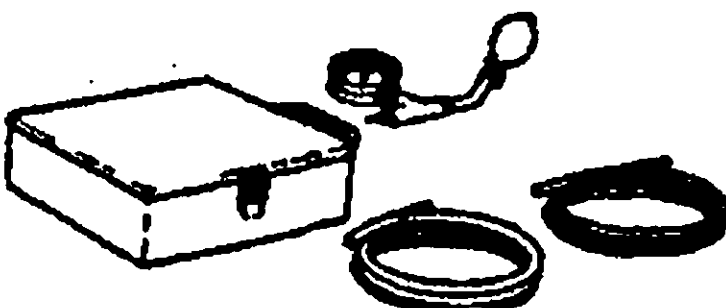
PREPARATION

SST (SPECIAL SERVICE TOOLS)

EG007-20

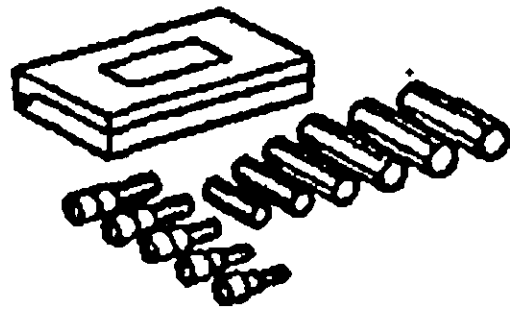
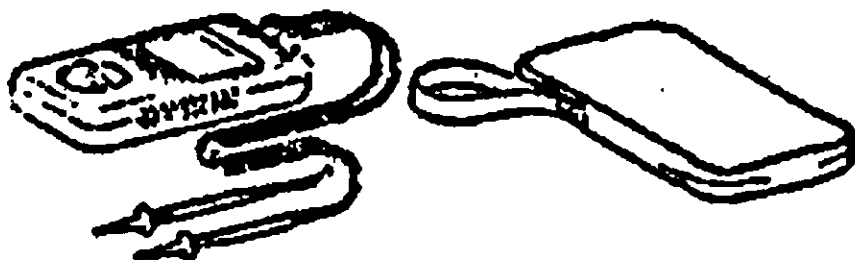
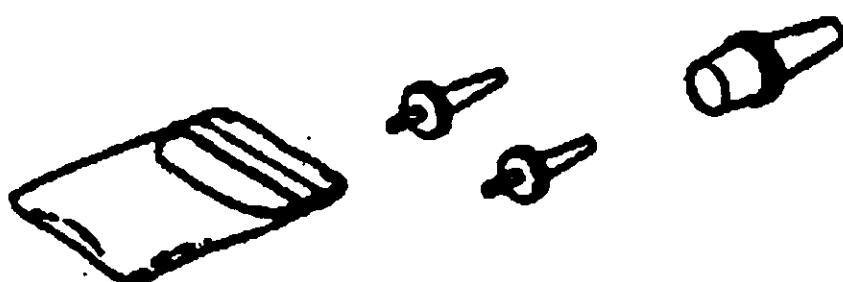
EG

	09228-64010 Fuel Filter Wrench	
	09236-00101 Water Pump Overhaul Tool Set	
	(09237-00070) Shaft "C"	Governor sleeve plug
	09241-76022 Injection Pump Stand Set	
	09245-54010 Injection Pump Stand Arm	
	09260-54012 Injection Pump Tool Set	
	(09262-54010) Distributor Head Plug Wrench	
	(09262-54020) Regulator Valve Wrench	
	(09269-54020) Socket 14 mm	
	09950-50010 Puller C Set	
	(09951-05010) Hanger 150	Injection pump
	(09952-05010) Slide Arm	Injection pump

	(09953-05020) Center Bolt 150	Injection pump
	(09954-05010) Claw No.1	Injection pump
	09992-00241 Turbocharger Pressure Gauge	

ST01C-11

RECOMMENDED TOOLS

	09040-00010 Hexagon Wrench Set .	
	09082-00040 TOYOTA Electrical Tester.	
	09258-00030 Hose Plug Set .	

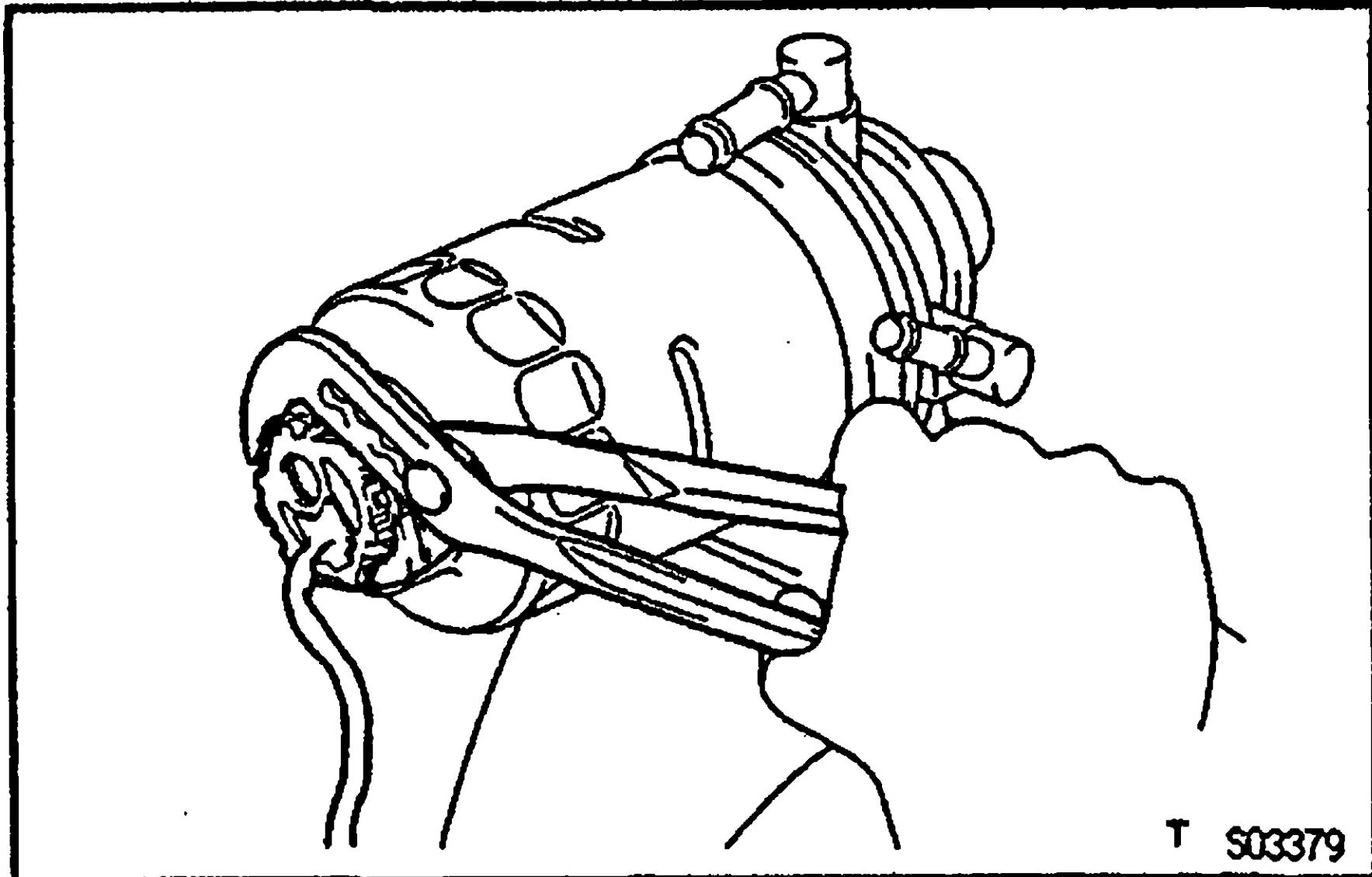
BO0CH-20

EQUIPMENT

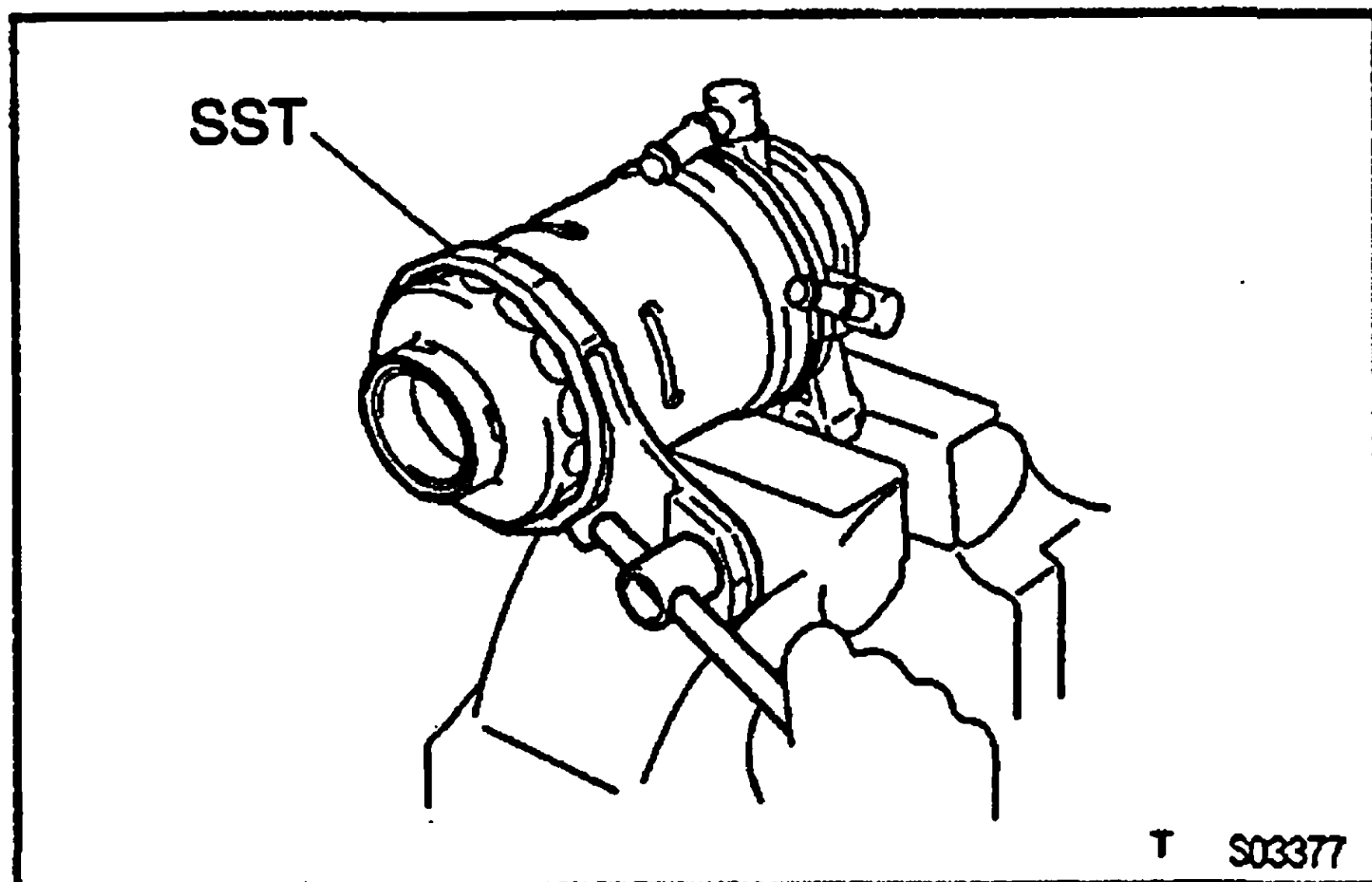
19 mm diam. deep socket wrench	Fuel temp. sensor
Angle gauge	
Injection nozzle tester	
Injection pump tester	
Inner pressure gauge	
Timer measuring device	
Torque wrench	
Water pump pliers	

FUEL FILTER REPLACEMENT

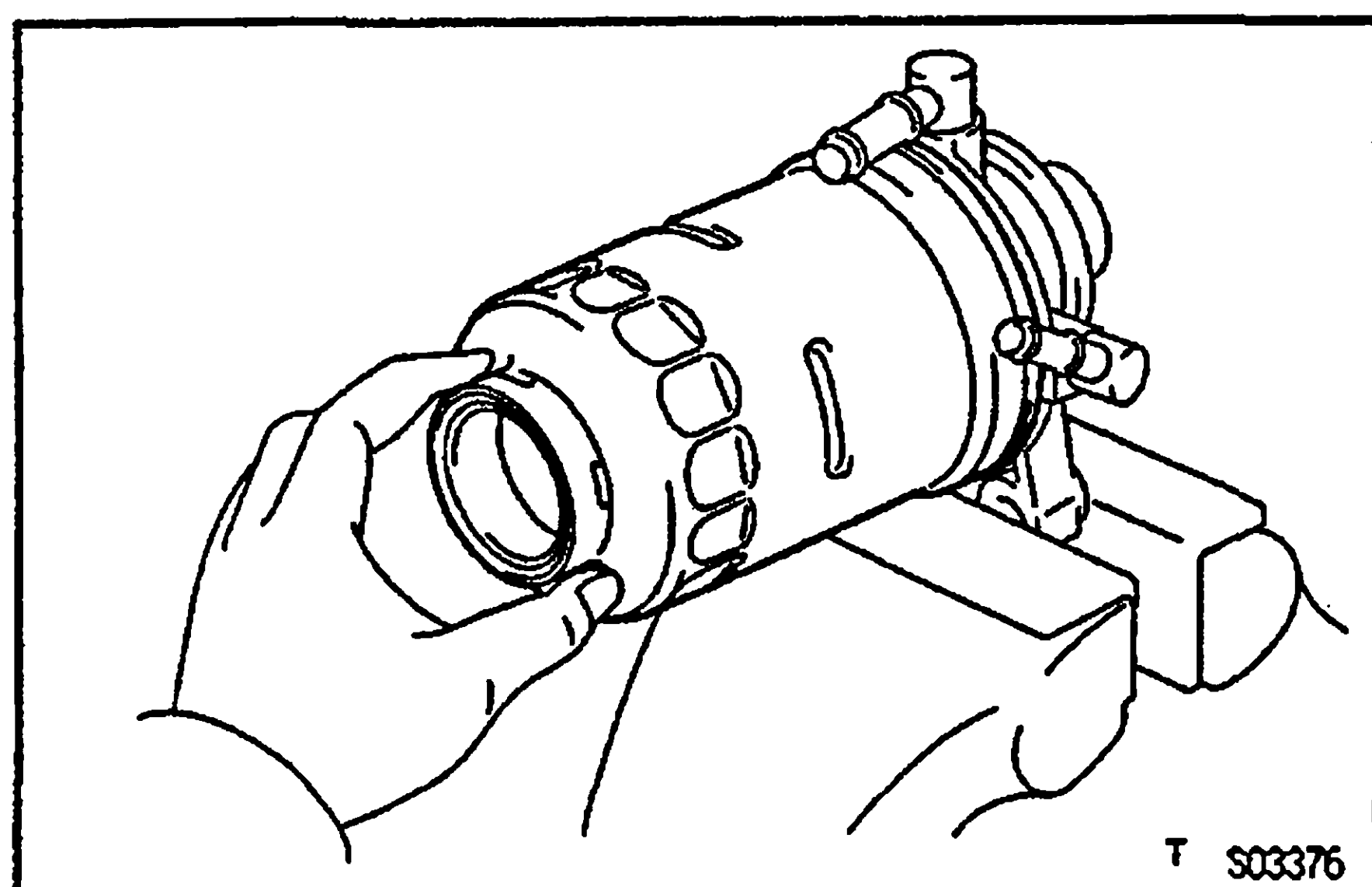
1. REMOVE FUEL FILTER ASSEMBLY FROM FUEL FILTER SUPPORT
2. REPLACE FUEL FILTER
 - A. Drain fuel from fuel filter
Loosen the drain plug, and drain the fuel from the fuel filter.
 - B. Mount fuel filter cap in soft jaw vise



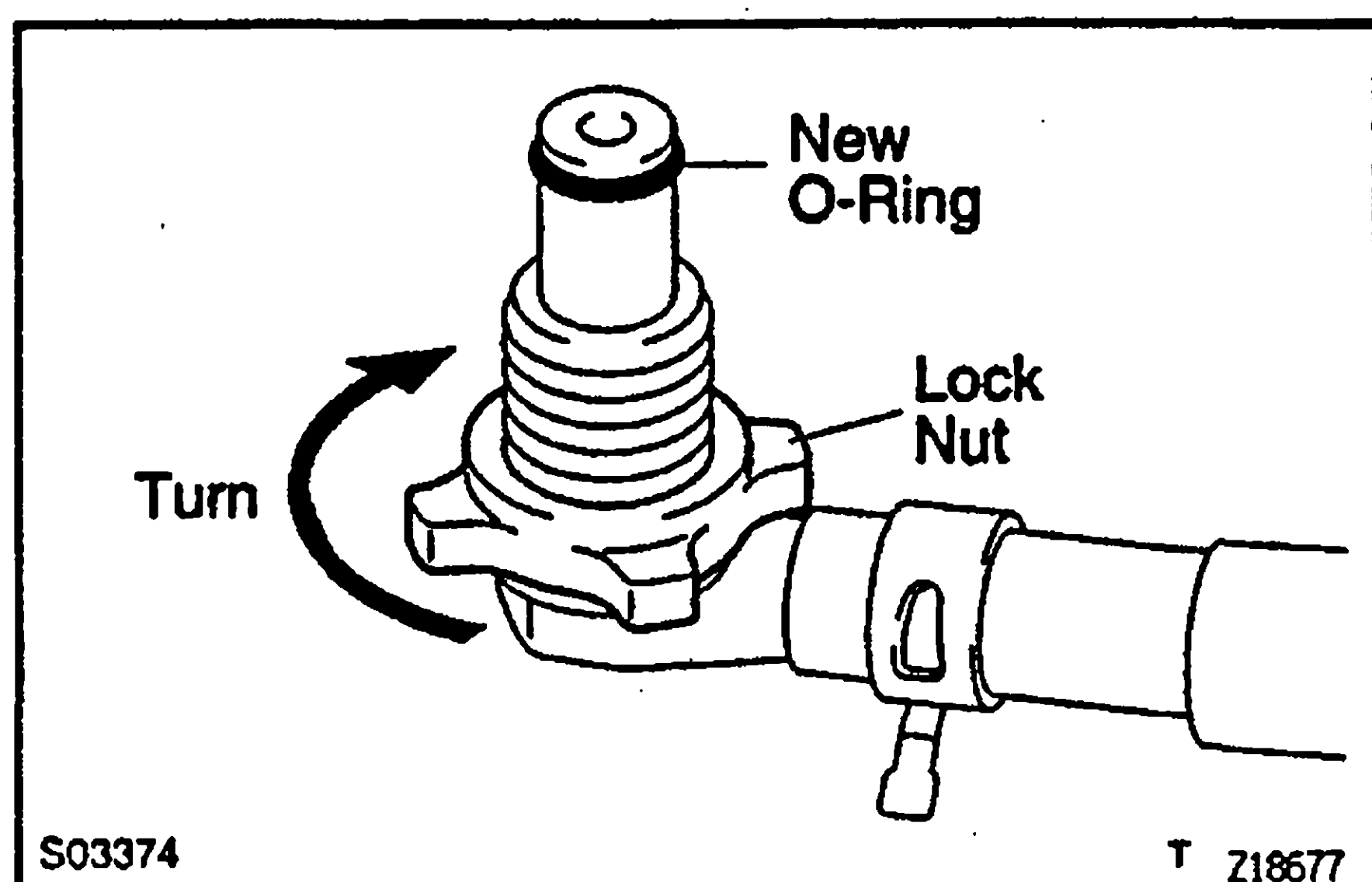
- C. Remove fuel filter warning switch from fuel filter
 Drain union:
 Loosen the lock nut, and remove the drain union and O-ring.
 Warning switch:
 Using water pump pliers, remove the warning switch and O-ring.
NOTICE: Be careful not to damage the warning switch.

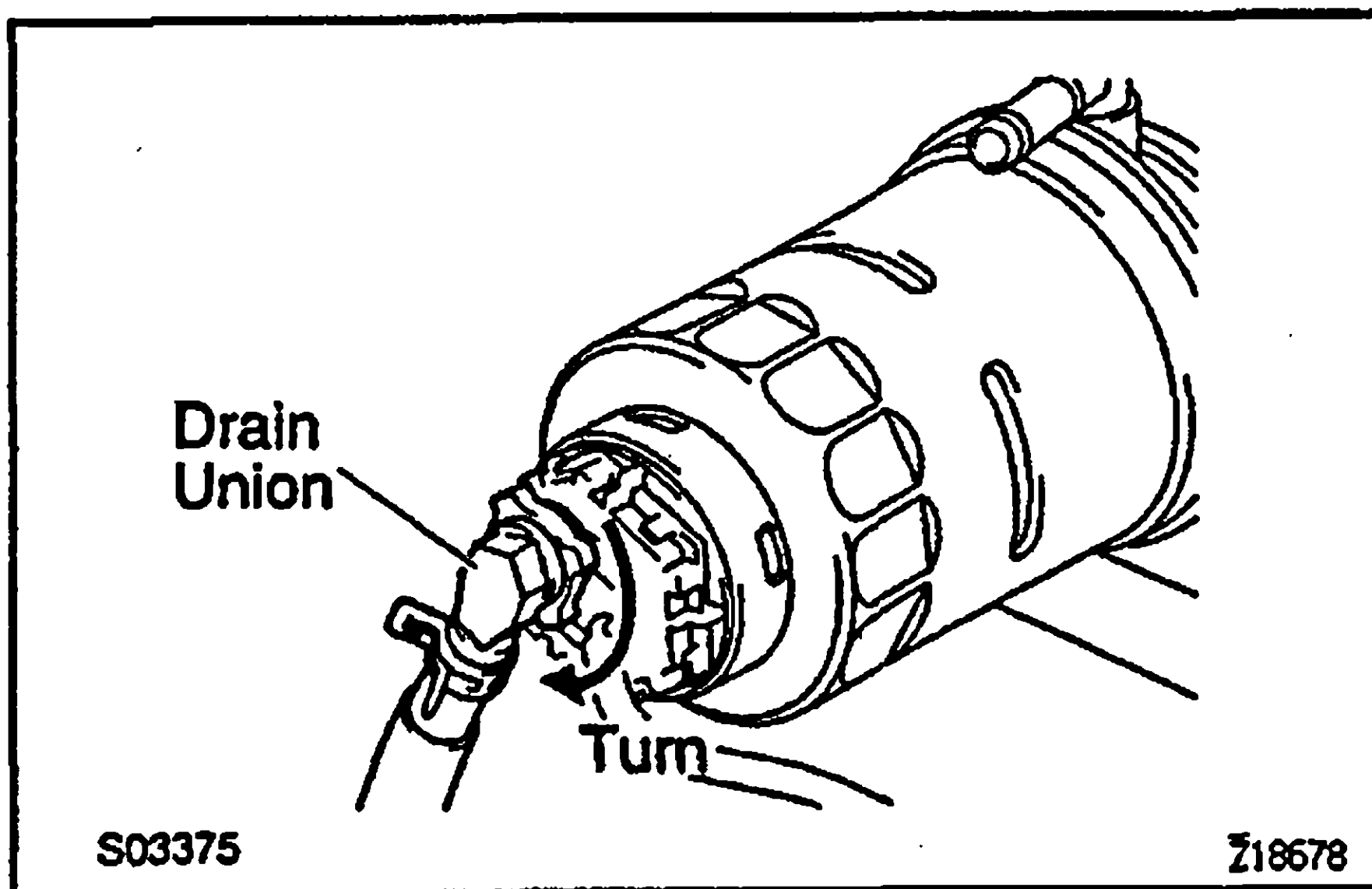


- D. Remove fuel filter
 Using SST, remove the fuel filter.
 SST 09228-64010

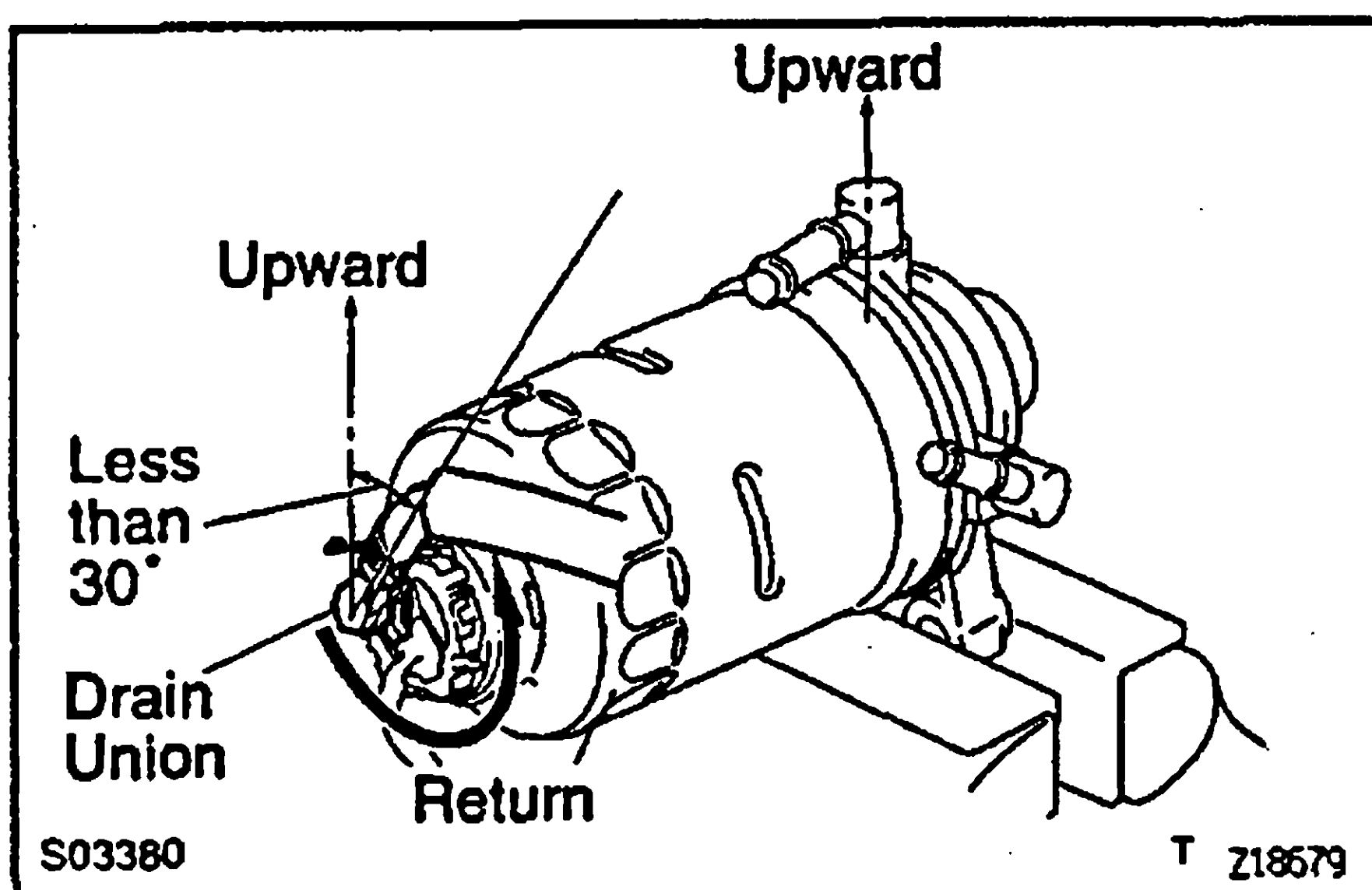


- E. Install new fuel filter
 - (a) Check and clean the fuel filter installation surface.
 - (b) Apply fuel to the gasket on a new fuel filter.
 - (c) Lightly screw the fuel filter into place, and tighten it until the gasket comes into contact with the seat.
 - (d) Tighten it additional 3/4 turn by hand.
- F. Install fuel filter warning switch to new fuel filter
 Warning switch:
 - (a) Install a new O-ring to the warning switch.
 - (b) Apply fuel to the O-ring on the warning switch.
 - (c) Install the warning switch to a new fuel filter by hand.
 Drain union:
 - (a) Fully loosen the lock nut on the drain union.
 - (b) Install a new O-ring to the drain union.
 - (c) Apply fuel to the O-ring on the drain union.



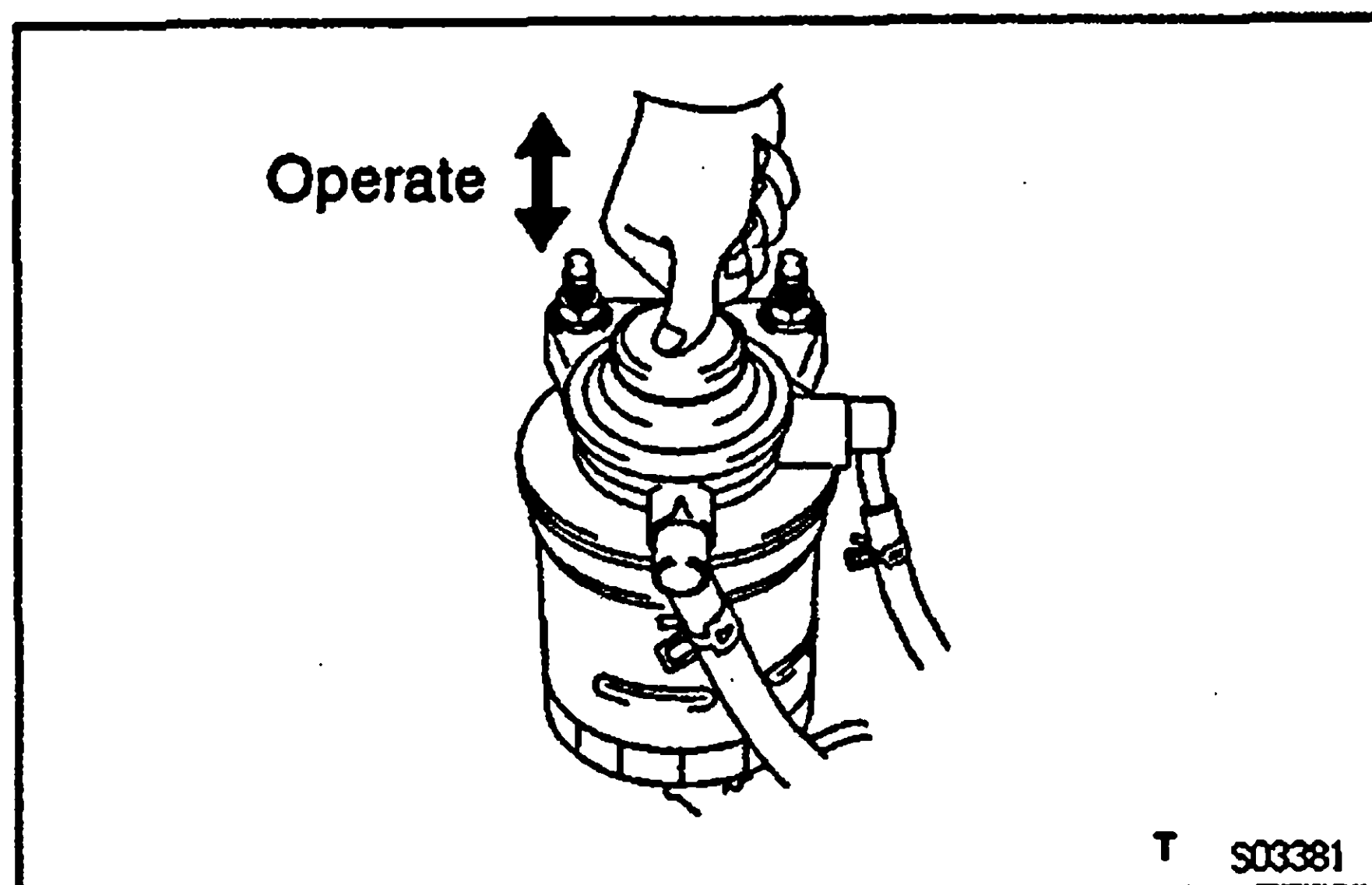


- (d) Install the drain union by turning it with a hand until it slightly stops.

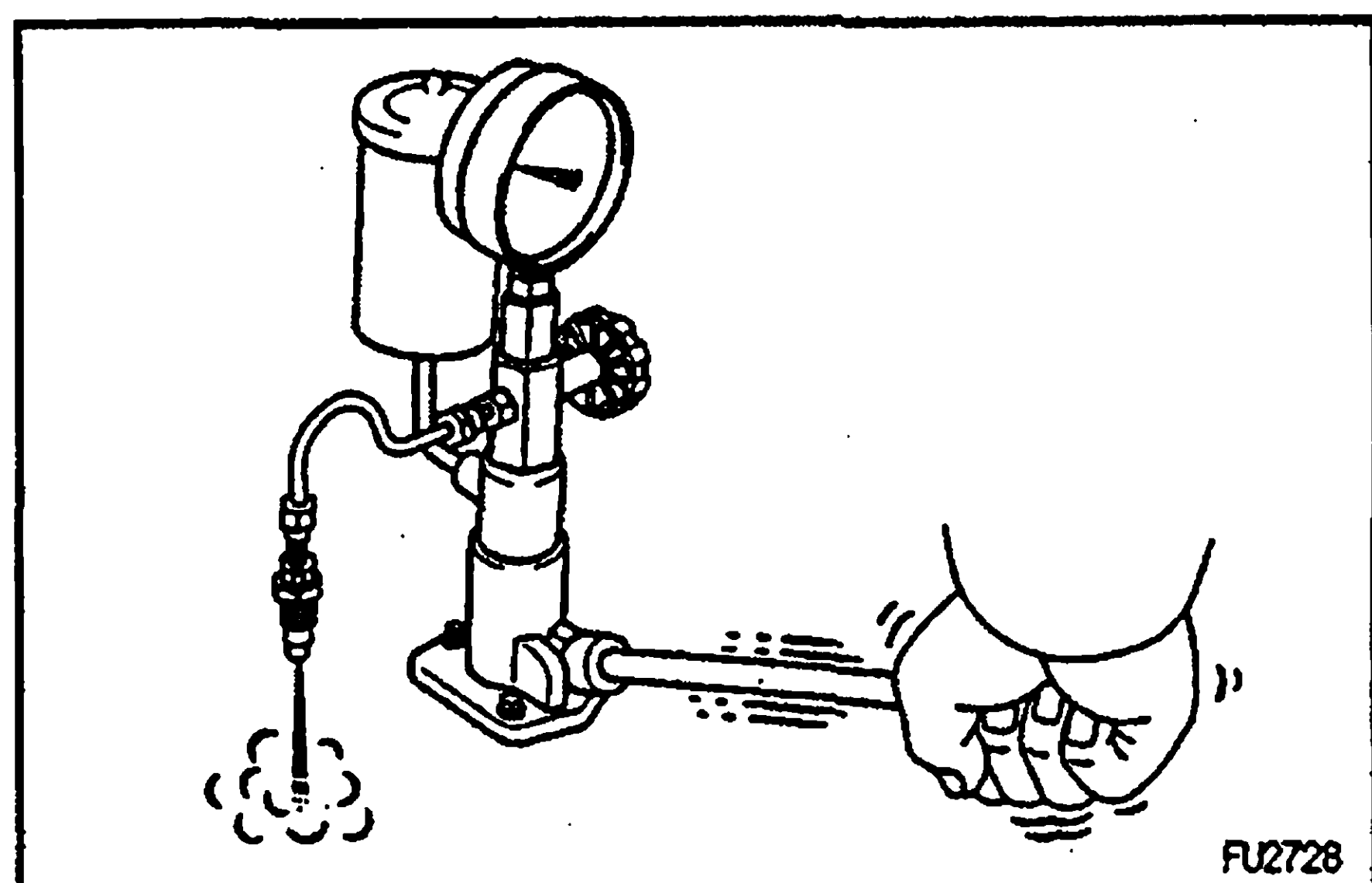
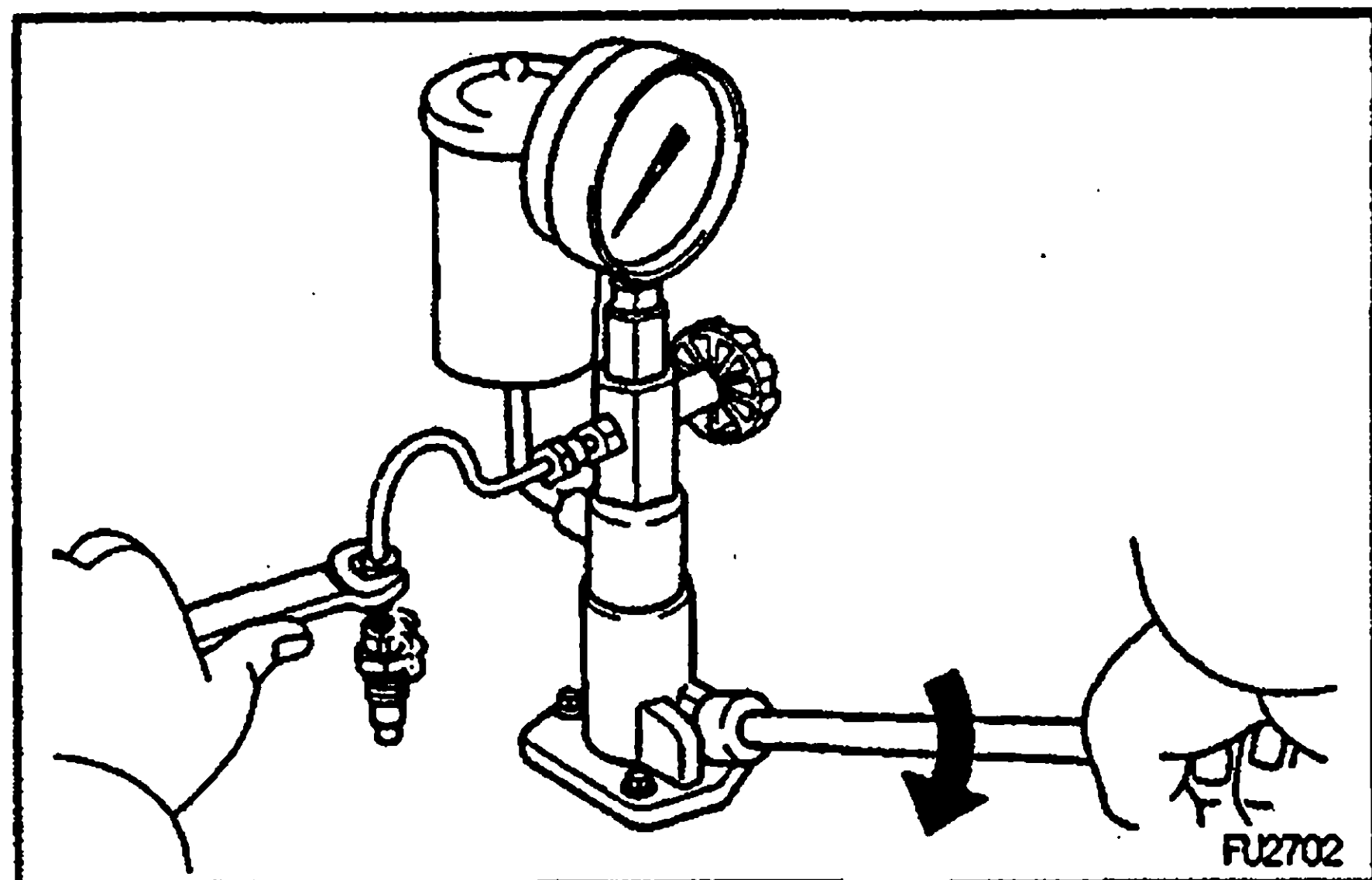


- (e) Return the drain union in the direction indicated in the illustration.

NOTICE: If the drain union has turned to the same direction as the wire harness did, shift the direction of the drain union.



3. REINSTALL FUEL FILTER ASSEMBLY TO FUEL FILTER SUPPORT
4. REFILL FUEL FILTER WITH FUEL
Operate the hand pump until you feel more resistance.
5. START ENGINE AND CHECK FOR FUEL LEAKS



INJECTION NOZZLE INJECTION NOZZLES TEST

8033Y-06

1. INJECTION PRESSURE TEST

- (a) Install the injection nozzle to the injection nozzle hand tester and bleed air from the union nut.

CAUTION: Do not place your finger over the nozzle injection hole.

- (b) Pump the tester handle a few times as fast as possible to discharge the carbon from the injection hole.
- (c) Pump the tester handle slowly and observe the pressure gauge.
- (d) Read the pressure gauge just as the injection pressure begins to drop.

Opening pressure:

New nozzle

14,808 — 15,593 kPa

(151 — 159 kgf/cm²)

(2,148 — 2,261 psi)

Reused nozzle

14,320 — 15,100 kPa

(146 — 154 kgf/cm²)

(2,076 — 2,190 psi)

HINT: Proper nozzle operation can be determined by a swishing sound.

If the opening pressure is not as specified, disassemble the nozzle holder and change the adjusting shim on the top of the pressure spring.

Adjusted opening pressure:

14,220 — 15,200 kPa

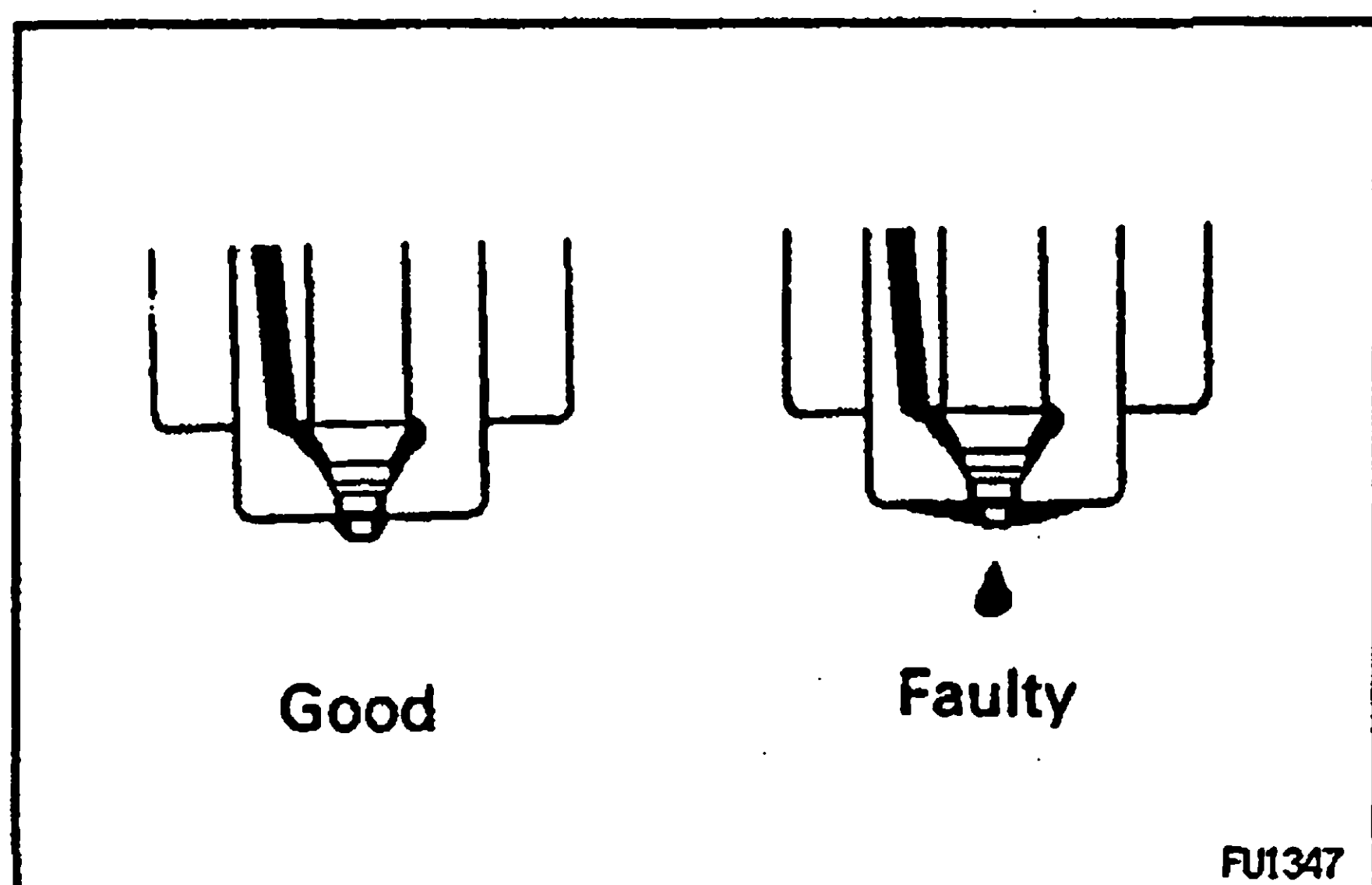
(145 — 155 kgf/cm²)

(2,062 — 2,205 psi)

Adjusting shim thickness		mm (in.)
0.900 (0.0354)	1.275 (0.0502)	1.650 (0.0650)
0.925 (0.0364)	1.300 (0.0512)	1.675 (0.0659)
0.950 (0.0374)	1.325 (0.0522)	1.700 (0.0669)
0.975 (0.0384)	1.350 (0.0531)	1.725 (0.0679)
1.000 (0.0394)	1.375 (0.0541)	1.750 (0.0689)
1.025 (0.0404)	1.400 (0.0551)	1.775 (0.0699)
1.050 (0.0413)	1.425 (0.0561)	1.800 (0.0709)
1.075 (0.0423)	1.450 (0.0571)	1.825 (0.0719)
1.100 (0.0433)	1.475 (0.0581)	1.850 (0.0728)
1.125 (0.0443)	1.500 (0.0591)	1.875 (0.0738)
1.150 (0.0453)	1.525 (0.0600)	1.900 (0.0748)
1.175 (0.0463)	1.550 (0.0610)	1.925 (0.0758)
1.200 (0.0472)	1.575 (0.0620)	1.950 (0.0768)
1.225 (0.0482)	1.600 (0.0630)	
1.250 (0.0492)	1.625 (0.0640)	

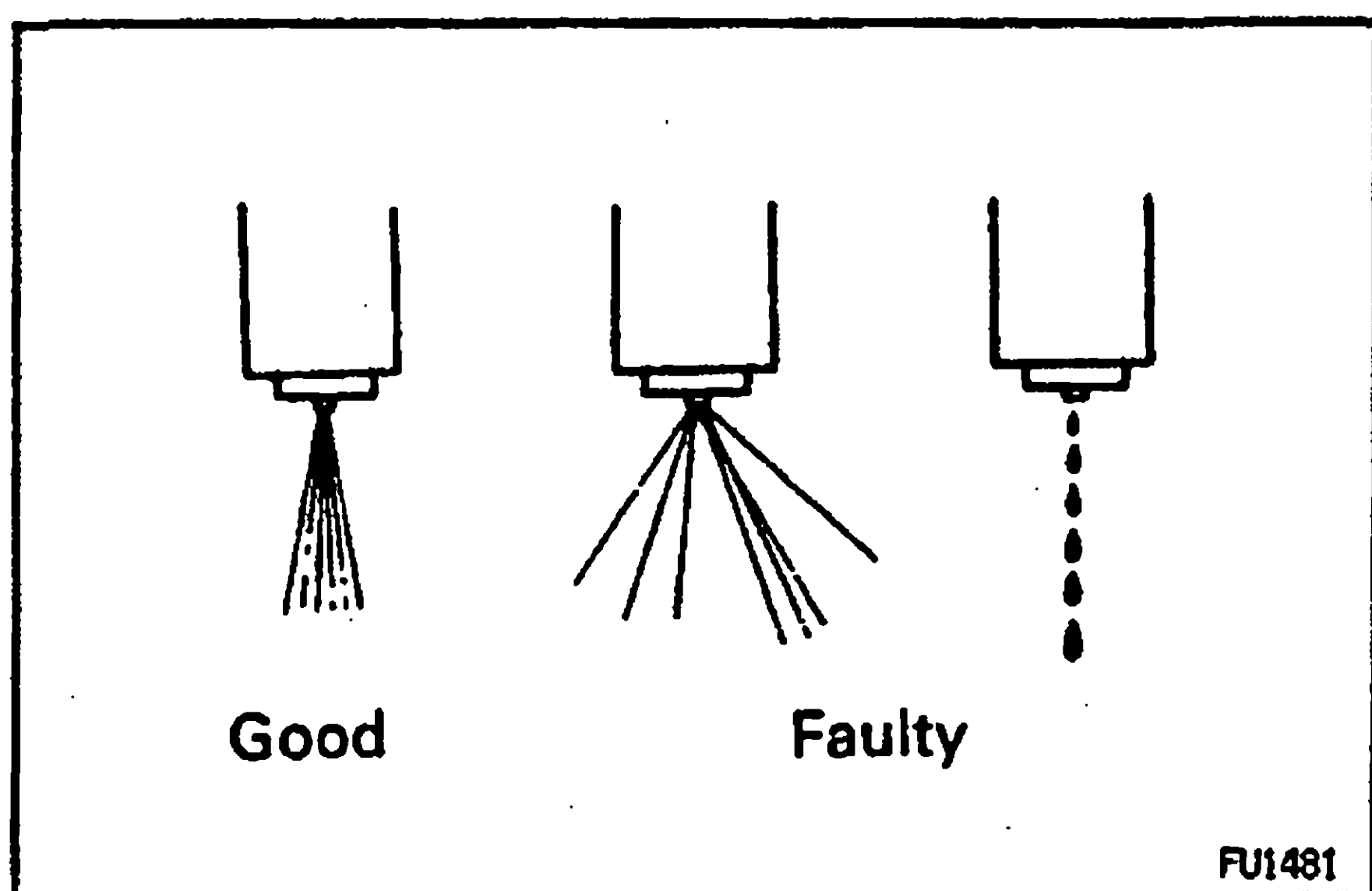
HINT:

- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 471 kPa (4.8 kgf/cm², 68 psi).
 - Only one adjusting shim should be used.
- (e) There should be no dripping after injection.

**2. LEAKAGE TEST**

While maintaining pressure at about 981 — 1,961 kPa (10 — 20 kgf/cm², 142 — 284 psi) below opening pressure (adjust by tester handle), check that there is no dripping for 10 seconds from the injection hole or around the retaining nut.

If the nozzle drips within 10 seconds, replace or clean and overhaul the nozzle assembly.

**3. SPRAY PATTERN TEST**

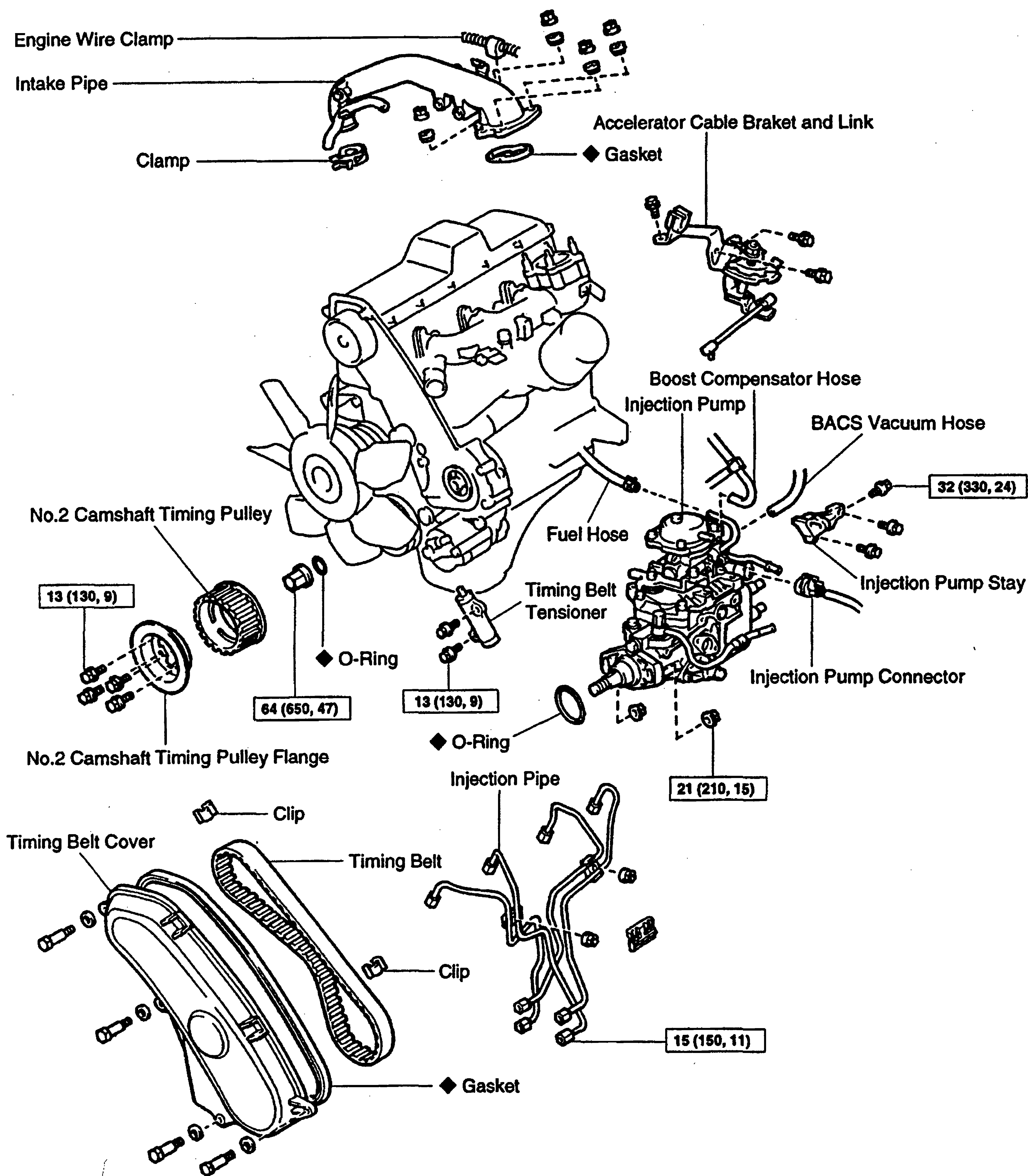
- (a) The injection nozzle should shudder at a certain pumping speed between 15 — 60 times (old nozzle) or 30 — 60 times (new nozzle) per minute.
- (b) Check the spray pattern during shuddering. If the spray pattern is not correct during shuddering, the nozzle must be replaced or cleaned.

INJECTION PUMP

(1KZ-T)

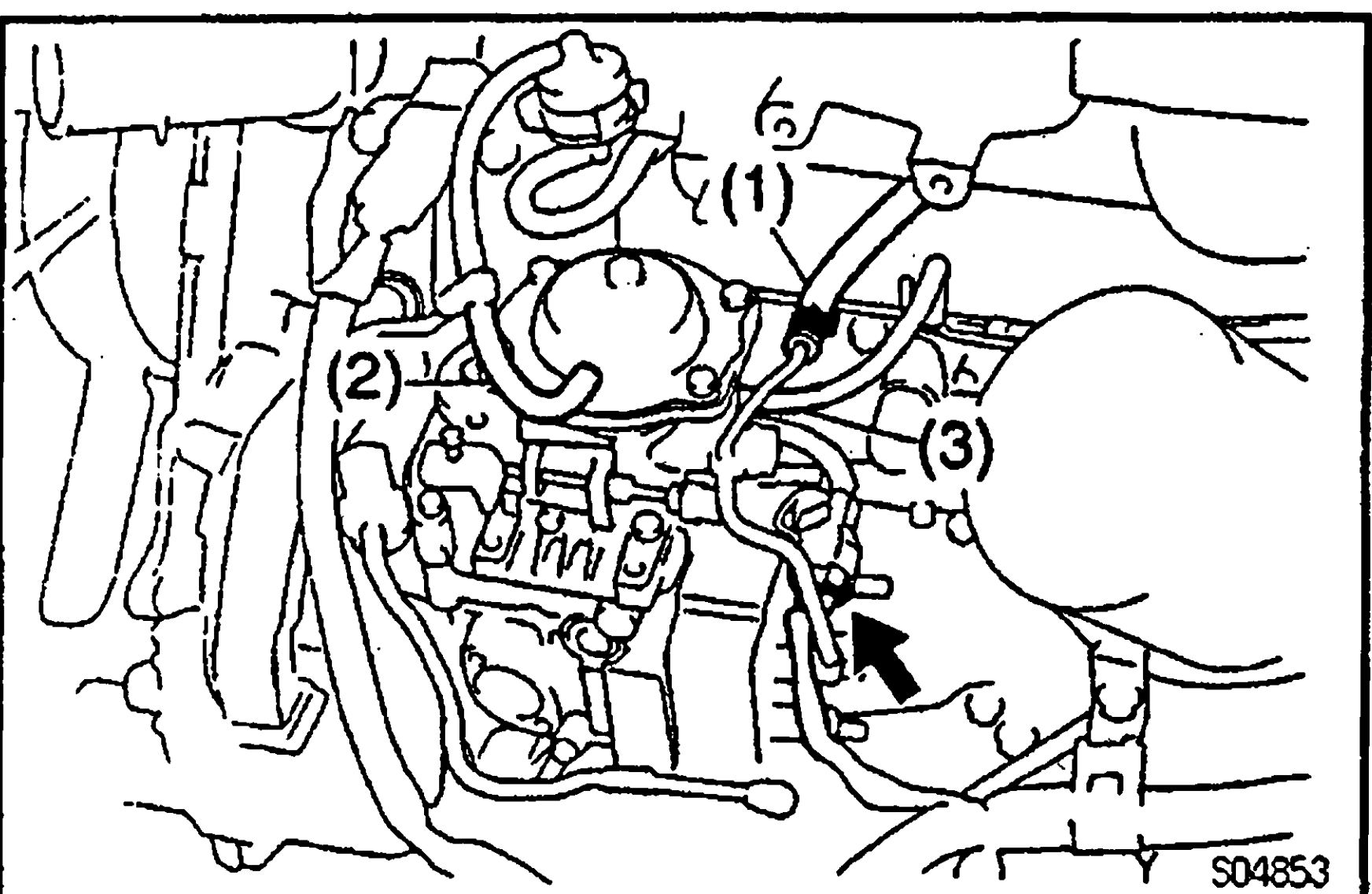
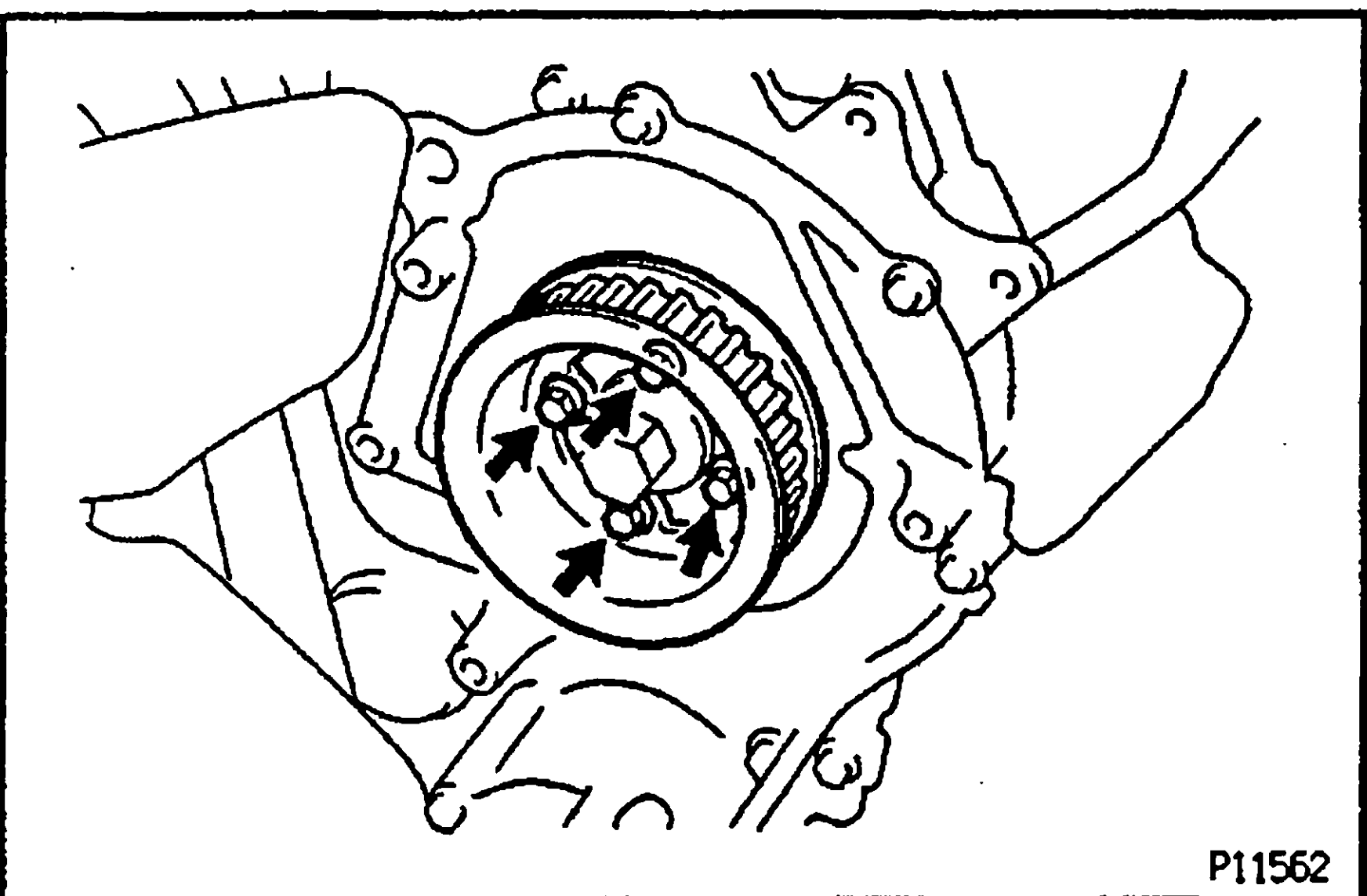
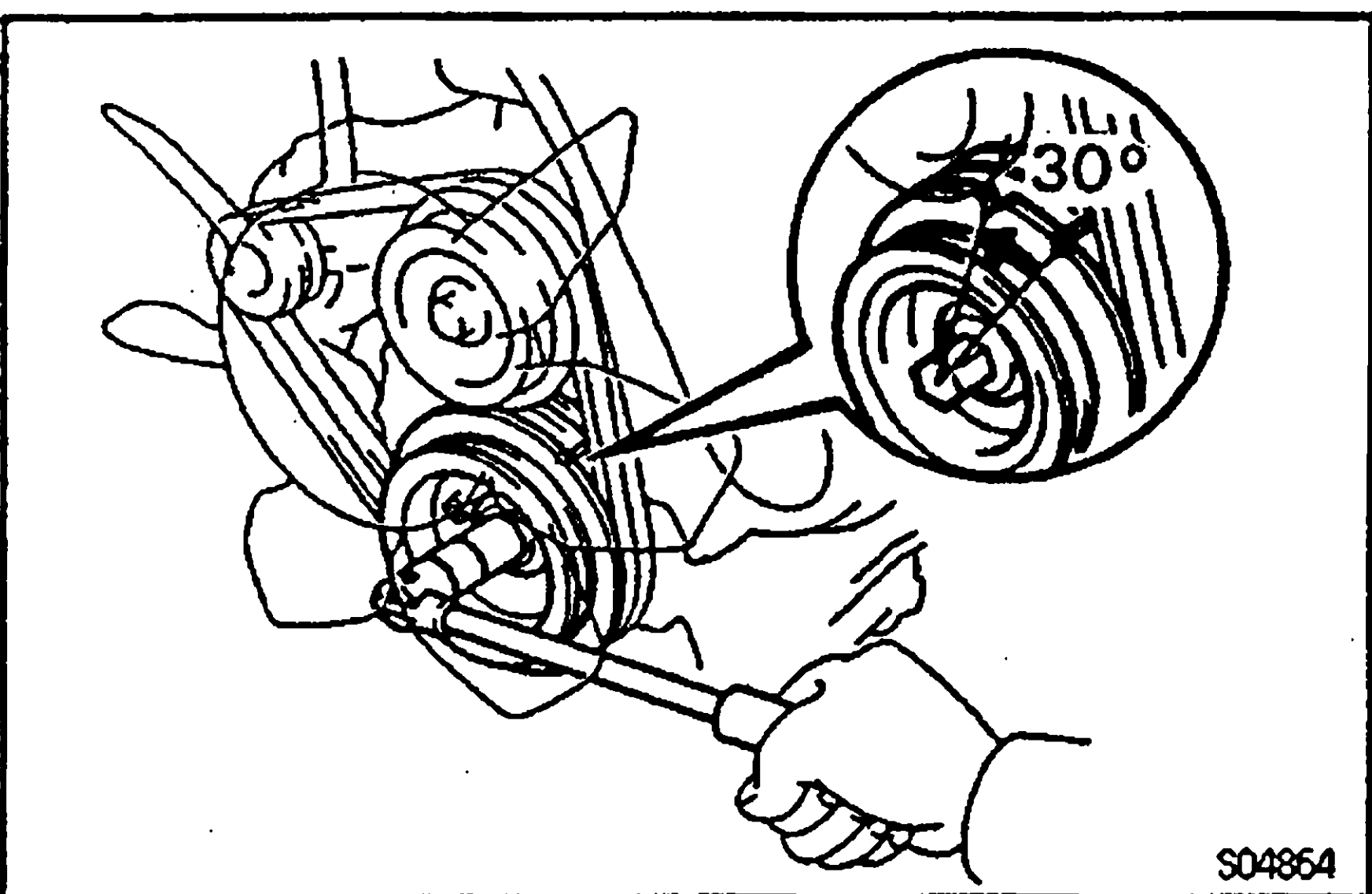
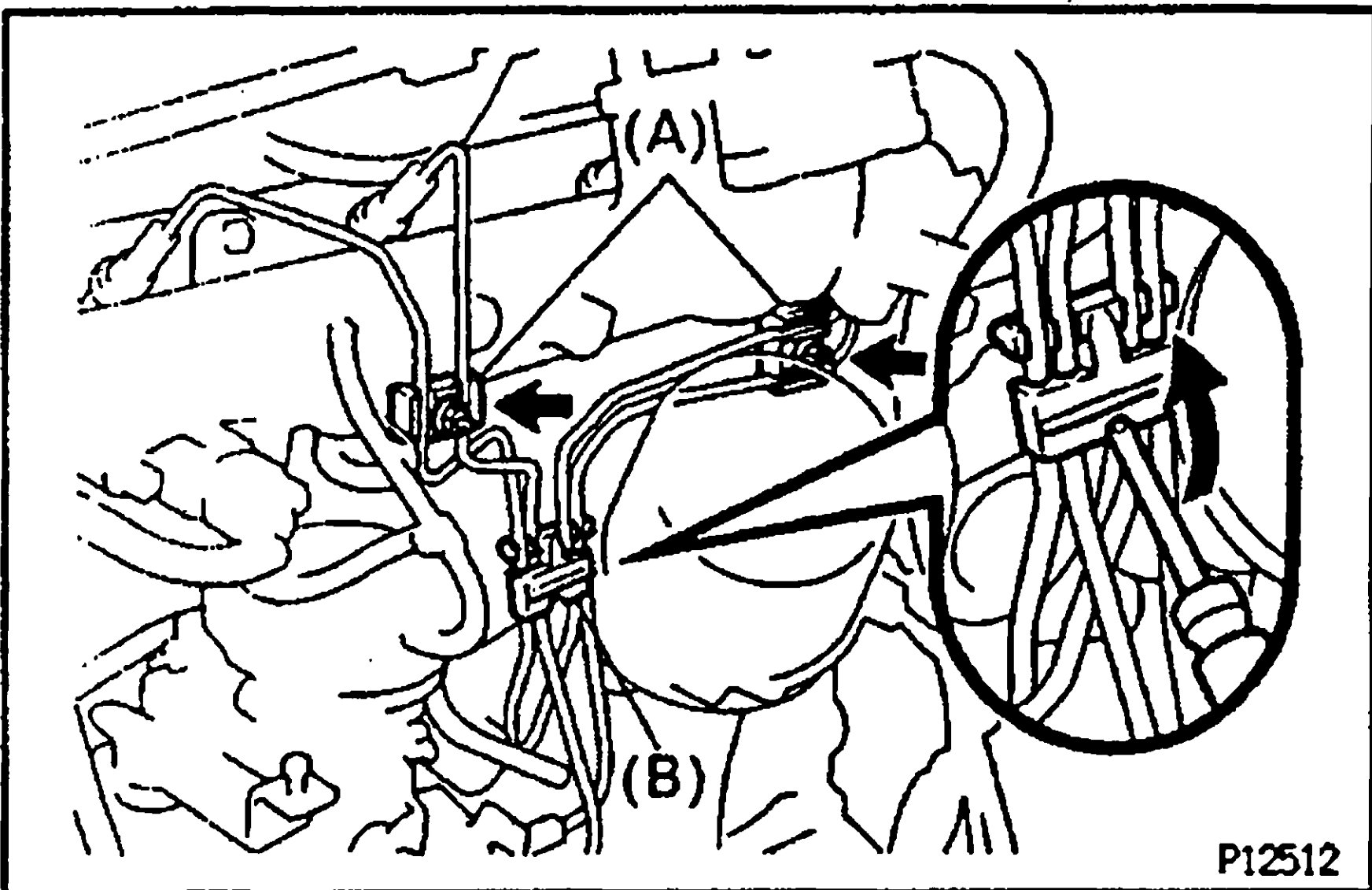
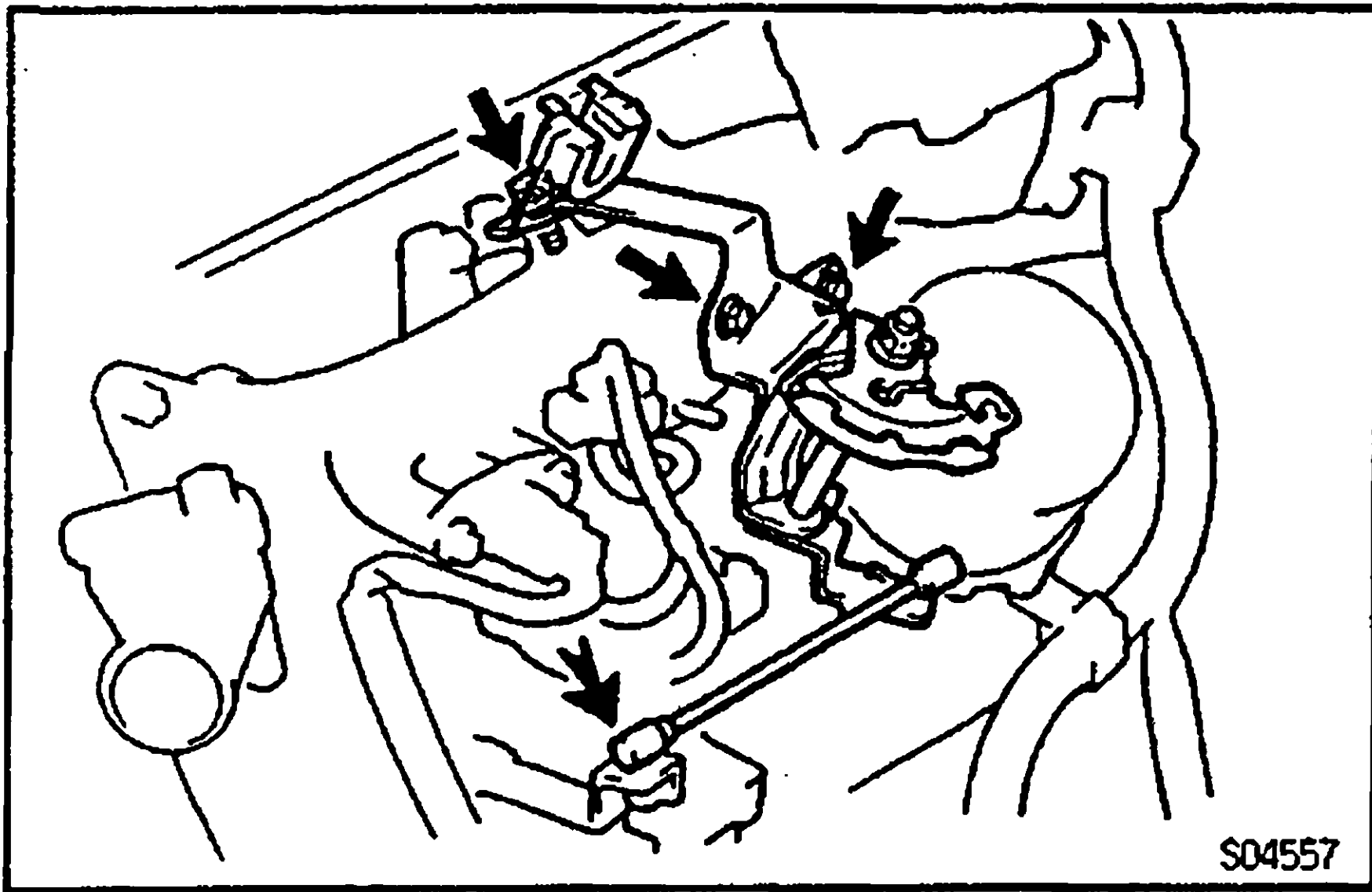
COMPONENTS FOR REMOVAL AND
INSTALLATION

EG344-06



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part



INJECTION PUMP REMOVAL

1. REMOVE INTAKE PIPE

(See step 2 in cylinder head removal in Engine Mechanical)

2. REMOVE ACCELERATOR CABLE BRACKET AND LINK

- (a) Disconnect the accelerator link from the injection pump.
- (b) Remove the 3 bolts, accelerator cable bracket and link.

3. REMOVE INJECTION PIPES

- (a) Remove the 2 nuts holding the clamps (A) to the intake manifold.
- (b) Using a screwdriver, pry out the clamp (B).
- (c) Loosen the 8 union nuts of the injection pipes.
- (d) Remove the 4 injection pipes and 2 clamps (A).

4. REMOVE TIMING BELT

(See steps 10 to 14 in cylinder head removal in Engine Mechanical)

5. CHECK INJECTION PUMP DRIVE SHAFT THRUST CLEARANCE

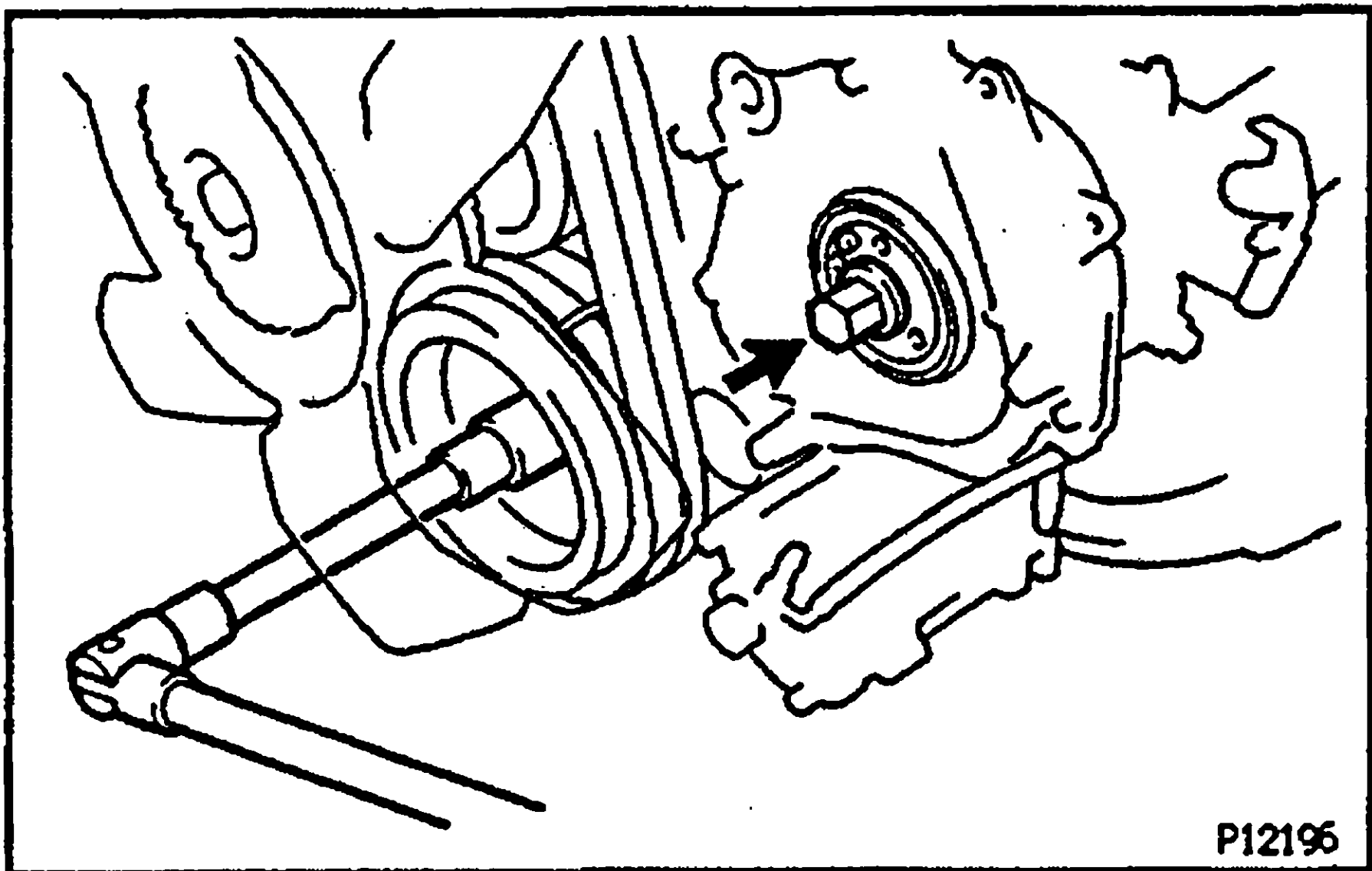
- (a) Turn the crankshaft pulley counterclockwise, so the pulley groove is about 30° from the timing pointer. HINT: To do this in order to adjust the teeth of the scissors portion of the idler gear.
- (b) Move the No.2 camshaft timing pulley forward and backward and understand the sense of thrust clearance of the injection pump.

6. REMOVE NO.2 CAMSHAFT TIMING PULLEY

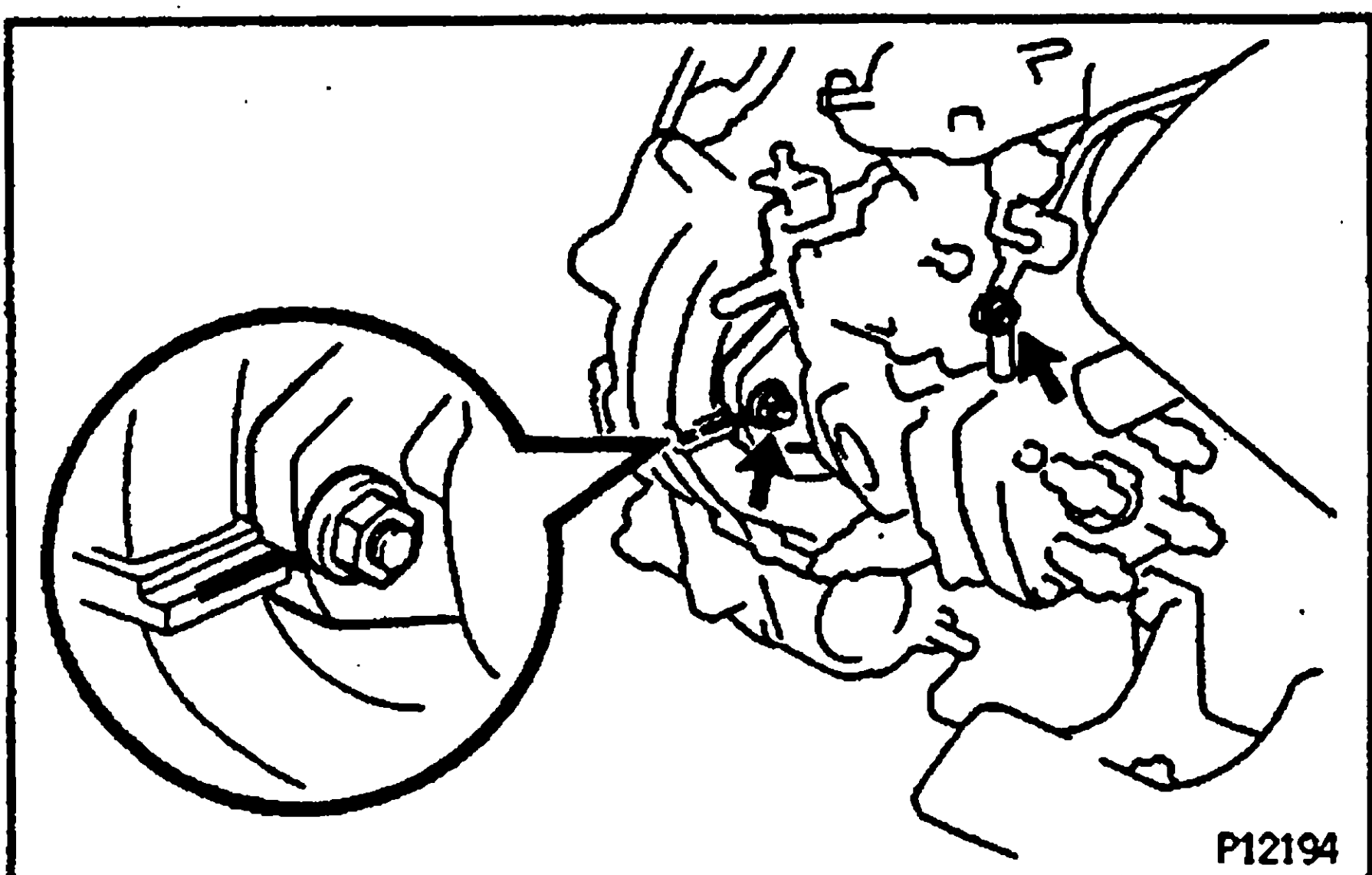
Remove the 4 bolts, camshaft timing pulley flange and camshaft timing pulley.

7. REMOVE INJECTION PUMP

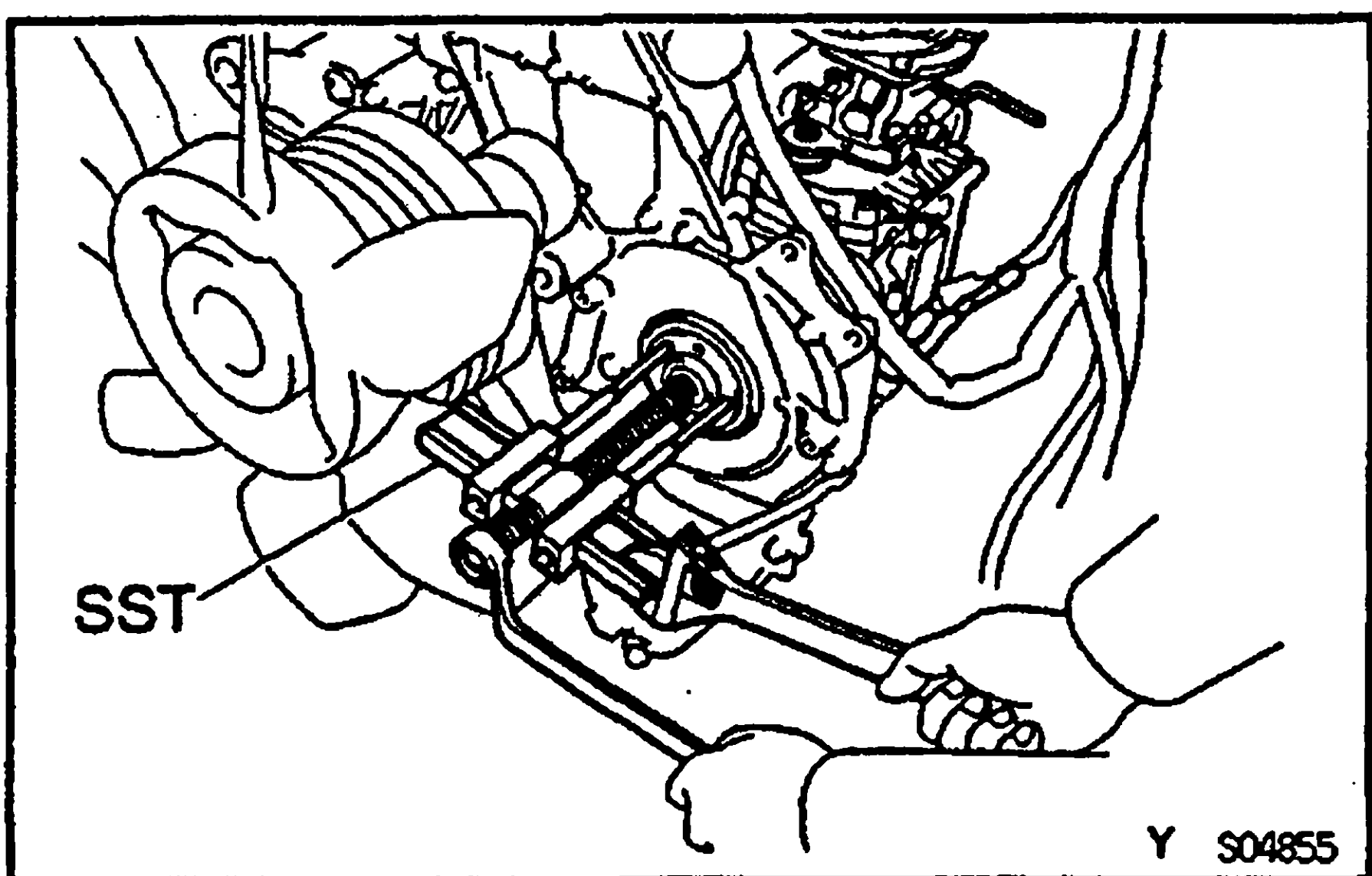
- (a) Disconnect the injection pump connector.
- (b) Disconnect these hoses:
 - (1) Fuel hose
 - (2) Boost compensator hose
 - (3) BACS vacuum hose



- (c) Hold the crankshaft pulley, and remove the injection pump drive gear set nut.
- (d) Remove the O—ring from the injection pump drive gear.



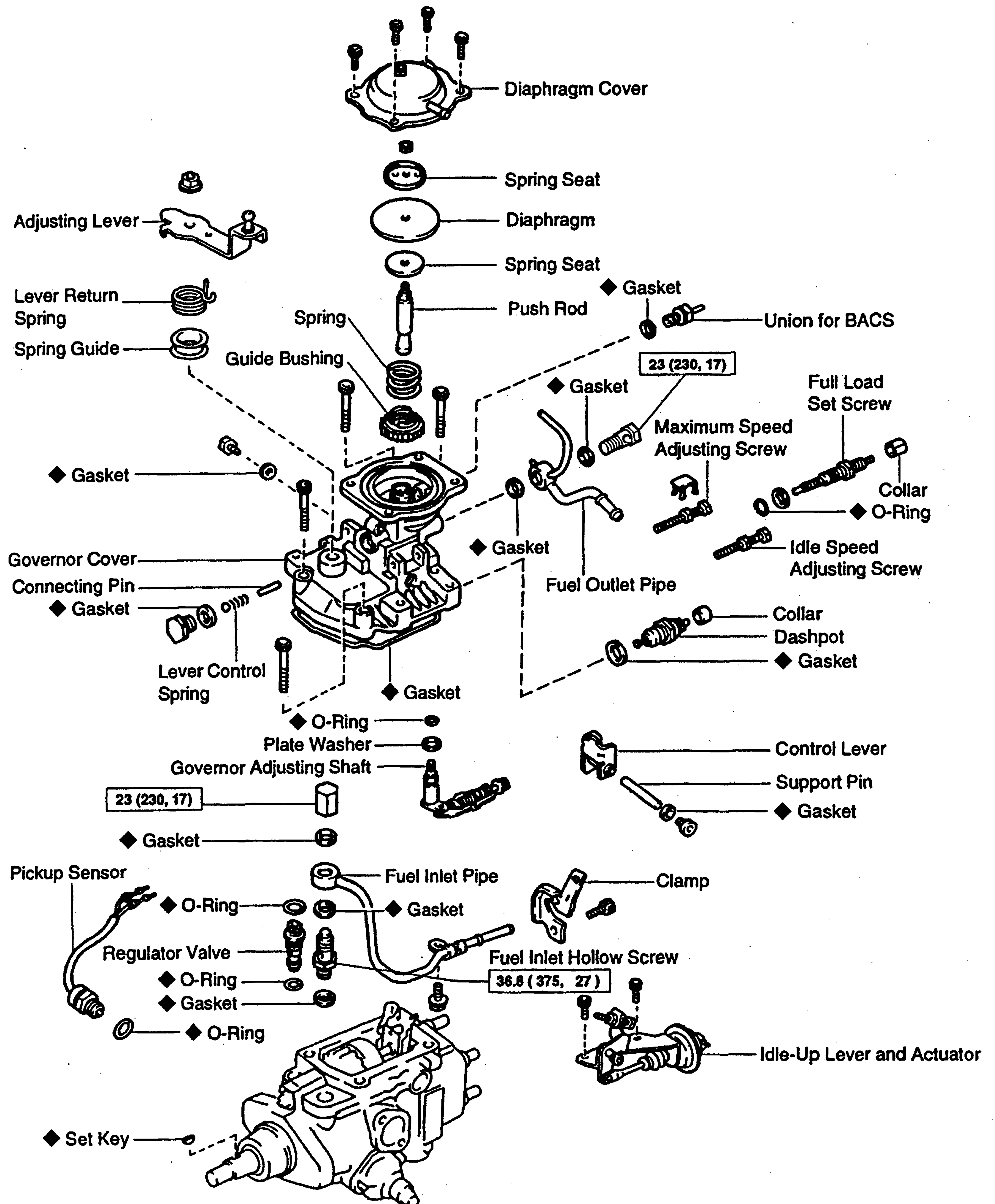
- (e) Before removing the injection pump, check if the punching line of the injection pump flange and upper processing surface are aligned. If not, place new matchmarks for reinstallation.
- (f) Loosen the 2 nuts holding the injection pump to the timing gear case.
- (g) Remove the 3 bolts and injection pump stay.



- (h) Using SST, disconnect the injection pump from the timing gear case.
SST 09950—50010 (09951—05010, 09952—05010, 09953—05020, 09954—05010)
- NOTICE:**
- Do not hold or carry the injection pump by the adjusting lever.
 - Do not put the injection pump at an angle more than 45° from the horizontal.
- (i) Remove the 2 nuts and injection pump.
 - (j) Remove the O—ring from the injection pump.

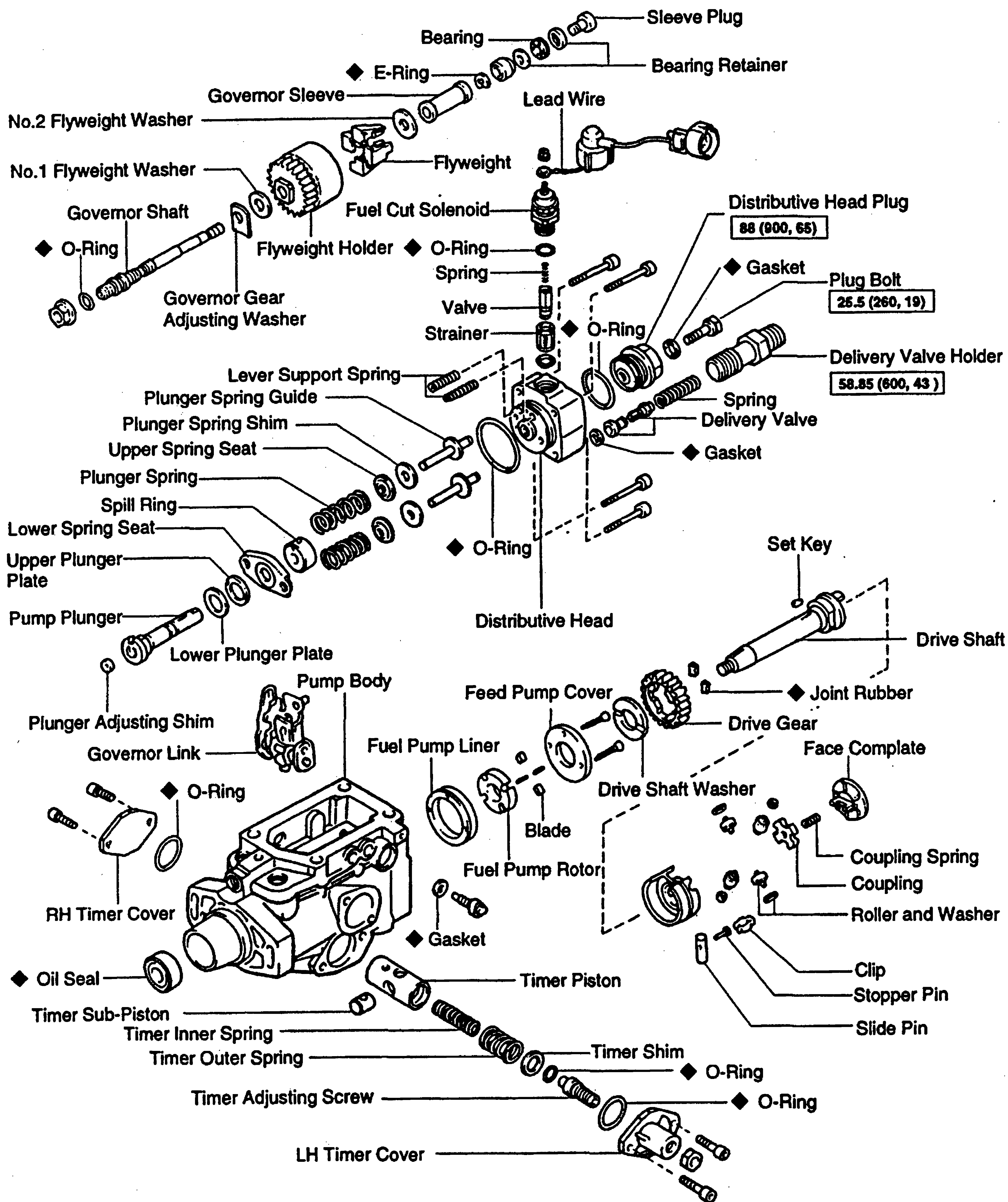
COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

EG348-09



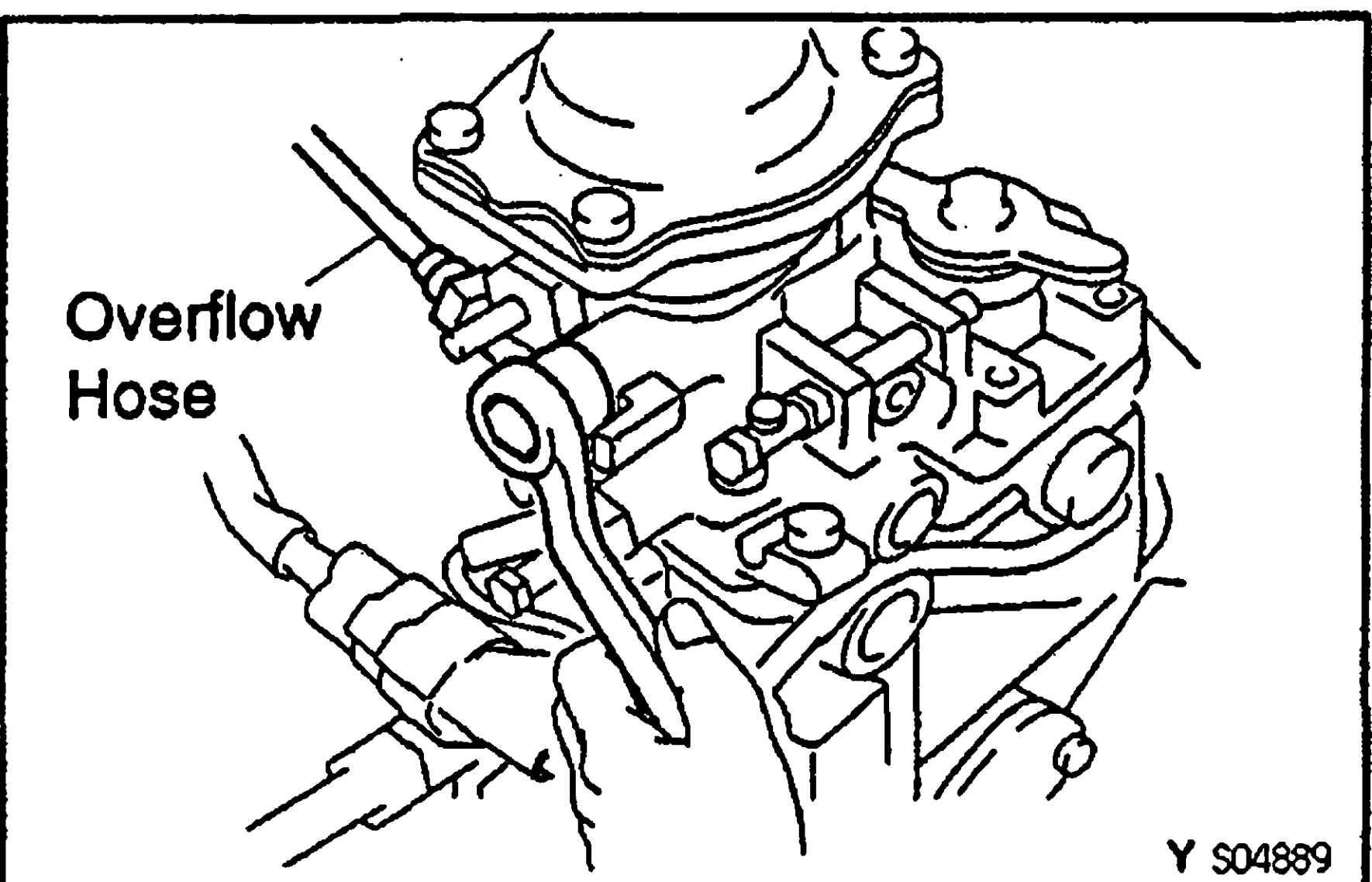
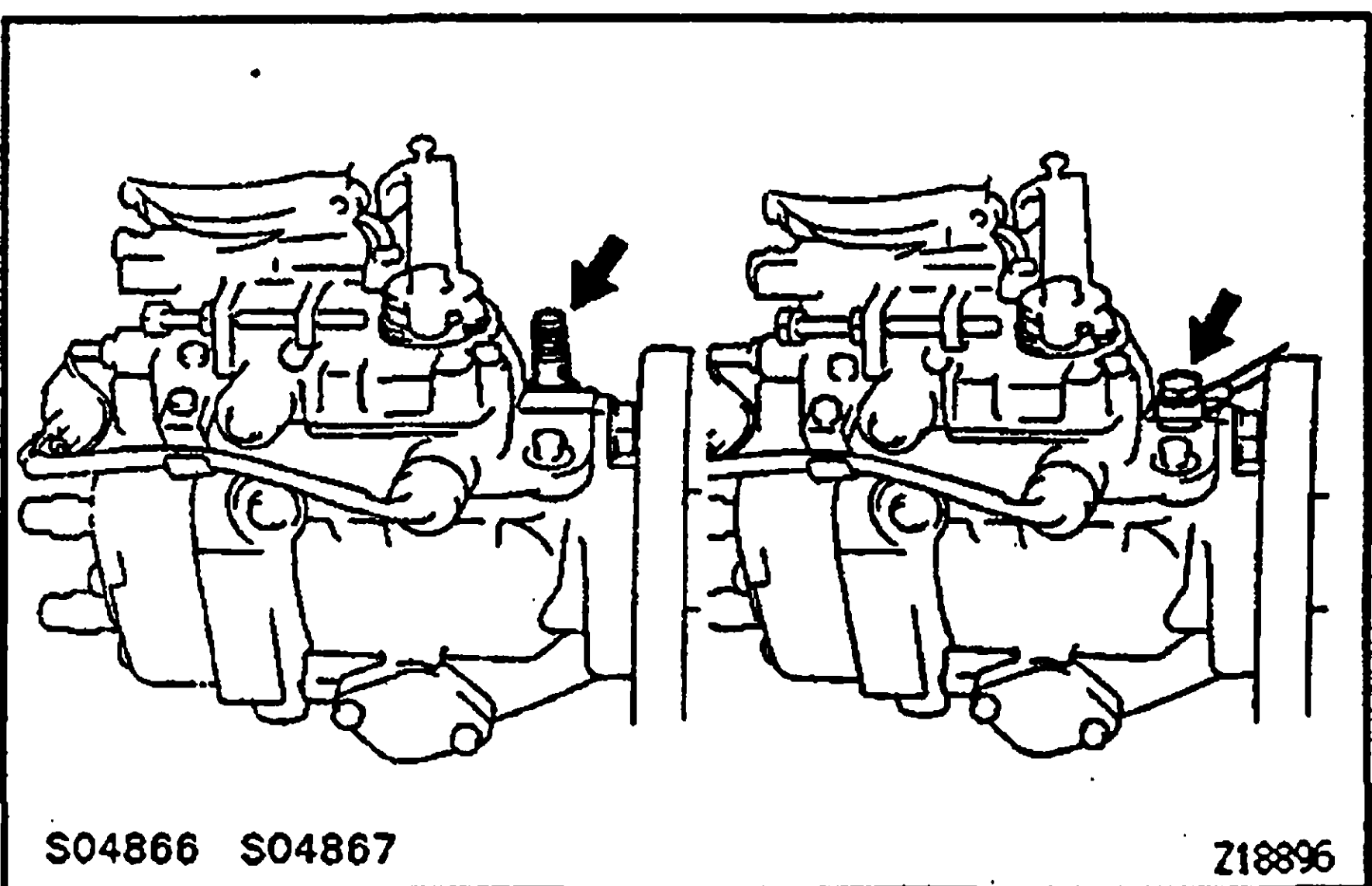
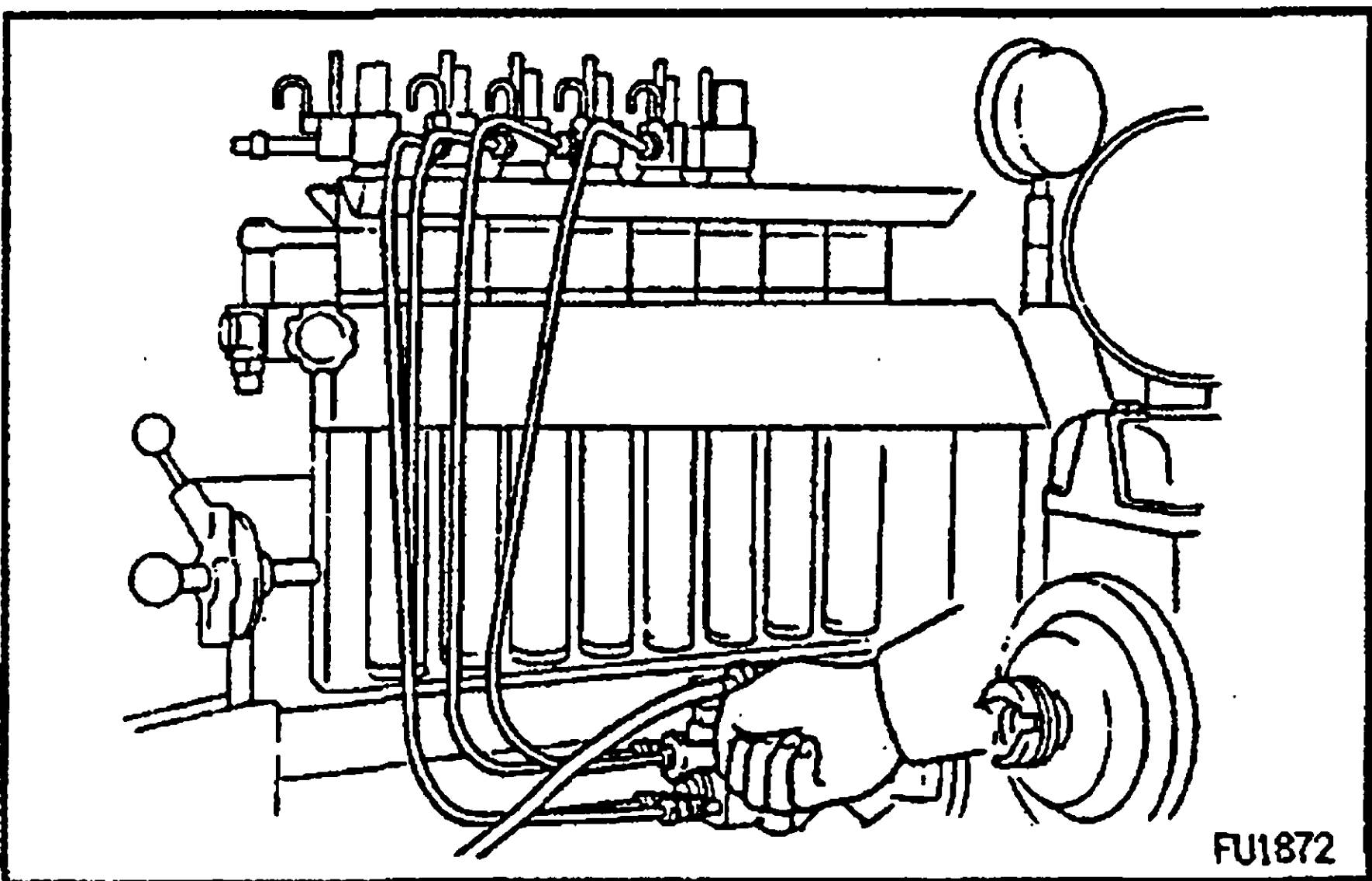
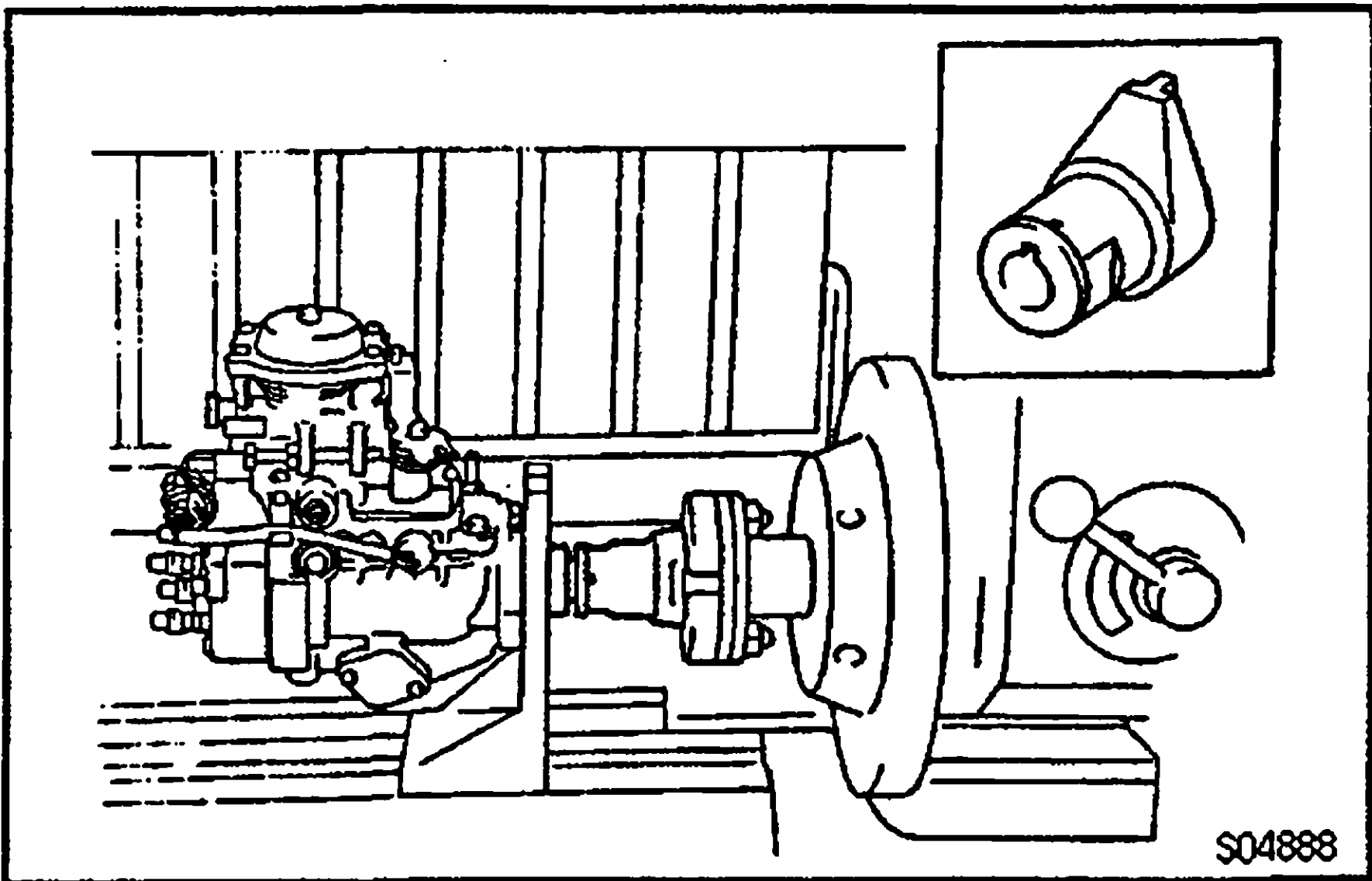
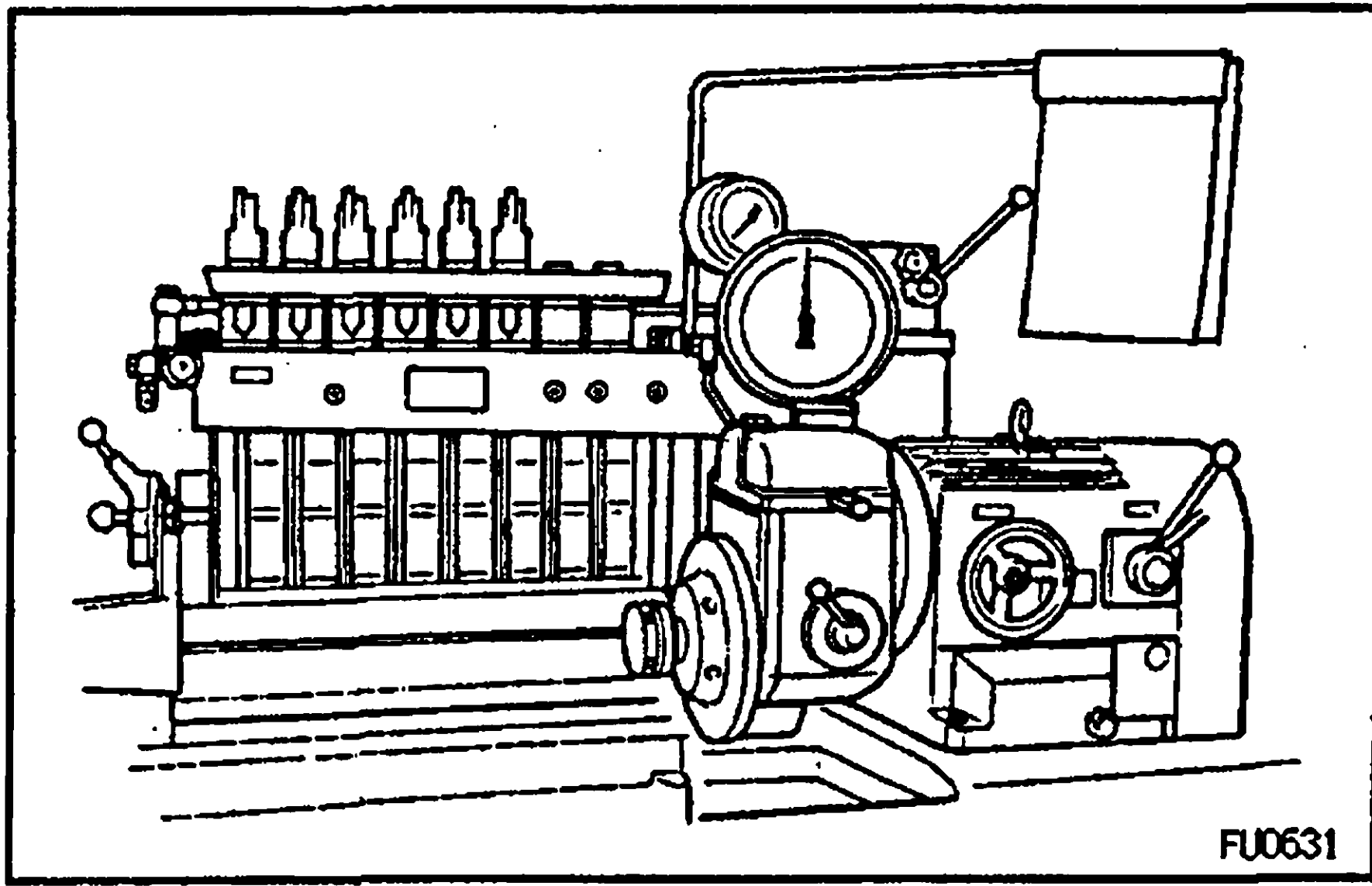
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part



INJECTION PUMP ADJUSTMENT

1. PRE-TEST CHECK AND PREPARATION

- (a) The specifications for test nozzle and nozzle holders are as follows.

Test nozzle:

DN12SD12 (NIPPONDENSO)

Test nozzle opening pressure:

14,220 — 15,200 kPa

(145 — 155 kgf/cm², 2,062 — 2,205 psi)

- (b) Check the accuracy of the tachometer.

Allowable error:

± 40 rpm

- (c) Install the angle gauge stand.

- (d) Mount the injection pump body on the pump tester.
HINT: Place a mark on the key groove portion of the coupling.

- (e) Install an injection pipe with these specifications:

Outer diameter	6.0 mm (0.236 in.)
Inner diameter	2.0 mm (0.079 in.)
Length	840 mm (33.07 in.)
Minimum bending radius	25 mm (0.98 in.) or more

Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

- (f) Remove the fuel inlet hollow screw.

- (g) Connect the fuel inlet pipe with an adapter.

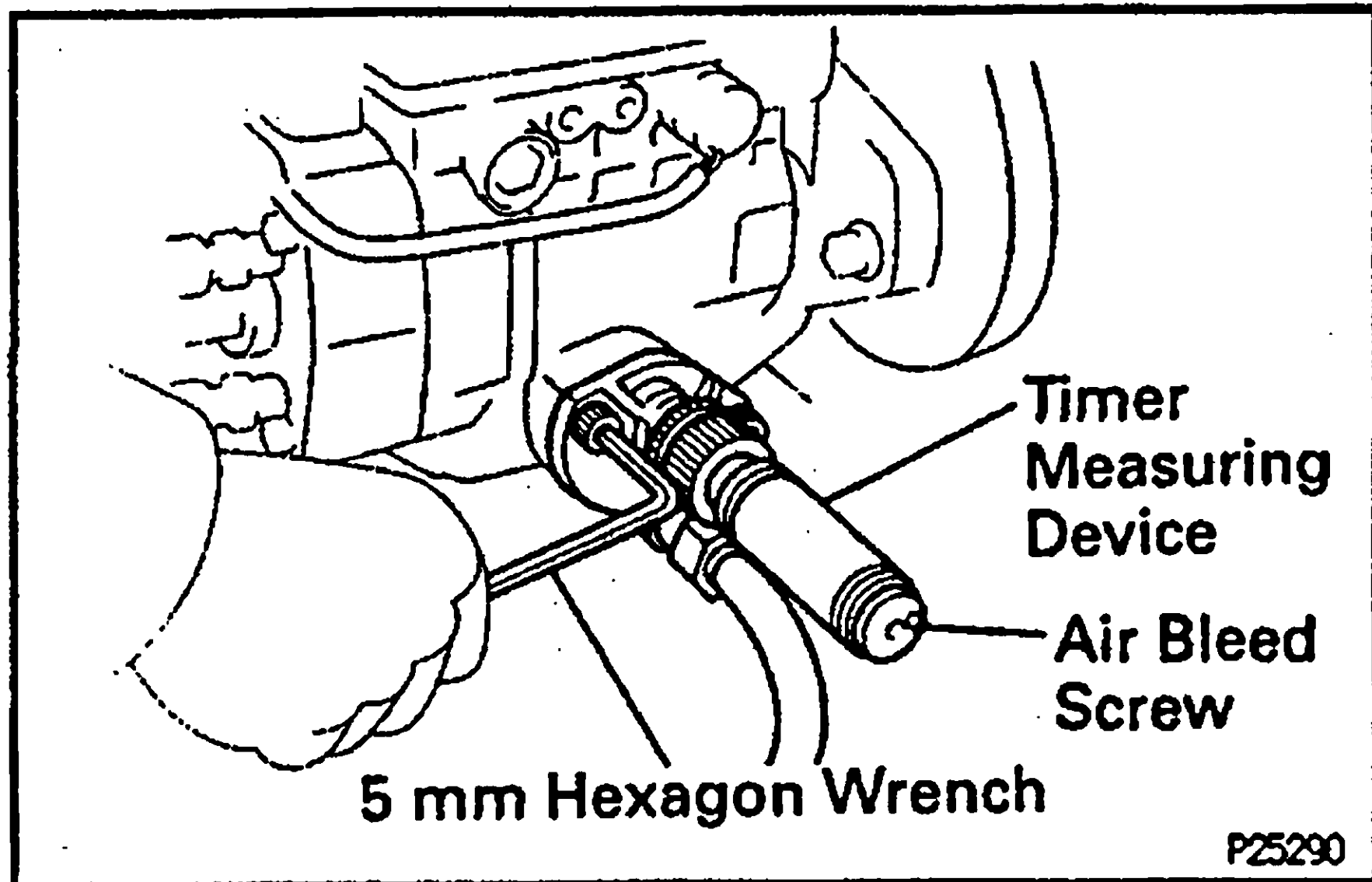
Torque: 36.8 N·m (375 kgf·cm, 27 ft·lbf)

- (h) Install an overflow hose with the 2 gaskets and an overflow screw.

Torque: 24.55 N·m (250 kgf·cm, 18 ft·lbf)

HINT: Always use the overflow screw installed on the pump to be adjusted.

- (i) Using a 5 mm hexagon wrench, remove the 2 bolts and RH timer cover.



- (j) Install the inner pressure gauge with the timer measuring device.

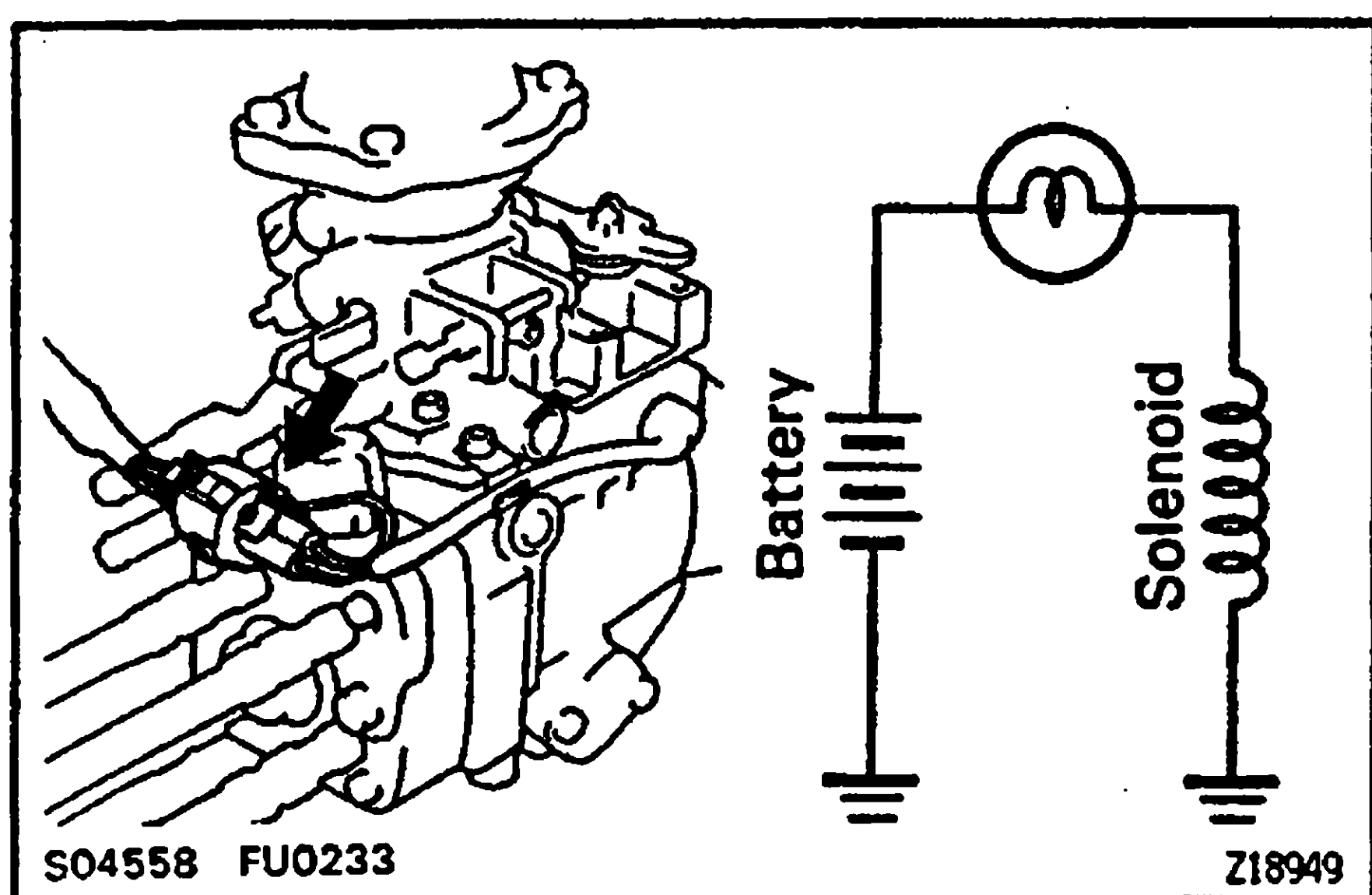
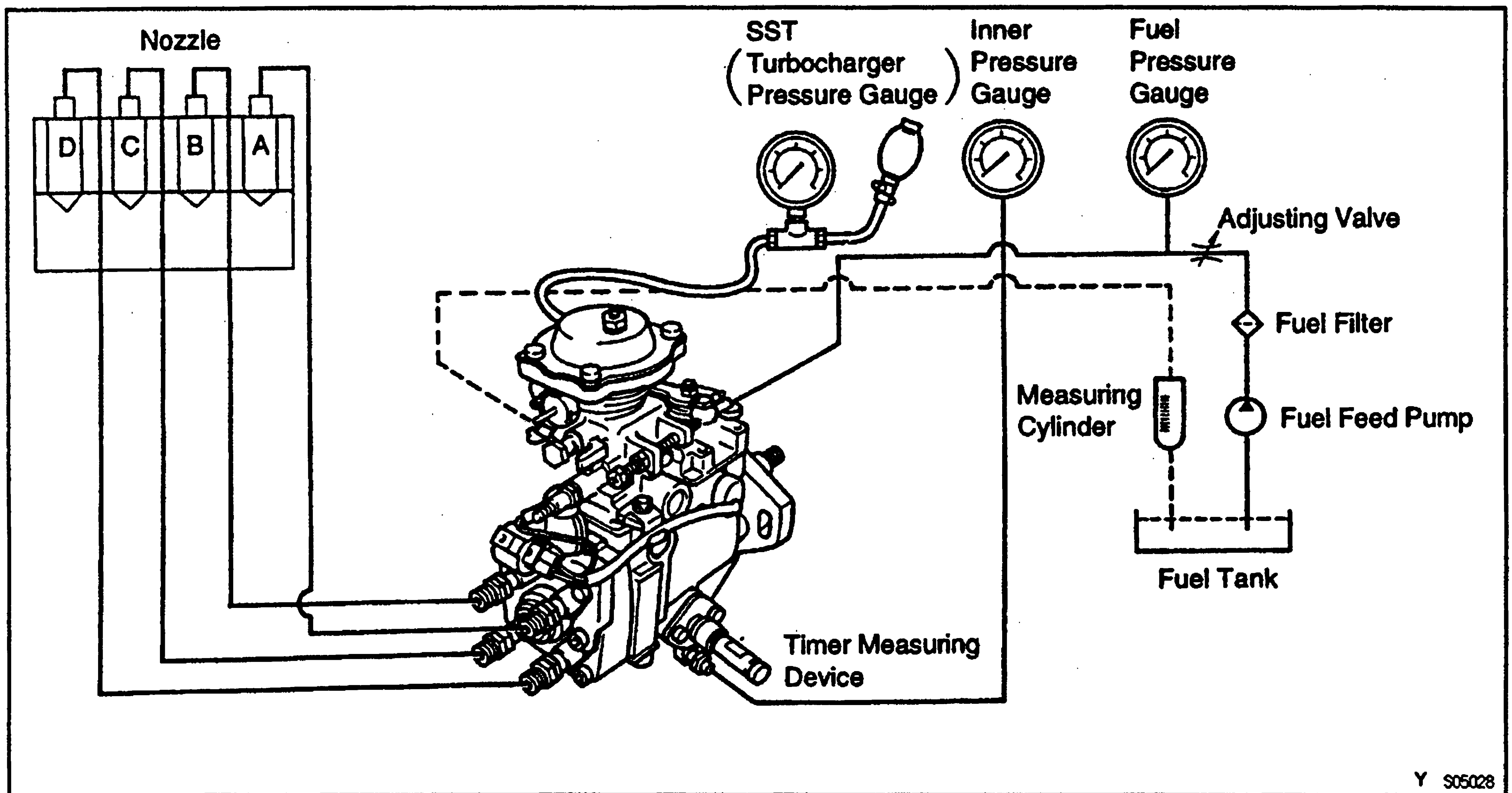
Part No. 95095-10231, 95095-10480
(NIPPONDENSO)

Torque: 8.35 N·m (85 kgf·cm, 74 in.-lbf)

HINT: Bleed the air by the air bleed screw.

- (k) Connect SST (turbocharger pressure gauge) to the boost compensator.

SST 09992-00241



- (l) Apply about 6 volts of DC power to the fuel cut solenoid.

NOTICE:

- When applying voltage to the solenoid, position the battery as far away from the solenoid as possible so that a spark does not occur.
- When connecting the battery cable, connect the solenoid side first.

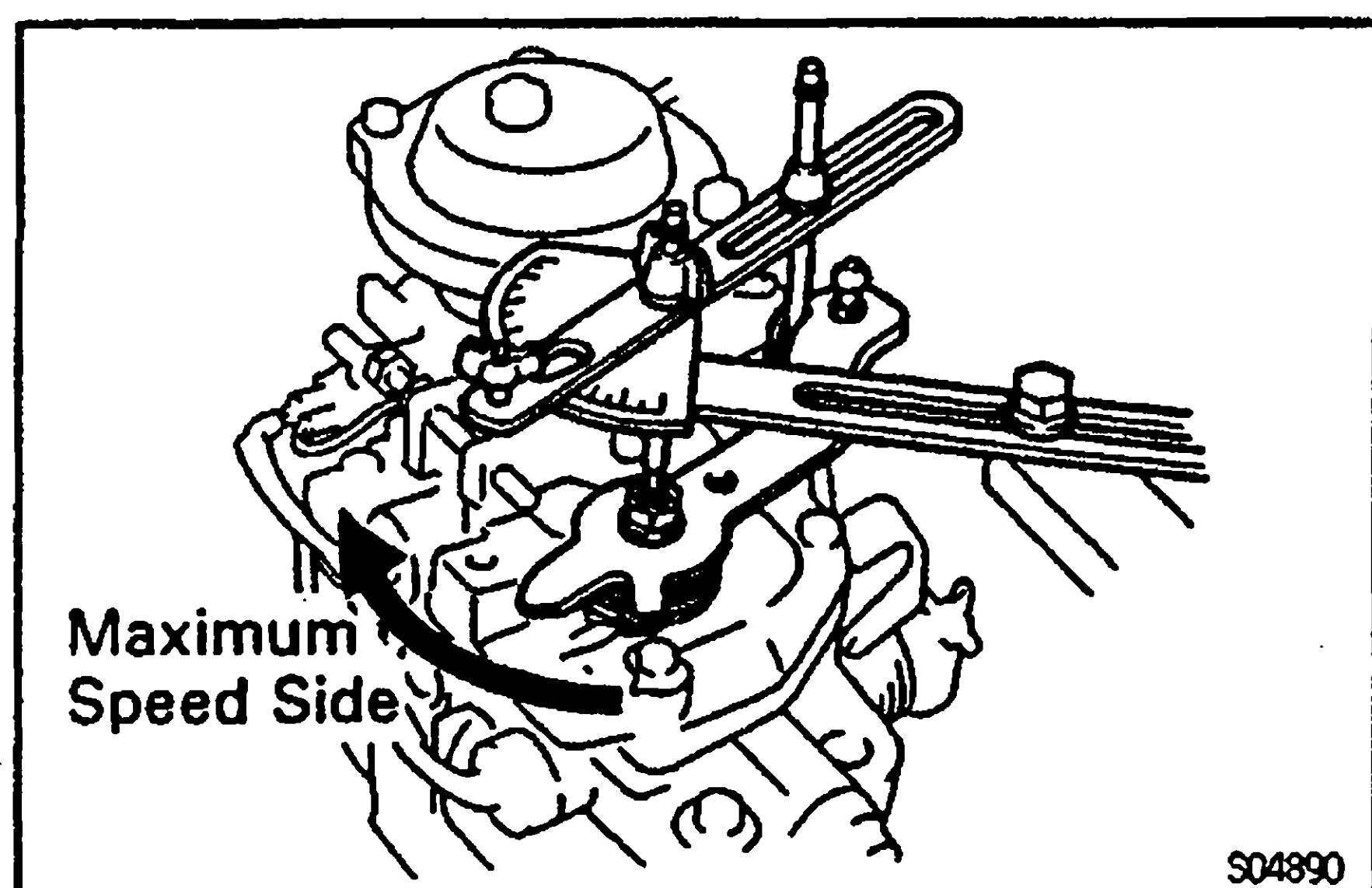
HINT: Connect the battery through a 10 W bulb.

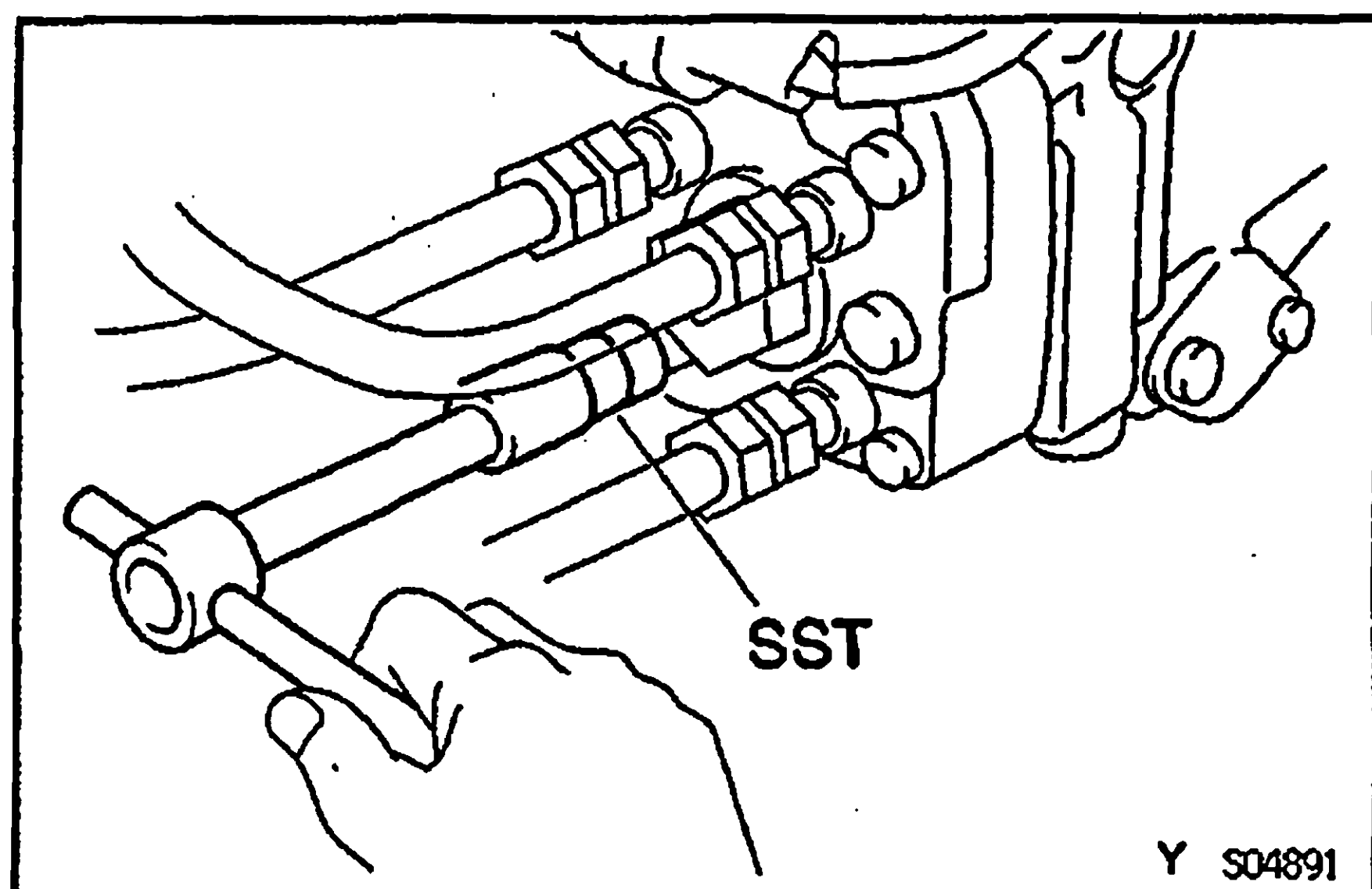
- (m) The pressure for feeding fuel to the injection pump should be 20 kPa (0.2 kgf/cm², 2.8 psi). The fuel temperature for pump testing should be 40 – 45°C (104 – 113°F).

- (n) Install an angle gauge to the stand, and set it to the adjusting lever.

Part No. 95095-10360 (Stand w/ angle gauge)

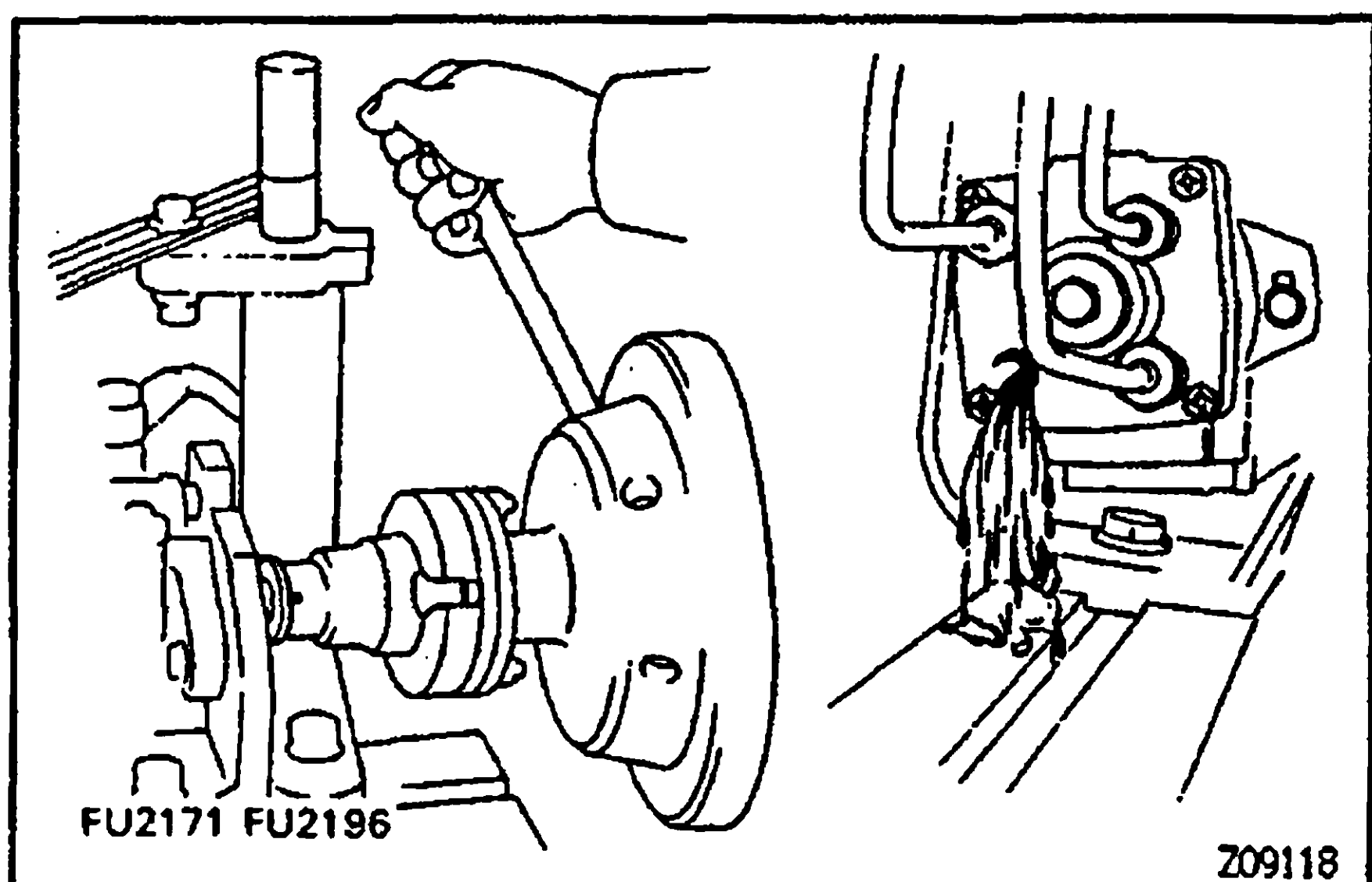
- (o) Secure the adjusting lever fully on the maximum speed side.





(p) Check the installation direction of the camplate as follows:

- Disconnect the injection pipe from the position marked "C" on the distributive head.
- Using SST, remove the delivery valve holder.
SST 09260–54012 (09269–54020)

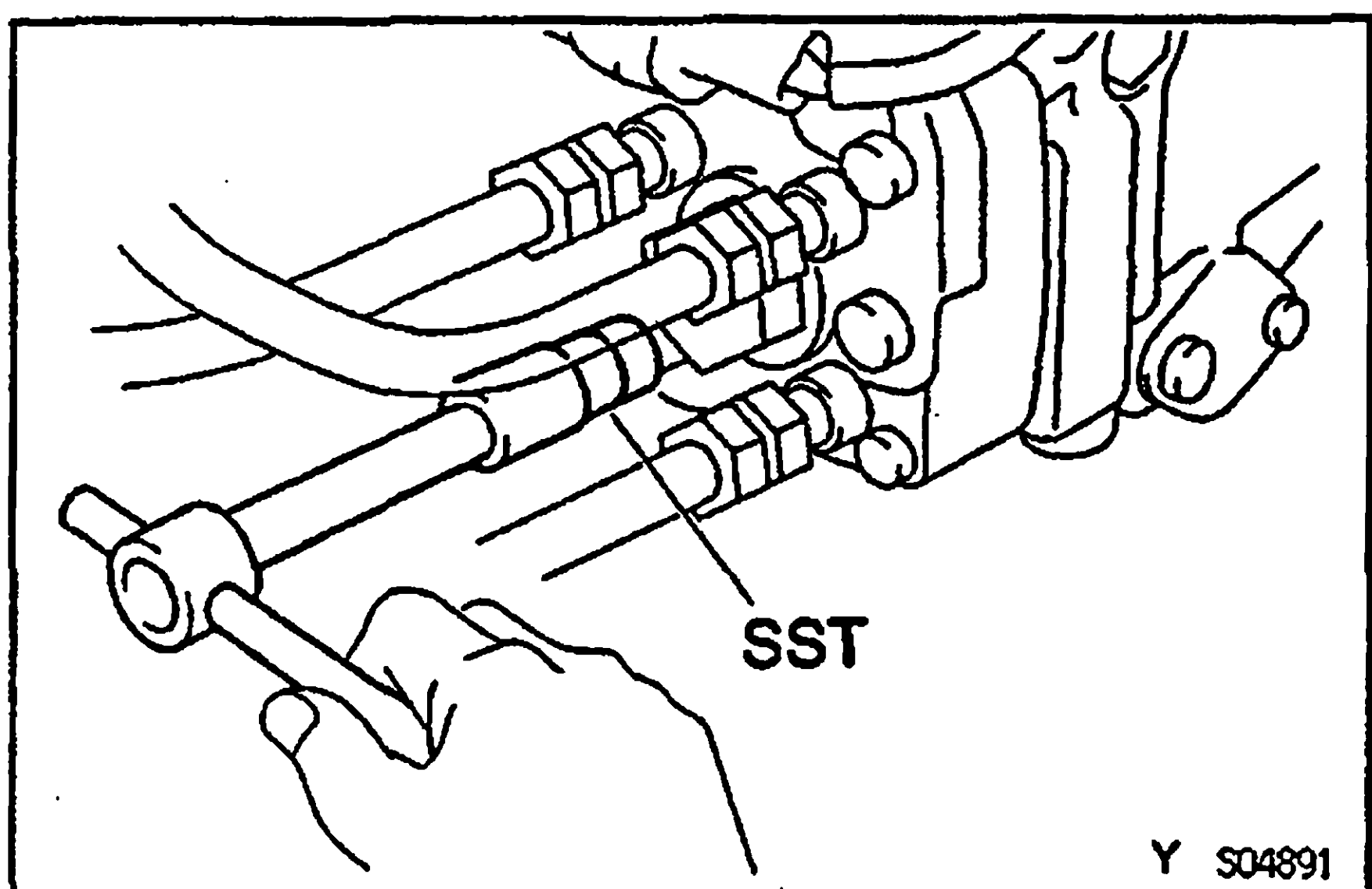


- Check that fuel is flowing out when the mark is in the position shown in the illustration.

If not, it is improperly assembled.

- Disassemble and change the camplate position 180° in the opposite direction.

HINT: At this time, disconnect the fuel cut solenoid connector.

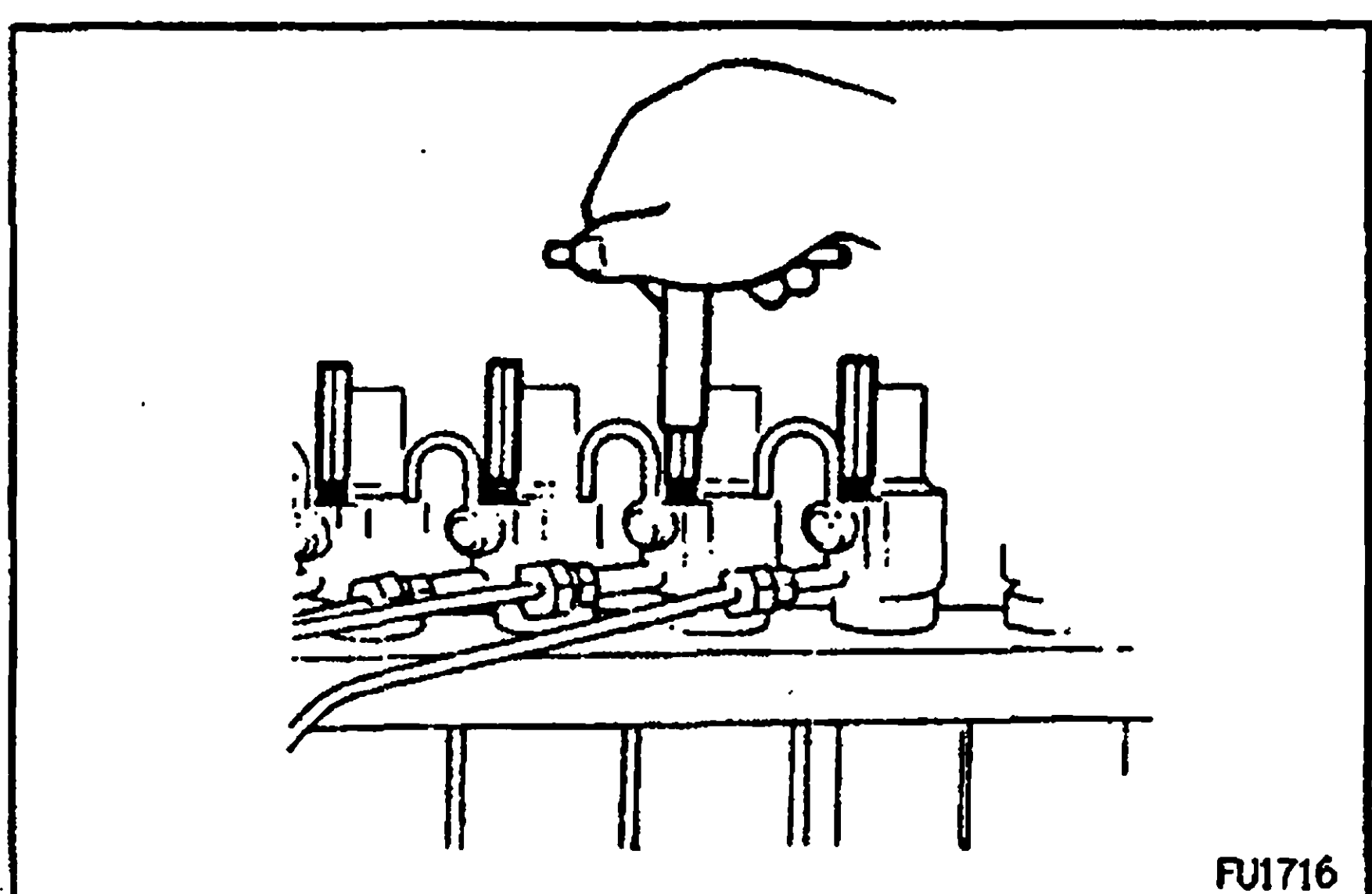


- Using SST, install the delivery valve holder.
SST 09260–54012 (09269–54020)

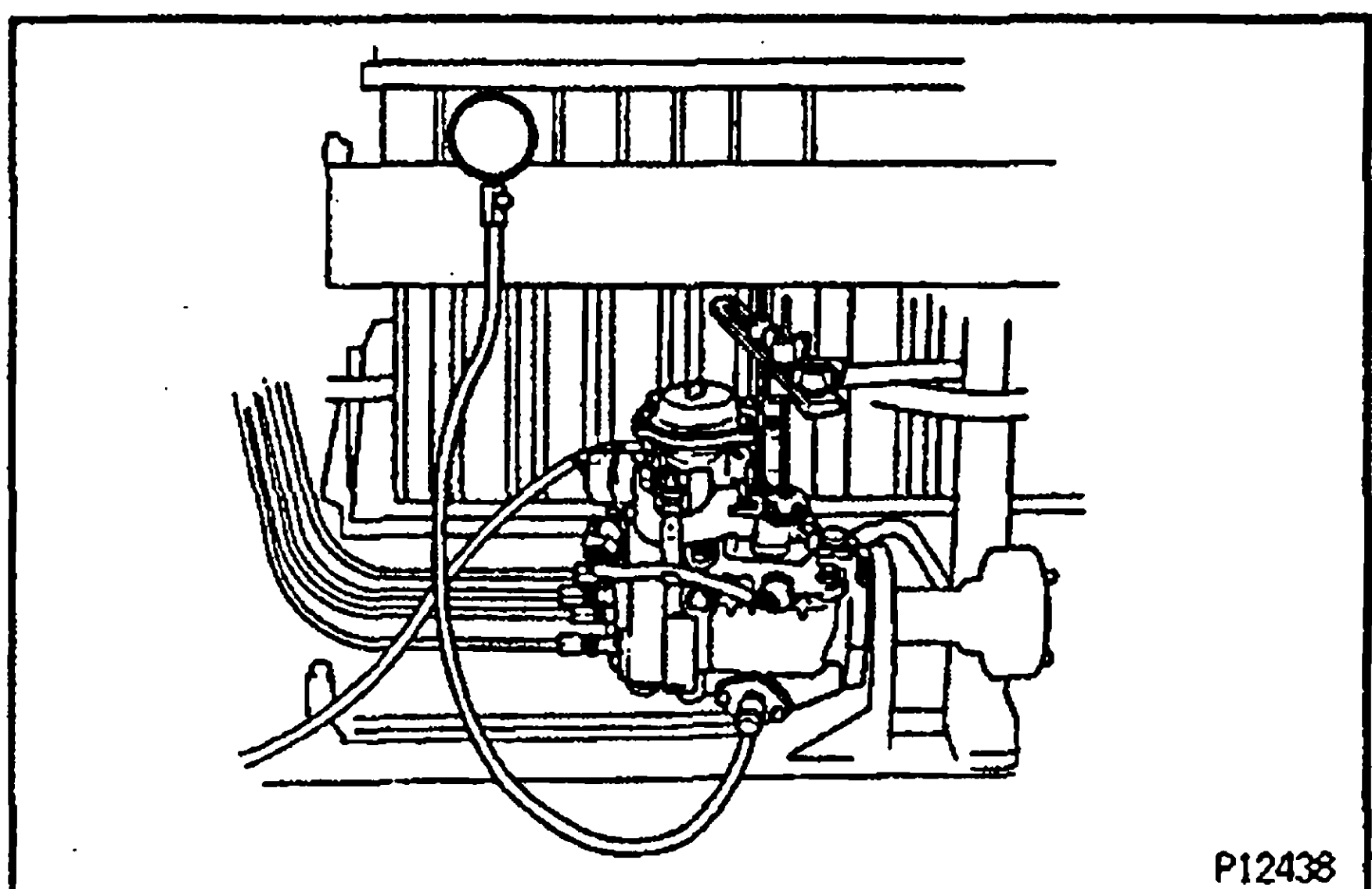
Torque: 58.85 N·m (600 kgf·cm, 43 ft·lbf)

- Connect the injection pipe.

Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

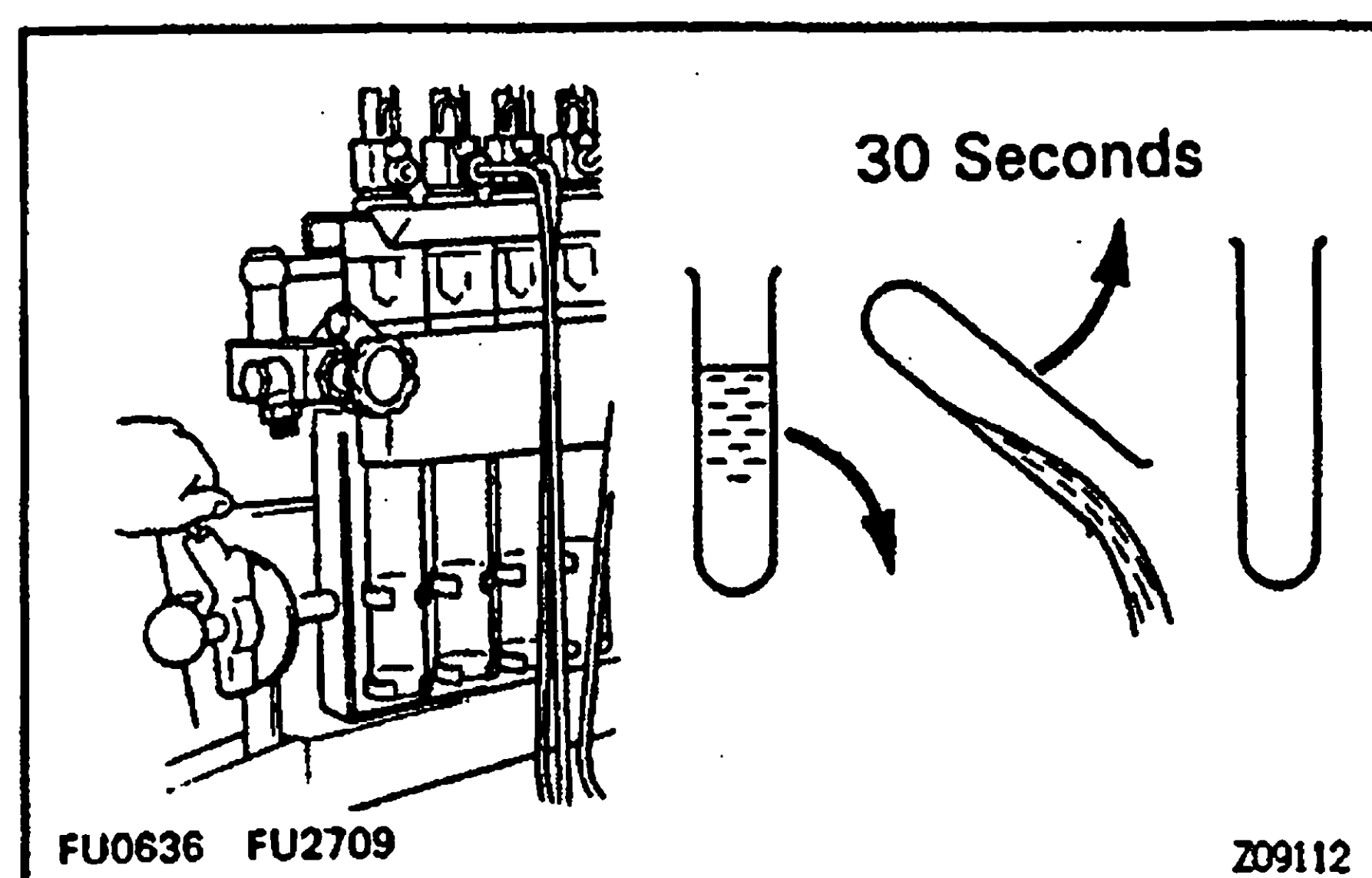


(q) Bleed the air from the injection pipes.



(r) Race the injection pump for 5 minutes at 2,000 rpm.
HINT: Do this operation by replacing the overflow screw to a hollow screw.

NOTICE: Check that there is no fuel leakage or abnormal noise.

**HINT:**

- Measure the volume of each injection cylinder with a measuring cylinder.
- Before measuring the injection volume, first hold the cylinder tilted for at least 30 seconds to discard all the fuel.

2. CHECK BOOST COMPENSATOR FOR AIR TIGHTNESS

- Operate the boost compensator with 0 kPa (0 kgf/cm², 0 psi) to 120 ± 6.7 kPa (1.22 ± 0.07 kgf/cm², 17.4 ± 1.0 psi) of pressure for 10 seconds for each and repeat this operation 4 times.
- Apply 133 kPa (1.36 kgf/cm², 19.3 psi) of pressure to the boost compensator.
- Measure the time it takes for pressure to drop to 131 kPa (1.34 kgf/cm², 19.1 psi).

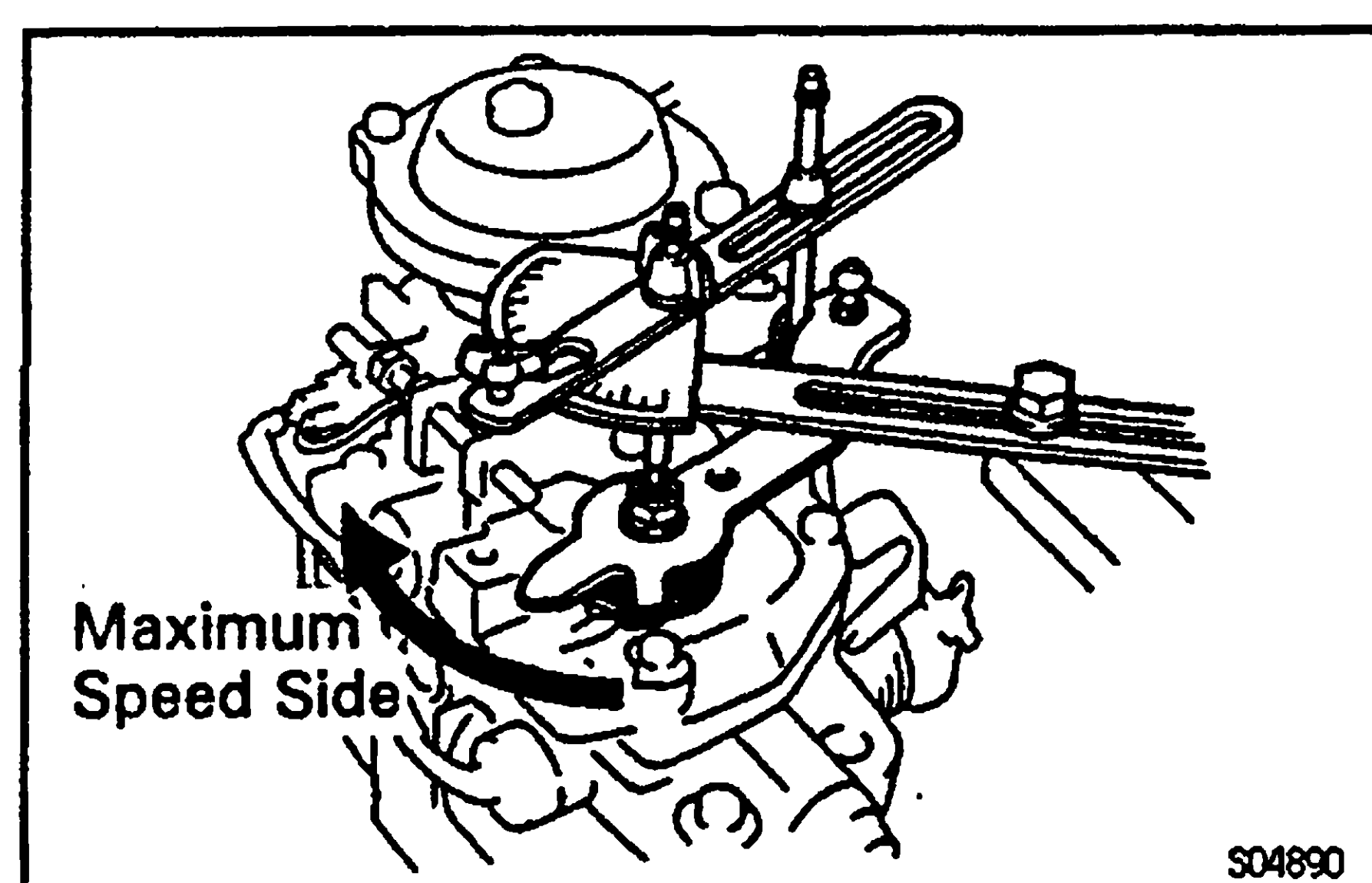
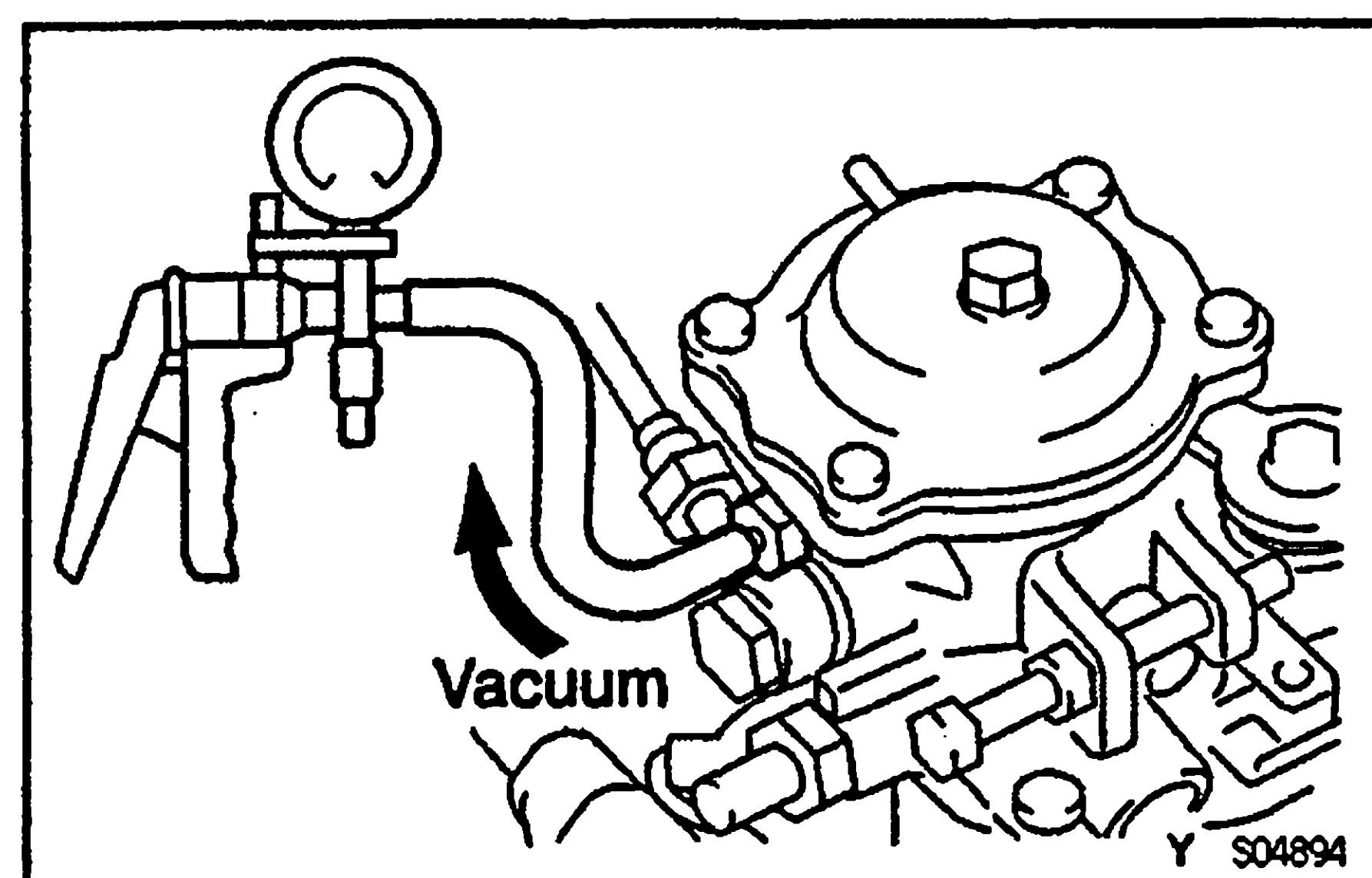
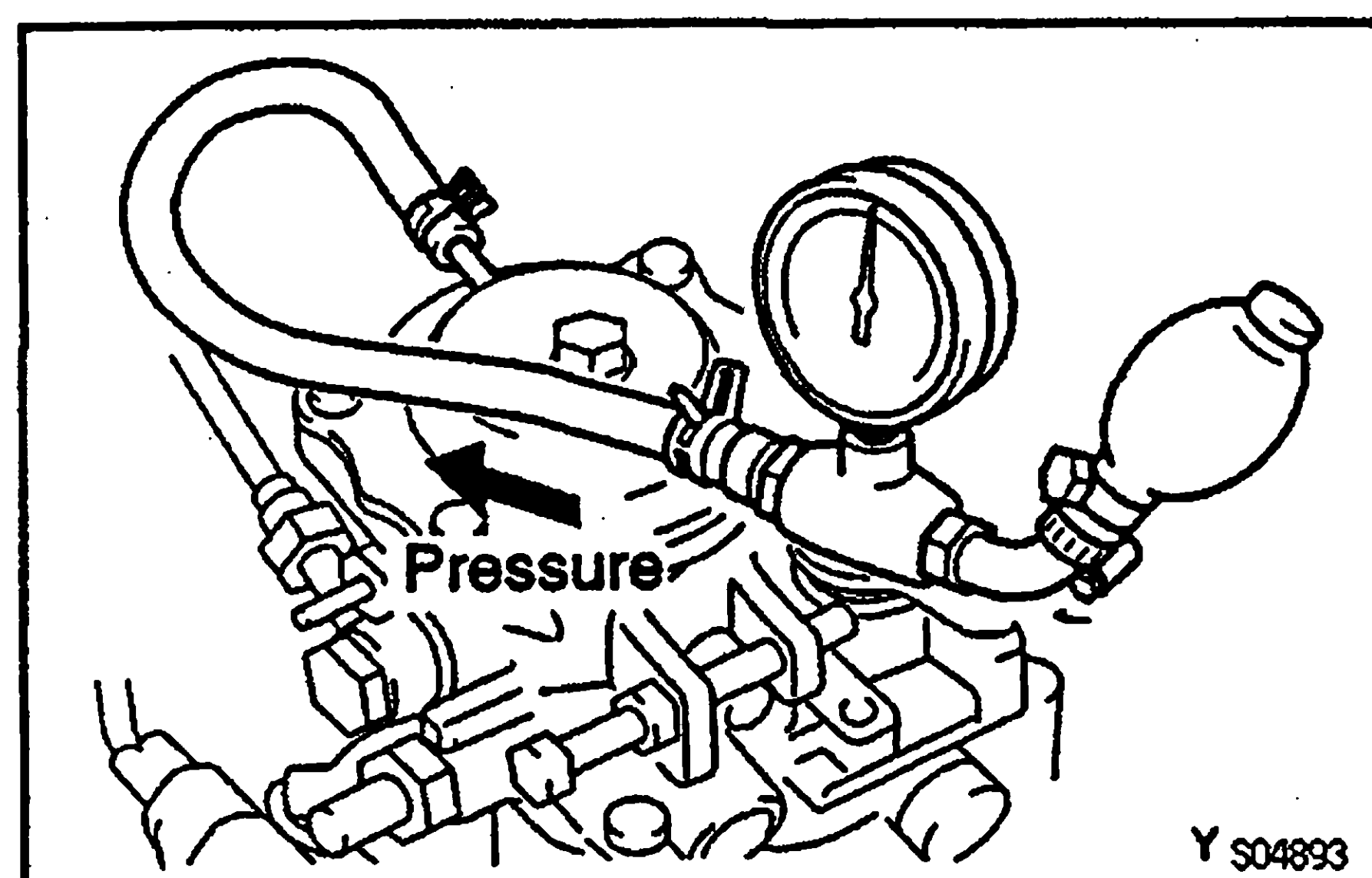
Pressure drop:

10 seconds or more

- Apply 73 kPa (548 mmHg, 21.56 in.Hg) of vacuum to the union for the BACS.
- Measure the time it takes for vacuum to drop to 72 kPa (540 mmHg, 21.26 in.Hg).

Vacuum drop:

5 seconds or more



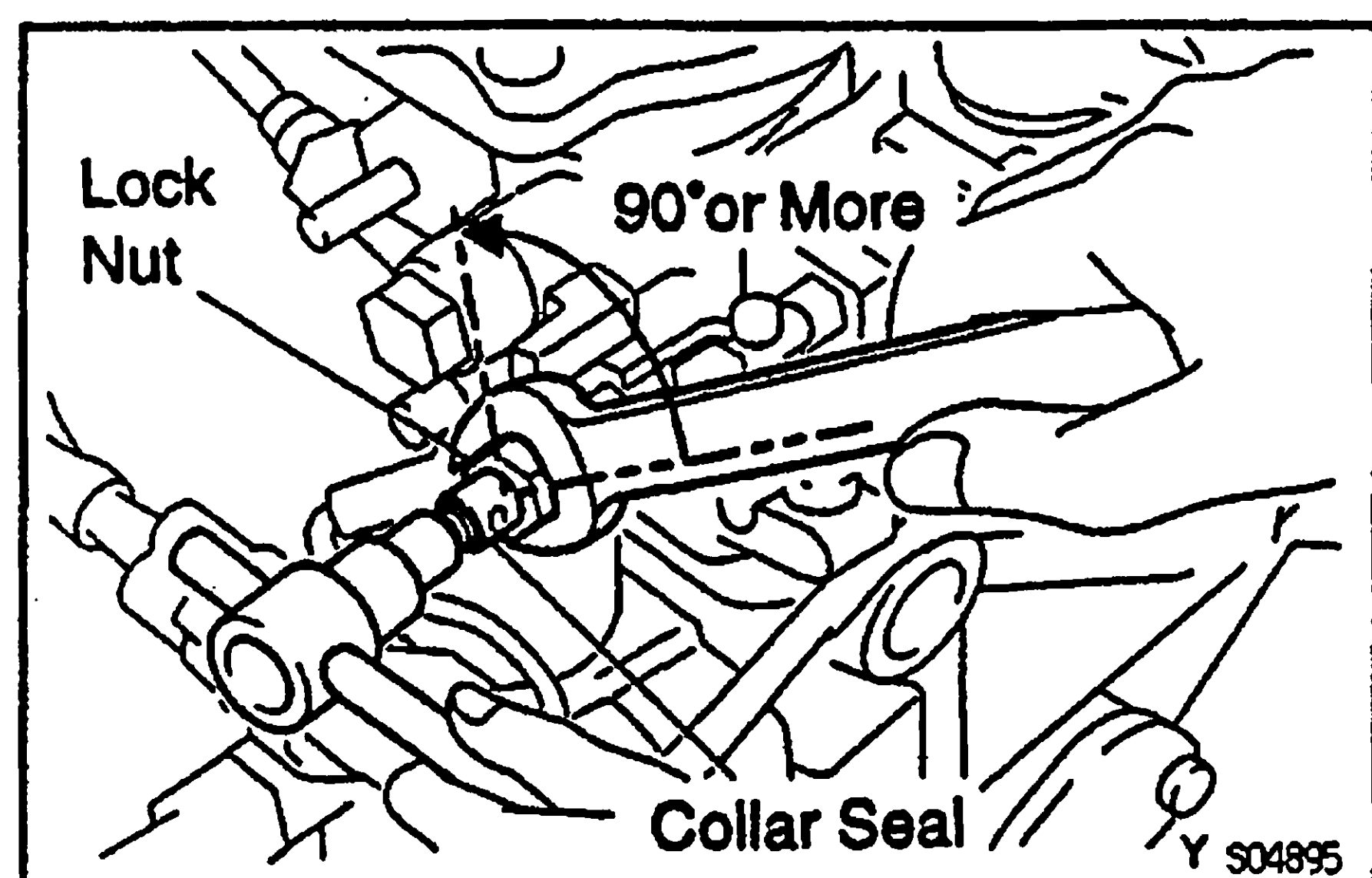
3. PRE-SET FULL LOAD INJECTION VOLUME

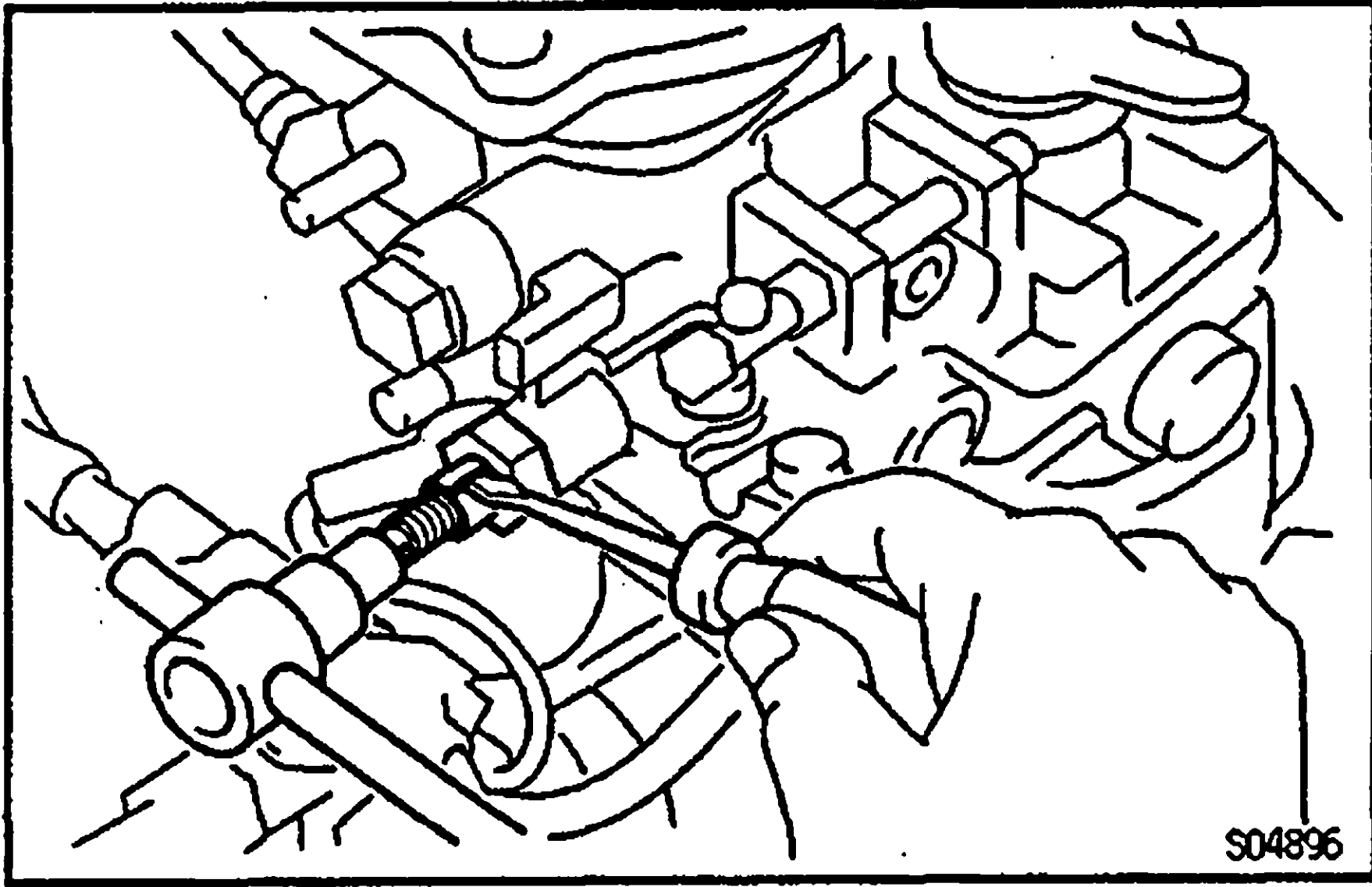
- Set the adjusting lever to maximum position.
- Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
- Measure the injection volume.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
1,800	200	14.5 – 14.9 (0.88 – 0.91)

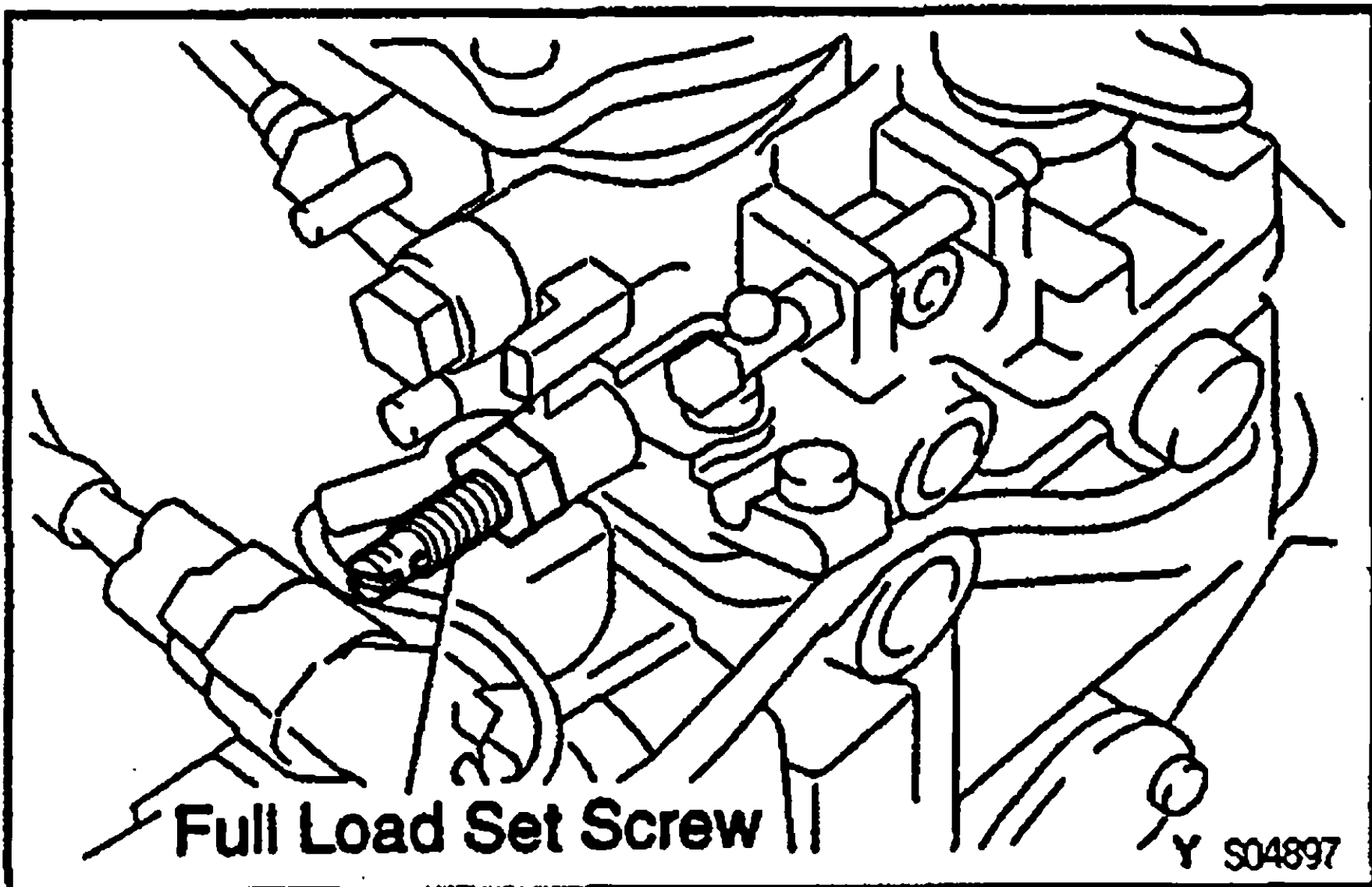
- Remove the collar seal as follows:

- Hold the full load set screw, and release the collar seal from the spot weld by turning the lock nut counterclockwise by 90° or more.

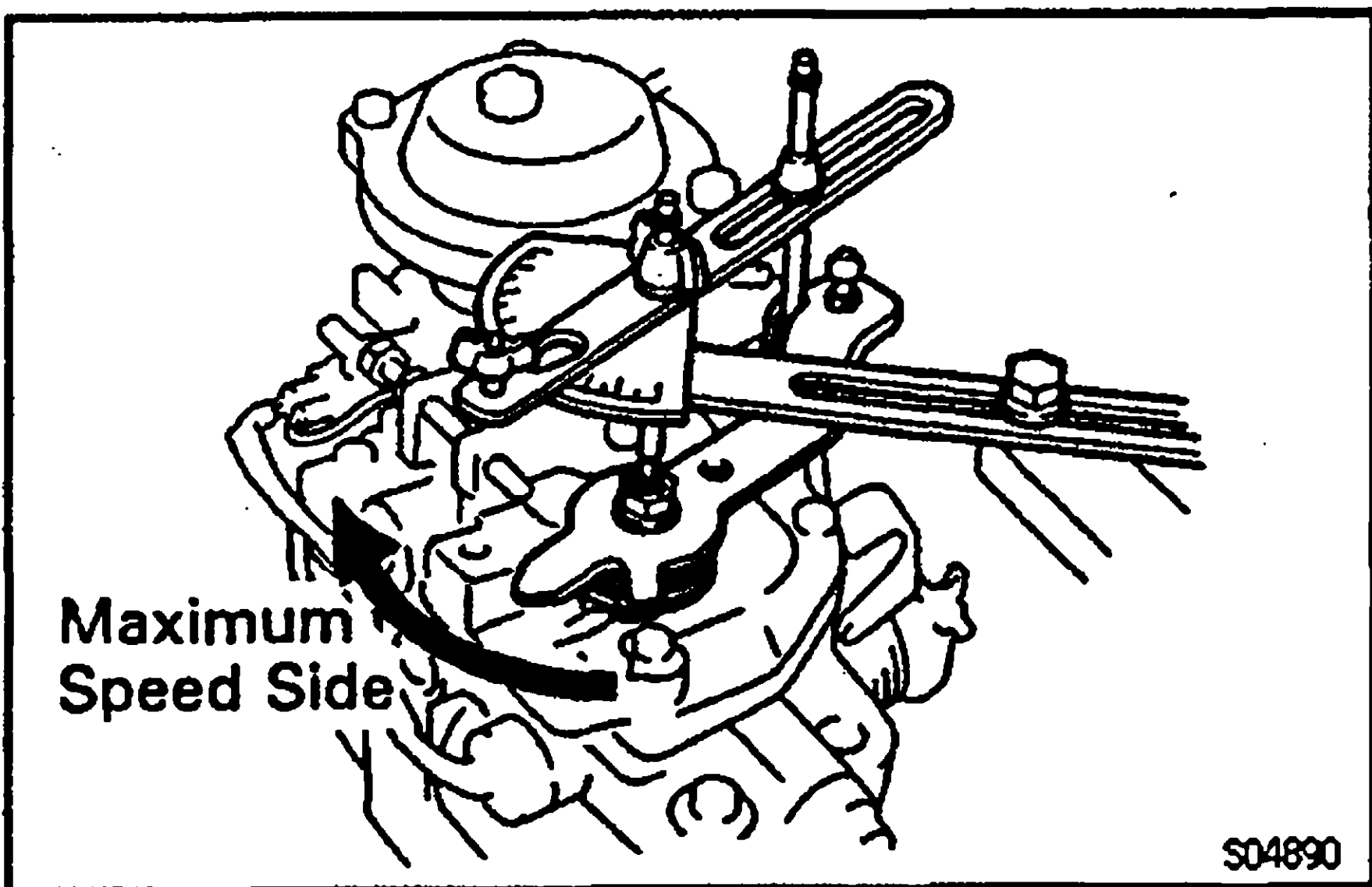




- Using a screwdriver, pry out the collar seal.



- (e) Adjust by turning the full load set screw.
 HINT: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.

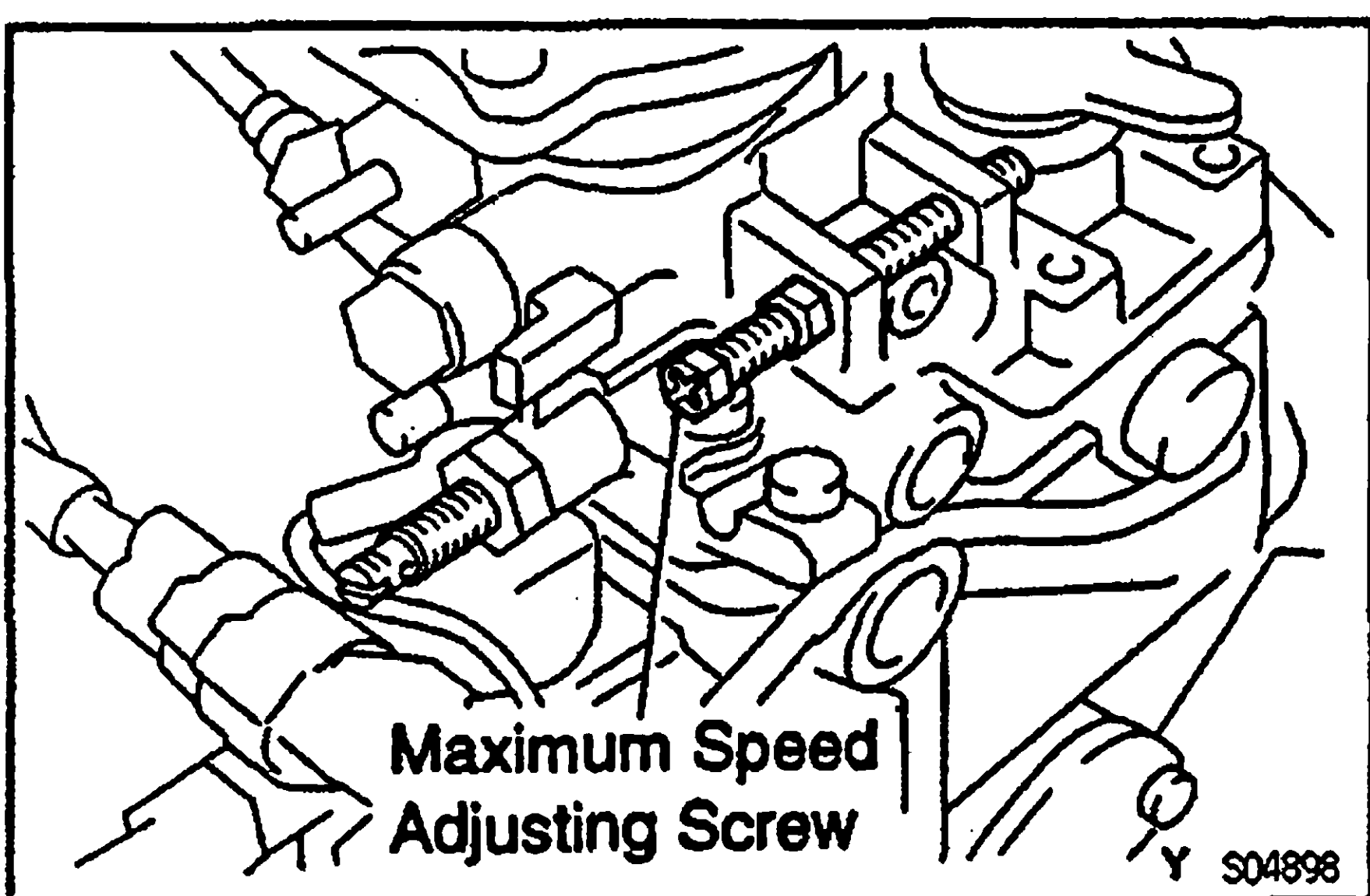


4. PRE—SET MAXIMUM SPEED

- Set the adjusting lever to maximum position.
- Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
- Measure the injection volume.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
2,300	200	5.2 — 7.2 (0.32 — 0.44)

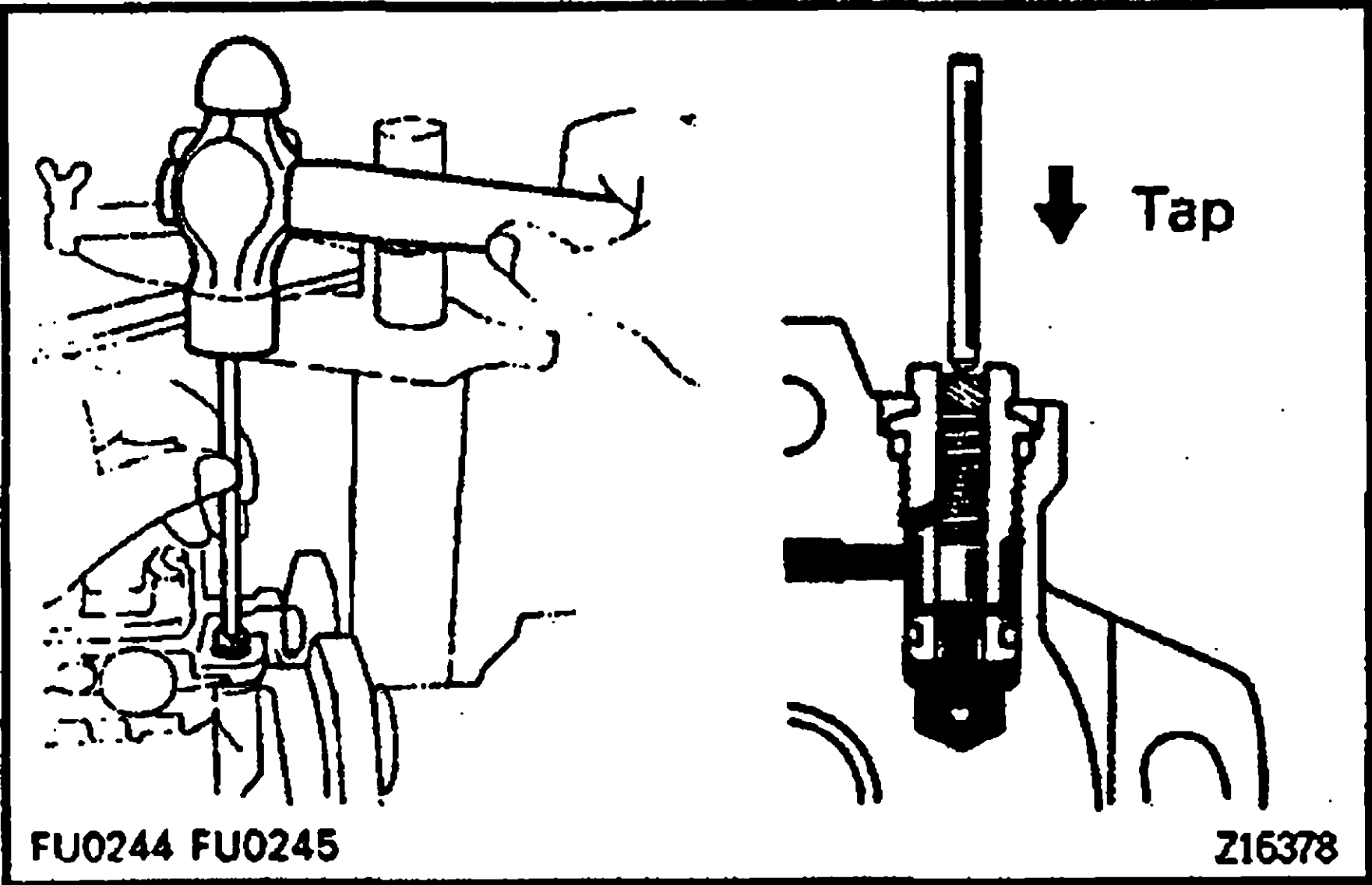
- Cut off the seal wire.
- Adjust the injection volume with the maximum speed adjusting screw.



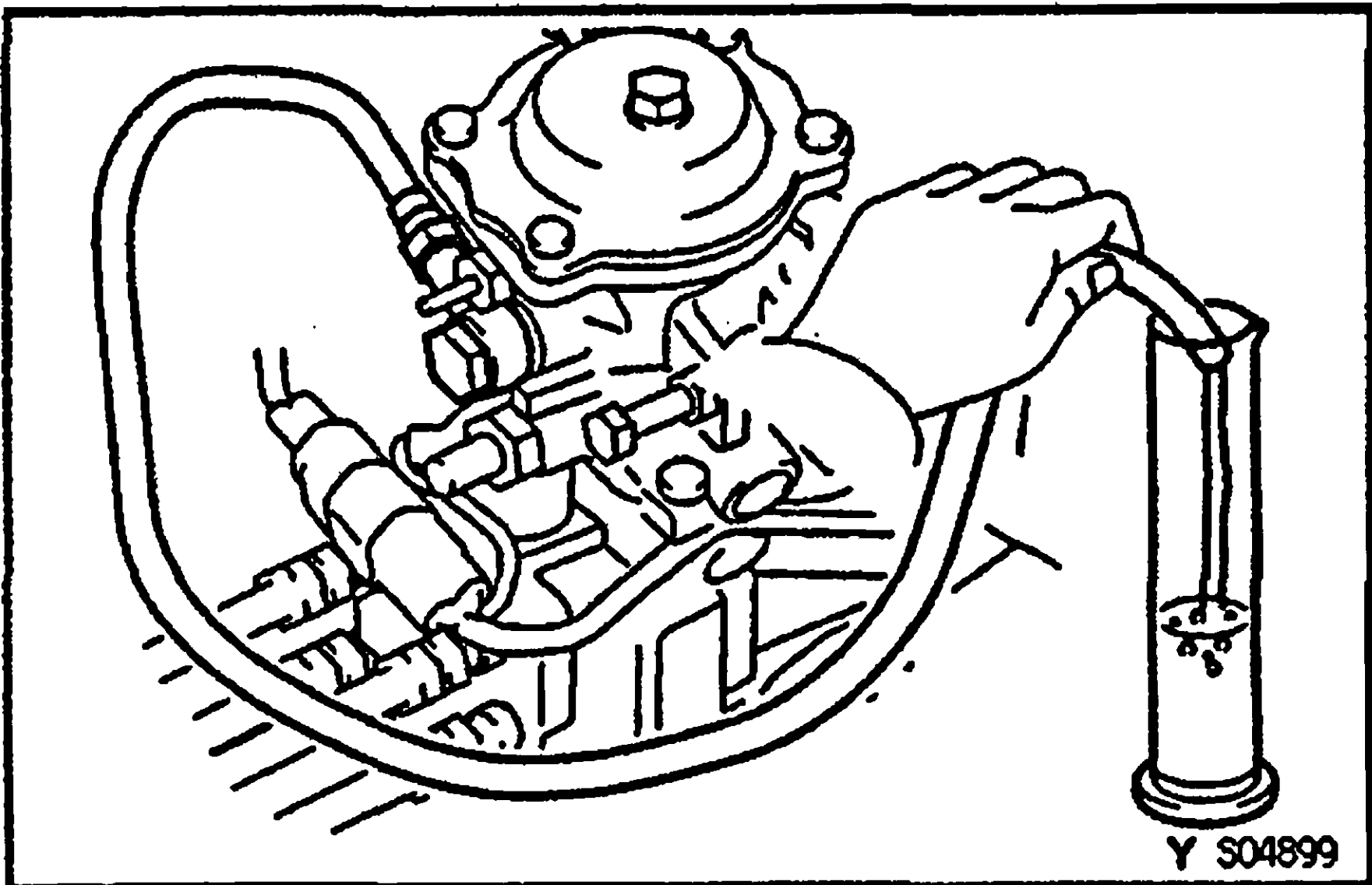
5. ADJUST PUMP INNER PRESSURE

- Set the adjusting lever to maximum position.
- Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
- Measure the pump inner pressure at the below listed rpm.

Pump rpm	Inner pressure kPa (kgf/cm ² , psi)
500	412 — 471 (4.2 — 4.8, 60 — 68)
2,000	785 — 843 (8.0 — 8.6, 114 — 122)



- (d) If the pressure is low, adjust by lightly tapping the regulator valve piston while watching the pressure gauge.
HINT: If the pressure is too high or if the regulator valve was tapped in too far, the regulator valve must be replaced.

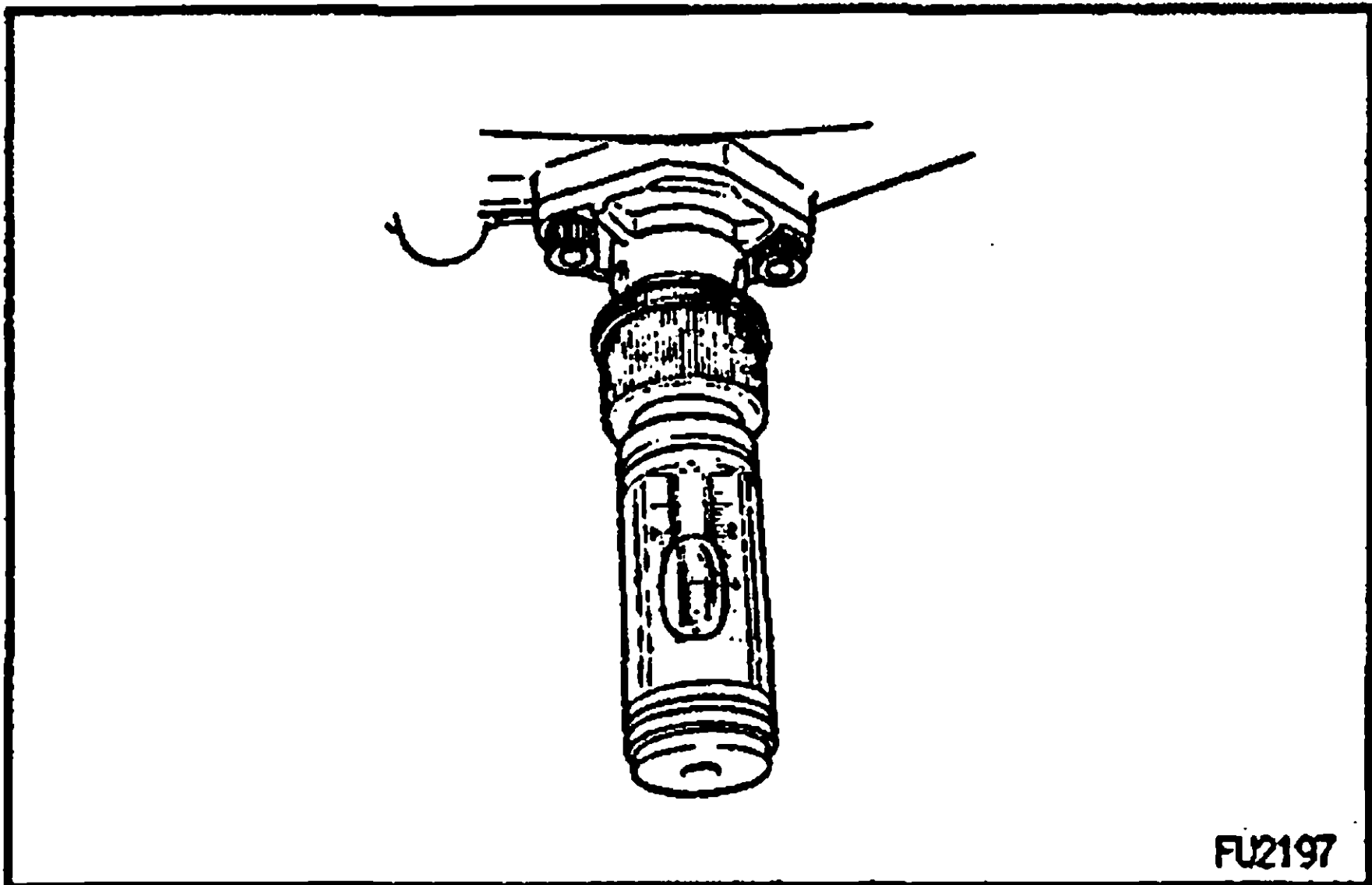


6. CHECK OVERFLOW VOLUME

- (a) Set adjusting lever to maximum position.
(b) Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
(c) Measure the overflow volume at the below listed rpm.

Pump rpm	Overflow volume cc/min. (cu in./min.)
500	720 – 1,150 (43.9 – 70.2)

HINT: Always use the overflow screw installed on the pump to be adjusted.

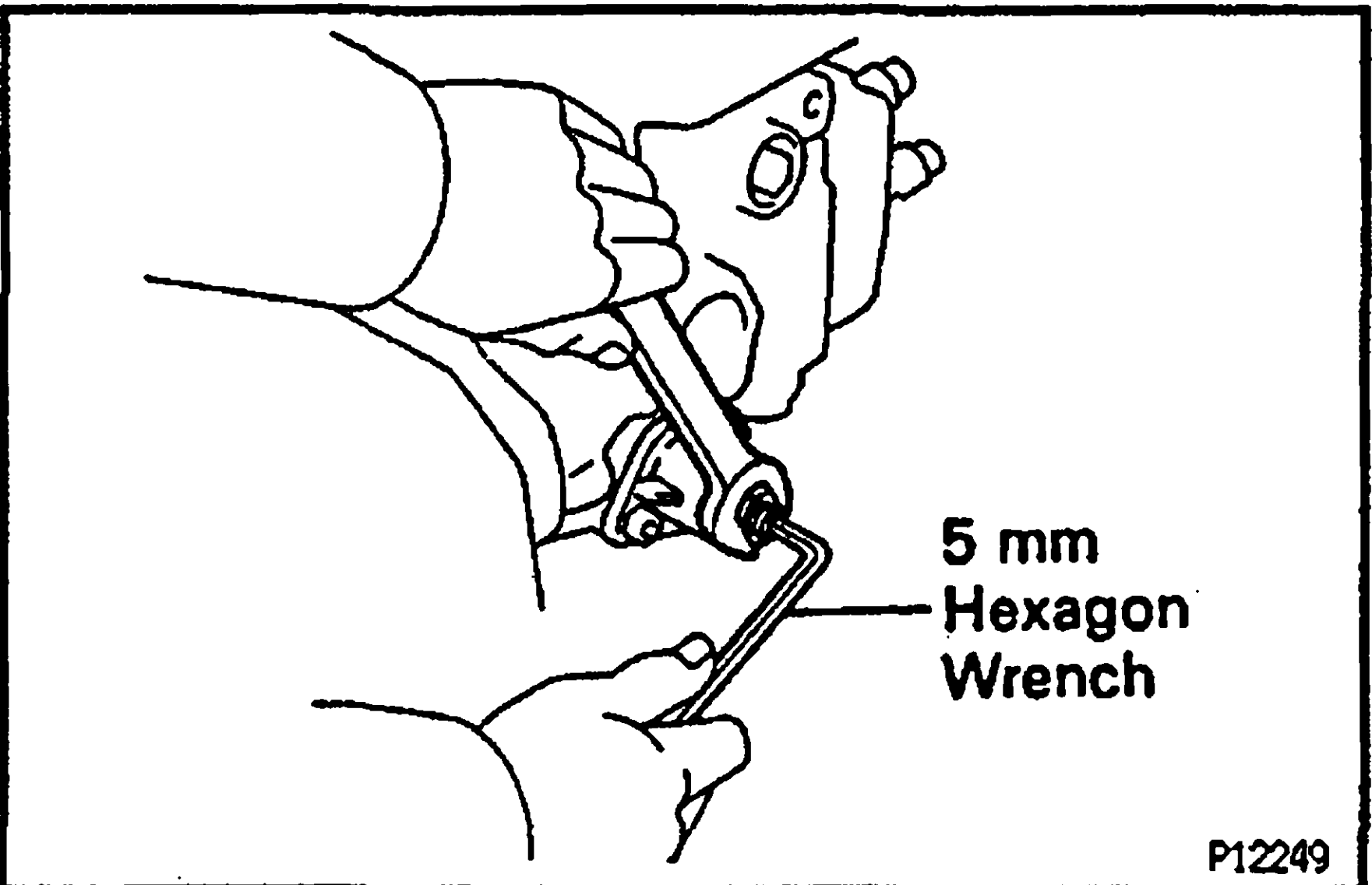


7. ADJUST TIMER

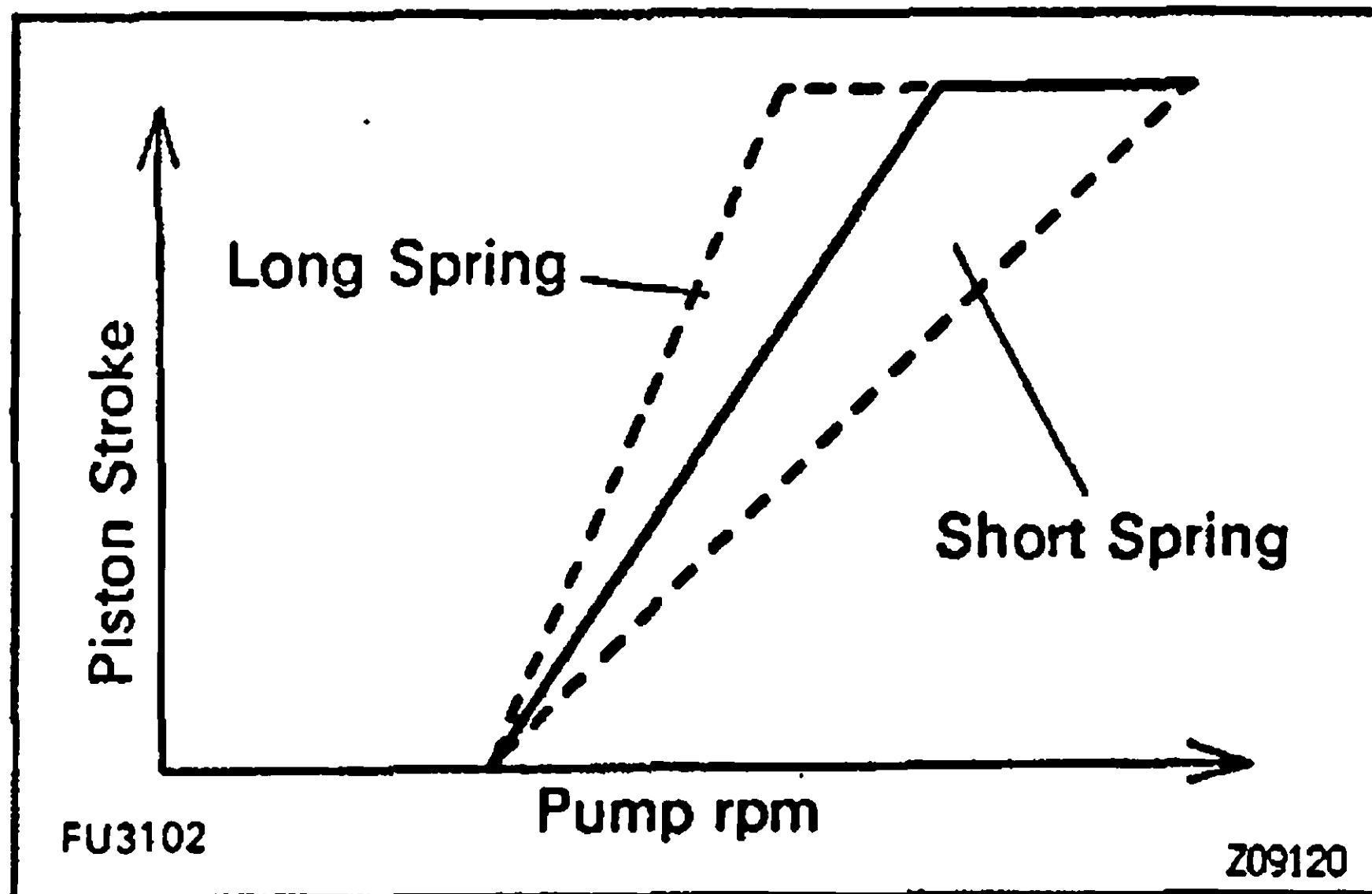
- (a) Set the timer measuring device at zero.
(b) Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
(c) Measure the timer piston stroke at the below listed rpm.

Pump rpm	Piston stroke mm (in.)
750	0.60 – 1.40 (0.0236 – 0.0551)
1,000	2.30 – 3.10 (0.0906 – 0.1220)
1,500	5.10 – 5.90 (0.2008 – 0.2323)
2,000	7.06 – 7.54 (0.2780 – 0.2969)

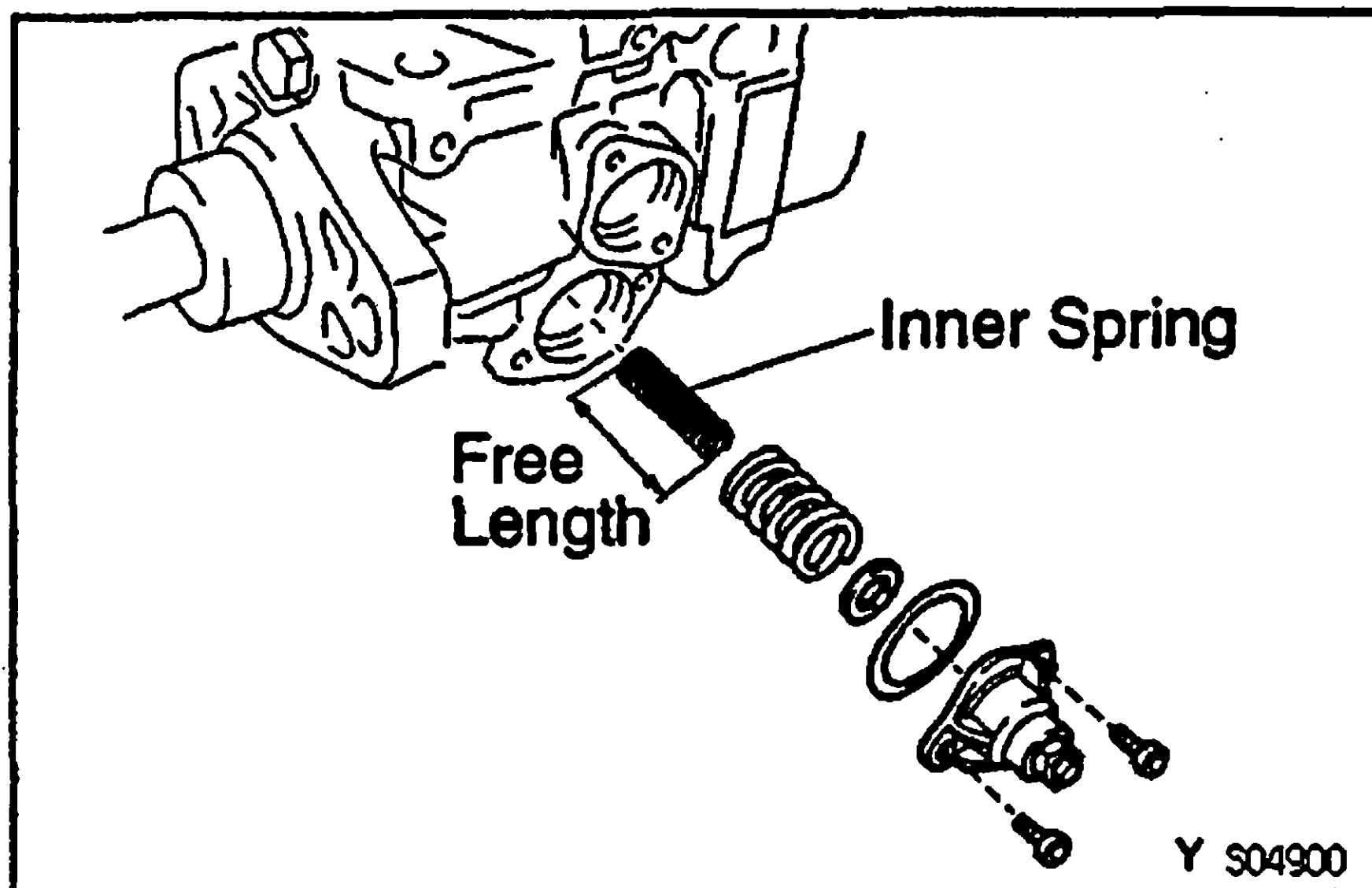
HINT: Check that the hysteresis is within 0.3 mm (0.012 in.).



- (d) Using a 5 mm hexagon wrench, adjust by turning the timer adjusting screw.
HINT: Turn clockwise to reduce the stroke, turn counterclockwise to increase the stroke.



- (e) Check the timer stroke for characteristic tendency.



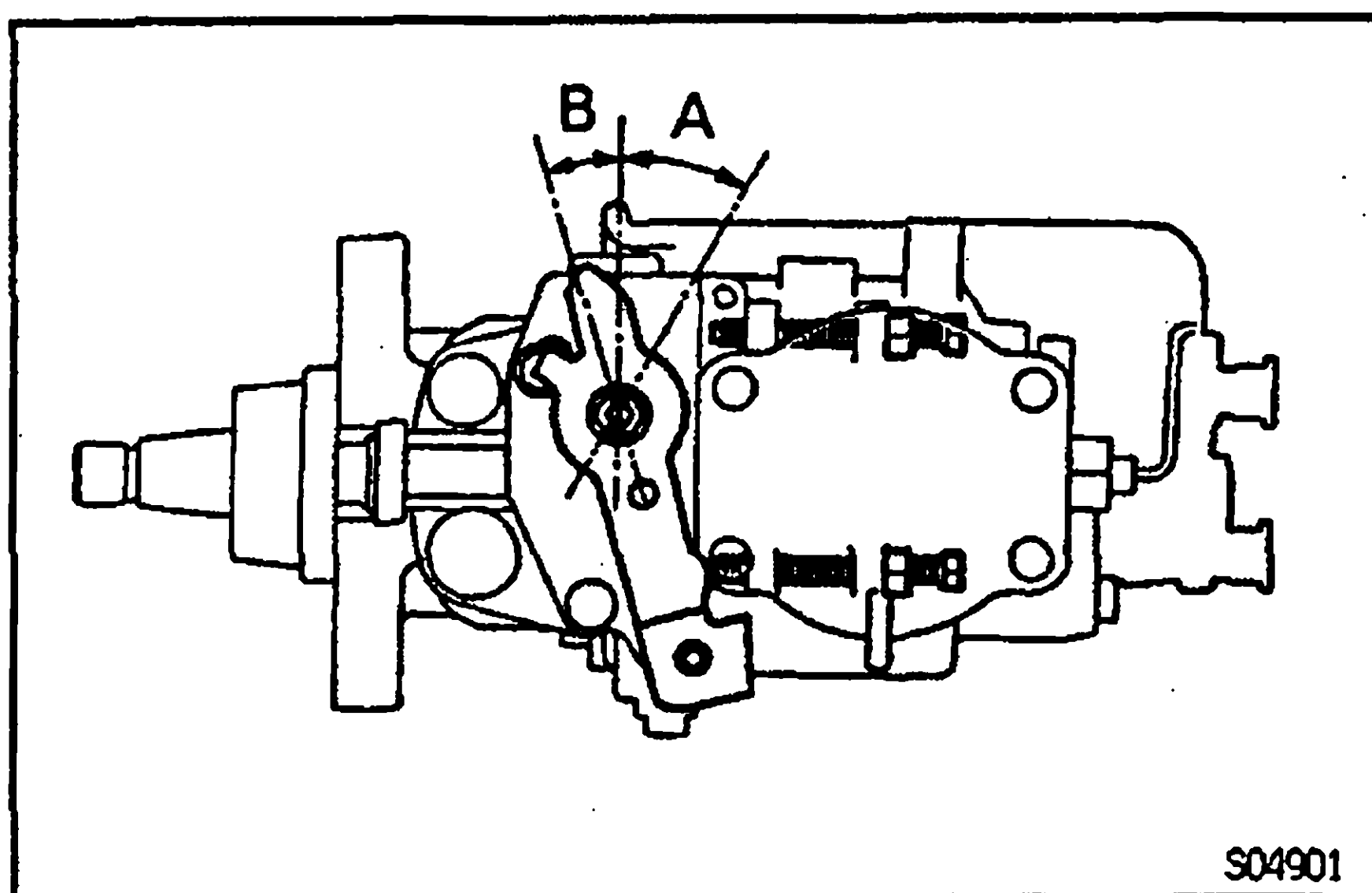
- (f) If tendency is not as specified, select and replace the inner spring.

Timer inner spring free length:

mm (in.)

38.2 (1.50)	38.8 (1.53)
39.5 (1.56)	40.4 (1.59)

HINT: The timer stroke will increase with a long spring and decrease with a short spring.



8. ADJUST FULL LOAD INJECTION VOLUME

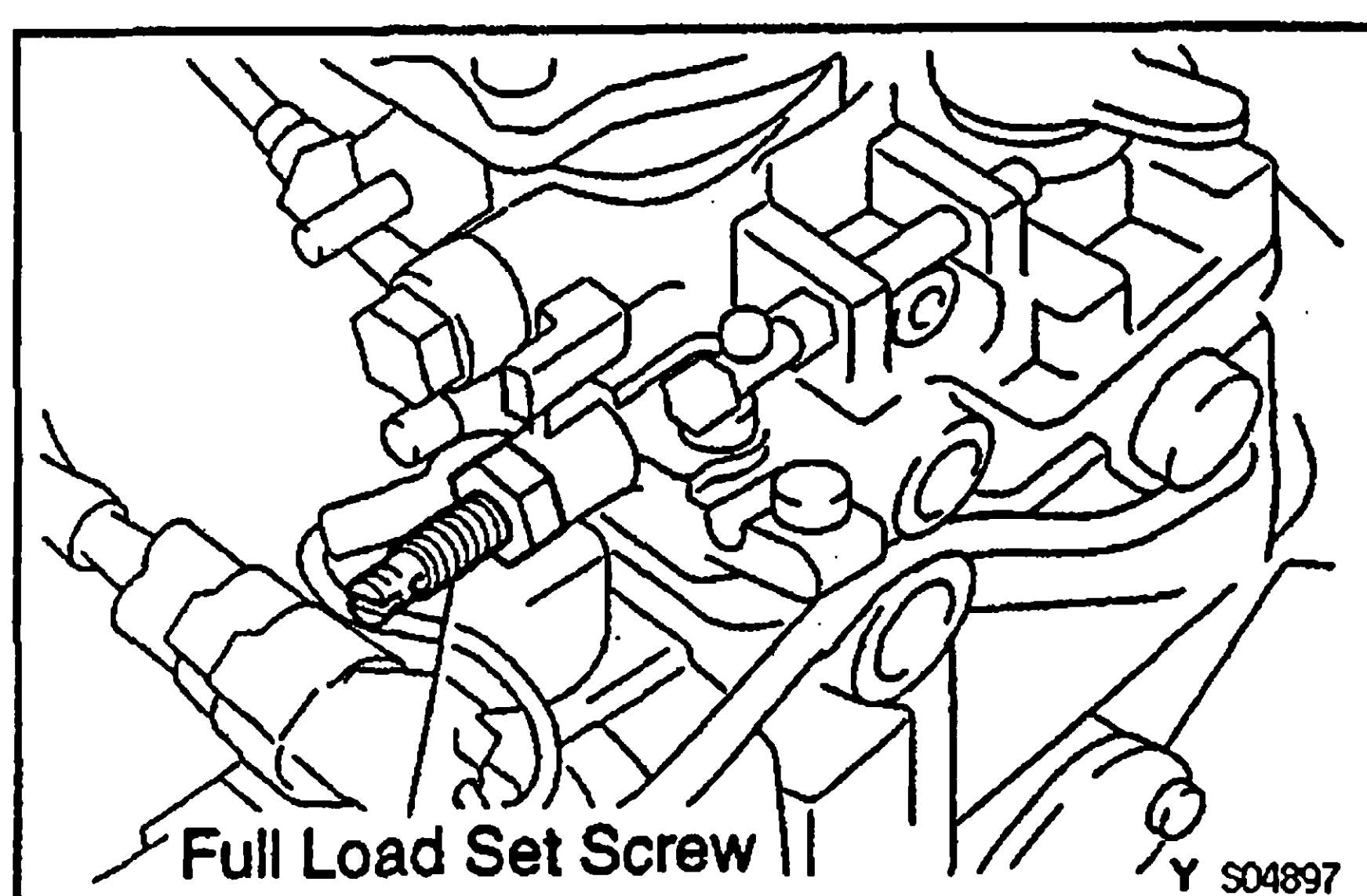
- (a) The adjusting lever angle for the adjustment below should be as shown in the illustration.

Adjusting lever angle:

A (Maximum speed side)	B (Idle speed side)
Plus 23.5 – 33.5°	Minus 12.5 – 22.5°

- (b) Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
(c) Measure the full load injection volume.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
1,800	200	14.54 – 14.86 (0.88 – 0.91)



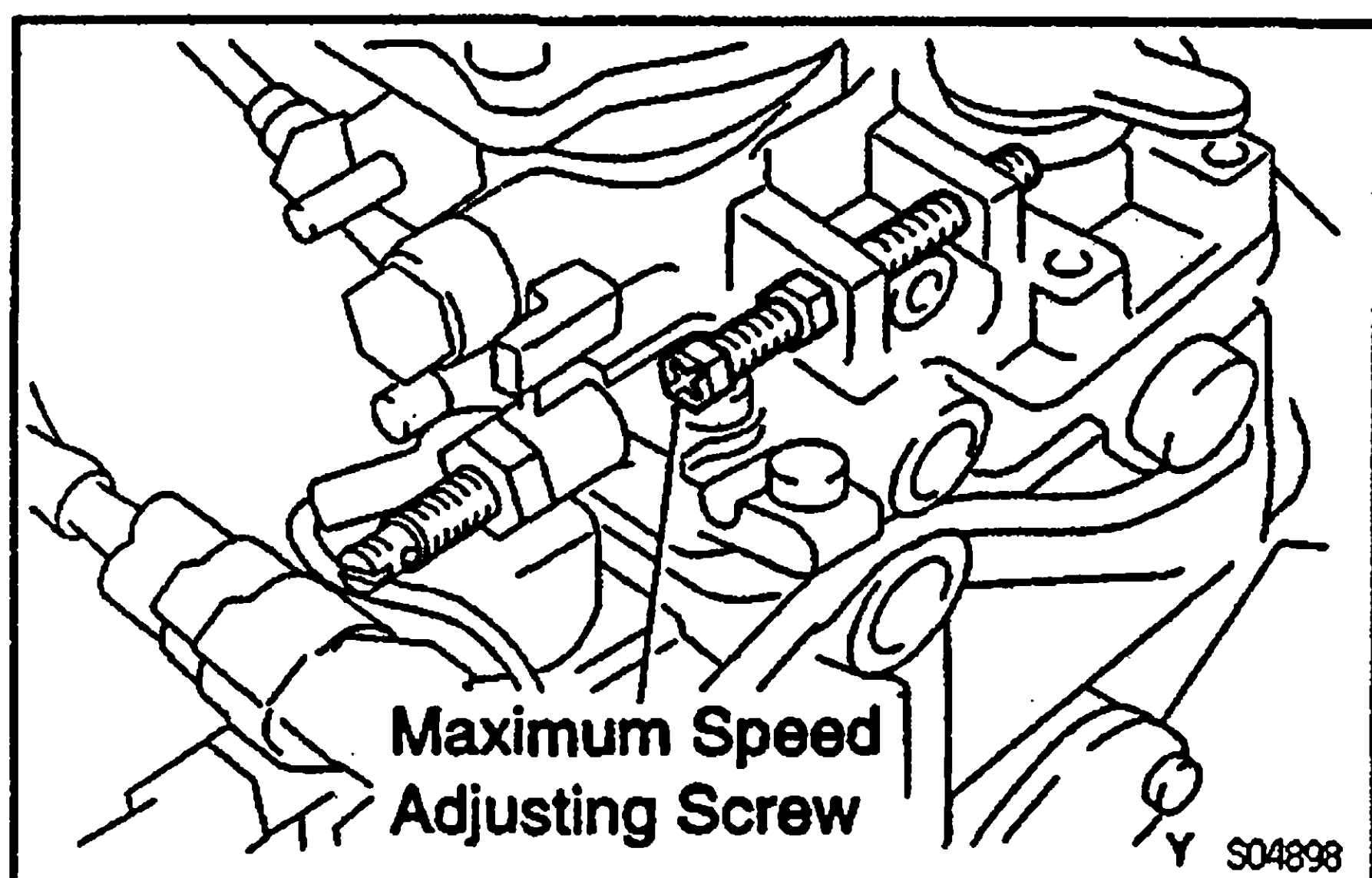
- (d) Adjust by turning the full load set screw.
HINT: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.

9. ADJUST MAXIMUM SPEED

- (a) Apply 116 kPa (1.17 kgf/cm², 16.6 psi) of pressure to the boost compensator.
(b) Measure the injection volume at each pump rpm.

Adjusting lever angle	Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)	Remark
Plus 23.5 - 33.5°	2,200	200	7.6 - 12.4 (0.46 - 0.76)	—
	2,300		5.2 - 7.2 (0.32 - 0.44)	Adjust
	2,450		3.0 (0.18) or less	—

T V08109



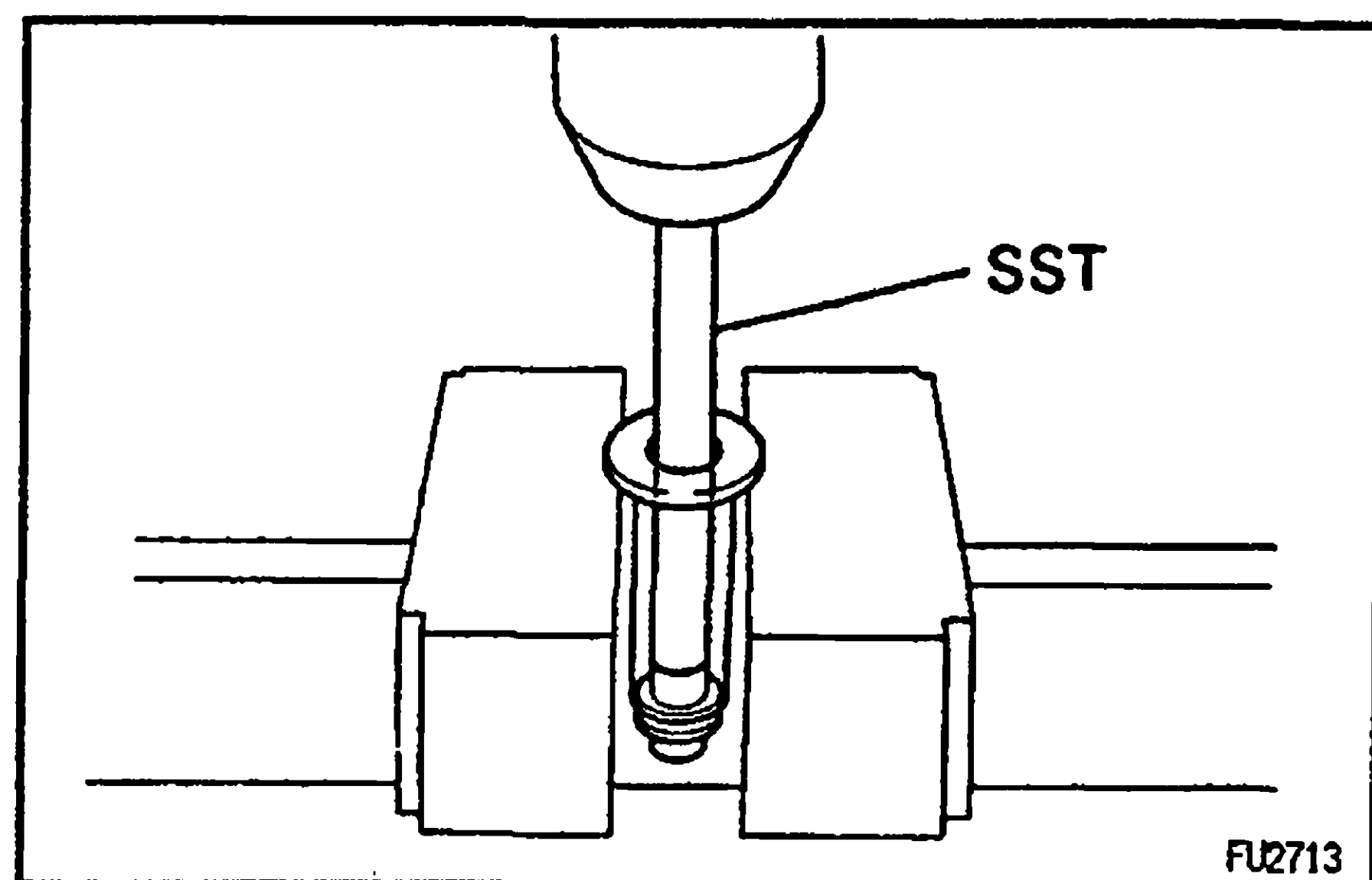
(c) Adjust by turning the maximum speed adjusting screw.

10. CHECK INJECTION VOLUME

Measure the injection volume at each pump rpm and boost pressure.

Adjusting lever angle	Pump rpm	Boost pressure kPa (kg/cm ² , psi)	No. of measuring Strokes	Injection volume of each cylinder cc (cu in.)	Variation limit cc (cu in.)	Remarks
Plus 23.5 - 33.5°	1,800	116.0 (1.17, 16.6)	200	14.54 - 14.86 (0.89 - 0.91)	0.7 (0.04)	Basic full-load injection volume
	100	49.3 (0.50, 7.1)		14.6 - 19.4 (0.89 - 1.18)	1.3 (0.08)	Volume during starting
	700	76.7 (0.79, 11.2)		13.8 - 15.0 (0.84 - 0.92)	—	—
	1,200	116.0 (1.17, 16.6)		16.3 - 17.5 (0.99 - 1.07)	0.7 (0.04)	—

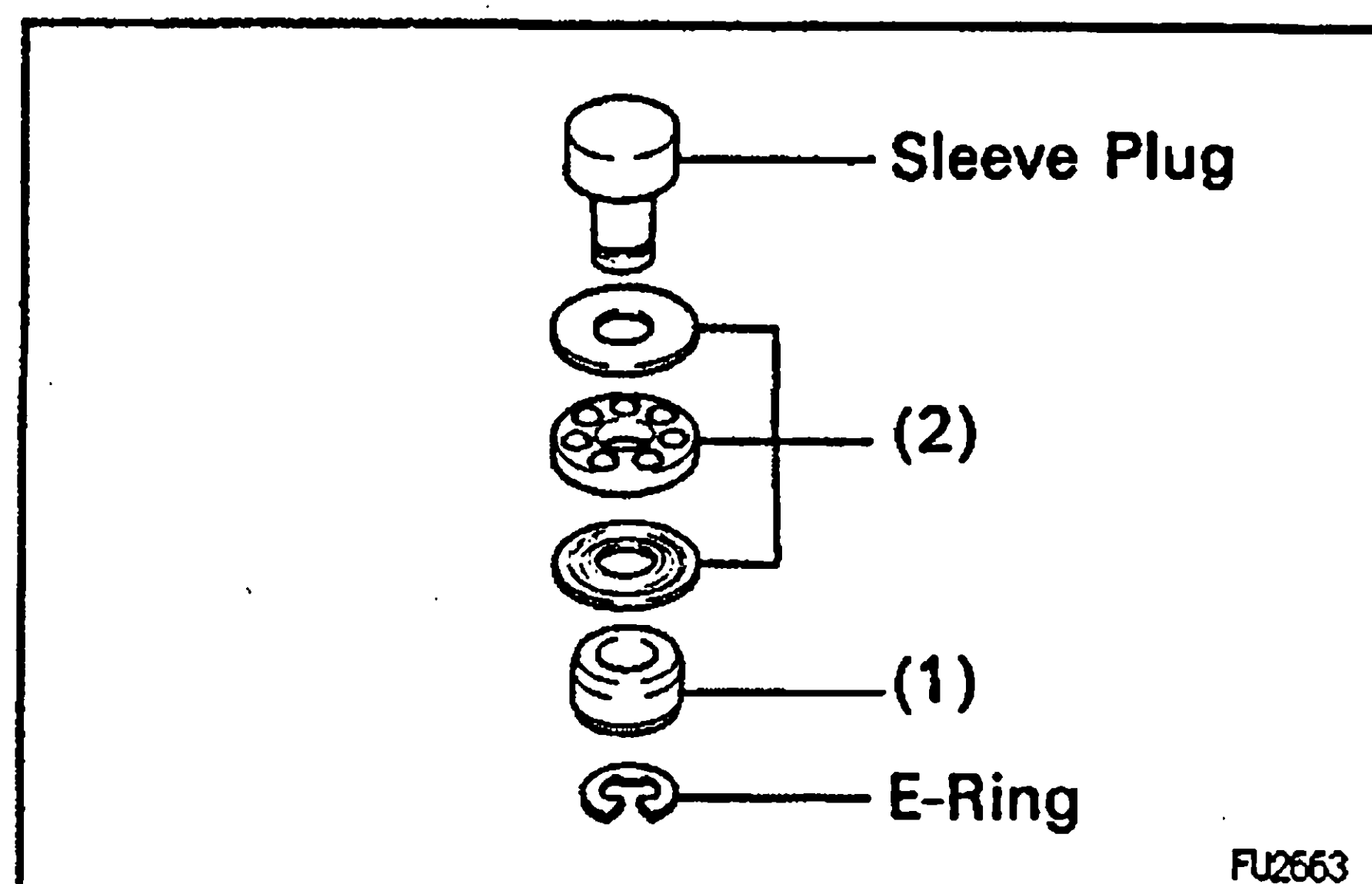
T V08110



If the injection volume at 100 rpm is not as specified, replace the governor sleeve plug as follows:

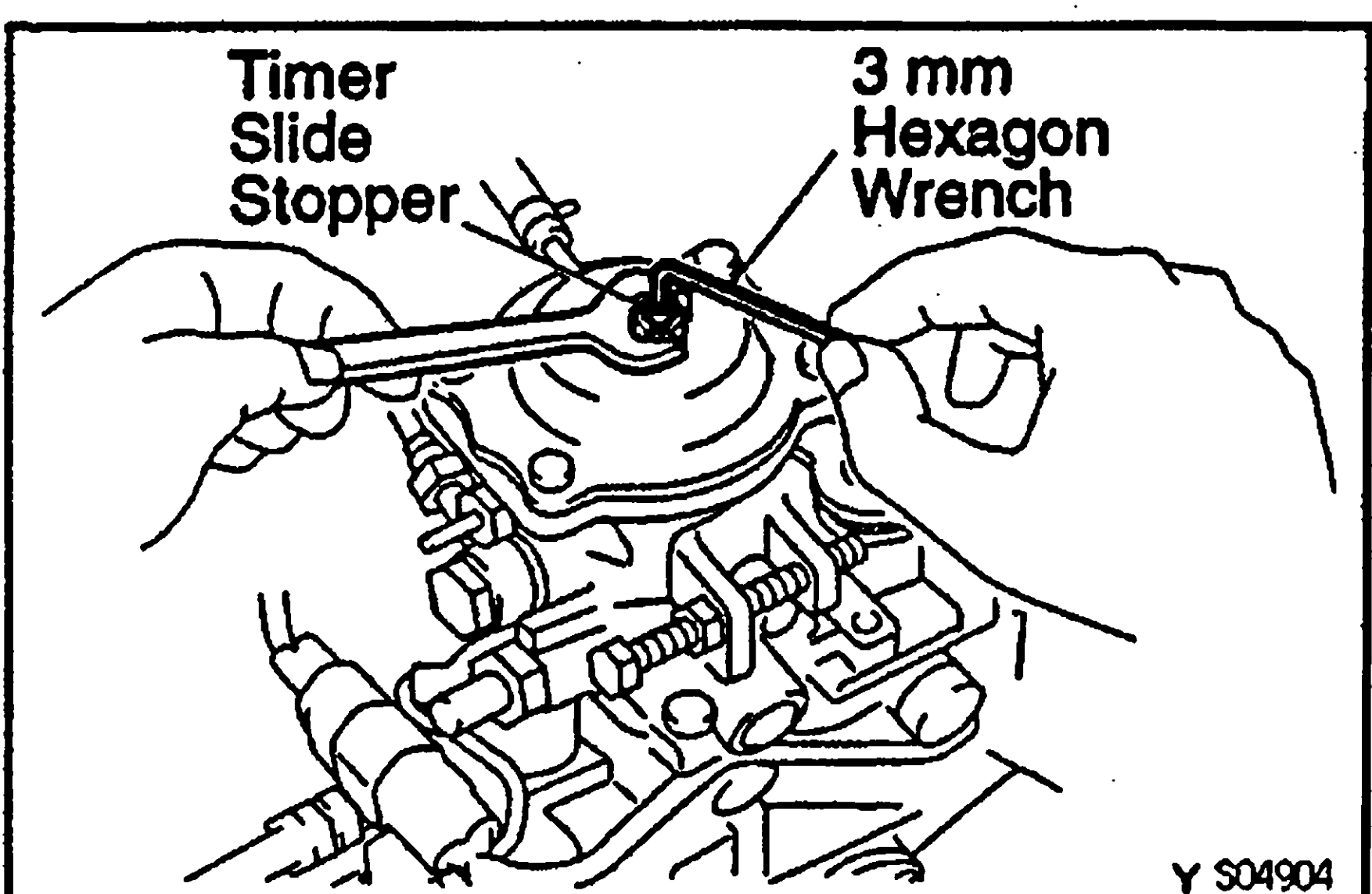
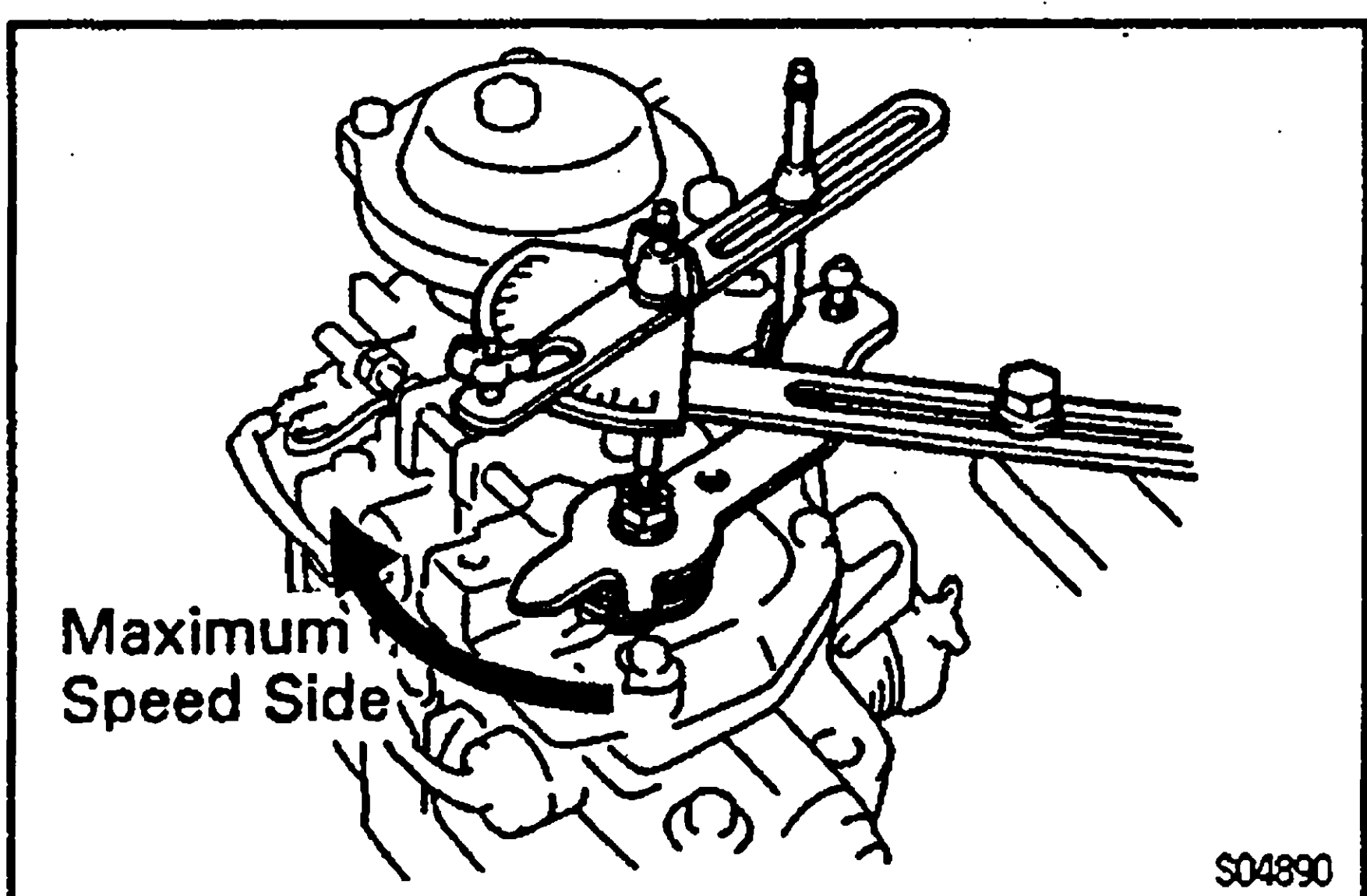
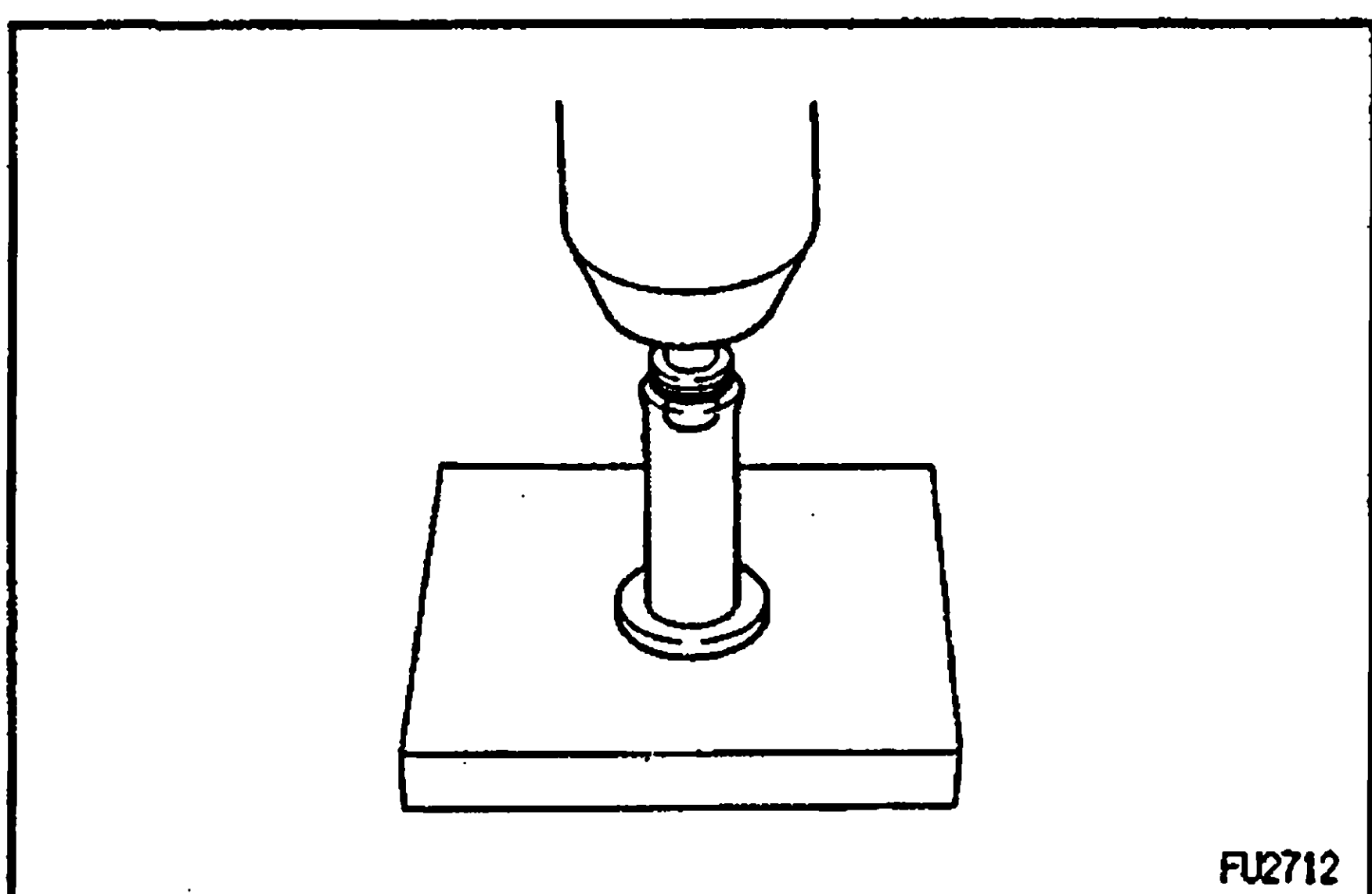
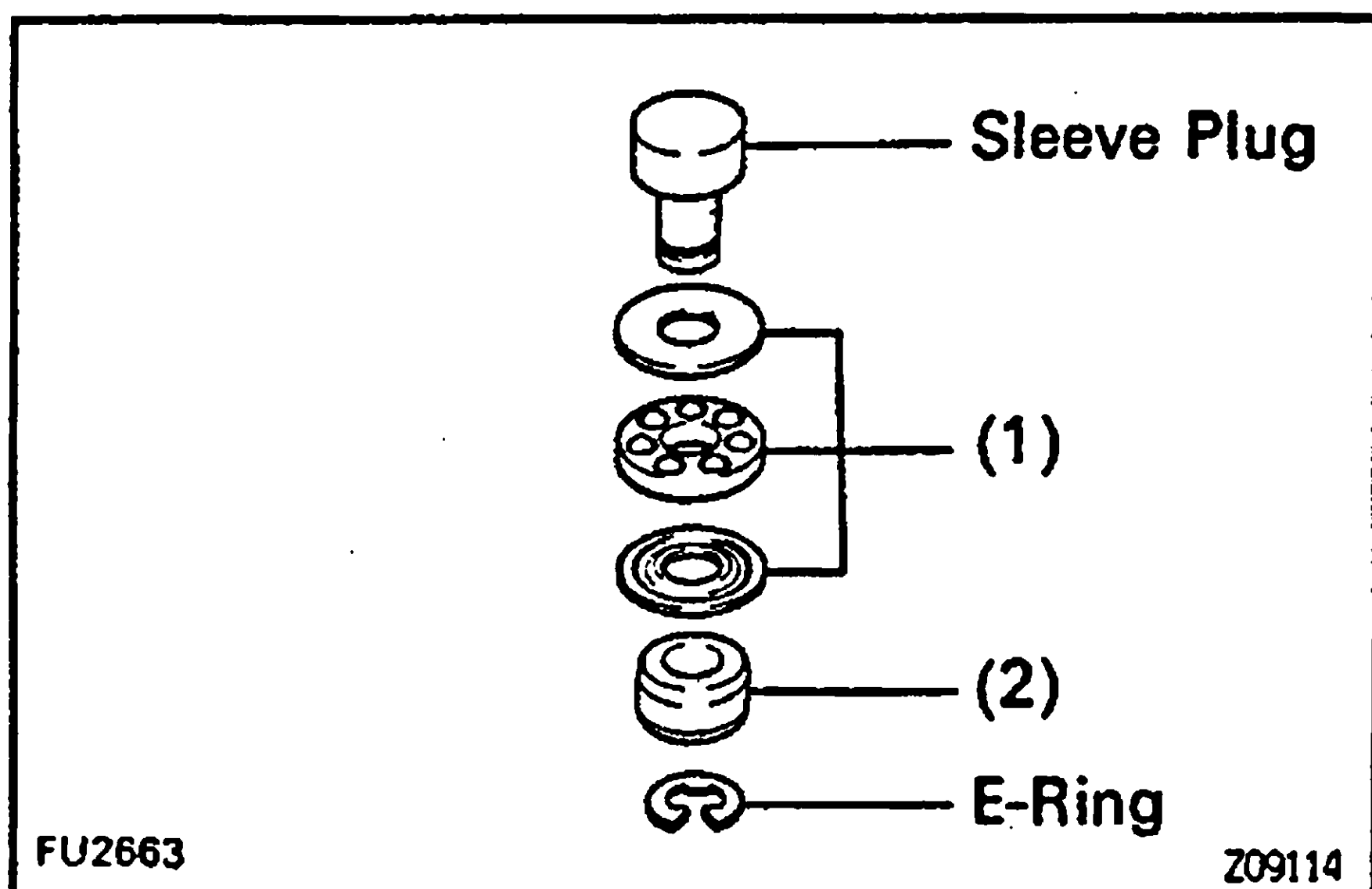
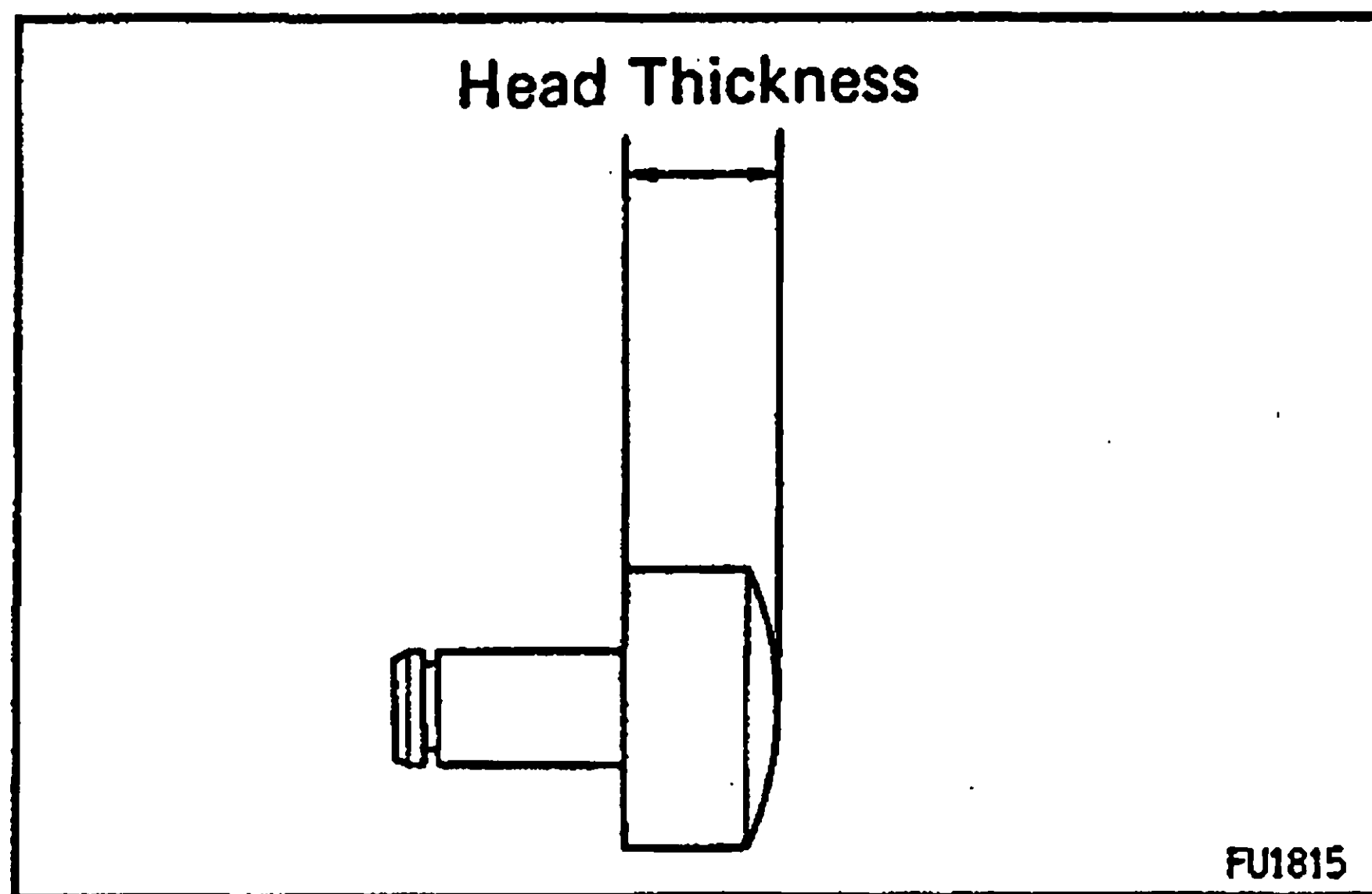
- Using SST and a press, press out the sleeve plug assembly from the governor sleeve.

SST 09236-00101 (09237-00070)



- Remove the E-ring and these parts from the sleeve plug:

- Stop ring
- Bearing and 2 bearing retainers



- Measure the head thickness of the sleeve plug, and select a new sleeve plug.

Governor sleeve plug head thickness: mm (in.)

3.0 (0.118)	3.6 (0.142)	4.2 (0.165)
3.2 (0.126)	3.8 (0.150)	4.4 (0.173)
3.4 (0.134)	4.0 (0.157)	—

HINT: Lengthening the plug by 0.1 mm (0.004 in.) will decrease injection volume by 1.0 cc (0.06 cu in.). If the variation limit is greater than specified, replace the delivery valve.

- Install these parts to the new sleeve plug with a new E-ring:

- (1) Bearing and 2 retainers
- (2) Stop ring

- Using a press, press in the sleeve plug assembly to the governor sleeve.

11. ADJUST FULL LOAD MINIMUM INJECTION VOLUME

- (a) Set the adjusting lever to maximum position.
- (b) Release the pressure from the boost compensator.
- (c) Measure the injection volume.

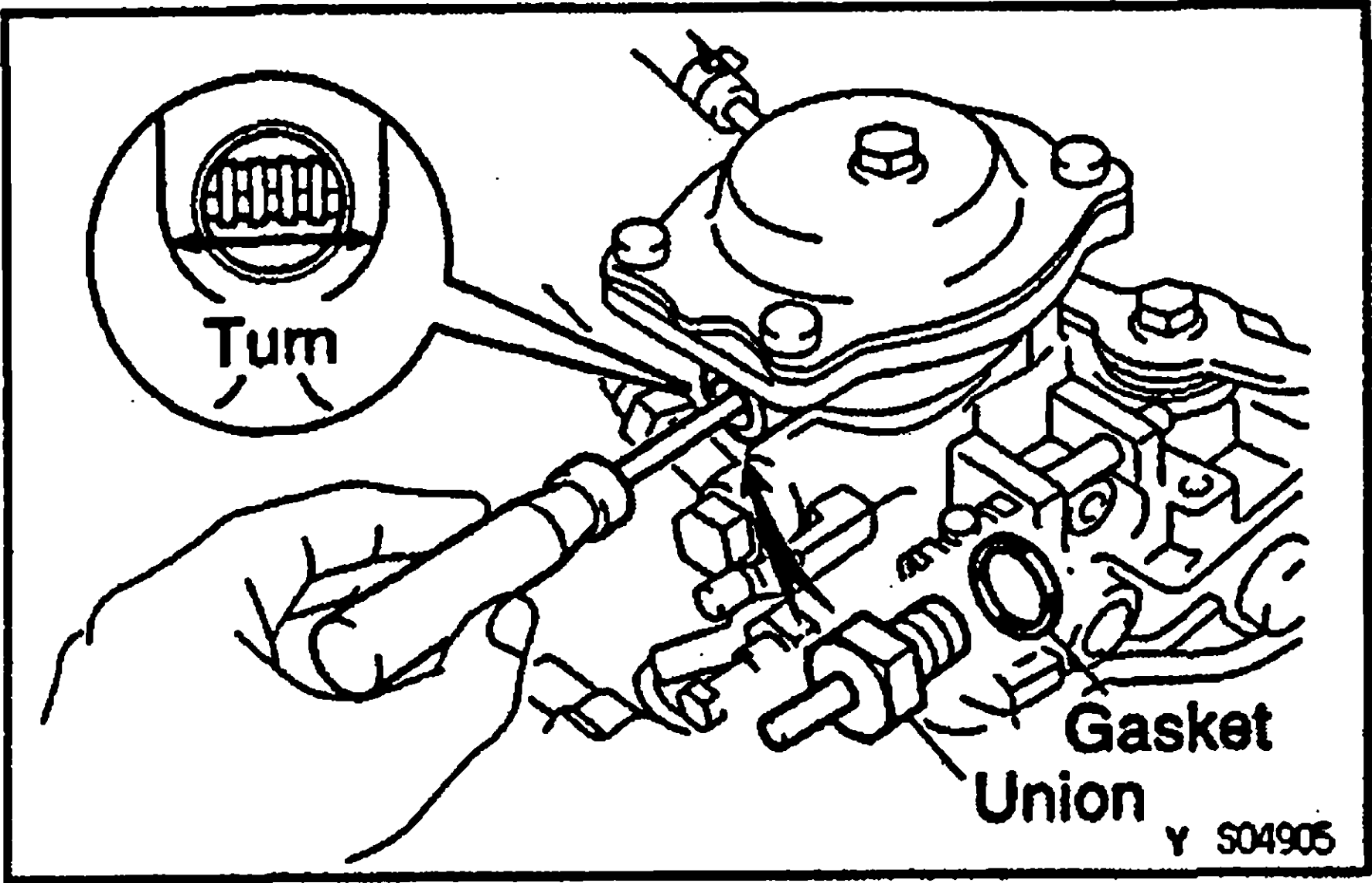
Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
500	200	8.1 — 9.3 (0.49 — 0.57)

- (d) Using a 3 mm hexagon wrench, adjust by turning the timer slide stopper.

12. ADJUST BOOST COMPENSATOR

A. Adjust characteristic

- (a) Set the adjusting lever to maximum position.
- (b) Apply 64.7 kPa (0.66 kgf/cm², 9.4 psi) of pressure to the boost compensator.
- (c) Measure the injection volume.



Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
500	200	12.2 – 13.0 (0.74 – 0.79)

- (d) Remove the union and gasket.
- (e) Using a screwdriver, adjust the injection volume by the guide bushing.
HINT: When the guide bushing is turned clockwise, as seen from above, the injection volume will increase.
- (f) Install a new gasket and the union.

B. Check for characteristic tendency

- (a) Set the adjusting lever to maximum position.
- (b) Apply 76.7 kPa (0.79 kgf/cm², 11.2 psi) of pressure to the boost compensator.
- (c) Measure the injection volume.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
700	200	13.8 – 15.0 (0.84 – 0.92)

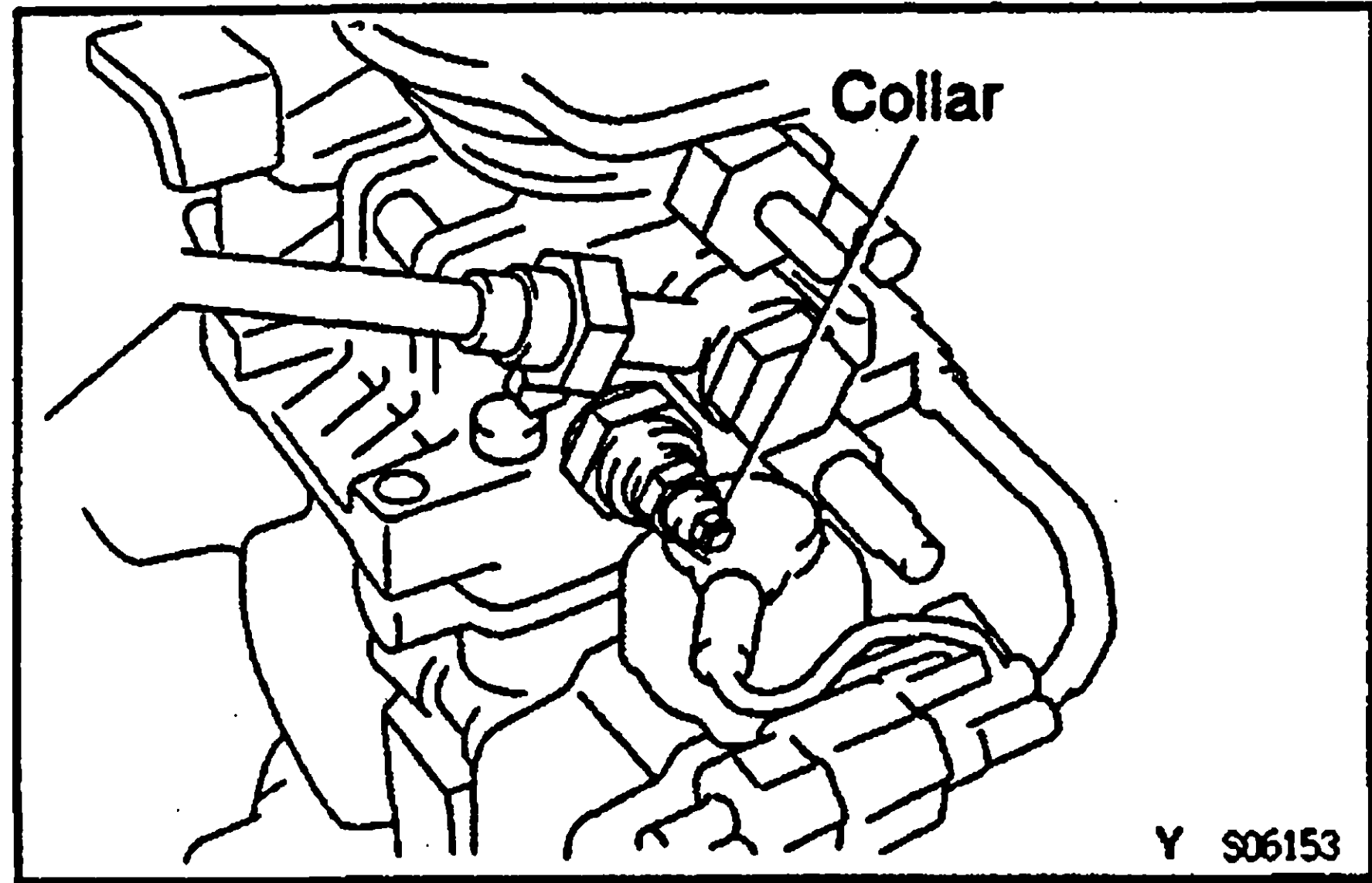
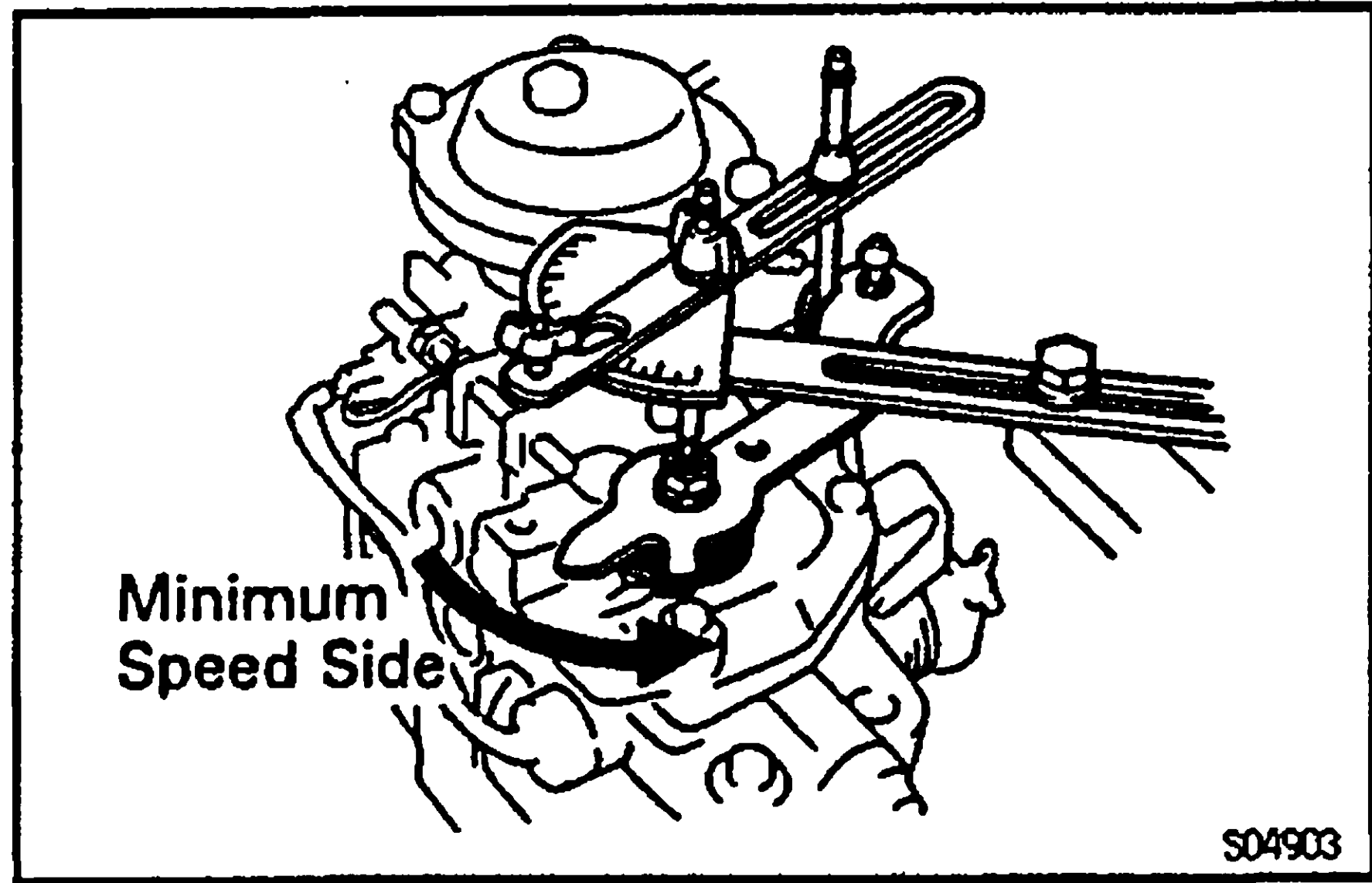
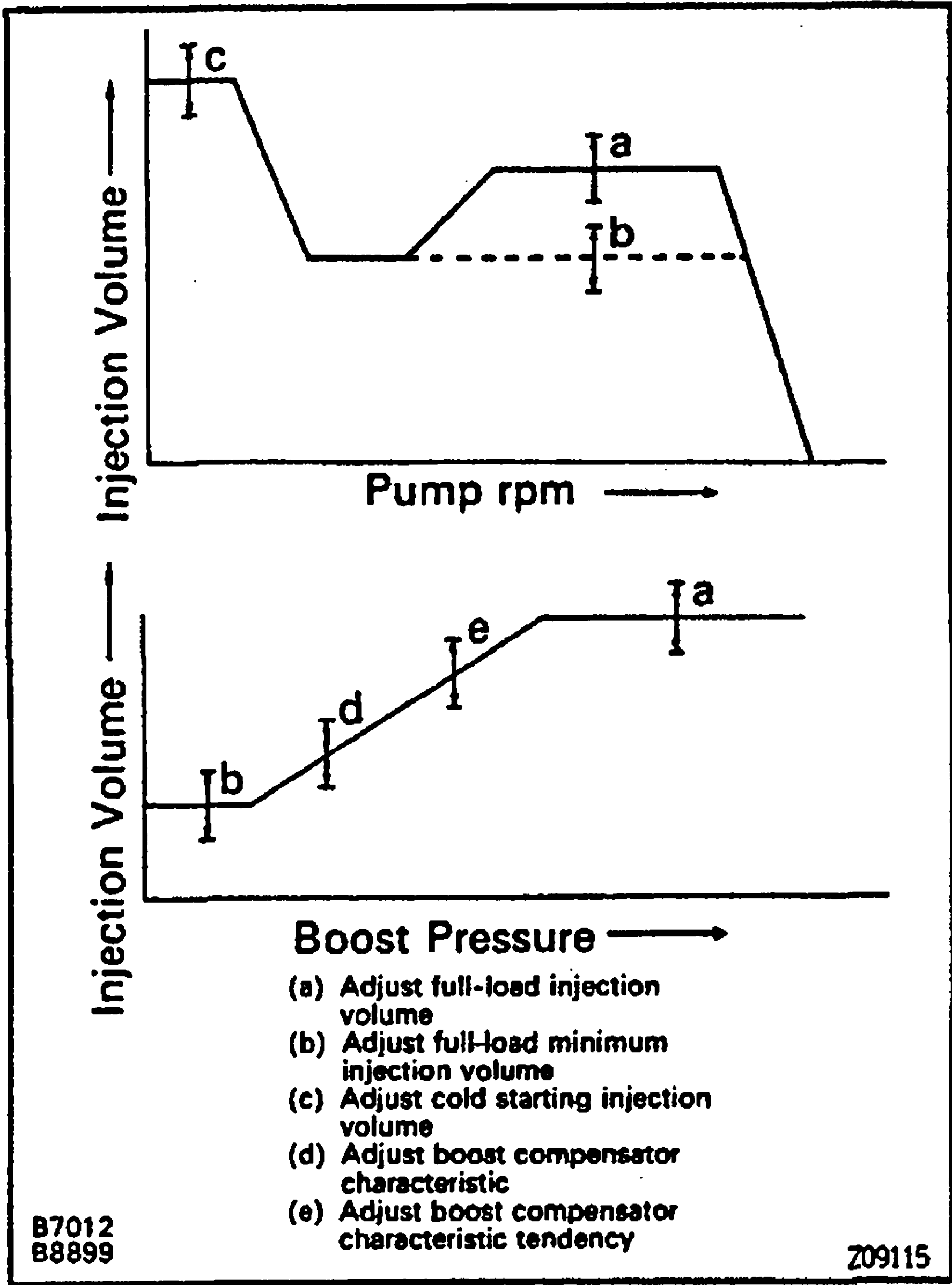
- (d) Measure the injection volume for each set of pump 1,800 rpm/ boost pressure conditions listed in the table below.

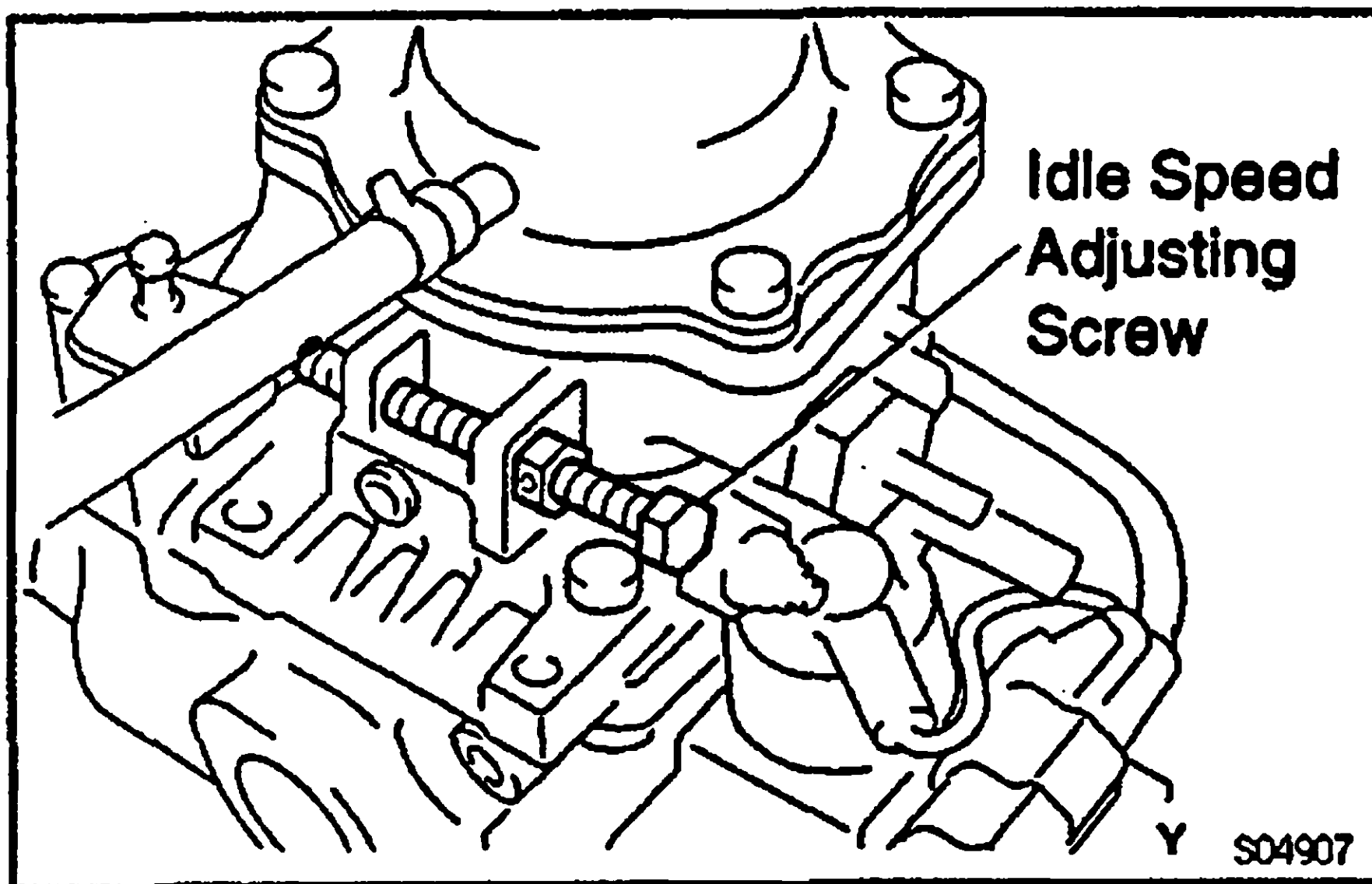
Boost pressure kPa (kgf/cm², psi)	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
175 (1.79, 25.5)	200	12.4 (0.76) or less
136 (1.38, 19.6)	200	14.44 – 14.96 (0.88 – 0.91)
116 (1.17, 16.6)	200	14.54 – 14.86 (0.89 – 0.91)

If not within standard value, check each sliding part of the boost compensator and check whether or not there is any oil.

13. ADJUST IDLE SPEED

- (a) Set the adjusting lever to the minimum position.
- (b) Using pliers, remove the collar from the dashpot (DP).
- (c) Fully loosen the DP adjusting screw.
- (d) Apply 49 kPa (0.50 kgf/cm², 7.1 psi) of pressure to the boost compensator.

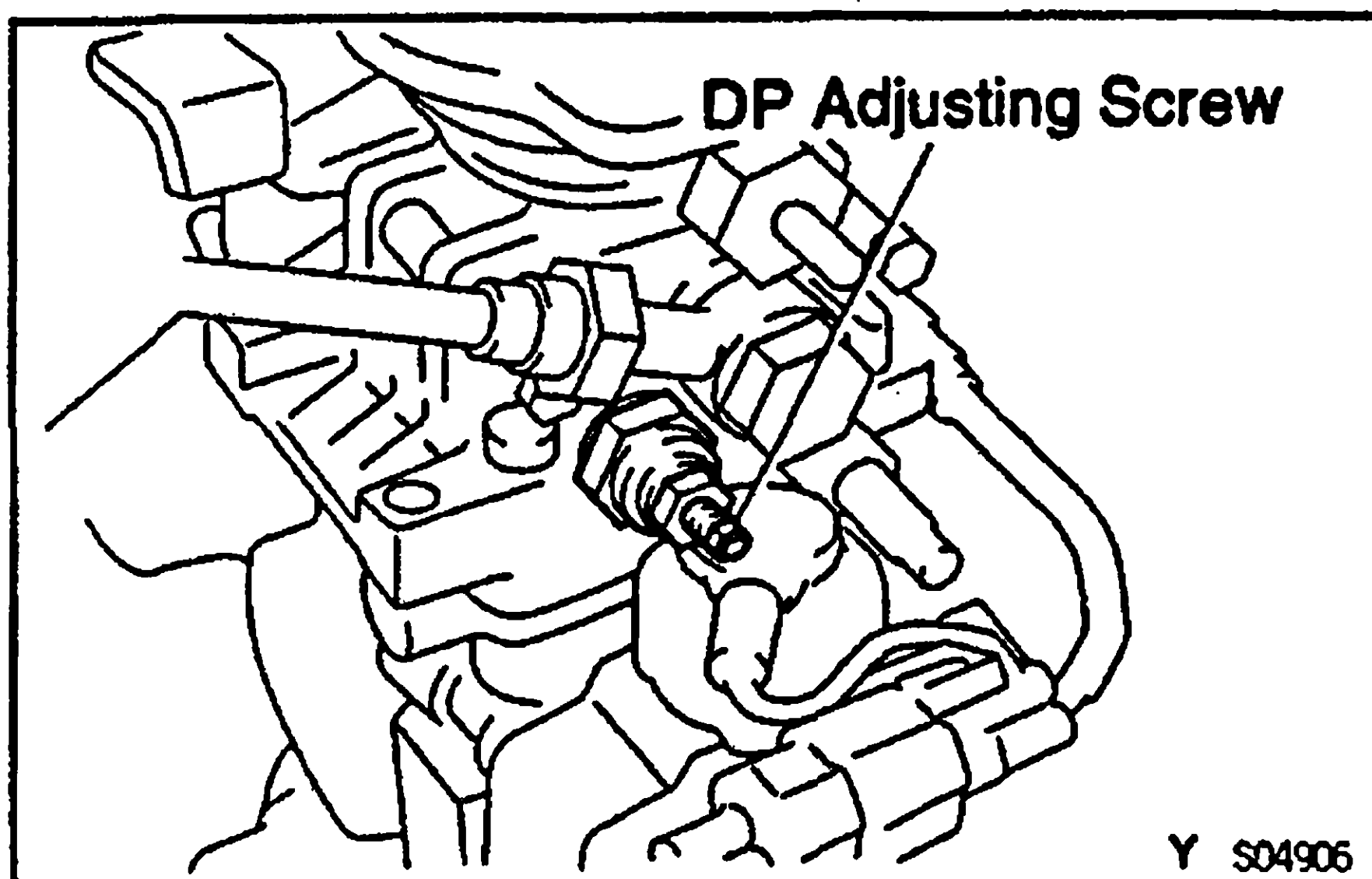




(e) Pre-Set Idle Speed

Adjust injection volume by turning the idle speed adjusting screw.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
1,000	200	q = 1.7 – 2.1 (0.10 – 0.13)

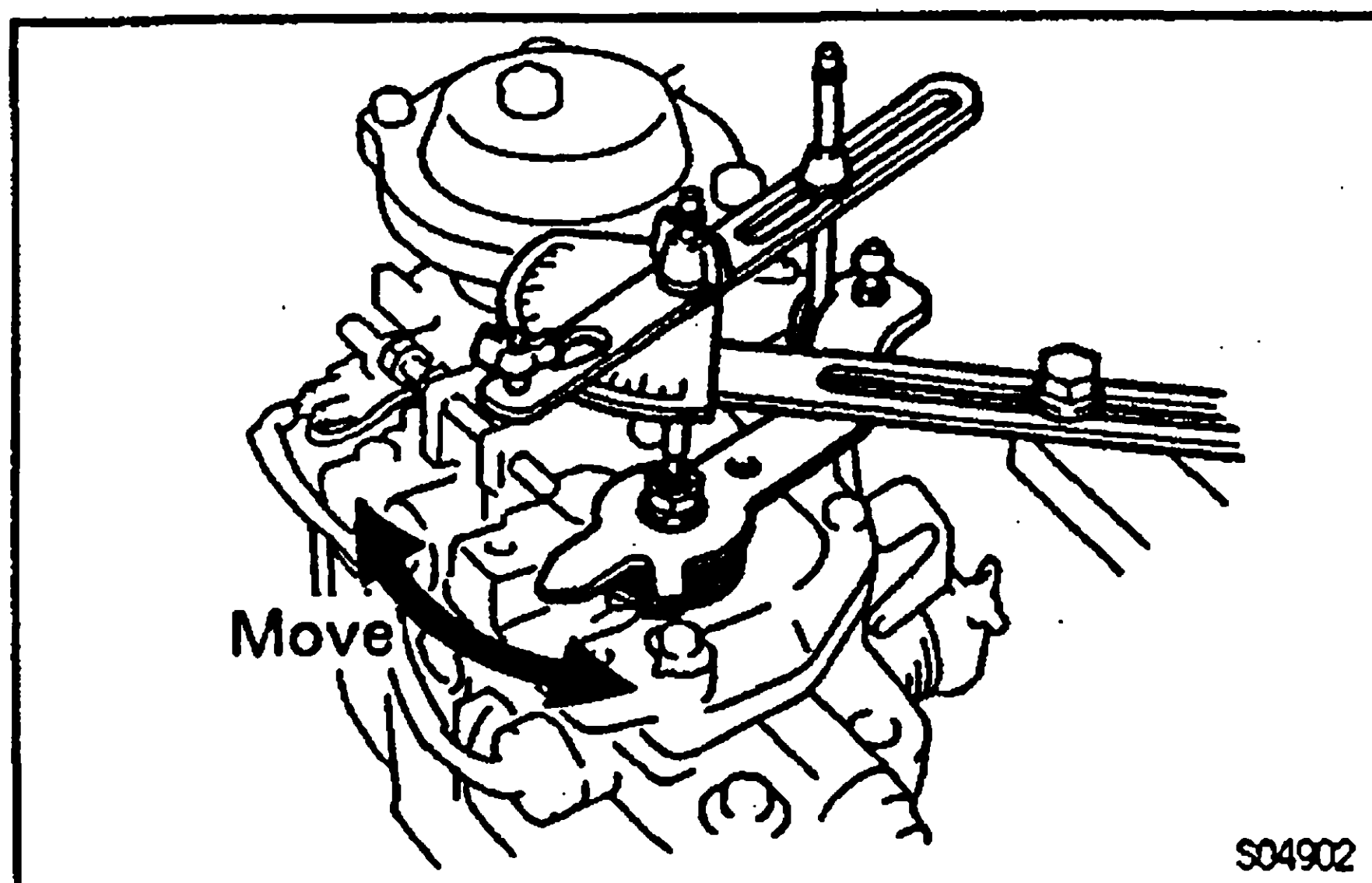


(f) Adjust DP Speed

Adjust injection volume by turning the DP adjusting screw.

HINT: The stroke will decrease with turn to clockwise and increase with turn to counterclockwise.

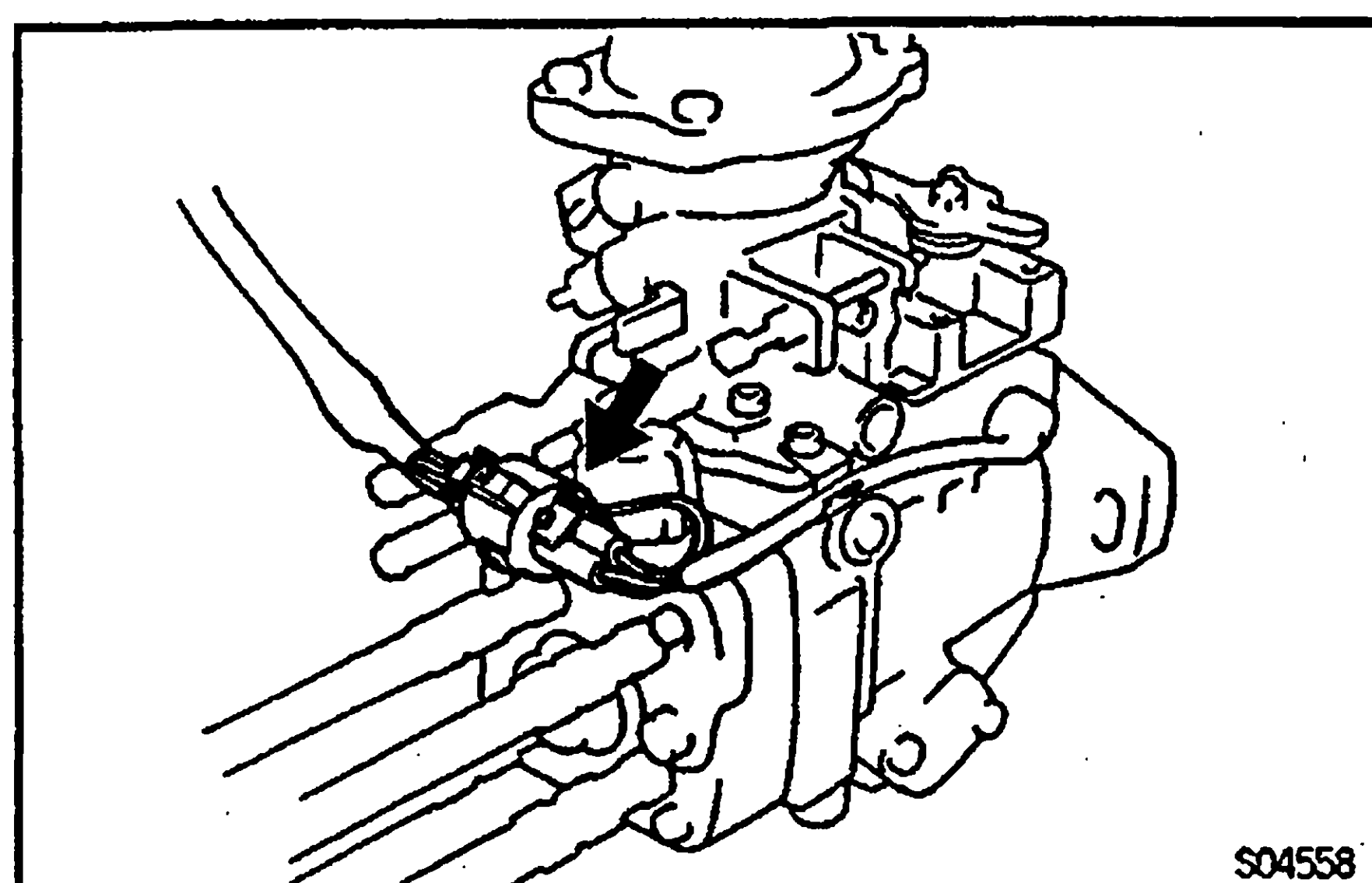
Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
1,000	200	q plus 0.06 – 0.16 (0.004 – 0.010)



(g) Adjust Idle Speed

Adjust injection volume by turning the idle speed adjusting screw.

Pump rpm	No. of measuring strokes	Injection volume of each cylinder cc (cu in.)
350	200	3.0 – 4.0 (0.18 – 0.24)



14. POST ADJUSTMENT CHECK

- (a) Check that injection stops when the fuel cut solenoid connector is disconnected.

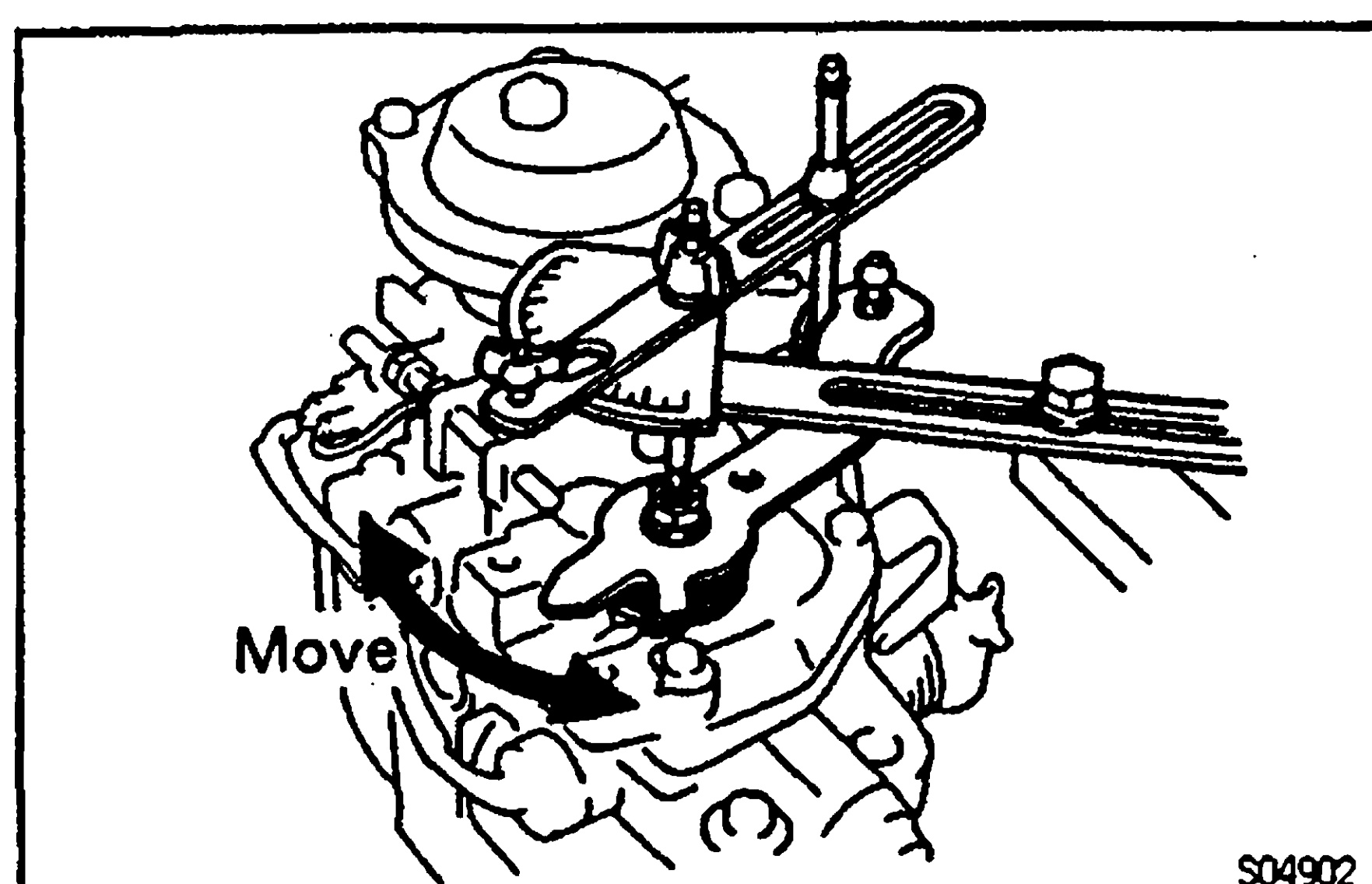
Pump revolution:

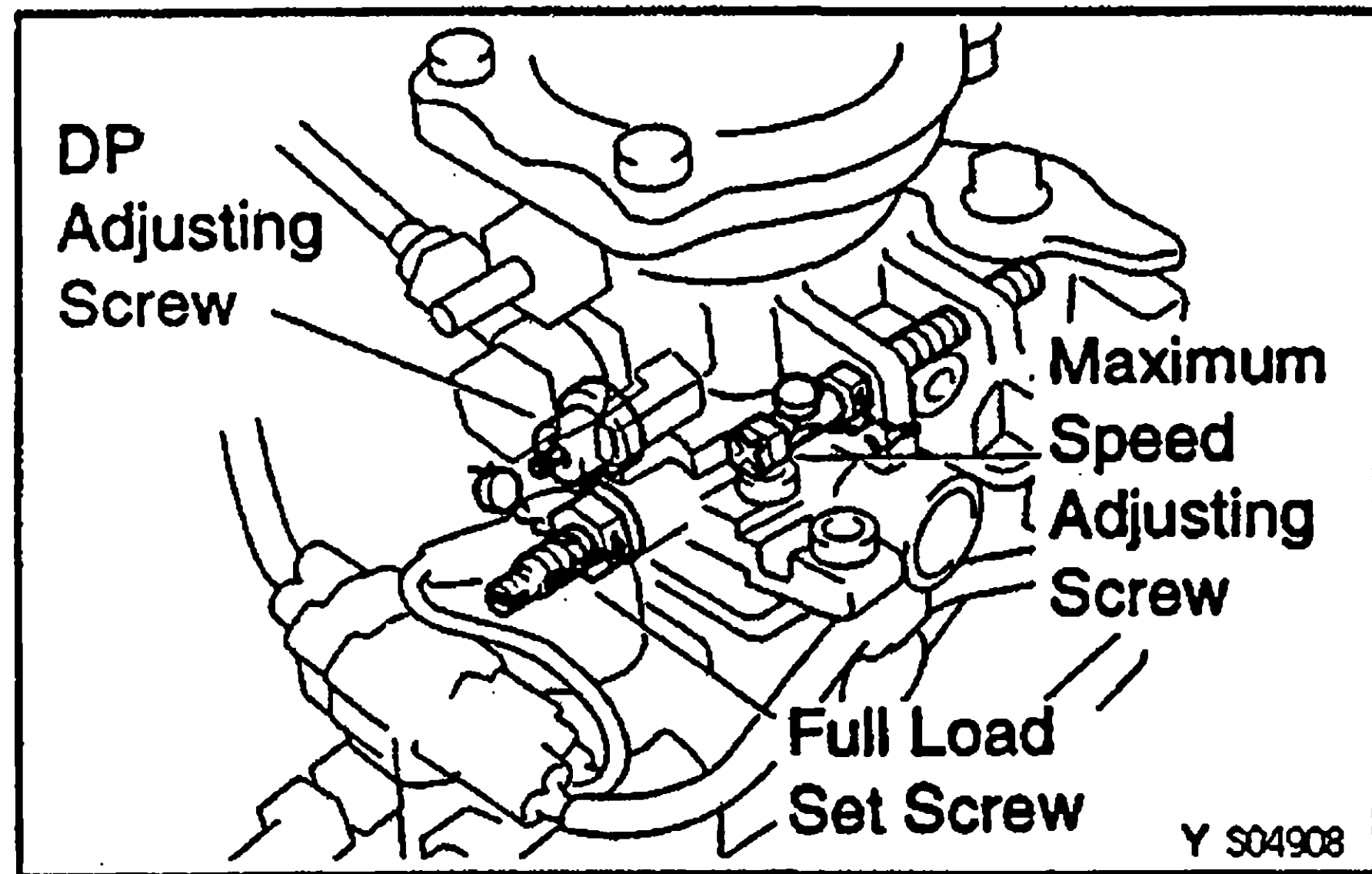
100 rpm

- (b) Check the adjusting lever movement.

Adjusting lever angle:

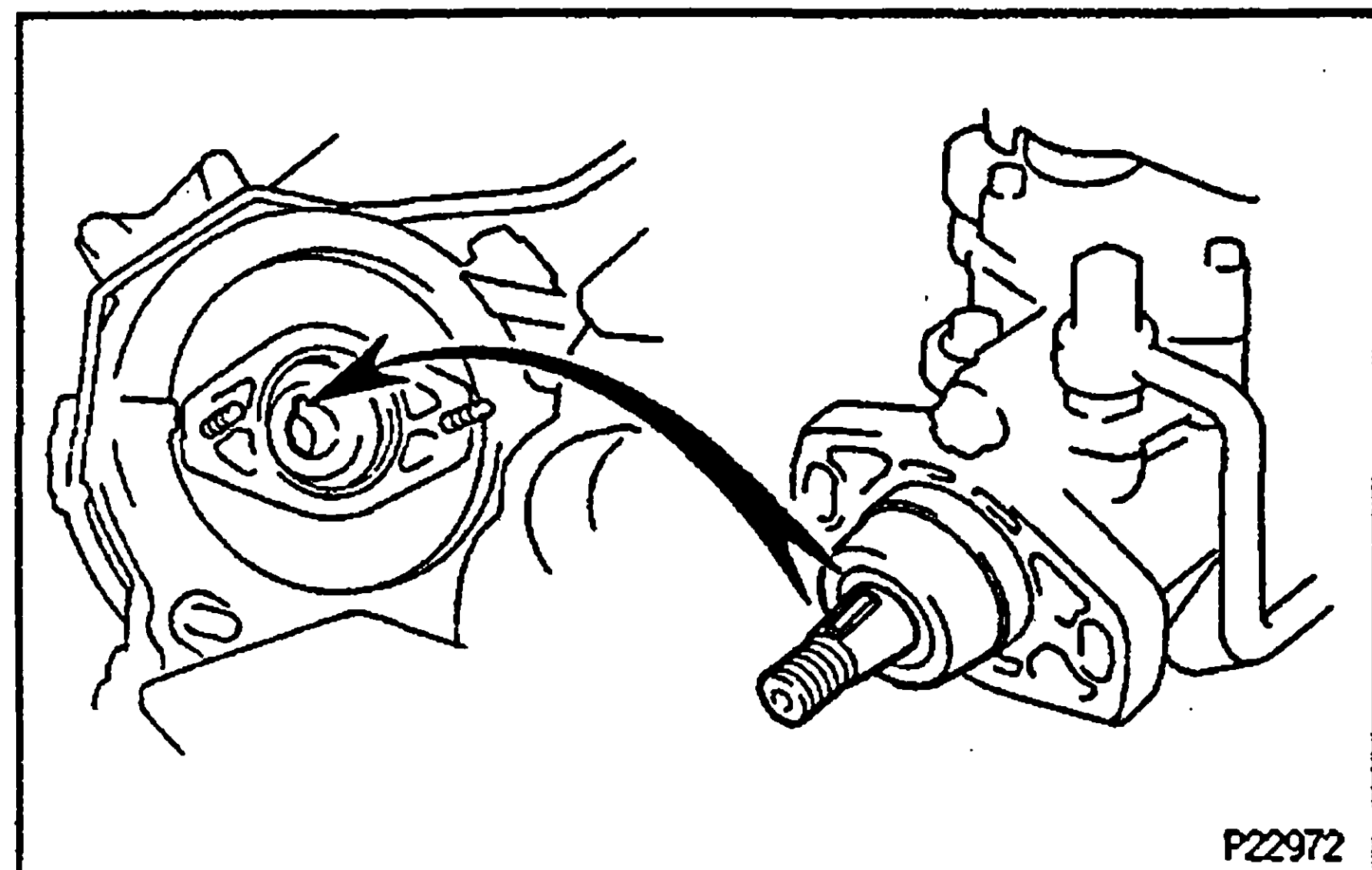
41 – 51°





15. SEAL PARTS

- Seal the full load set screw and maximum speed adjusting screw with new lead seals.
- Seal the DP adjusting screw with new collar.



INJECTION PUMP INSTALLATION

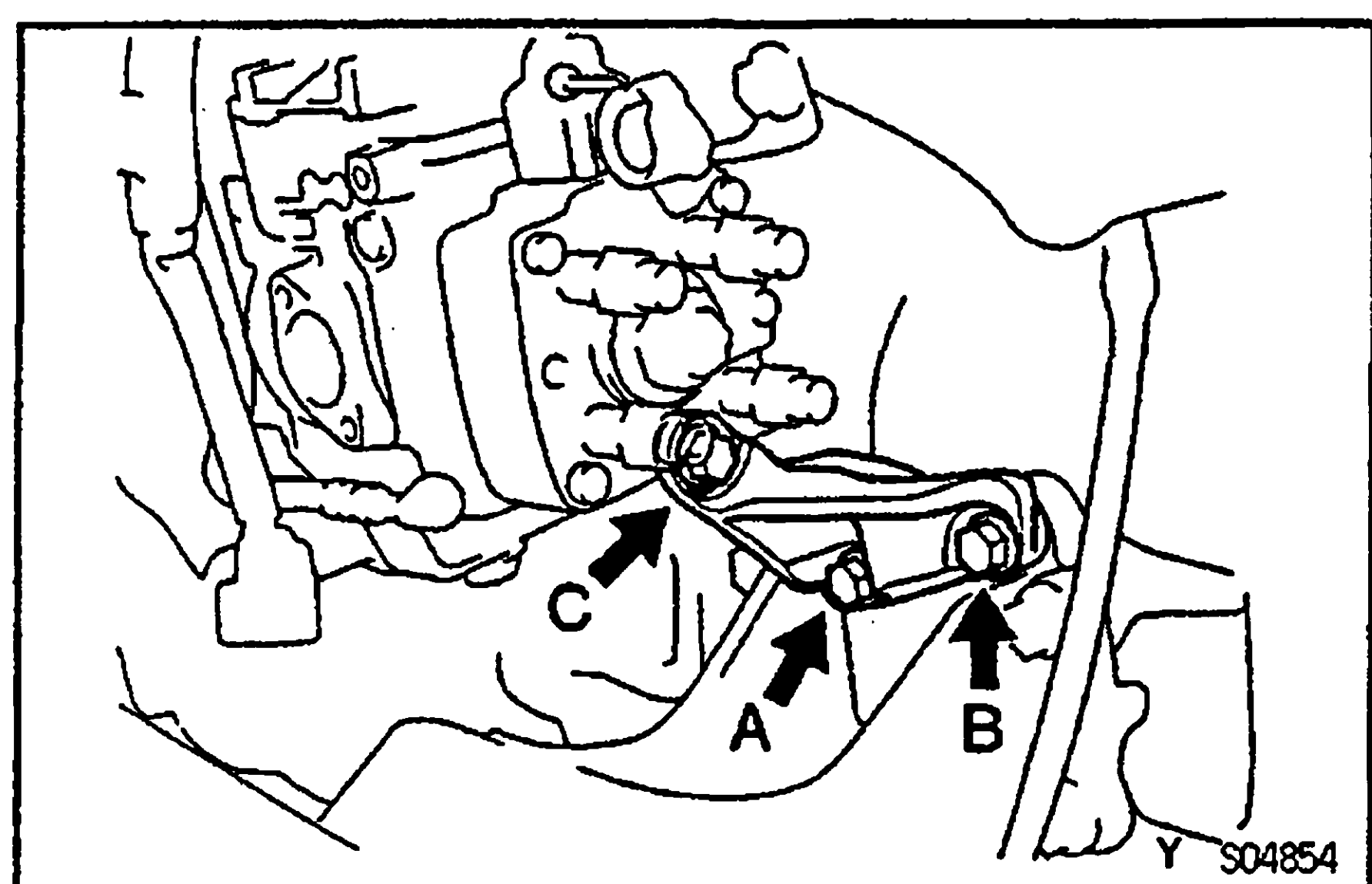
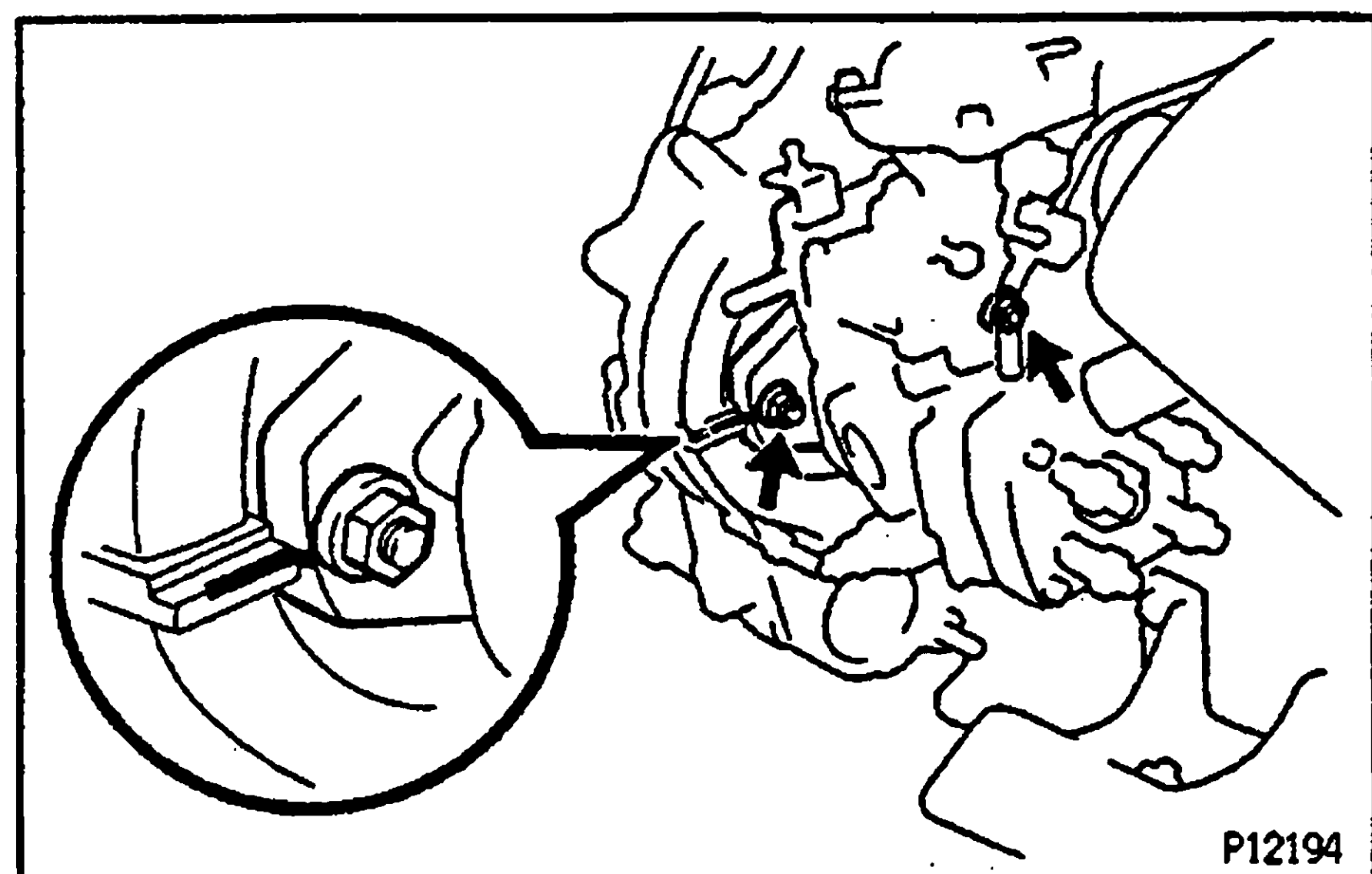
E87C7-02

1. INSTALL INJECTION PUMP

NOTICE: Do not put the injection pump at an angle more than 45° from the horizontal.

- Install a new O—ring to the pump.
- Apply a light coat of engine oil on the O—ring.
- Align the set key on the drive shaft and groove of the injection pump drive gear.
- Hold the injection pump with hands and press the injection pump drive gear to the backward and weld it with the injection pump drive shaft.
- Align the matchmarks of the injection pump and timing gear case, and then temporarily install the 2 nuts.
- Tighten the 2 nuts holding the injection pump to the timing gear case.

Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)



- Temporarily install the injection pump stay with the 2 bolts (A, B).
- Install the injection pump set C bolt.
- Torque the A and B bolts.

Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

NOTICE: Before tightening to the standard torque, check whether the pump stay is up against the injection pump.

- Install a new O—ring to the injection pump drive gear.
- Install the injection pump drive gear set nut.
- Hold the crankshaft pulley, and torque the set nut.

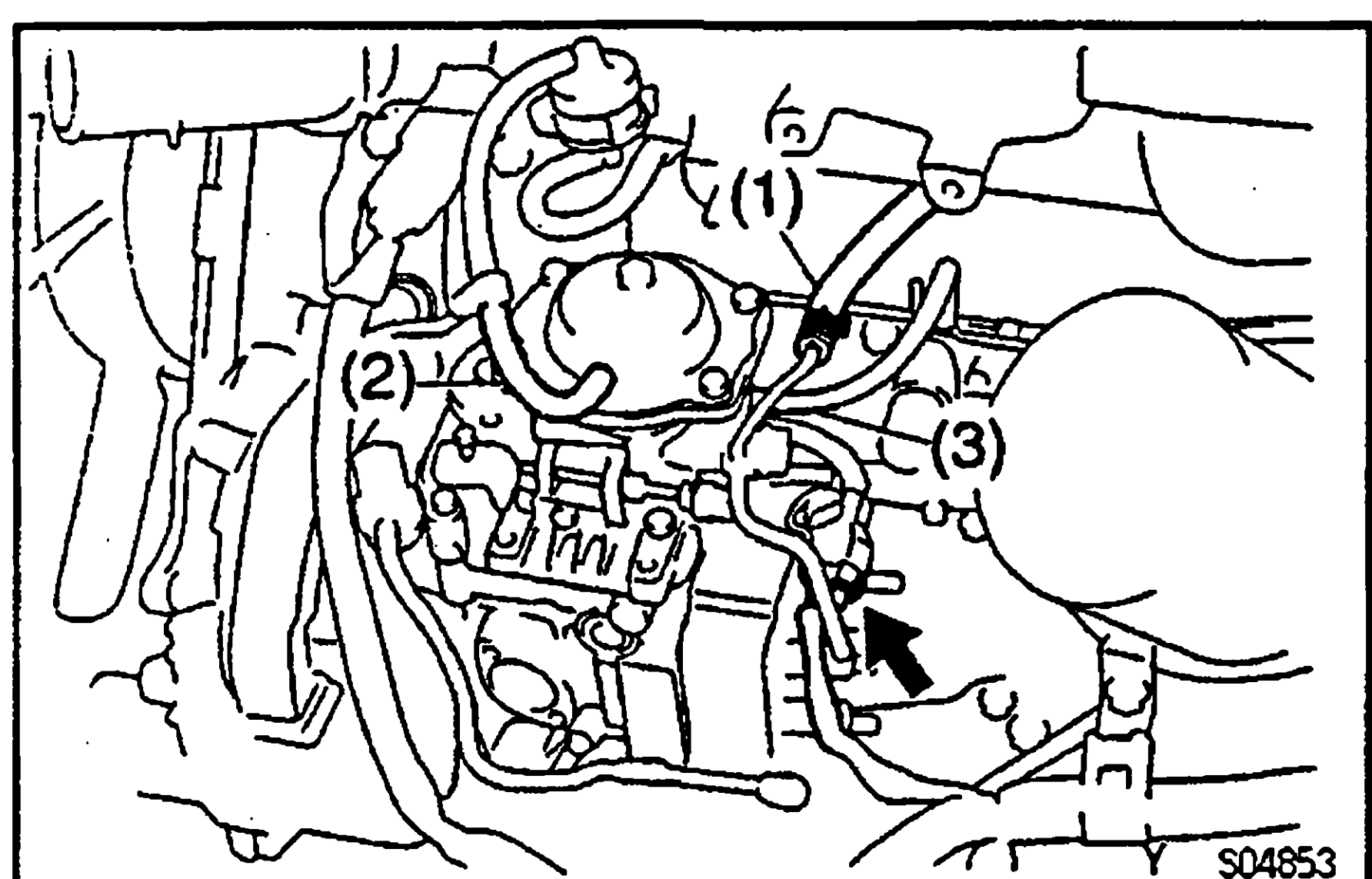
Torque: 64 N·m (650 kgf·cm, 47 ft·lbf)

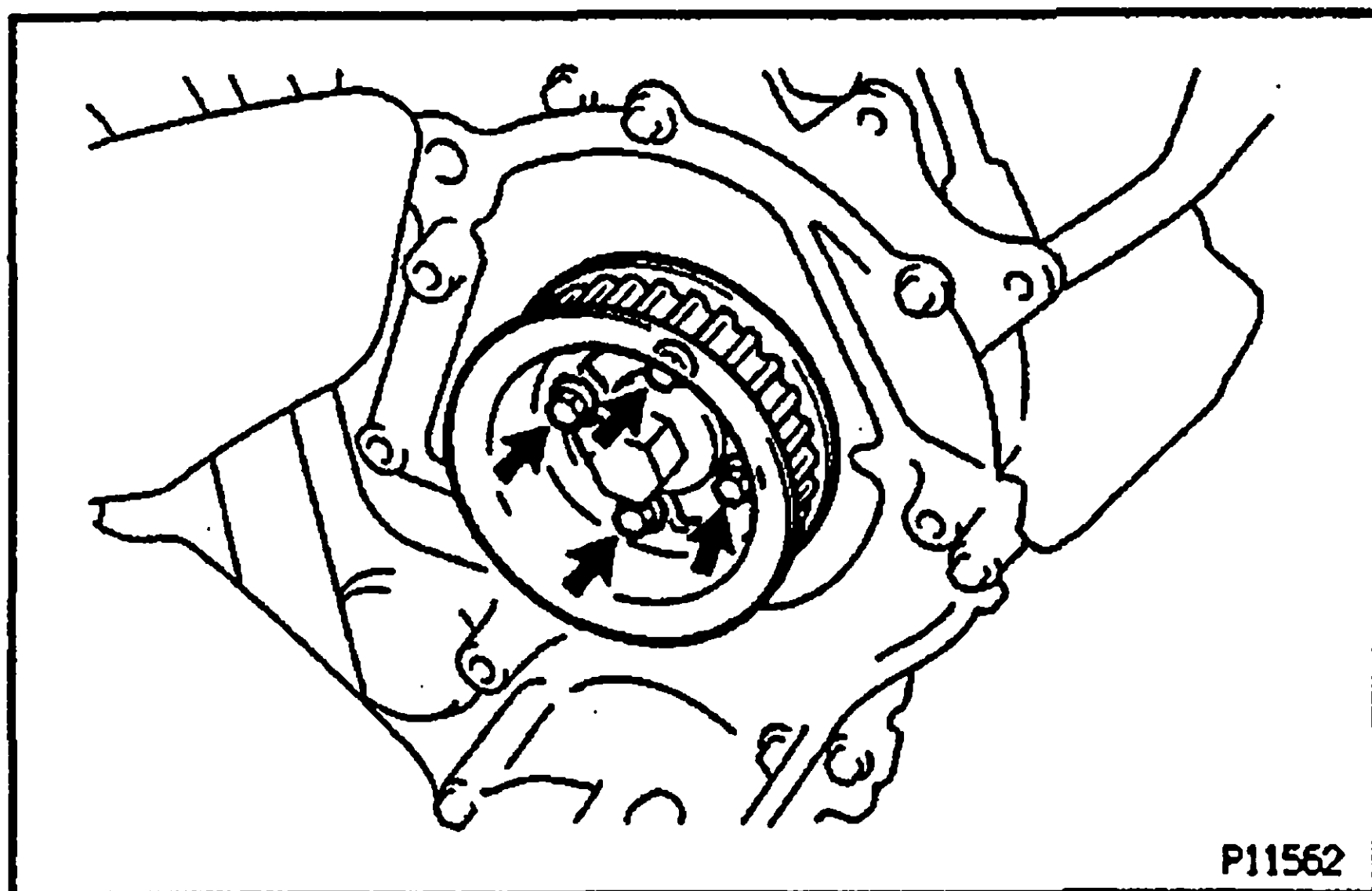
NOTICE: Do not turn the crankshaft pulley. The valve heads will hit against the piston top.

- Connect these hoses:

- Fuel hose
- Boost compensator hose
- BACS vacuum hose

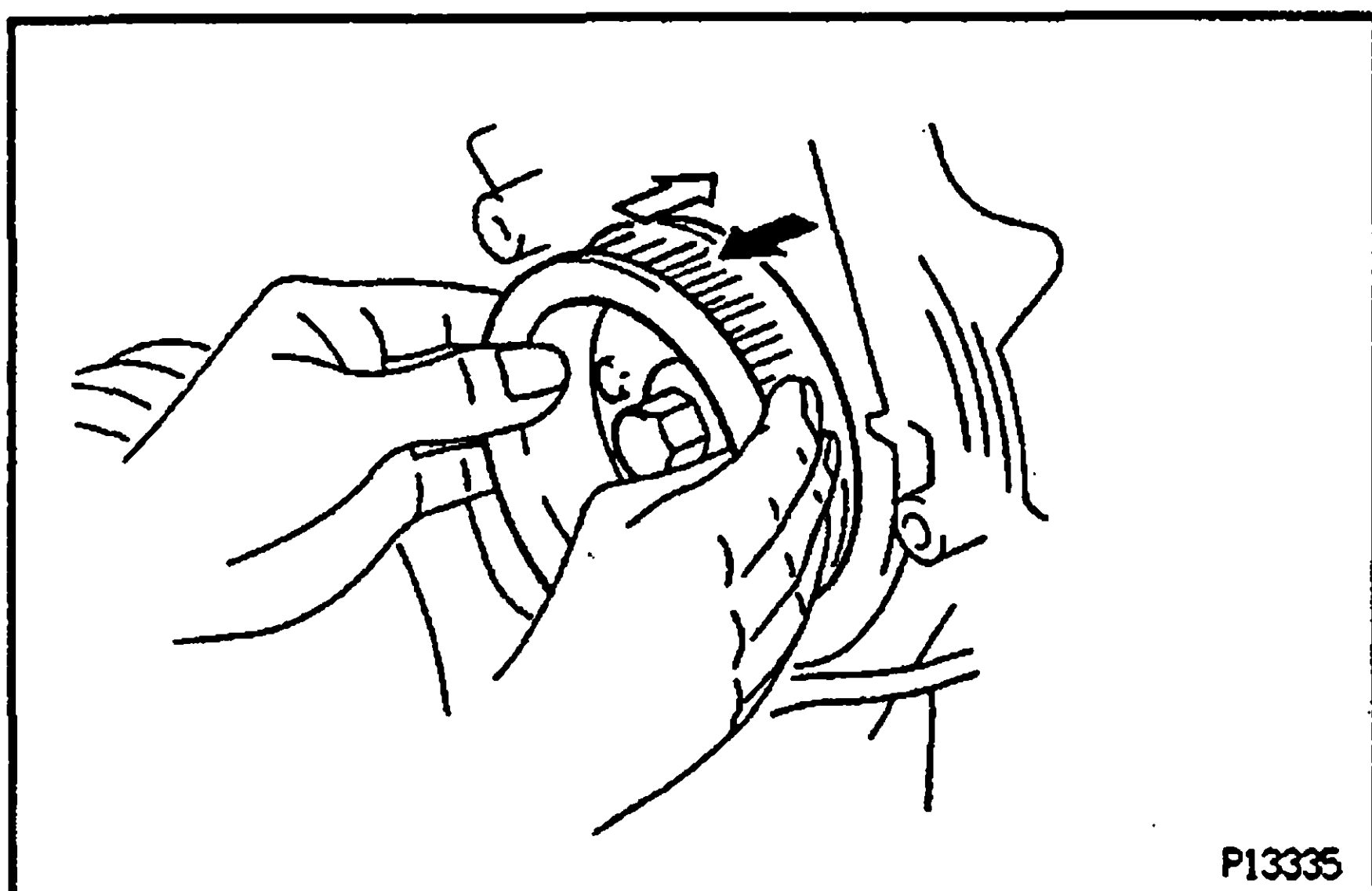
- Connect the injection pump connector.





2. INSTALL NO.2 CAMSHAFT TIMING PULLEY

Align the knock pin of the injection pump drive gear with the knock pin hole of the camshaft timing pulley.
Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)



3. CHECK INJECTION PUMP DRIVE SHAFT THRUST CLEARANCE

Move the No.2 camshaft timing pulley back and forth to check that the injection pump drive shaft has sufficient thrust clearance.

Thrust clearance (Reference)

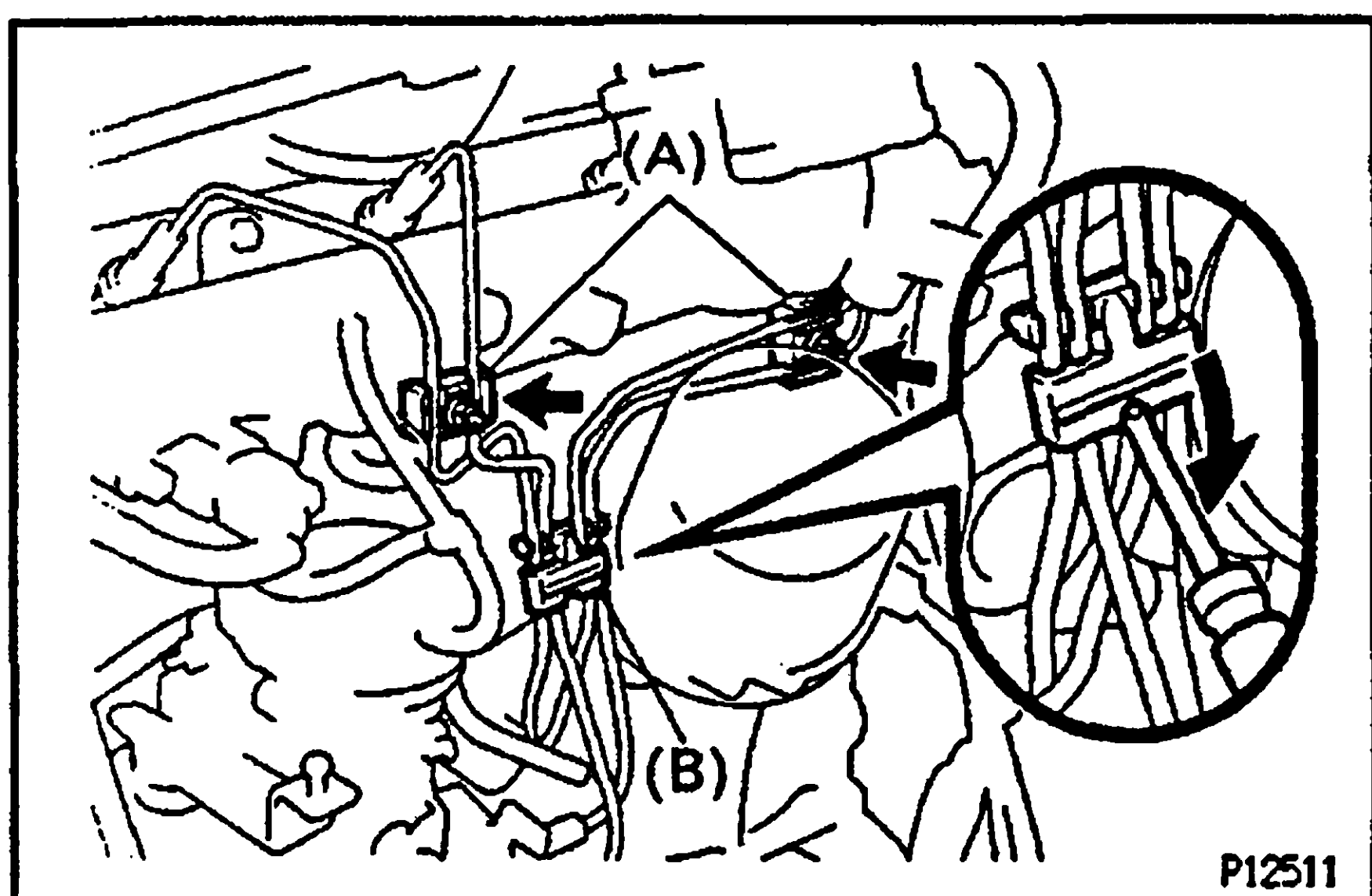
0.15 — 0.55 mm (0.0059 — 0.0217 in.)

If the thrust clearance is not sufficient, loosen the 2 injection pump nuts and the 3 pump stay bolts, then retighten them.

If the thrust clearance is still not sufficient, remove the timing gear cover and then reinstall it.

4. INSTALL TIMING BELT

(See steps 8 to 12 in cylinder head installation in Engine Mechanical)



5. INSTALL INJECTION PIPES

(a) Temporarily install the 4 injection pipes and 2 clamps (A).

(b) Install the 2 nuts holding the clamps (A) to the intake manifold.

Torque: 6 N·m (65 kgf·cm, 56 in·lbf)

(c) Using a screwdriver, attach the clamp (B).

(d) Tighten the 8 union nuts.

Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

6. INSTALL ACCELERATOR CABLE BRACKET AND LINK

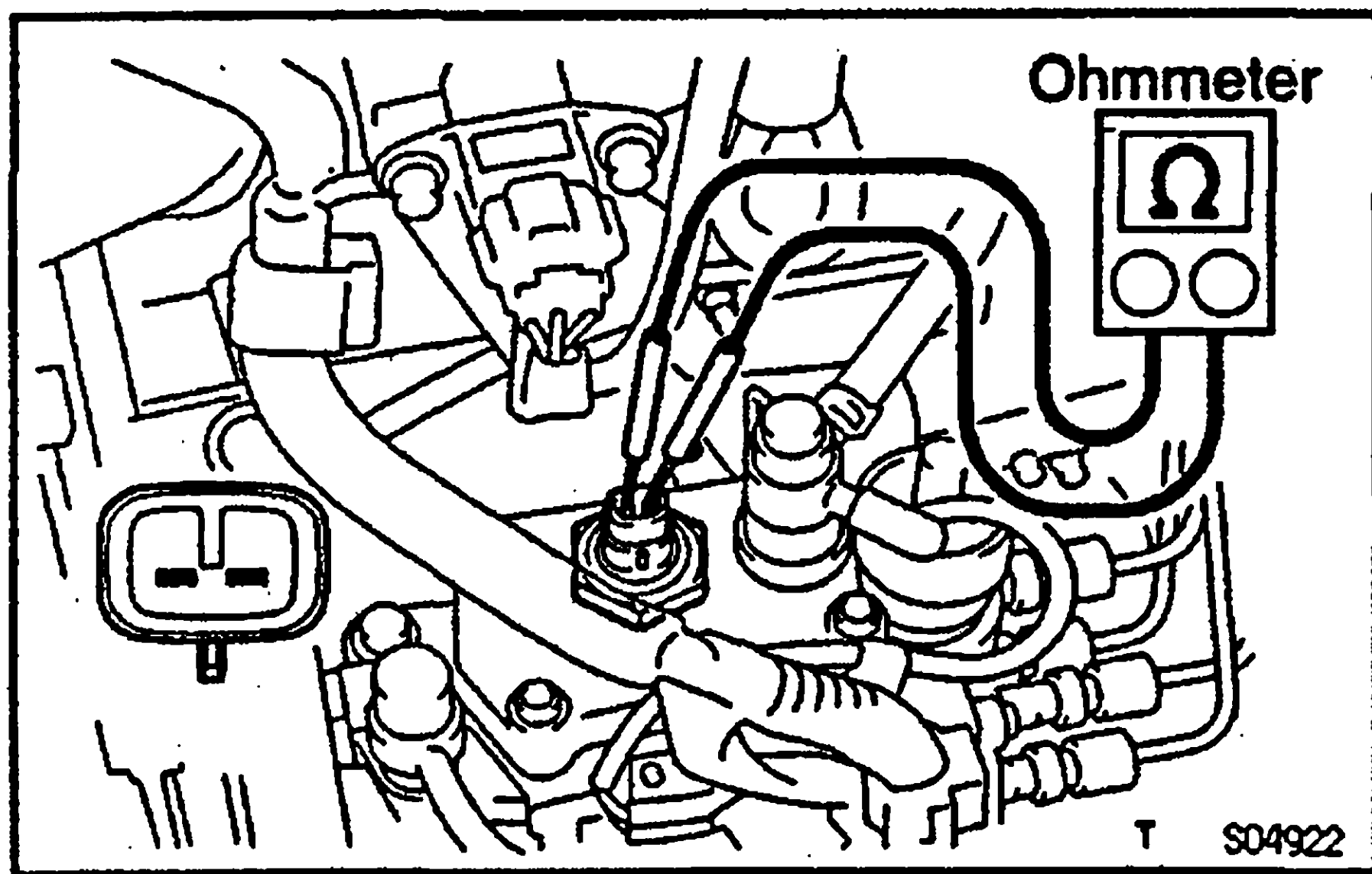
(a) Install the accelerator cable bracket and link with the 3 bolts.

Torque: 20 N·m (200 kgf·cm, 15 ft·lbf)

(b) Connect the accelerator link to the injection pump.

7. INSTALL INTAKE PIPE

(See step 22 in cylinder head installation in Engine Mechanical)



INJECTION PUMP (1KZ—TE)

E577V-01

ON—VEHICLE INSPECTION

1. INSPECT ENGINE SPEED SENSOR RESISTANCE

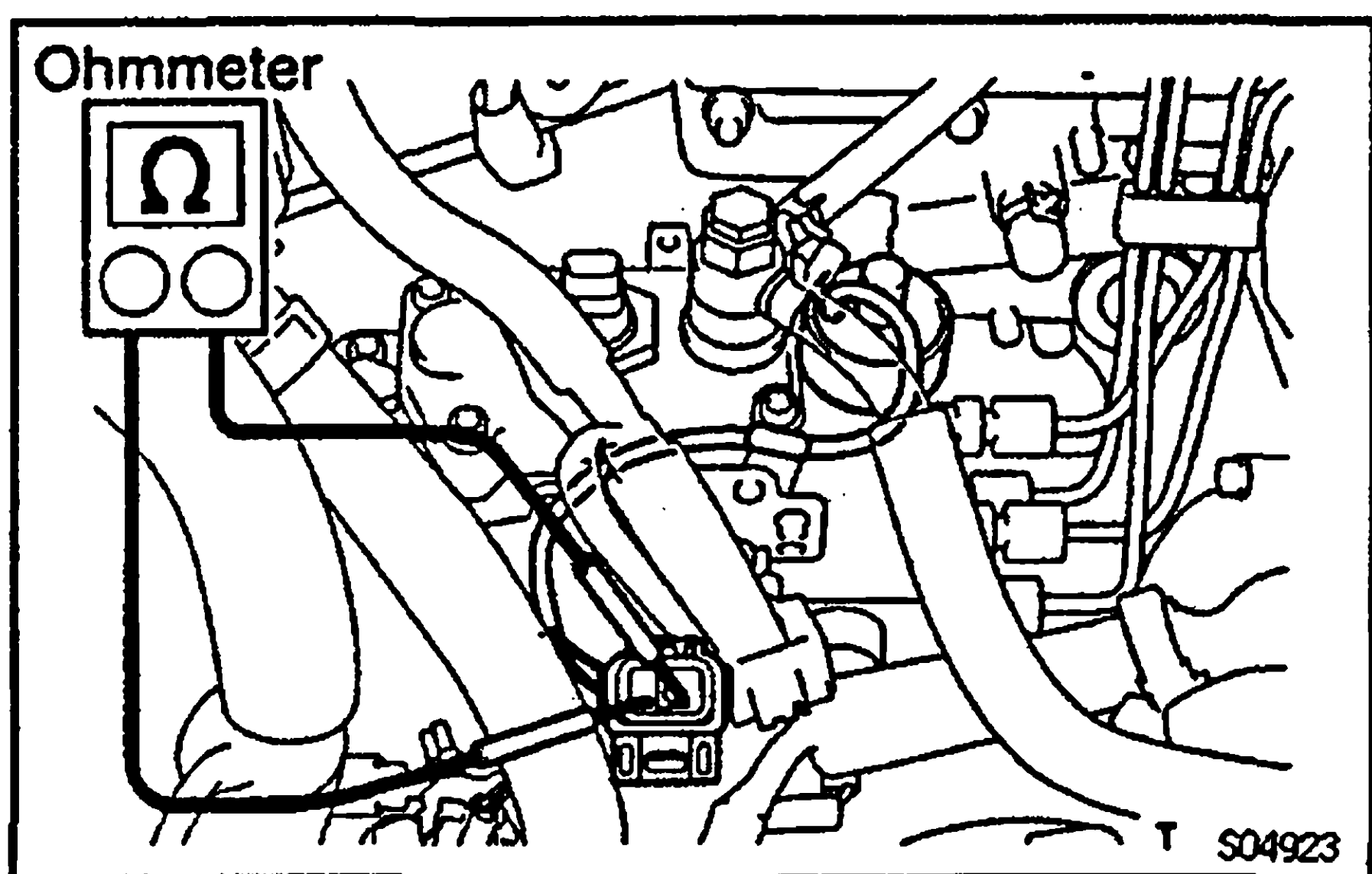
- Disconnect the sensor connector.
- Using an ohmmeter, measure the resistance between the terminals.

Resistance:

205 — 255 Ω at 20°C (68°F)

If the resistance is not as specified, replace the injection pump.

- Reconnect the sensor connector.



2. INSPECT SPILL CONTROL VALVE RESISTANCE

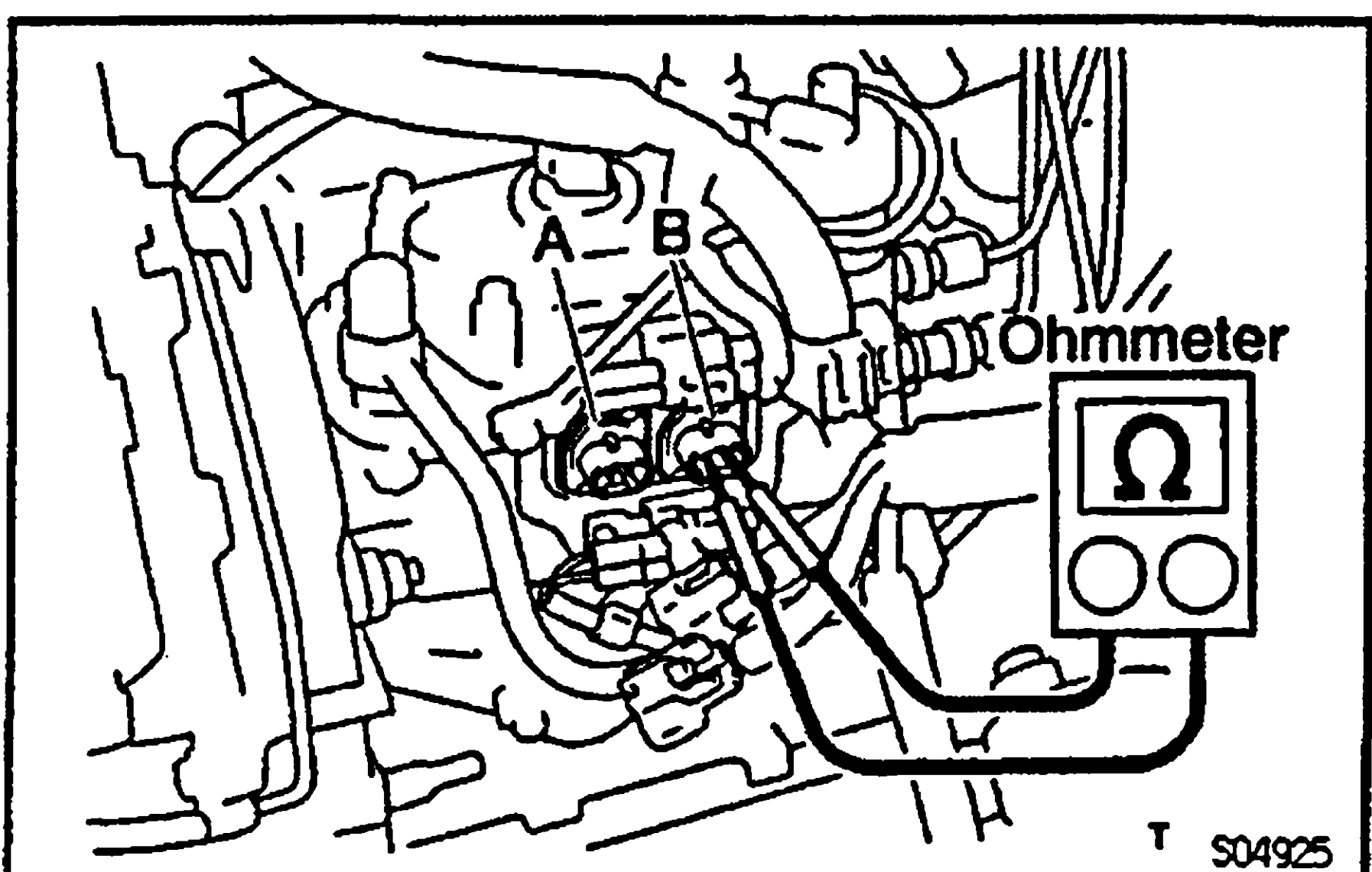
- Disconnect the valve connector.
- Using an ohmmeter, measure the resistance between the terminals.

Resistance:

1 — 2 Ω at 20°C (68°F)

If the resistance is not as specified, replace the injection pump.

- Reconnect the valve connector.



3. INSPECT CORRECTION RESISTORS RESISTANCE

- Disconnect the resistor connector.
- Using an ohmmeter, measure the resistance between the terminals.

Resistance:

0.1 — 2.5 k Ω at 20°C (68°F)

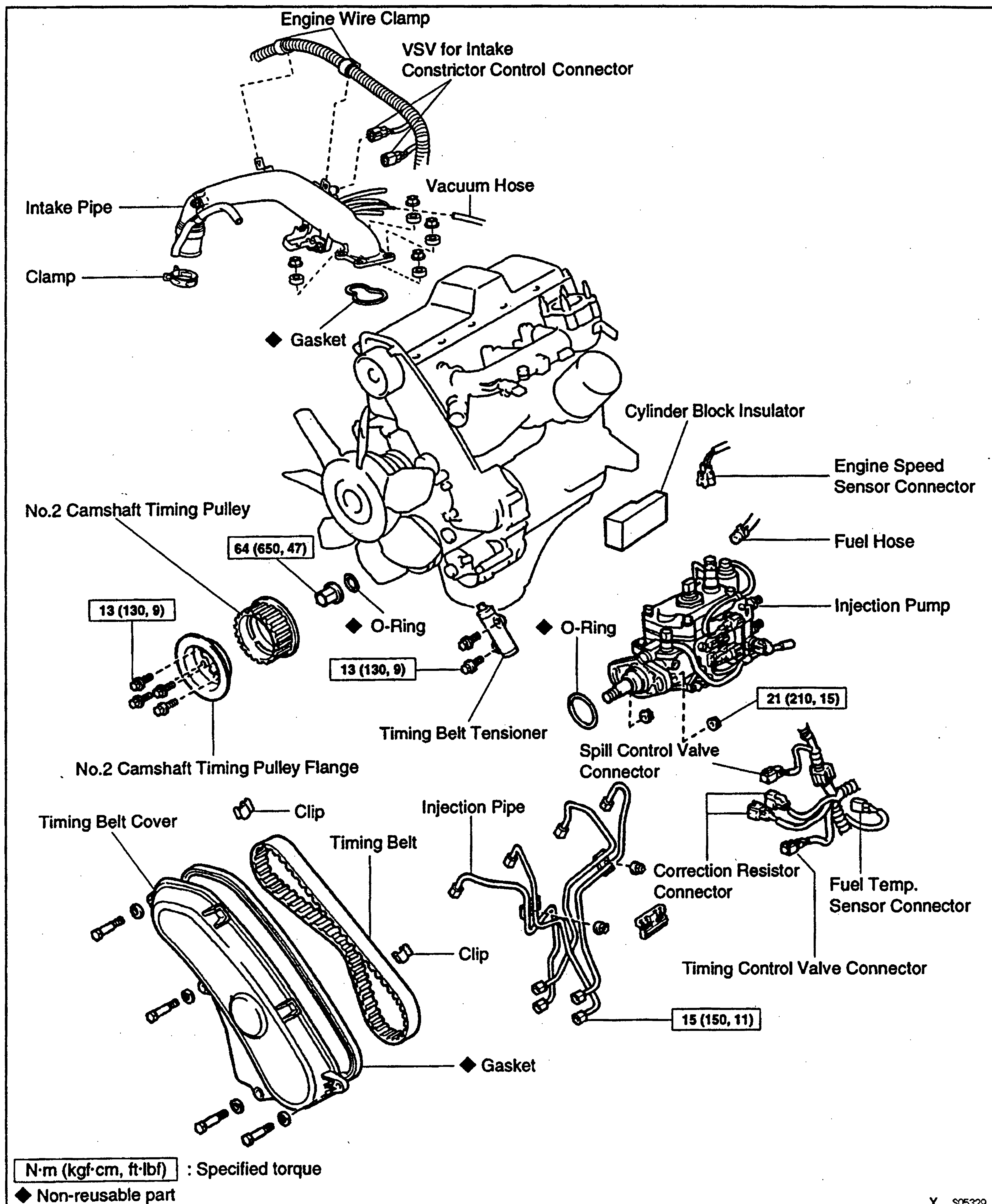
If the resistance is not as specified, replace the injection pump.

- Reconnect the resistor connector.

4. INSPECT TIMING CONTROL VALVE RESISTANCE (See timing control valve in ECD System)

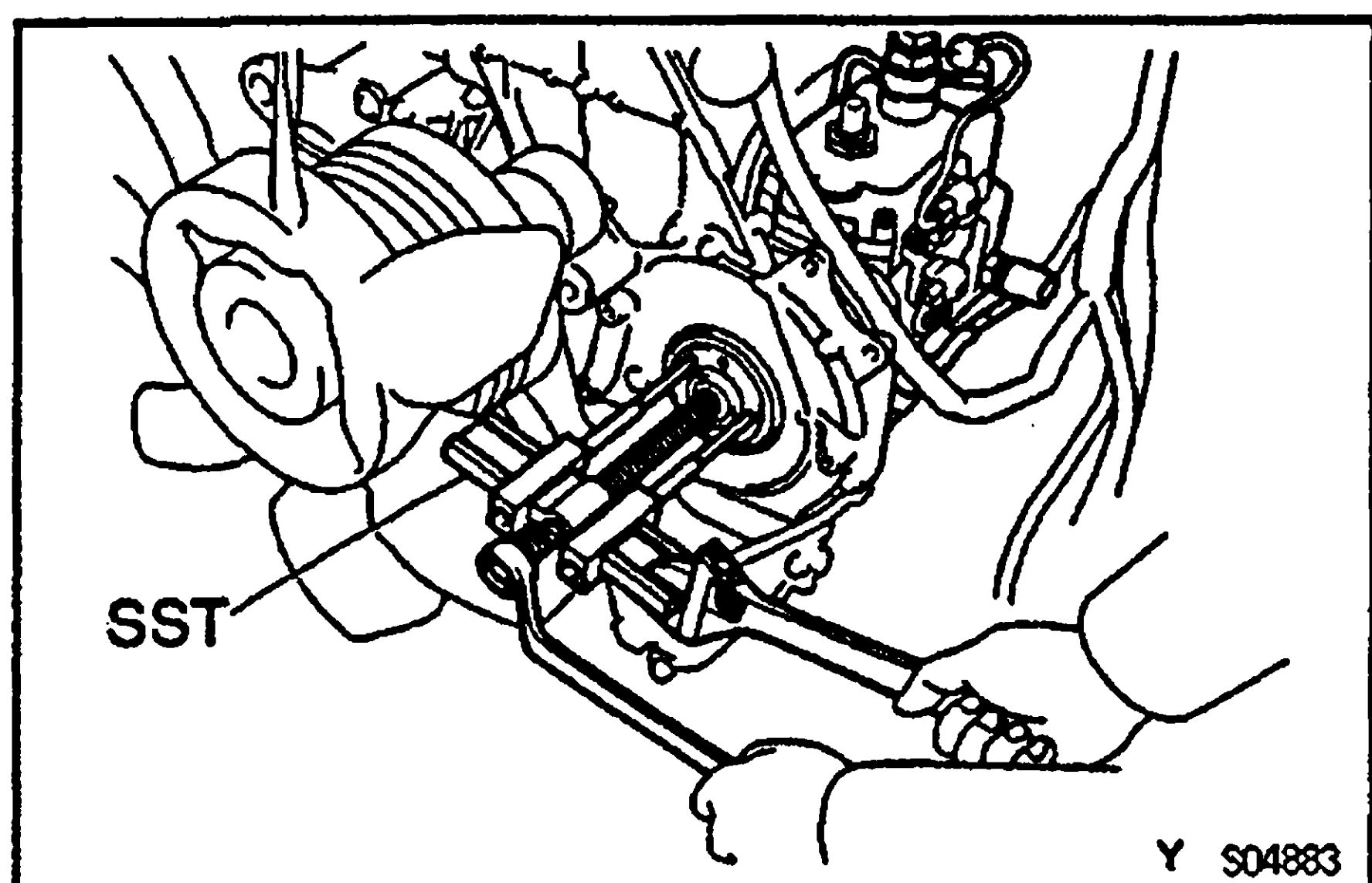
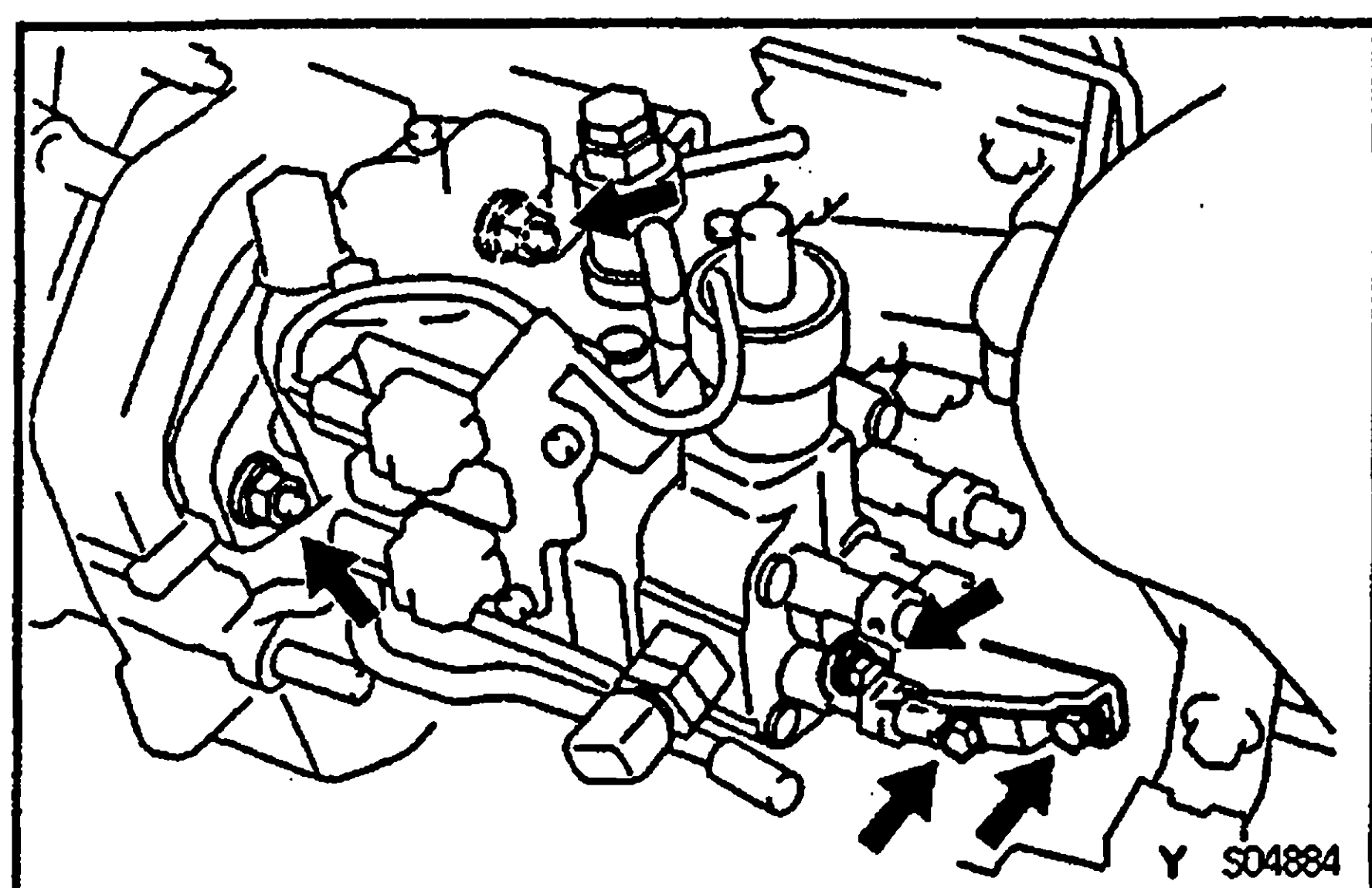
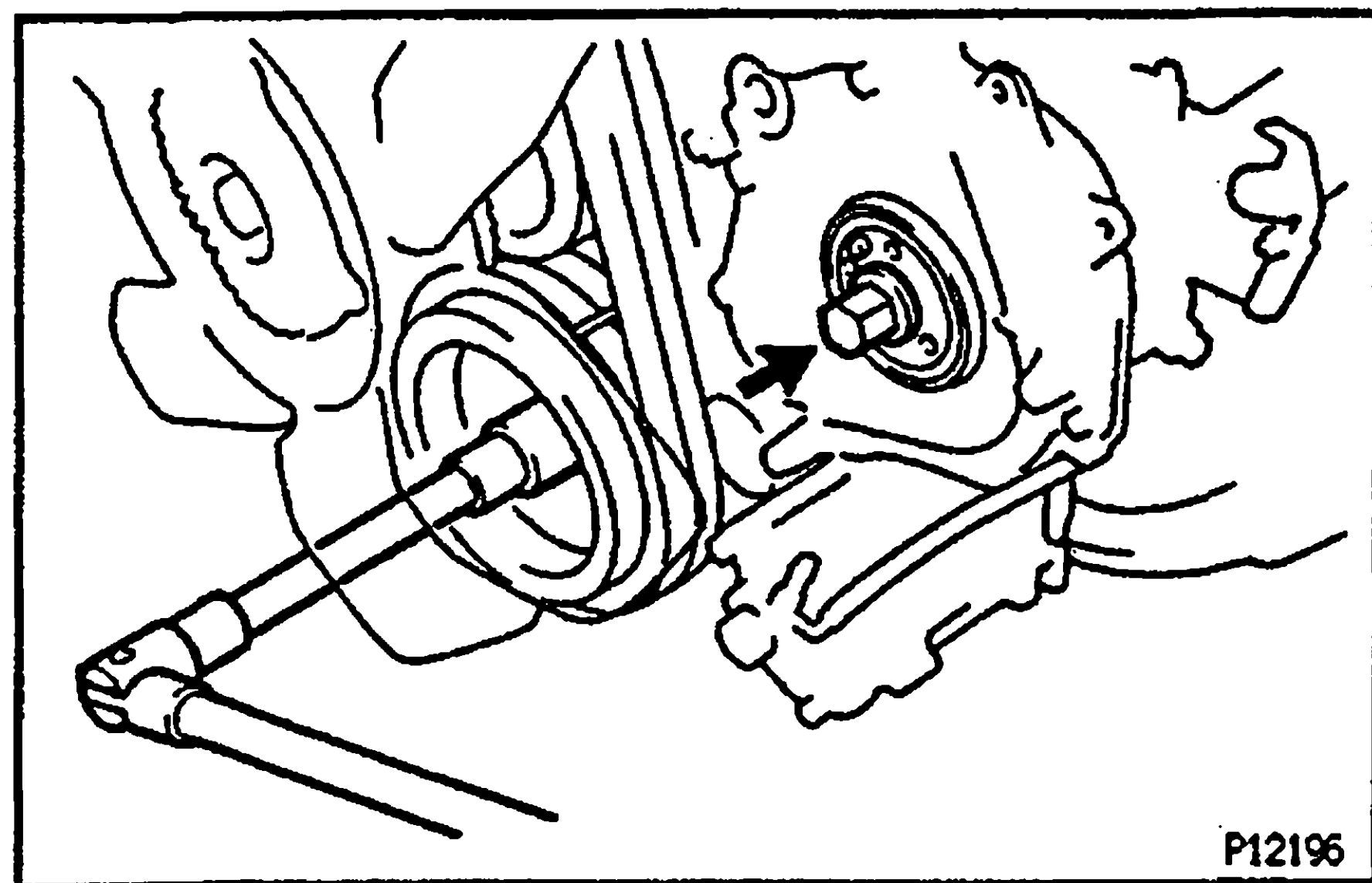
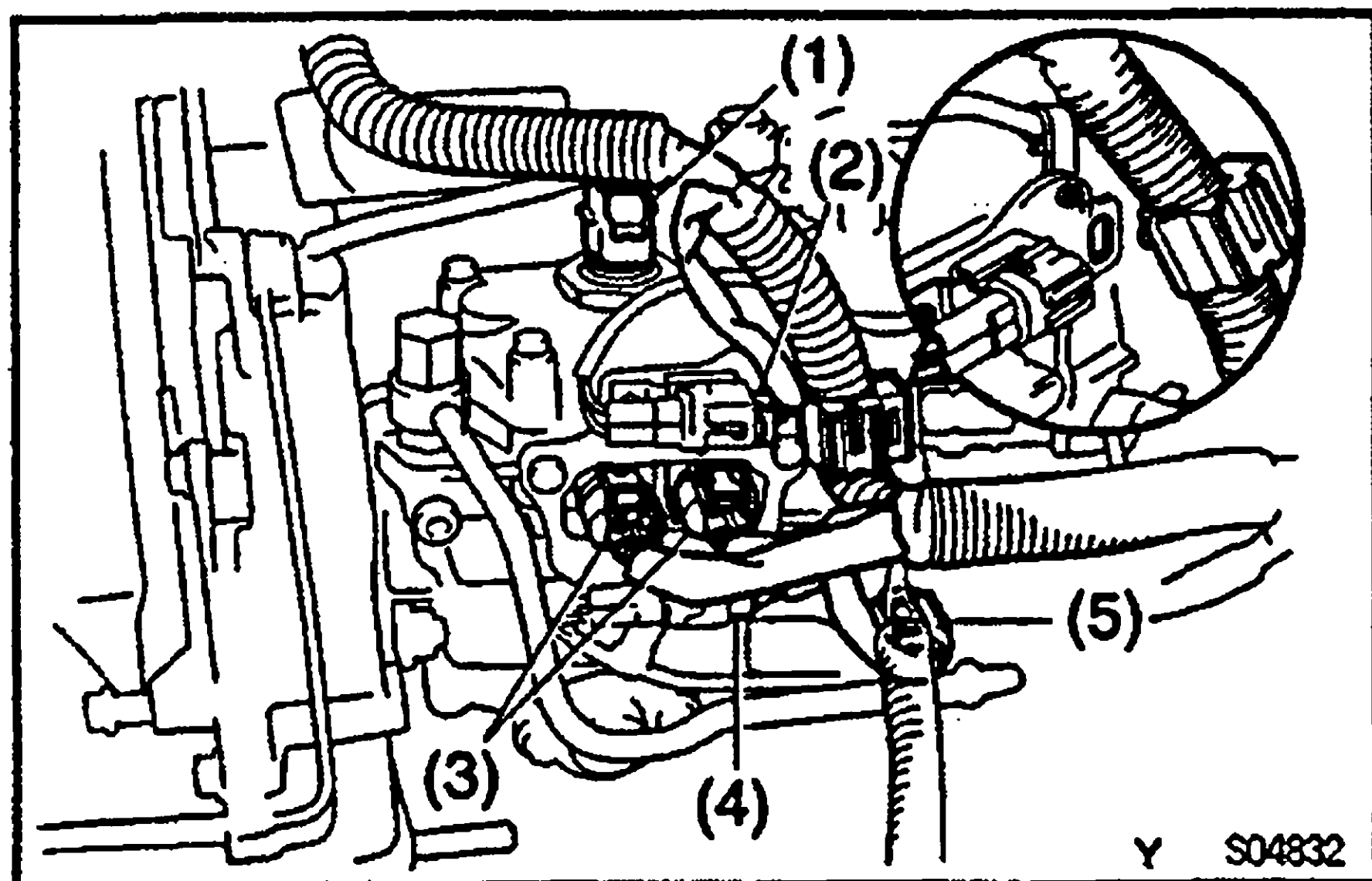
COMPONENTS FOR REMOVAL AND INSTALLATION

EG



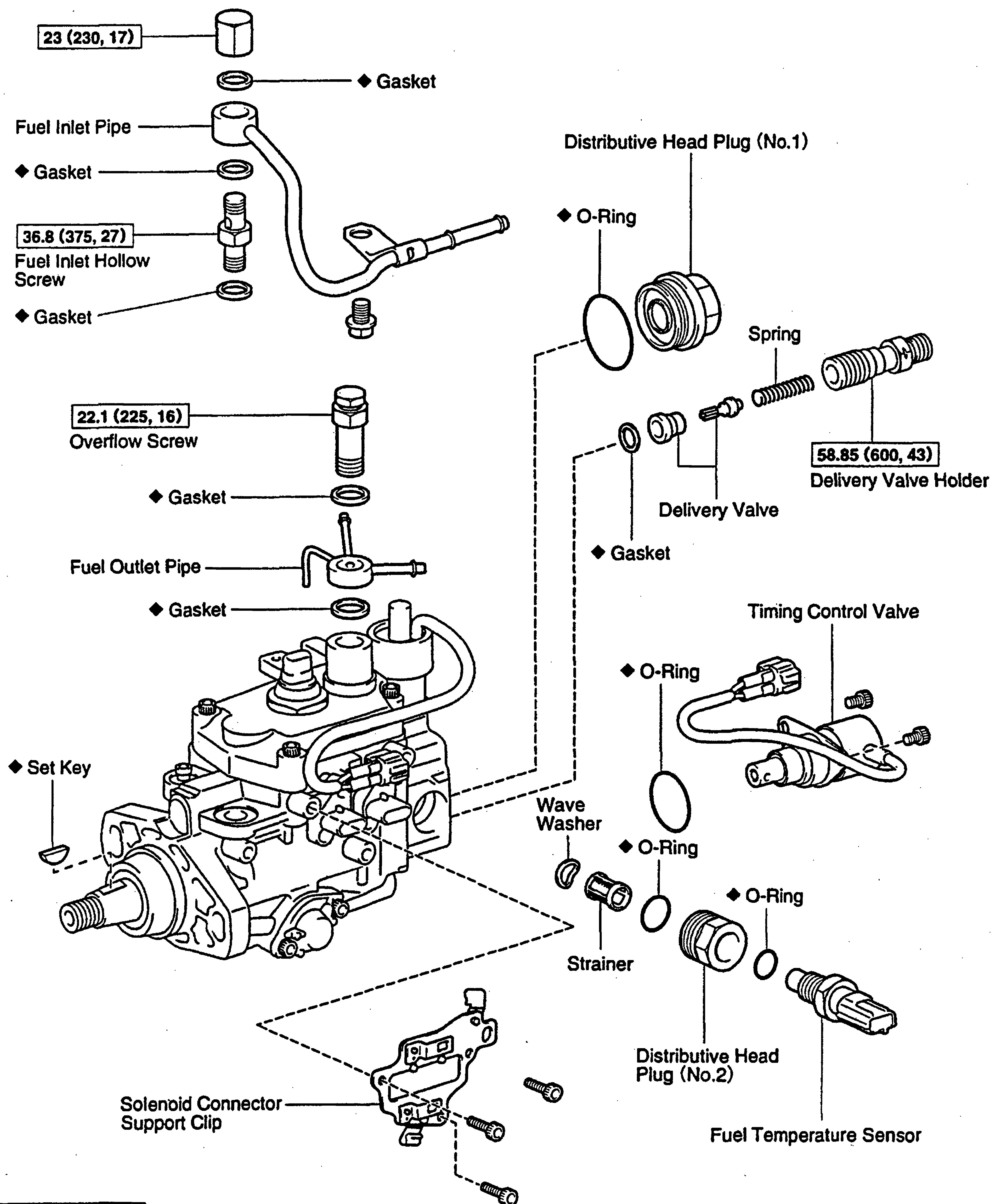
INJECTION PUMP REMOVAL

1. **REMOVE INTAKE PIPE**
(See step 2 in cylinder head removal in Engine Mechanical)
2. **REMOVE INJECTION PIPES**
(See step 3 in injection pump removal (1KZ-T))
3. **REMOVE TIMING BELT**
(See steps 10 to 14 in cylinder head removal in Engine Mechanical)
4. **CHECK INJECTION PUMP DRIVE SHAFT THRUST CLEARANCE**
(See step 5 in injection pump removal (1KZ-T))
5. **REMOVE NO.2 CAMSHAFT TIMING PULLEY**
(See step 6 in injection pump removal (1KZ-T))
6. **REMOVE INJECTION PUMP**
 - (a) Disconnect these connectors:
 - (1) Engine speed sensor connector
 - (2) Spill control valve connector
 - (3) Correction resistor connectors
 - (4) Timing control valve connector
 - (5) Fuel temperature sensor connector
 - (b) Disconnect the engine wire clamp and fuel hose.
 - (c) Hold the crankshaft pulley, and remove the injection pump drive gear set nut.
 - (d) Remove the O-ring from the injection pump drive gear.
 - (e) Loosen the 2 nuts holding the injection pump to the timing gear case.
 - (f) Remove the 3 bolts and injection pump stay.
 - (g) Using SST, disconnect the injection pump from the timing gear case.
SST 09950-50010 (09951-05010, 09952-05010, 09953-05020, 09954-05010)
 - (h) Remove the 2 nuts, injection pump and cylinder block insulator.
 - (i) Remove the O-ring from the injection pump.



COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

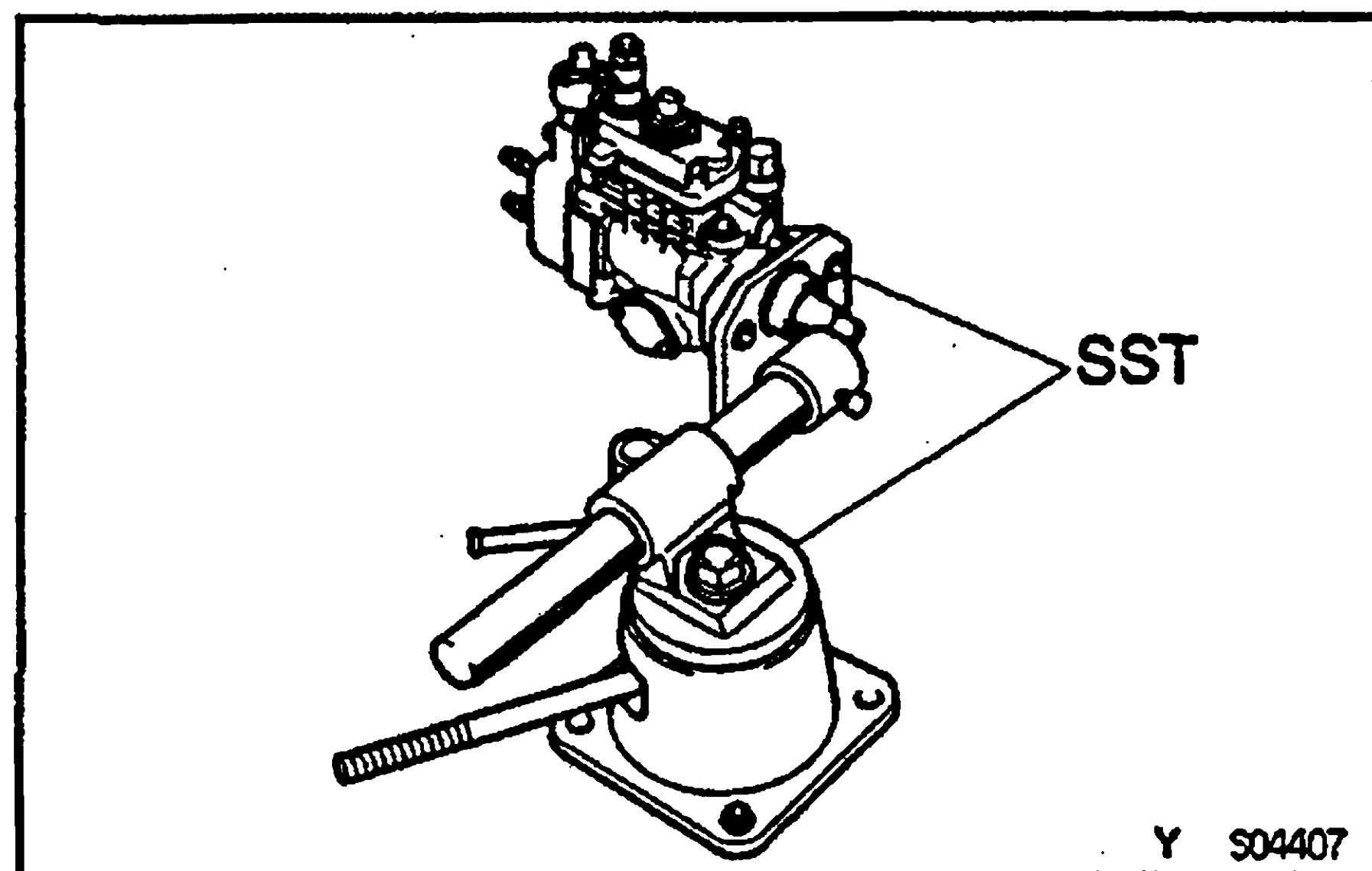
EG790-01



N·m (kgf·cm, ft·lbf): Specified torque

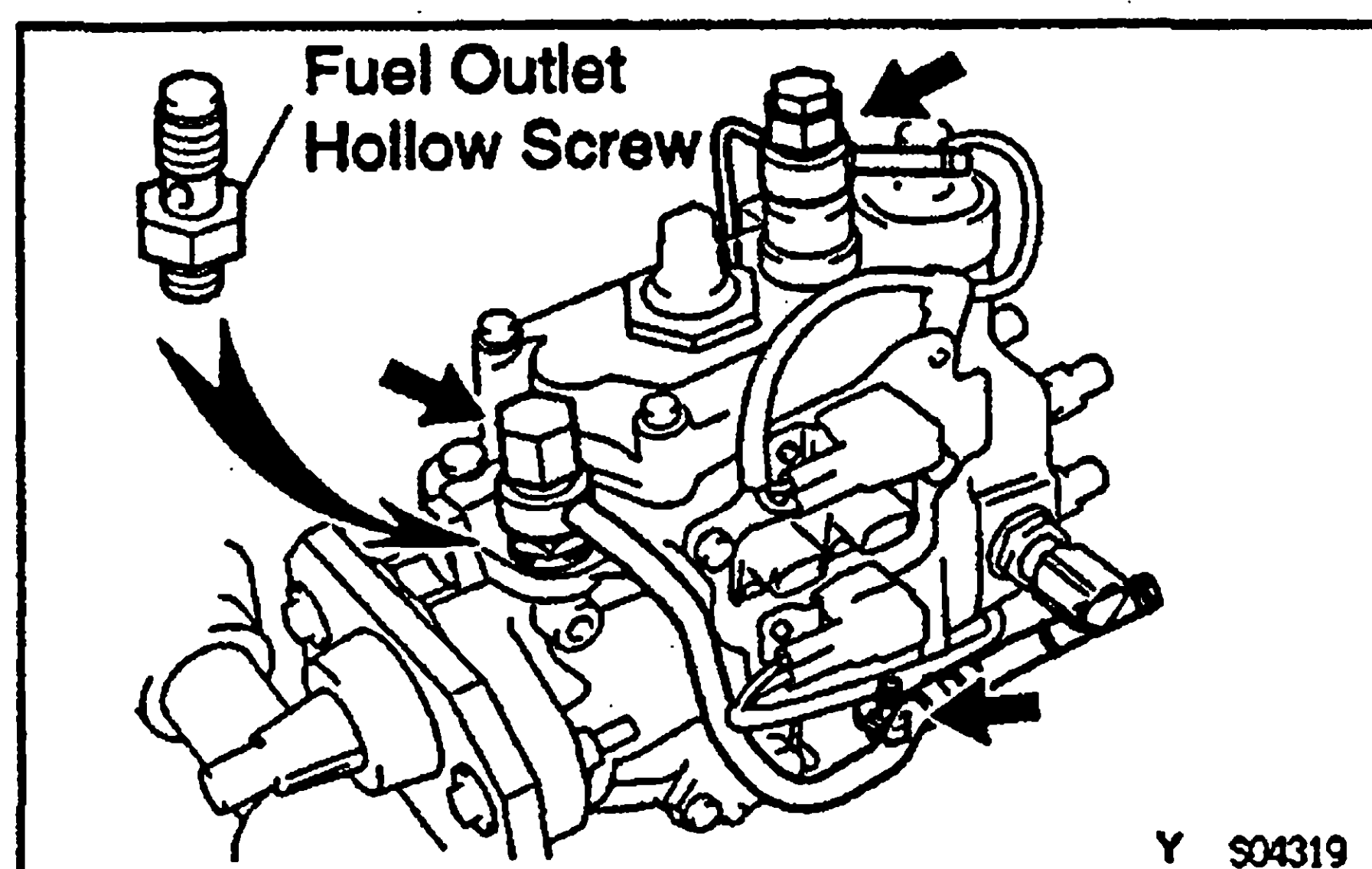
◆ Non-reusable part

EG

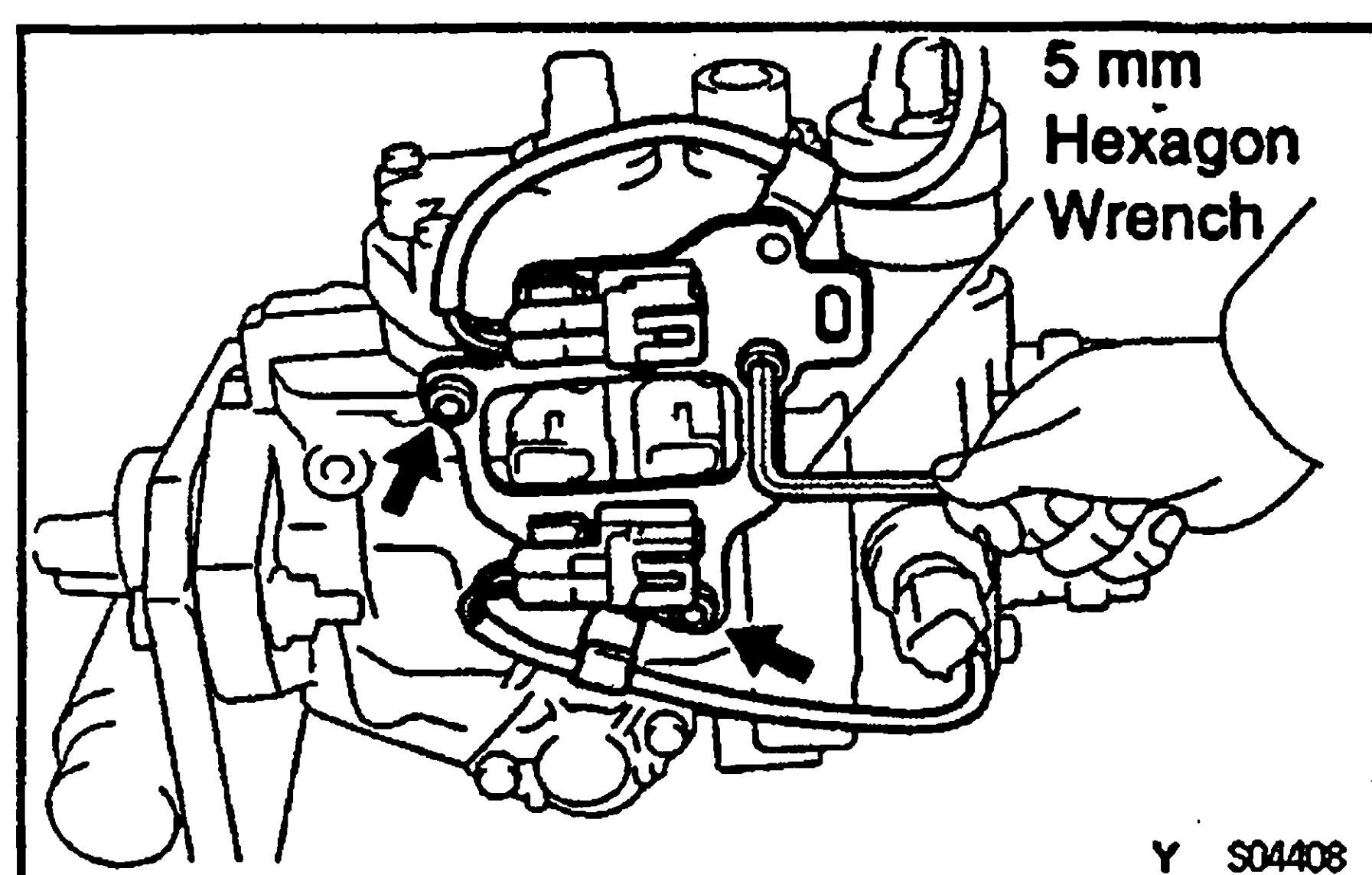


INJECTION PUMP DISASSEMBLY

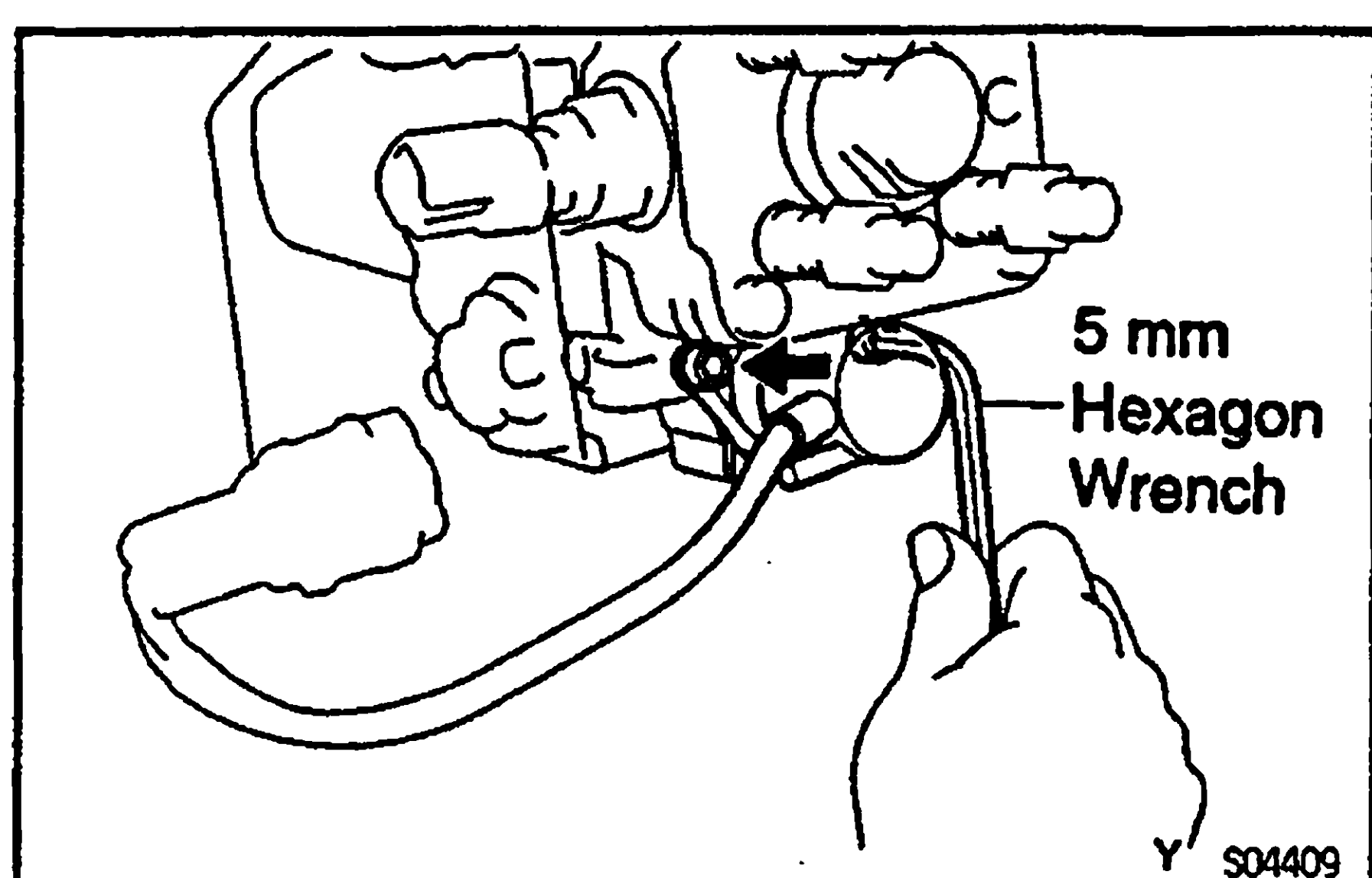
1. **MOUNT PUMP ASSEMBLY TO SST (STAND)**
SST 09241-76022, 09245-54010
2. **REMOVE SET KEY OF DRIVE PULLEY FROM DRIVE SHAFT**



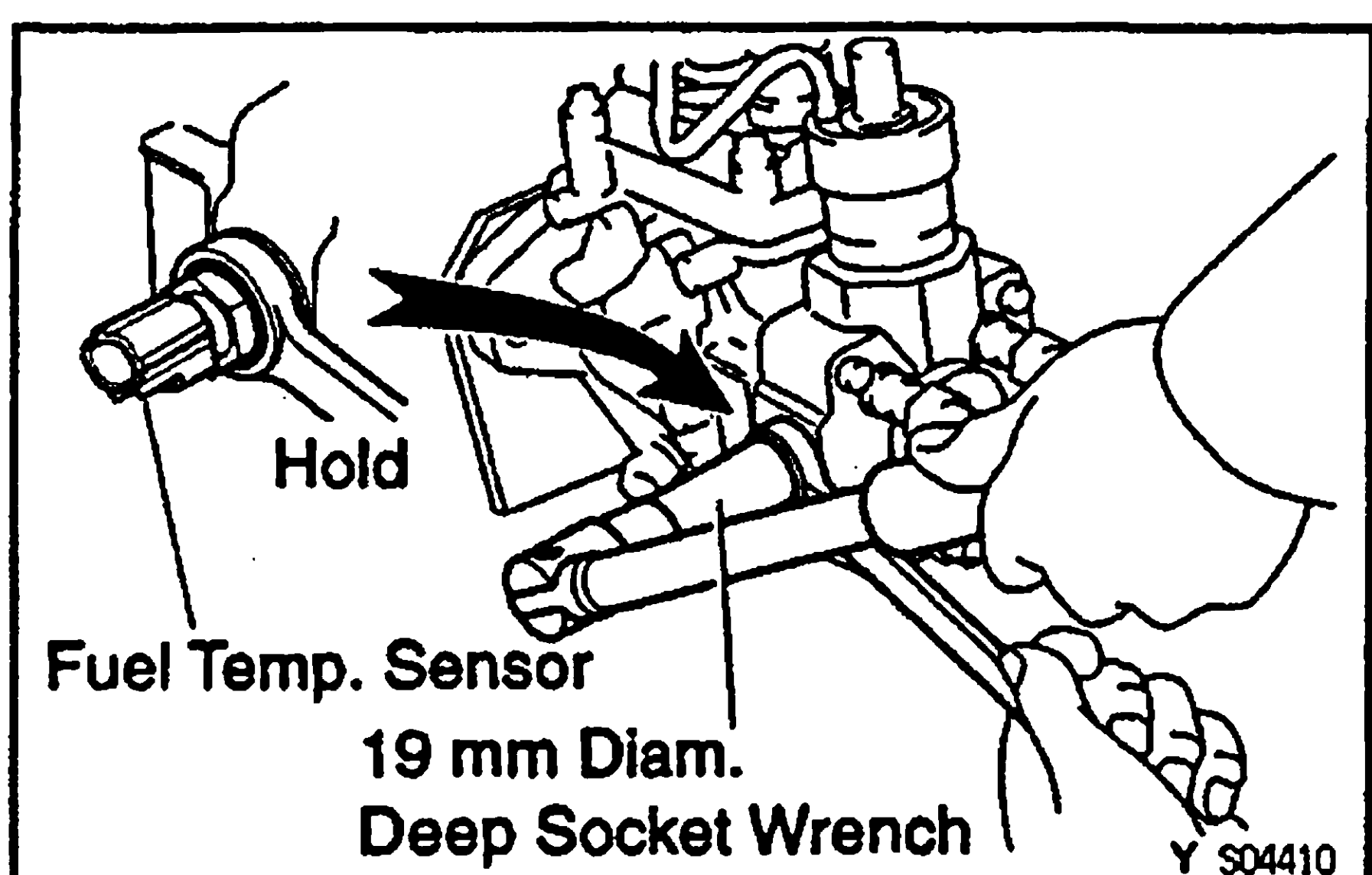
3. **REMOVE FUEL PIPES AND INLET HOLLOW SCREW**
 - (a) Remove the overflow screw, fuel outlet pipe and 2 gaskets.
 - (b) Remove the cap nut, bolt, fuel inlet pipe and 2 gaskets.
 - (c) Remove the fuel outlet hollow screw and gasket.



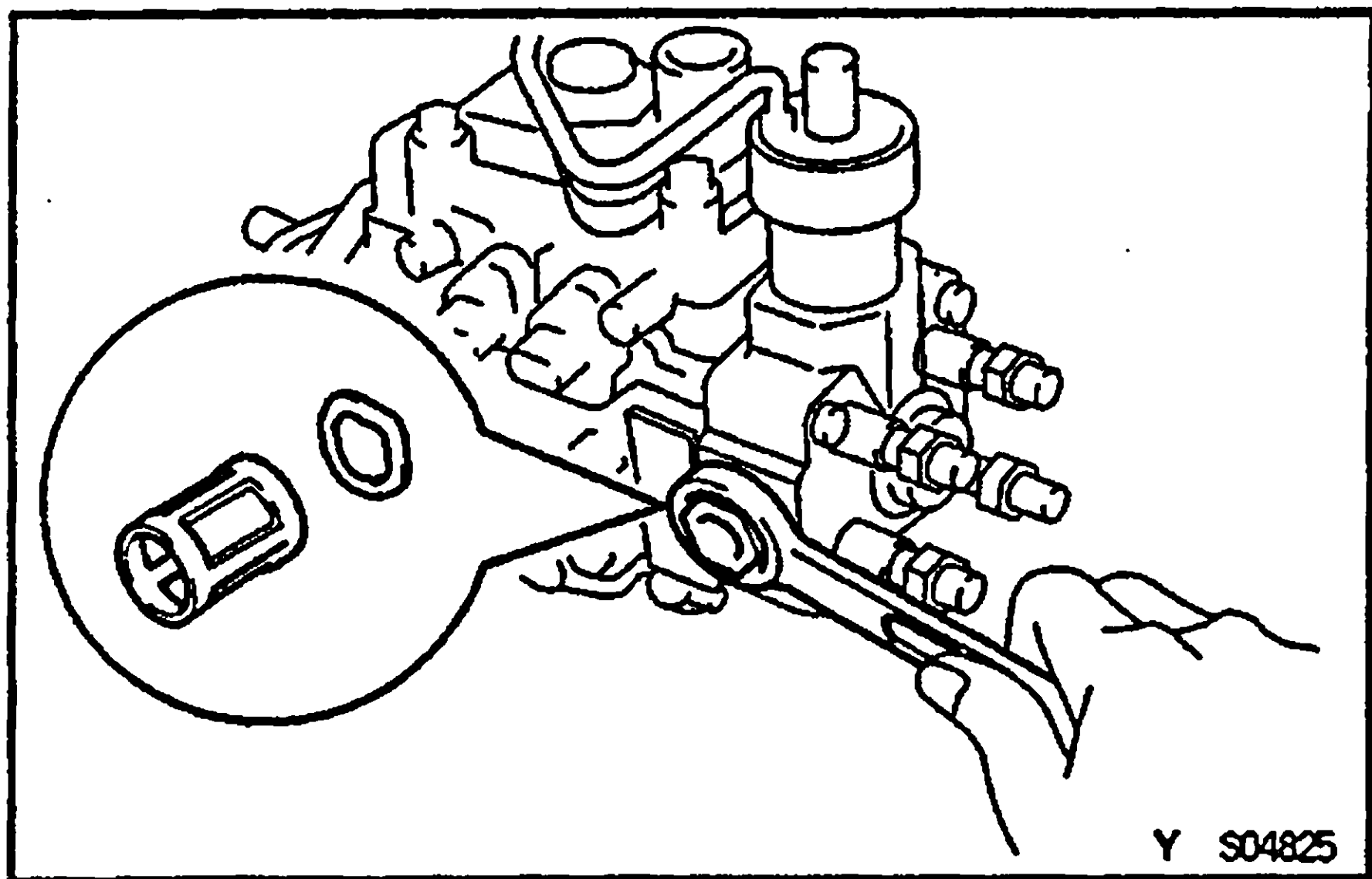
4. **REMOVE SOLENOID CONNECTOR SUPPORT CLIP**
 - (a) Using a 5 mm hexagon wrench, remove the 3 bolts and solenoid connector support clip.
 - (b) Disconnect the 2 lead wires and connectors from the clamps.



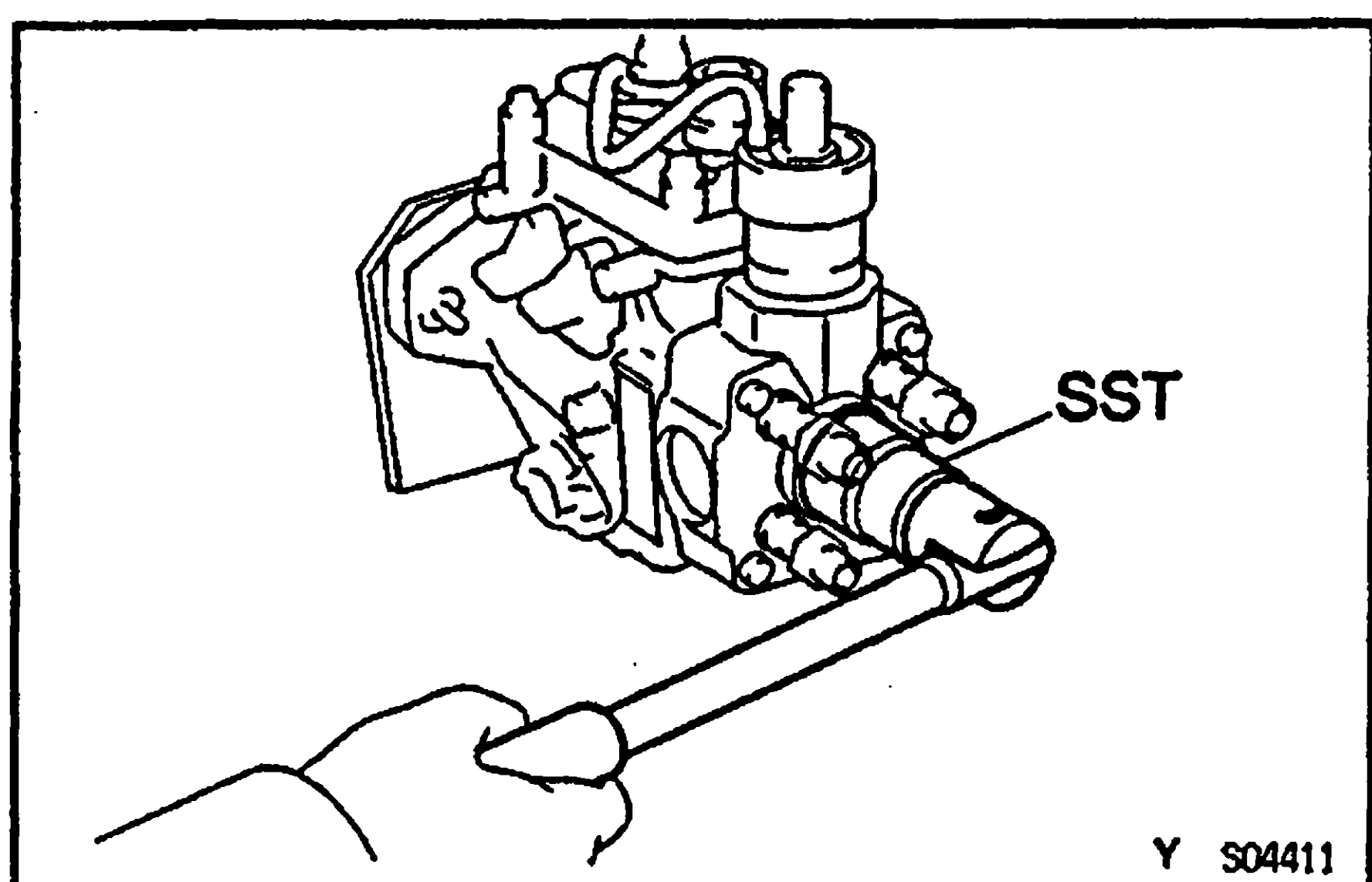
5. **REMOVE TIMING CONTROL VALVE**
Using a 5 mm hexagon wrench, remove the 2 bolts and timing control valve.



6. **REMOVE FUEL TEMPERATURE SENSOR AND DISTRIBUTIVE HEAD PLUG (NO.2)**
 - (a) Hold the distributive head plug, and using a 19 mm diam. deep socket wrench, remove the fuel temperature sensor and O-ring.

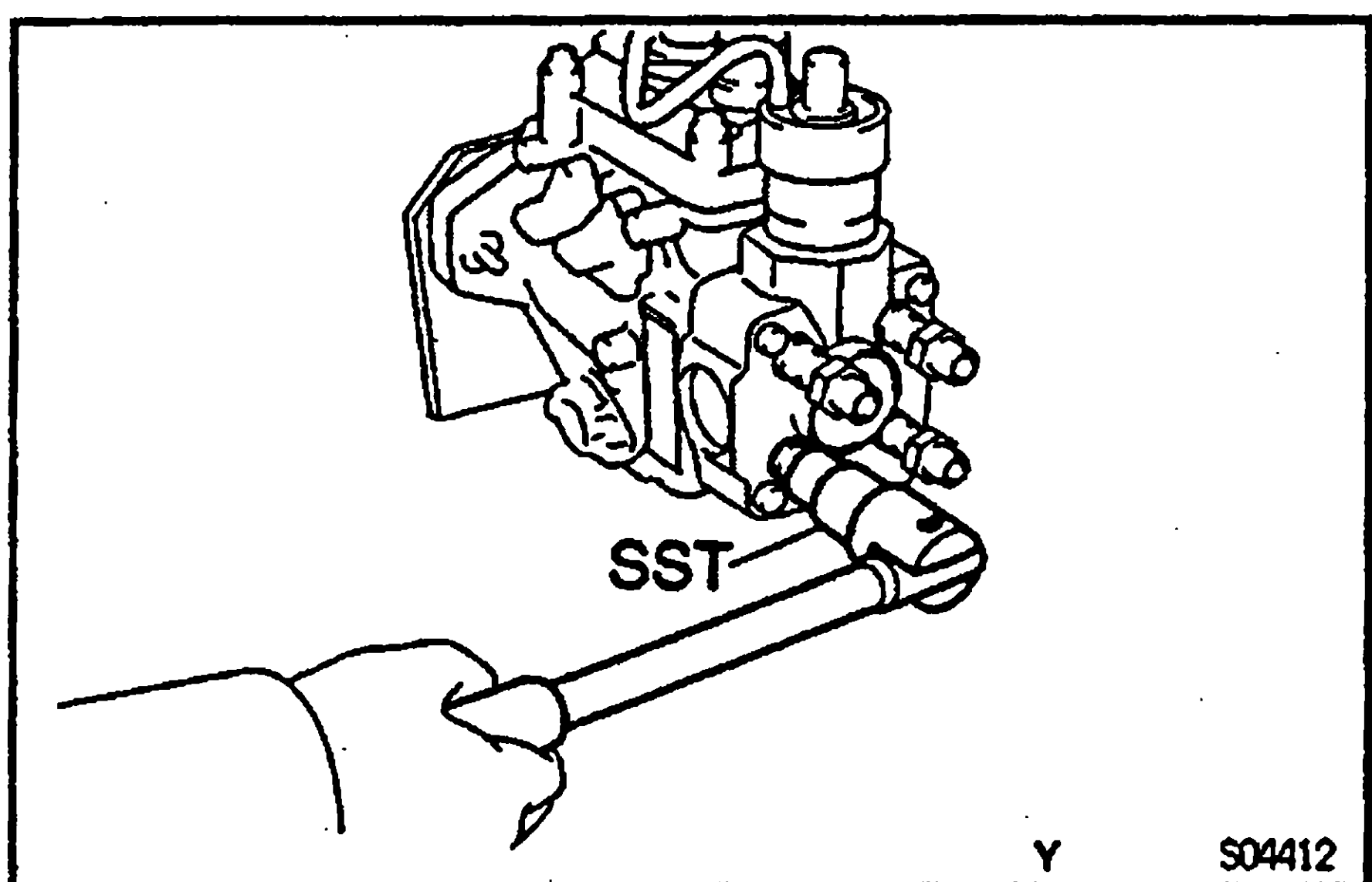


- (b) Remove the distributive head plug and O—ring.
- (c) Remove the strainer and wave washer.



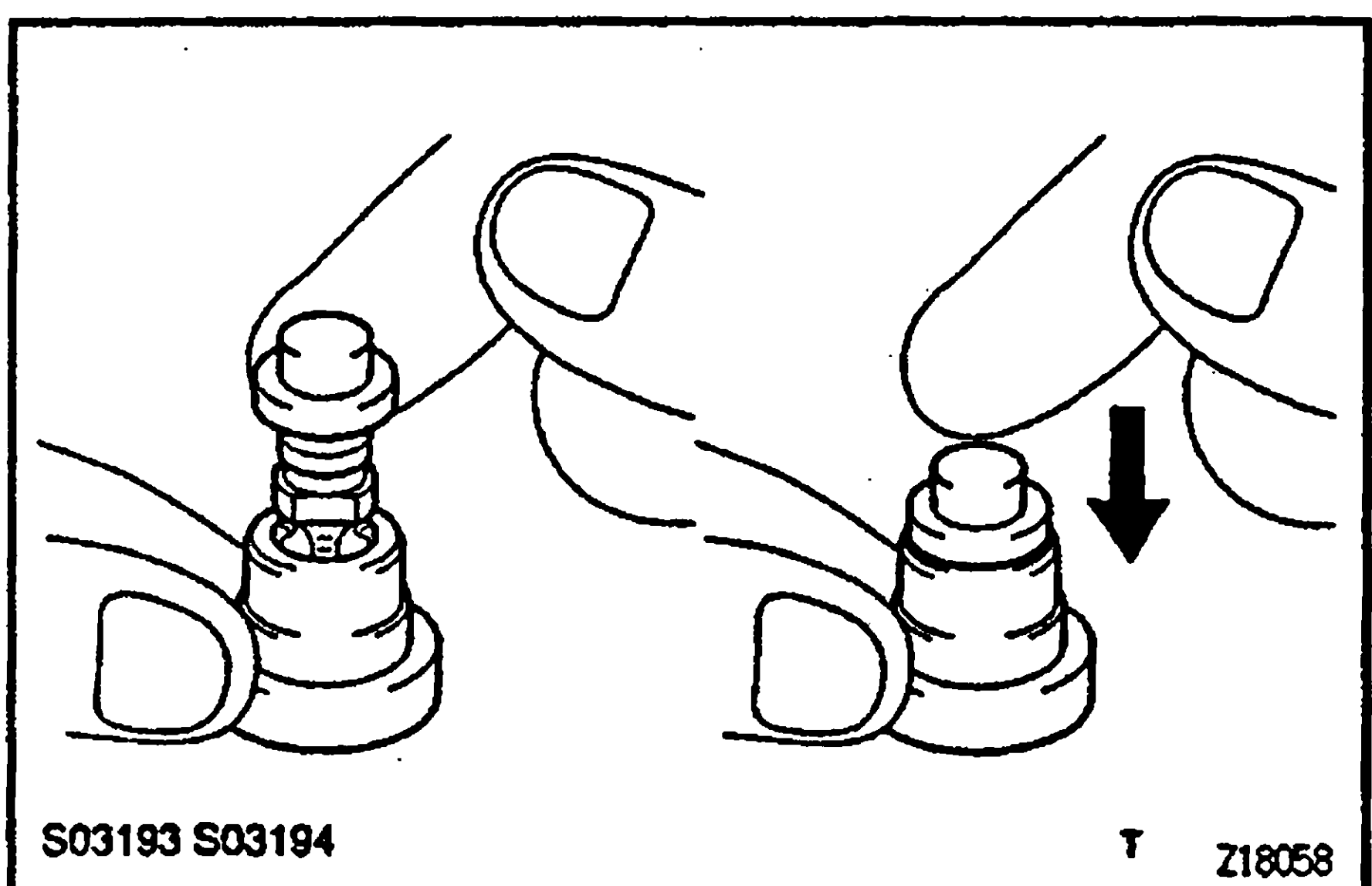
7. REMOVE DISTRIBUTIVE HEAD PLUG (NO.1)

Using SST, remove the distributive head plug.
SST 09260—54012 (09262—54010)



8. REMOVE DELIVERY VALVE HOLDERS

- (a) Using SST, remove the 4 delivery valve holders and springs.
SST 09260—54012 (09269—54020)
- (b) Remove the 4 delivery valves and gaskets.
NOTICE: Do not touch the sliding surfaces of the delivery valve with your hand.
HINT: Arrange the delivery valves, springs, and holders in order.



INJECTION PUMP COMPONENTS INSPECTION

B0762-01

NOTICE: Do not touch the sliding surfaces of the delivery valves.

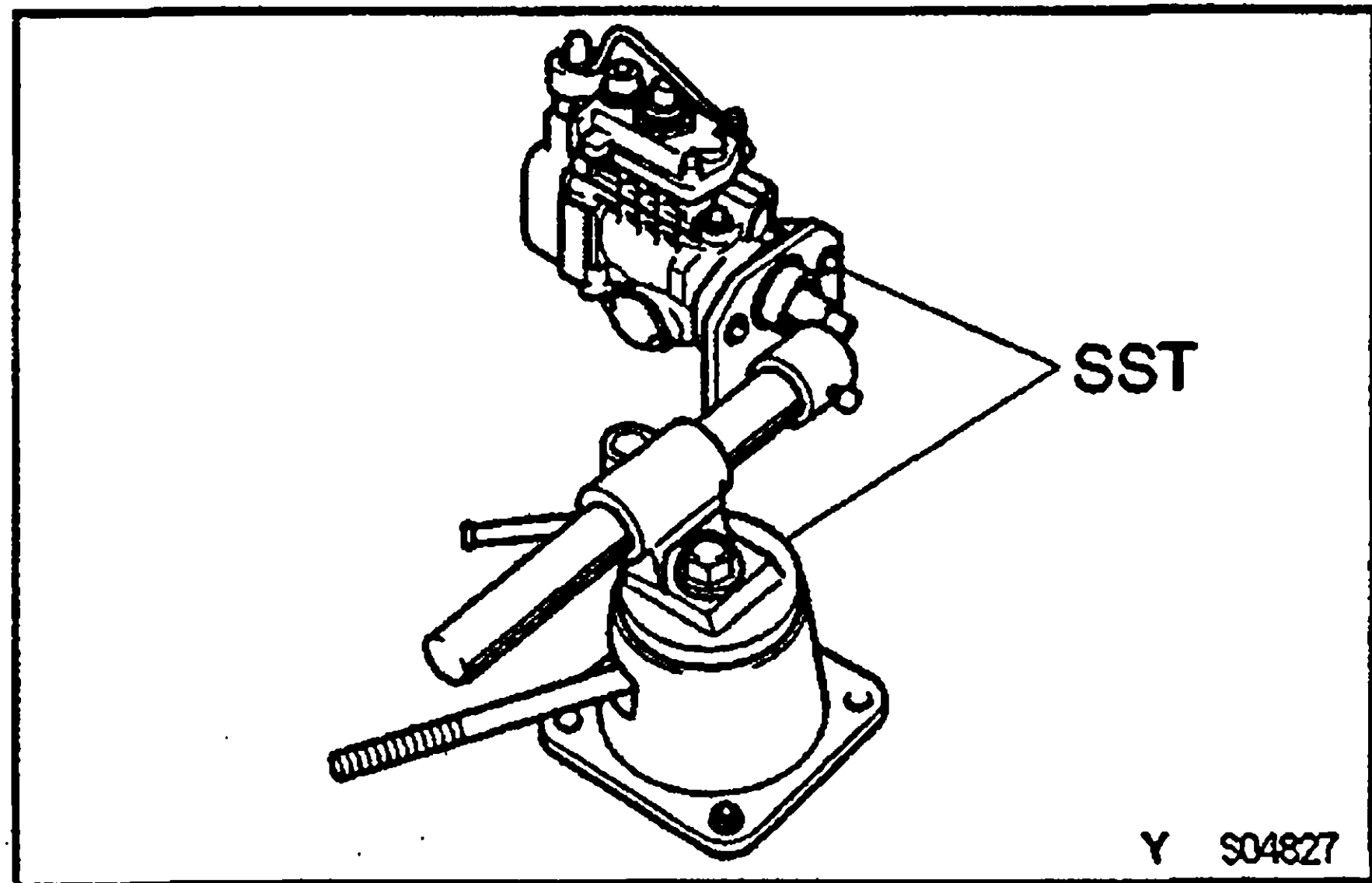
INSPECT DELIVERY VALVES

Pull up the valve, release it.

Check that it sinks smoothly to the valve seat.

If operation is not as specified, replace the valve as a set.

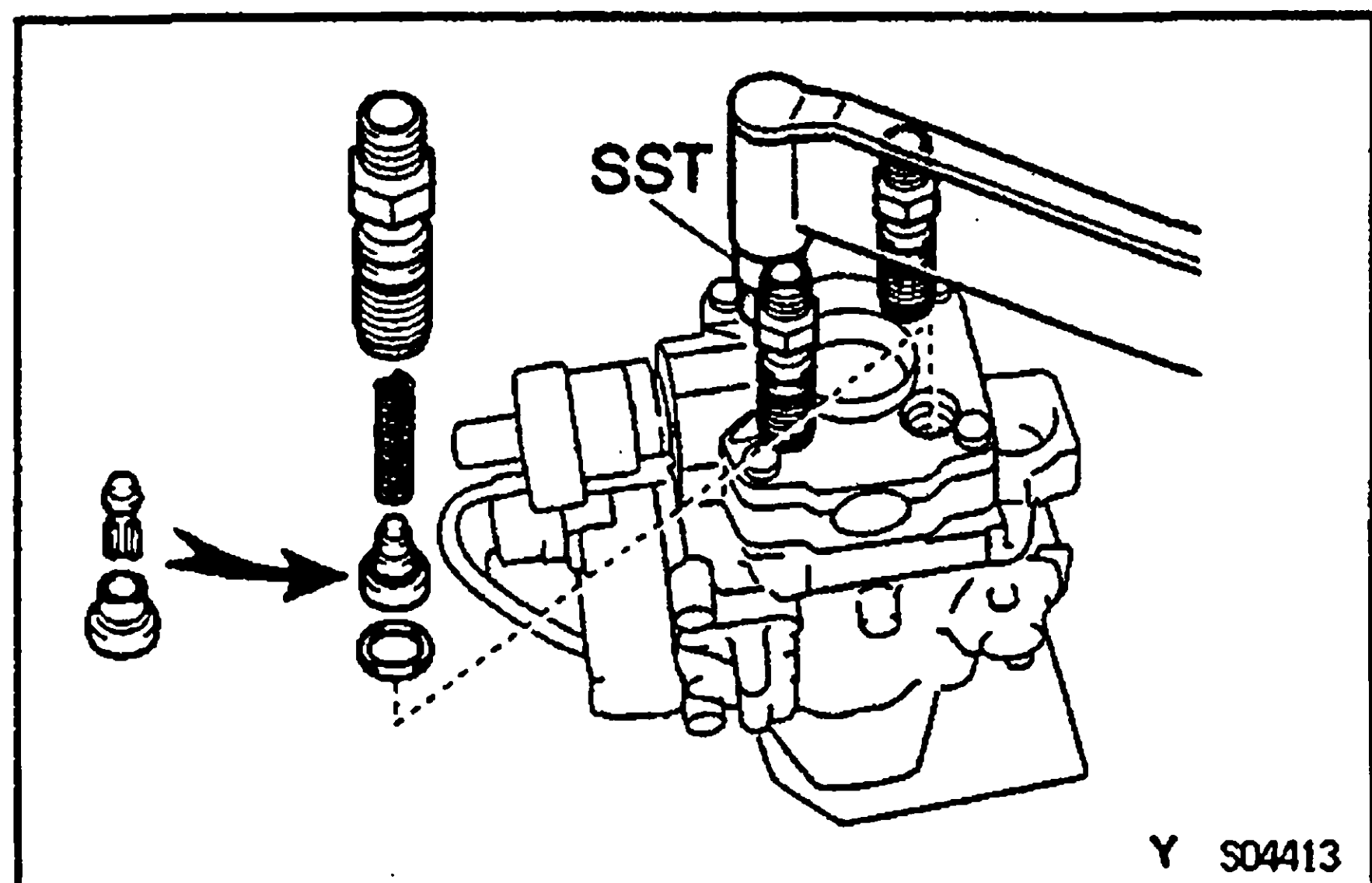
HINT: Before using a new valve set, wash off the rust prevention compound with diesel fuel. Then re—wash with diesel fuel and perform the above tests.



INJECTION PUMP ASSEMBLY

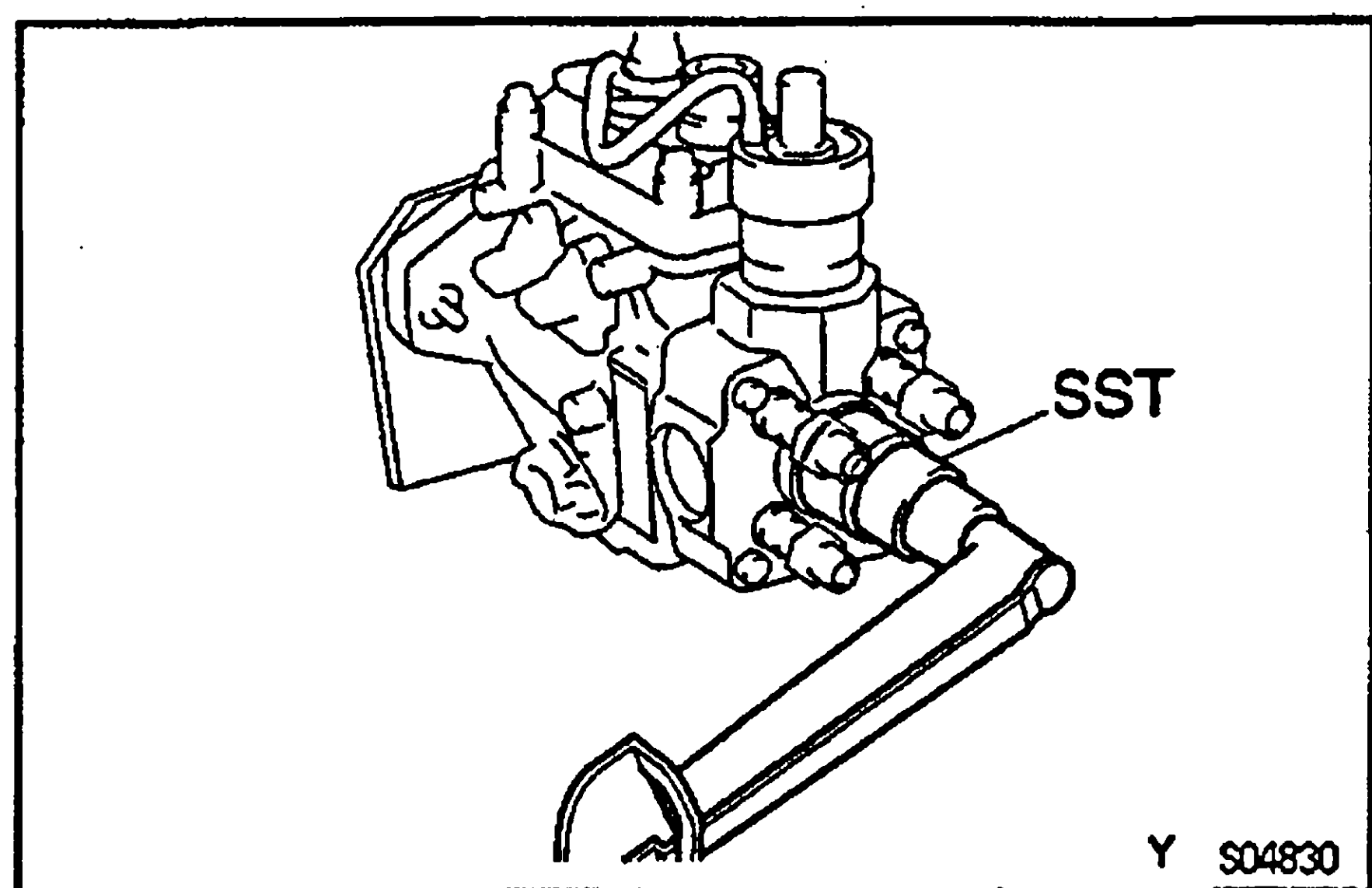
1. MOUNT PUMP BODY TO SST (STAND)

SST 09241-76022, 09245-54010



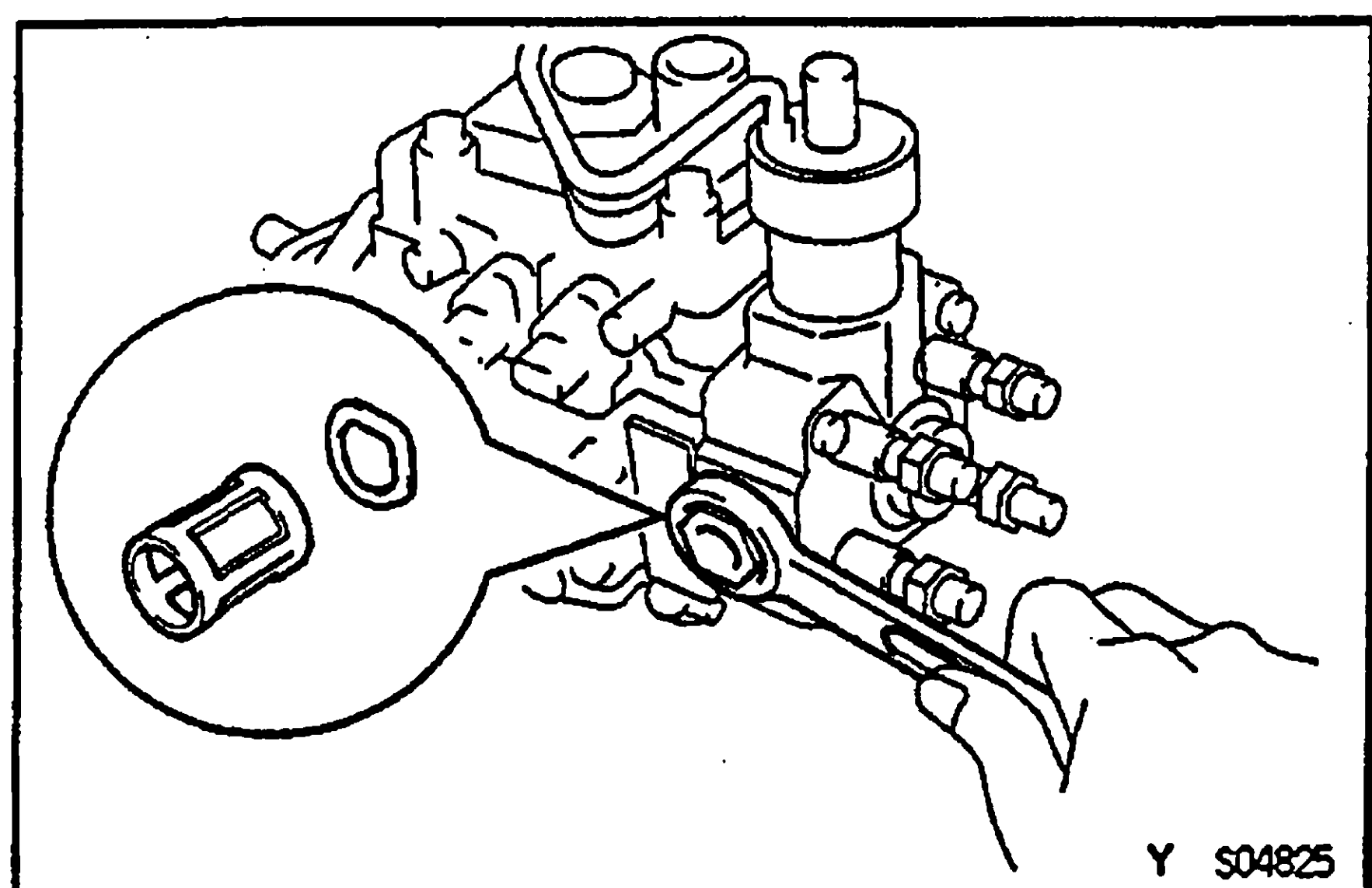
2. INSTALL DELIVERY VALVE HOLDERS

- Install new gaskets and the valves into the distributive head.
- Install the springs into the delivery valve holders.
- Using SST, install the delivery valve holders.
SST 09260-54012 (09269-54020)
Torque: 58.85 N·m (600 kgf·cm, 43 ft·lbf)



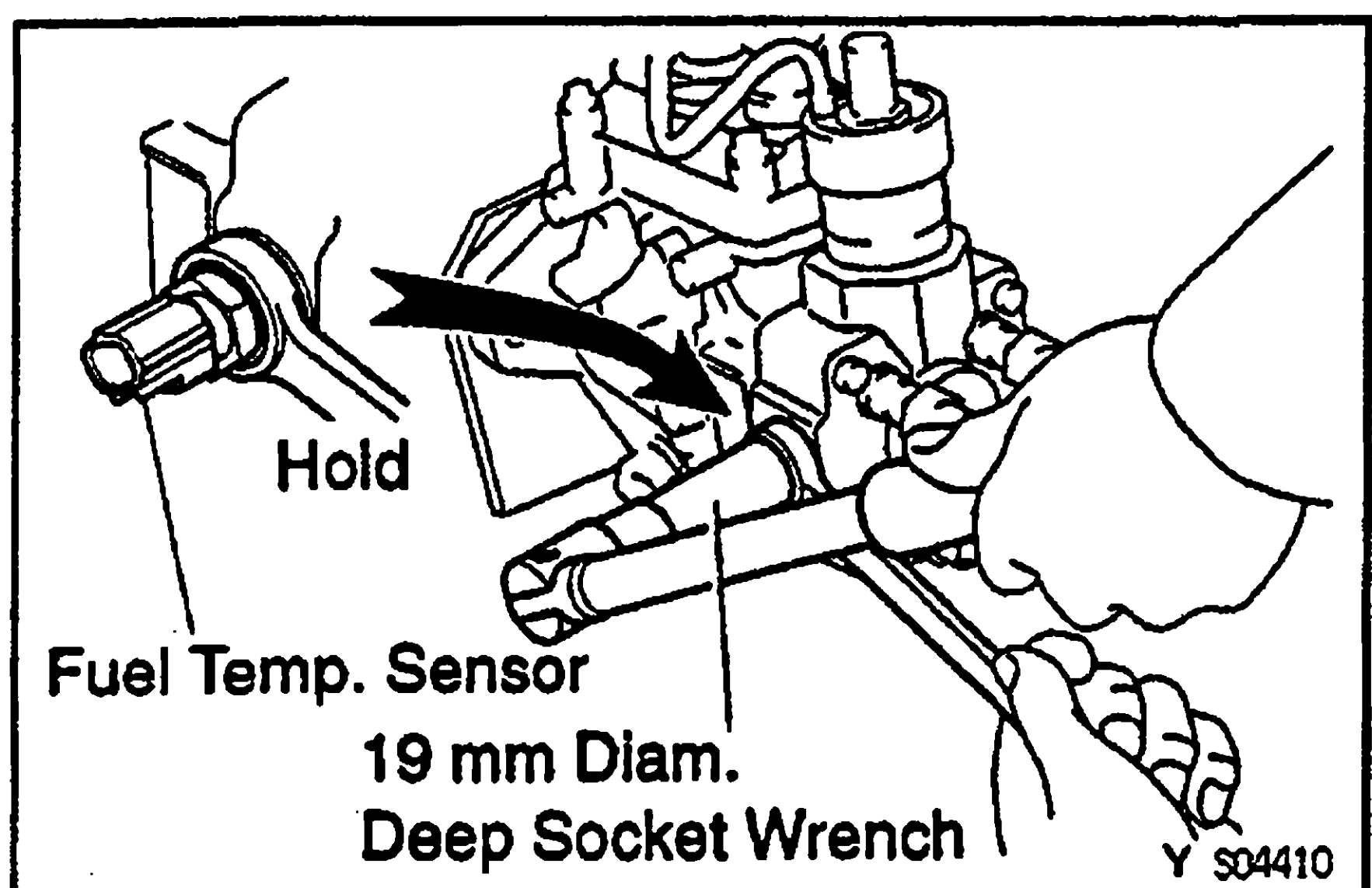
3. INSTALL DISTRIBUTIVE HEAD PLUG

- Install a new O-ring to the distributive head plug.
- Using SST, install the head plug.
SST 09260-54012 (09262-54010)
Torque: 88 N·m (900 kgf·cm, 65 ft·lbf)



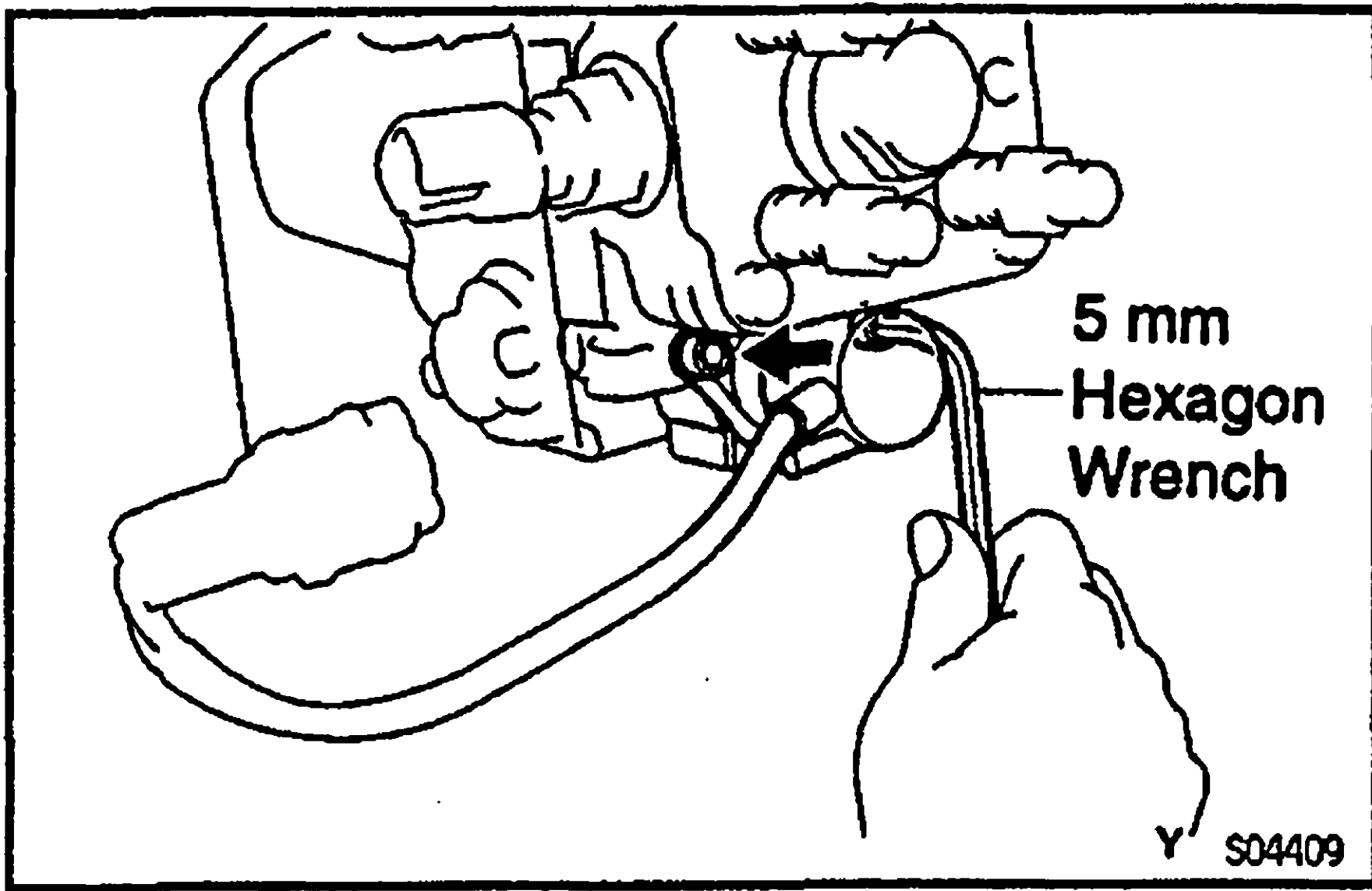
4. INSTALL DISTRIBUTIVE HEAD PLUG (NO.2) AND FUEL TEMPERATURE SENSOR

- Install a new O-ring to the distributive head plug.
- Install the wave washer, strainer and head plug.

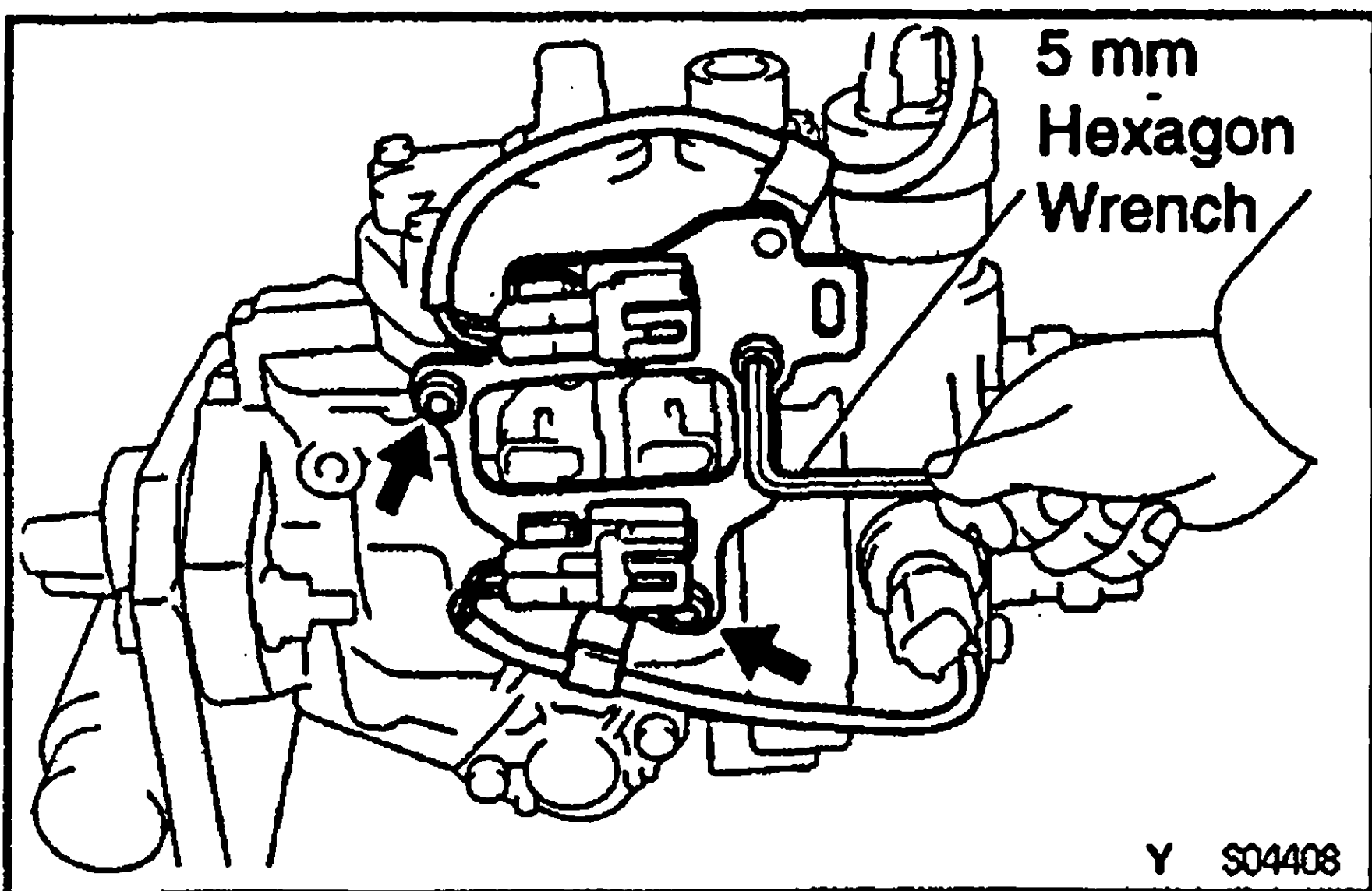


- Install a new O-ring to the fuel temperature sensor.
- Hold the distributive head plug, and using a 19 mm diam. deep socket wrench, install the fuel temperature sensor.

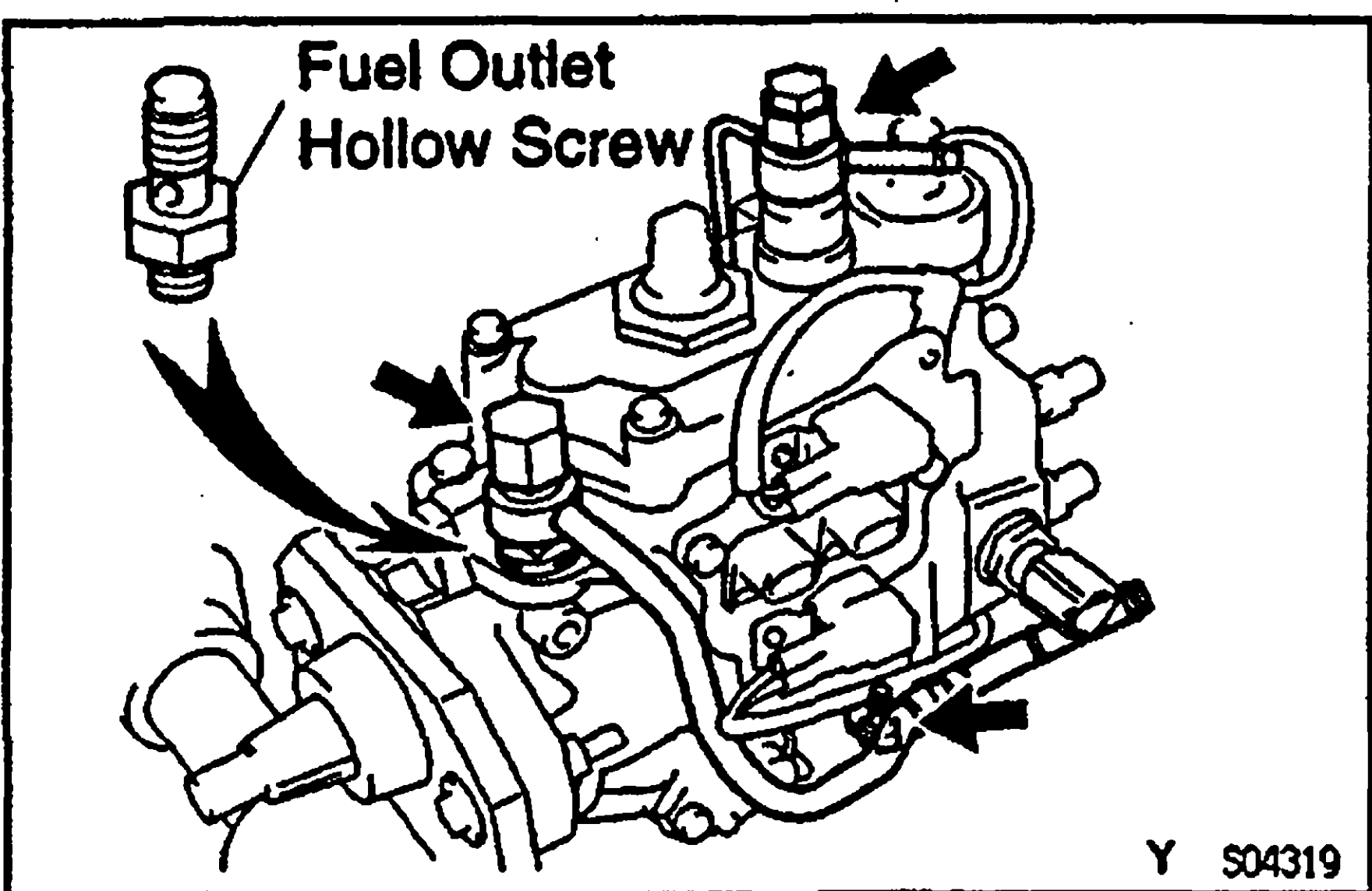
Torque: 21.6 N·m (220 kgf·cm, 16.5 ft·lbf)

**5. INSTALL TIMING CONTROL VALVE**

Using a 5 mm hexagon wrench, install the timing control valve with the 2 bolts.

**6. INSTALL SOLENOID CONNECTOR SUPPORT CLIP**

- (a) Using a 5 mm hexagon wrench, install the solenoid connector support clip with the 3 bolts.
- (b) Connect the 2 lead wire and connectors to clamps.

**7. INSTALL FUEL INLET HOLLOW SCREW FUEL PIPES**

- (a) Install a new gasket and the hollow screw.
Torque: 36.8 N·m (375 kgf·cm, 27 ft·lbf)
- (b) Install fuel inlet pipe with 2 new gaskets, the cap nut and bolt.

Torque:

Cap nut

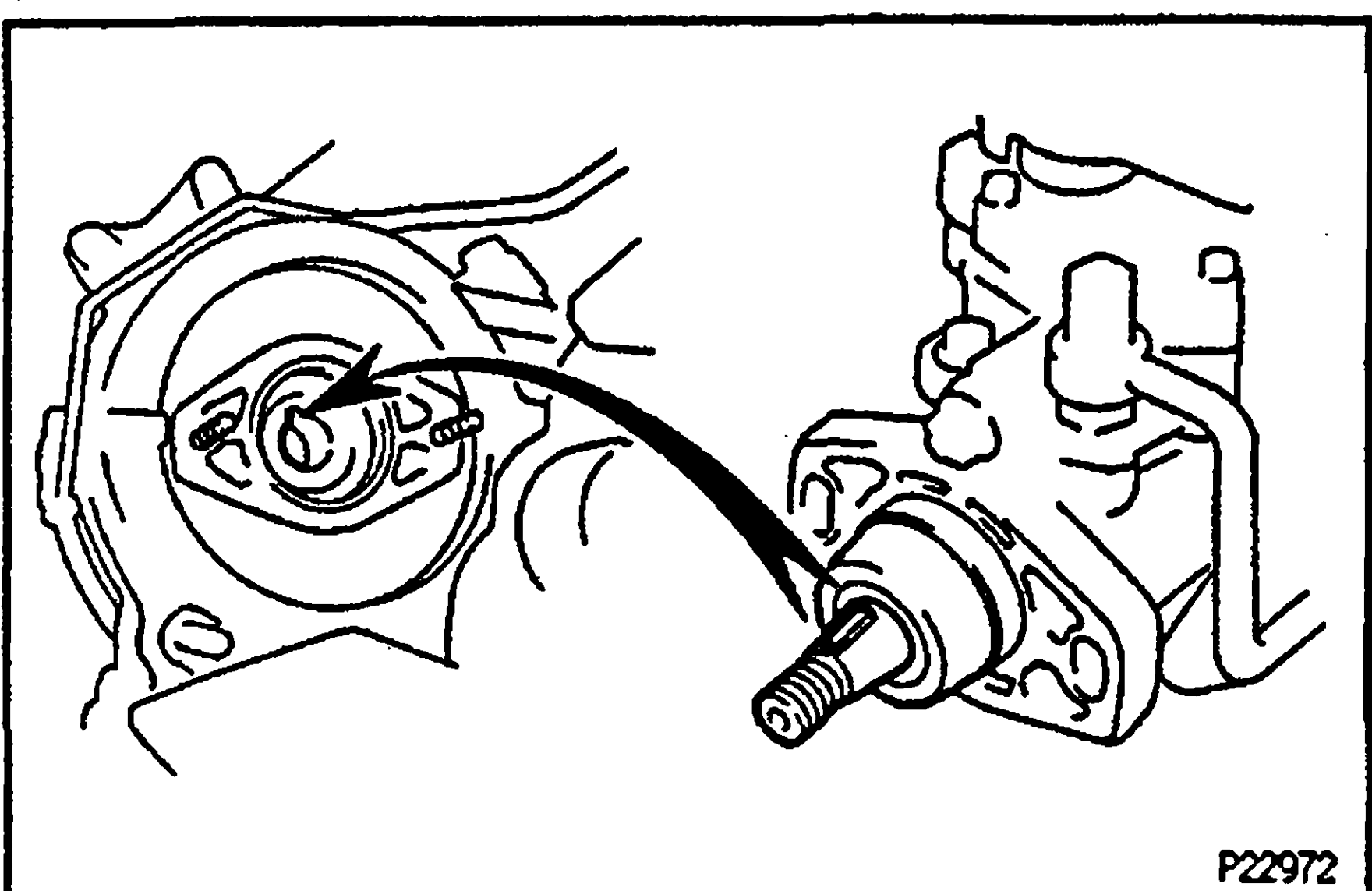
23 N·m (230 kgf·cm, 17 ft·lbf)

Bolt

24.5 N·m (250 kgf·cm, 18 ft·lbf)

- (c) Install fuel outlet pipe with a new gasket and the overflow screw.

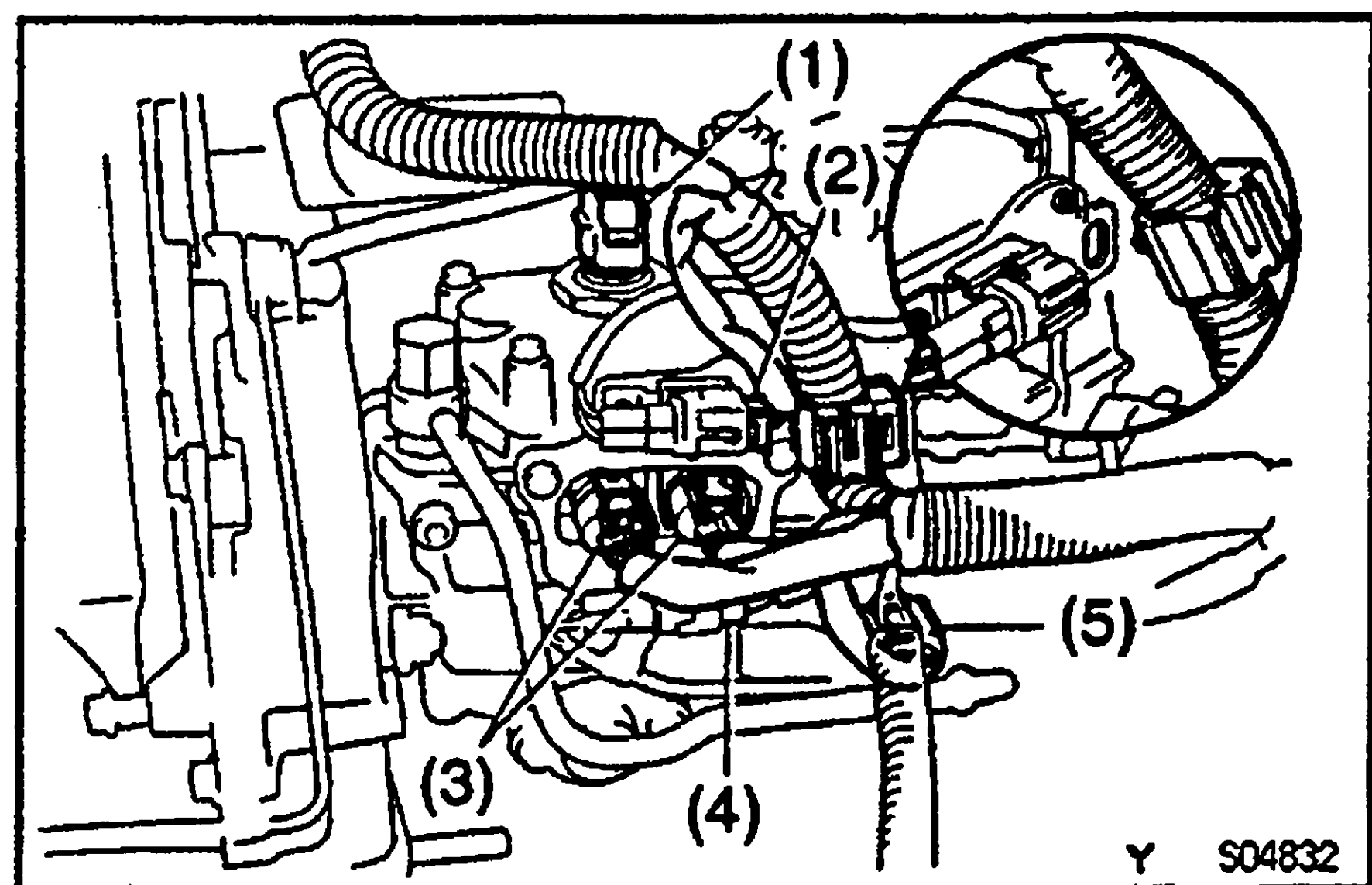
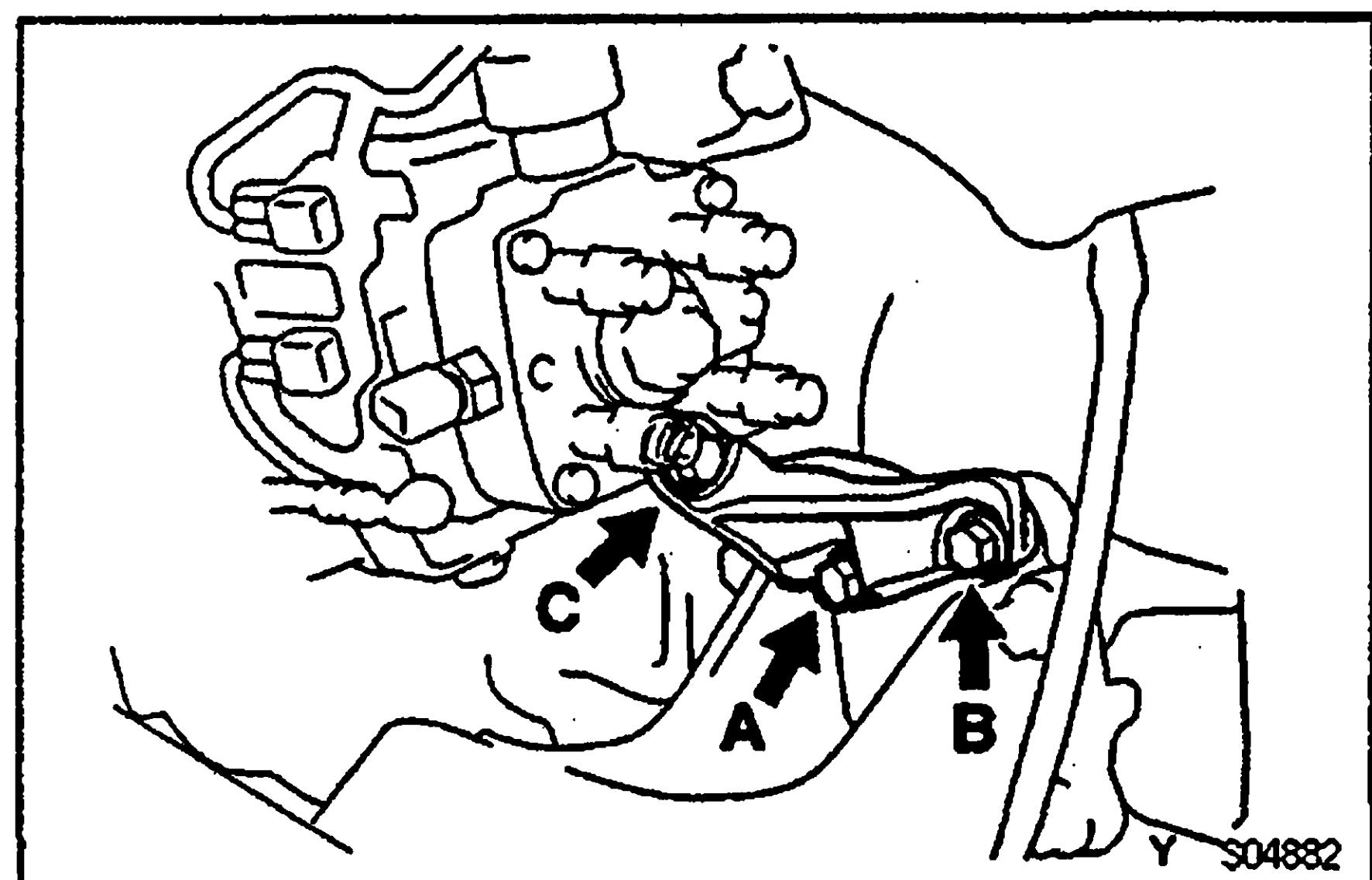
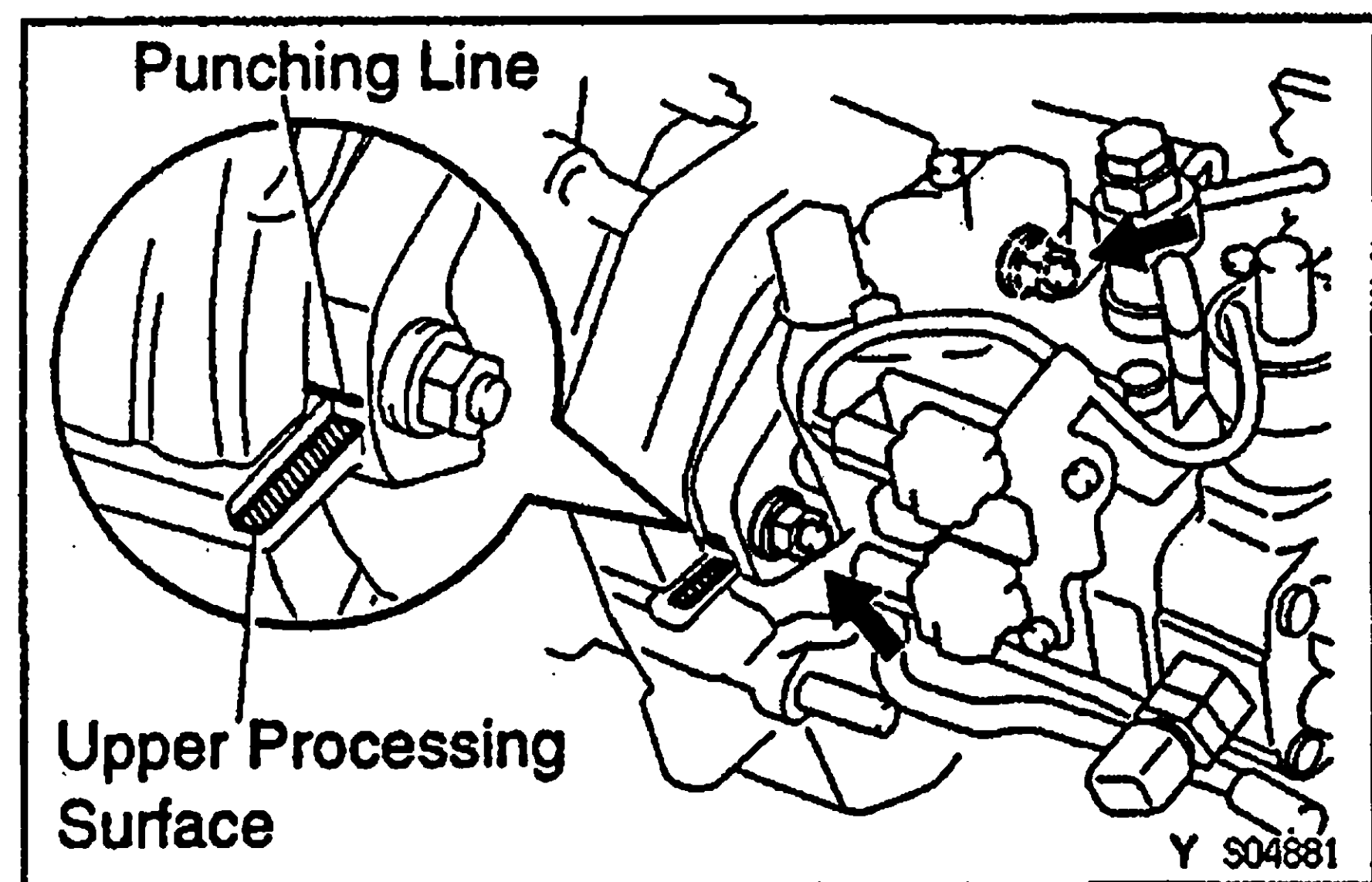
Torque: 22.1 N·m (225 kgf·cm, 16 ft·lbf)

8. REMOVE INJECTION PUMP FROM SST (STAND)
SST 09241-76022, 09245-54010**9. INSTALL SET KEY OF INJECTION PUMP DRIVE PULLEY ON DRIVE SHAFT****INJECTION PUMP INSTALLATION**

88704-01

1. INSTALL INJECTION PUMP

- (a) Install a new O-ring to the pump.
- (b) Apply a light coat of engine oil on the O-ring.
- (c) Align the set key on the drive shaft and groove of the injection pump drive gear.



- (d) Hold the injection pump with hands and press the injection pump drive gear to the backward and weld it with the injection pump drive shaft.
- (e) Align the punching line of the injection pump flange and the upper processing surface of the timing gear case, and then temporarily install the 2 nuts.
- (f) Tighten the 2 nuts holding the injection pump to the timing gear case.
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

- (g) Temporarily install the injection pump stay with the 2 bolts (A, B).
- (h) Install the injection pump set C bolt.
Torque: 32 N·m (330 kgf·cm, 24 ft·lbf)
- (i) Torque the A and B bolts.
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

NOTICE: Before tightening to the standard torque, check whether the pump stay is up against the injection pump.

- (j) Install the cylinder block insulator.
- (k) Install a new O—ring to the injection pump drive gear.
- (l) Install the injection pump drive gear set nut.
- (m) Hold the crankshaft pulley, and torque the set nut.
Torque: 64 N·m (650 kgf·cm, 47 ft·lbf)

NOTICE: Do not turn the crankshaft pulley. The valve heads will hit against the piston top.

- (n) Connect these connectors:
 - (1) Engine speed sensor connector
 - (2) Spill control valve connector
 - (3) Correction resistor connectors
 - (4) Timing control valve connector
 - (5) Fuel temperature sensor connector

- (o) Connect the engine wire clamp and fuel hose.

2. INSTALL NO.2 CAMSHAFT TIMING PULLEY

(See step 2 in injection pump installation (1KZ—T))

3. CHECK INJECTION PUMP DRIVE SHAFT THRUST CLEARANCE

(See step 3 in injection pump installation (1KZ—T))

4. INSTALL TIMING BELT

(See steps 8 to 12 in cylinder head installation in Engine Mechanical)

5. INSTALL INJECTION PIPES

(See step 5 in injection pump installation (1KZ—T))

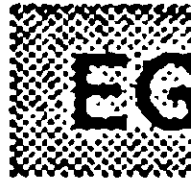
6. INSTALL INTAKE PIPE

(See step 6 in cylinder head installation in Engine Mechanical)

SERVICE SPECIFICATIONS
SERVICE DATA

E0795-01

Fuel heater	Resistance	at 20°C (68°F)	1.4 — 2.0 Ω
Injection nozzle	Nozzle type		DN0PD619
	Nozzle opening pressure	New nozzle	14,808 — 15,593 kPa (151 — 159 kgf/cm², 2,148 — 2,261 psi)
		Reused nozzle	14,320 — 15,100 kPa (146 — 154 kgf/cm², 2,076 — 2,190 psi)
	Adjusting shim thickness		0.900 mm (0.0354 in.) 0.925 mm (0.0364 in.) 0.950 mm (0.0374 in.) 0.975 mm (0.0384 in.) 1.000 mm (0.0394 in.) 1.025 mm (0.0404 in.) 1.050 mm (0.0413 in.) 1.075 mm (0.0423 in.) 1.100 mm (0.0433 in.) 1.125 mm (0.0443 in.) 1.150 mm (0.0453 in.) 1.175 mm (0.0463 in.) 1.200 mm (0.0472 in.) 1.225 mm (0.0482 in.) 1.250 mm (0.0492 in.) 1.275 mm (0.0502 in.) 1.300 mm (0.0512 in.) 1.325 mm (0.0522 in.) 1.350 mm (0.0531 in.) 1.375 mm (0.0541 in.) 1.400 mm (0.0551 in.) 1.425 mm (0.0561 in.) 1.450 mm (0.0571 in.) 1.475 mm (0.0581 in.) 1.500 mm (0.0591 in.) 1.525 mm (0.0600 in.) 1.550 mm (0.0610 in.) 1.575 mm (0.0620 in.) 1.600 mm (0.0630 in.) 1.625 mm (0.0640 in.) 1.650 mm (0.0650 in.) 1.675 mm (0.0659 in.) 1.700 mm (0.0669 in.) 1.725 mm (0.0679 in.) 1.750 mm (0.0689 in.) 1.775 mm (0.0699 in.)



Injection nozzle (cont'd)	Adjusting shim thickness	1.800 mm (0.0709 in.) 1.825 mm (0.0719 in.) 1.850 mm (0.0728 in.) 1.875 mm (0.0738 in.) 1.900 mm (0.0748 in.) 1.925 mm (0.0758 in.) 1.950 mm (0.0768 in.)
Injection pump	Part No. 1KZ-T 1KZ-TE Direction of rotation Injection order Drive shaft thrust clearance Reference	22100-67060 22100-67070 Clockwise as seen from drive side 1 - 3 - 4 - 2 (A - B - C - D) 0.15 - 0.55 mm (0.0059 - 0.0217 in.)
Injection pump (1KZ-T)	Roller height variation Plunger spring squareness Spring free length Delivery valve spring Plunger spring Coupling spring Boost compensator spring Pickup sensor resistance Timer adjusting screw protrusion pre-setting Plunger spring shim thickness Plunger adjusting shim thickness Flyweight holder thrust clearance Governor shaft protrusion Governor gear adjusting washer thickness	0.02 mm (0.0008 in.) 2.0 mm (0.079 in.) 24.4 mm (0.961 in.) 30.0 mm (1.181 in.) 15.5 mm (0.610 in.) 19.3 mm (0.760 in.) 650 - 970 Ω 7.5 - 8.0 mm (0.295 - 0.315 in.) 0.5 mm (0.020 in.) 0.8 mm (0.031 in.) 1.0 mm (0.039 in.) 1.2 mm (0.047 in.) 1.5 mm (0.059 in.) 1.8 mm (0.071 in.) 2.0 mm (0.079 in.) 1.9 mm (0.075 in.) 2.0 mm (0.079 in.) 2.1 mm (0.083 in.) 2.2 mm (0.087 in.) 2.3 mm (0.091 in.) 2.4 mm (0.094 in.) 2.5 mm (0.098 in.) 2.6 mm (0.102 in.) 2.7 mm (0.106 in.) 2.8 mm (0.110 in.) 2.9 mm (0.114 in.) 0.15 - 0.35 mm (0.0059 - 0.0138 in.) 0.5 - 2.0 mm (0.020 - 0.079 in.) 1.05 mm (0.0413 in.) 1.25 mm (0.0492 in.) 1.45 mm (0.0571 in.) 1.65 mm (0.0650 in.) 1.85 mm (0.0728 in.)

EG

TORQUE SPECIFICATIONS

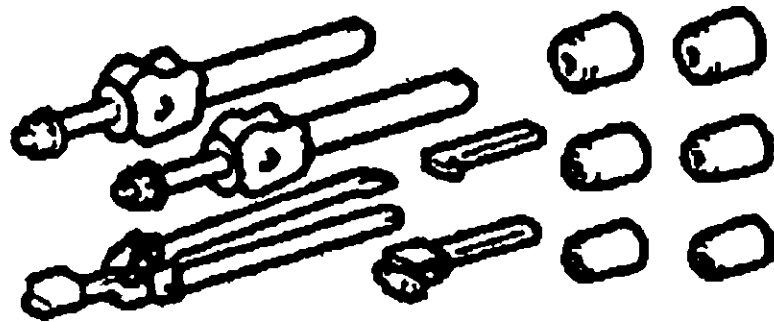
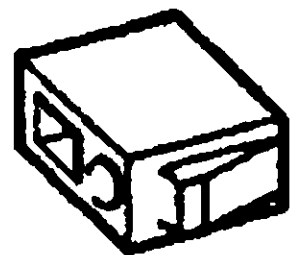
Part tightened		N-m	kgf-cm	ft-lbf
Nozzle holder body x Nozzle holder retaining nut		37	375	27
Injection nozzle x Cylinder head		64	650	47
Nozzle leakage pipe x Injection nozzle		30	300	22
Injection pump clamp x Intake manifold		6	65	56 in.-lbf
Injection pipe x Injection nozzle		15	150	11
Injection pipe x Injection pump		15	150	11
Accelerator cable bracket x Intake manifold	1KZ-T	20	200	15
Fuel inlet hollow screw x Injection pump body		36.8	375	27
Regulator valve x Injection pump body	1KZ-T	8.8	90	78 in.-lbf
Feed pump cover x Injection pump body	1KZ-T	2.5	25	22 in.-lbf
Distributive head x Injection pump body	1KZ-T	25.5	260	19
Governor link support bolt	1KZ-T	14	140	10
Delivery valve holder x Distributive head		58.85	600	43
Distributive head plug x Distributive head		88	900	65
Governor cover x Injection pump body	1KZ-T	8.3	85	74 in.-lbf
Pickup sensor x Injection pump body	1KZ-T	21	210	15
Fuel cut solenoid x Distributive head	1KZ-T	22	225	16
Dashpot x Injection pump	1KZ-T	11	115	8
Fuel outlet pipe x Injection pump	Cap nut	23	230	17
	Bolt	24.5	250	17
Fuel inlet pipe x Injection pump	1KZ-T	23	230	17
	1KZ-TE	22.1	225	16
Injection pump x Timing gear case		21	210	15
Pump stay x Injection pump		32	330	24
Pump stay x Cylinder block		32	330	24
Injection pump drive gear x Injection pump		64	650	47
Distributive head plug bolt	1KZ-T	25	260	19
Fuel temp. sensor x Distributive head plug (No.2)	1KZ-TE	21.6	220	16.5

COOLING SYSTEM

PREPARATION

SST (SPECIAL SERVICE TOOLS)

EG00L-0K

	09230-01010 Radiator Service Tool Set	
	09231-14010 Punch	

EQUIPMENT

EG12W-0W

Heater	
Radiator cap tester	
Thermometer	
Torque wrench	
Vernier caliper	

COOLANT

EG12X-14

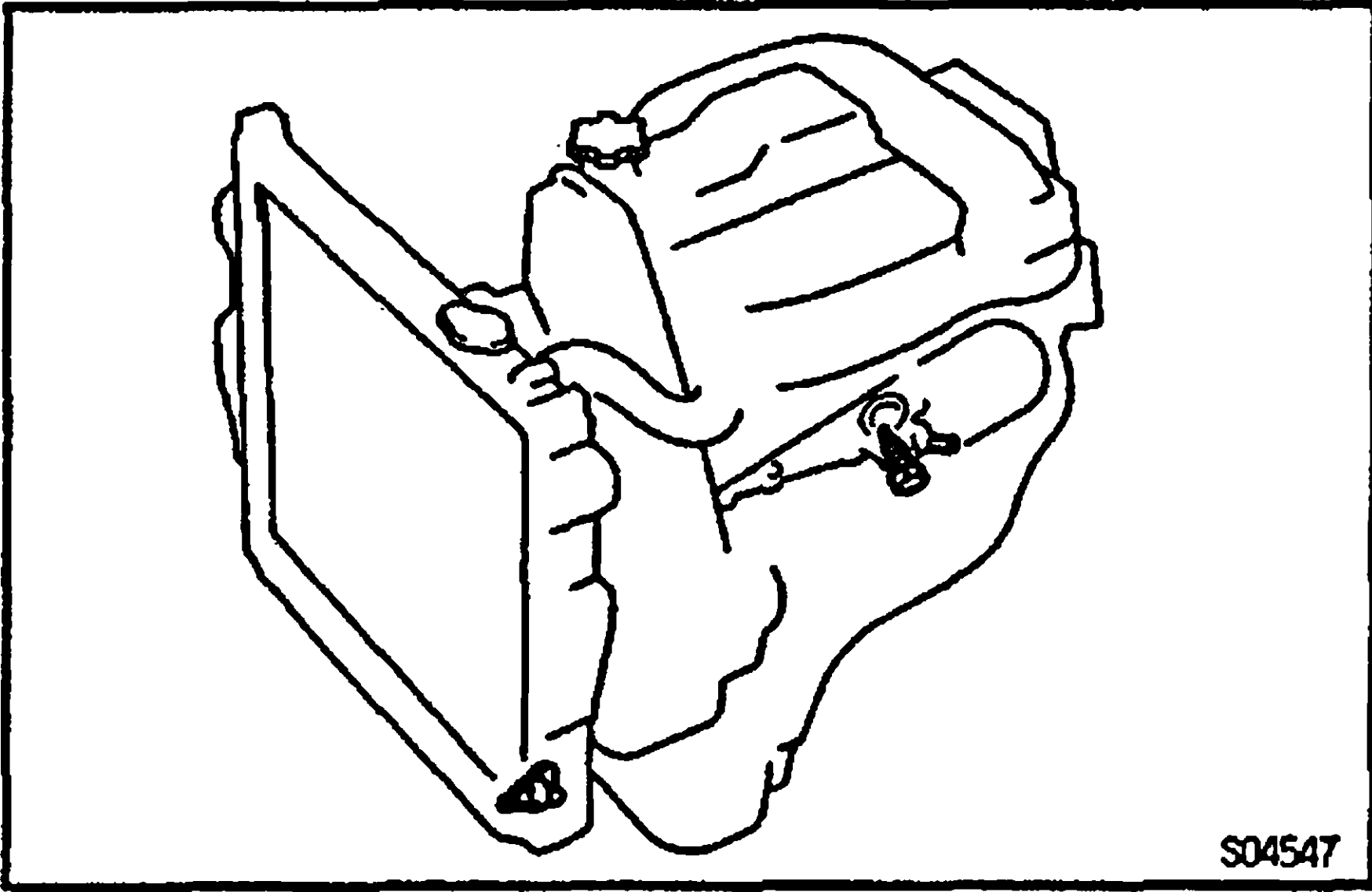
Item	Capacity	Classification
Engine coolant		Ethylene—glycol base
w/ Front and rear heaters M/T	10.5 liters (11.1 US qts, 9.2 Imp. qts)	
A/T	11.0 liters (11.6 US qts, 9.7 Imp. qts)	
w/ Front heater M/T	9.5 liters (10.0 US qts, 8.4 Imp. qts)	
A/T	10.0 liters (10.7 US qts, 8.8 Imp. qts)	
w/o Heater	9.3 liters (9.8 US qts, 8.2 Imp. qts)	

COOLANT CHECK

EG06N-04

HINT: Check the coolant level when the engine is cold.

1. CHECK ENGINE COOLANT LEVEL AT RADIATOR RESERVOIR
- The engine coolant level should be between the "L" and "F" lines.
If low, check for leaks and add engine coolant up to the "F" line.
2. CHECK ENGINE COOLANT QUALITY
- (a) Remove the radiator cap.
- CAUTION: To avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.
- (b) There should not be any excessive deposits of rust or scale around the radiator cap or water filler hole, and the coolant should be free from oil.
If excessively dirty, replace the coolant.
- (c) Reinstall the radiator cap.



S04547

COOLANT REPLACEMENT

B074M-02

1. DRAIN ENGINE COOLANT

- (a) Remove the radiator cap.

CAUTION: To avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.

- (b) Loosen the radiator drain plug (on the right side of the radiator lower tank) and engine drain plug (on the oil cooler cover), and drain the coolant.

- (c) Close the drain plugs.

Torque (Engine): 8 N·m (80 kgf·cm, 69 in.-lbf)

2. FILL ENGINE COOLANT

- (a) Slowly fill the system with coolant.

- Use a good brand of ethylene—glycol base coolant and mix it according to the manufacturer's directions.
- Using coolant which includes more than 50 % ethylene—glycol (but not more than 70 %) is recommended.

NOTICE:

- Do not use an alcohol type coolant.
- The coolant should be mixed with demineralized water or distilled water.

Capacity:

w/ Front and rear heaters

M/T

10.5 liters (11.1 US qts, 9.2 Imp. qts)

A/T

11.0 liters (11.6 US qts, 9.7 Imp. qts)

w/o Front heater

M/T

9.5 liters (10.0 US qts, 8.4 Imp. qts)

A/T

10.0 liters (10.7 US qts, 8.8 Imp. qts)

w/o Heater

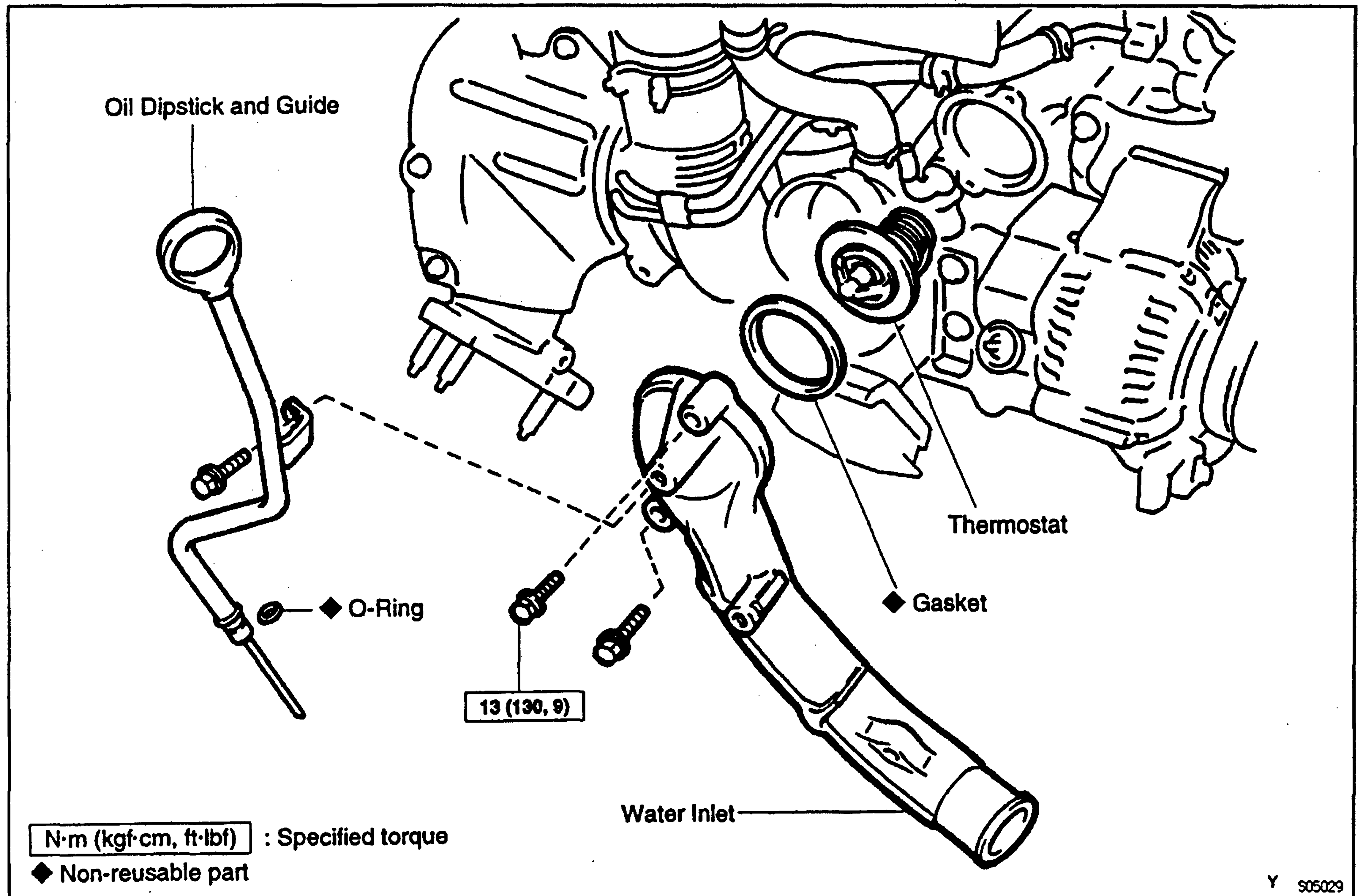
9.3 liters (9.8 US qts, 8.2 Imp. qts)

- (b) Install the radiator cap.
- (c) Start the engine, and bleed the cooling system.
- (d) Refill the radiator reservoir with coolant until it reaches the "F" line.

3. CHECK ENGINE COOLANT FOR LEAKS

THERMOSTAT COMPONENTS FOR REMOVAL AND INSTALLATION

E0130-1M



THERMOSTAT REMOVAL

E0708-01

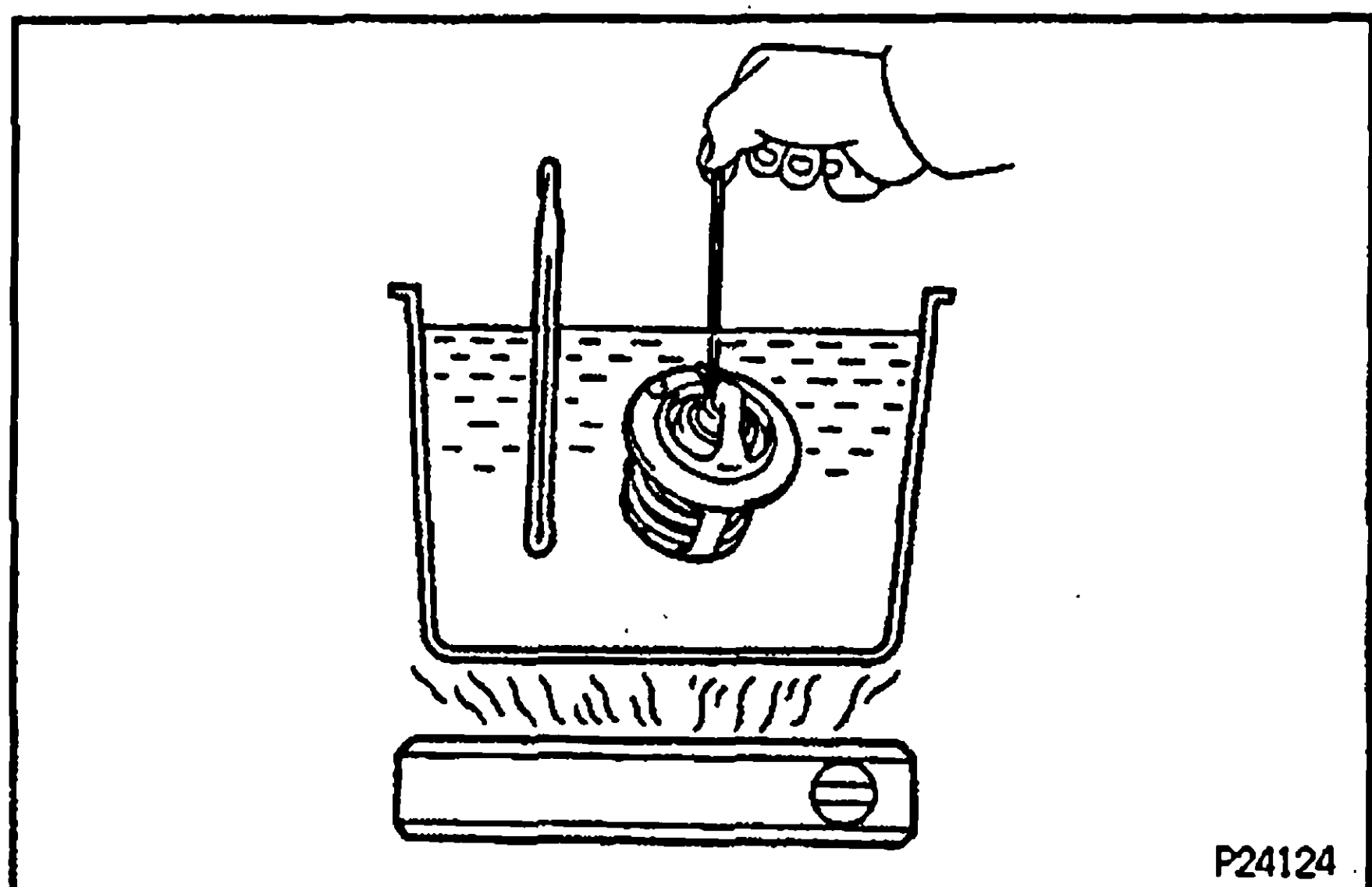
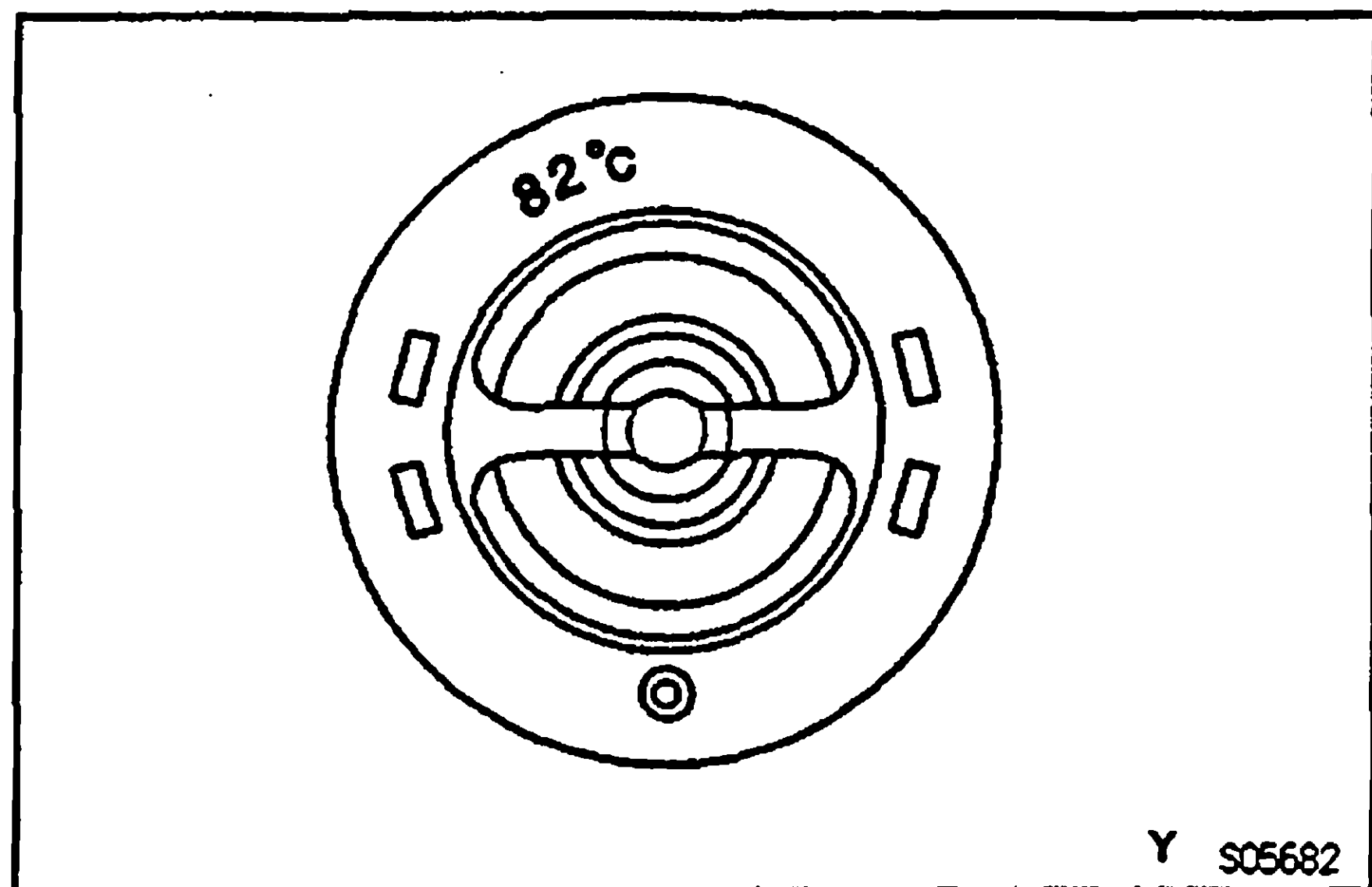
HINT: Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

- 1. DRAIN ENGINE COOLANT**
- 2. REMOVE OIL DIPSTICK AND GUIDE**
 - (a) Remove the bolt holding the dipstick guide to the water inlet.
 - (b) Pull out the dipstick guide together with the dipstick from the cylinder block.
 - (c) Remove the O-ring from the dipstick guide.
- 3. REMOVE WATER INLET AND THERMOSTAT**
 - (a) Remove the 3 bolts and water inlet from the cylinder block.
 - (b) Remove the thermostat.
 - (c) Remove the gasket from the thermostat.

THERMOSTAT INSPECTION

INSPECT THERMOSTAT

HINT: The thermostat is numbered with the valve opening temperature.



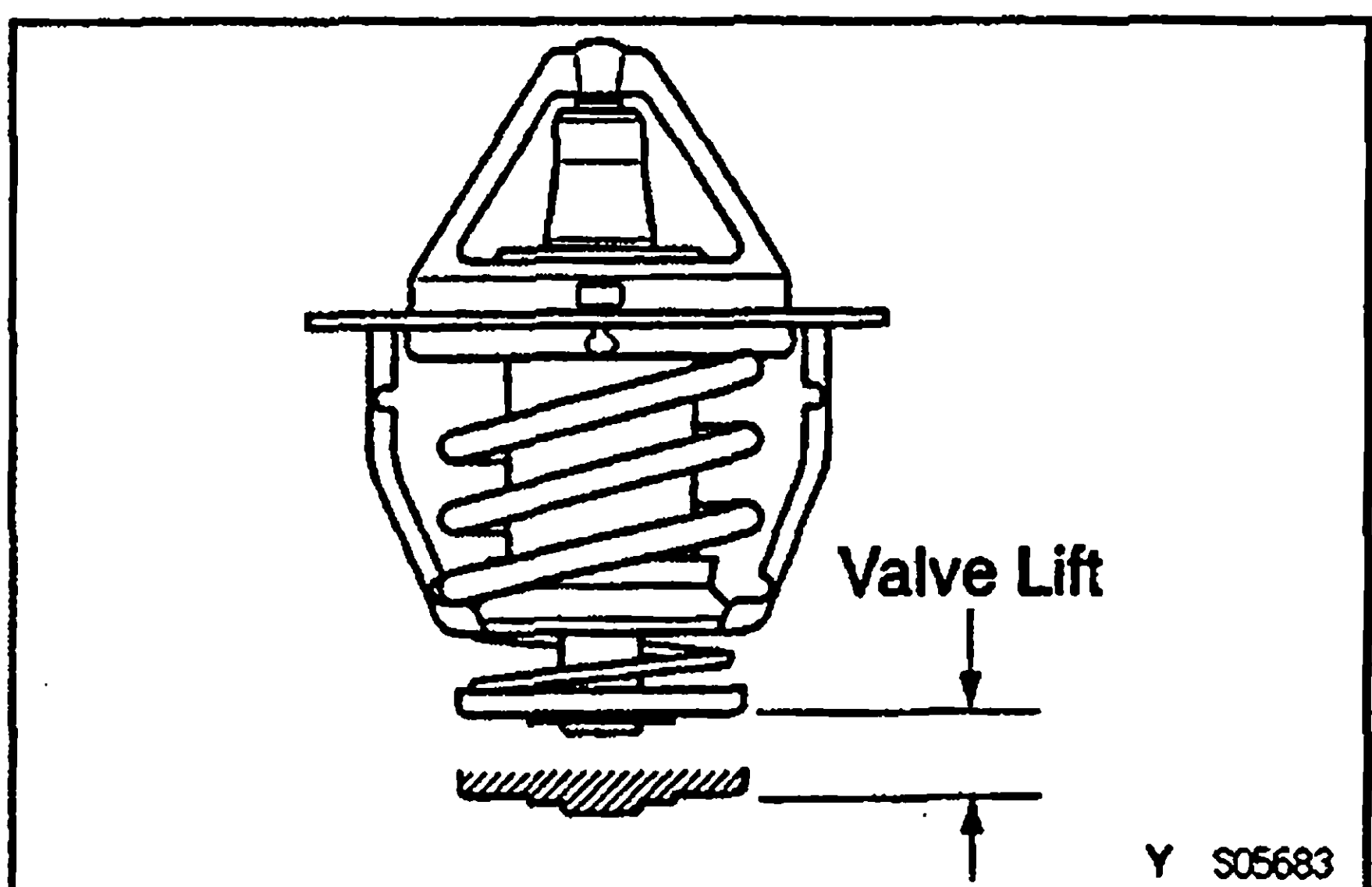
- (a) Immerse the thermostat in water and gradually heat the water.

- (b) Check the valve opening temperature.

Valve opening temperature:

80 — 84°C (176 — 183°F)

If the valve opening temperature is not as specified, replace the thermostat.



- (c) Check the valve lift.

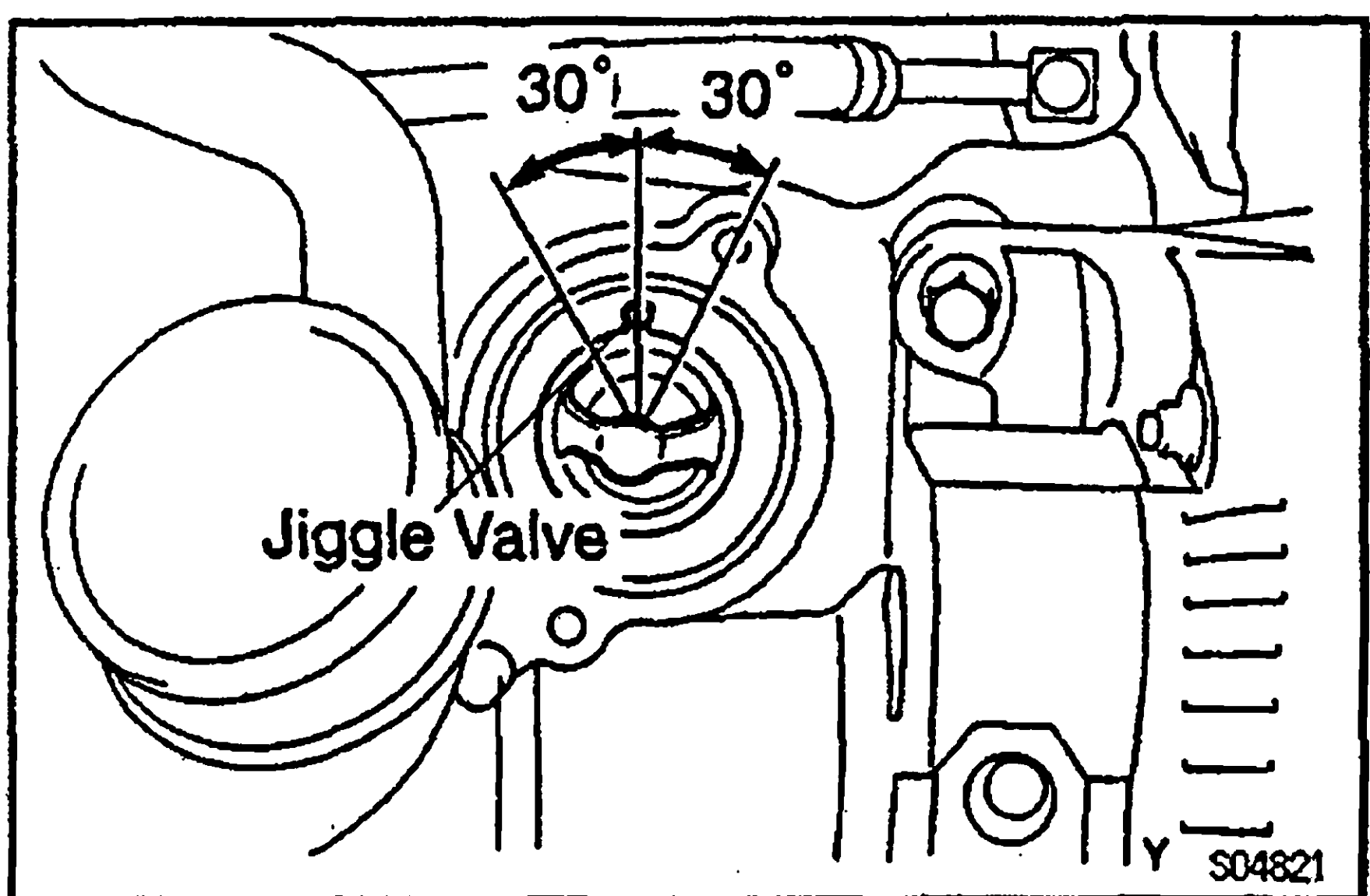
Valve lift:

10 mm (0.39 in.) or more at 95°C (203°F)

If the valve lift is not as specified, replace the thermostat.

- (d) Check that the valve is fully closed when the thermostat is at low temperatures (below 40°C (104°F)).

If not closed, replace the thermostat.



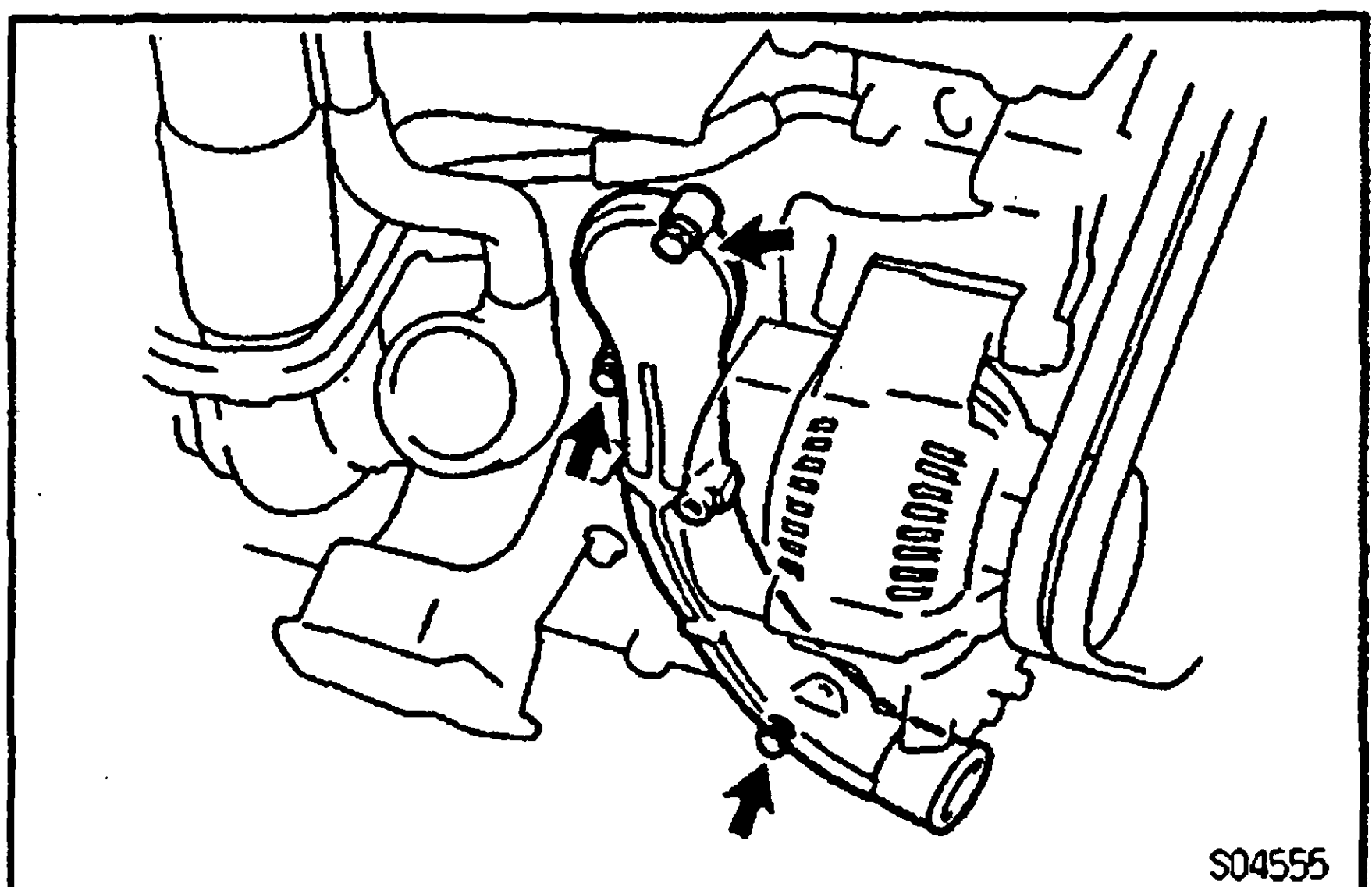
THERMOSTAT INSTALLATION

1. PLACE THERMOSTAT IN CYLINDER BLOCK

- (a) Install a new gasket to the thermostat.

- (b) Install the thermostat with the jiggle valve upward.

HINT: The jiggle valve may be set within 30° of either side of the prescribed position.

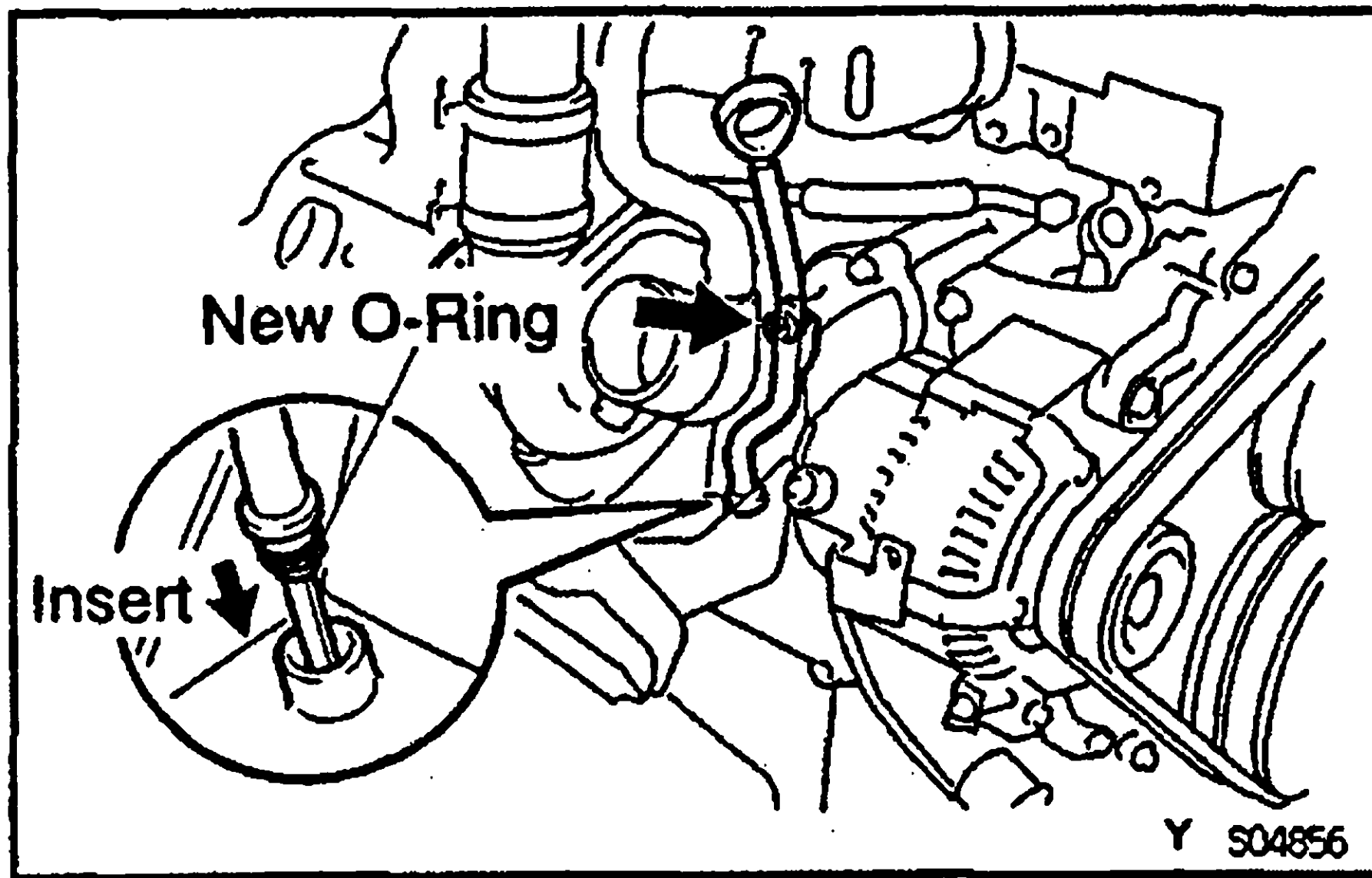


2. INSTALL WATER INLET TO CYLINDER BLOCK

Install the water inlet with the 3 bolts.

Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

NOTICE: Torque the 2 upper bolts first.



- 3. INSTALL OIL DIPSTICK AND GUIDE**
 - (a) Install a new O—ring to the dipstick guide.
 - (b) Apply soapy water to the O—ring.
 - (c) Push in the dipstick guide end into the guide hole of the cylinder block.
 - (d) Install the dipstick guide with the bolt.
 - (e) Install the dipstick.
- 4. FILL WITH ENGINE COOLANT**
- 5. START ENGINE AND CHECK FOR COOLANT LEAKS**

RADIATOR

RADIATOR CLEANING

E0000-04

Using water or a steam cleaner, remove any mud and dirt from the radiator core.

NOTICE: If using a high pressure type cleaner, be careful not to deform the fins of the radiator core. (i.e. Maintain a distance between the cleaner nozzle and radiator core.)

RADIATOR INSPECTION

E0700-01

1. REMOVE RADIATOR CAP

CAUTION: To avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.

2. INSPECT RADIATOR CAP

NOTICE:

- If the radiator cap has contaminations, always rinse it with water.
- Before using a radiator cap tester, wet the relief valve and pressure valve with engine coolant or water.
- When performing steps (a) and (b) below, keep the radiator cap tester at an angle of over 30° above the horizontal.

- (a) Using a radiator cap tester, slowly pump the tester and check that air is coming from the vacuum valve.
Pump speed:

1 push/(3 seconds or more)

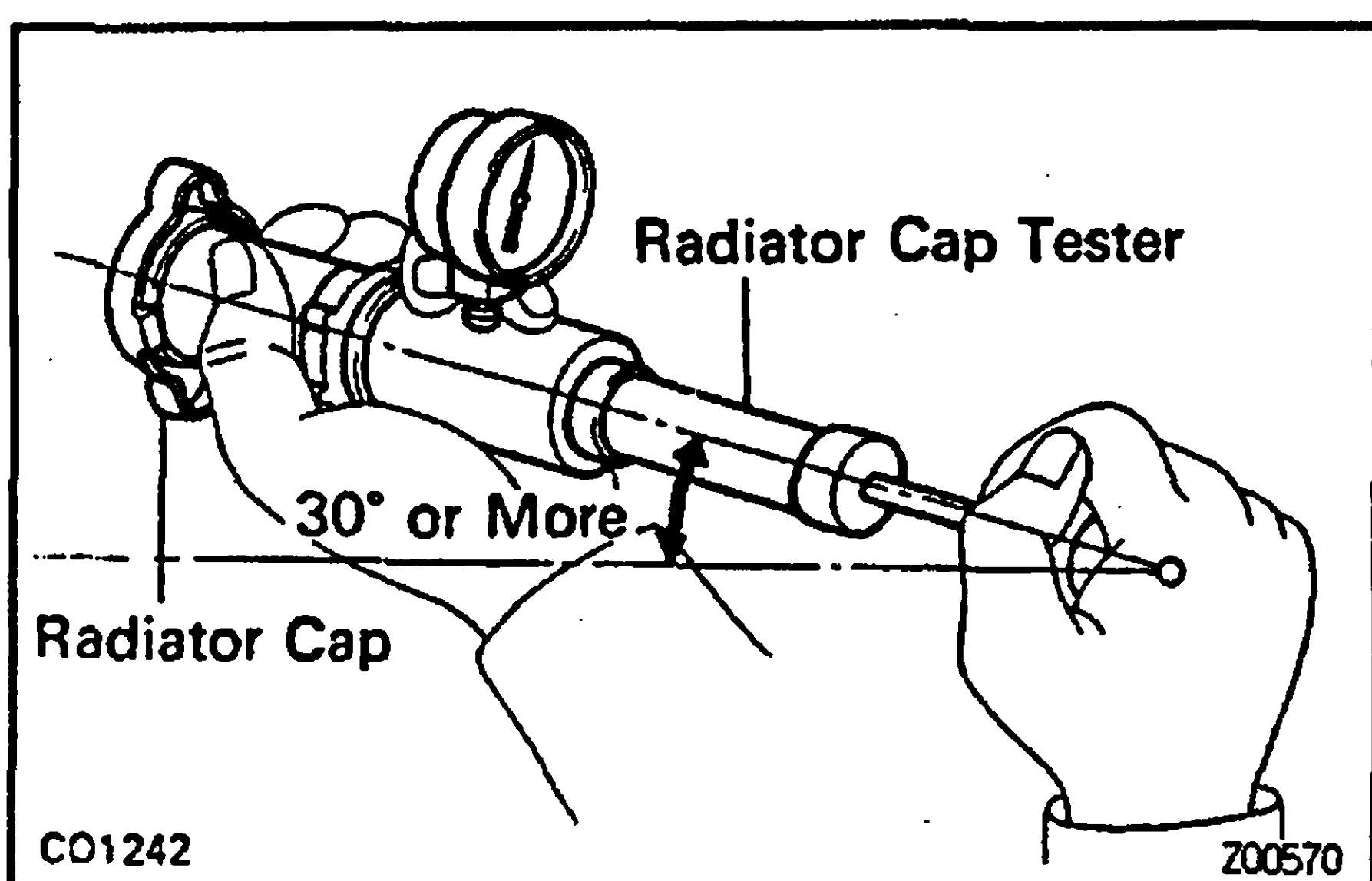
NOTICE: Push the pump at a constant speed.

If air is not coming from the vacuum valve, replace the radiator cap.

- (b) Pump the tester and measure the relief valve opening pressure.

Pump speed:

1 push within 1 second



NOTICE: This pump speed is for the first pump only (in order to close the vacuum valve). After this, the pump speed can be reduced.

Standard opening pressure:

74 — 103 kPa

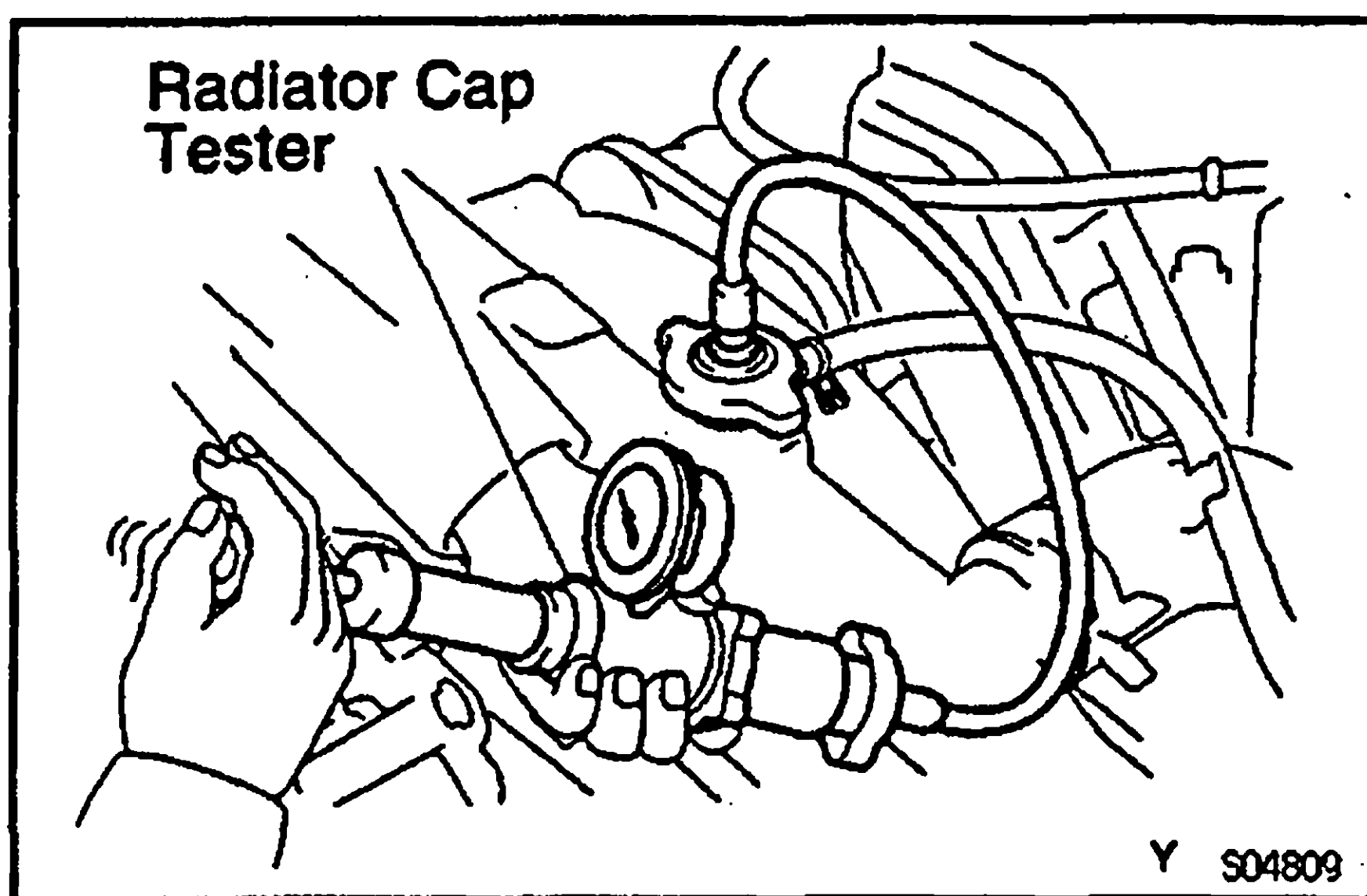
(0.75 — 1.05 kgf/cm², 10.7 — 14.9 psi)

Minimum opening pressure:

59 kPa (0.6 kgf/cm², 8.5 psi)

HINT: Use the tester's maximum reading as the opening pressure.

If the opening pressure is less than minimum, replace the radiator cap.



3. INSPECT COOLING SYSTEM FOR LEAKS

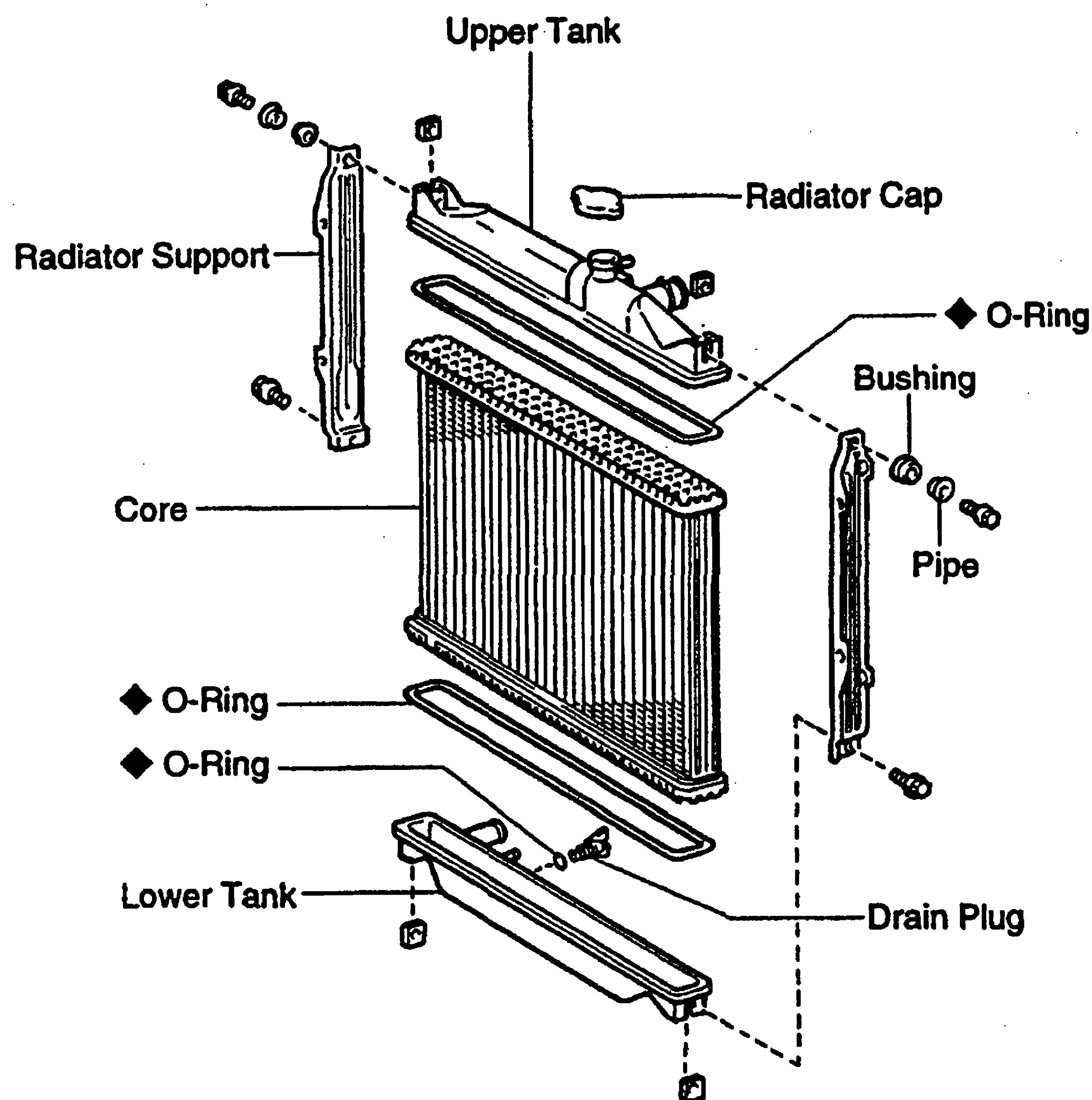
- (a) Fill the radiator with coolant, and attach a radiator cap tester to the radiator.
- (b) Warm up the engine.
- (c) Pump it to 118 kPa (1.2 kgf/cm², 17.1 psi), and check that the pressure does not drop.

If the pressure drops, check the hoses, radiator or water pump for leaks. If no external leaks are found, check the heater core, cylinder block and head.

4. REINSTALL RADIATOR CAP

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

EG0A3-0L



◆ Non-reusable part

Y S05044

RADIATOR DISASSEMBLY

EG006-09

1. REMOVE RADIATOR SUPPORTS

Remove the 2 bolts, nuts, pipe, bushing and radiator support. Remove the LH and RH supports.

2. REMOVE RADIATOR CAP

3. REMOVE DRAIN PLUG

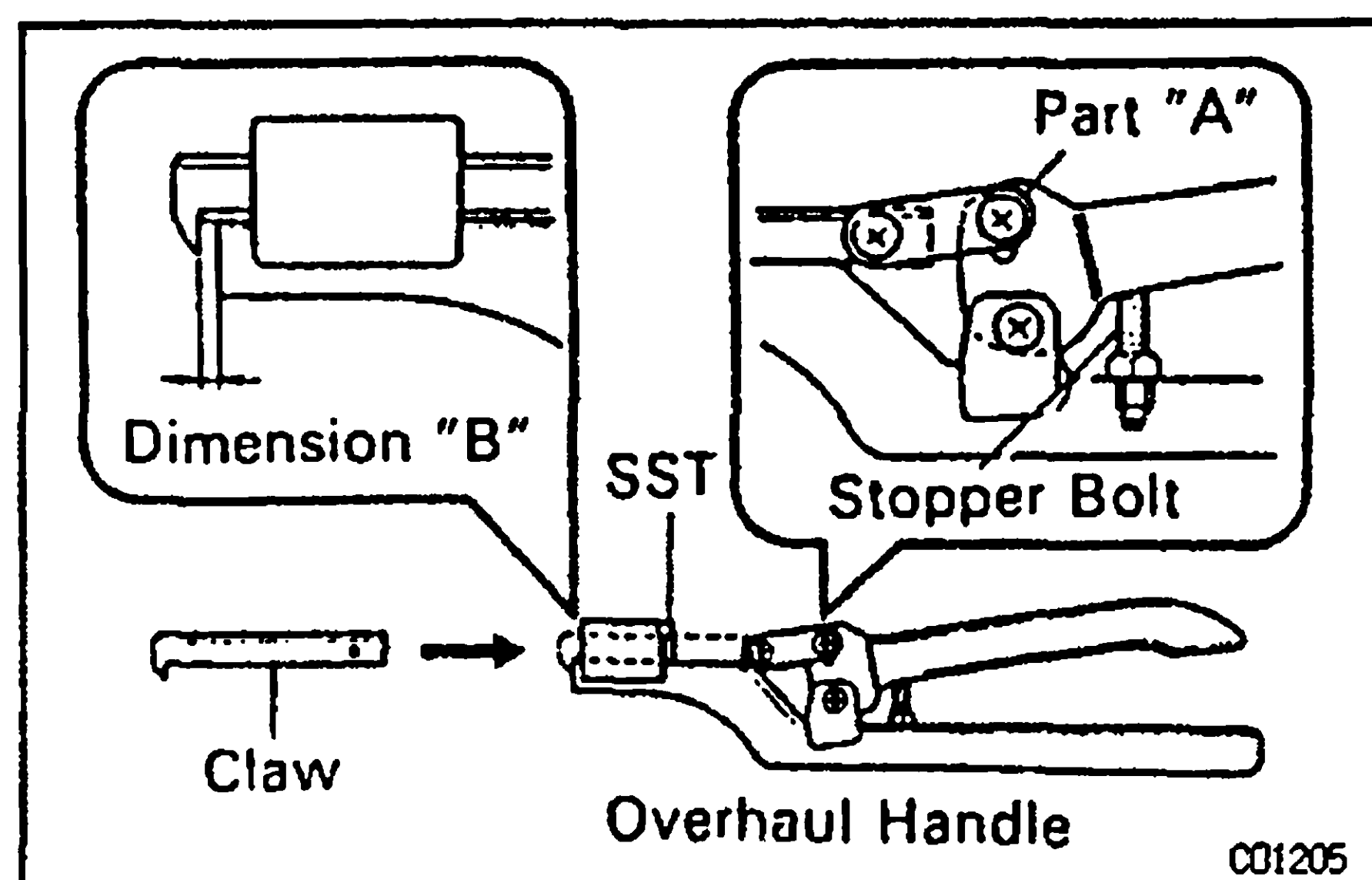
- Remove the drain plug.
- Remove the O-ring from the drain plug.

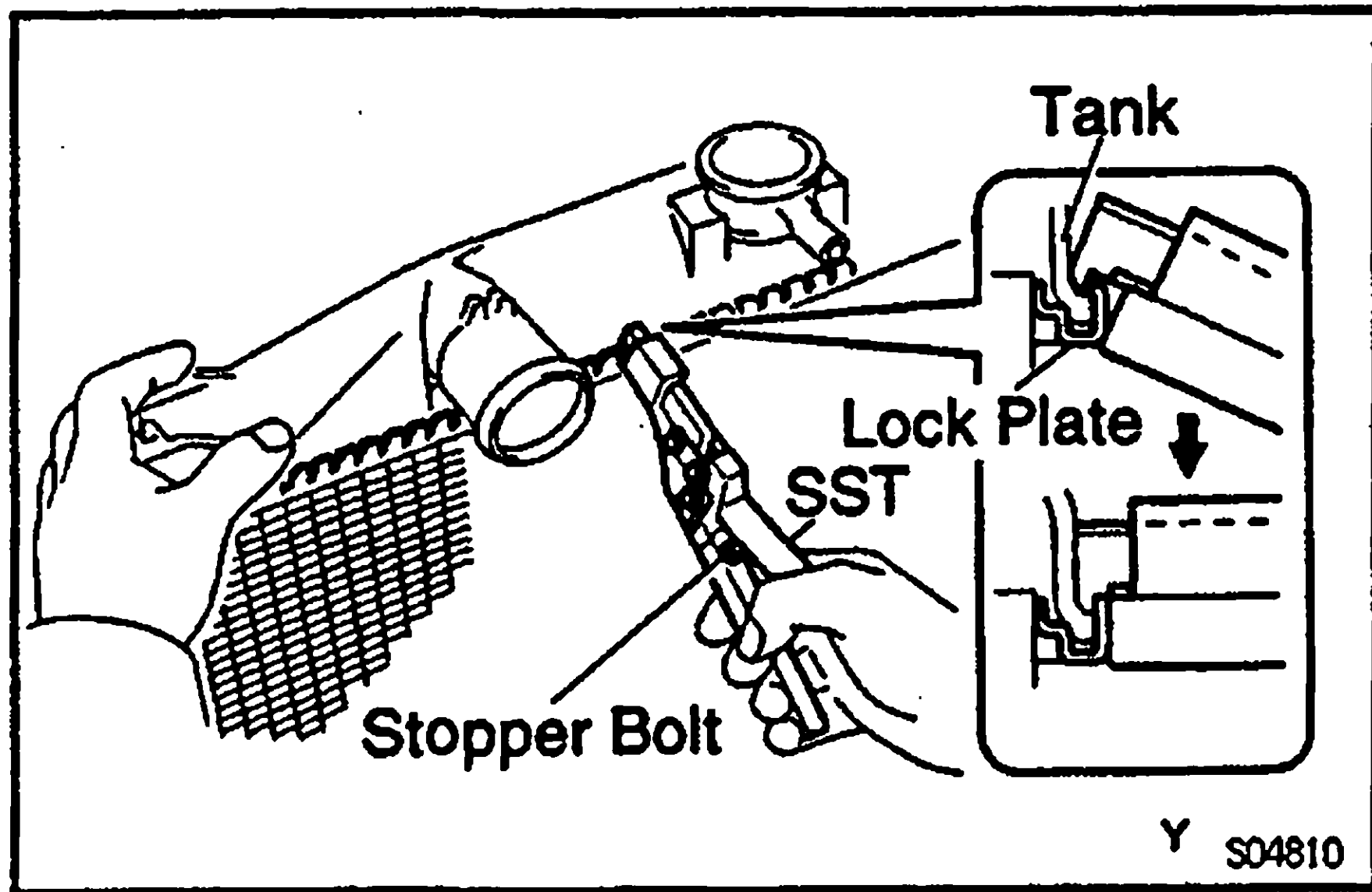
4. ASSEMBLE SST

SST 09230-01010

- Install the claw to the overhaul handle, inserting it in the hole in part "A" as shown in the diagram.
- While gripping the handle, adjust the stopper bolt so that dimension "B" shown in the diagram is 0.2 — 0.3 mm (0.008 — 0.012 in.).

NOTICE: If this adjustment is not done, the claw may be damaged.



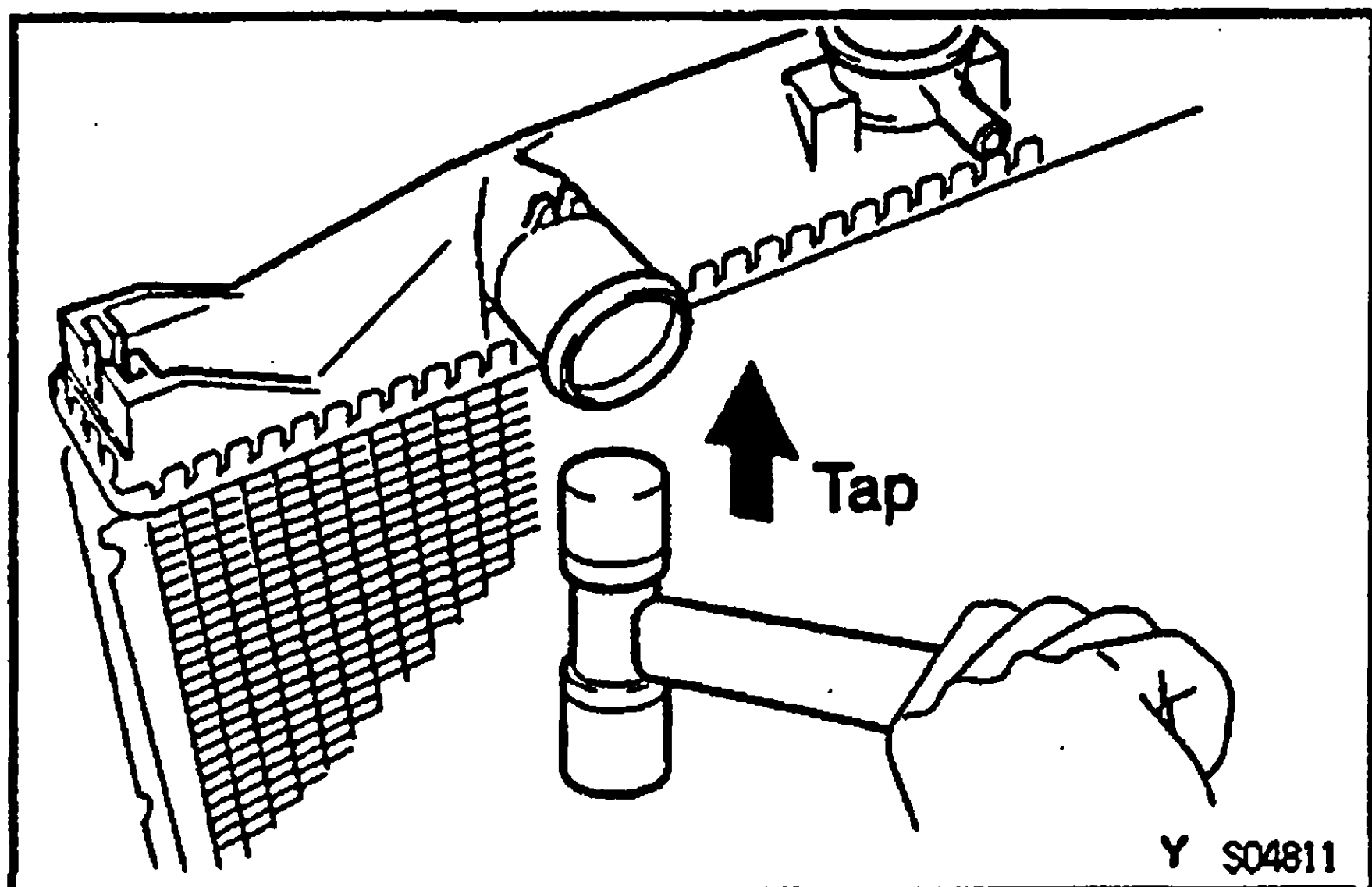


5. UNCAULK LOCK PLATES

Using SST to release the caulking, squeeze the handle until stopped by the stopper bolt.

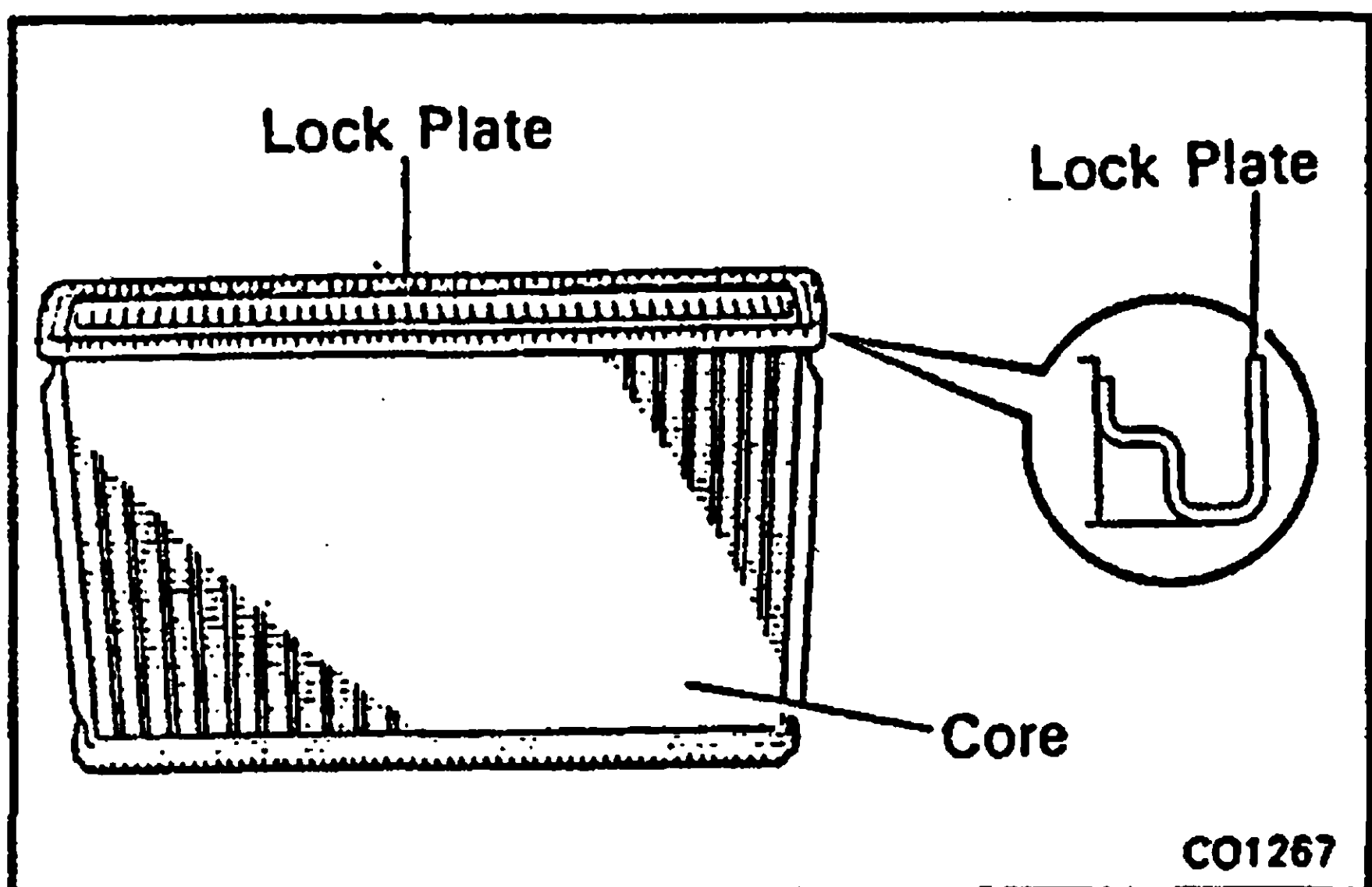
SST 09230-01010

NOTICE: Do not raise the lock plate higher than horizontal.



6. REMOVE TANKS AND O-RINGS

- Lightly tap the radiator port (inlet or outlet) with a soft-faced hammer, and remove the tank.
- Remove the O-ring.



RADIATOR ASSEMBLY

1. INSPECT LOCK PLATE

Inspect the lock plate for damage.

HINT:

- If the sides of the lock plate groove are deformed, reassembly of the tank will be impossible.
- First correct any deformation with pliers or similar objects if necessary. Water leakage will result if the bottom of the lock plate groove is damaged or dented. Therefore, repair or replace if necessary.

NOTICE: The radiator can only be recaulked 2 times.

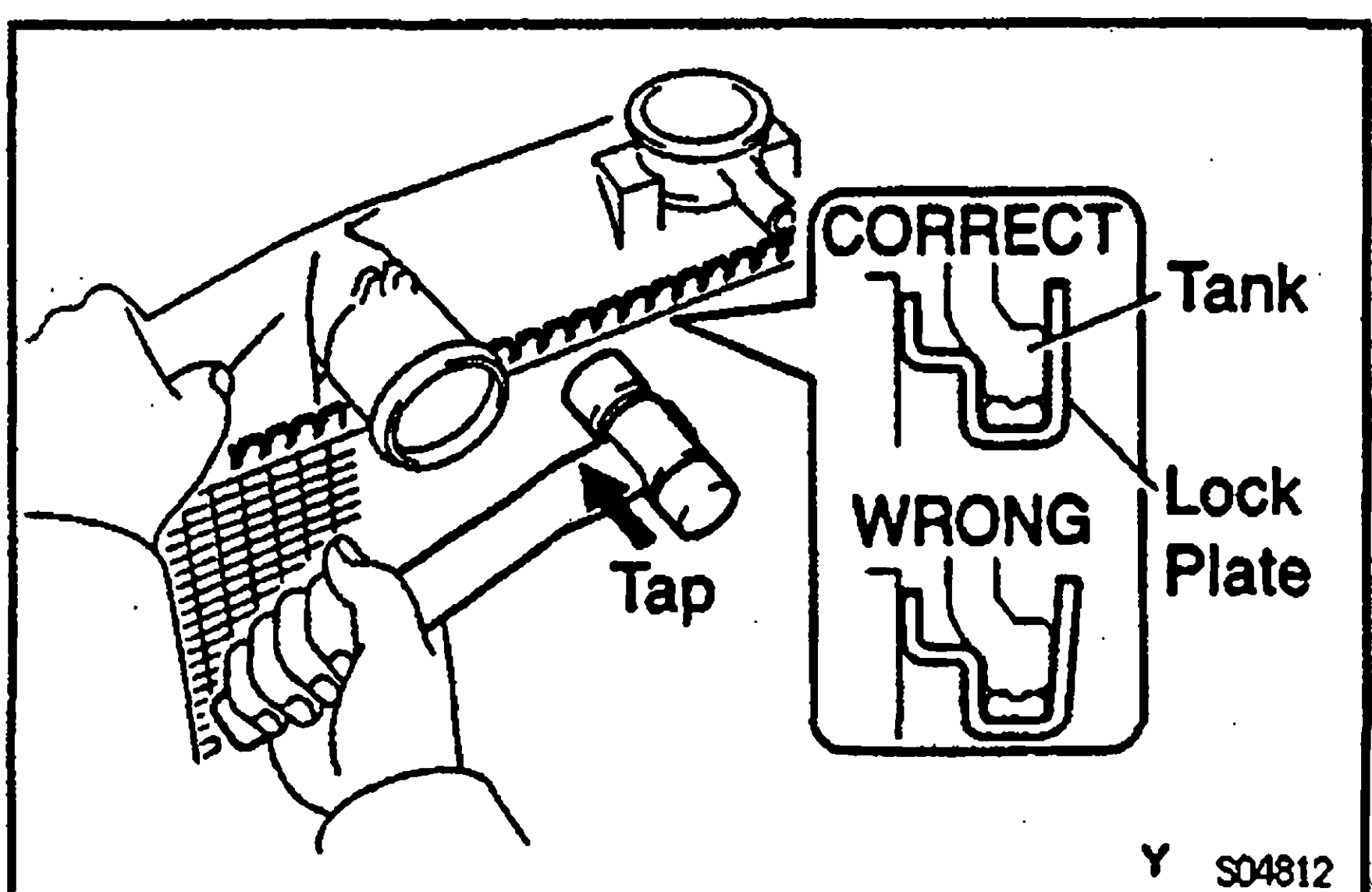
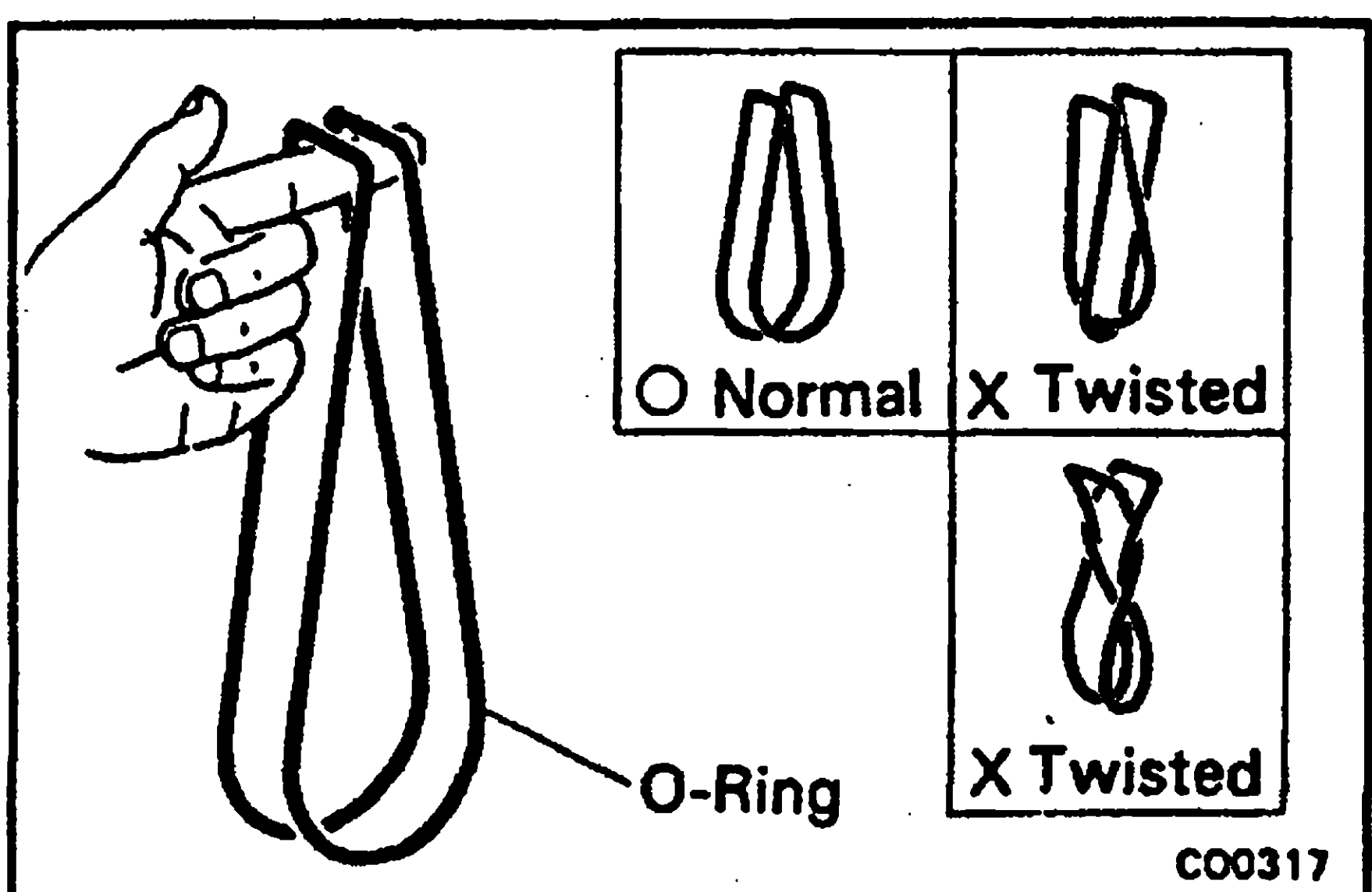
After the 2nd time, the radiator core must be replaced.

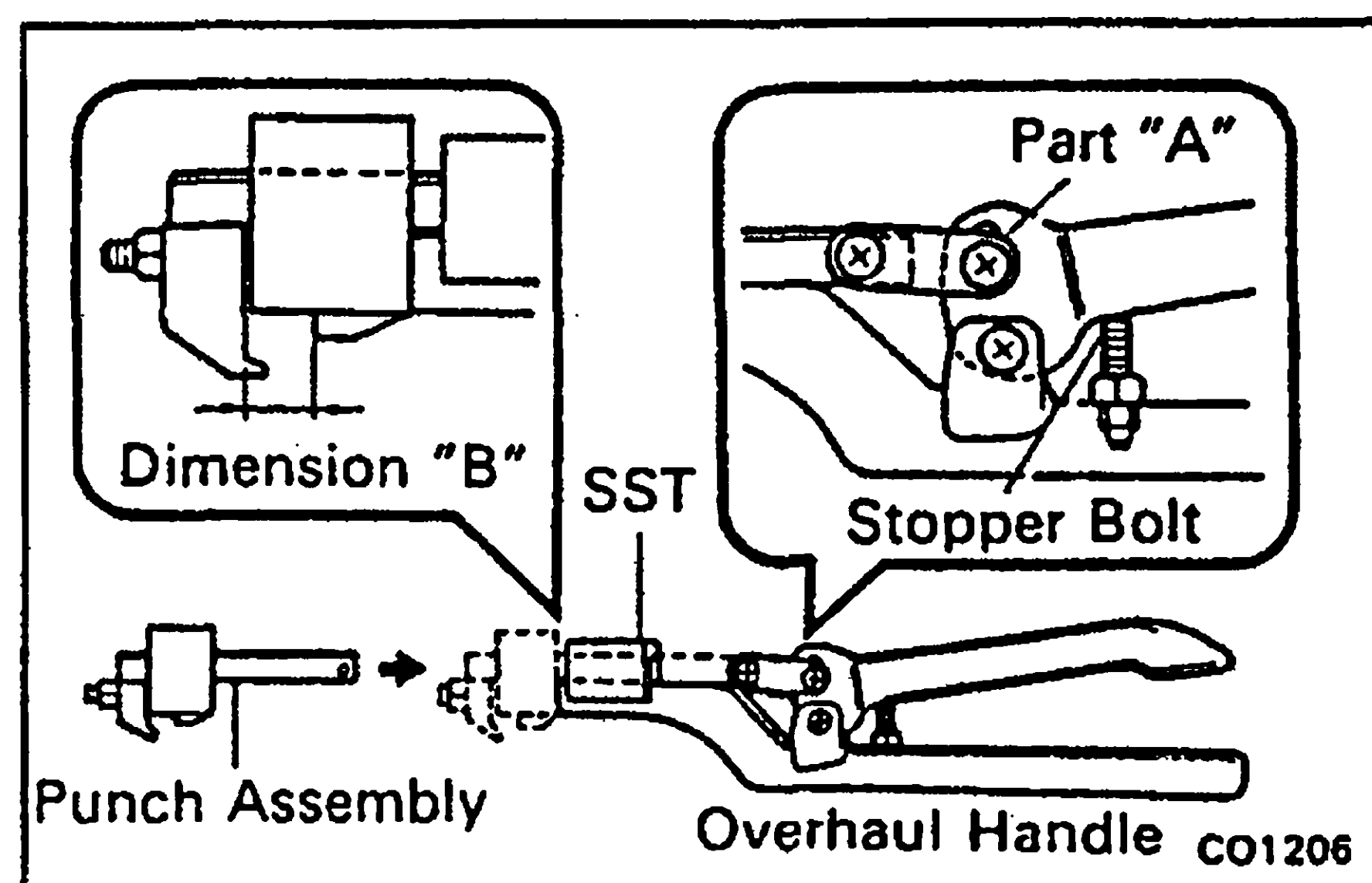
2. INSTALL NEW O-RINGS AND TANKS

- After checking that there are no foreign objects in the lock plate groove, install the new O-ring without twisting it.

HINT: When cleaning the lock plate groove, lightly rub it with sand paper without scratching it.

- Install the tank without damaging the O-ring.
- Tap the lock plate with a soft-faced hammer so that there is no gap between it and the tank.





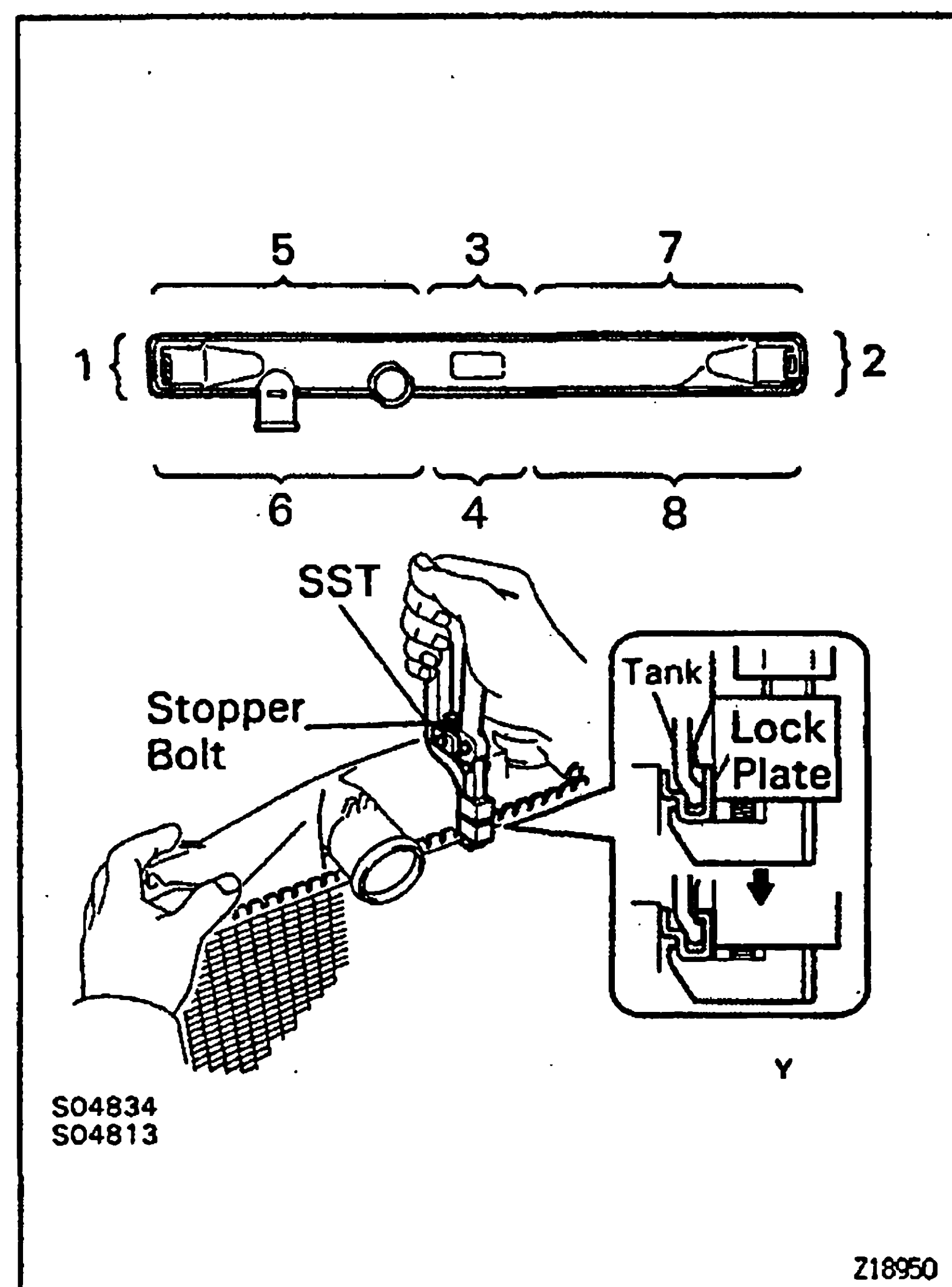
3. ASSEMBLE SST

SST 09230-01010, 09231-14010

- Install the punch assembly to the overhaul handle, inserting it in the hole in part "A" as shown in the illustration.
- While gripping the handle, adjust the stopper bolt so that dimension "B" shown in the diagram.

Dimension "B":

8.4 mm (0.331 in.)



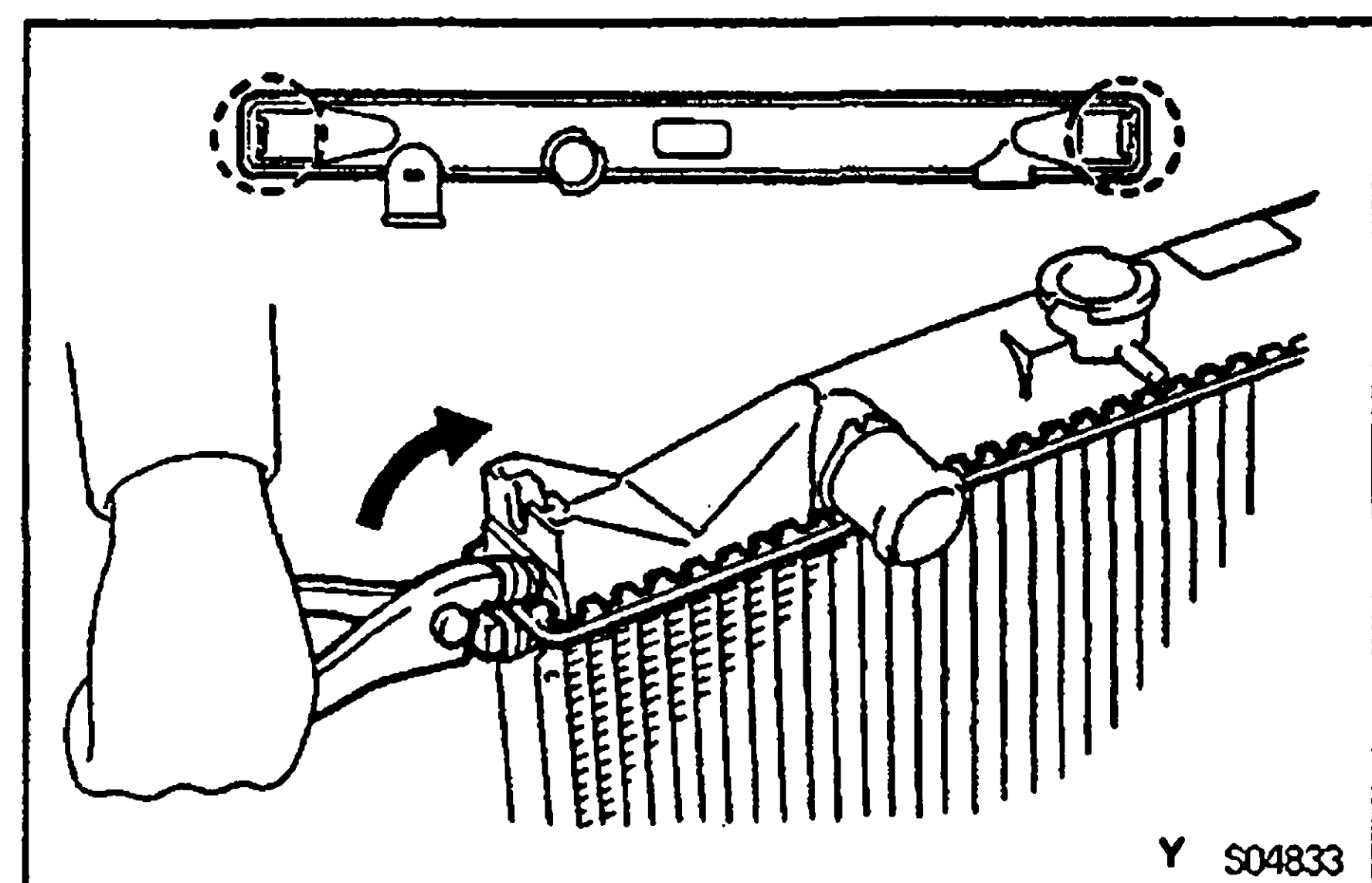
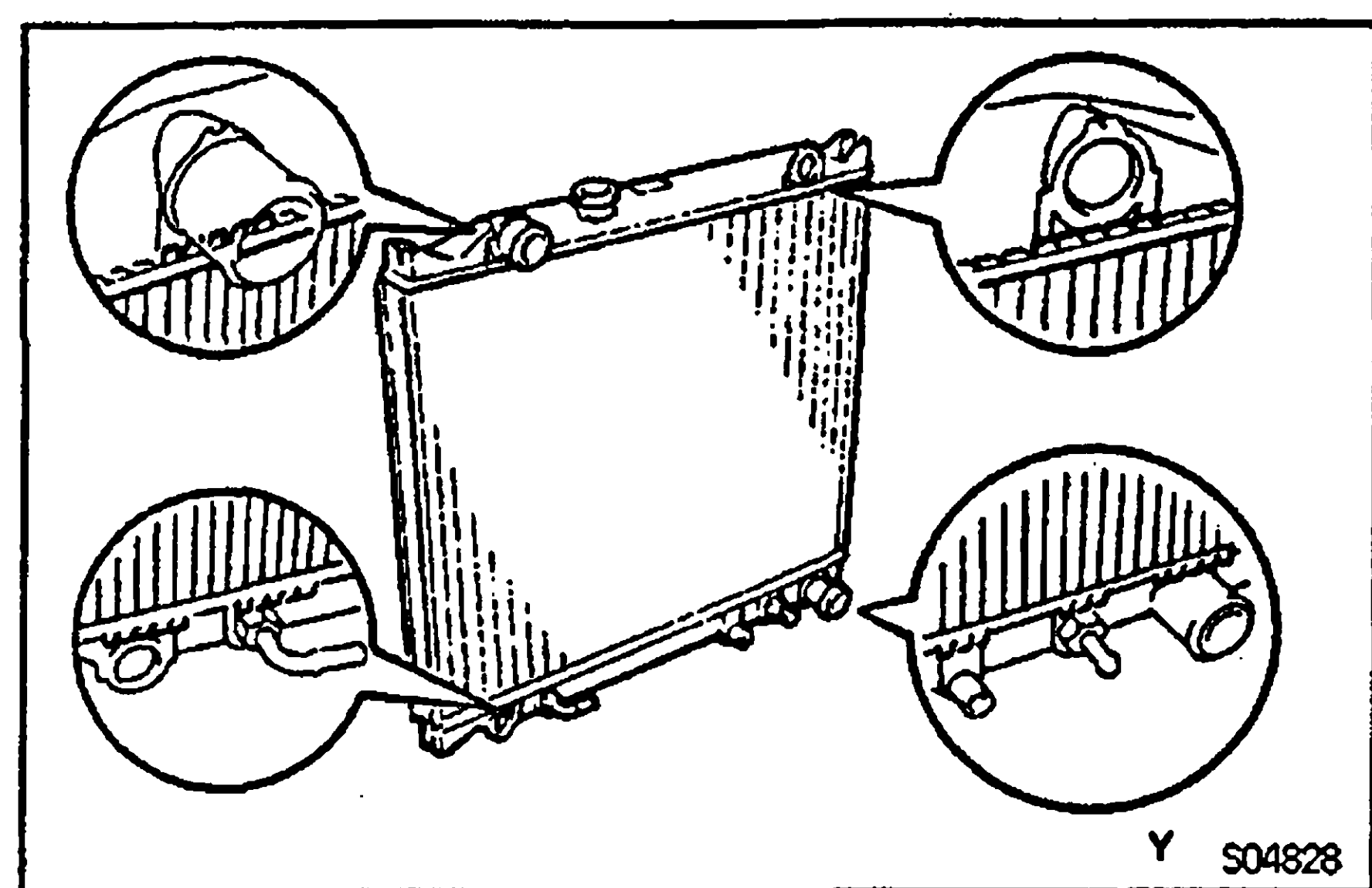
4. CAULK LOCK PLATE

- Lightly press SST against the lock plate in the order shown in the illustration. After repeating this a few times, fully caulk the lock plate by squeezing the handle until stopped by the stopper bolt.

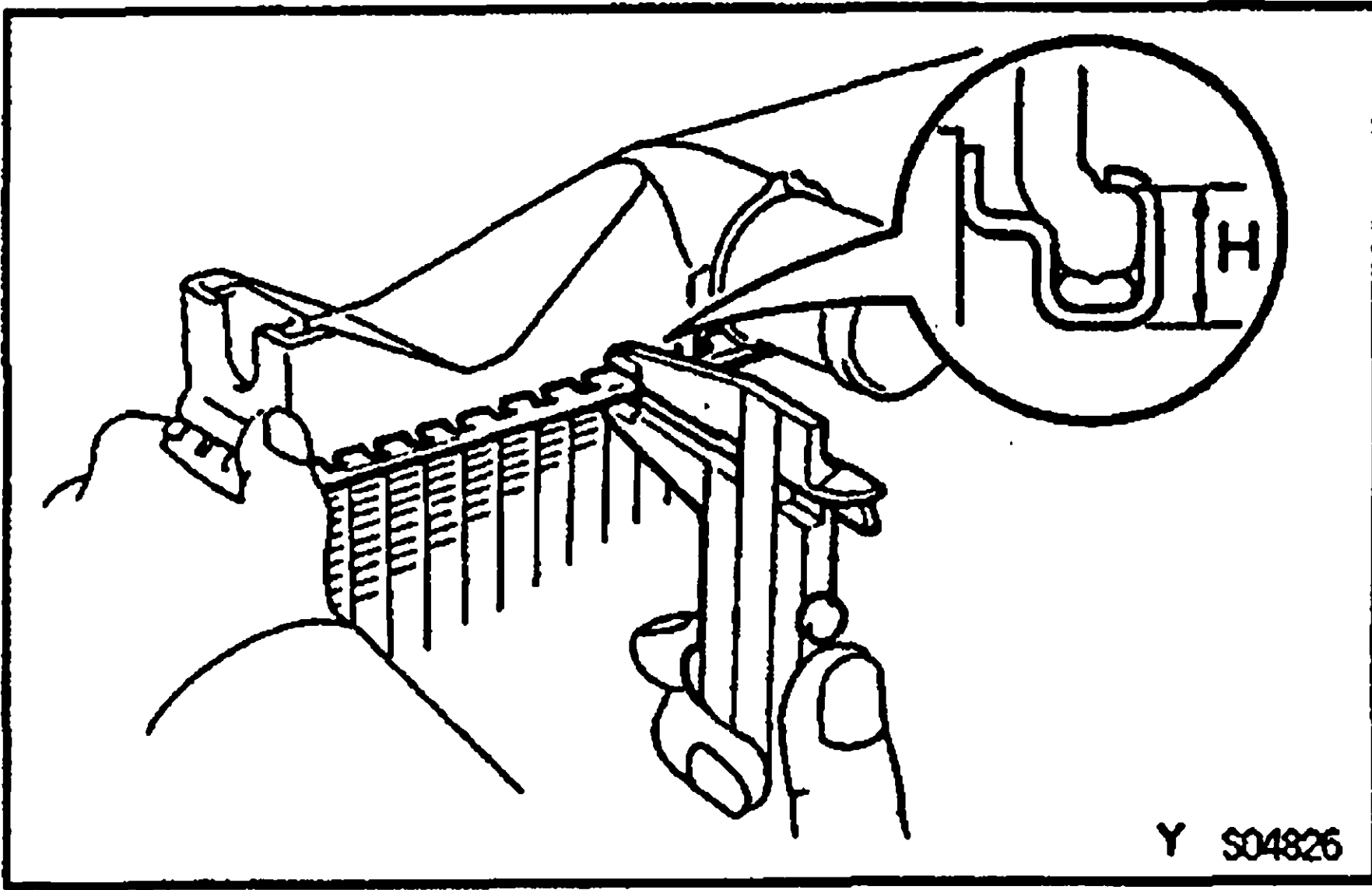
SST 09230-01010

HINT:

- Do not stake the areas protruding around the ports, flange and bracket.



- The points shown in the rib sides near here cannot be staked with SST. Use wrap vinyl tape around the tip of a pair of pliers or similar object and be careful not to damage the core plates.



- (b) Check the lock plate height (H) after completing the caulking.

Plate height (H):

7.40 — 7.80 mm (0.2913 — 0.3071 in.)

If not within the specified height, adjust the stopper bolt of the handle again and caulk again.

5. INSTALL RADIATOR CAP

6. INSTALL DRAIN PLUG TO RADIATOR

- Install a new O—ring to the drain plug.
- Apply soapy water to the O—ring.
- Install the drain plug.

7. CHECK FOR WATER LEAKS

- Using SST, plug the inlet and outlet pipes of the radiator.

SST 09230—01010

- Using a radiator cap tester, apply pressure to the radiator.

Test pressure:

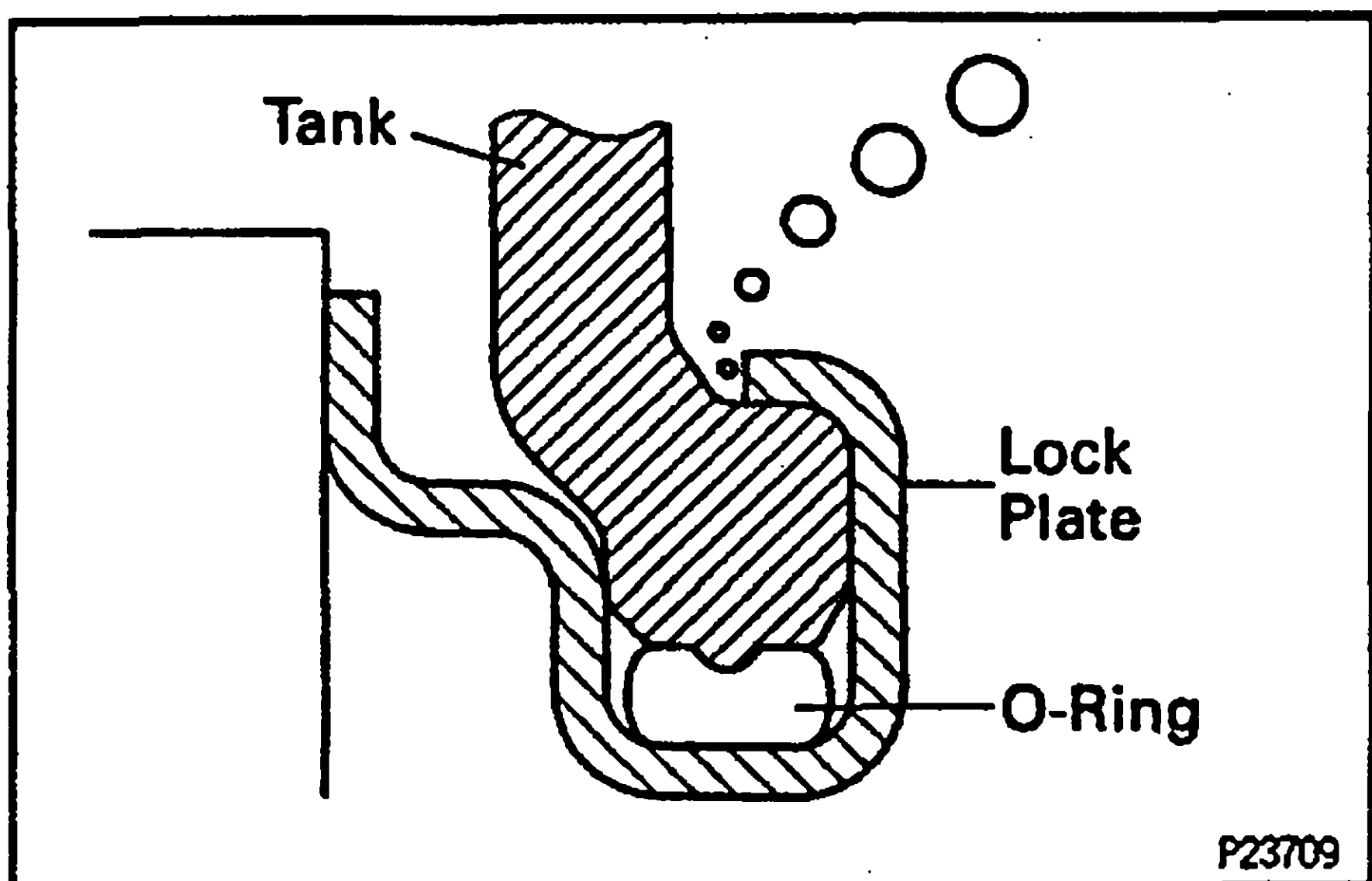
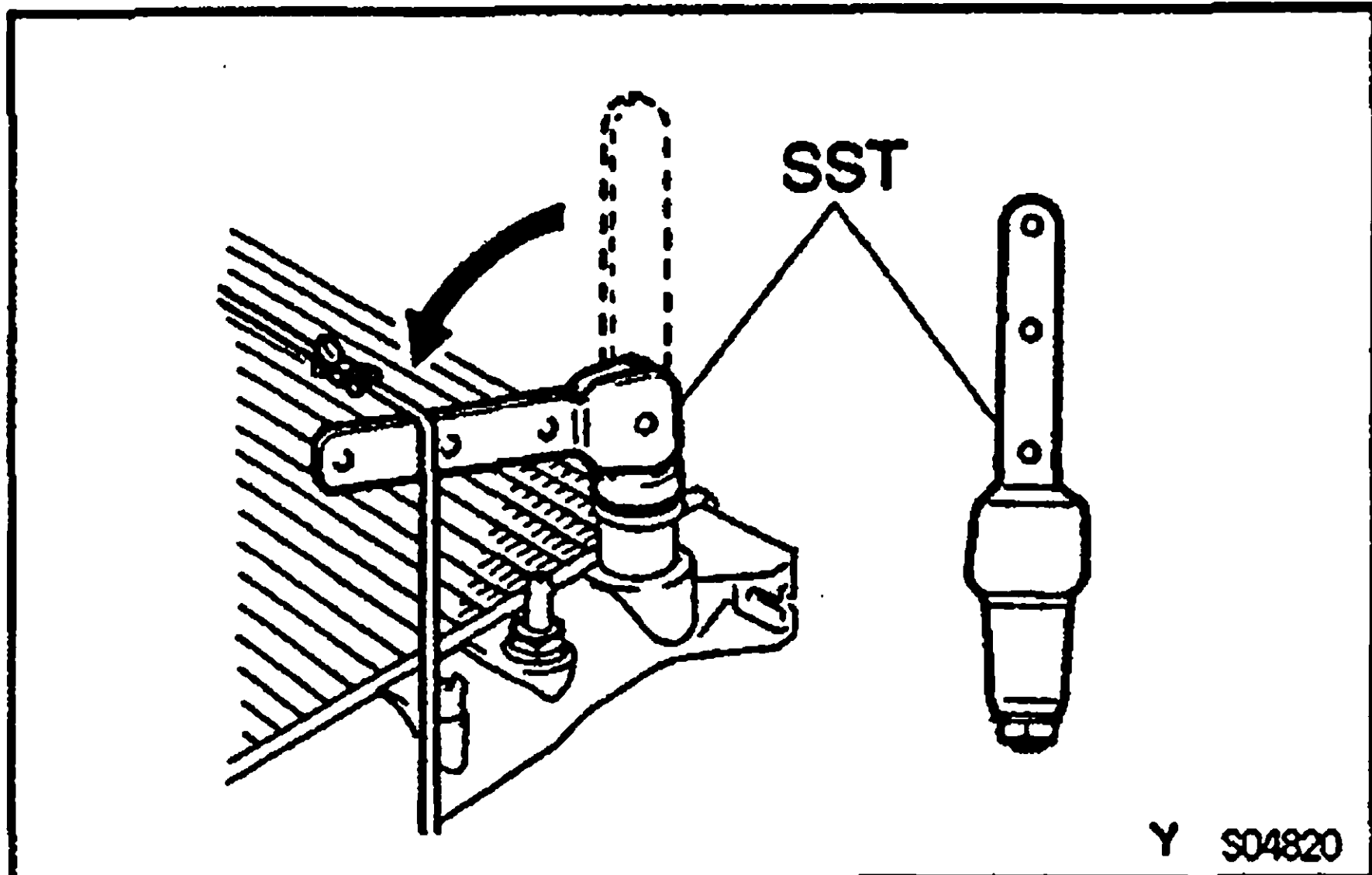
177 kPa (1.8 kgf/cm², 26 psi)

- Check for water leaks.

HINT: On radiators with resin tanks, there is a clearance between the core plate and tank plate where a minute amount of air will remain, giving the appearance of an air leak when the radiator is submerged in water. Therefore, before performing the water leak test, first swirl the radiator around in the water until all air bubbles disappear.

8. INSTALL RADIATOR SUPPORTS

Torque: 12.74 N·m (130 kgf·cm, 9 ft·lbf)



SERVICE SPECIFICATIONS

SERVICE DATA

B007L-27

Thermostat	Valve opening temperature	80 — 84°C (176 — 183°F)
	Valve lift at 95°C (203°F)	10 mm (0.39 in.) or more
Radiator cap	Relief valve opening pressure STD	74 — 103 kPa (0.75 — 1.05 kgf/cm ² , 10.7 — 14.9 psi)
	Minimum	59 kPa (0.6 kgf/cm ² , 8.5 psi)

TORQUE SPECIFICATIONS

B007M-29

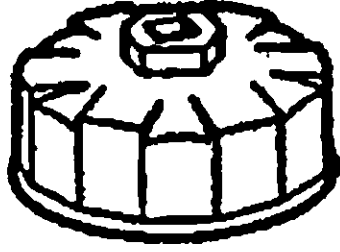
Part tightened	N·m	kgf·cm	ft·lbf
Cylinder block x Drain plug	8	80	69 in·lbf
Water inlet x Cylinder block	13	130	9
Radiator support x Tank on radiator	12.74	130	9

LUBRICATION SYSTEM

PREPARATION

SST (SPECIAL SERVICE TOOLS)

B014U-13

EG  09228-10002 Oil Filter Wrench	
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EQUIPMENT

B014W-10

Oil pressure gauge	
Torque wrench	

LUBRICANT

B014X-1R

Item	Capacity	Classification
Engine oil		API grade CD
Dry fill	7.5 liters (7.9 US qts, 6.6 Imp. qts)	(You may also use API CE or API CF.)
Drain and refill		
w/ Oil filter change	7.0 liters (7.4 US qts, 6.2 Imp. qts)	
w/o Oil filter change	6.4 liters (6.8 US qts, 5.6 Imp. qts)	

SSM (SPECIAL SERVICE MATERIALS)

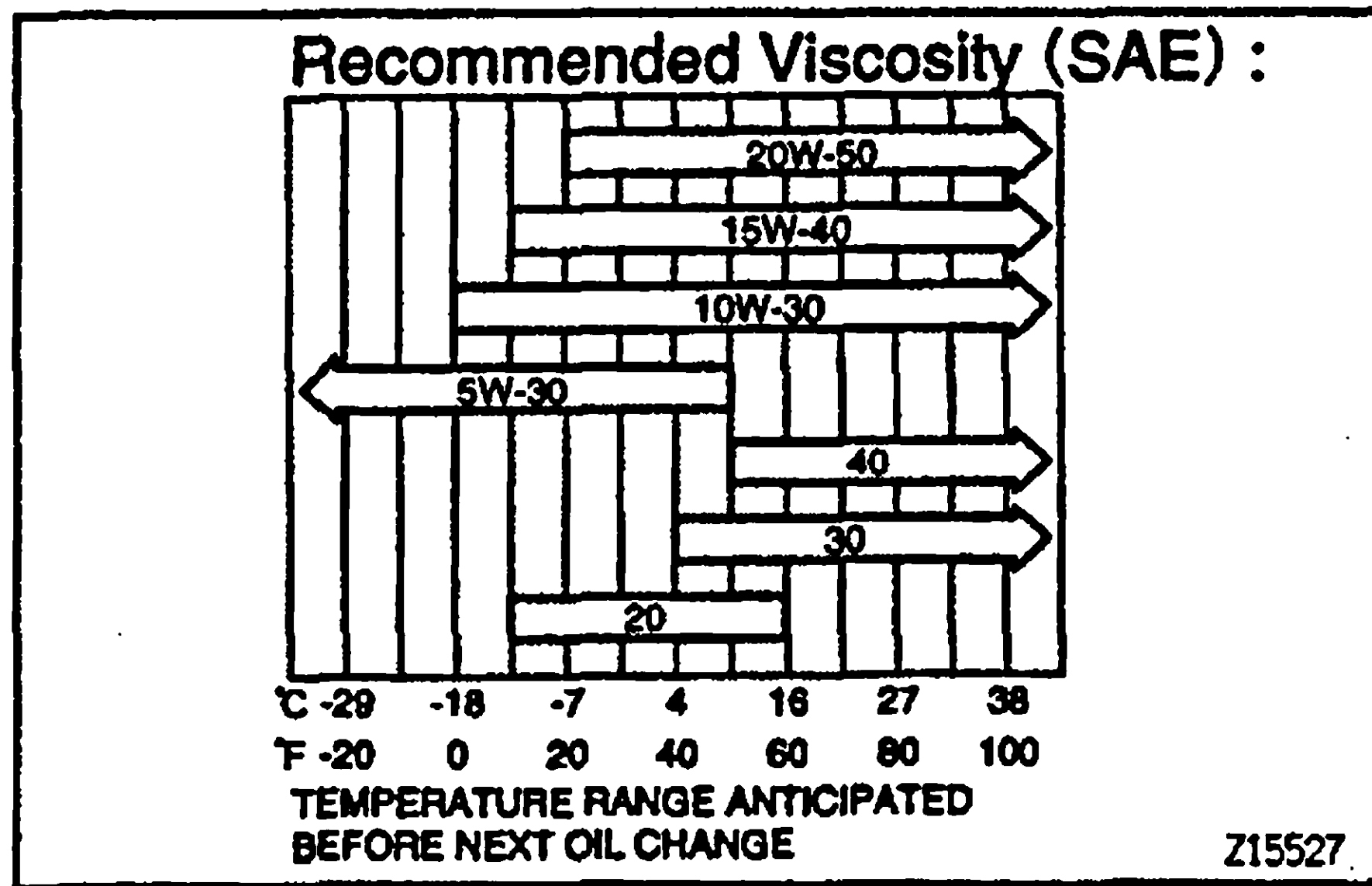
B014Y-11

08833-00080 Adhesive 1344, THREE BOND 1344, LOCTITE 242 or equivalent	Oil pressure switch
---	---------------------

OIL PRESSURE CHECK

B036A-02

1. CHECK ENGINE OIL QUALITY
- Check the oil for deterioration, entry of water, dis-coloring or thinning.
- If the quality is visibly poor, replace the oil.



Oil grade:

API grade CD

(You may also use API CE or API CF.)

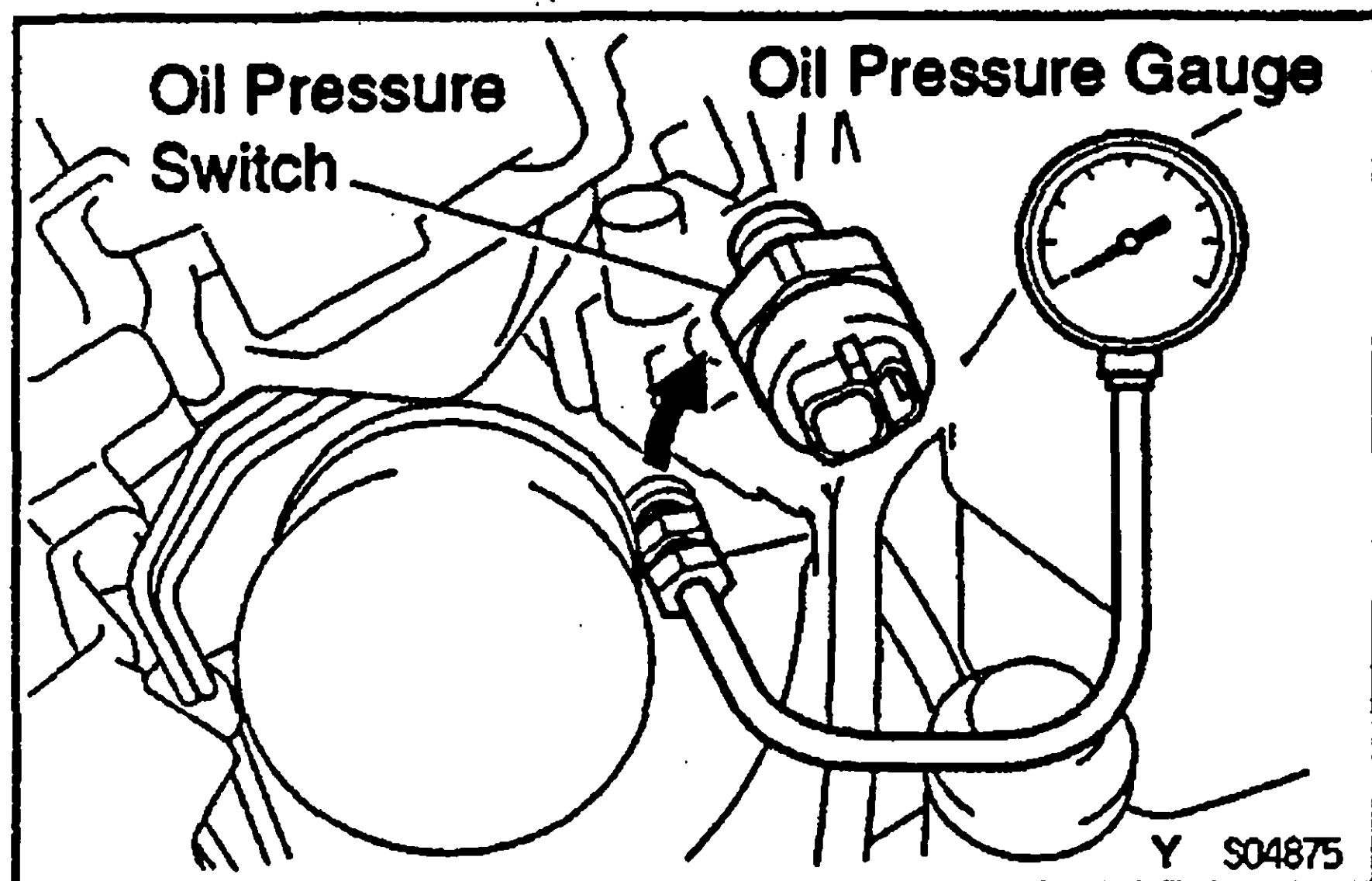
Recommended viscosity:

Refer to illustration

2. CHECK ENGINE OIL LEVEL

The oil level should be between the "L" and "F" marks on the dipstick.

If low, check for leakage and add oil up to "F" mark.



3. REMOVE OIL PRESSURE SWITCH

4. INSTALL OIL PRESSURE GAUGE

5. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

6. CHECK OIL PRESSURE

Oil pressure:

At idle

29 kPa (0.3 kgf/cm², 4.3 psi) or more

At 3,000 rpm

245 kPa (2.5 kgf/cm², 33 psi) or more

7. REMOVE OIL PRESSURE GAUGE

8. REINSTALL OIL PRESSURE SWITCH

(a) Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

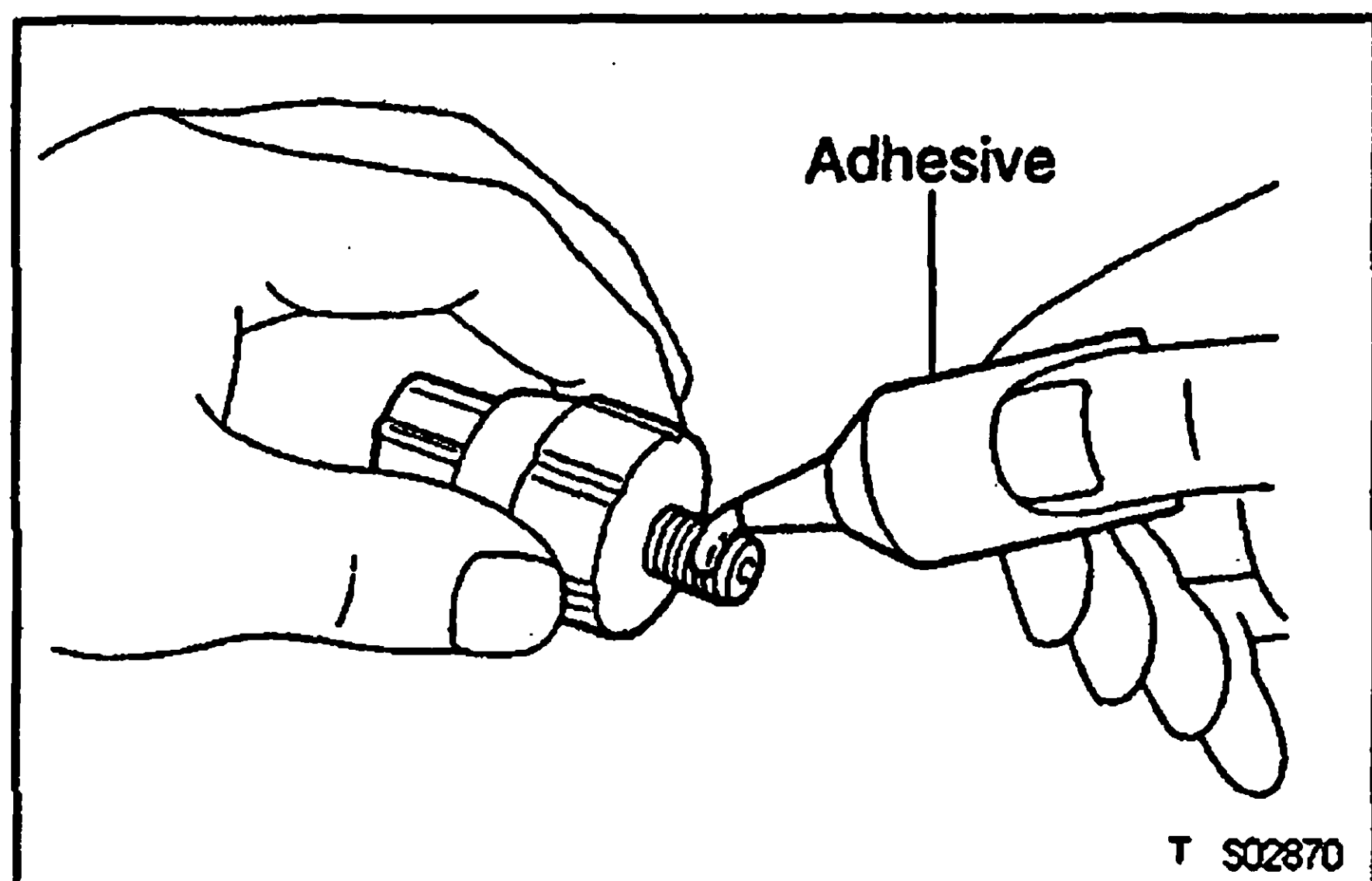
Part No. 08833-00080, THREE BOND 1344,

LOCTITE 242 or equivalent

(b) Install the oil pressure switch.

9. START ENGINE, AND CHECK FOR OIL LEAKS

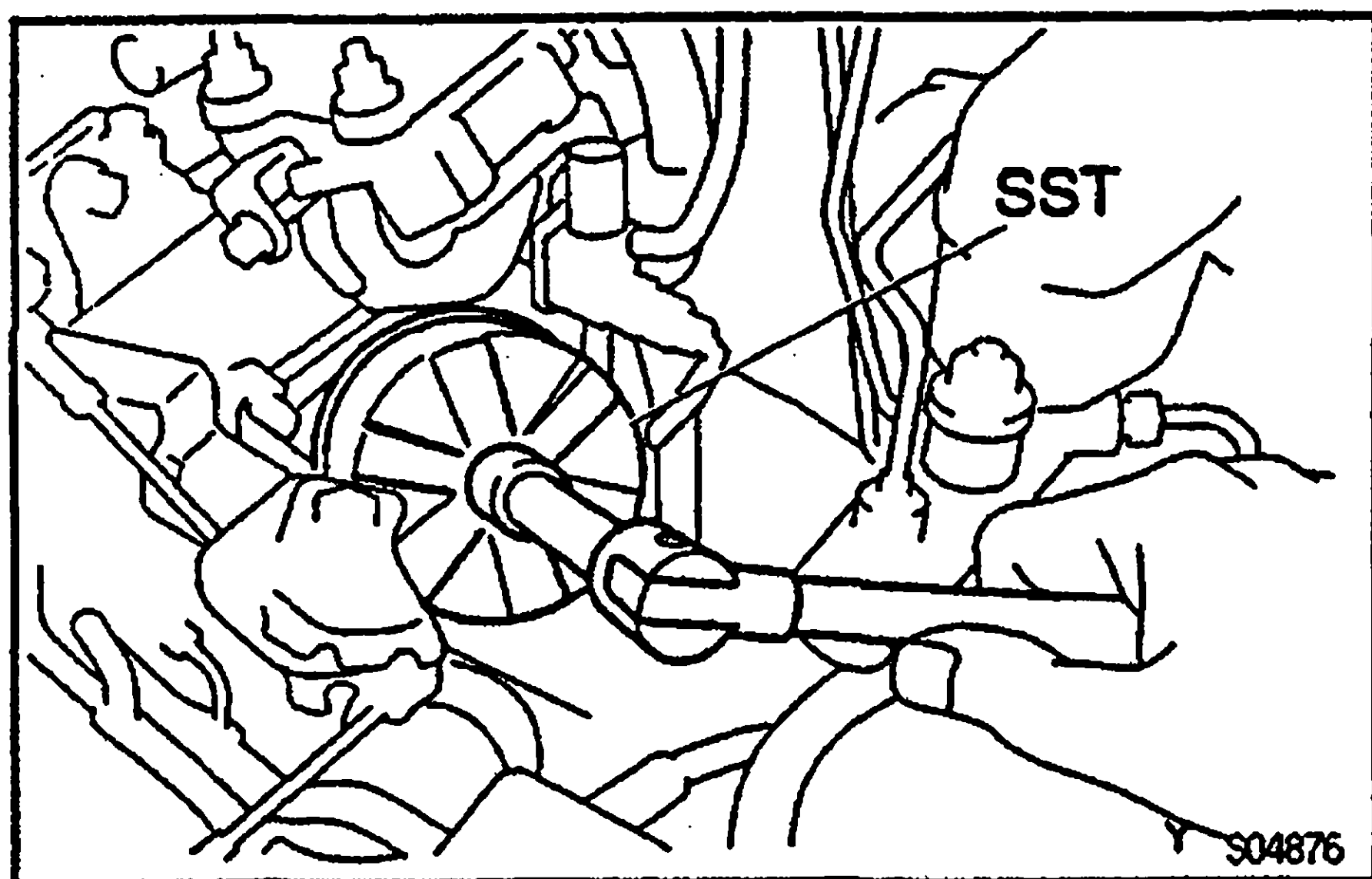
OIL AND FILTER REPLACEMENT



CAUTION:

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Care should be taken, therefore, when changing engine oil to minimize the frequency and length of time your skin is exposed to used engine oil. Protective clothing and gloves that cannot be penetrated by oil should be worn. The skin should be thoroughly washed with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.

EG70A-01



EG

1. DRAIN ENGINE OIL

- (a) Remove the oil filler cap.
- (b) Remove the oil drain plug, and drain the oil into a container.

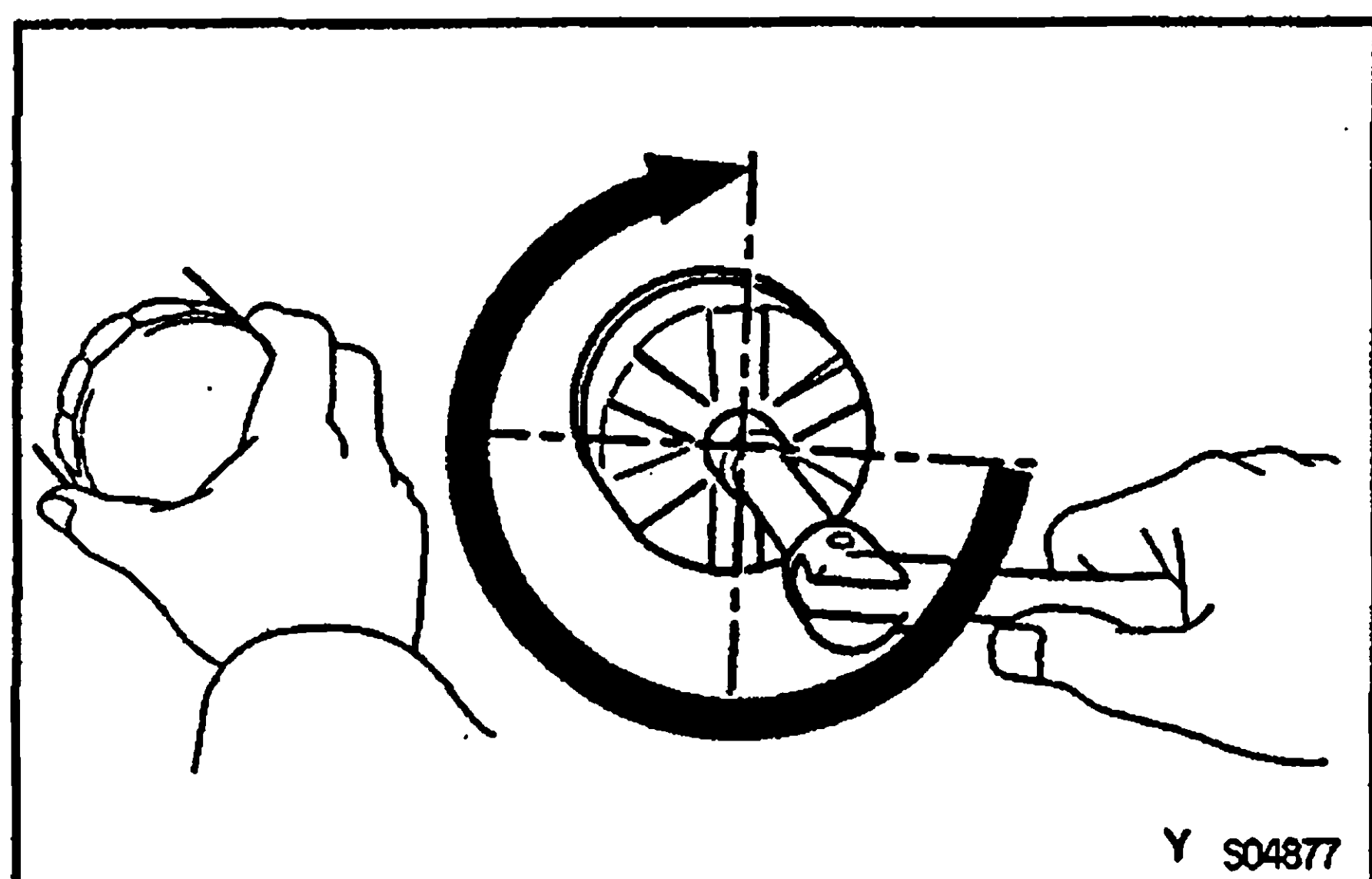
2. REPLACE OIL FILTER

- (a) Using SST, remove the oil filter.

SST 09228-10002

HINT: As the oil in the filter flows out through the drain hose, place the drain oil container under the drain hose.

- (b) Clean the oil filter contact surface on the oil filter mounting.
- (c) Lubricate the filter rubber gasket with clean engine oil.



- (d) Tighten the oil filter by hand until the rubber gasket contacts the seat of the filter mounting.
- (e) Using SST, give it an additional 3/4 turn to seat the filter.

SST 09228-10002

3. FILL WITH ENGINE OIL

- (a) Clean and install the oil drain plug with a new gasket. Torque: 34 N·m (350 kgf·cm, 25 ft·lbf)

- (b) Fill with fresh engine oil.

Oil grade: (See step 1 in oil pressure check)

Capacity:

Drain and refill

w/ Oil filter change

7.0 liters (7.4 US qts, 6.2 Imp. qts)

w/o Oil filter change

6.4 liters (6.8 US qts, 5.6 Imp. qts)

Dry fill

7.5 liters (7.9 US qts, 6.6 Imp. qts)

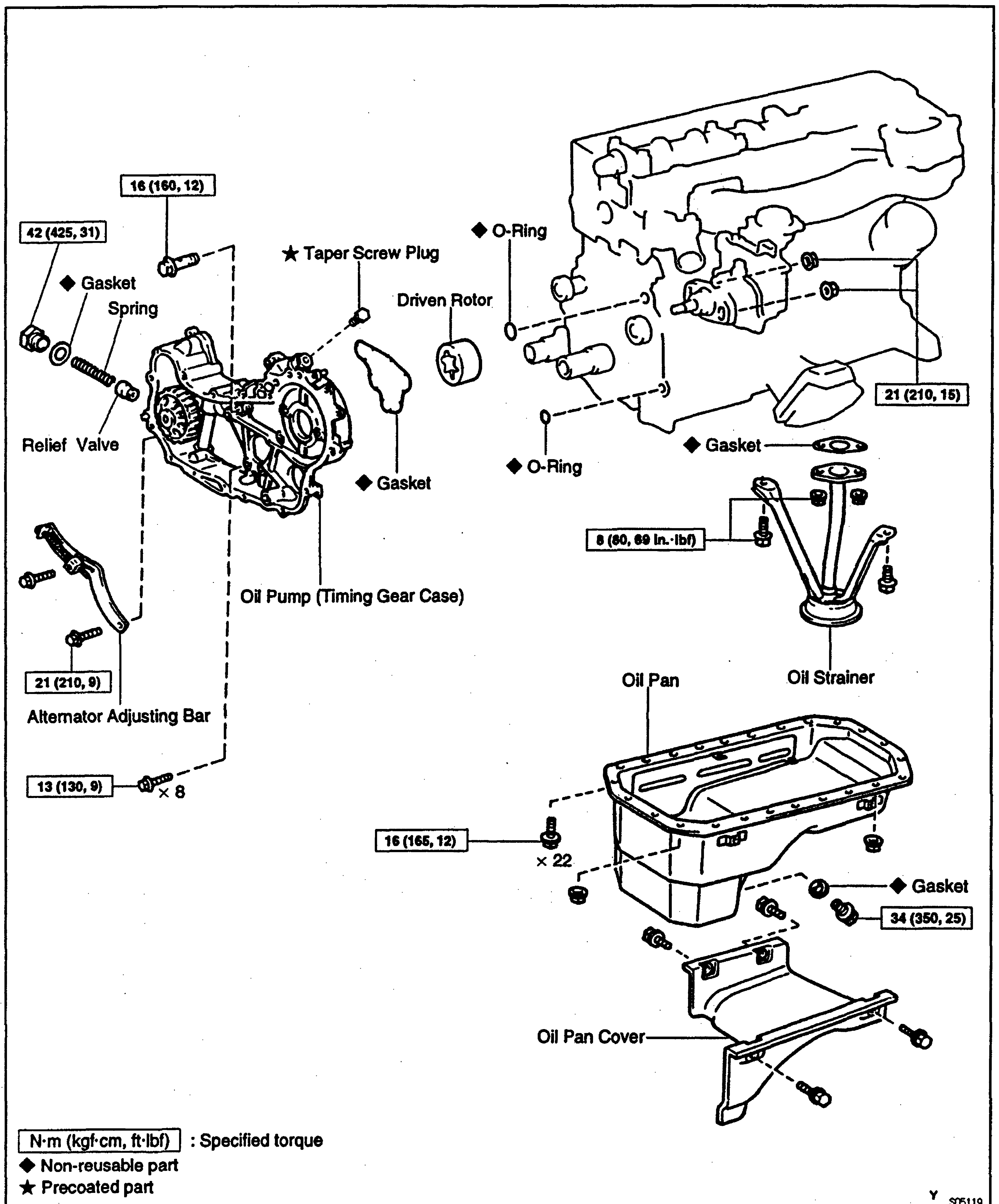
NOTICE: Use the dipstick to the oil quantity of the engine 5 minutes after stopping the warmed up engine.

- (c) Reinstall the oil filler cap.

4. START ENGINE AND CHECK FOR OIL LEAKS**5. RECHECK ENGINE OIL LEVEL**

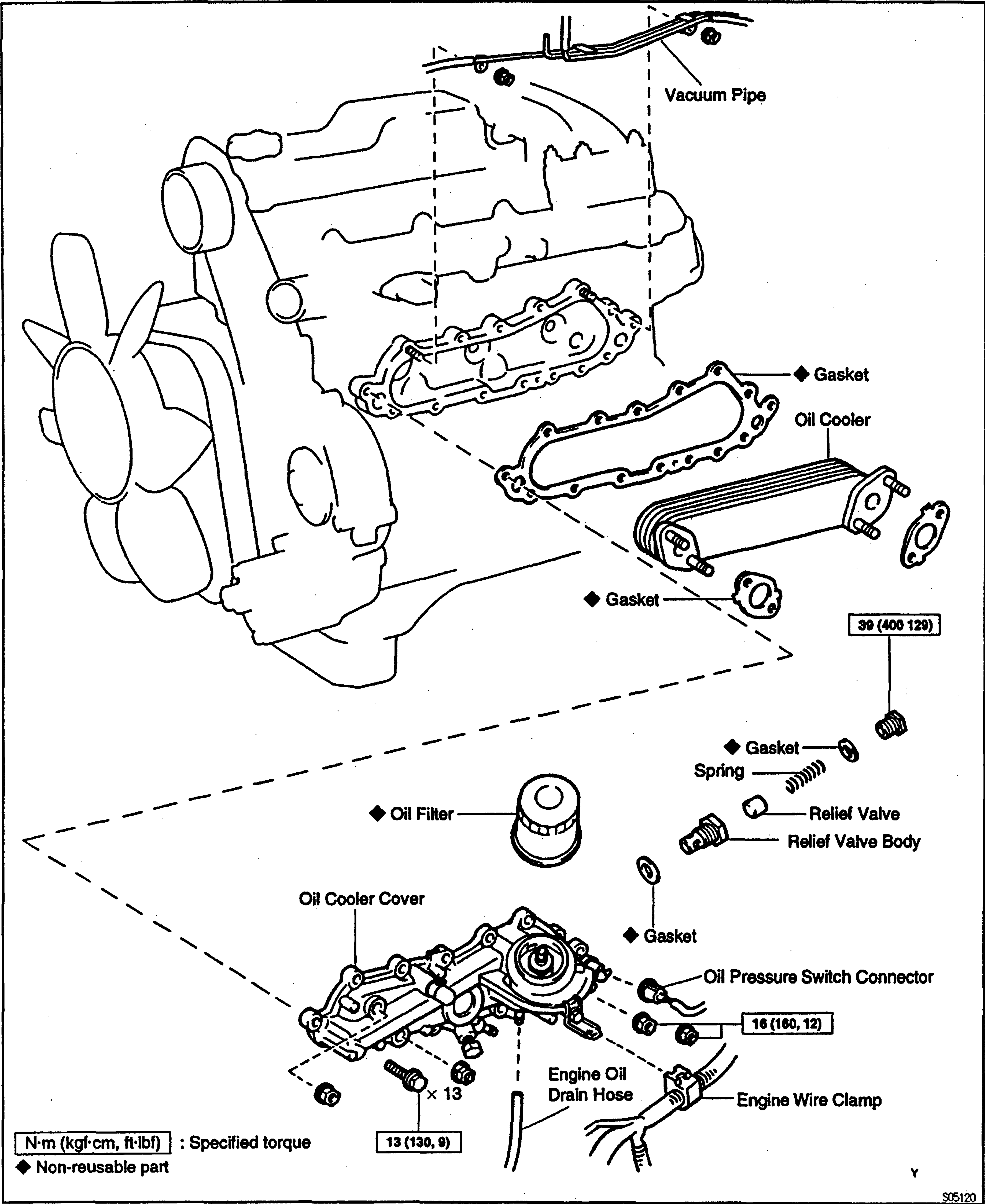
OIL PUMP COMPONENTS FOR REMOVAL AND INSTALLATION

EG178-08



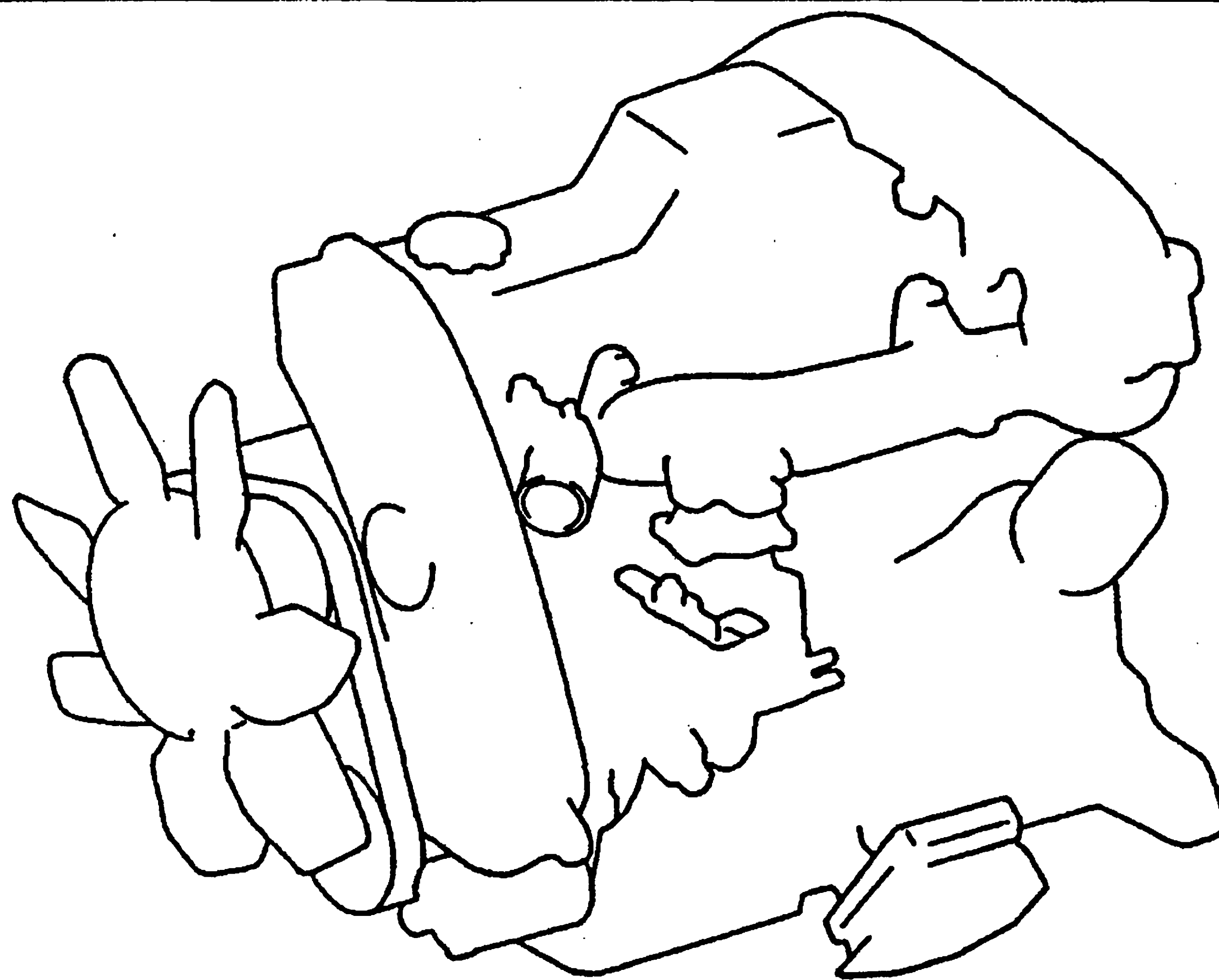
OIL COOLER
COMPONENTS FOR REMOVAL AND
INSTALLATION

88170-06



OIL NOZZLE COMPONENTS FOR REMOVAL AND INSTALLATION

B02K2-00



Oil Nozzle

Check Valve

26 (260, 19)

Oil Pan

16 (165, 12)

x 22

Gasket

34 (350, 25)

Oil Pan Cover

N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

SERVICE SPECIFICATIONS
SERVICE DATA

B015A-11

Oil pressure	at idle speed		29 kPa (0.3 kgf/cm², 4.3 psi) or more
	at 3,000 rpm		245 kPa (2.5 kgf/cm², 33 psi) or more
Oil pump	Body clearance	STD	0.100 — 0.170 mm (0.0039 — 0.0067 in.)
		Maximum	0.20 mm (0.0079 in.)
	Tip clearance	STD	0.060 — 0.160 mm (0.0024 — 0.0063 in.)
		Maximum	0.21 mm (0.0083 in.)
	Side clearance	STD	0.030 — 0.090 mm (0.0012 — 0.0035 in.)
		Maximum	0.15 mm (0.0059 in.)

TORQUE SPECIFICATIONS

B015C-1A

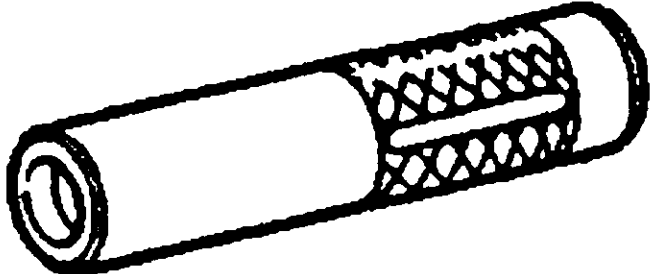
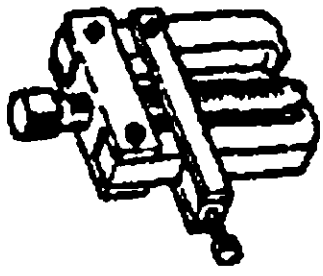
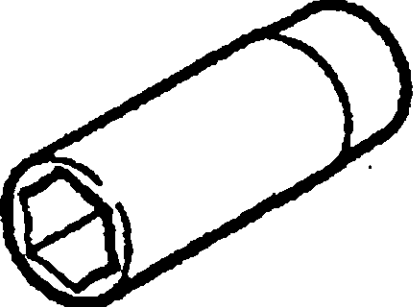
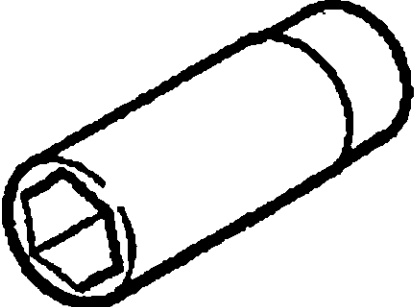
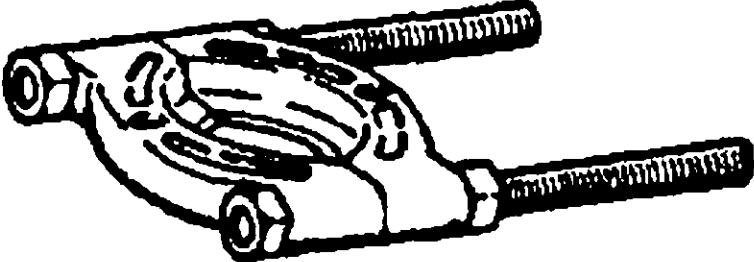
Part tightened	N·m	kgf·cm	ft·lbf
Oil pan x Drain plug	34	350	25
Relief valve x Oil pump	42	425	31
Oil pump x Cylinder block	Bolt	13	9
	Union bolt	16	12
Injection pump x Oil pump	21	210	15
Oil strainer x Cylinder block	8	80	69 in.-lbf
Oil pan x Cylinder block	16	165	12
Alternator adjusting bar x Oil pump	21	210	15
Oil cooler cover x Oil cooler	16	160	12
Oil cooler cover x Cylinder block	13	130	9
Oil nozzle x Cylinder block	26	260	19

STARTING

PREPARATION	ST- 2
TROUBLESHOOTING (1KZ-TE)	ST- 3
PRE-HEATING SYSTEM	ST- 4
STARTER (2.2 kW)	ST- 6
STARTER (2.7 kW)	ST- 18
STARTER (3.0 kW)	ST- 28
STARTER RELAY	ST- 40
SERVICE SPECIFICATIONS	ST- 41

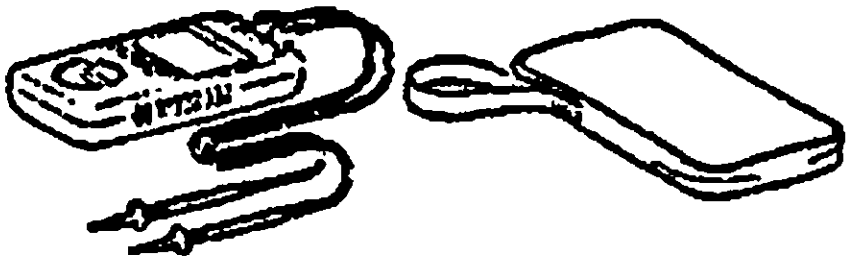
PREPARATION
SST (SPECIAL SERVICE TOOLS)

ST008-1F

	09201-41020 Valve Stem Oil Seal Replacer	Armature front bearing for 2.2 kW type
	09286-46011 Injection Pump Spline Shaft Puller	Armature rear bearing
	09810-38140 Starter Magnet Switch Nut Wrench 14	2.2 kW type
	09810-38170 Starter Magnet Switch Nut Wrench 17	2.7 kW, 3.0 kW types
	09820-00030 Alternator Rear Bearing Replacer	Armature front bearing for 2.7 kW, 3.0 kW types
	09950-00020 Bearing Remover	Armature front bearing for 2.2 kW, 3.0 kW types

RECOMMENDED TOOLS

ST007-1B

	09082-00040 TOYOTA Electrical Tester.	
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EQUIPMENT

ST00U-0Y

Dial indicator	Commutator
Magnetic finger	Steel ball
Press	Magnetic switch terminal kit
Pull scale	Brush spring
Sandpaper	Commutator
Torque wrench	
V-block	Commutator
Vernier calipers	Commutator, Brush

TROUBLESHOOTING (1KZ—TE)

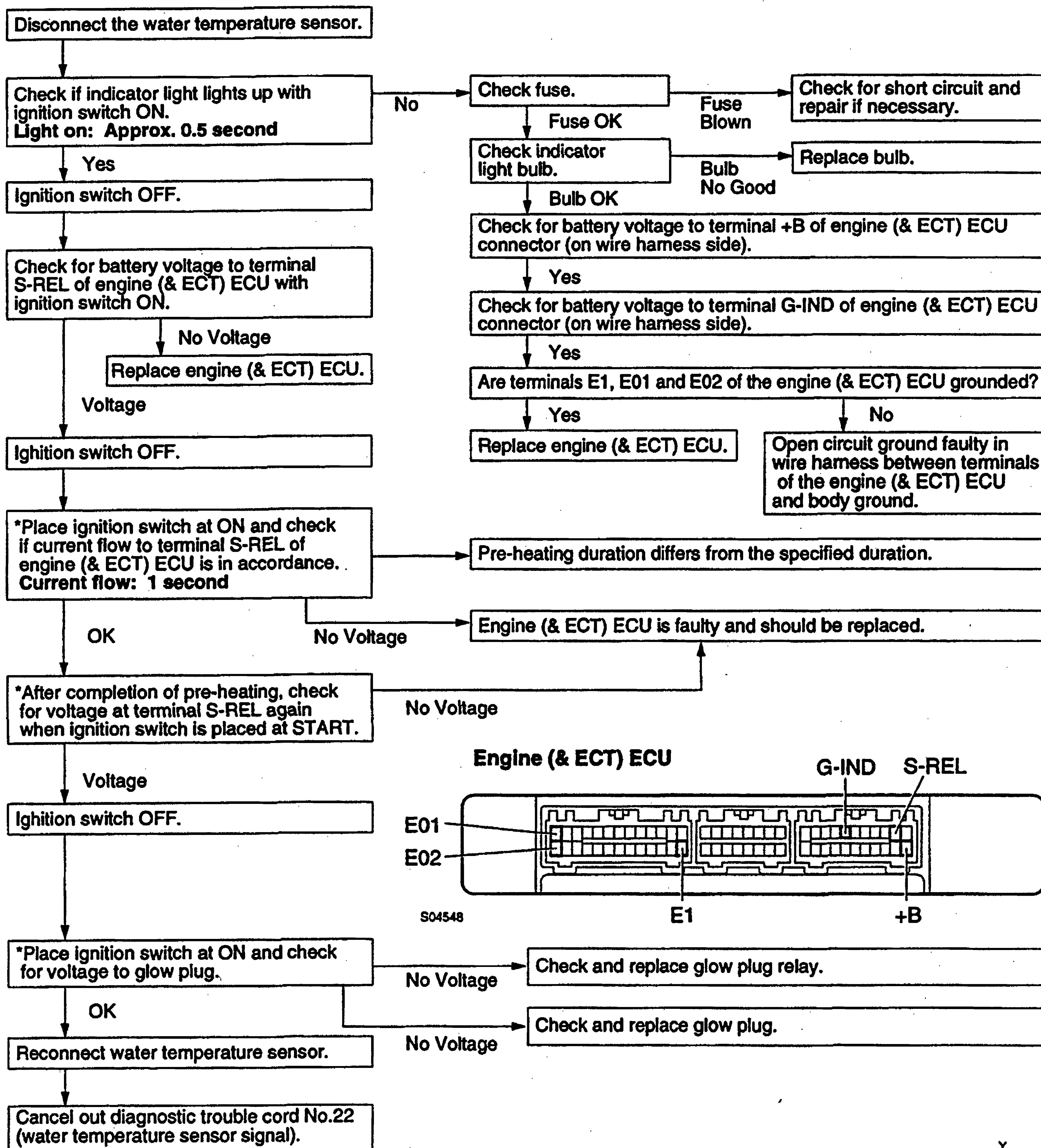
STOGA-01

Diesel Electrical System Diagnosis (Engine does not start cold)

HINT:

- Battery voltage at 12 V — Ignition switch OFF.
- Engine cranks normally. Fusible link okay.
- Check the voltage marked with an asterisk (*) just as the ignition switch is placed at ON because the voltage will change.

PRE-HEATING SYSTEM



PRE-HEATING SYSTEM ON-VEHICLE INSPECTION

ST060-0E

HINT: Refer to Diesel Electrical System Diagnosis for inspection procedures.

1. INSPECT LIGHTING TIME OF GLOW INDICATOR LIGHT

Turn the ignition switch "ON", measure the lighting time.

Light lighting time:

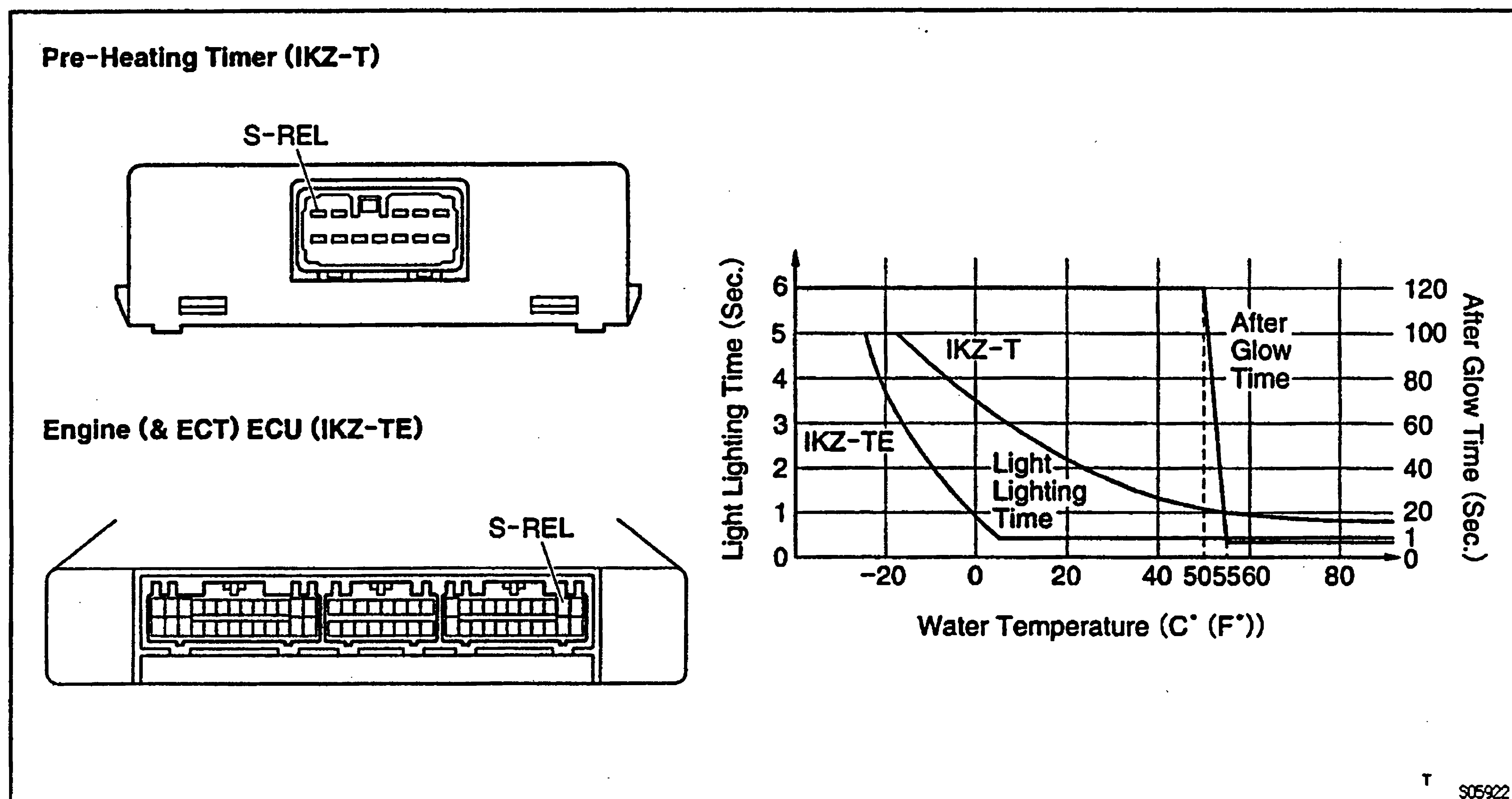
Refer to the chart graph

2. INSPECT AFTER GLOW TIME

Turn the ignition switch "ON", measure the time battery voltage is applied to terminal S-REL of the pre-heating timer.

After glow time:

Refer to the chart graph



ST060-0E

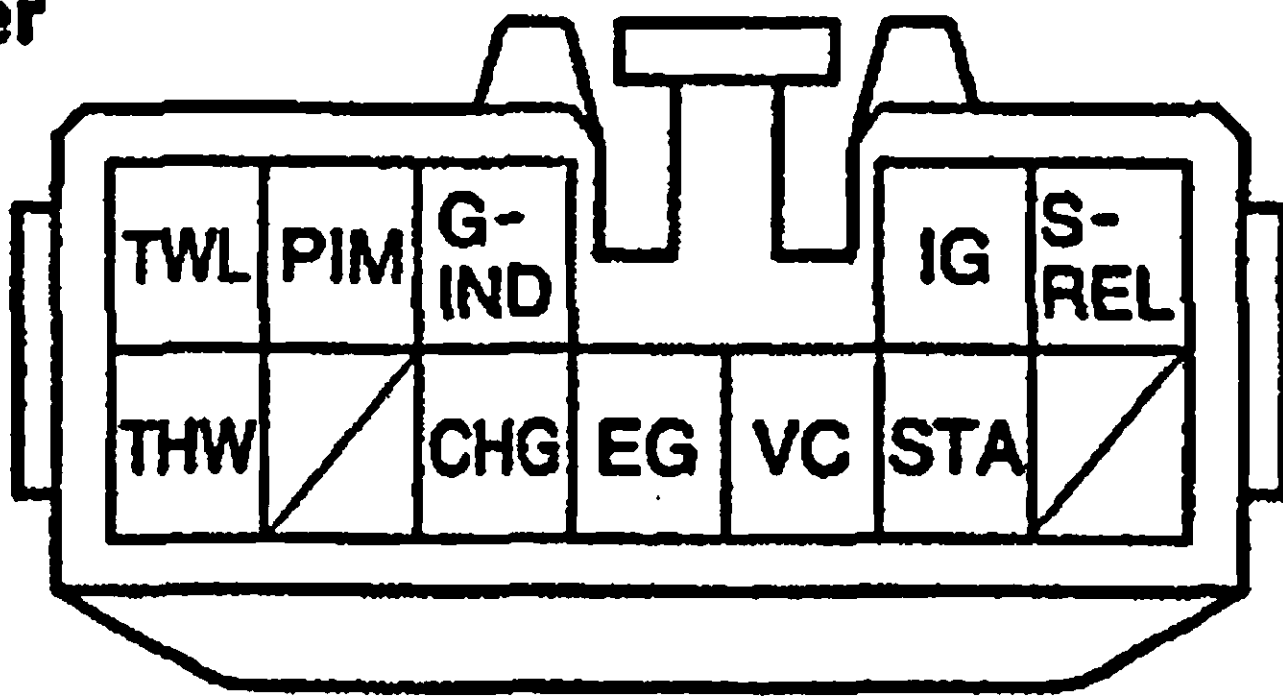
PRE-HEATING TIMER INSPECTION

INSPECT PRE-HEATING TIMER CIRCUIT

Disconnect the connector(s) from the pre-heating timer, and check the connector on the wire harness side as shown in the following chart:

Check for	Tester connection	Condition	Specified value
Voltage	G-IND-Ground	Ignition switch OFF	No voltage
		Ignition switch ON	Battery voltage
Voltage	IG -Ground	Ignition switch OFF	No voltage
		Ignition switch ON	Battery voltage
Voltage	STA-Ground	Ignition switch OFF	No voltage
		Ignition switch START	Battery voltage
Continuity	S-REL-Ground	—	Continuity
Continuity	THW-EG	—	Continuity

Wire Harness Side of Pre-Heating Timer



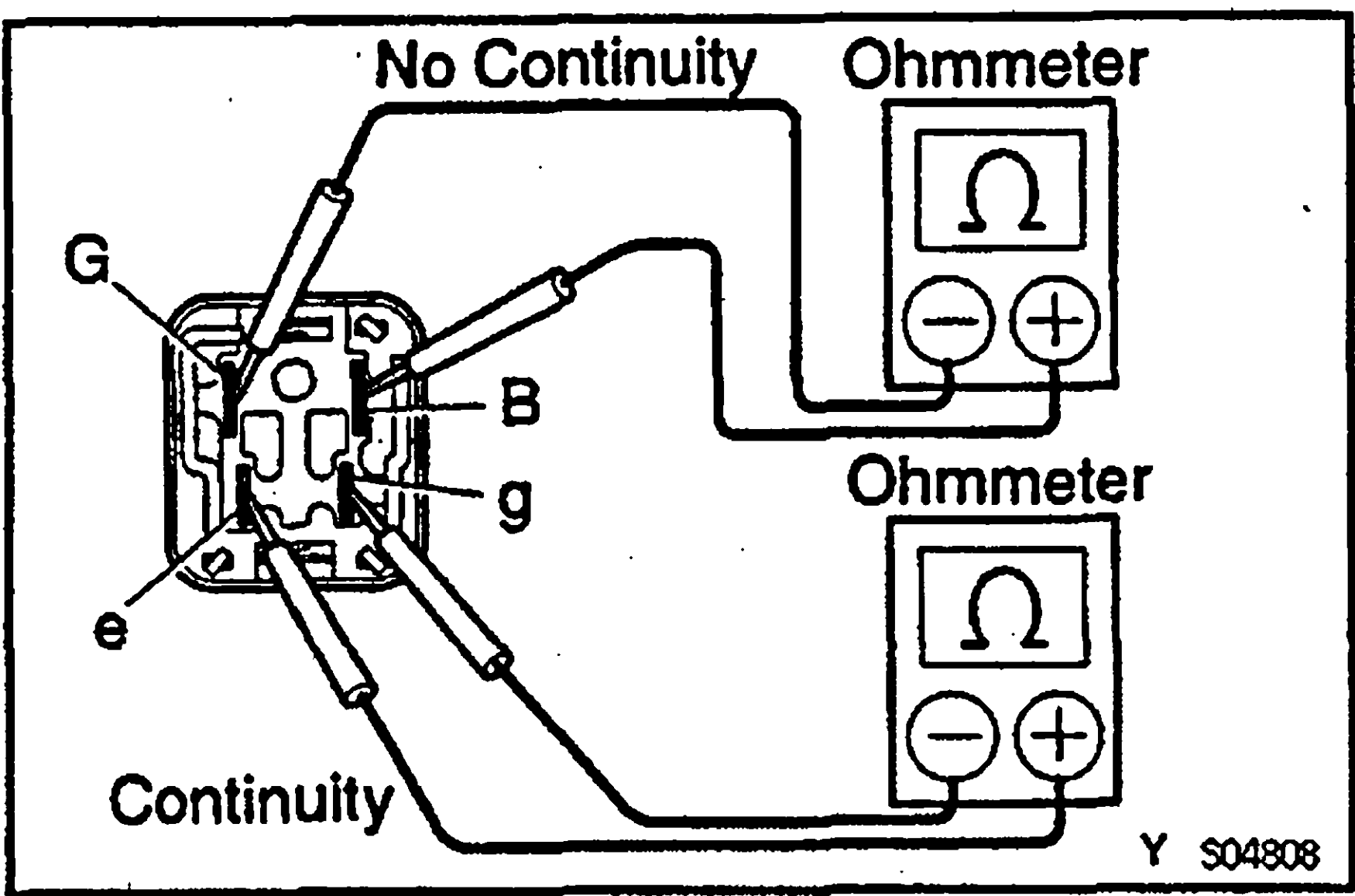
e-12-1

T V08295

ST028-01

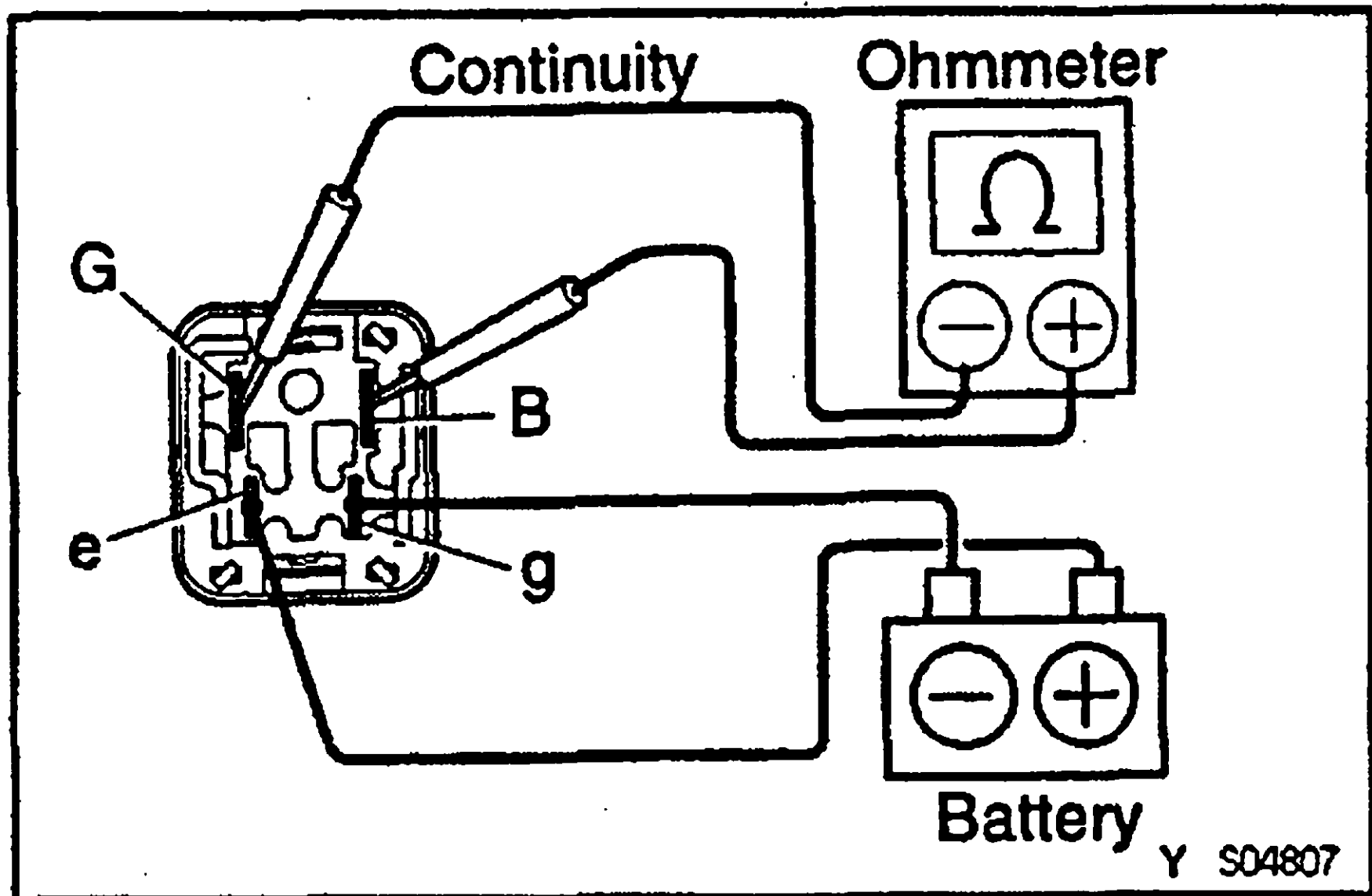
GLOW PLUG RELAY (Marking: "SUB GLW") INSPECTION

1. REMOVE GLOW PLUG RELAY
2. INSPECT GLOW PLUG RELAY



3. INSPECT RELAY CONTINUITY

- (a) Using an ohmmeter, check that there is continuity between terminals e and g.
If there is no continuity, replace the relay.
- (b) Check that there is no continuity between terminals B and G.
If there is continuity, replace the relay.



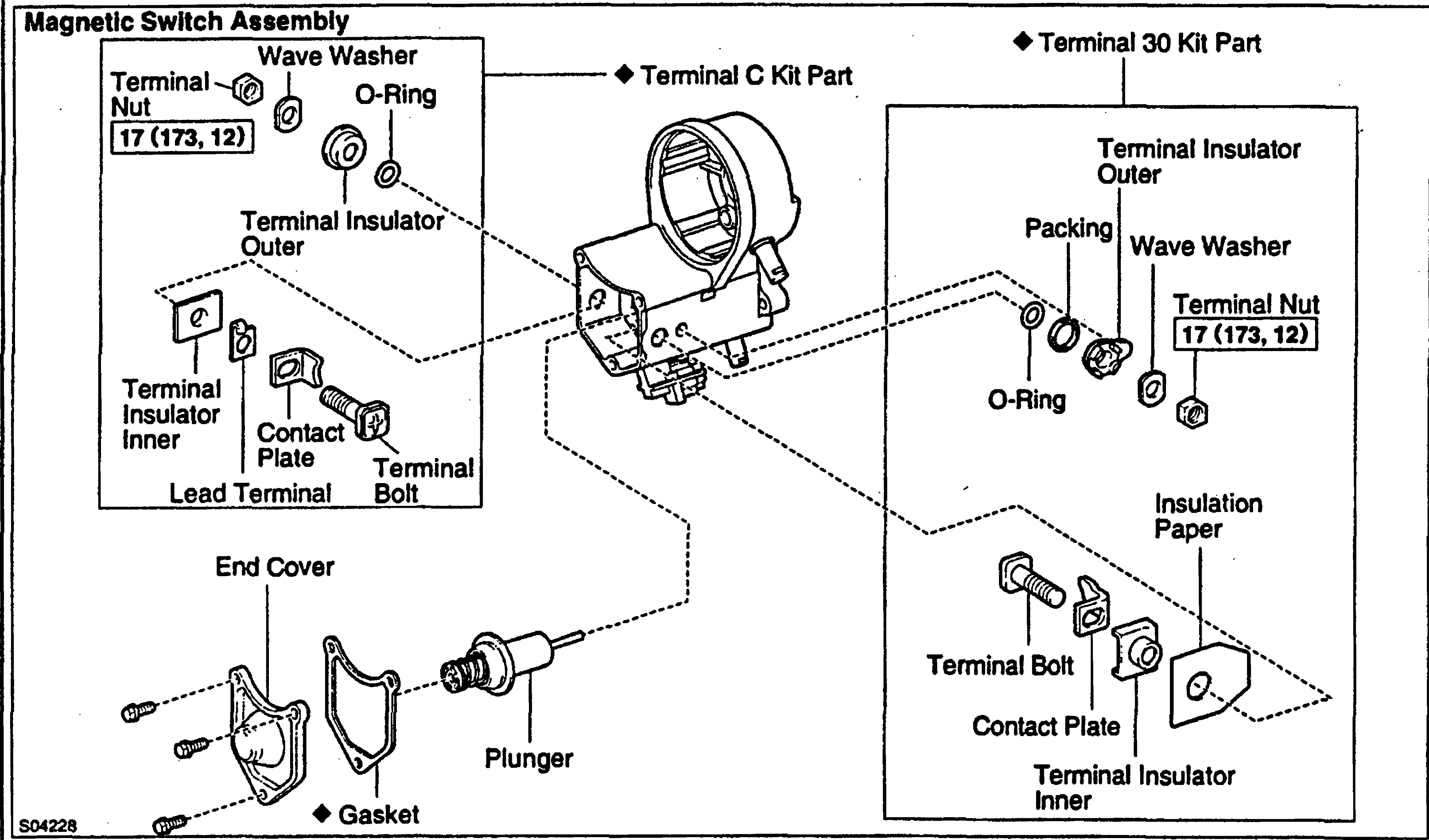
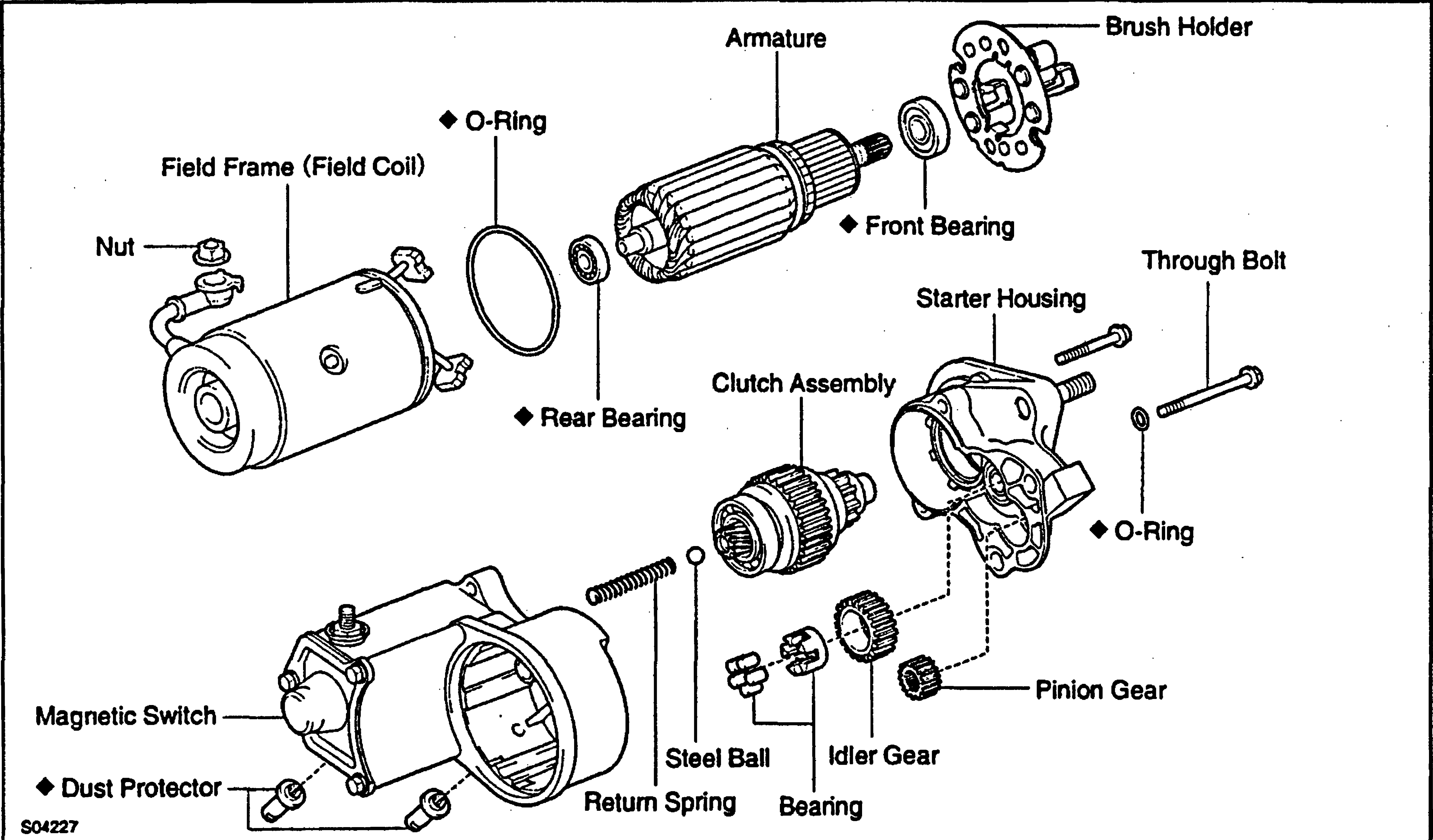
4. INSPECT RELAY OPERATION

- (a) Apply battery voltage across terminals e and g.
- (b) Using an ohmmeter, check that there is continuity between terminals B and G.
If there is no continuity, replace the relay.

5. REINSTALL GLOW PLUG RELAY

**STARTER
(2.2 kW)
COMPONENTS FOR DISASSEMBLY AND
ASSEMBLY**

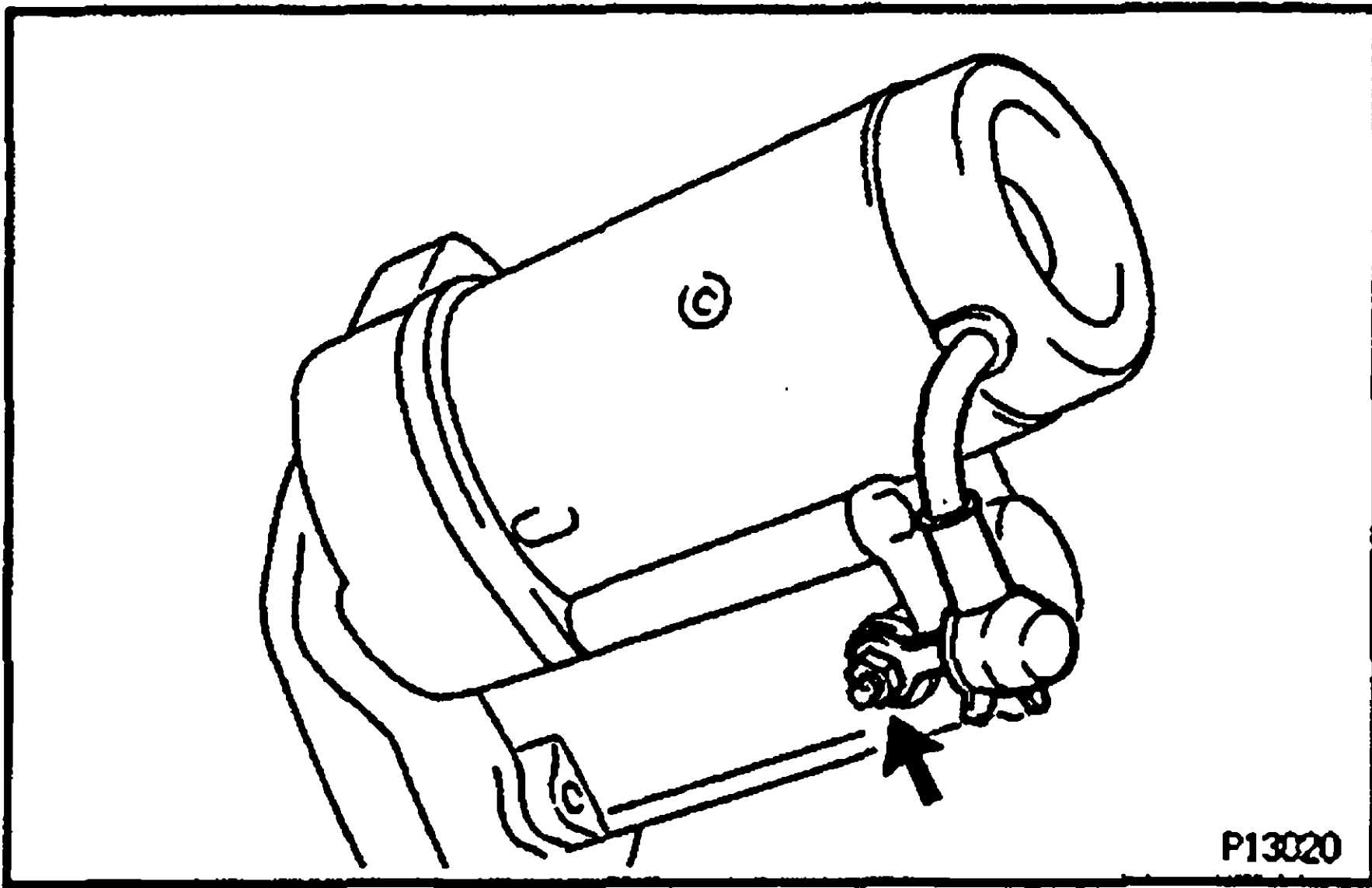
ST00W-21



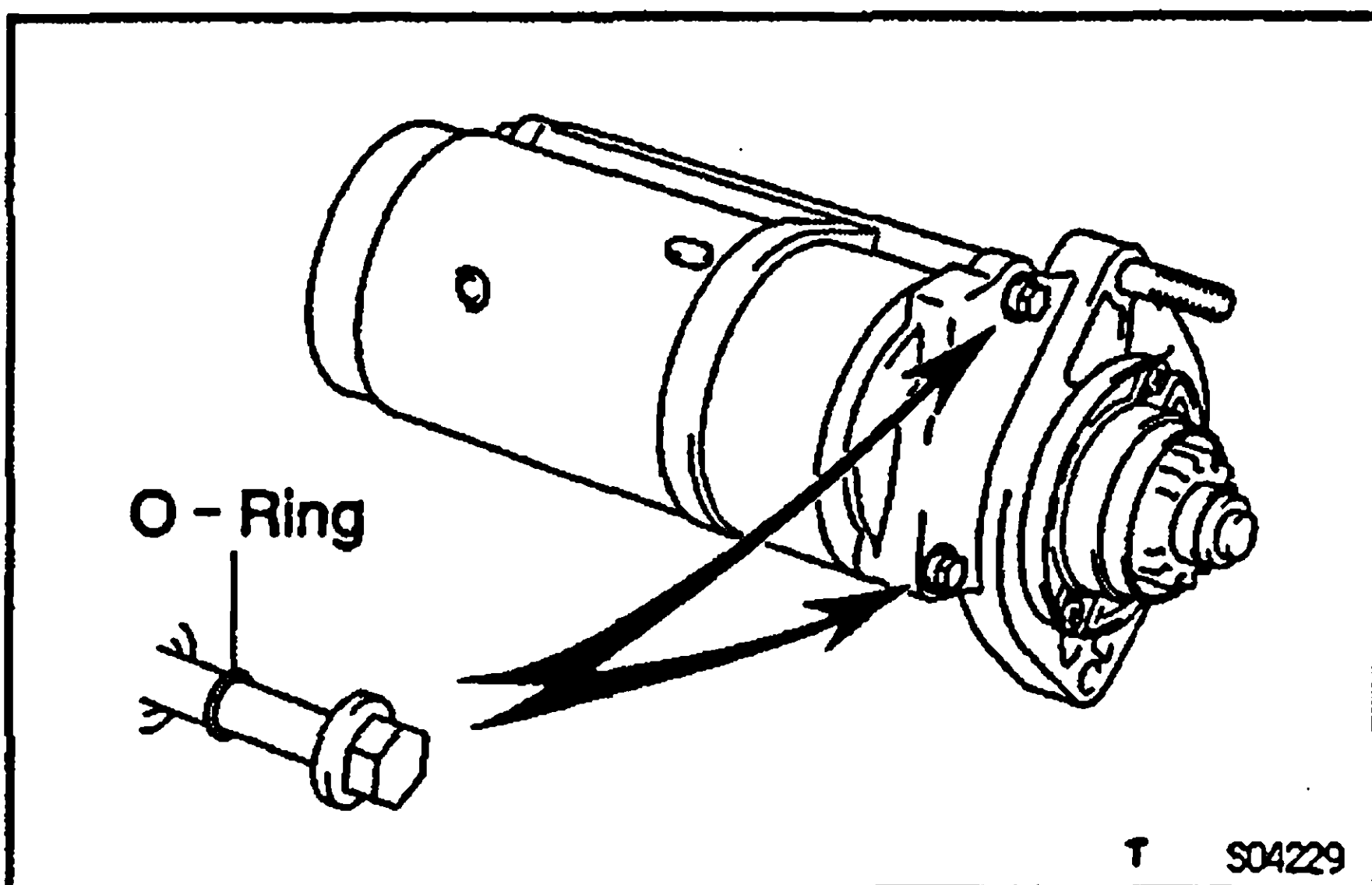
N·m (kgf·cm, ft·lbf): Specified torque
◆ Non-reusable part

STARTER DISASSEMBLY**1. REMOVE FIELD FRAME AND ARMATURE**

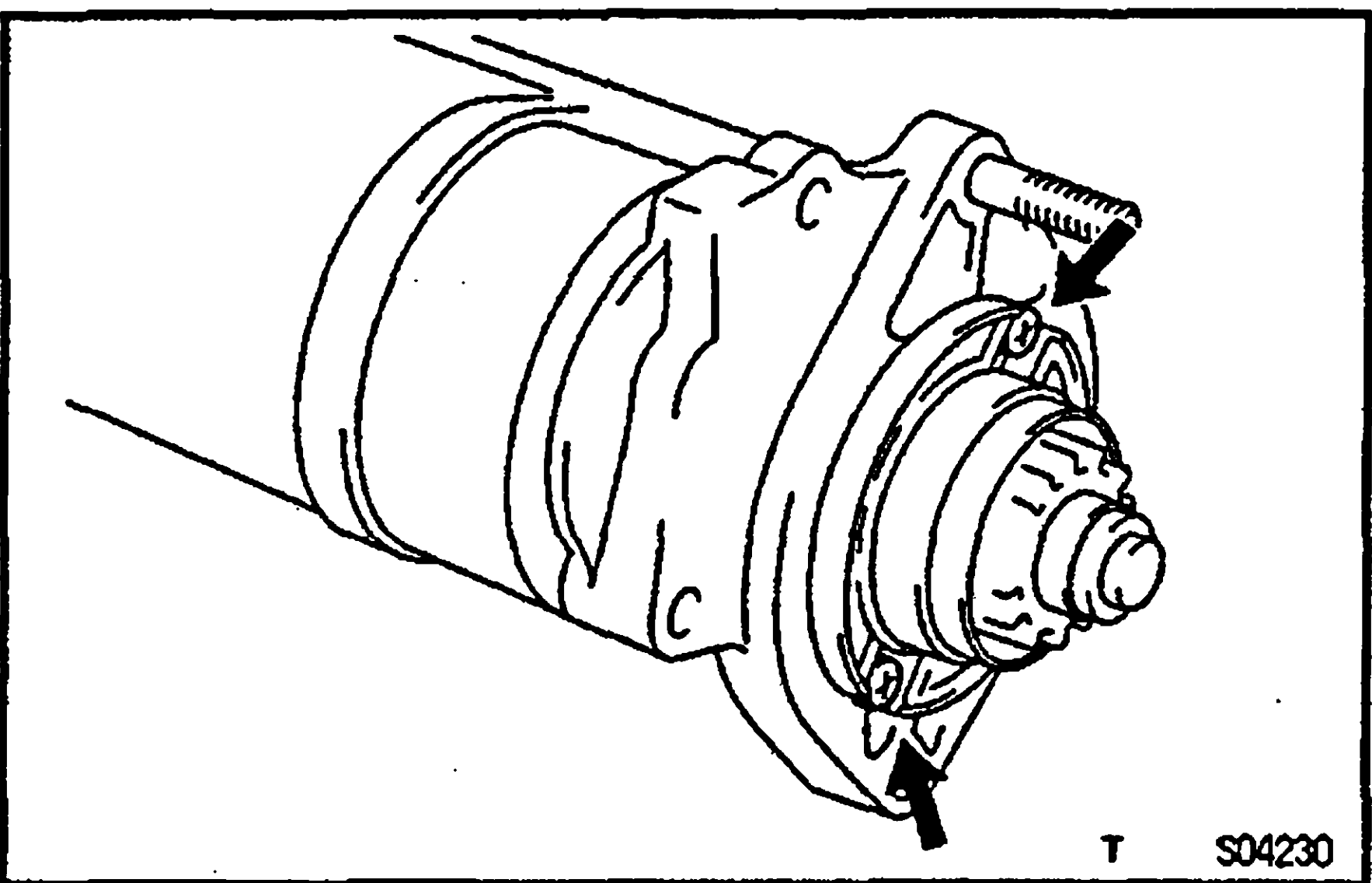
- (a) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.



- (b) Remove the 2 through bolts and O-rings.
 (c) Pull out the field frame with the armature from the magnetic switch assembly.
 (d) Remove the O-ring from the field frame.

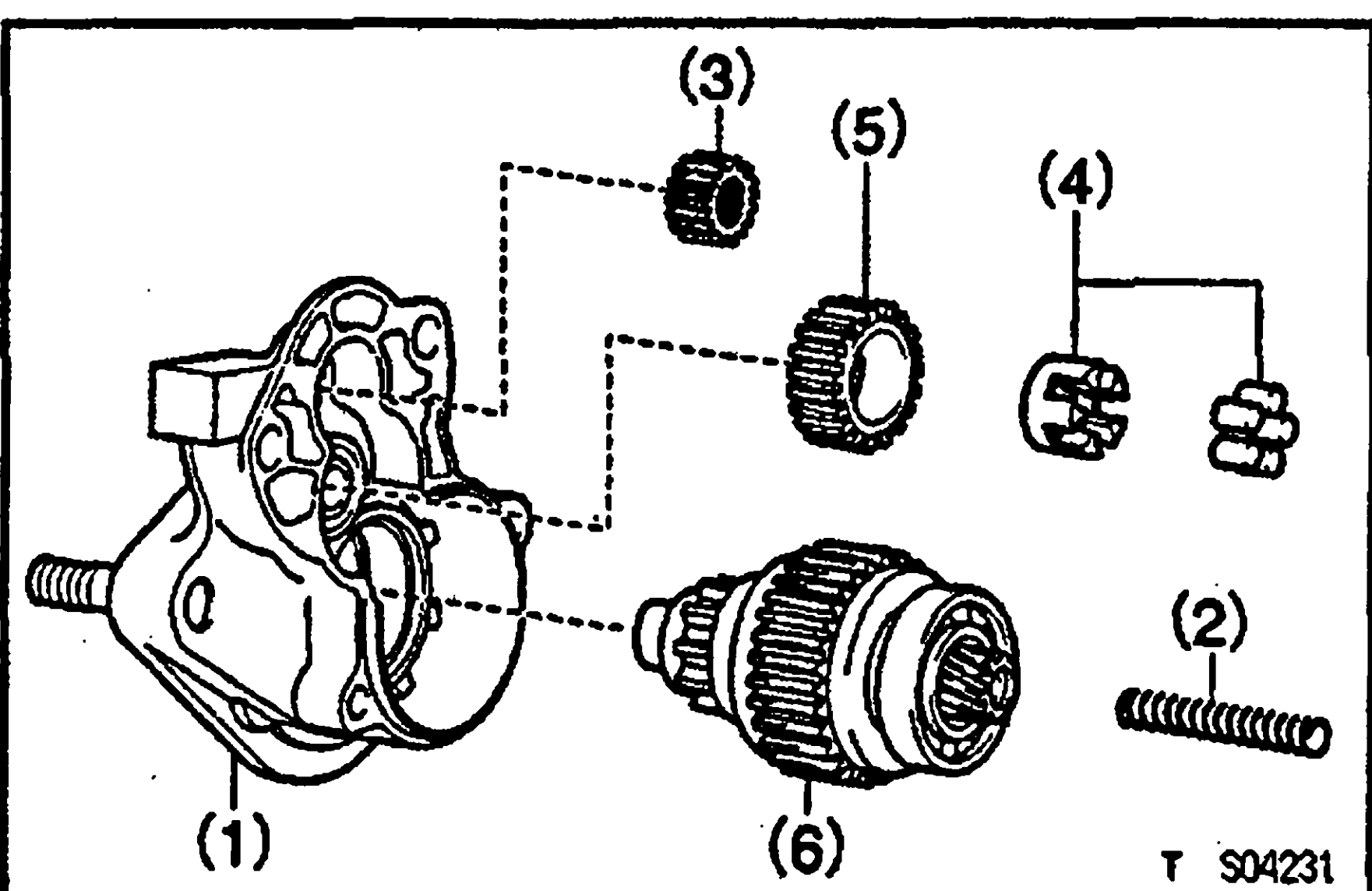
**2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS**

- (a) Remove the 2 screws.

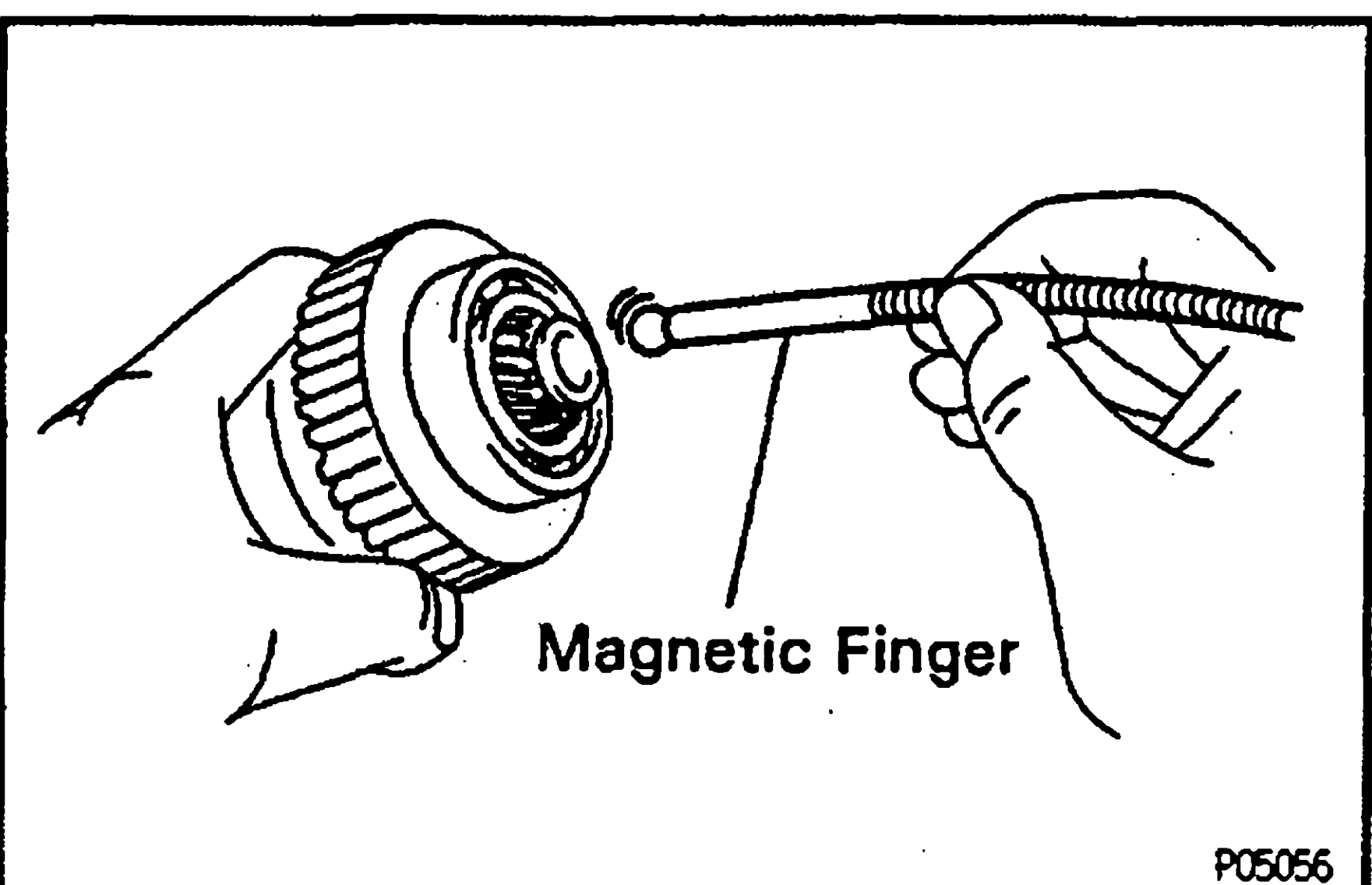


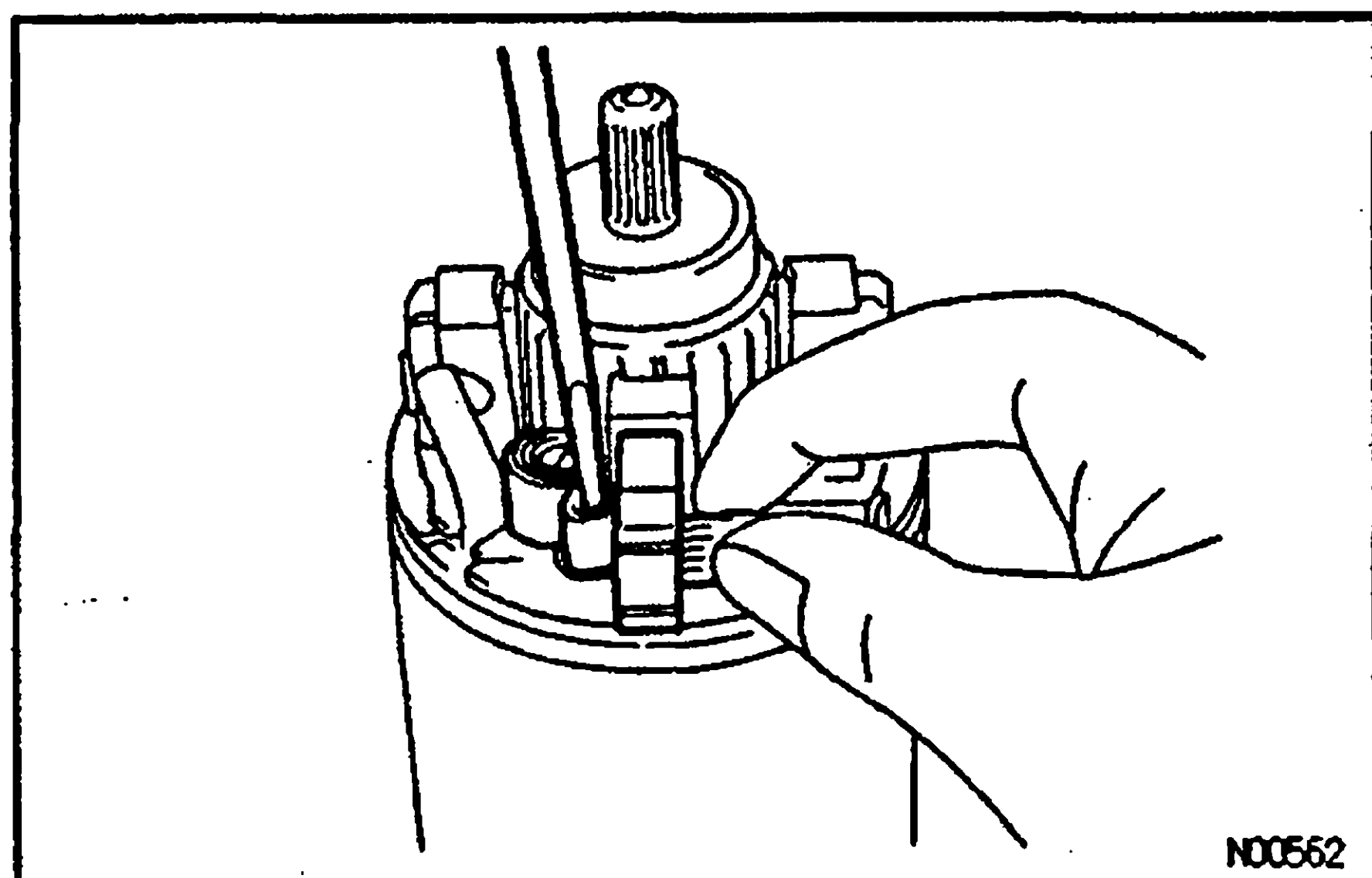
- (b) Remove these parts from the magnetic switch assembly:

- (1) Starter housing
 (2) Return spring
 (3) Pinion gear
 (4) Bearing
 (5) Idler gear
 (6) Clutch assembly

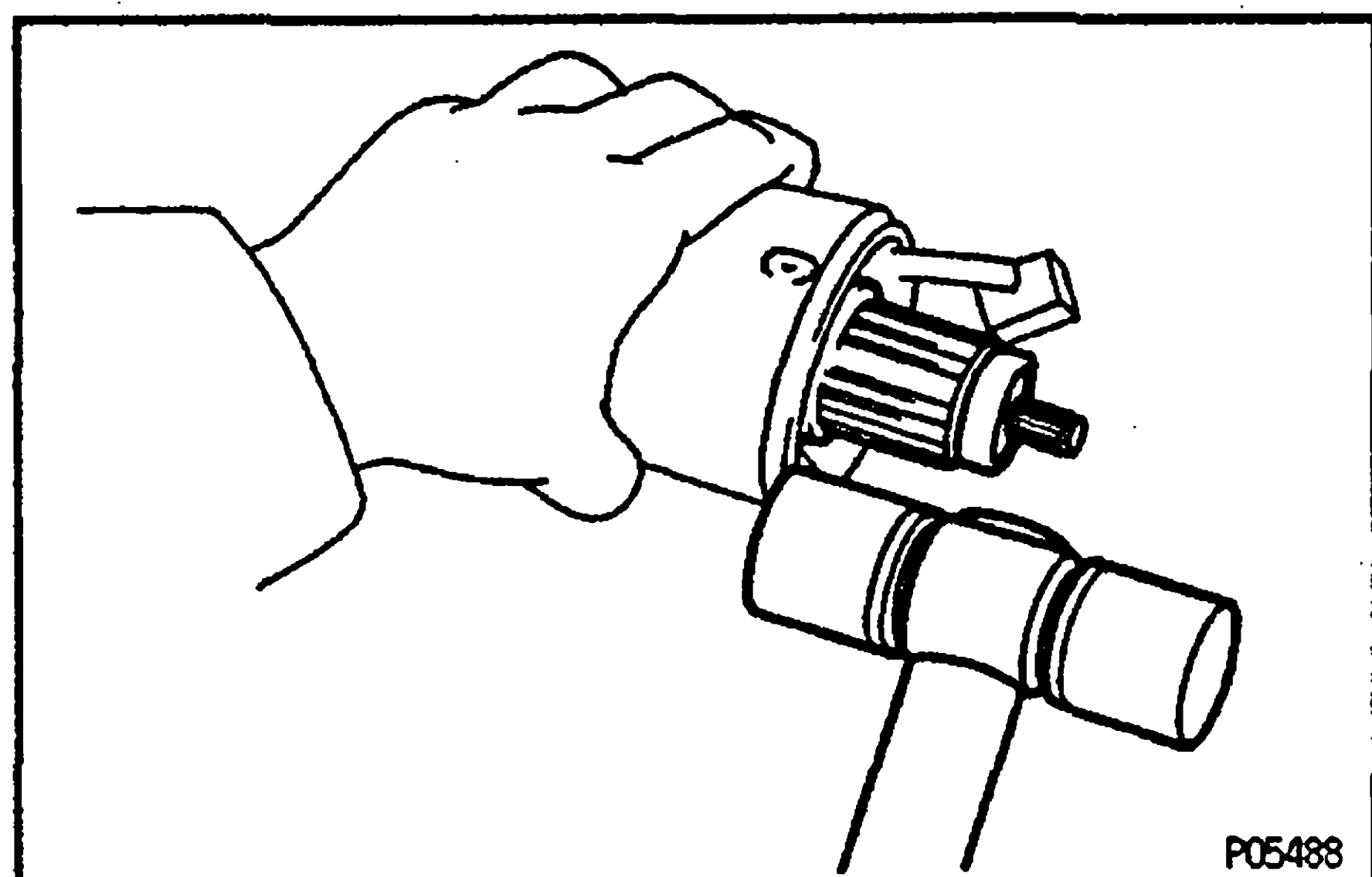
**3. REMOVE STEEL BALL**

Using a magnetic finger, remove the steel ball from the clutch shaft hole.

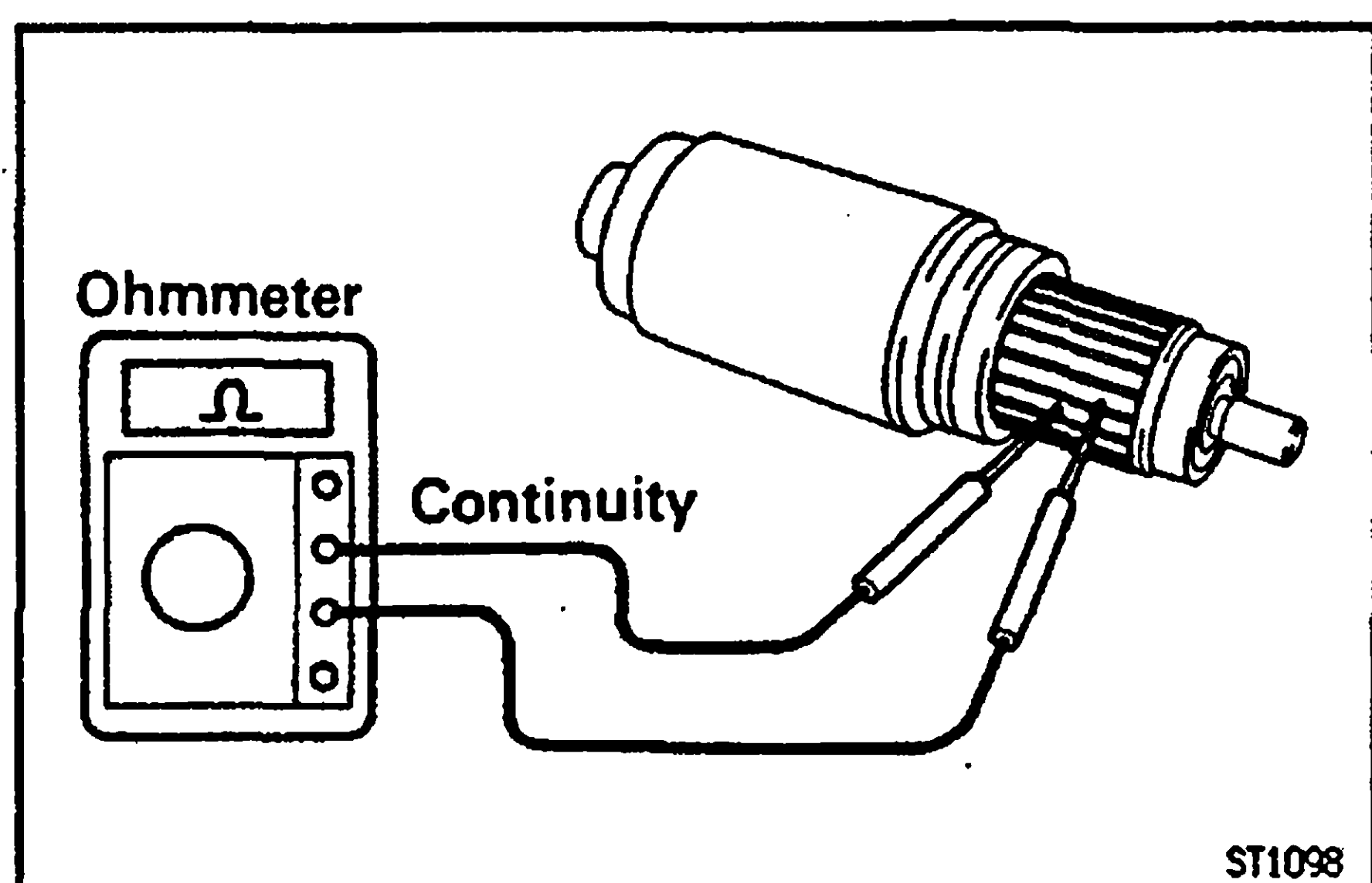


**4. REMOVE BRUSH HOLDER**

Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the 4 brushes and remove the brush holder.

**5. REMOVE ARMATURE FROM FIELD FRAME**

Using a plastic hammer, tap the frame end to remove the armature from the field frame.

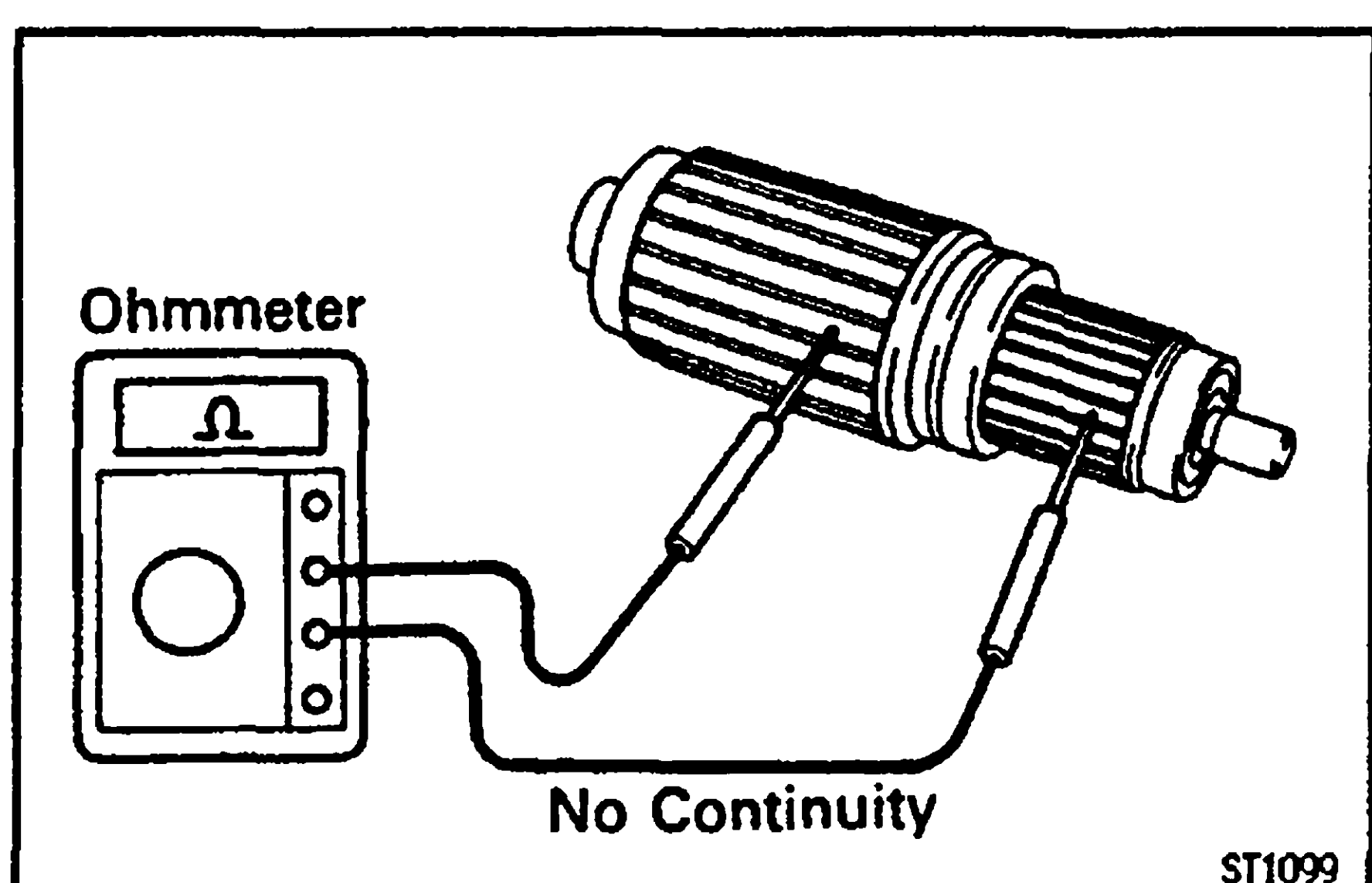


STARTER INSPECTION AND REPAIR

Armature Coil

1. INSPECT COMMUTATOR FOR OPEN CIRCUIT

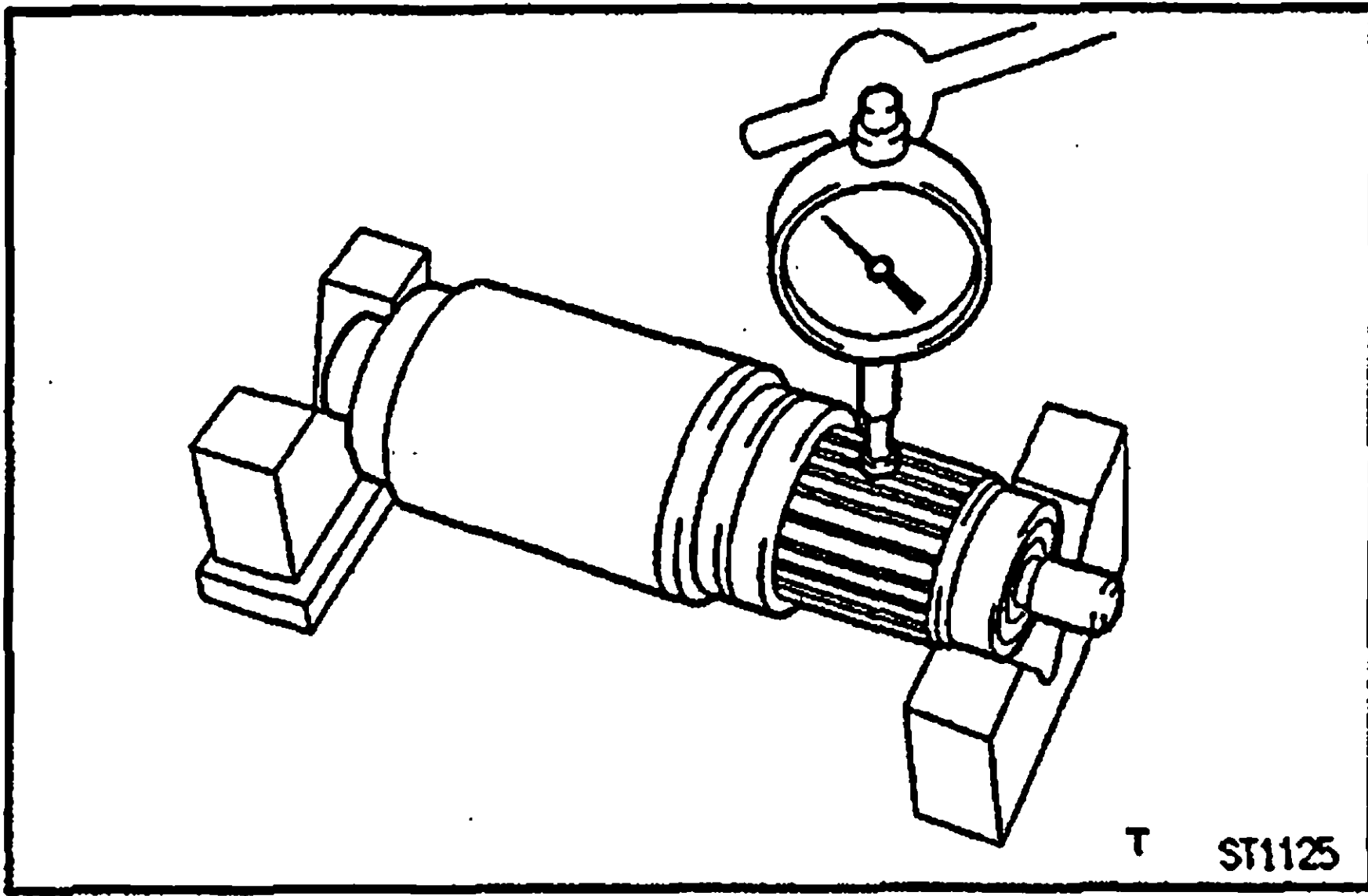
Using an ohmmeter, check that there is continuity between the segments of the commutator. If there is no continuity between any segment, replace the armature.

**2. INSPECT COMMUTATOR FOR GROUND**

Using an ohmmeter, check that there is no continuity between the commutator and armature coil core. If there is continuity, replace the armature.

Commutator**1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES**

If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.



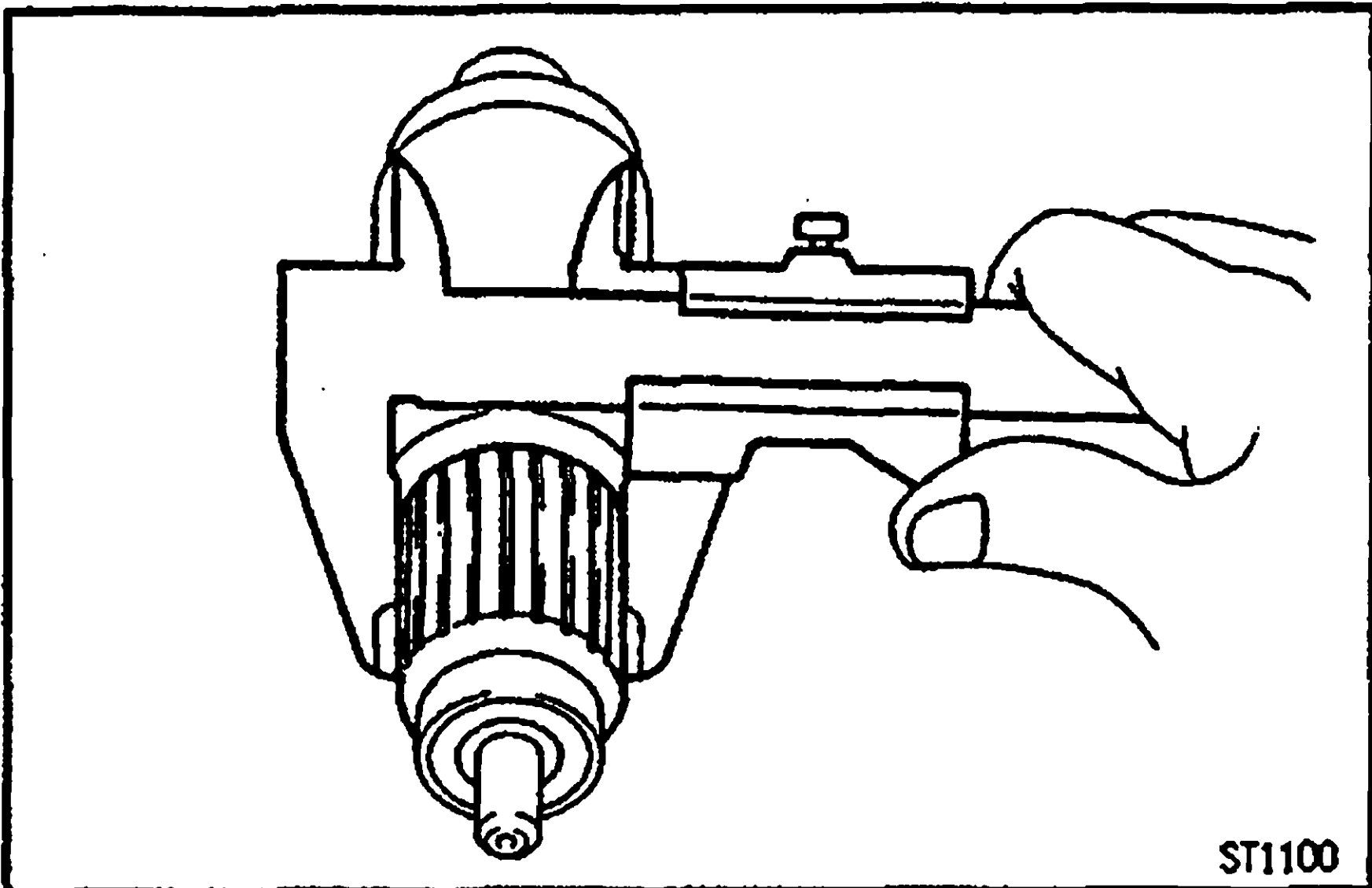
2. INSPECT COMMUTATOR CIRCLE RUNOUT

- (a) Place the commutator on V—blocks.
- (b) Using a dial gauge, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

If the circle runout is greater than maximum, correct it on a lathe.



3. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, measure the commutator diameter.

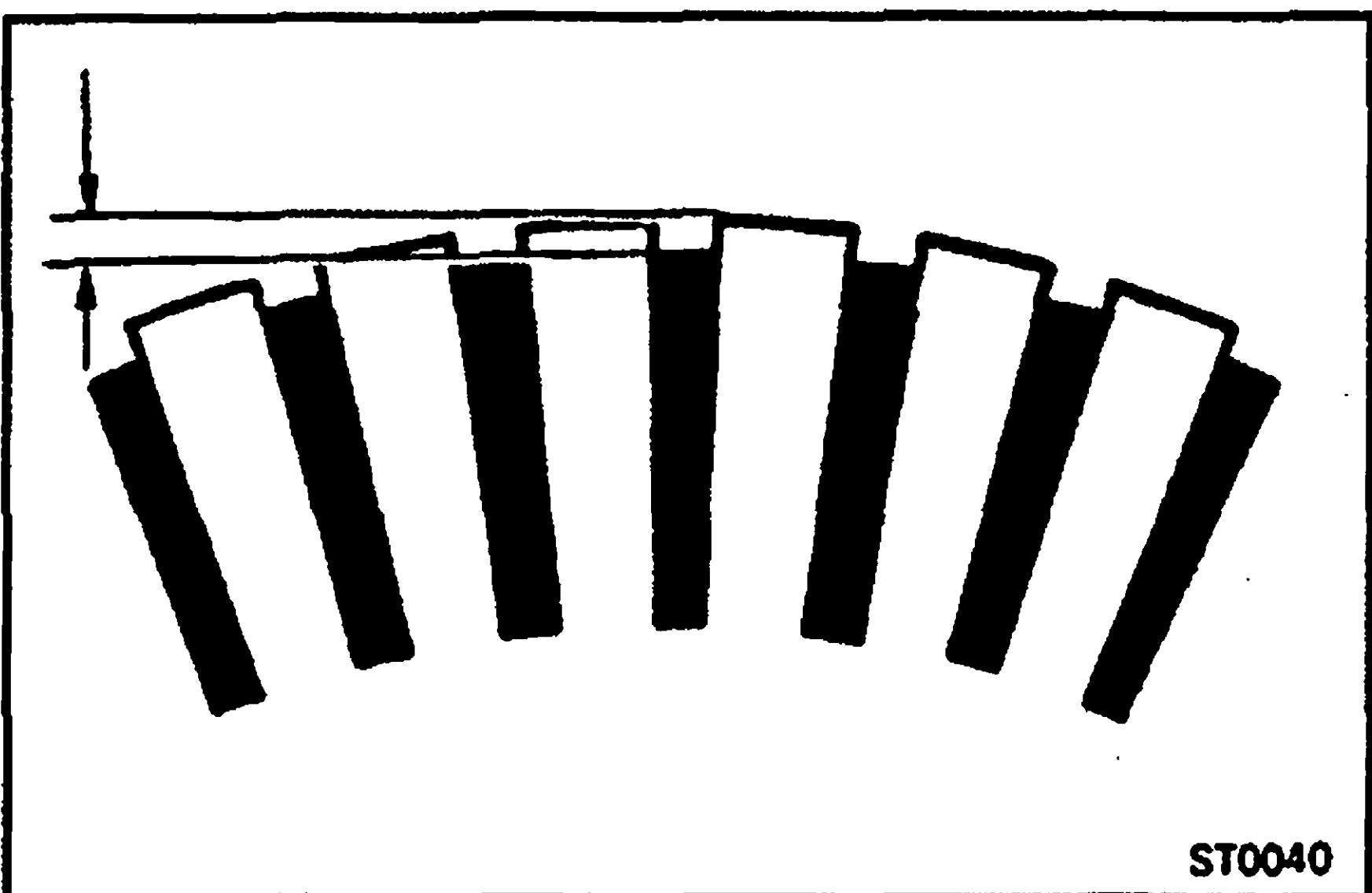
Standard diameter:

35 mm (1.38 in.)

Minimum diameter:

34 mm (1.34 in.)

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



4. INSPECT UNDERCUT DEPTH

Check that the undercut depth is clean and free of foreign materials. Smooth out the edge.

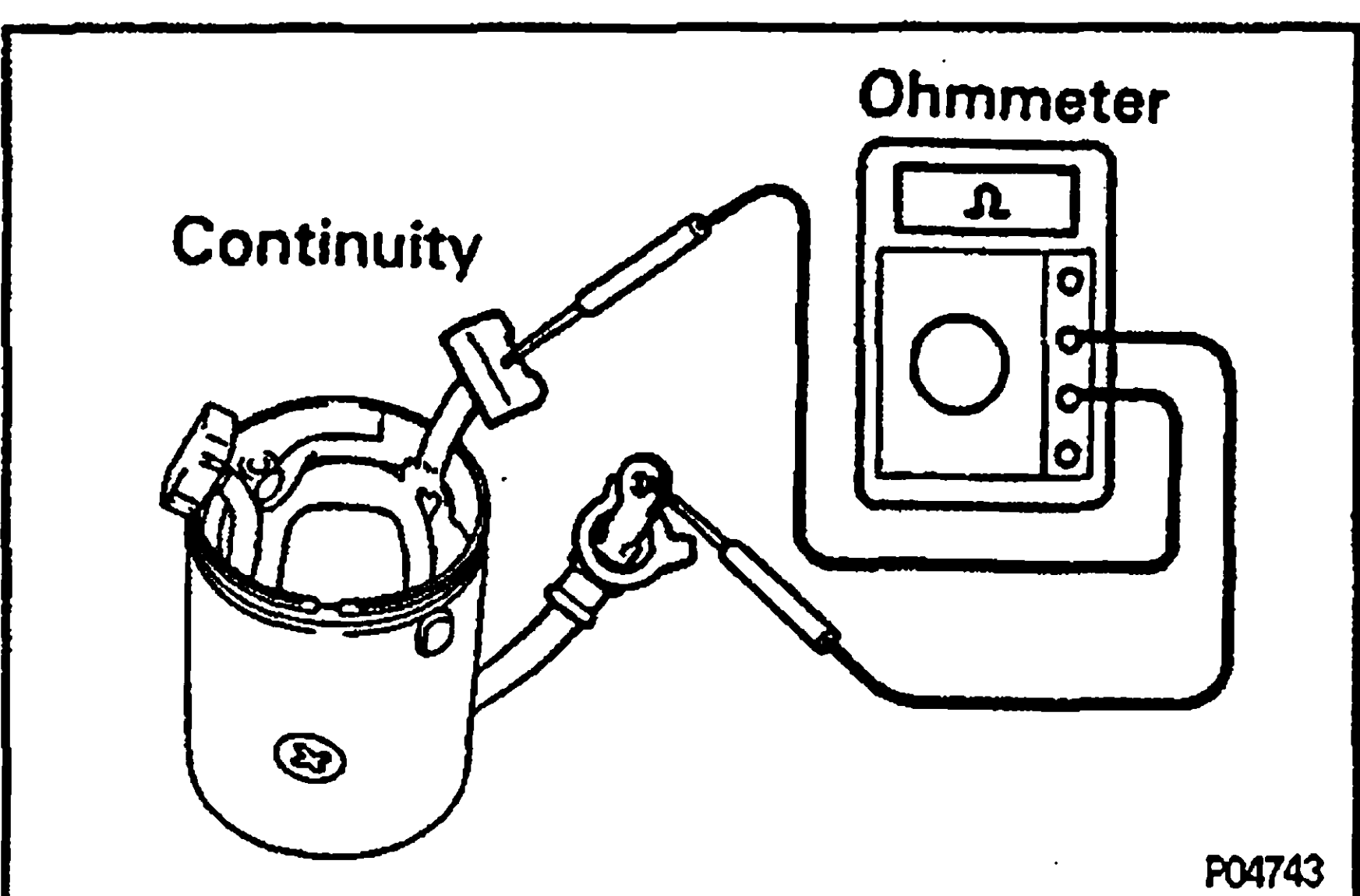
Standard undercut depth:

0.7 mm (0.027 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

If the undercut depth is less than minimum, correct it with a hacksaw blade.

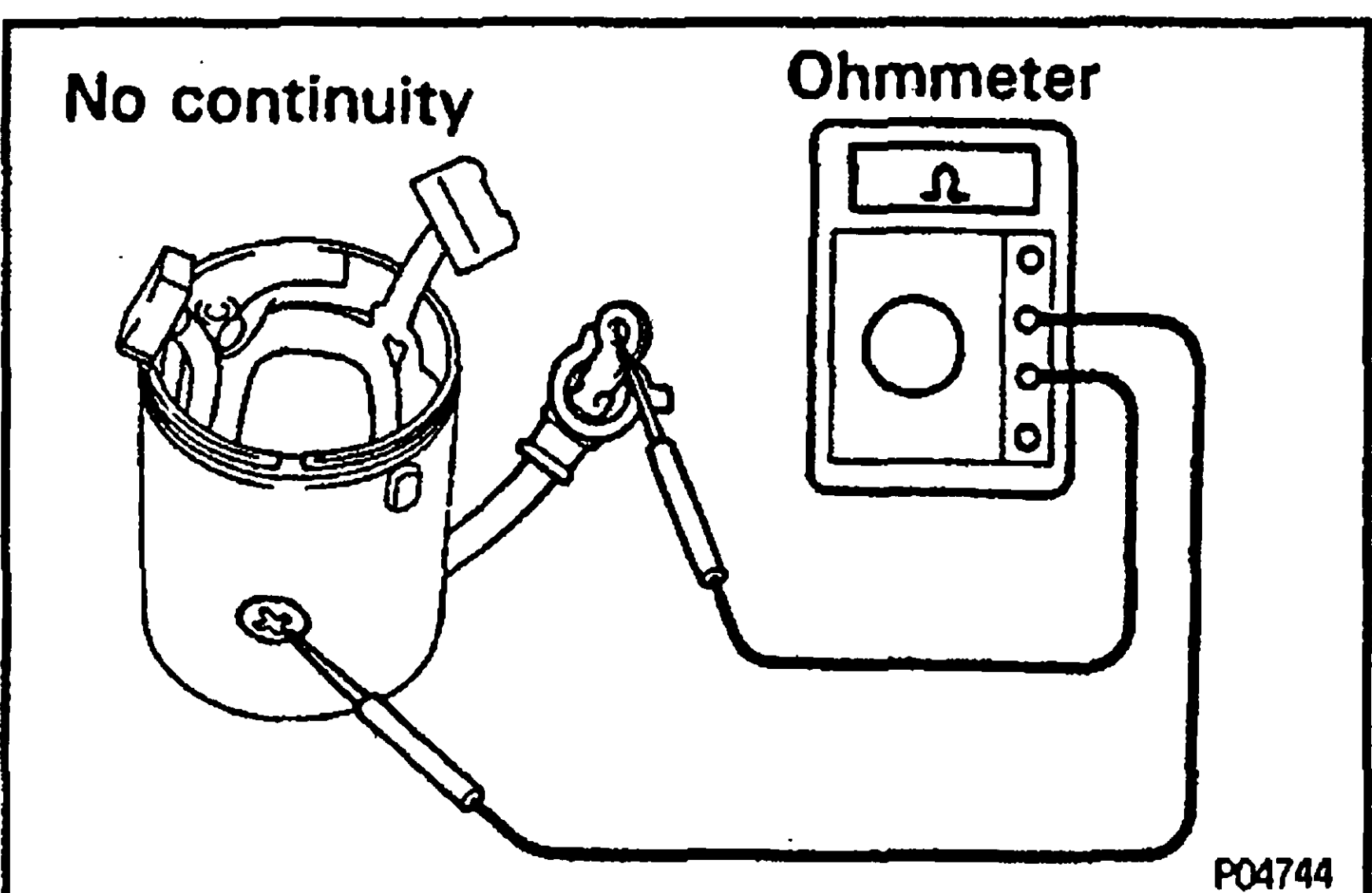


Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

If there is no continuity, replace the field frame.

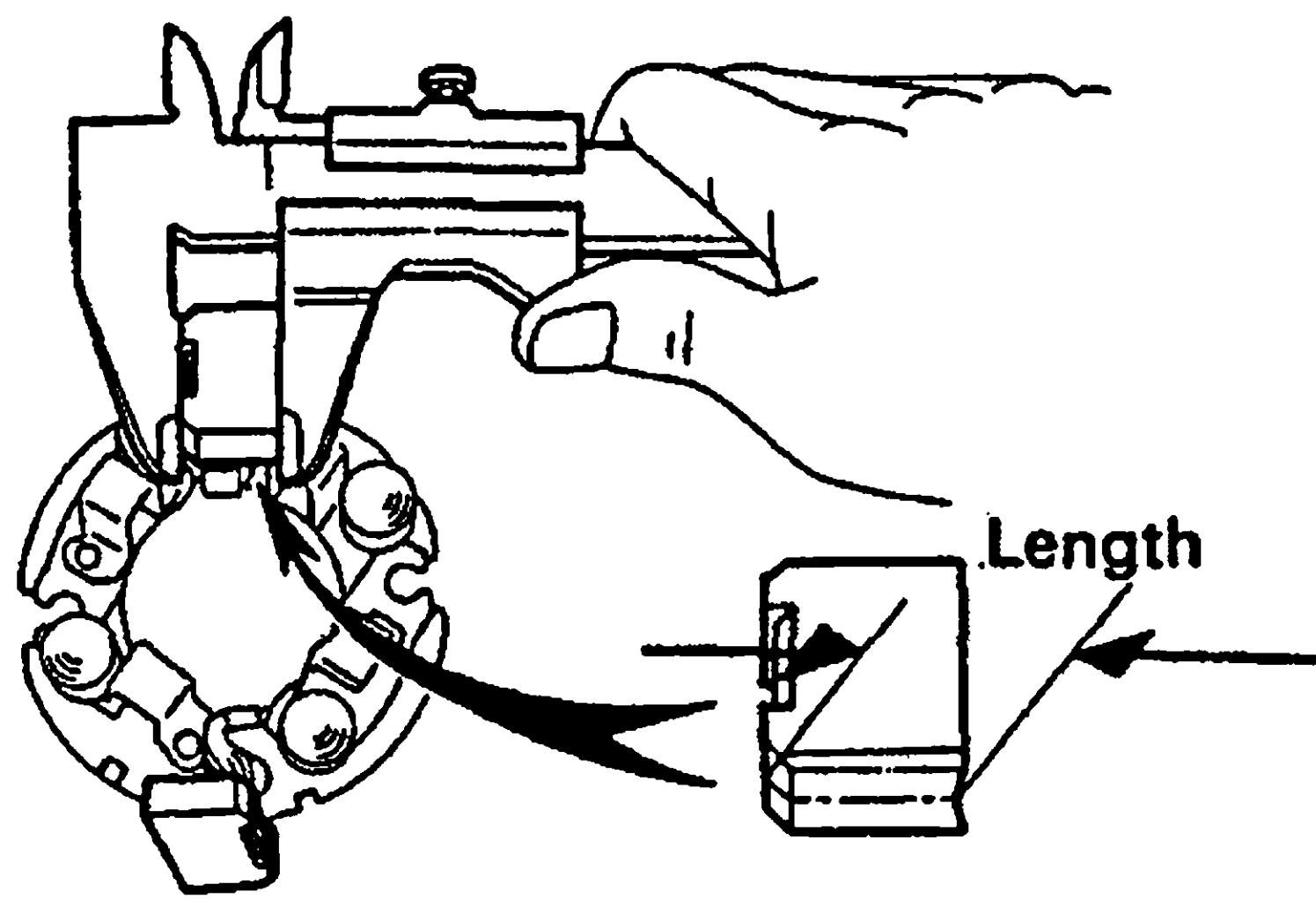


2. INSPECT FIELD COIL FOR GROUND

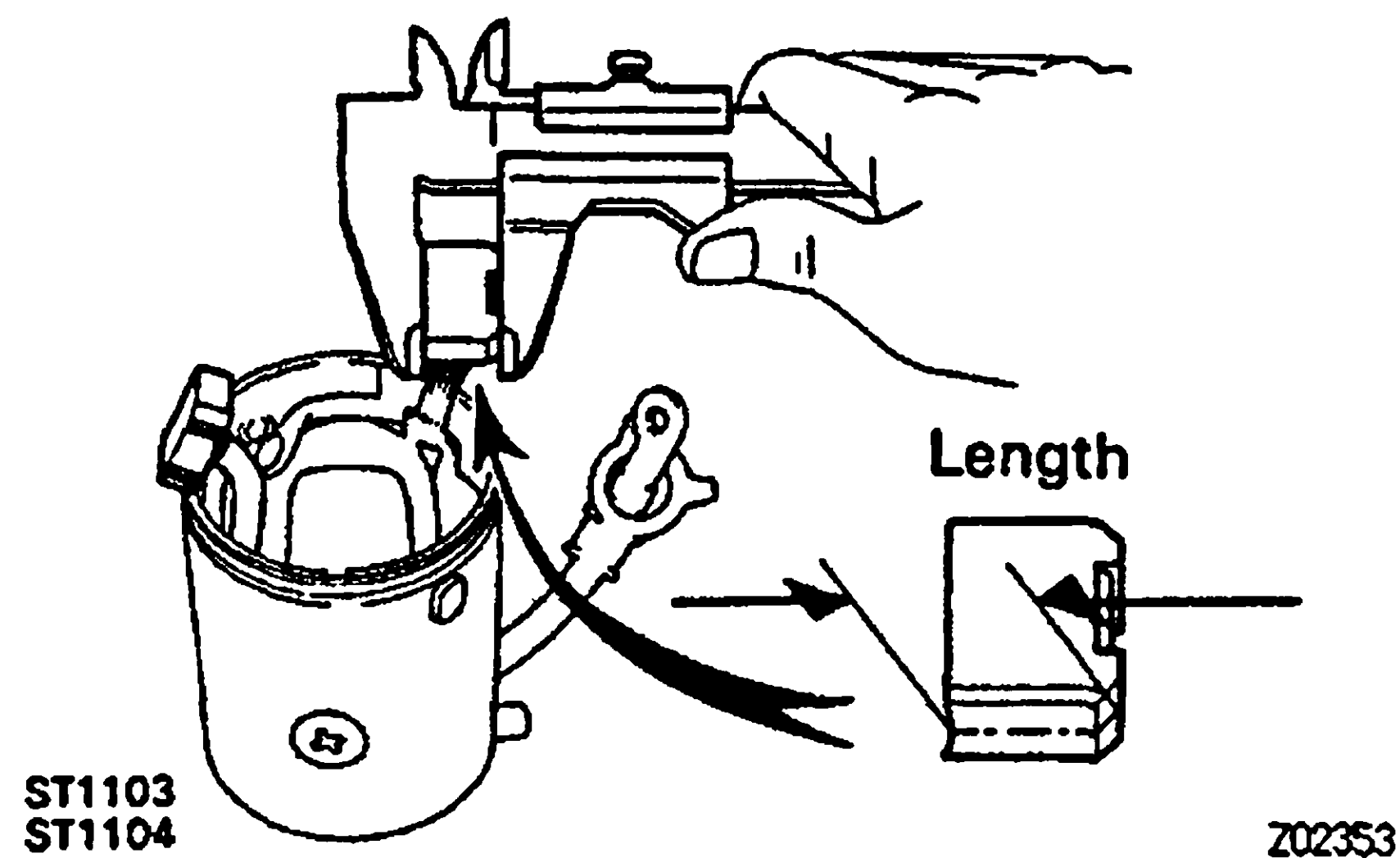
Using an ohmmeter, check that there is no continuity between the field coil end and field frame.

If there is continuity, repair or replace the field frame.

Brush Holder Side



Field Frame Side

ST1103
ST1104

Z02353

Brushes

INSPECT BRUSH LENGTH

Using a vernier caliper, measure the brush length.

Standard length:

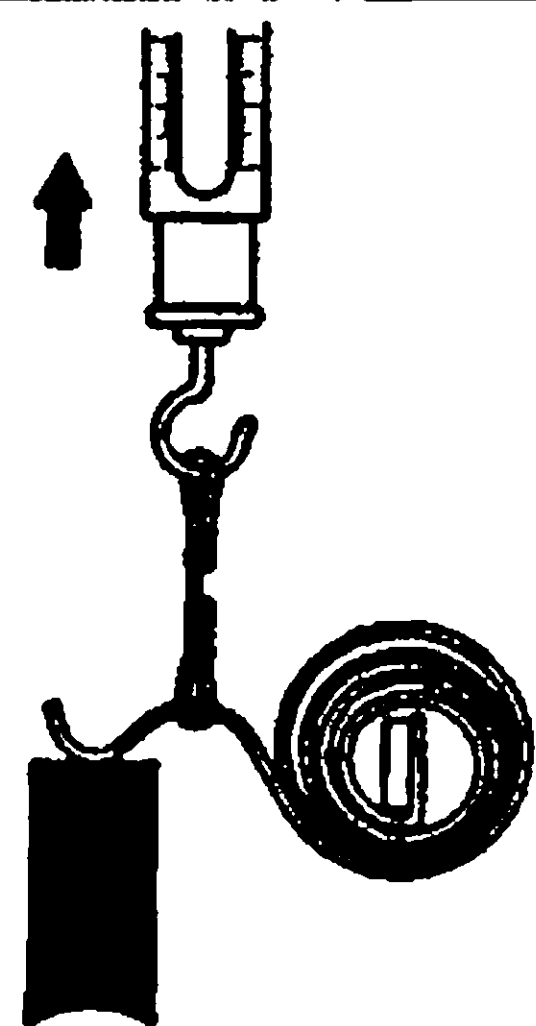
16.5 mm (0.650 in.)

Minimum length:

9.0 mm (0.354 in.)

If the length is less than minimum, replace the brush holder and field frame.

ST



ST0019

Brush Springs

INSPECT BRUSH SPRING LOAD

Take the pull scale reading the instant the brush spring separates from the brush.

Standard spring installed load:

26.5 – 32.3 N (2.7 – 3.3 kgf, 5.9 – 7.3 lbf)

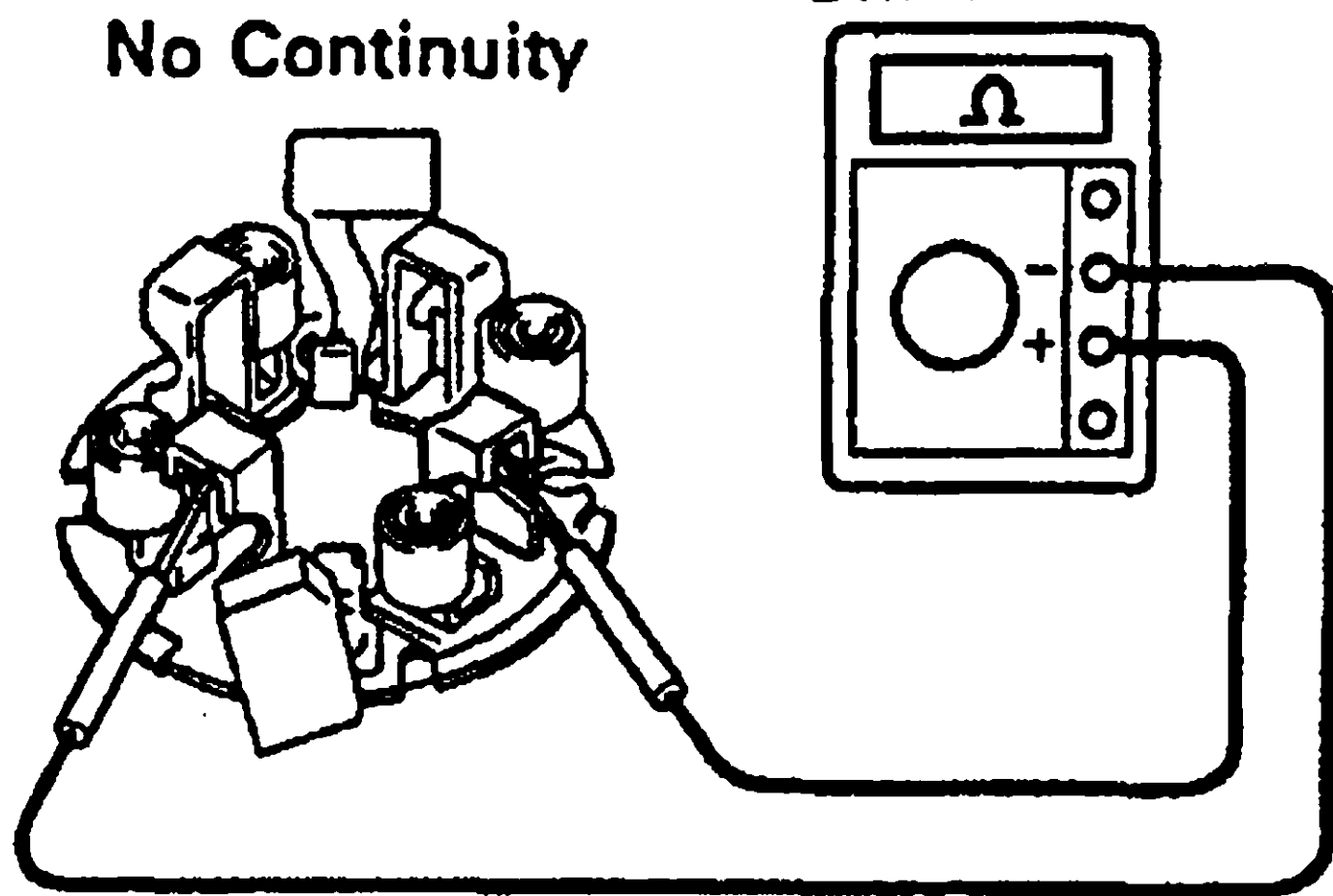
Minimum spring installed load:

17.6 N (1.8 kgf, 4.0 lbf)

If the installed load is less than minimum replace the brush springs.

No Continuity

Ohmmeter



ST1105

Brush Holder

INSPECT BRUSH HOLDER INSULATION

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (-) brush holders.

If there is continuity, repair or replace the brush holder.

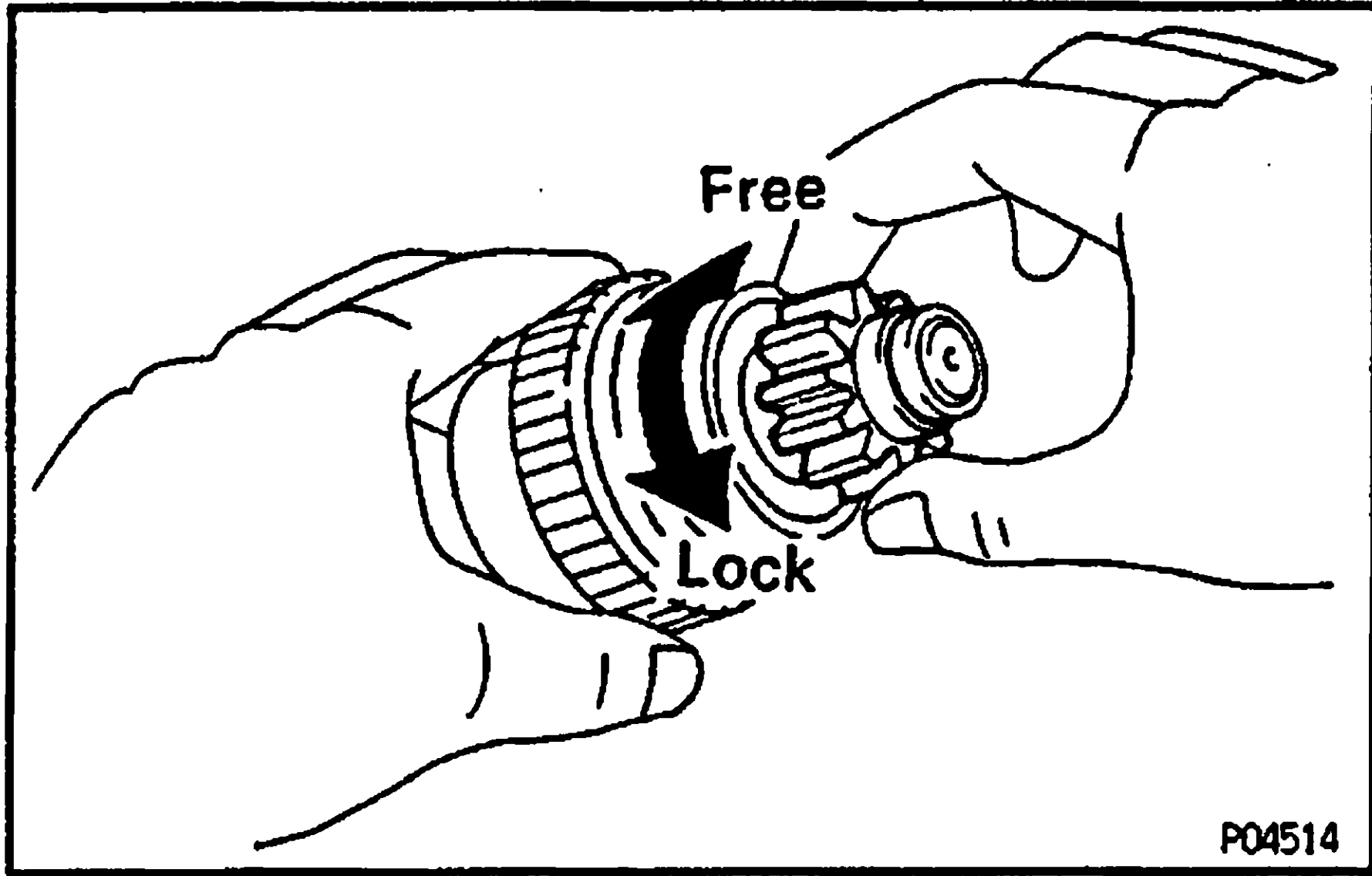
Clutch and Gears

1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idle gear and clutch assembly for wear or damage.

If damaged, replace the gear or clutch assembly.

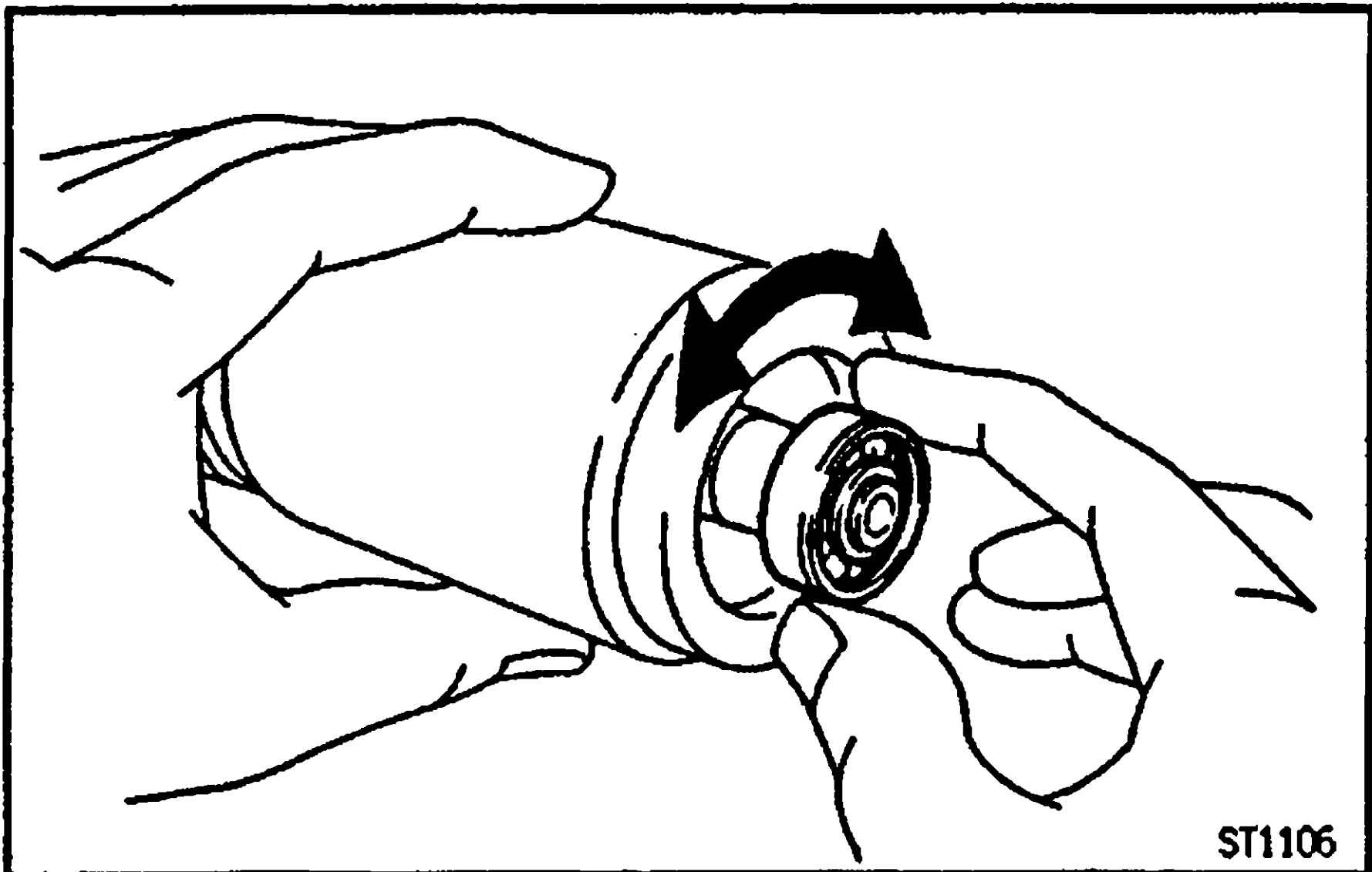
If damaged, also check the drive plate ring gear for wear or damage.



2. INSPECT CLUTCH PINION GEAR

Hold the starter clutch and rotate the pinion gear clockwise, and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

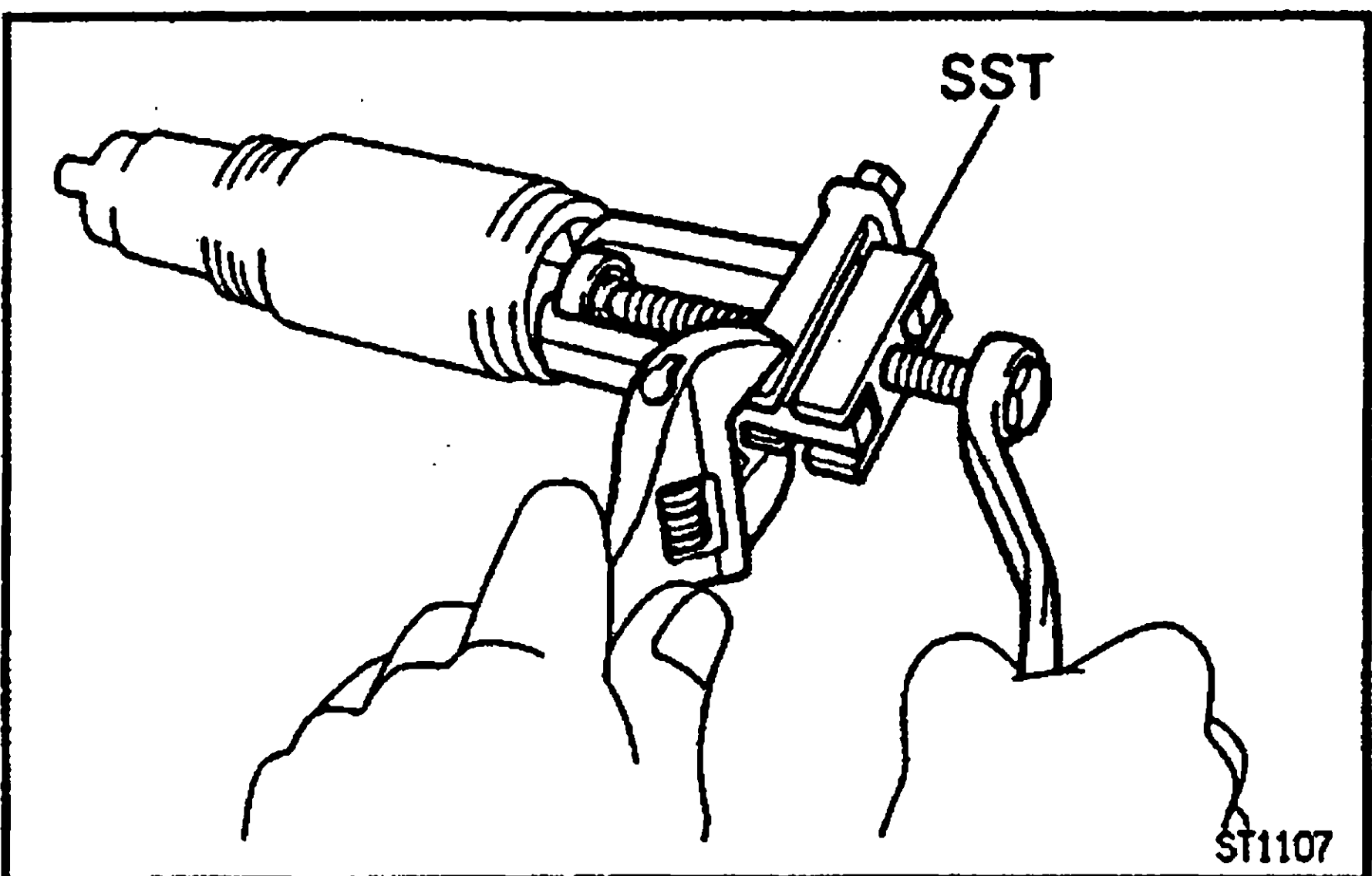
If necessary, replace the clutch assembly.



Bearings

1. INSPECT REAR BEARING

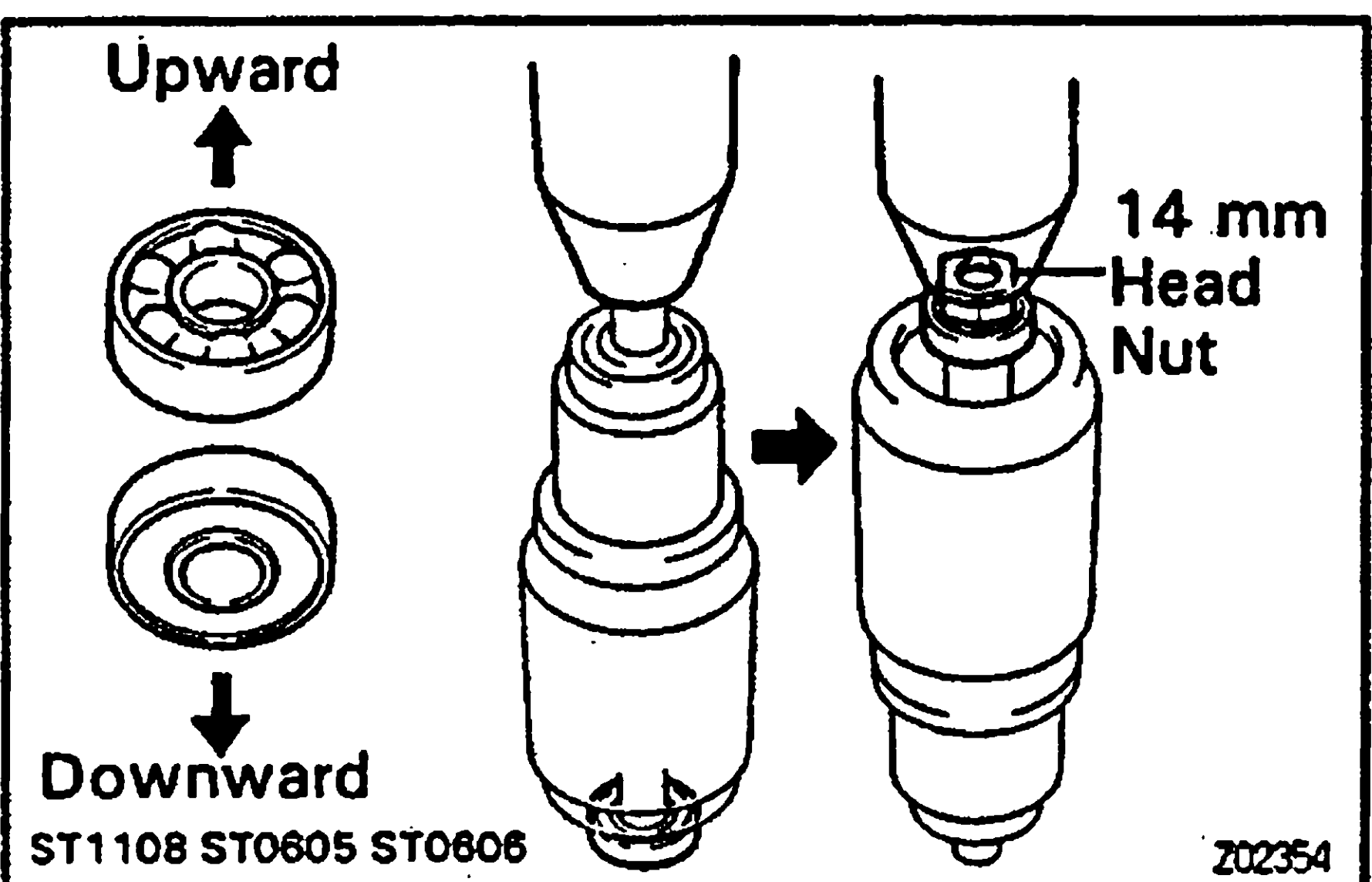
Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.



2. IF NECESSARY, REPLACE REAR BEARING

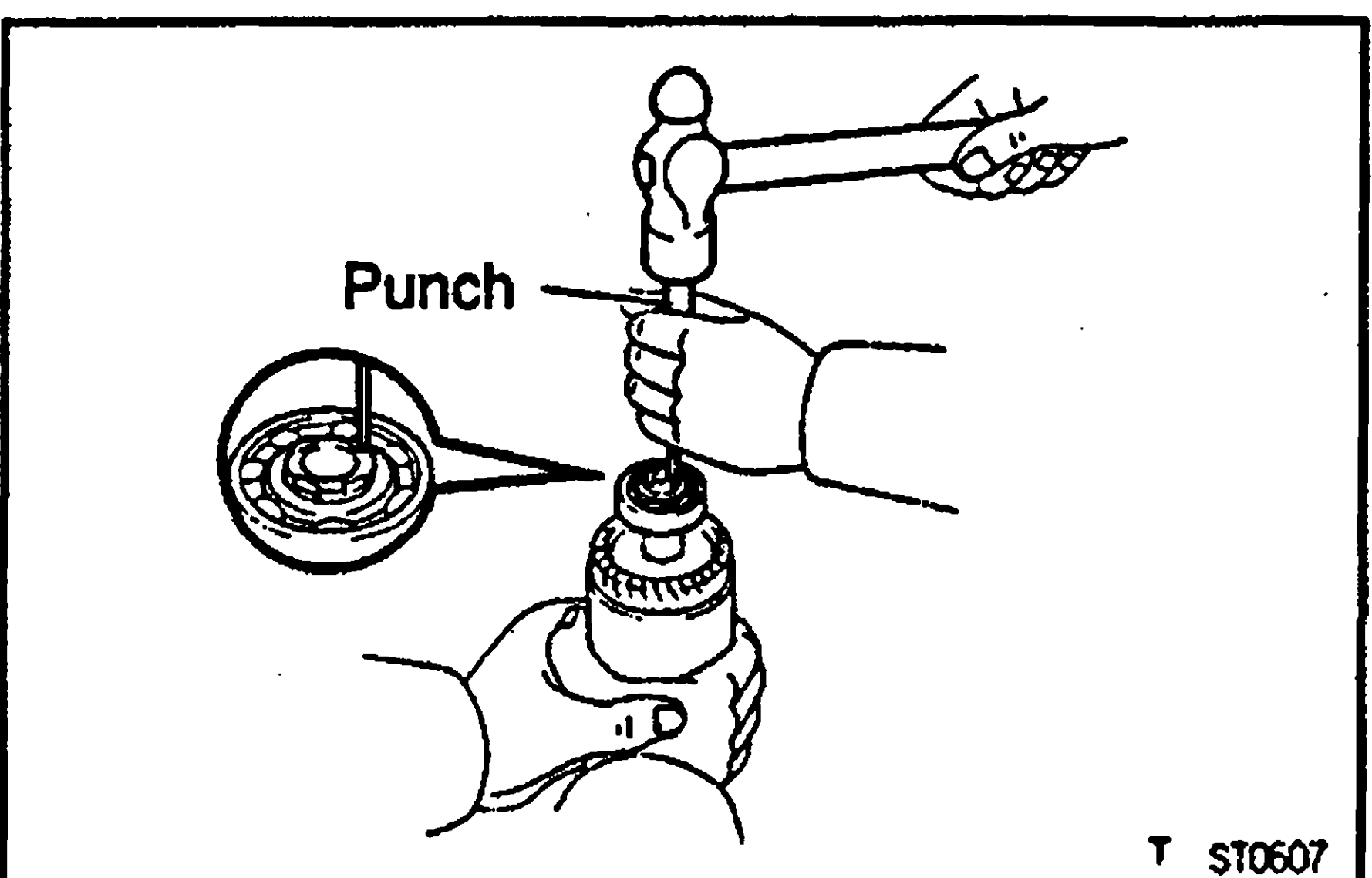
(a) Using SST, remove the bearing.

SST 09286-46011

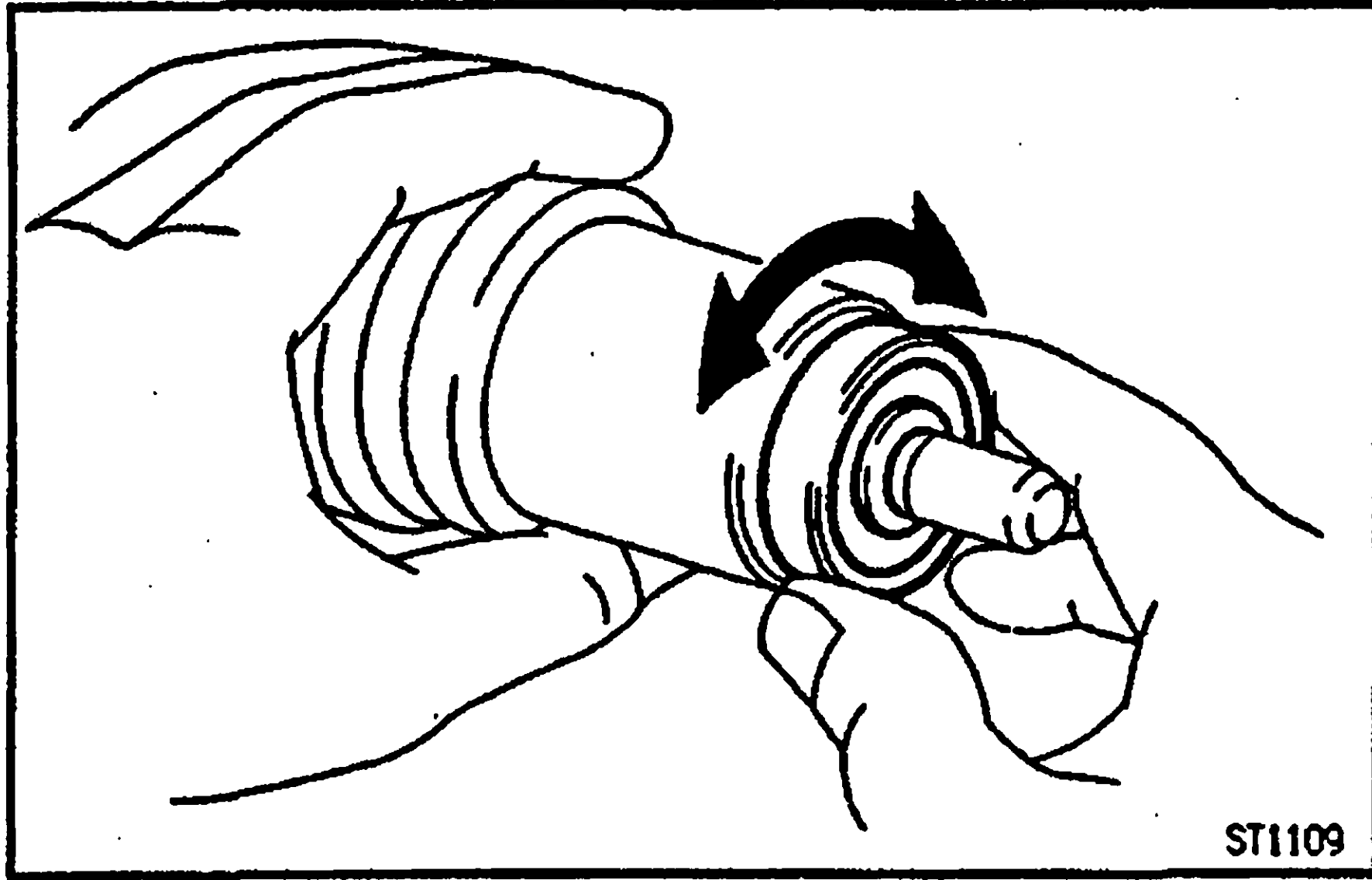


(b) Using a 14 mm head nut and press, press in a new bearing.

NOTICE: Be careful of the bearing installation direction.

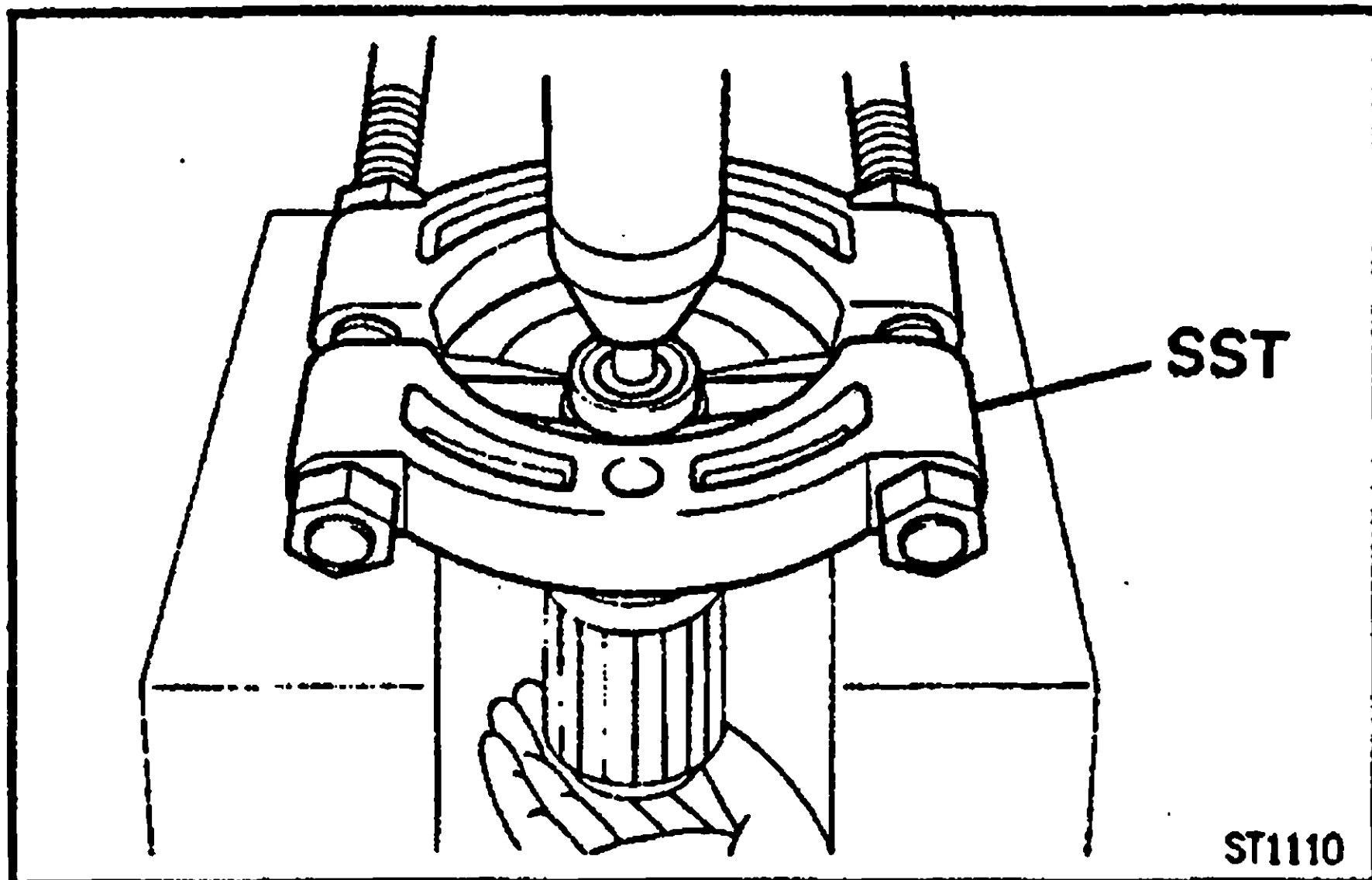


(c) Using a punch, stake the armature shaft.



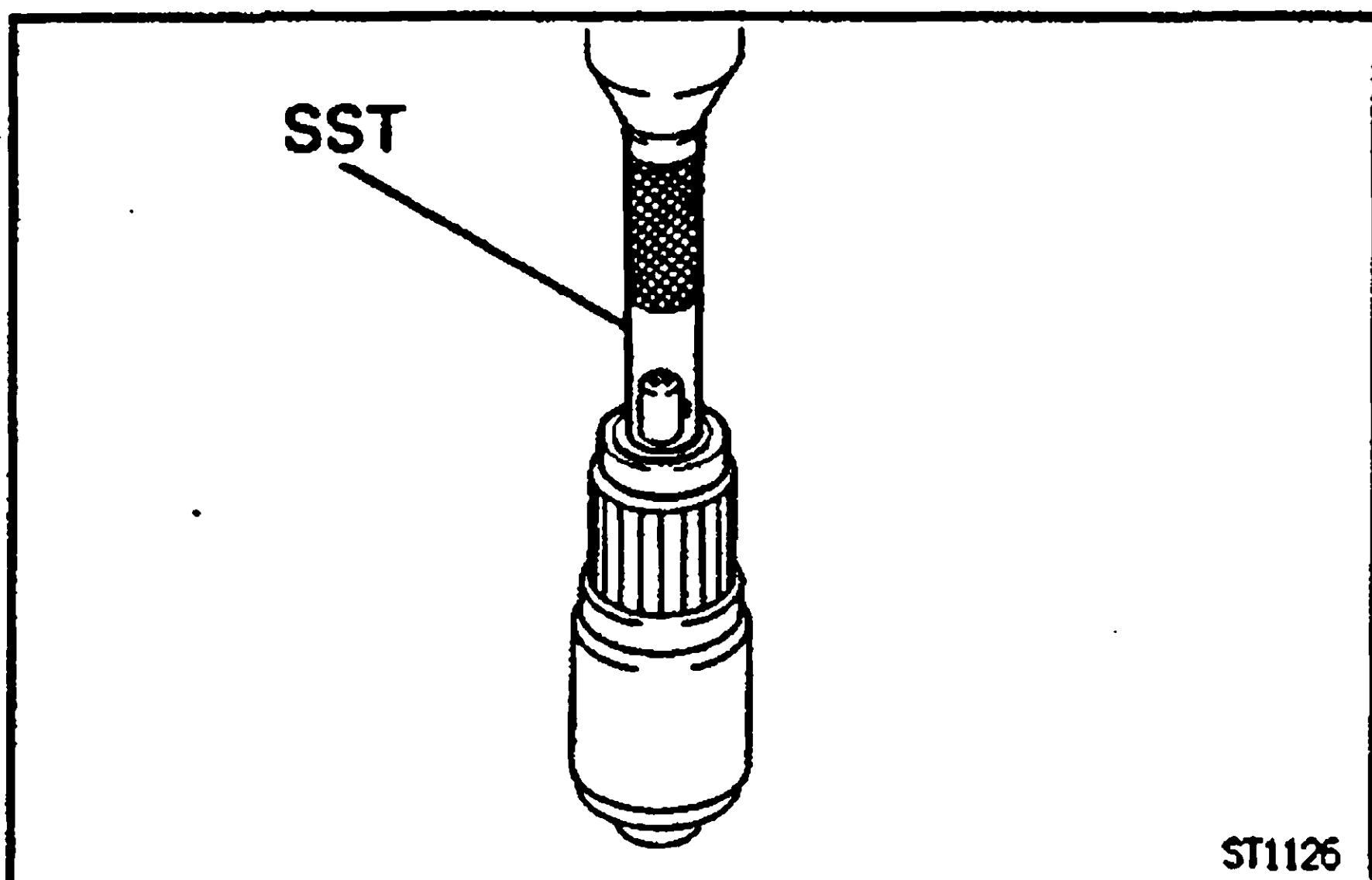
3. INSPECT FRONT BEARING

Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.

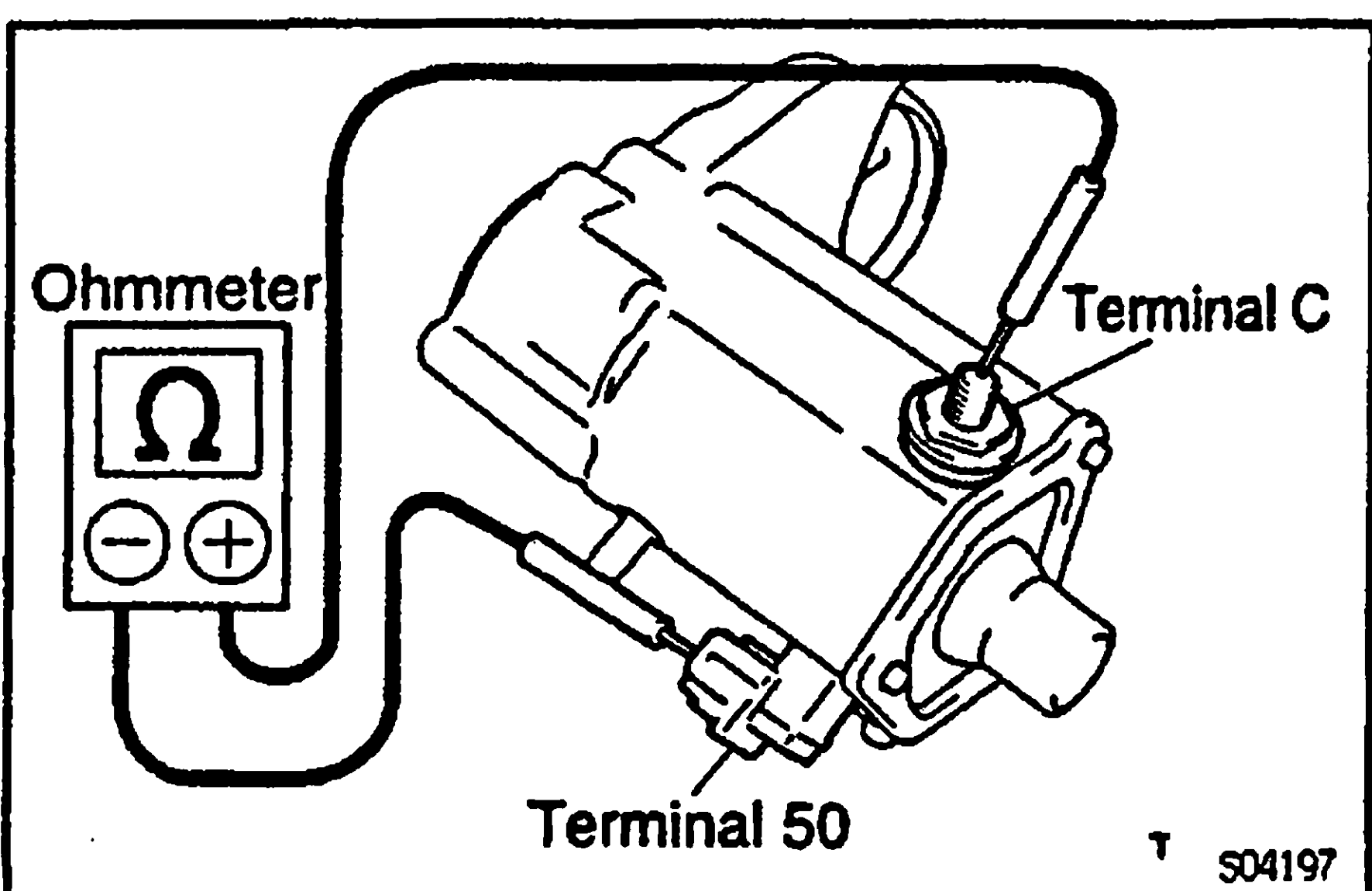


4. IF NECESSARY, REPLACE FRONT BEARING

- (a) Using SST and a press, press out the bearing.
SST 09950-00020



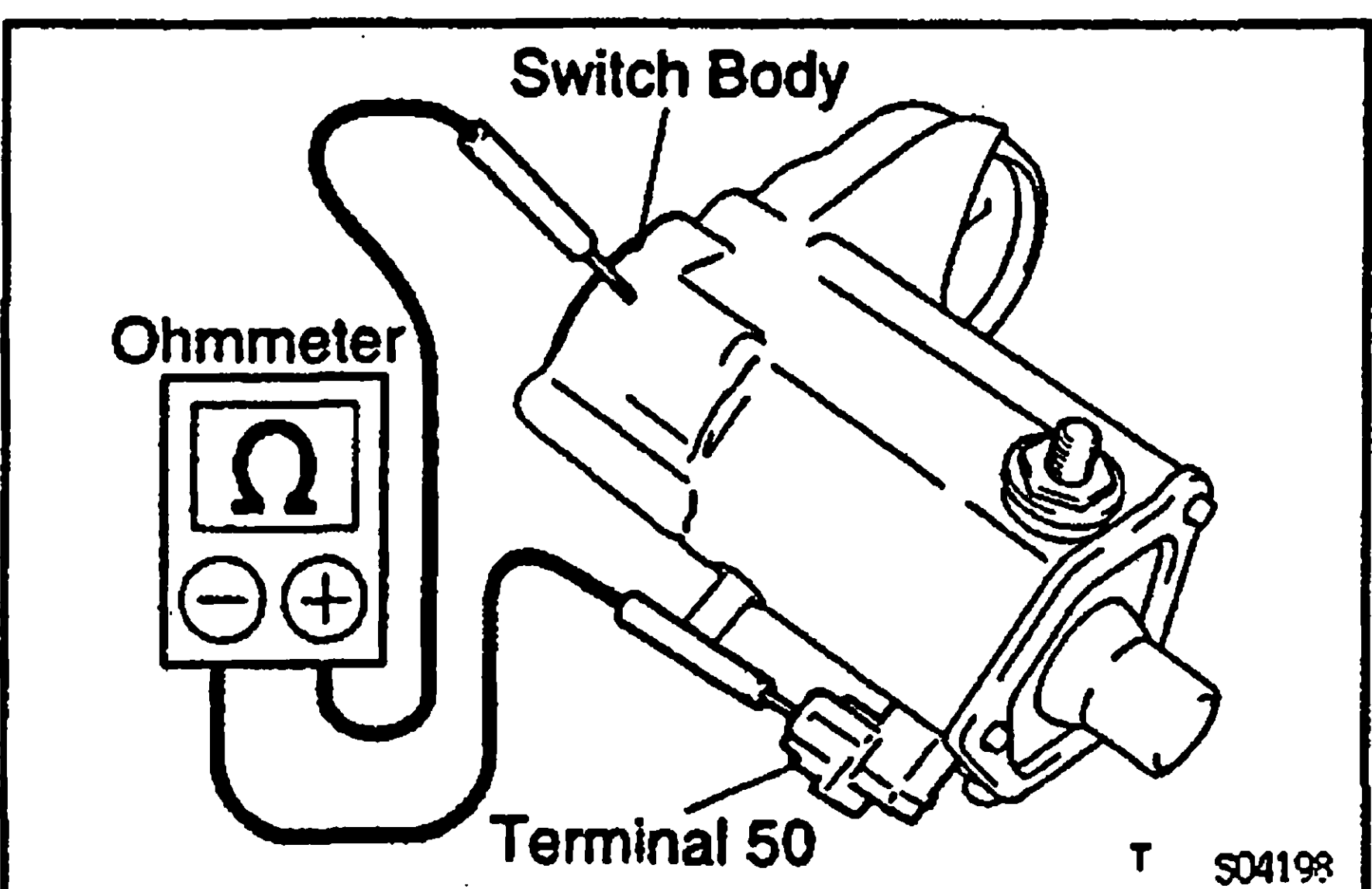
- (b) Using SST and a press, press in a new bearing.
SST 09201-41020



Magnetic Switch

1. DO PULL-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C. If there is no continuity, replace the magnetic switch.



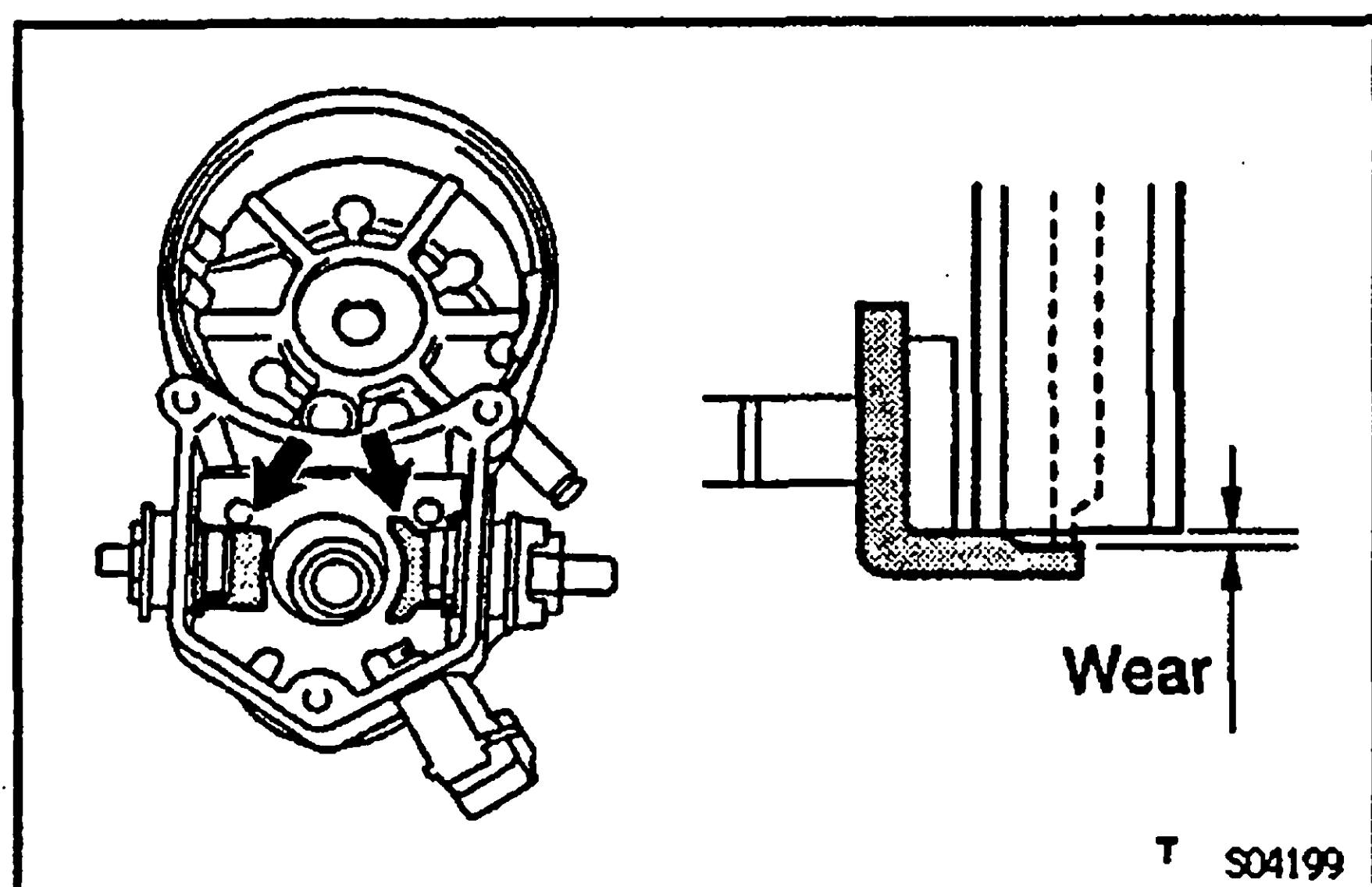
2. DO HOLD-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminal 50 and the switch body. If there is no continuity, replace the magnetic switch.

MAGNETIC SWITCH TERMINAL KIT PARTS REPLACEMENT

1. REMOVE MAGNETIC SWITCH END COVER

Remove the 3 bolts, end cover, gasket and plunger.



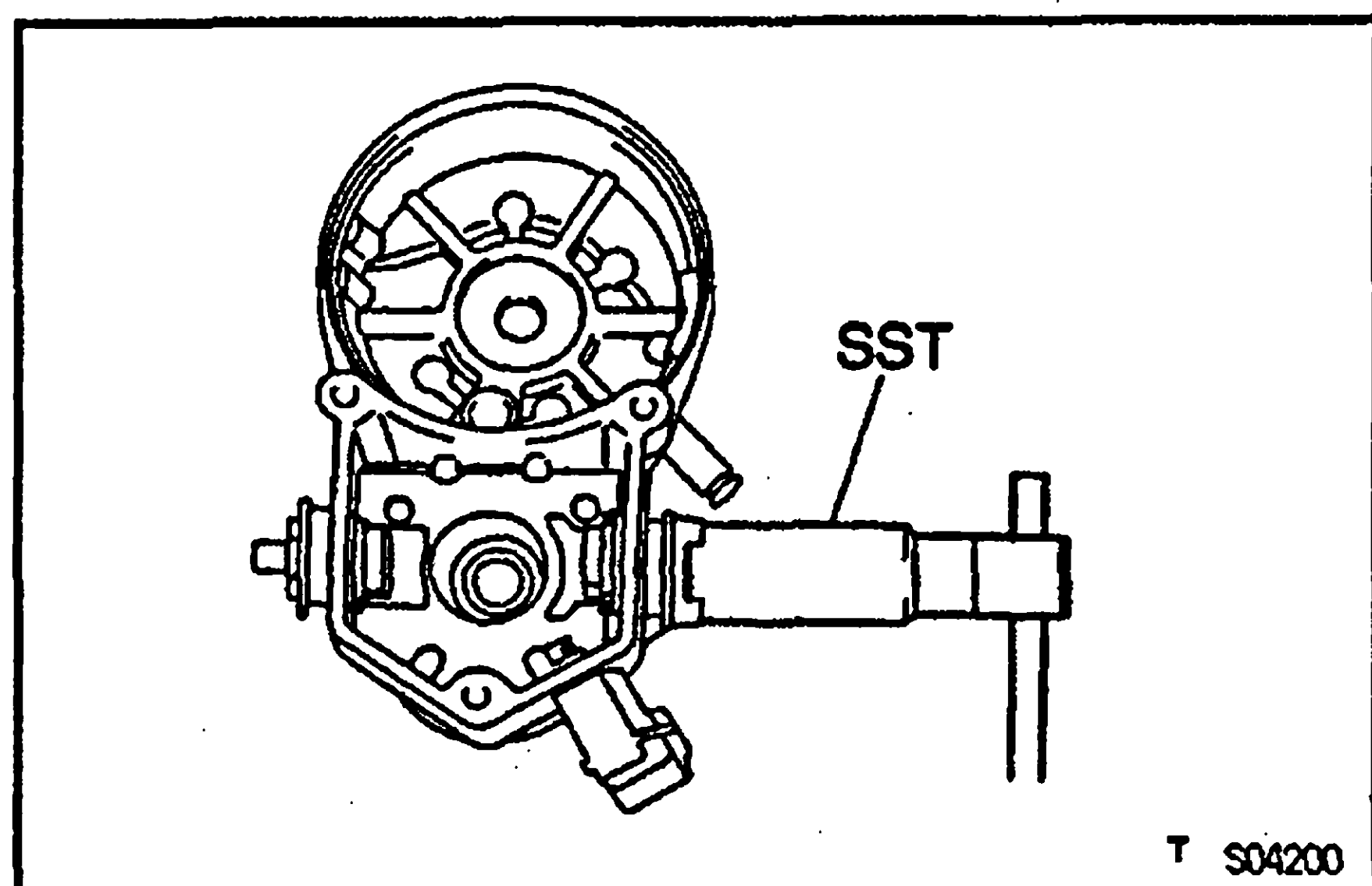
T S04199

2. INSPECT CONTACT PLATE FOR WEAR

Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear: 0.9 mm (0.035 in.)

If the depth of wear is greater than the maximum, replace the contact plate.



T S04200

3. REMOVE TERMINAL KIT PARTS

- (a) Using SST, loosen the terminal nuts.

SST 09810-38140

- (b) Terminal C:

Remove the terminal nut, wave washer, terminal insulator (outside), O-ring, terminal bolt, contact plate and terminal insulator (inside).

- (c) Terminal 30:

Remove the terminal nut, wave washer, terminal insulator (outside), packing, O-ring, terminal bolt, contact plate, terminal insulator (inside) and insulation paper.

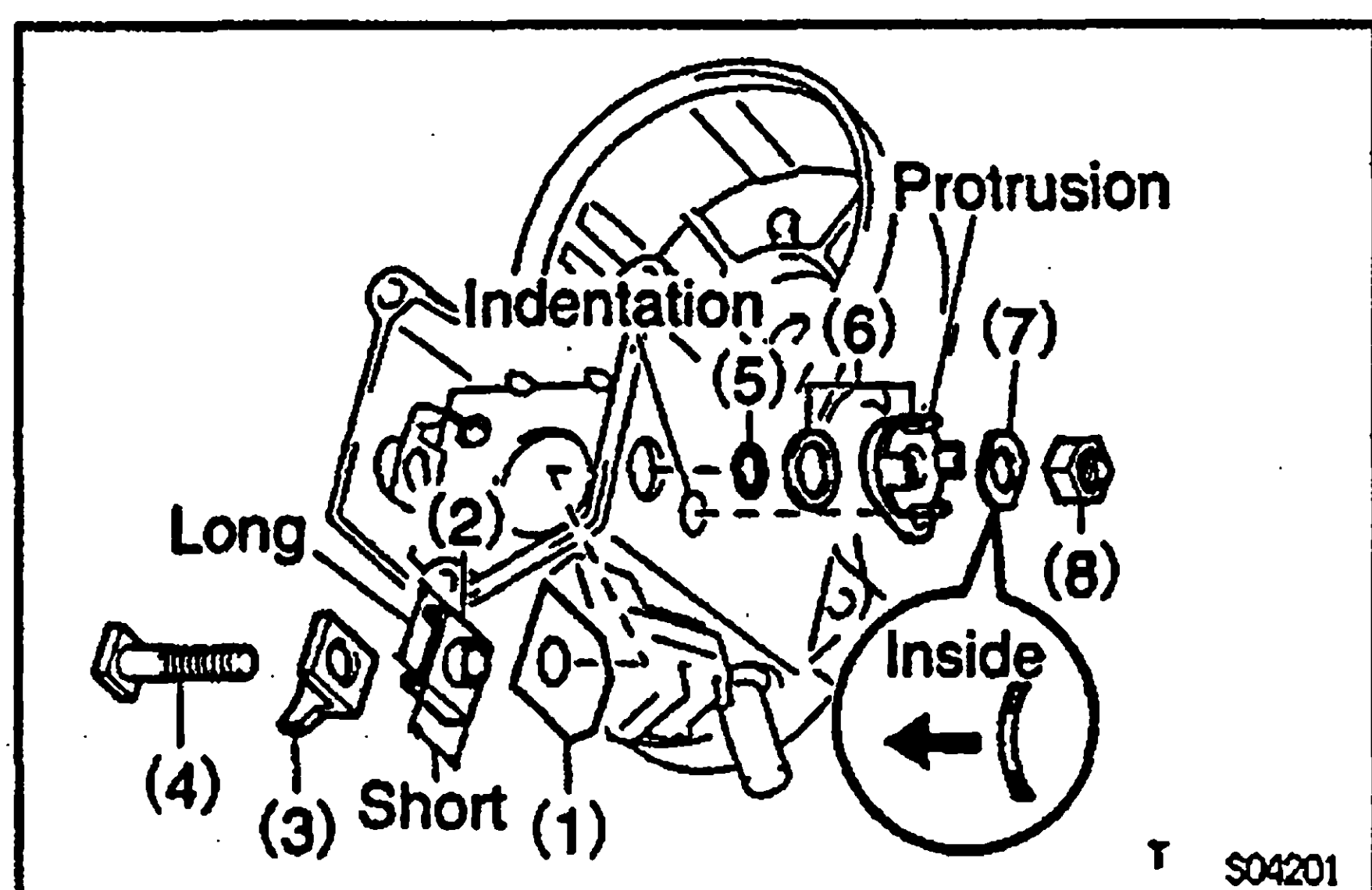
4. REINSTALL TERMINAL KIT PARTS

- (a) Install these new parts:

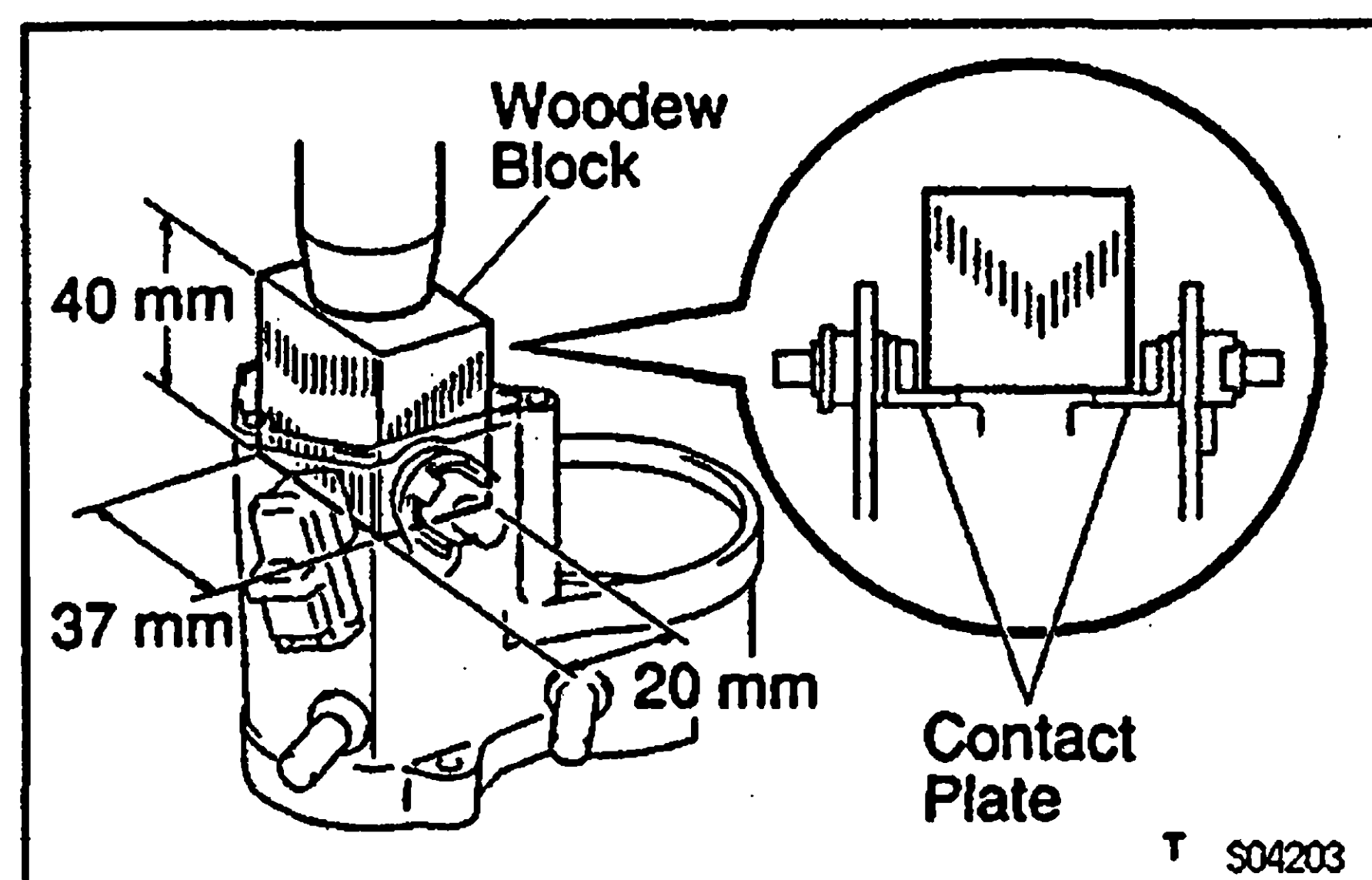
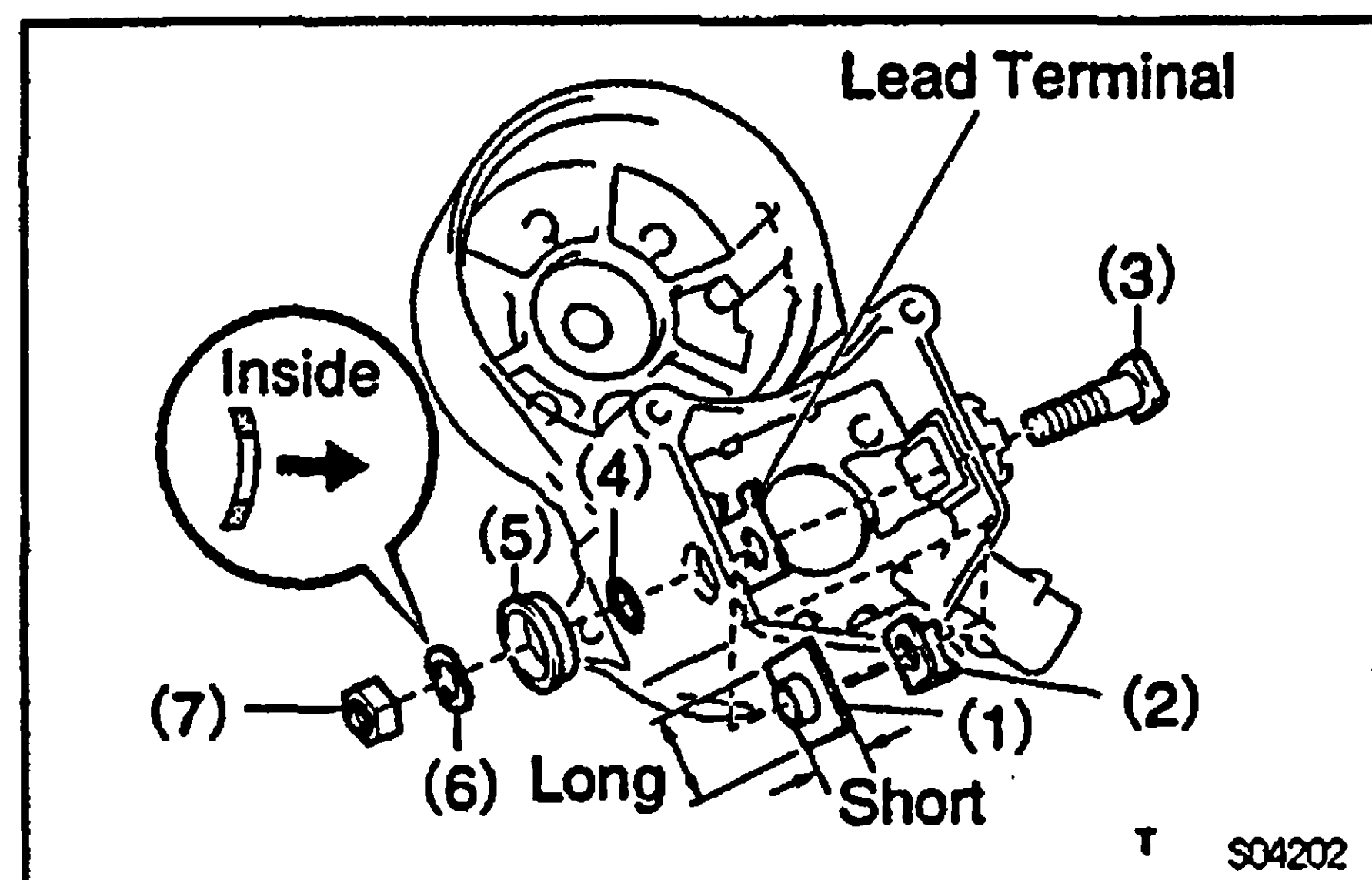
Terminal 30:

- (1) Insulation paper
- (2) Terminal insulator (inside)
- (3) Contact plate
- (4) Terminal bolt
- (5) O-ring
- (6) Packing and terminal insulator (outside)
- (7) Wave washer
- (8) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) and wave washer in the correct direction.



T S04201

**Terminal C:**

- (1) Terminal insulator (inside)
- (2) Contact plate
- (3) Terminal bolt
- (4) O-ring
- (5) Terminal insulator (outside)
- (6) Wave washer
- (7) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) and wave washer in the correct direction.

- (b) Temporarily tighten the terminal nuts.

5. TIGHTEN TERMINAL NUT

- (a) Put a wood block on the contact plate and press it down with a hand press.

Dimensions of wood block:

20 x 37 x 40 mm (0.97 x 1.46 x 1.57 in.)

Press force:

981 N (100 kgf, 221 lbf)

NOTICE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.

Gauge Pressure

$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

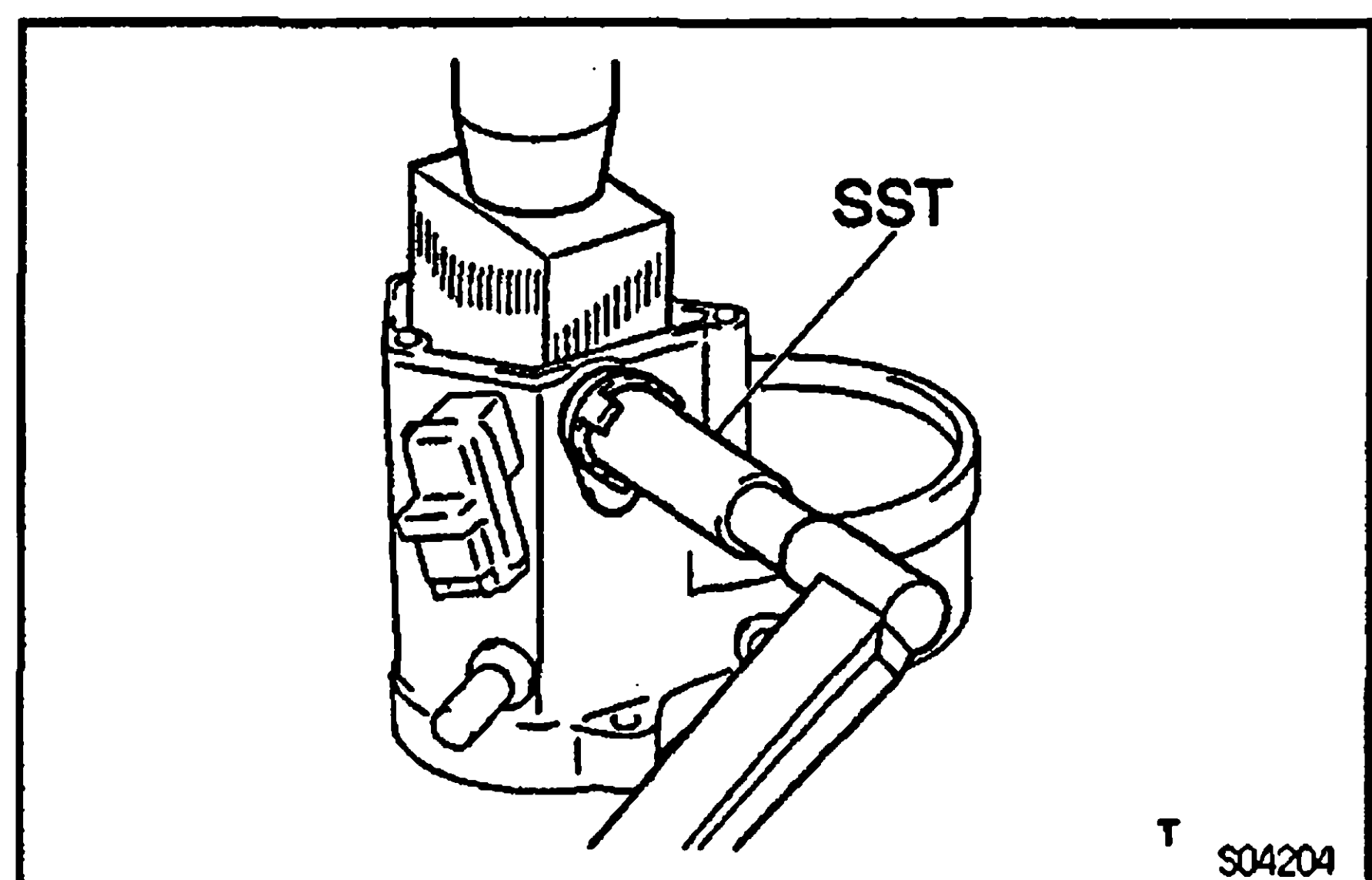
$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

$$(\text{kPa}) = (\text{psi}) \times 6.9$$

V06795

- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.

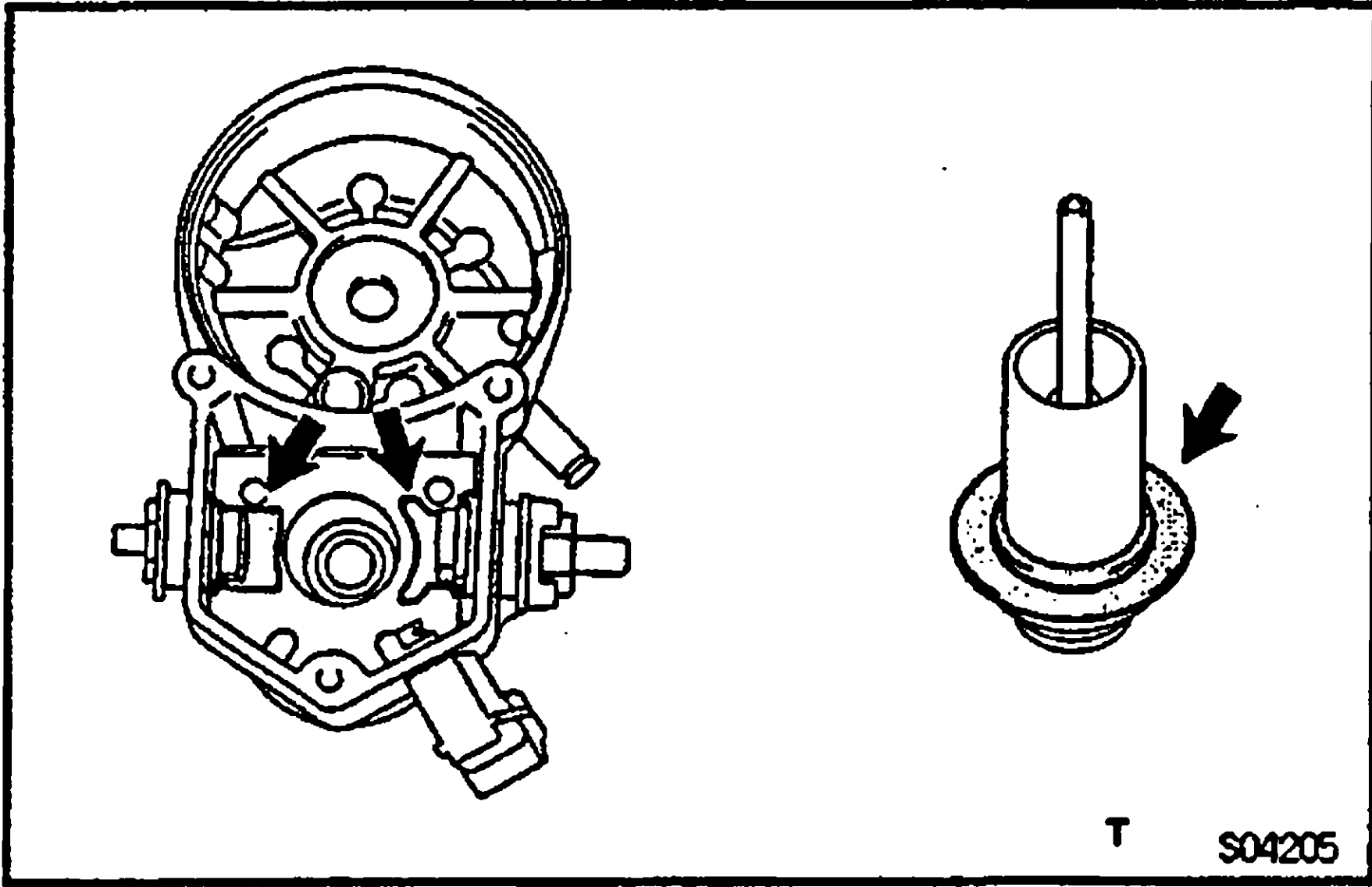


- (b) Using SST, tighten the nuts to the specified torque.

SST 09810-38140

Torque: 17 N·m (173 kgf·cm, 12 ft·lbf)

NOTICE: If the nut is over tightened, it may cause cracks on the inside of the insulator.



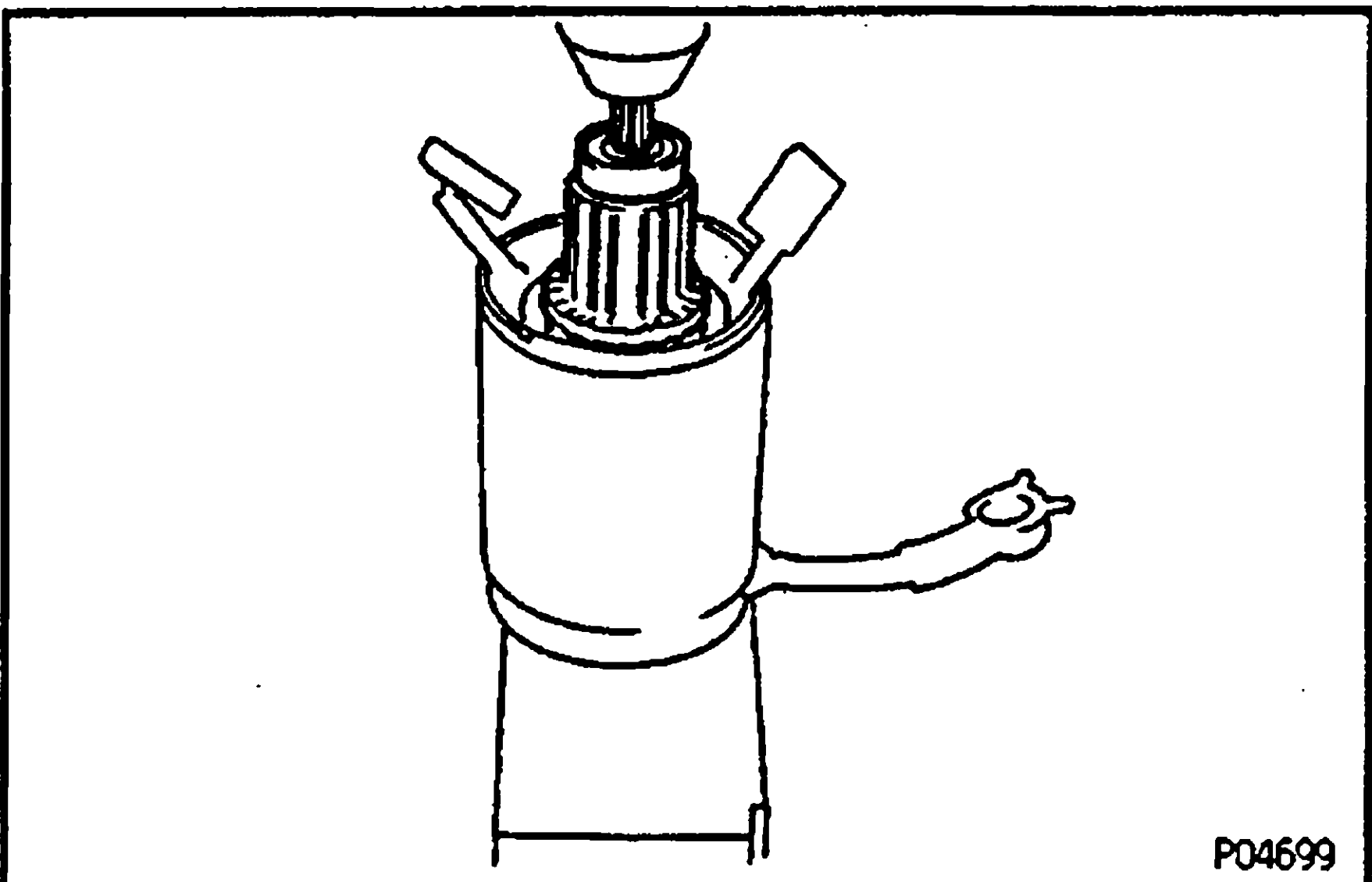
6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

7. REINSTALL MAGNETIC SWITCH END COVER

Install the plunger, new gasket and end cover with the 3 bolts.

Torque: 3.6 N·m (36 kgf·cm, 32 in·lbf)



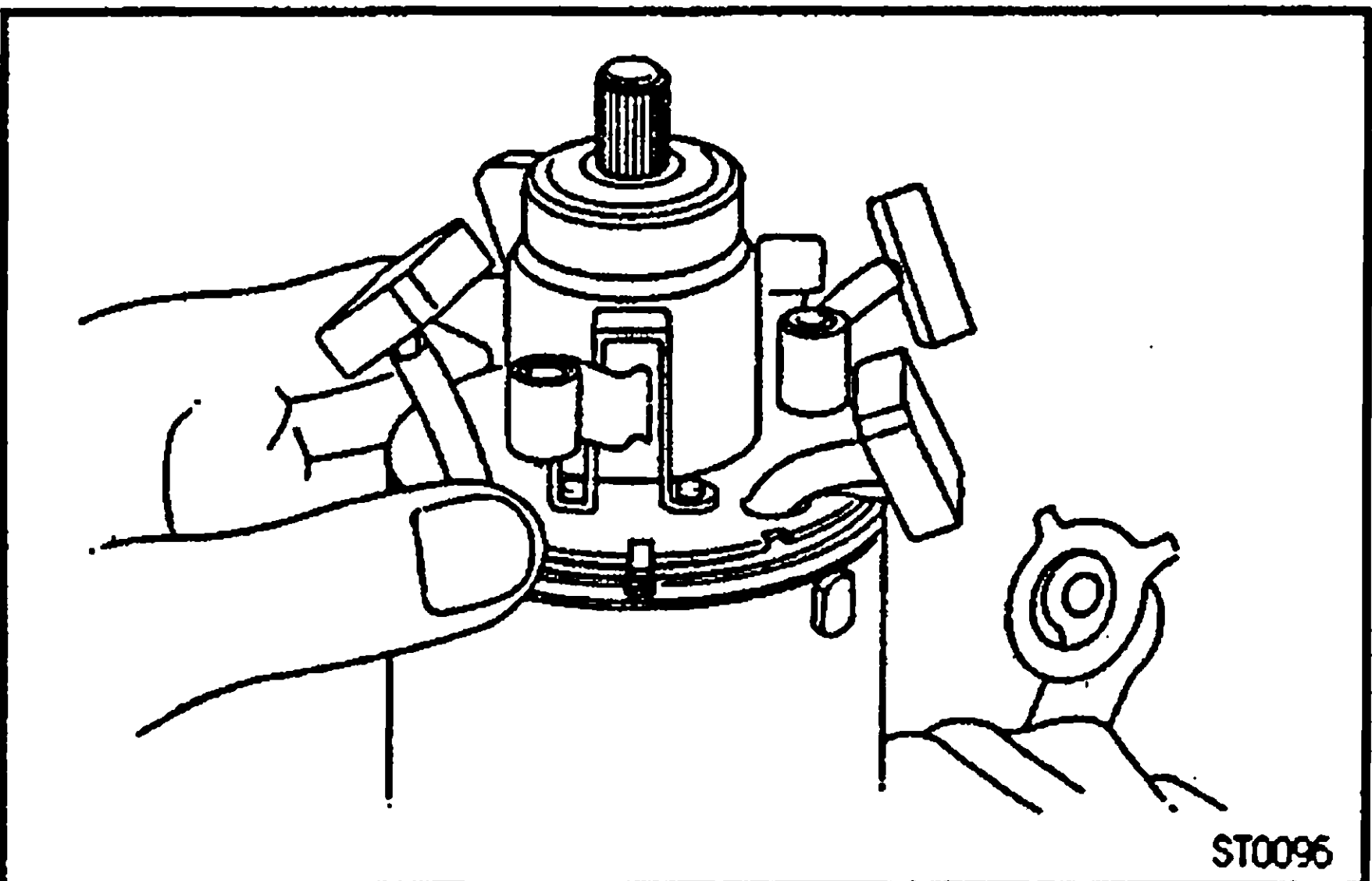
STARTER ASSEMBLY

ST000-01

HINT: Use high-temperature grease to lubricate the bearings and gears when assembling the starter.

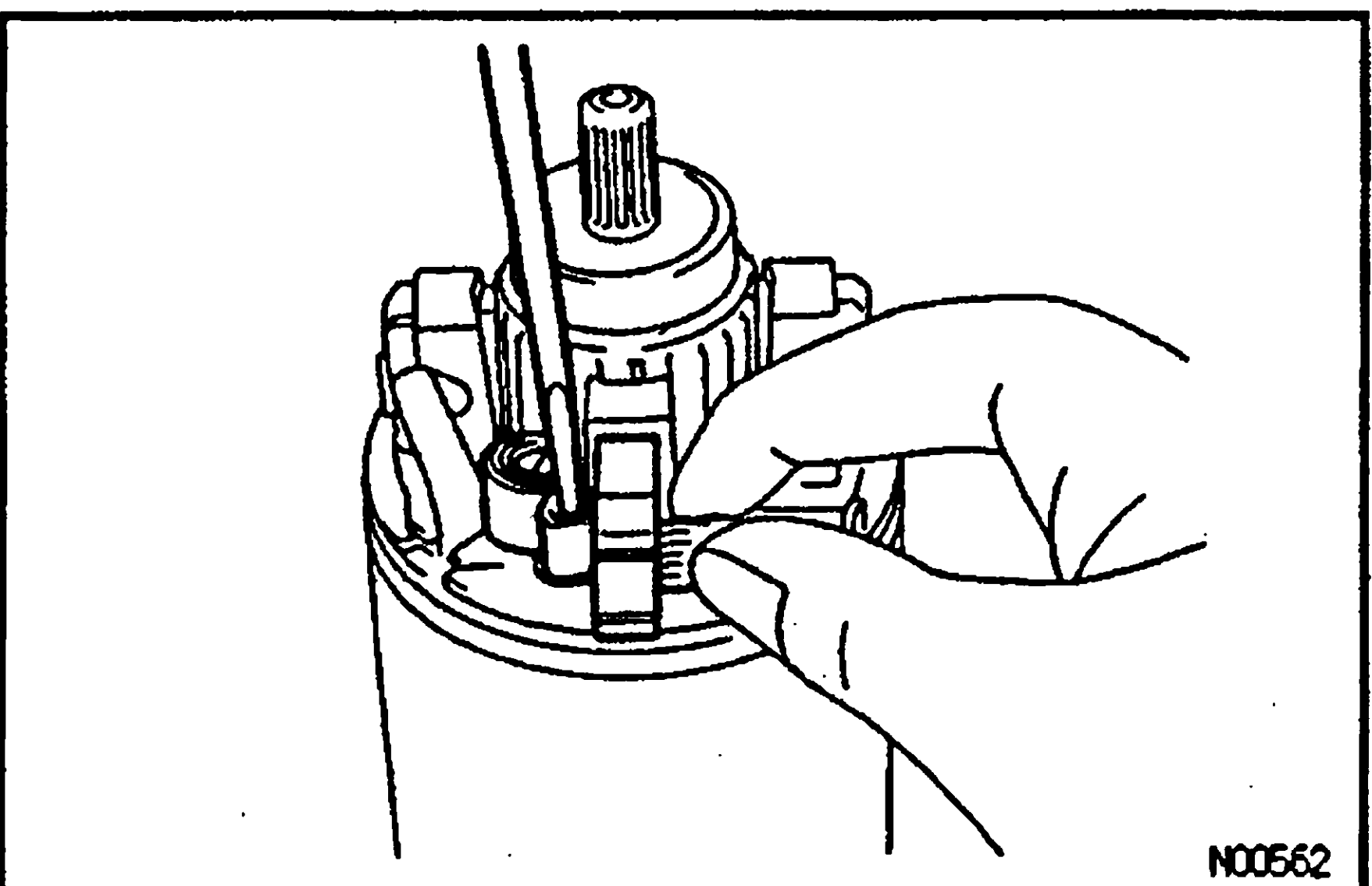
1. PLACE ARMATURE INTO FIELD FRAME

- Apply grease to the armature bearings.
- Using a press, press the armature into the field frame.



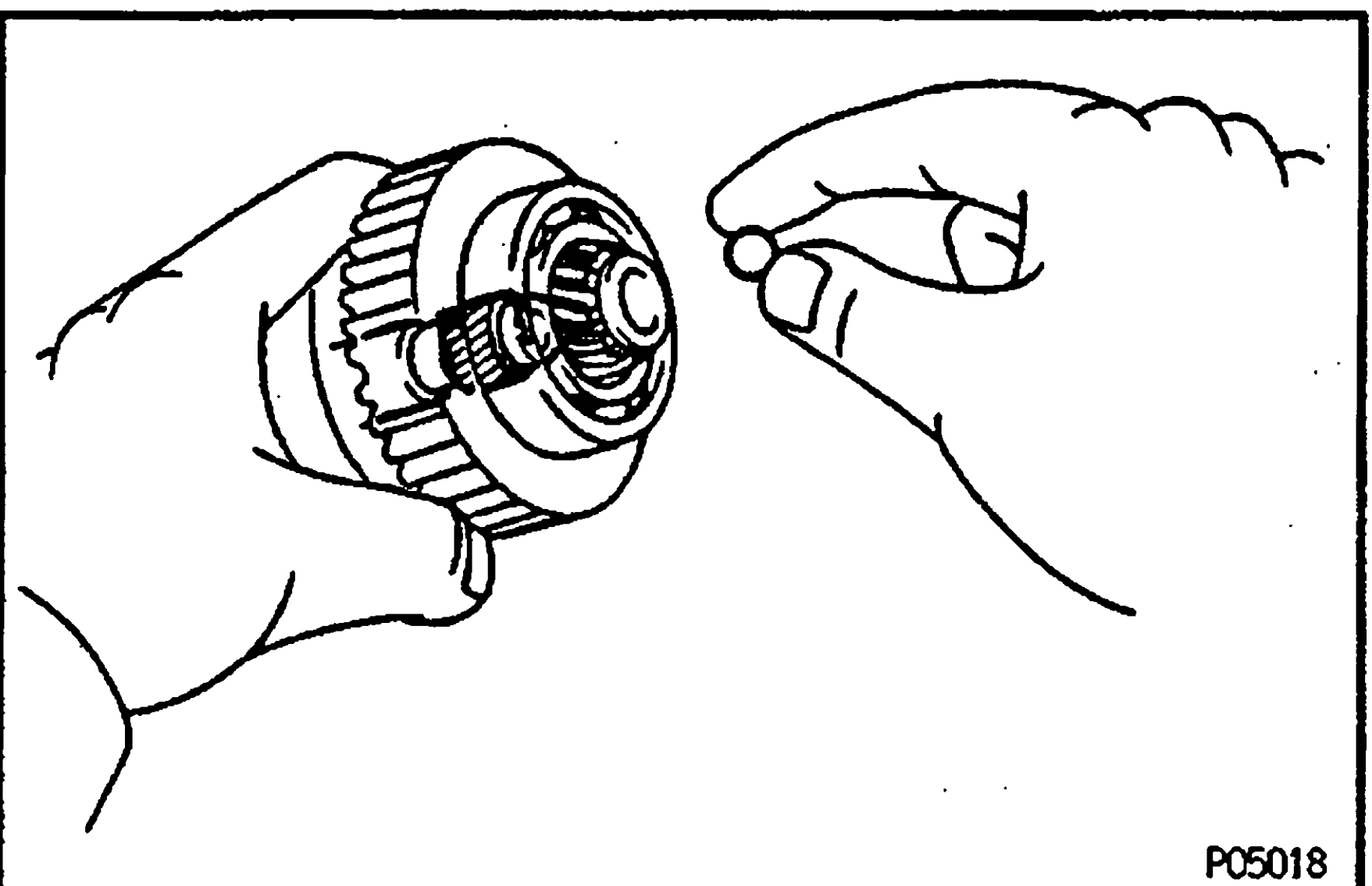
2. INSTALL BRUSH HOLDER

- Align the claw of the brush holder with the claw groove of the field frame.
- Place the brush holder on the field frame.



- Using a screwdriver, hold the brush spring back, and connect the brush into the brush holder. Connect the 4 brushes.

NOTICE: Check that the positive (+) lead wires are not grounded.

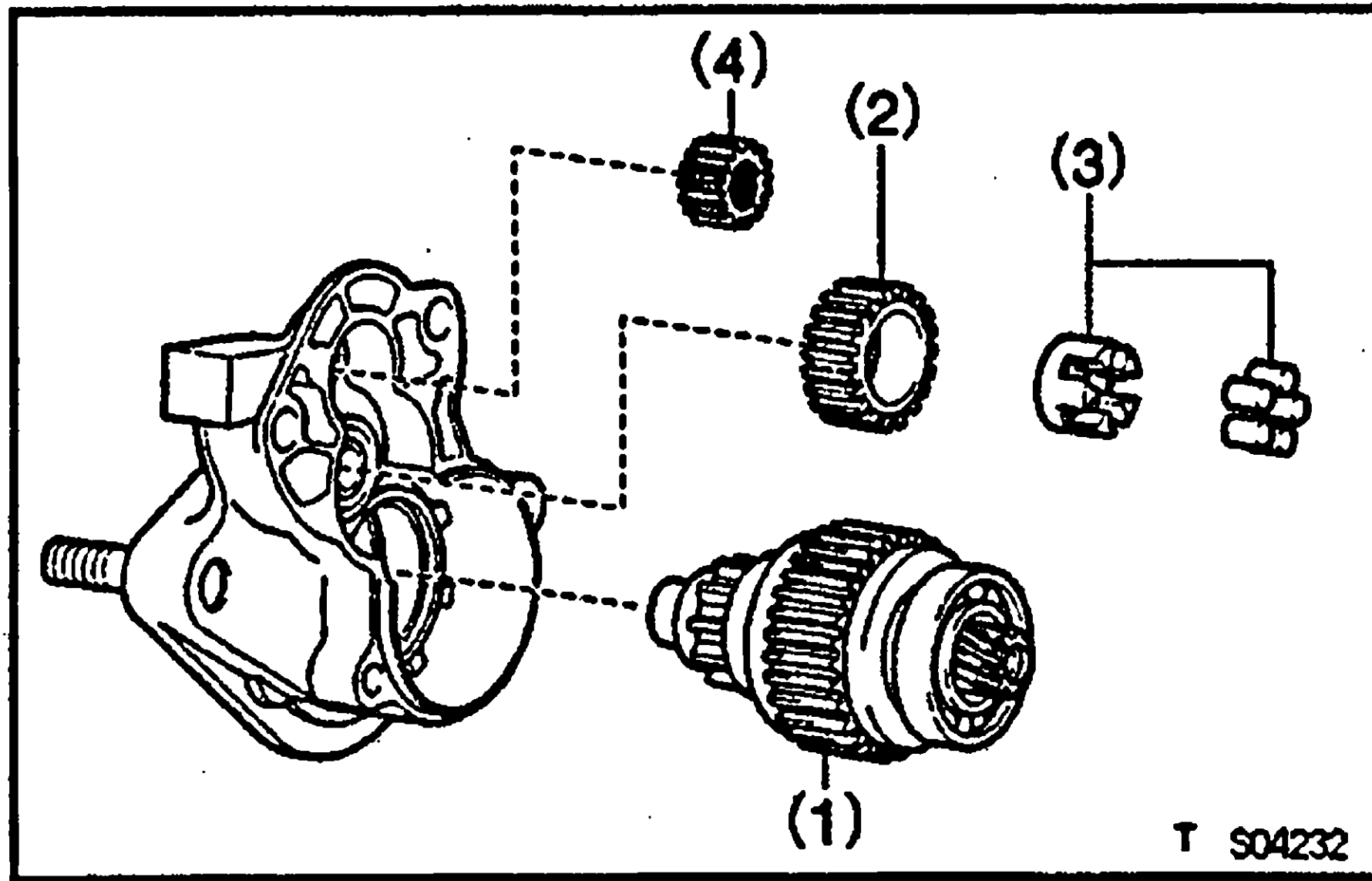


3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

- Apply grease to the steel ball.
- Insert the steel ball into the clutch shaft hole.

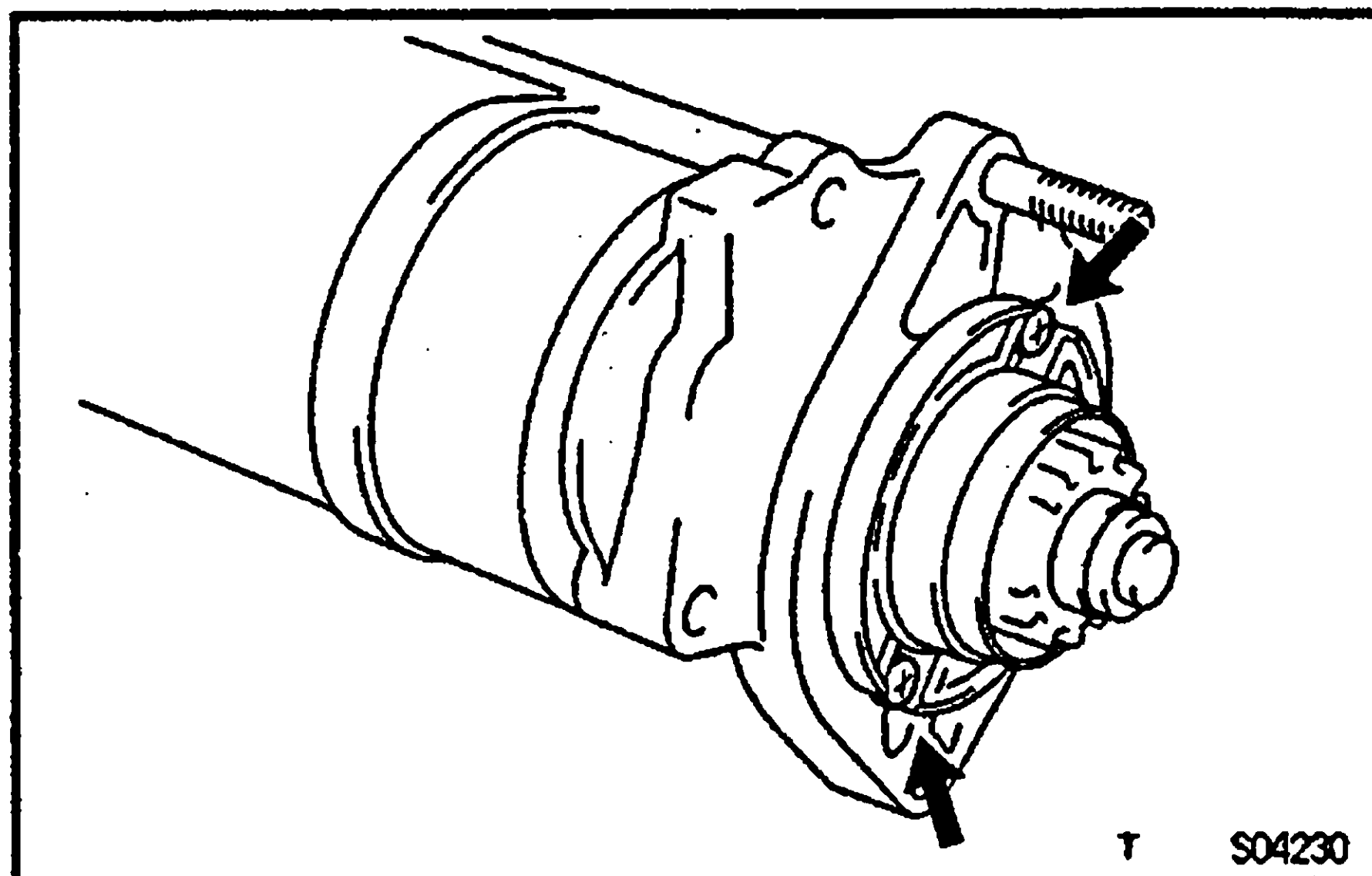
4. INSTALL STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- Apply grease to the return spring.
- Insert the return spring into the magnetic switch hole.



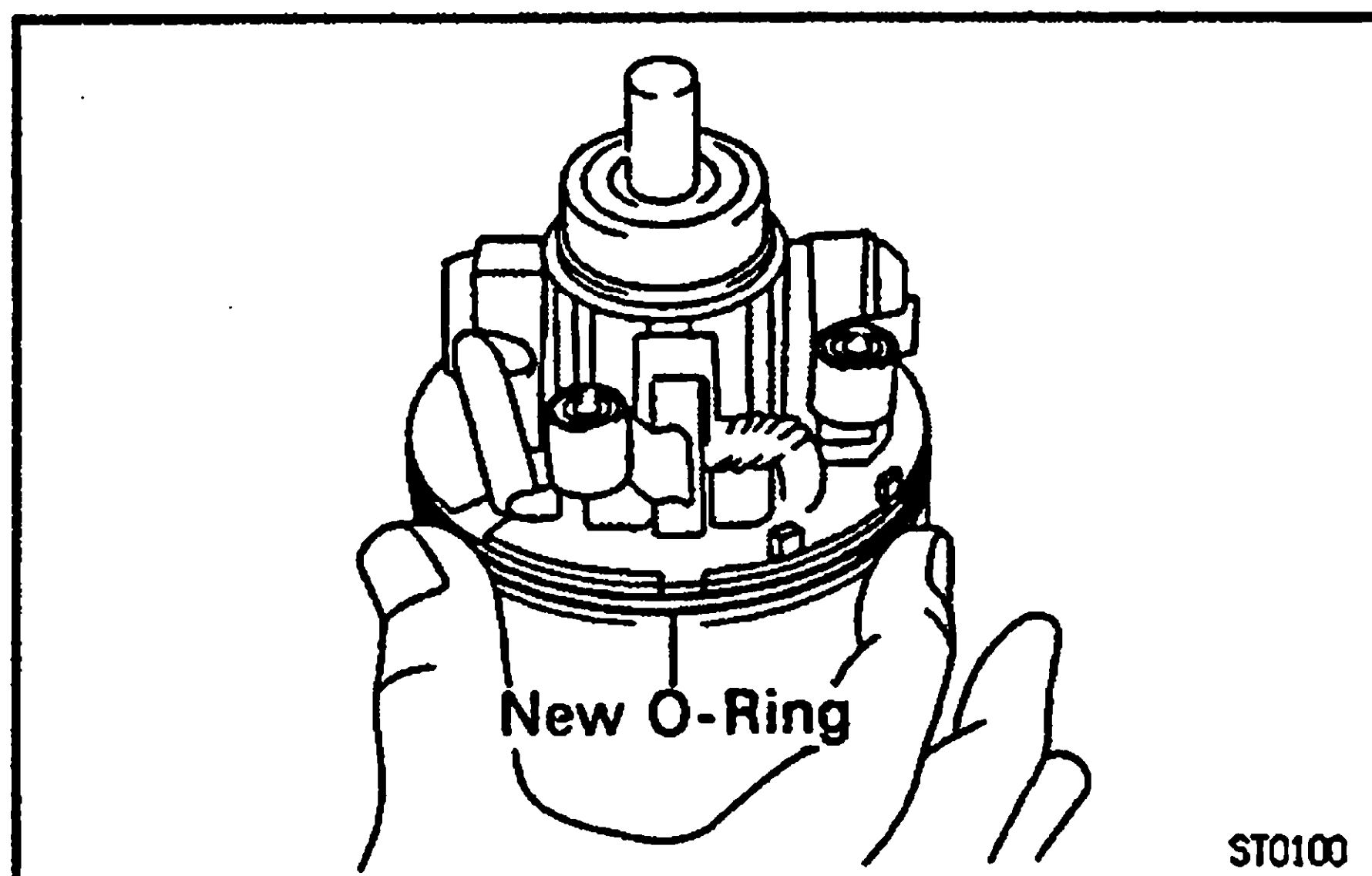
(c) Place the following parts in position on the starter housing:

- (1) Clutch assembly
- (2) Idler gear
- (3) Bearing
- (4) Pinion gear



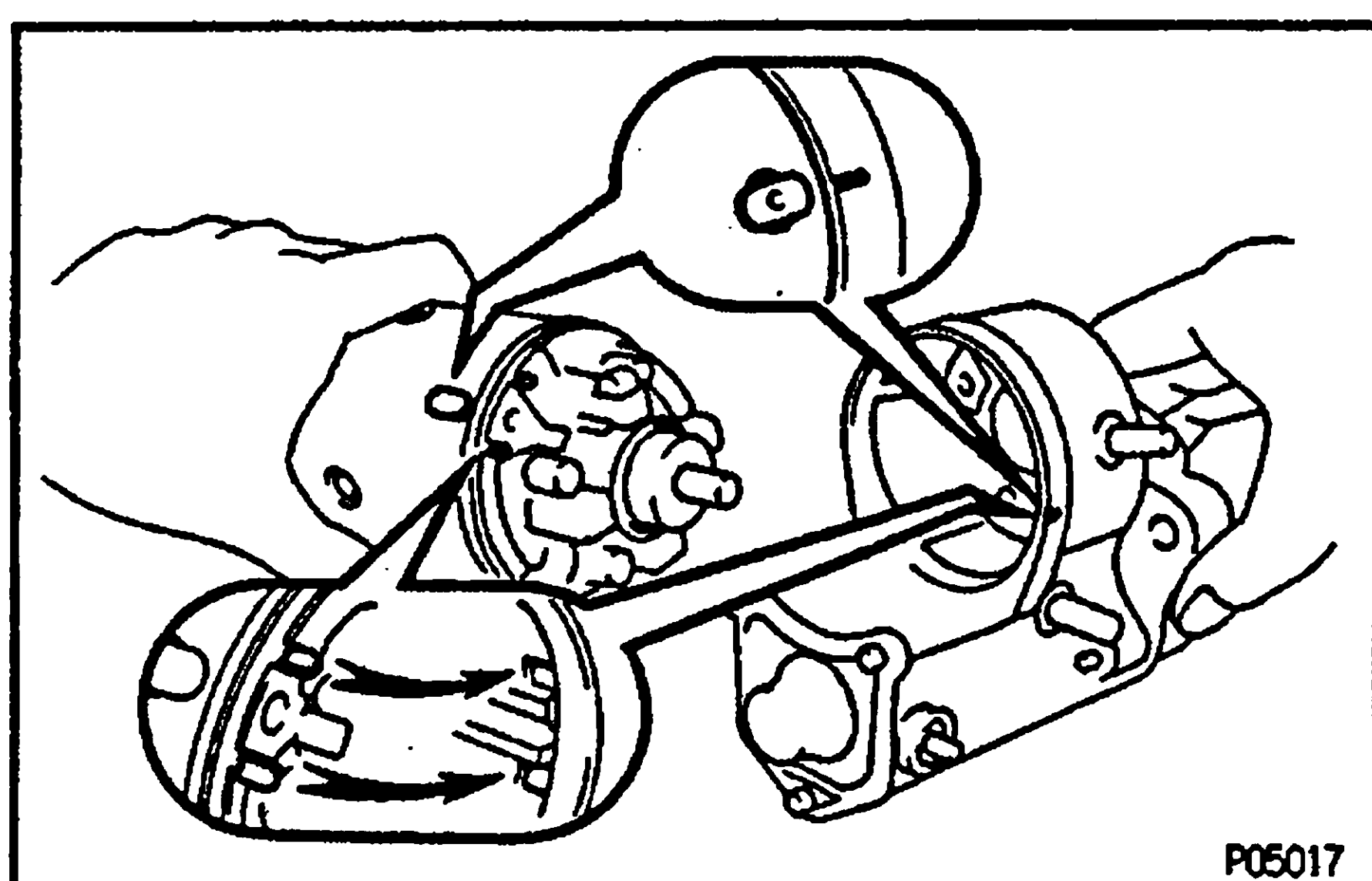
(d) Assemble the starter housing and magnetic switch assembly and install the 2 screws.

Torque: 9.3 N·m (95 kgf·cm, 82 in.-lbf)



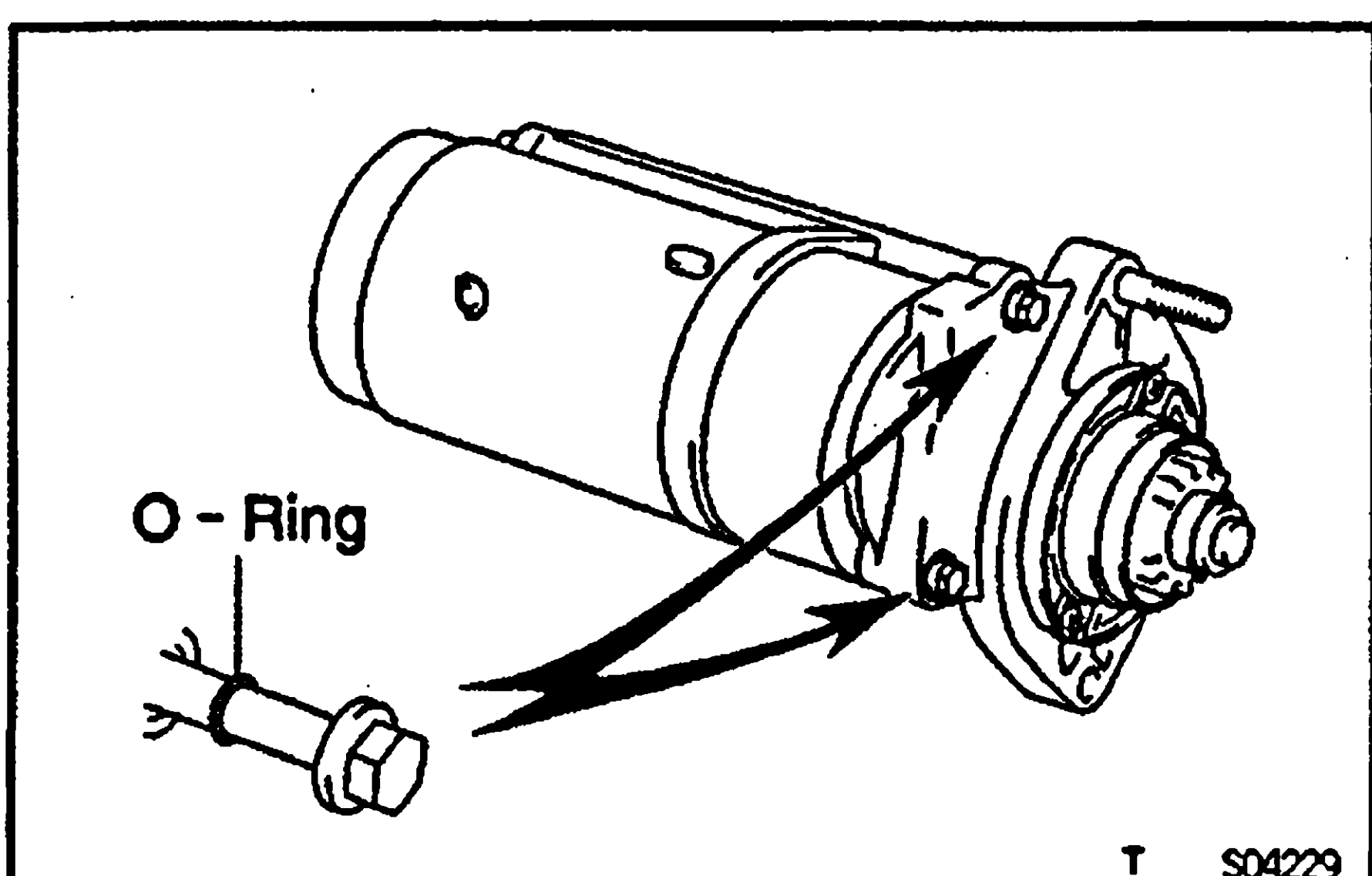
5. INSTALL FIELD FRAME AND ARMATURE ASSEMBLY

(a) Place a new O—ring in position on the field frame.



(b) Align the claws of the brush holder with the grooves of the magnetic switch, and install the field frame and armature shaft assembly.

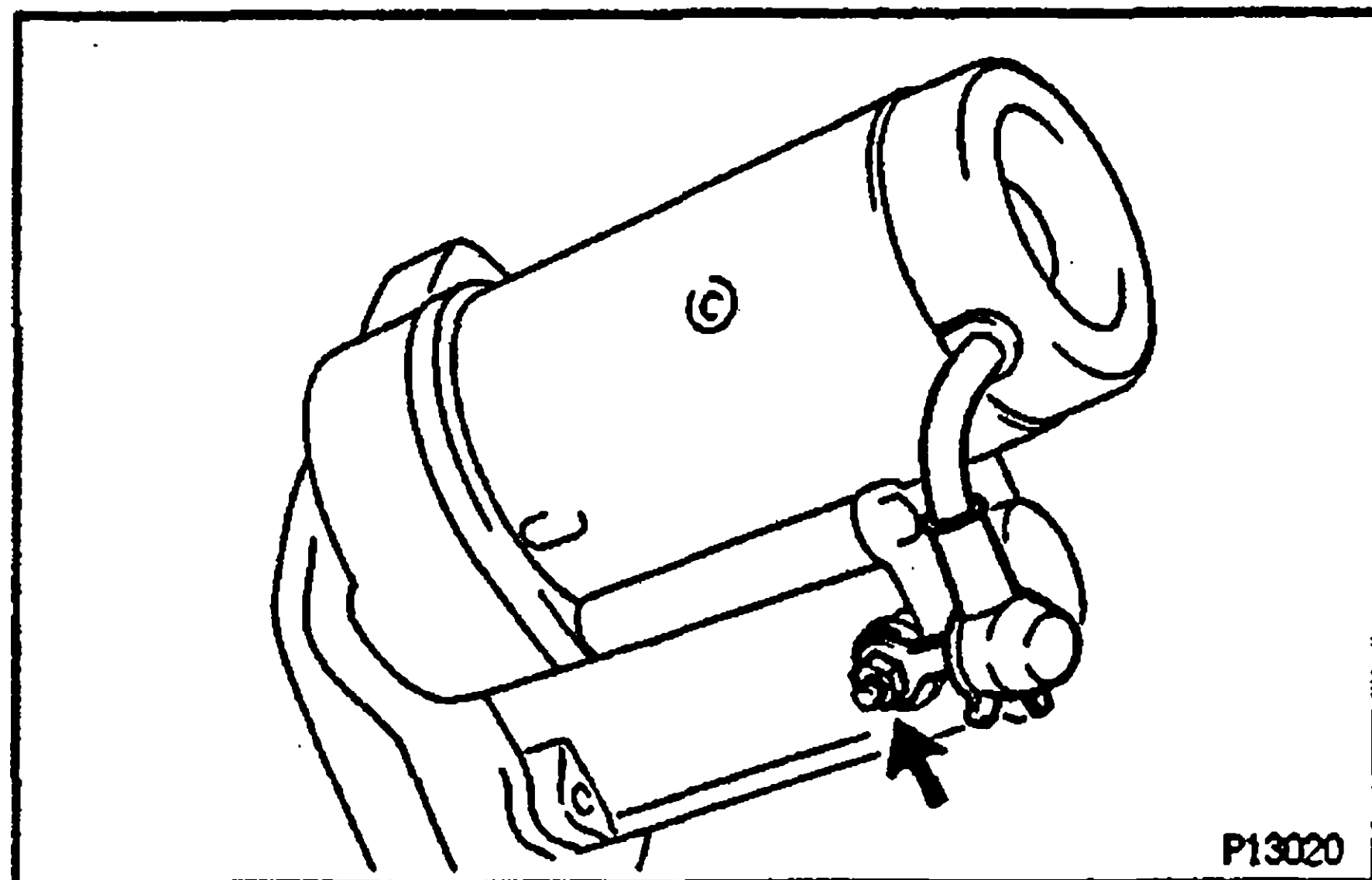
(c) Align the punch mark of the field frame with the line of the magnet switch.



(d) Install a new O—rings to the through bolts.

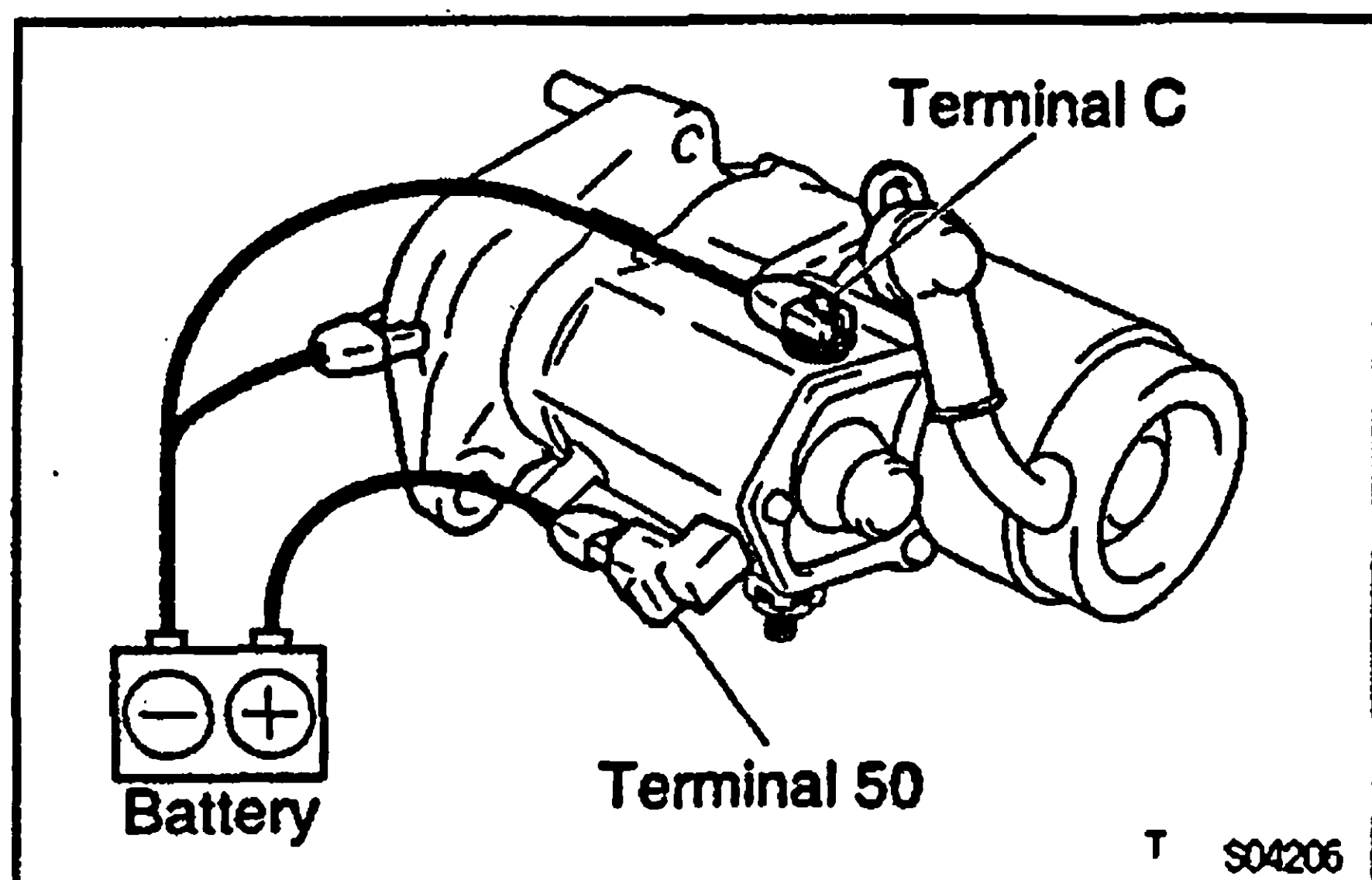
(e) Install the field frame and armature assembly with the 2 through bolts.

Torque: 12.7 N·m (130 kgf·cm, 9 ft·lbf)



- (f) Connect the lead wire to terminal C, and install the nut.

Torque: 5.9 N·m (60 kgf·cm, 52 in.-lbf)

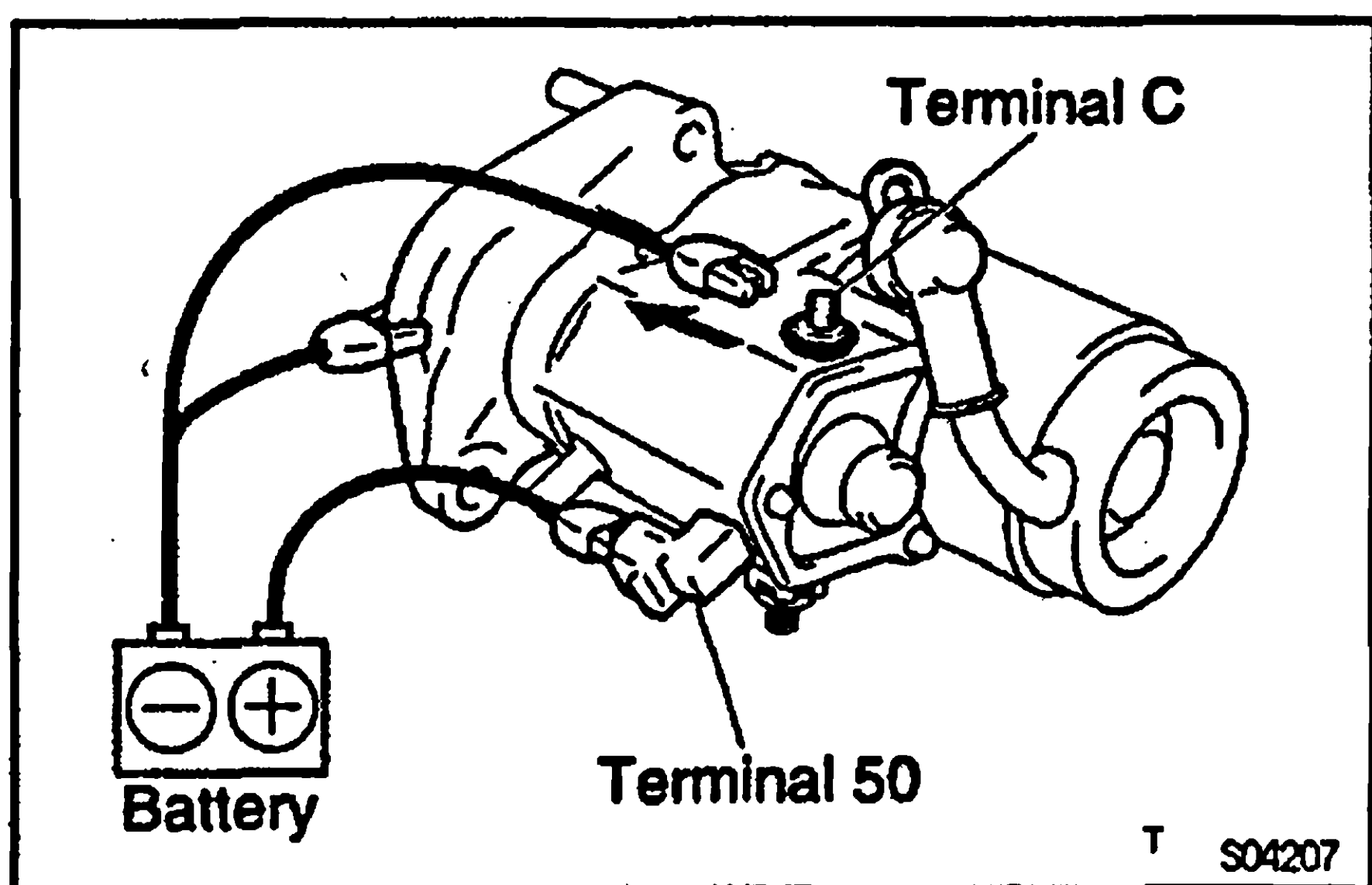


STARTER PERFORMANCE TEST

NOTICE: These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

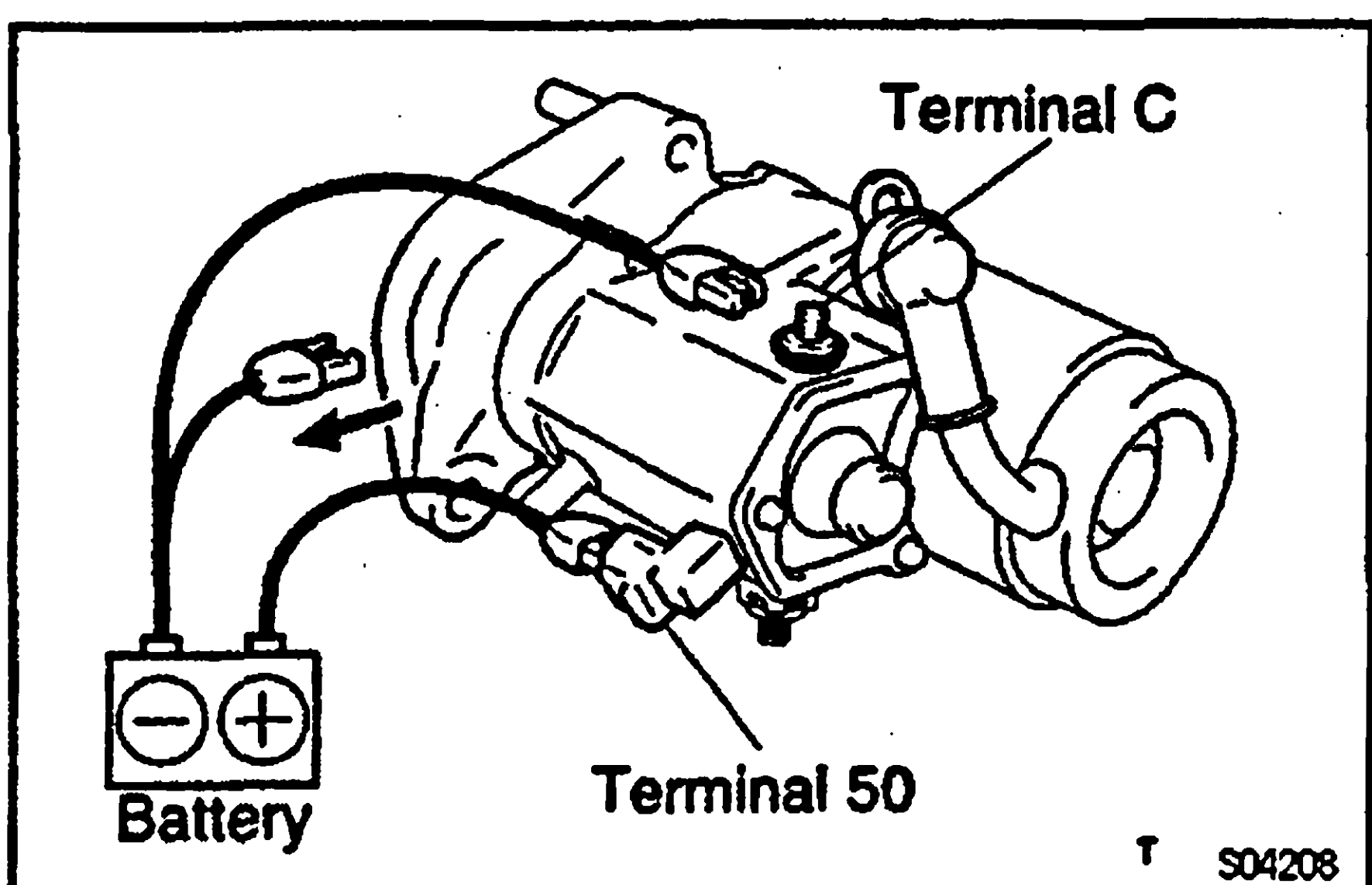
1. DO PULL-IN TEST

- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward. If the clutch pinion gear does not move, replace the magnetic switch assembly.



2. DO HOLD-IN TEST

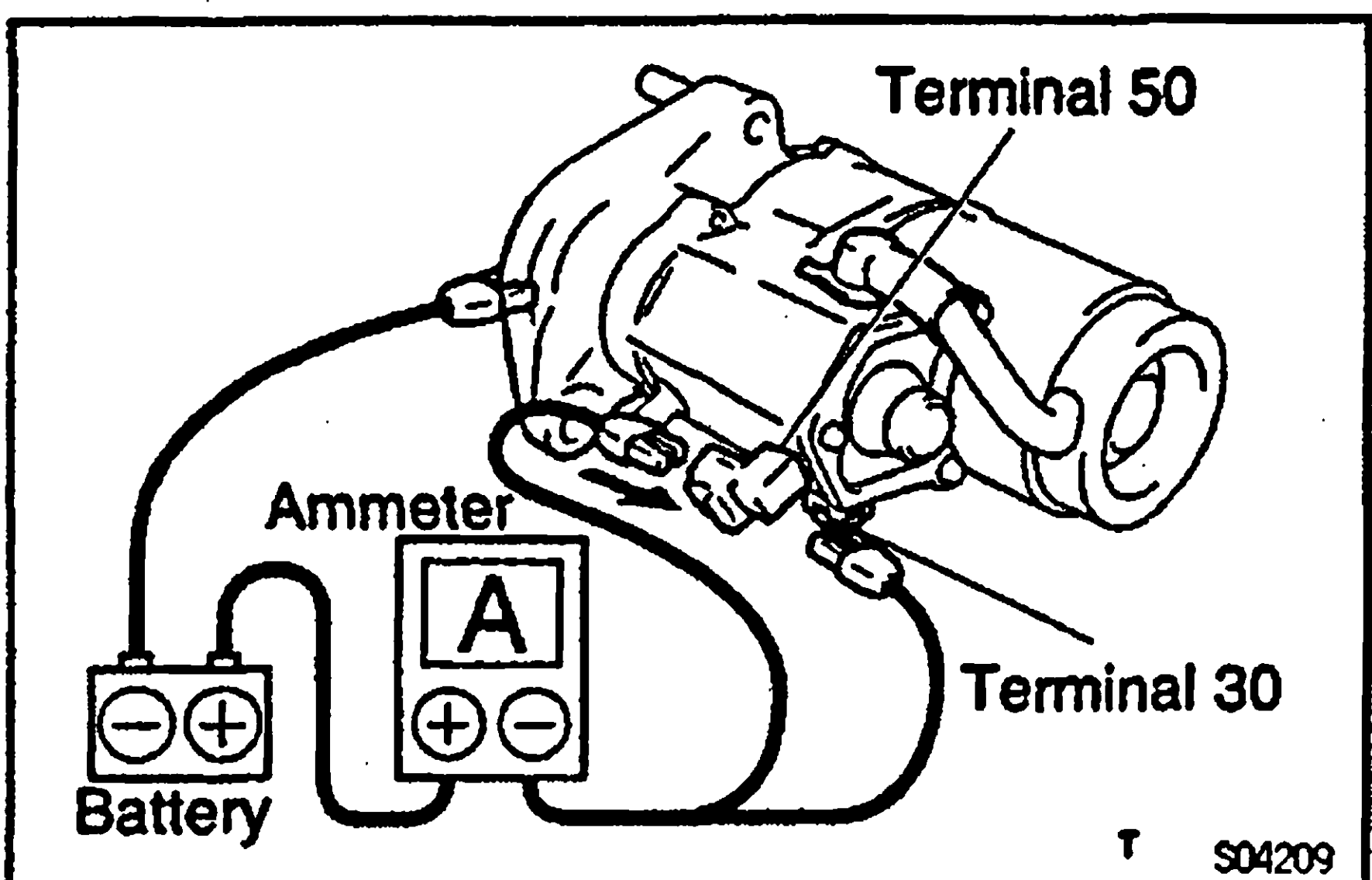
With battery connected as above with the clutch pinion gear out, disconnect the negative (—) lead from terminal C. Check that the pinion gear remains out. If the clutch pinion gear returns inward, replace the magnetic switch assembly.



3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (—) lead from the switch body.

Check that the clutch pinion gear returns inward. If the clutch pinion gear does not return, replace the magnetic switch assembly.



4. DO NO-LOAD PERFORMANCE TEST

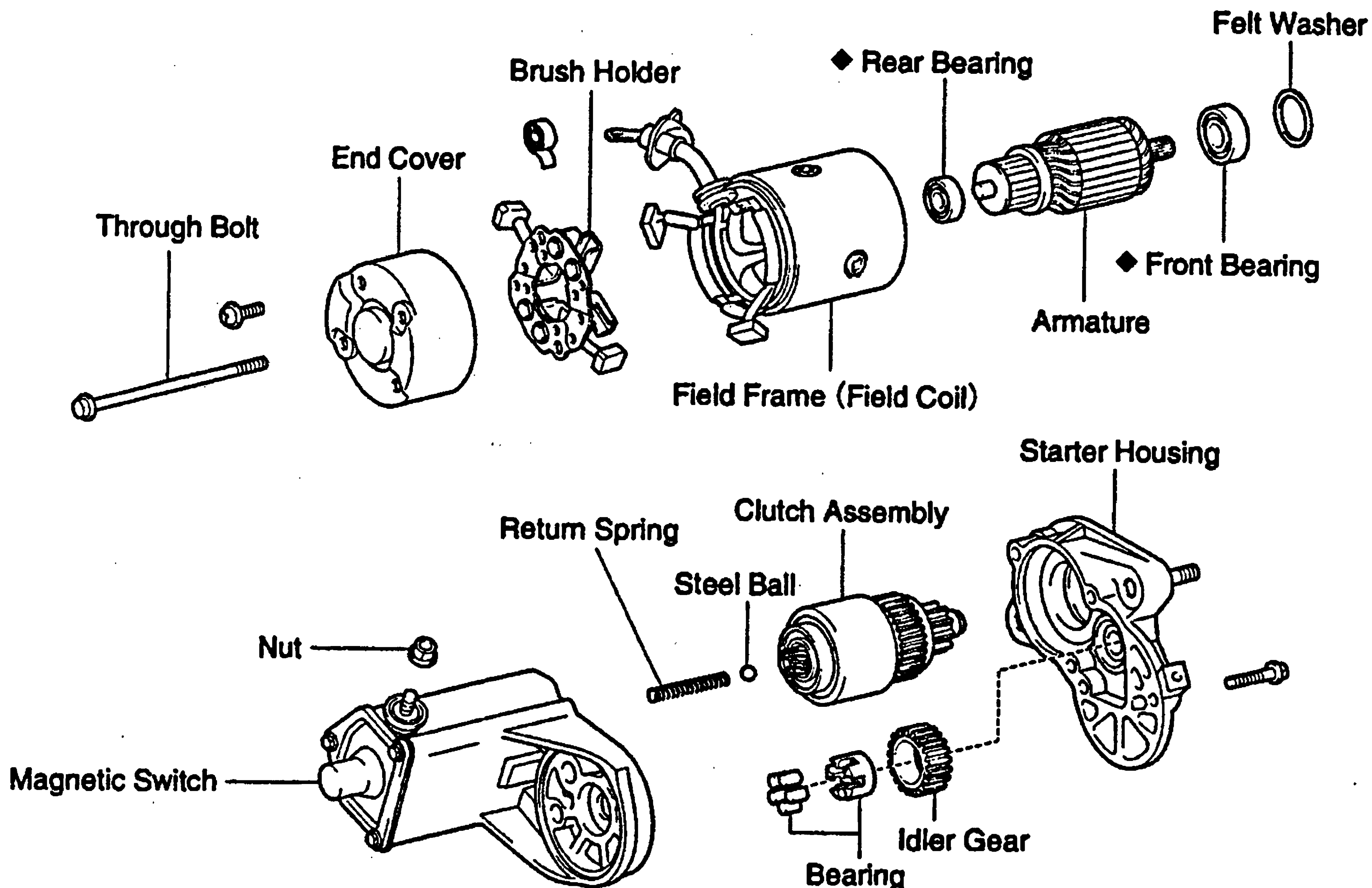
- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

120 A or less at 11.5 V

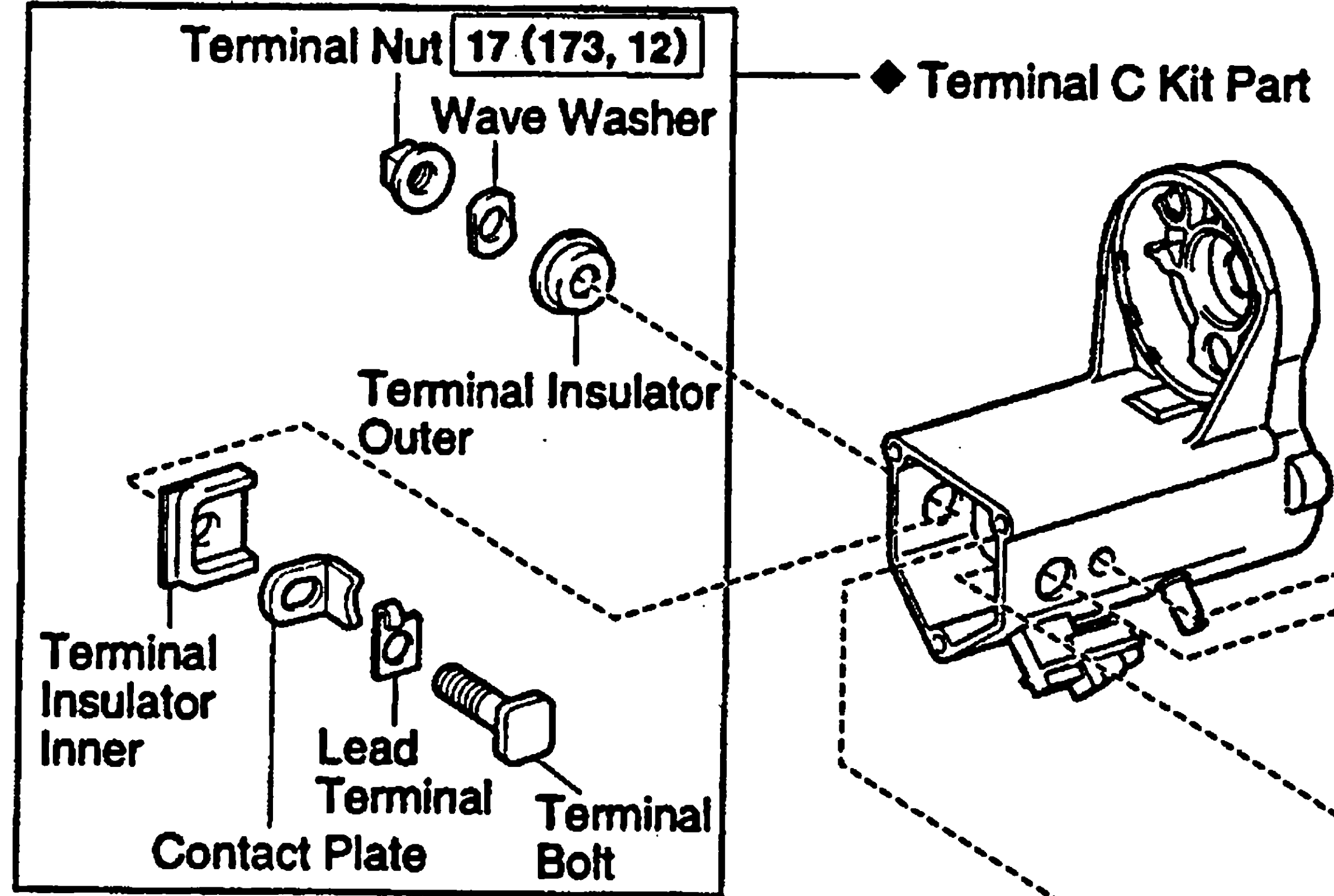
STARTER
(2.7 kW)
COMPONENTS FOR DISASSEMBLY AND
ASSEMBLY

ST00W-22

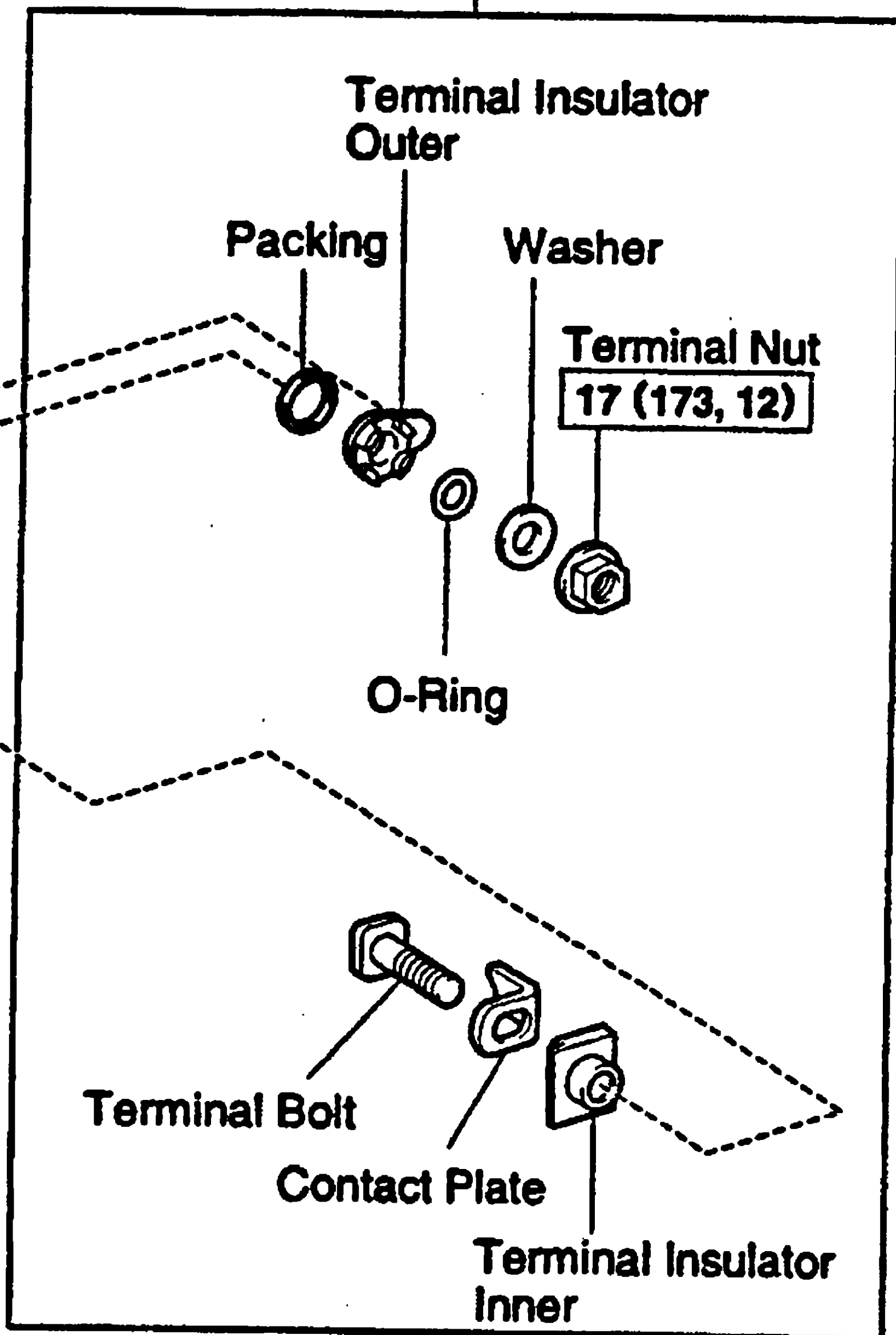


S04233

Magnetic Switch Assembly

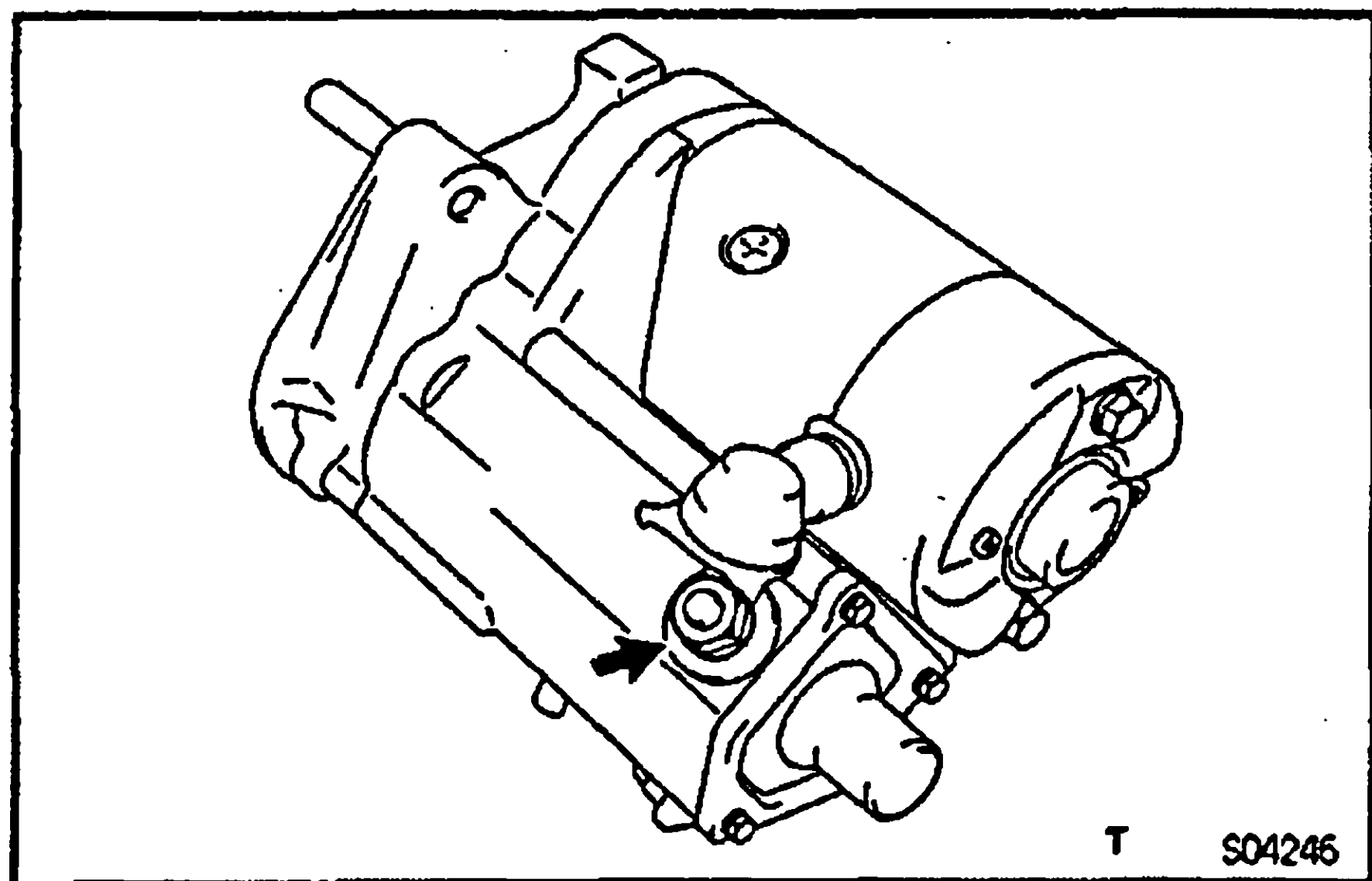


Terminal 30 Kit Part



S04234

N·m (kgf·cm, ft·lbf): Specified torque
◆ Non-reusable part

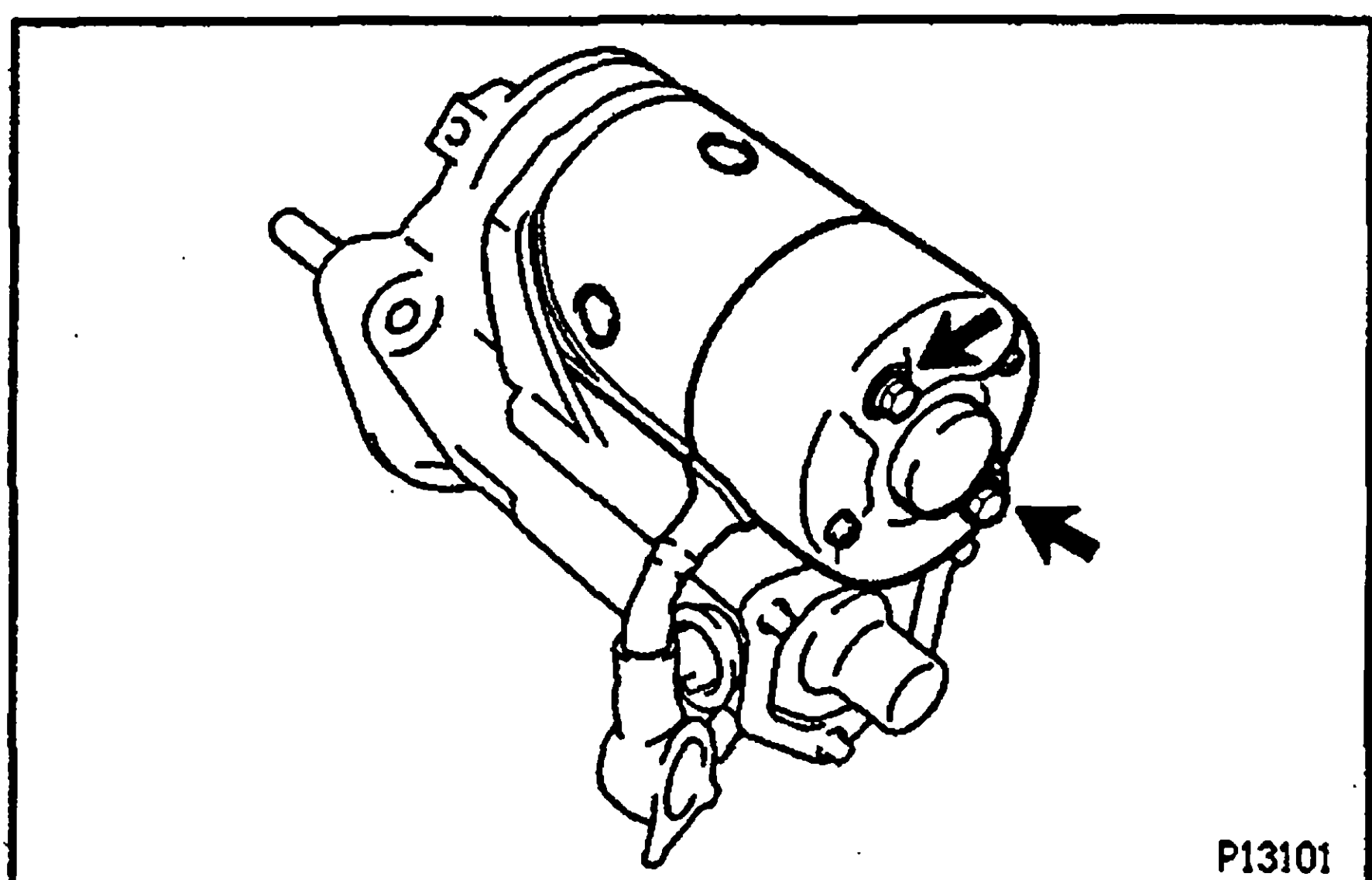


STARTER DISASSEMBLY

1. REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY

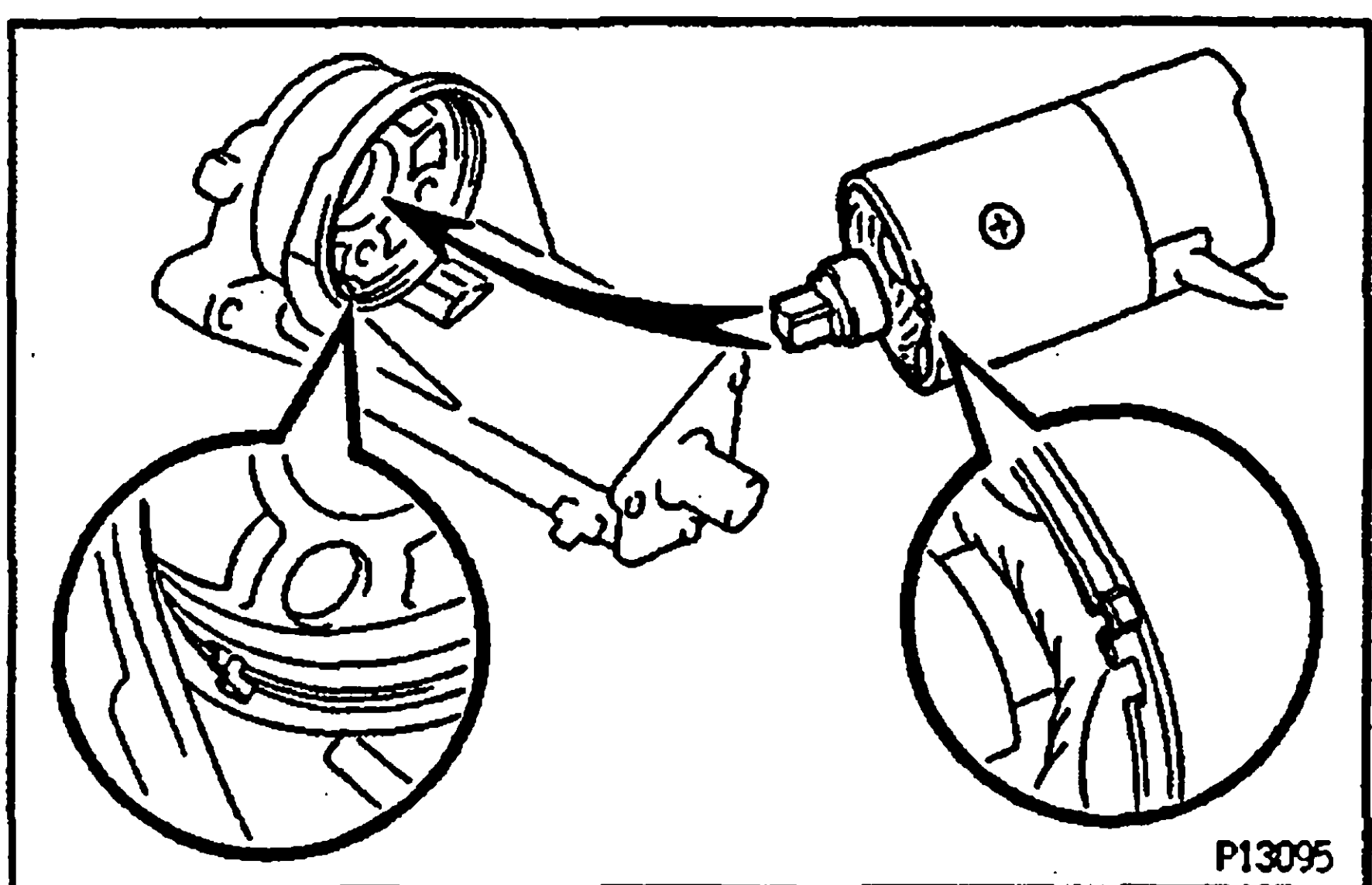
- (a) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.

Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)



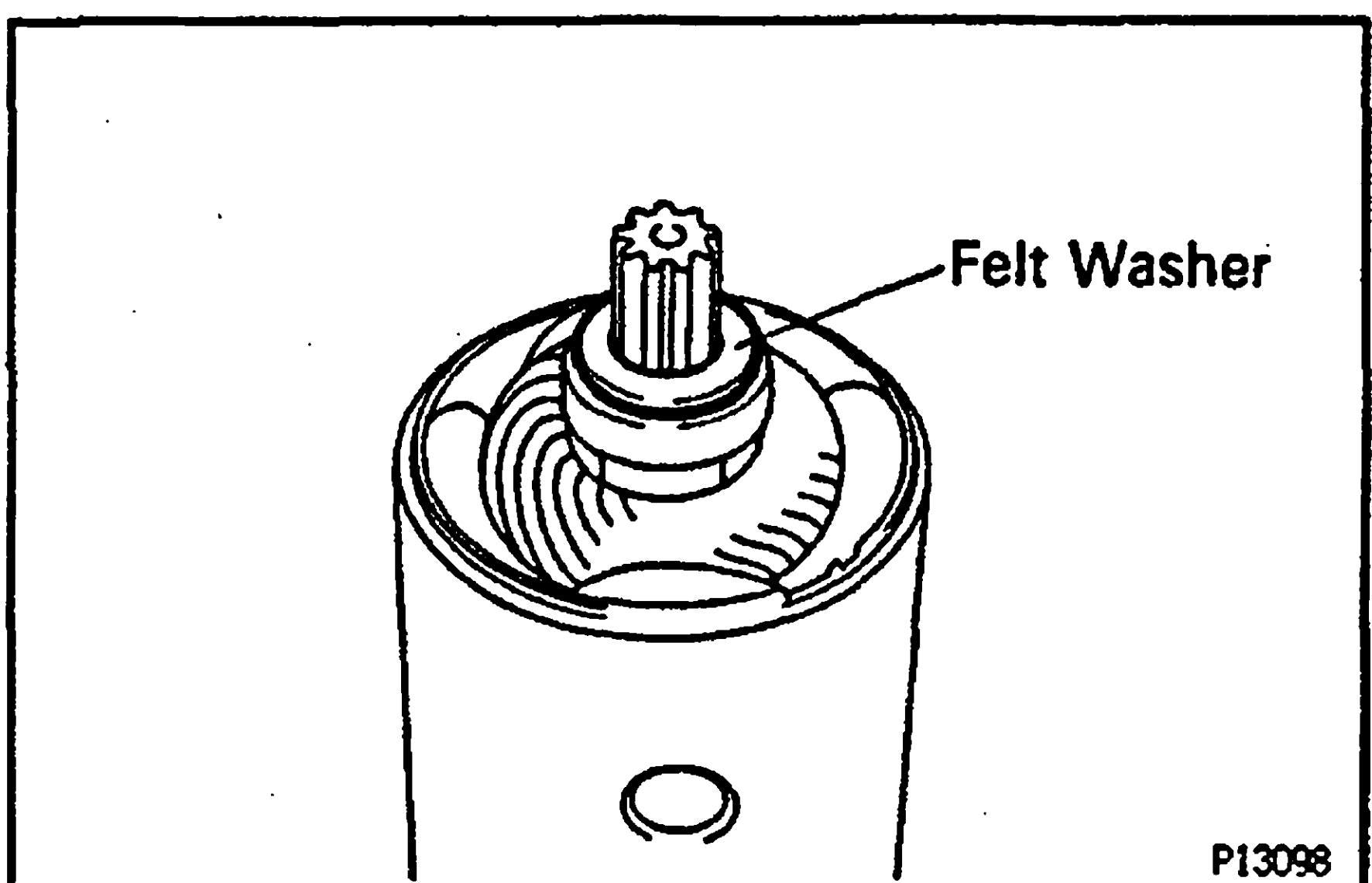
- (b) Remove the 2 through bolts.

Torque: 9.3 N·m (95 kgf·cm, 82 in·lbf)

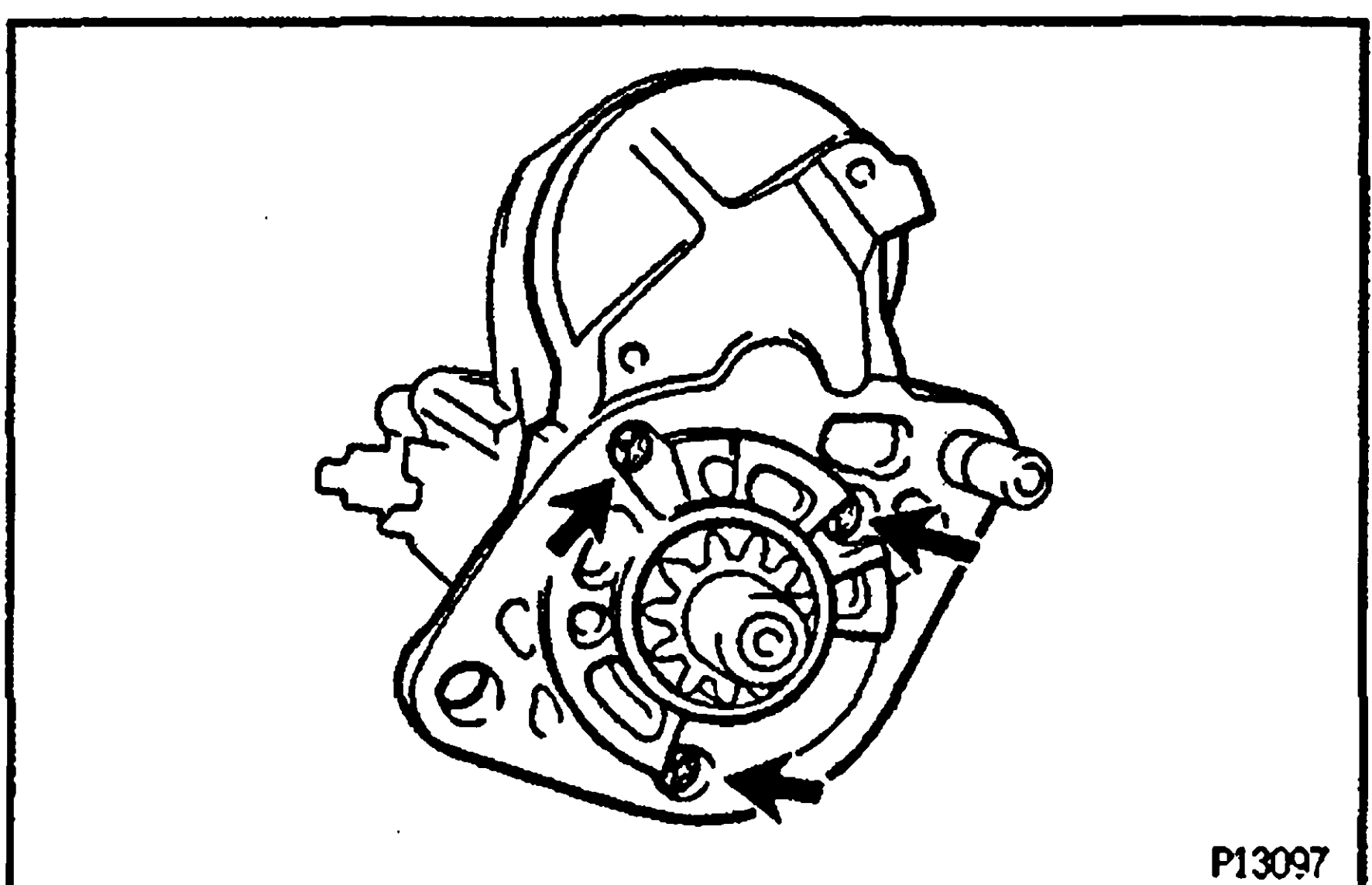


- (c) Pull out the field frame with the armature from the magnetic switch assembly.

ASSEMBLY NOTICE: Align the protrusion of the field frame with the cutout of the magnetic switch.



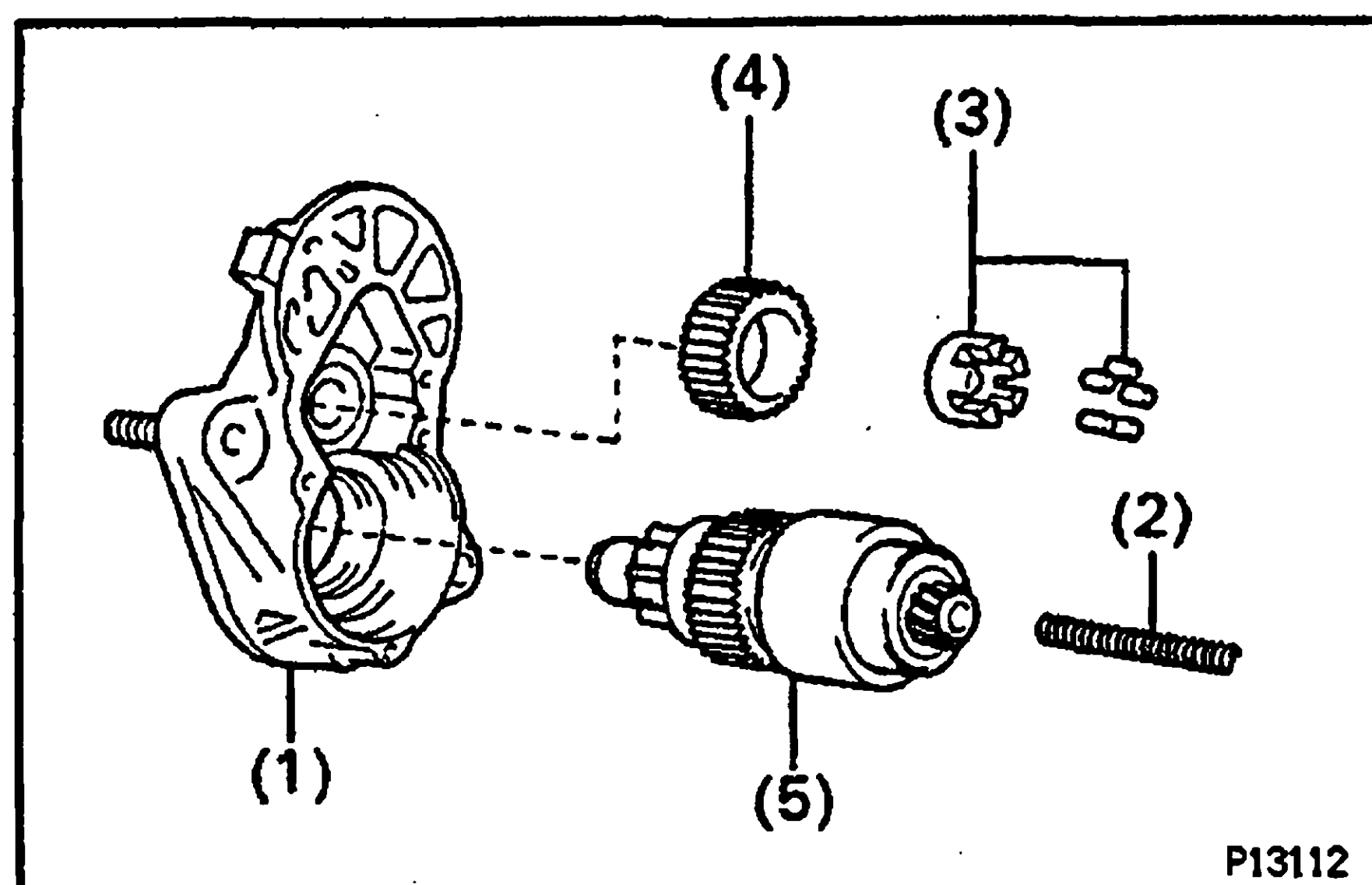
- (d) Remove the felt washer from the armature.



2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- (a) Remove the 3 screws.

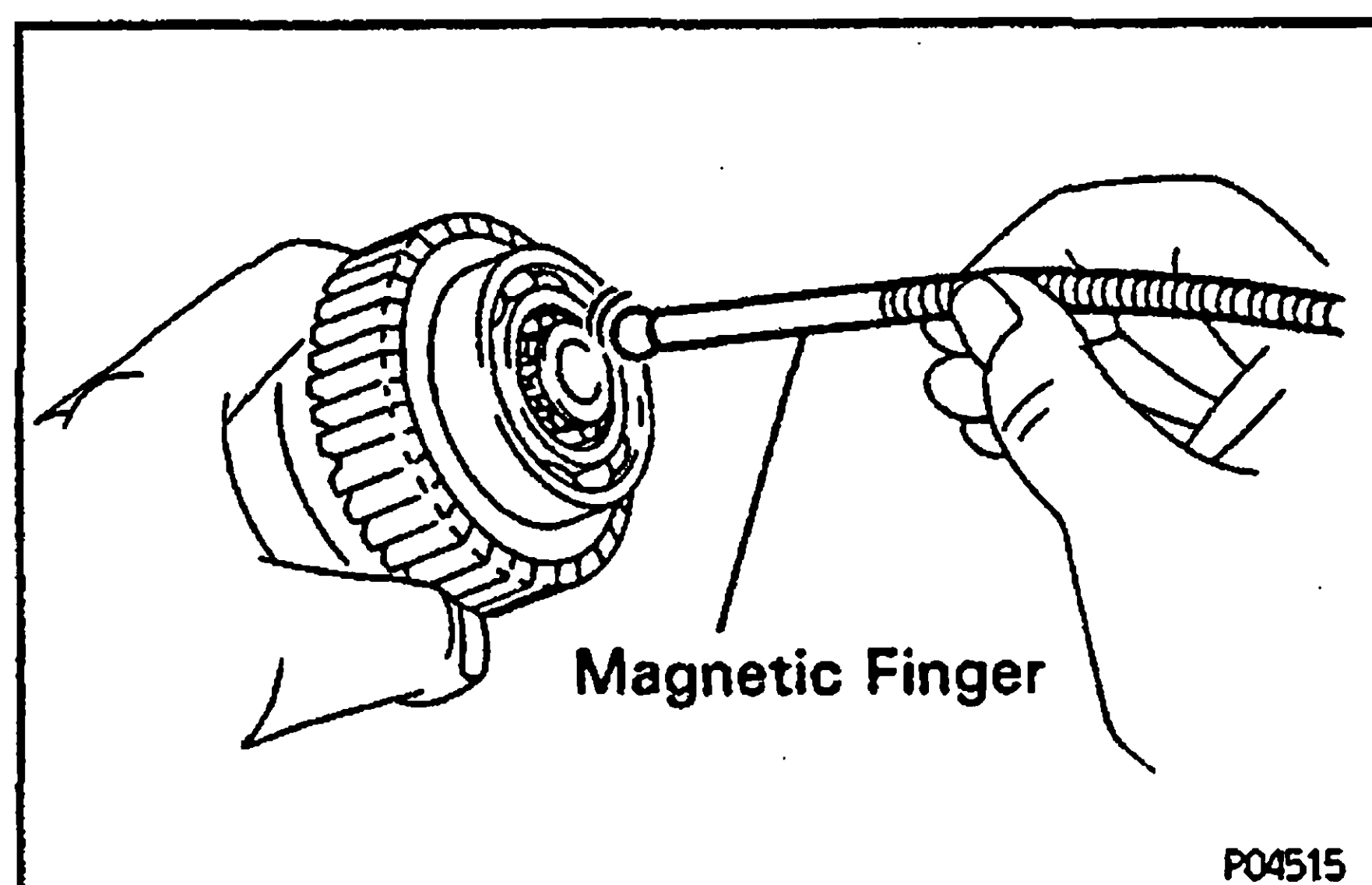
Torque: 9.3 N·m (95 kgf·cm, 82 in·lbf)



- (b) Remove these parts from the magnetic switch assembly:

- (1) Starter housing
- (2) Return spring
- (3) Bearing
- (4) Idler gear
- (5) Clutch assembly

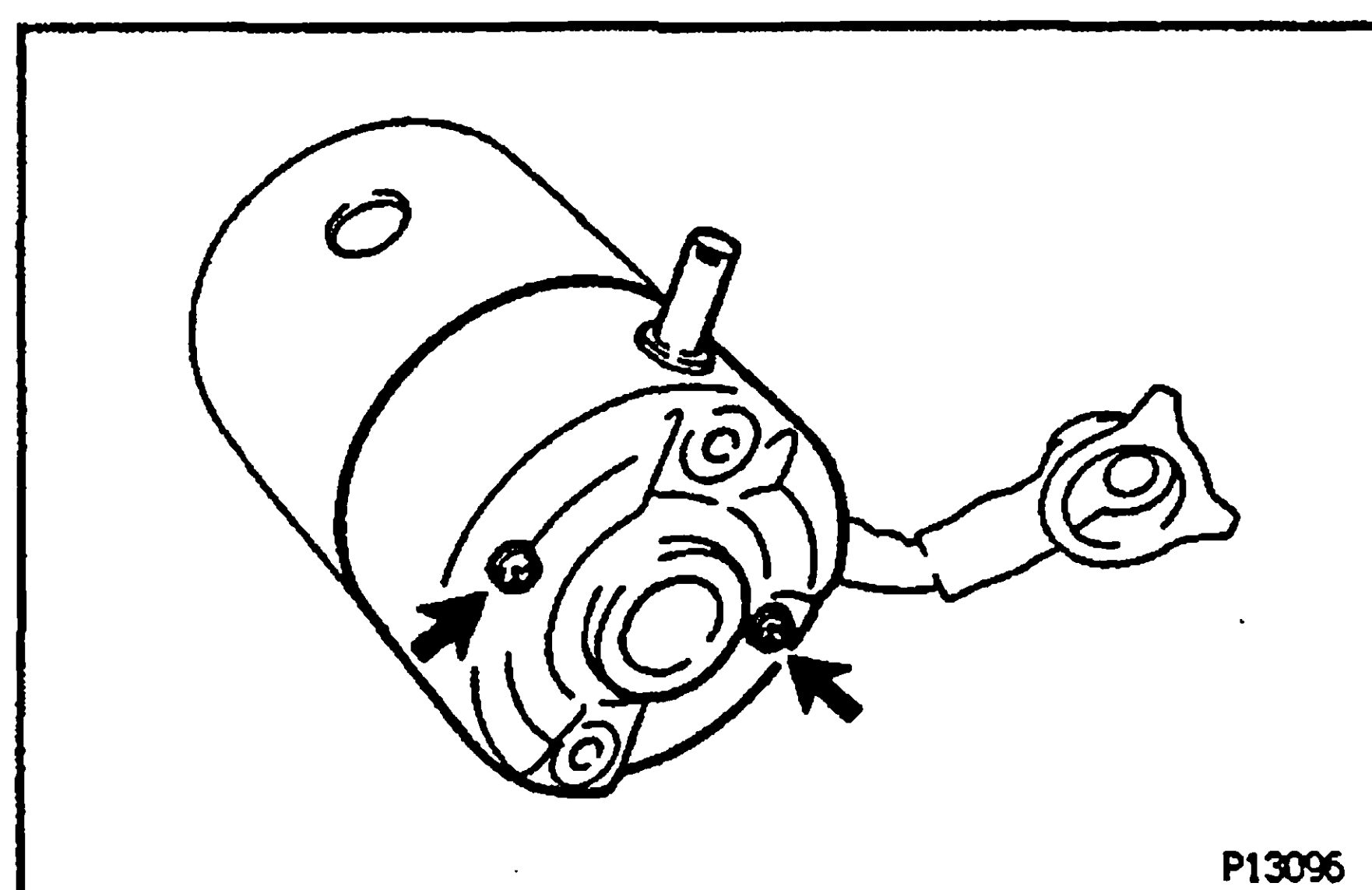
ASSEMBLY HINT: Apply grease to the return spring and insert the return spring into the clutch shaft hole.



3. REMOVE STEEL BALL

Using a magnetic finger, remove the steel ball from the clutch shaft hole.

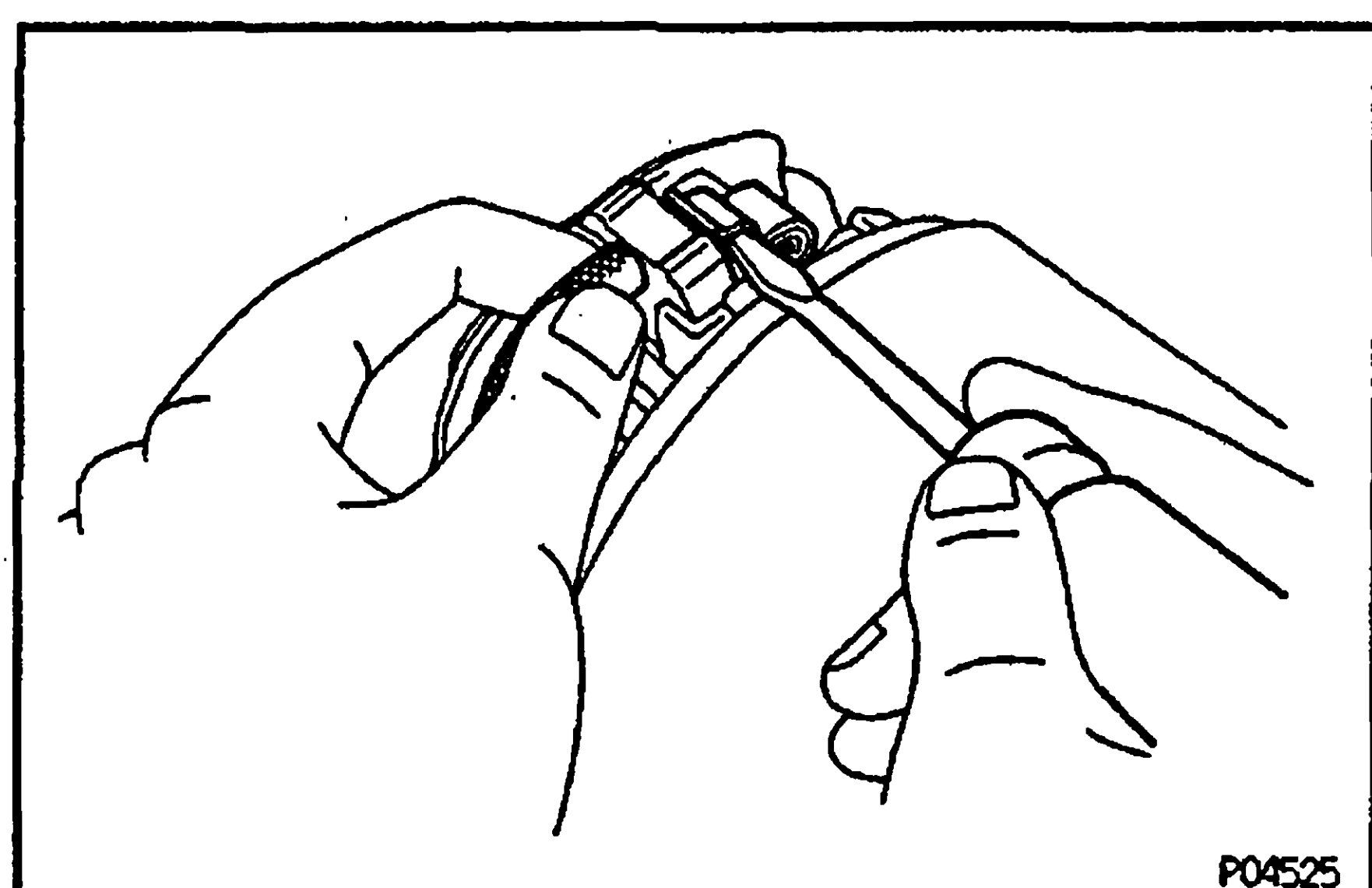
ASSEMBLY HINT: Apply grease to the steel ball and insert the steel ball into the clutch shaft hole.



4. REMOVE BRUSH HOLDER

- (a) Remove the 2 screws and end cover from the field frame.

Torque: 3.6 N·m (37 kgf·cm, 32 in·lbf)



- (b) Using a screwdriver, hold the spring tank back and disconnect the brush from the brush holder.
(c) Disconnect the 4 brushes and remove the brush holder.

ASSEMBLY NOTICE: Check that the positive (+) lead wire are not grounded.

5. REMOVE ARMATURE FROM FIELD FRAME

ASSEMBLY HINT: Use high-temperature grease to lubricate the bearing and gears when assembling the starter.

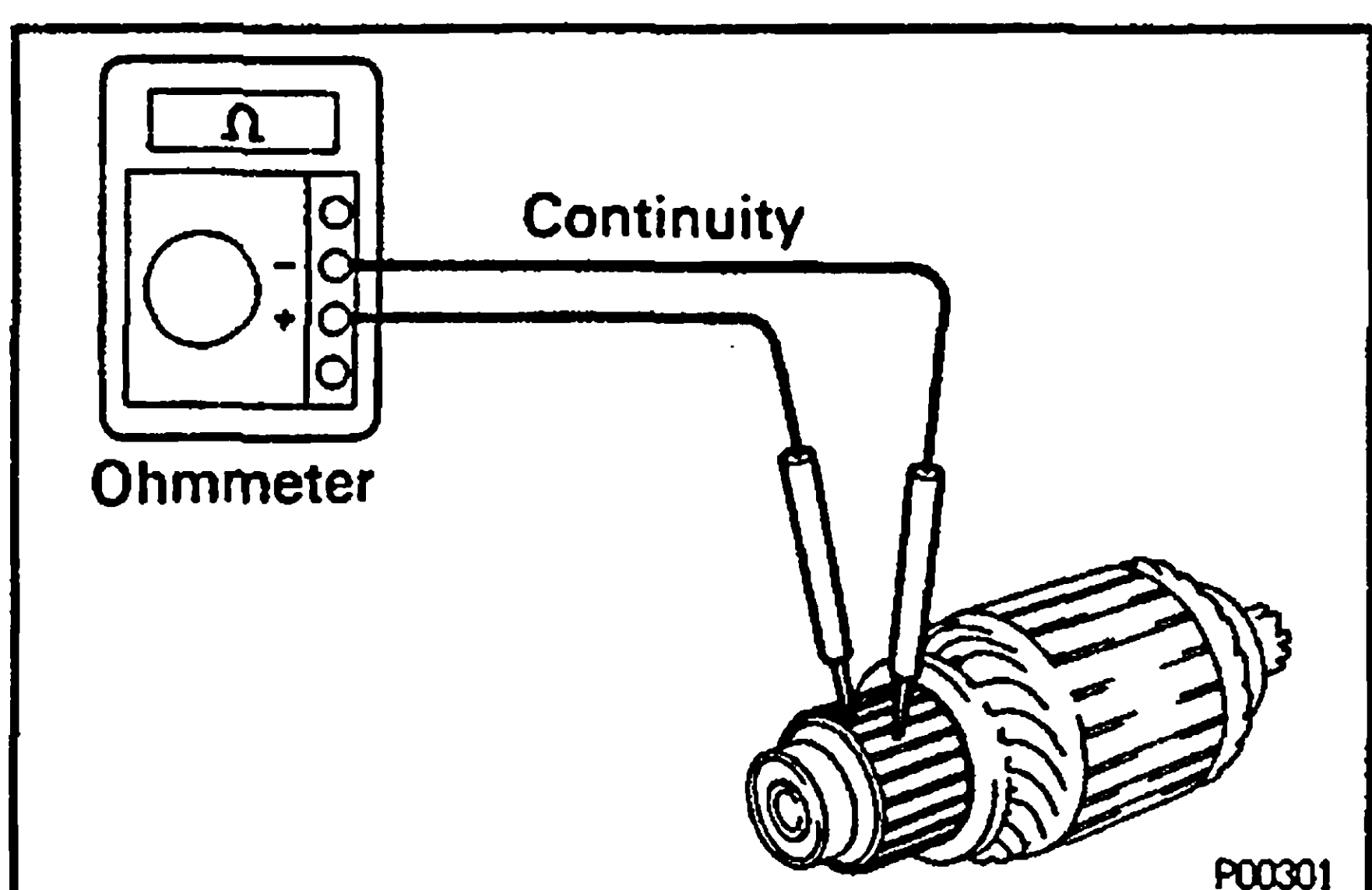
STARTER INSPECTION AND REPAIR

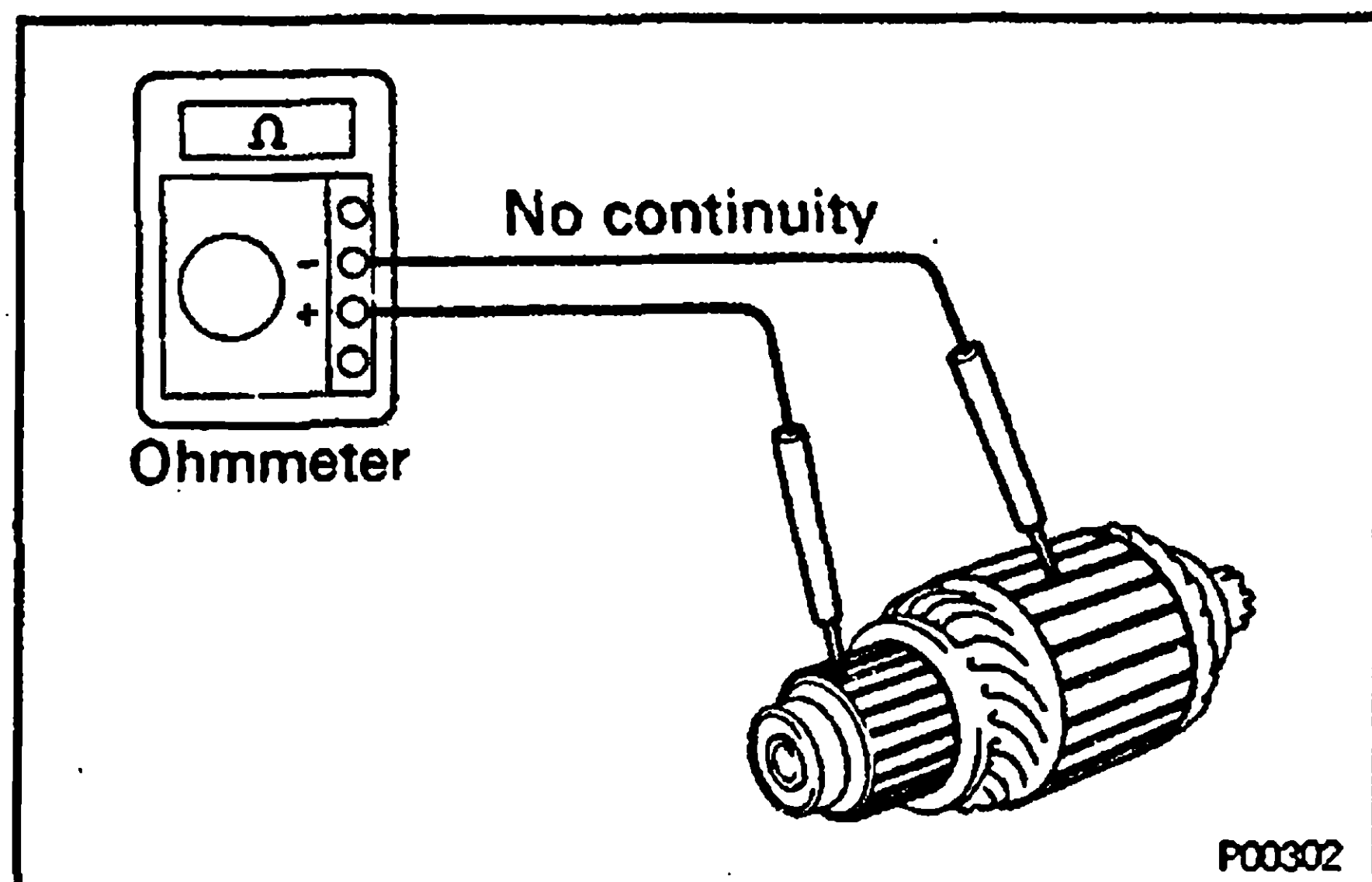
ST007-01

Armature Coil

1. INSPECT COMMUTATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the segments of the commutator. If there is no continuity between any segment, replace the armature.





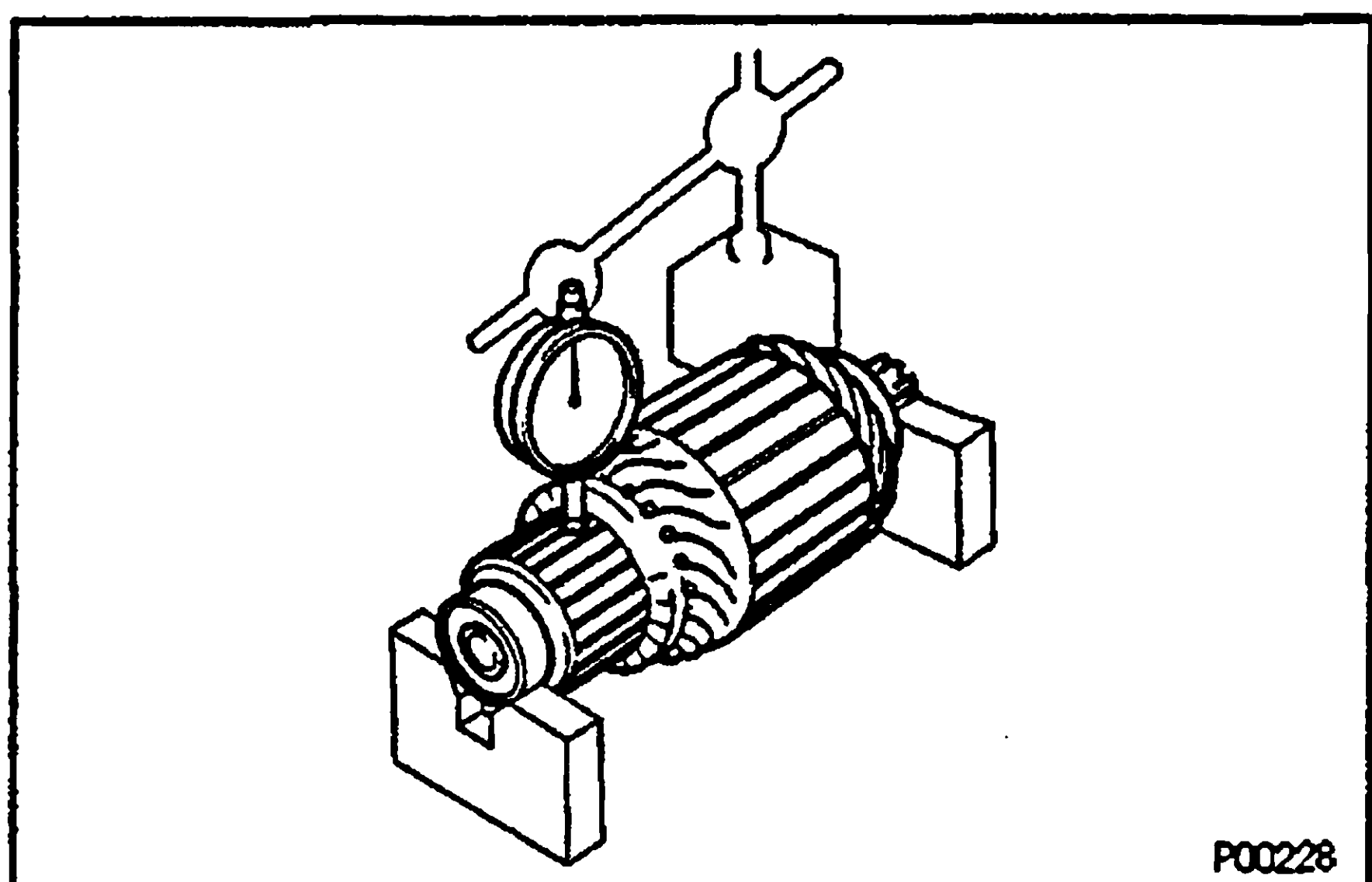
2. INSPECT COMMUTATOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the commutator and armature coil core. If there is continuity, replace the armature.

Commutator

1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.



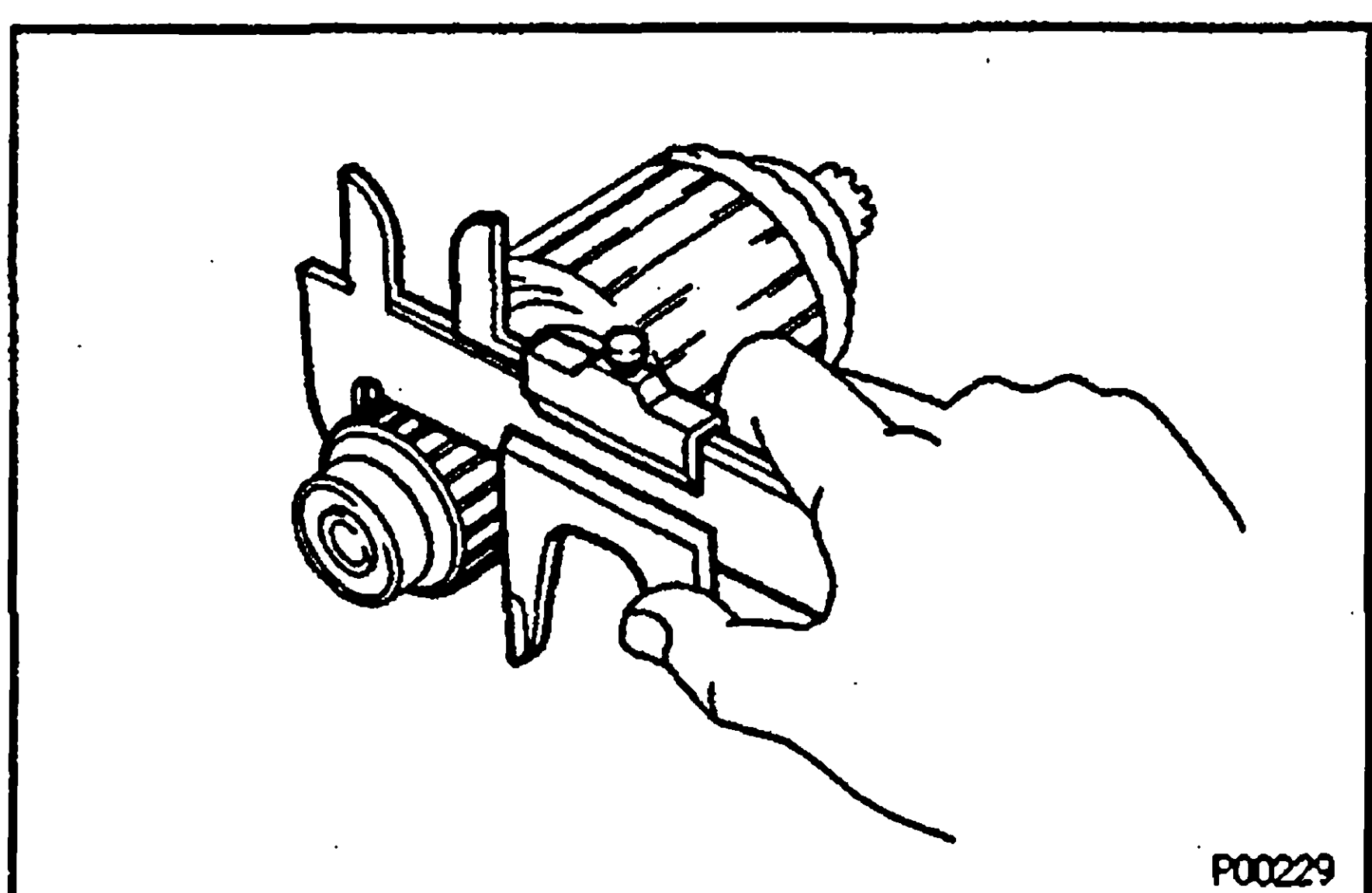
2. INSPECT COMMUTATOR CIRCLE RUNOUT

- Place the commutator on V-blocks.
- Using a dial gauge, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

If the circle runout is greater than maximum, correct it on a lathe.



3. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, measure the commutator diameter.

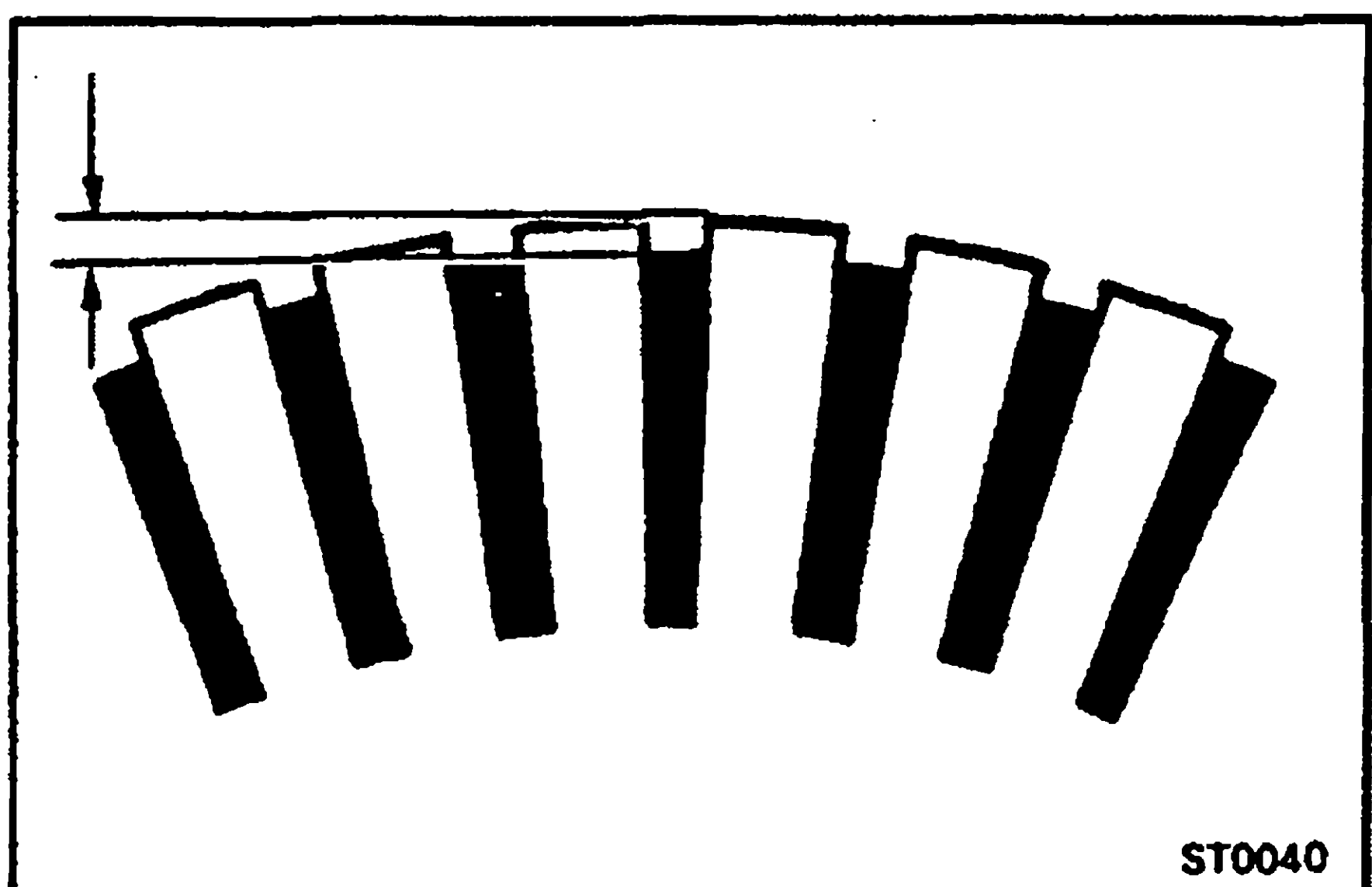
Standard diameter:

36 mm (1.42 in.)

Minimum diameter:

35 mm (1.38 in.)

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



4. INSPECT UNDERCUT DEPTH

Check that the undercut depth is clean and free of foreign materials. Smooth out the edge.

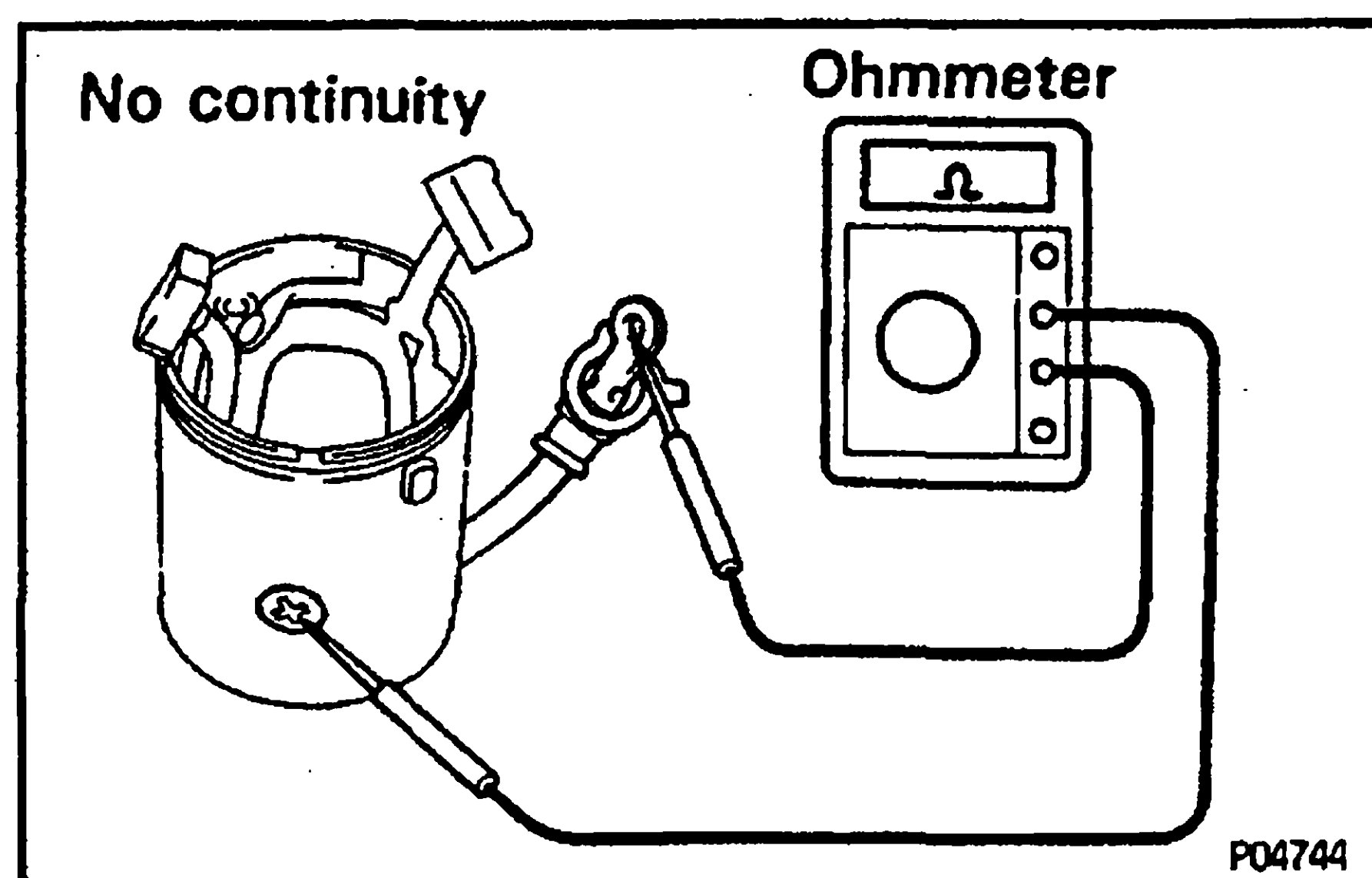
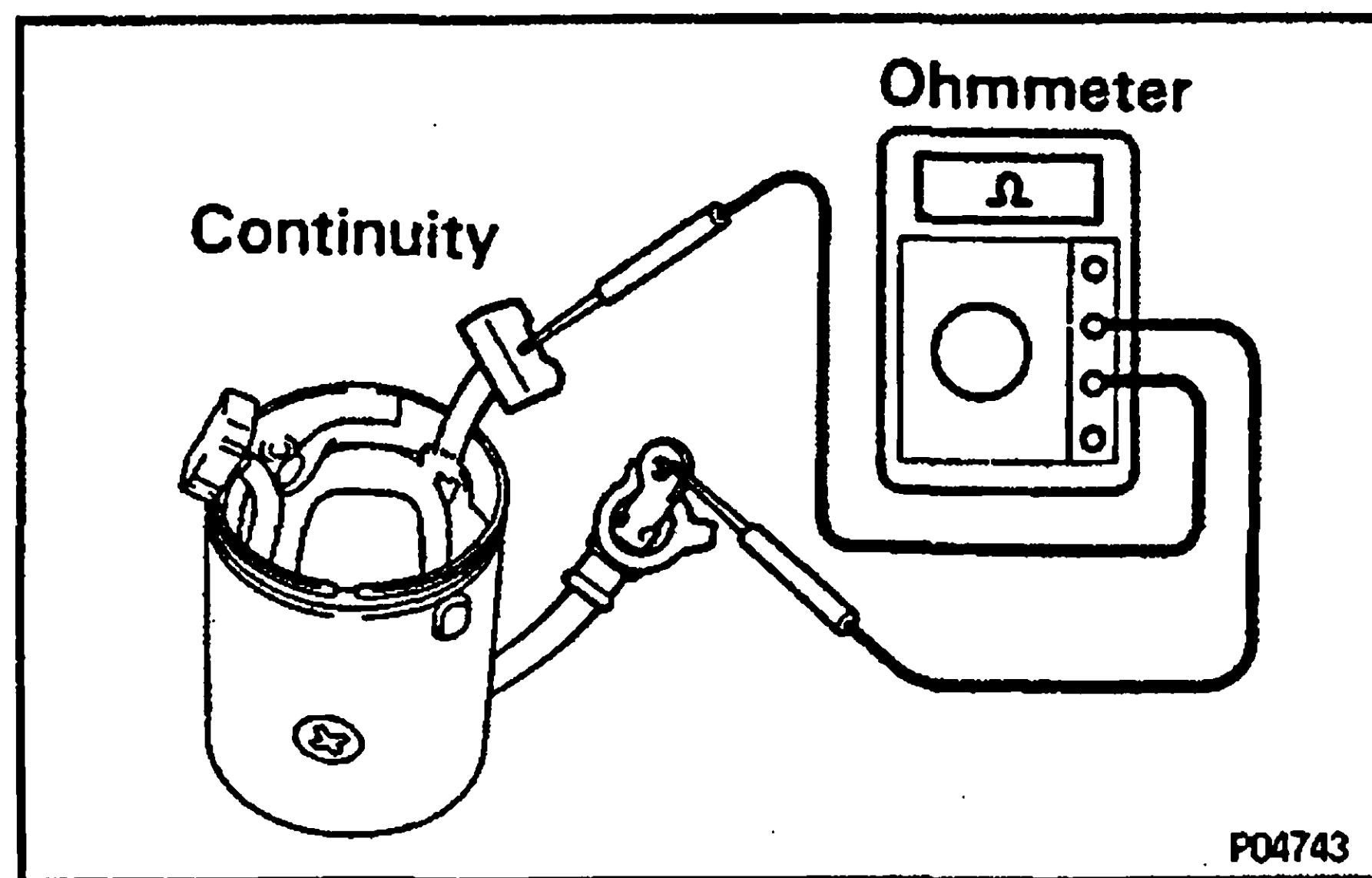
Standard undercut depth:

0.7 mm (0.028 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

If the undercut depth is less than minimum, correct it with a hacksaw blade.



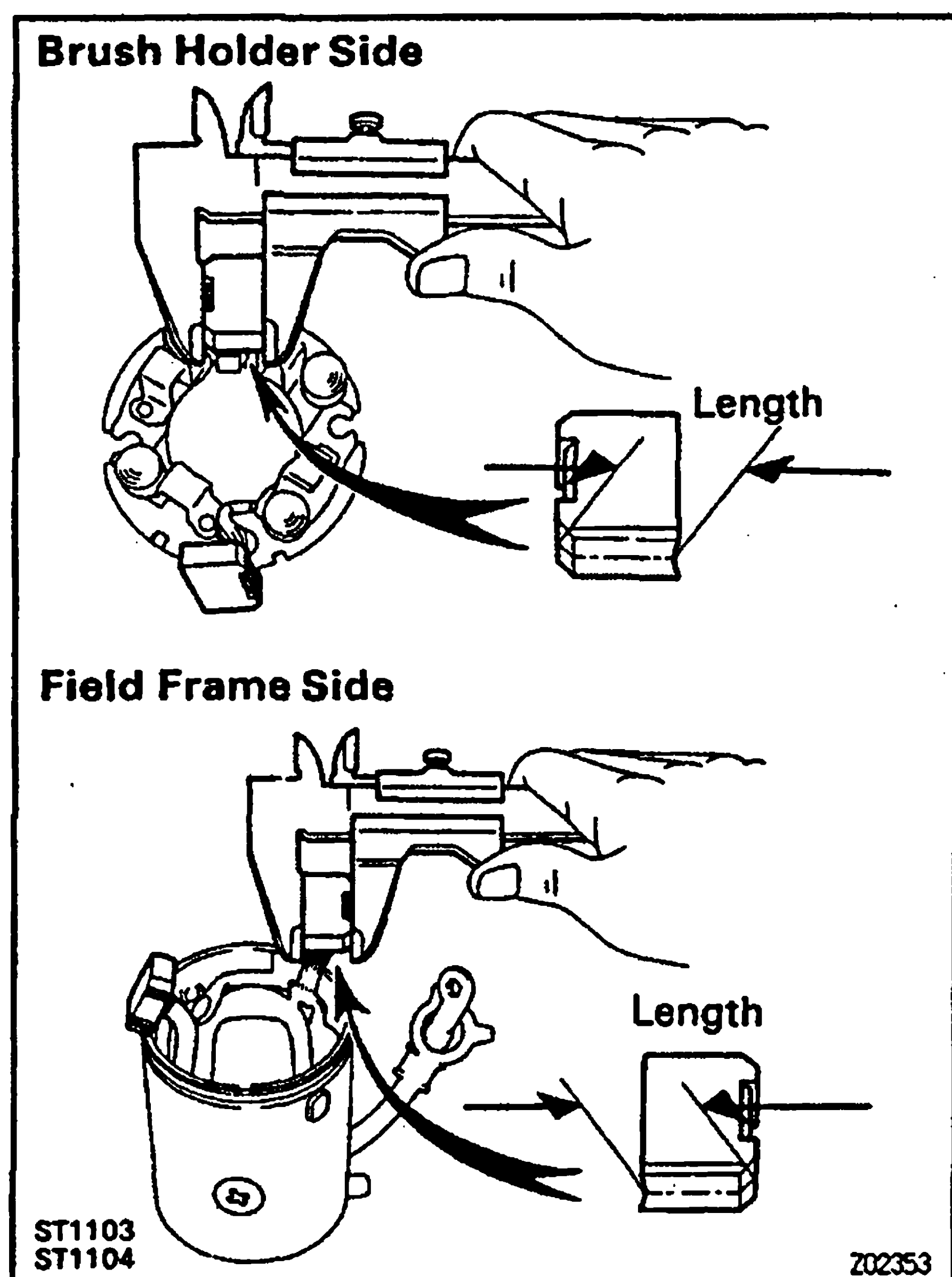
Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead. If there is no continuity, replace the field frame.

2. INSPECT FIELD COIL FOR GROUND

Using an ohmmeter, check that there is no continuity between the field coil end and field frame. If there is continuity, repair or replace the field frame.



Brushes

INSPECT BRUSH LENGTH

Using a vernier caliper, measure the brush length.

Standard length:

20.5 mm (0.807 in.)

Minimum length:

11 mm (0.433 in.)

If the length is less than minimum, replace the brush holder and field frame.

Brush Springs

INSPECT BRUSH SPRING LOAD

Take the pull scale reading the instant the brush spring separates from the brush.

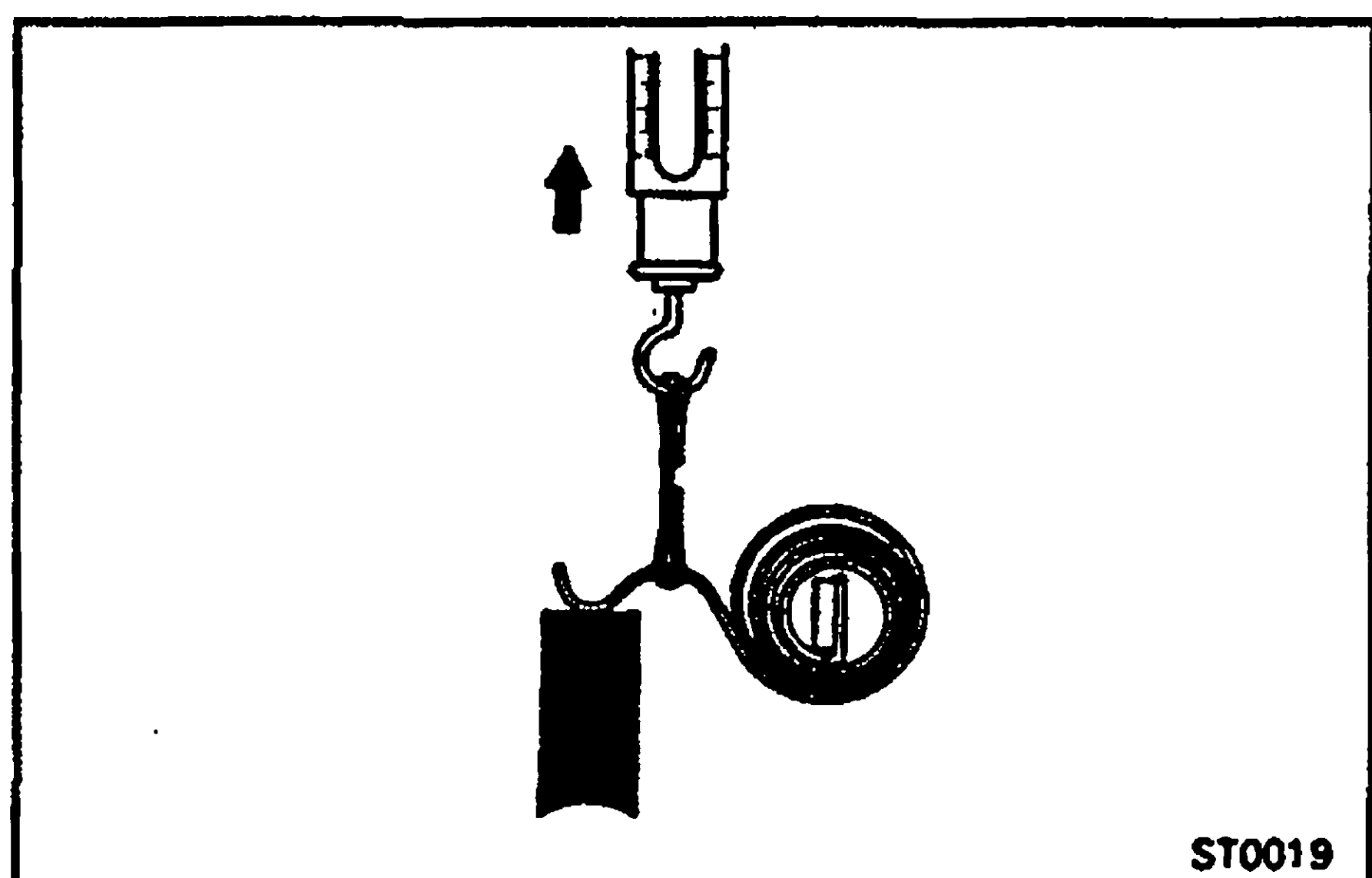
Standard spring installed load:

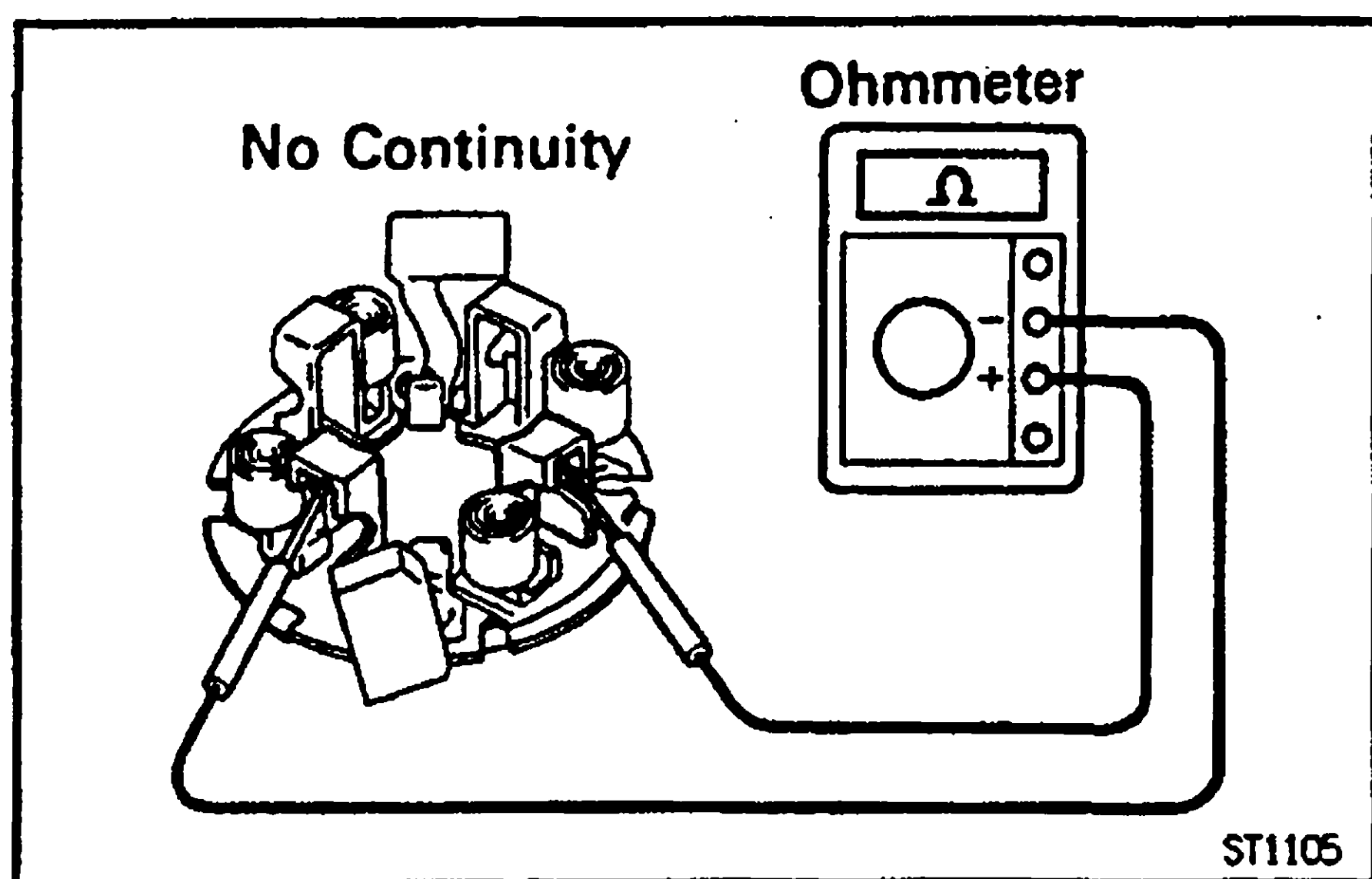
34.3 — 42.1 N (3.5 — 4.3 kgf, 7.7 — 9.5 lbf)

Minimum spring installed load:

18.6 N (1.9 kgf, 4.2 lbf)

If the installed load is less than minimum replace the brush springs.





Brush Holder

INSPECT BRUSH HOLDER INSULATION

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (-) brush holders.

If there is continuity, repair or replace the brush holder.

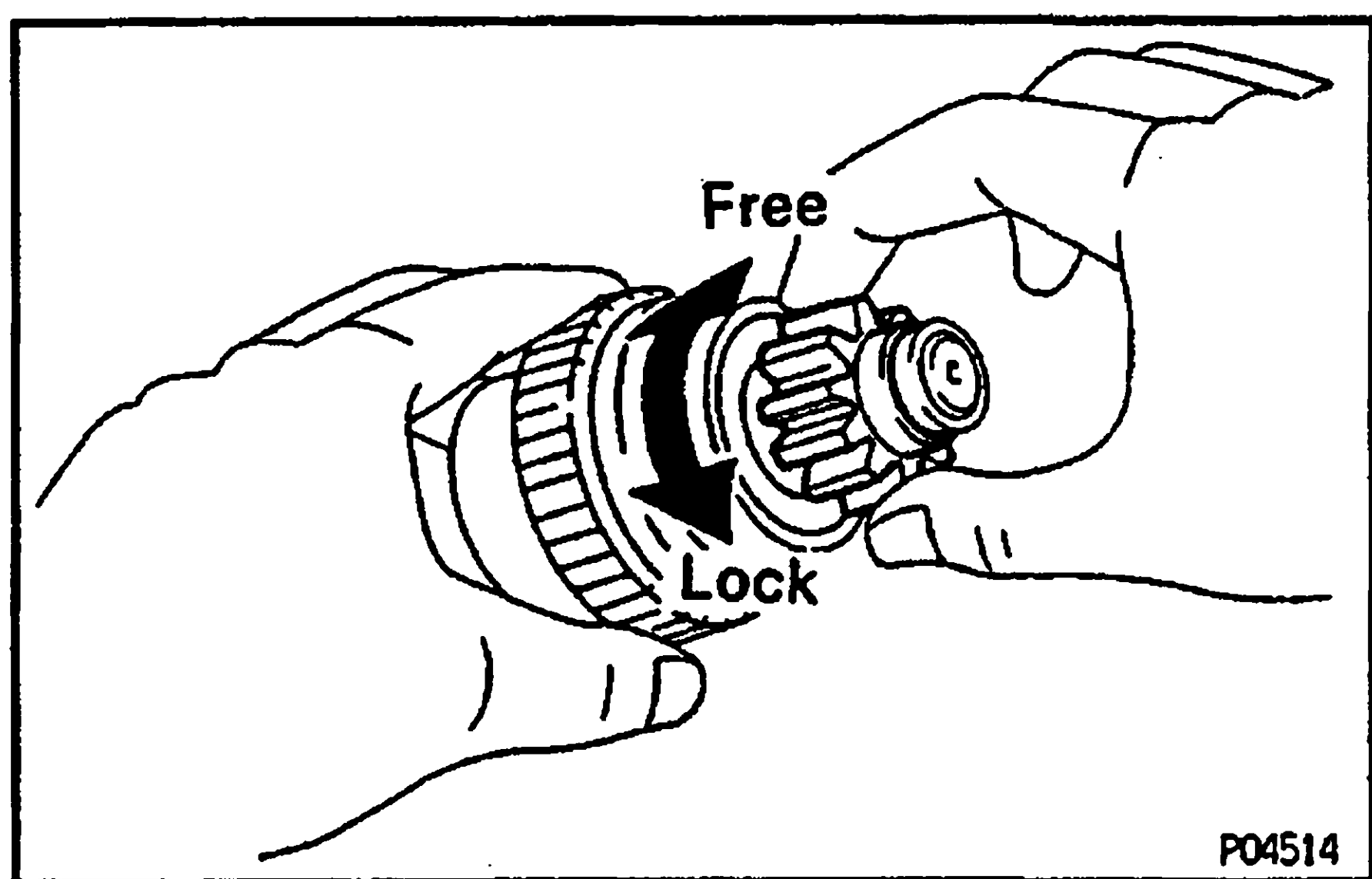
Clutch and Gears

1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idle gear and clutch assembly for wear or damage.

If damaged, replace the gear or clutch assembly.

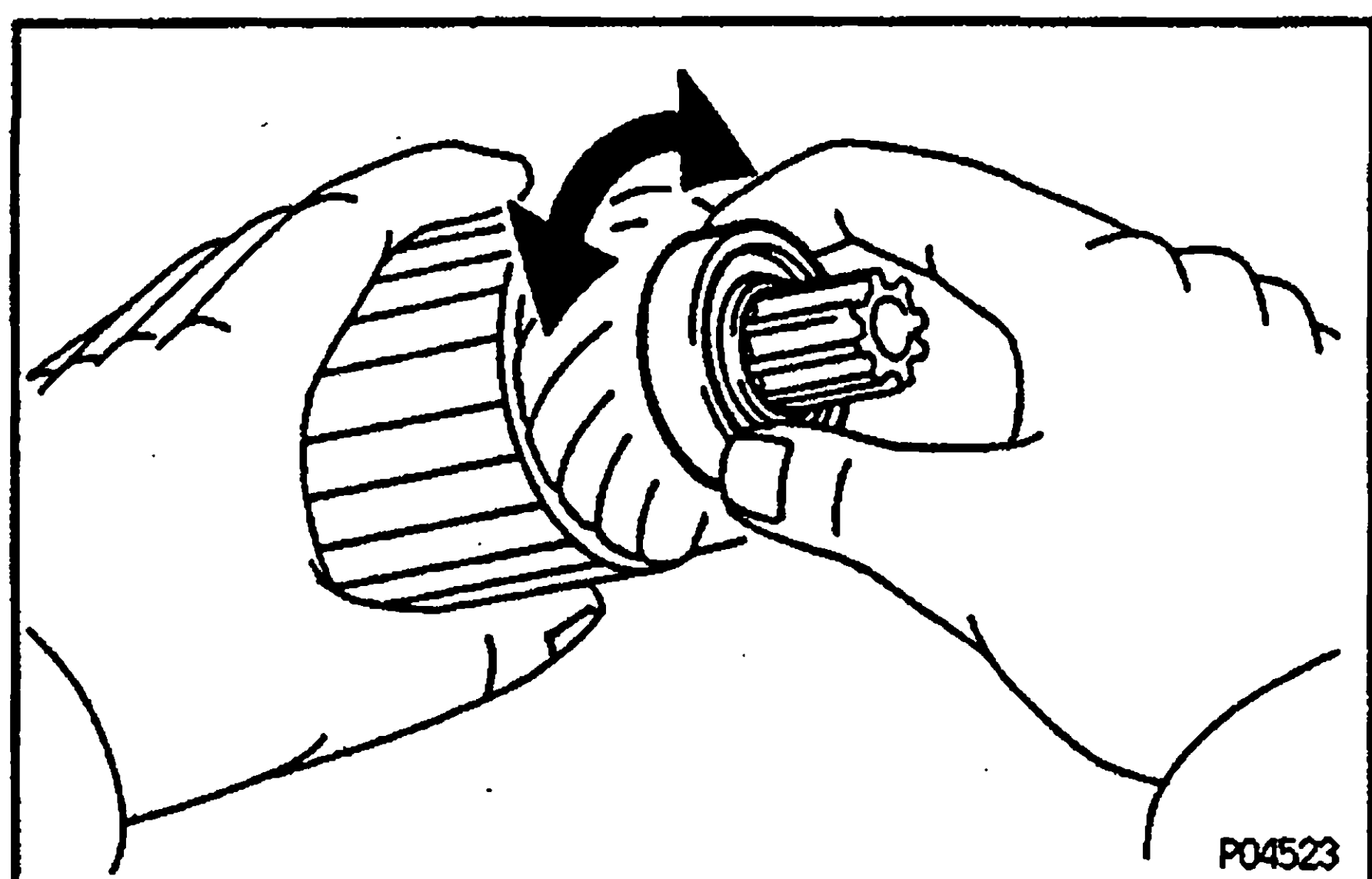
If damaged, also check the drive plate ring gear for wear or damage.



2. INSPECT CLUTCH PINION GEAR

Hold the starter clutch and rotate the pinion gear clockwise, and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

If necessary, replace the clutch assembly.



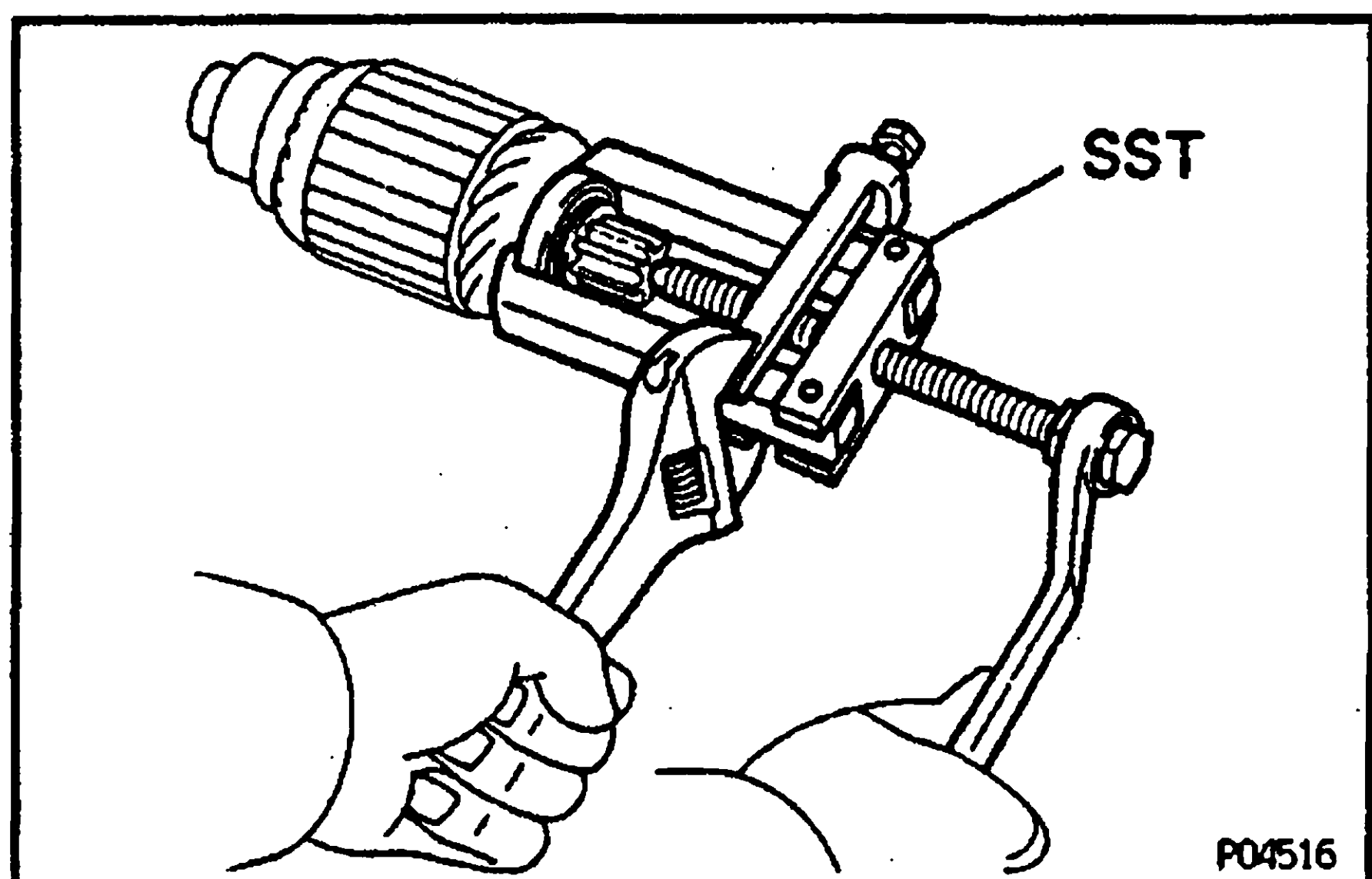
Bearings

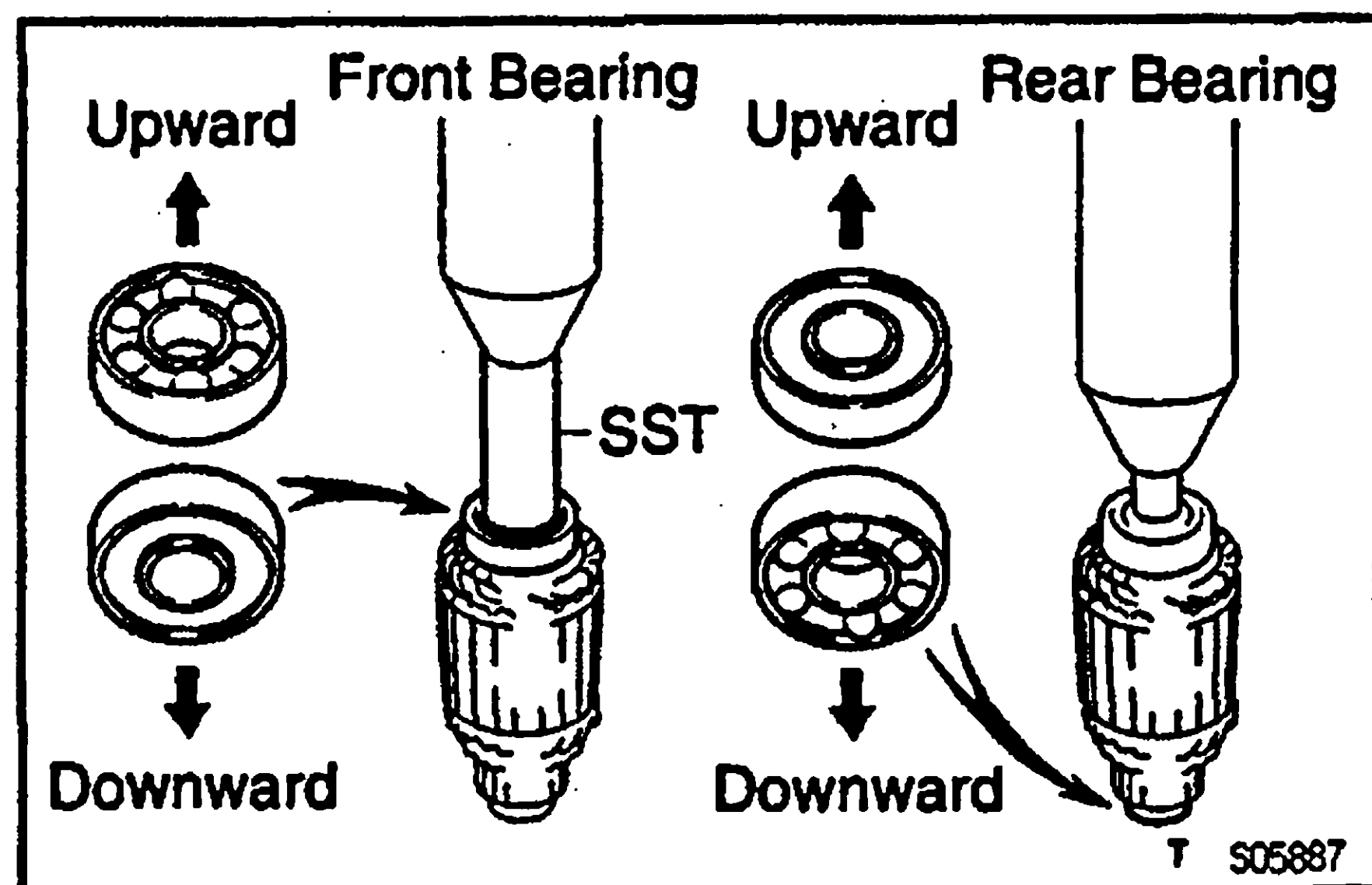
1. INSPECT BEARINGS

Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.

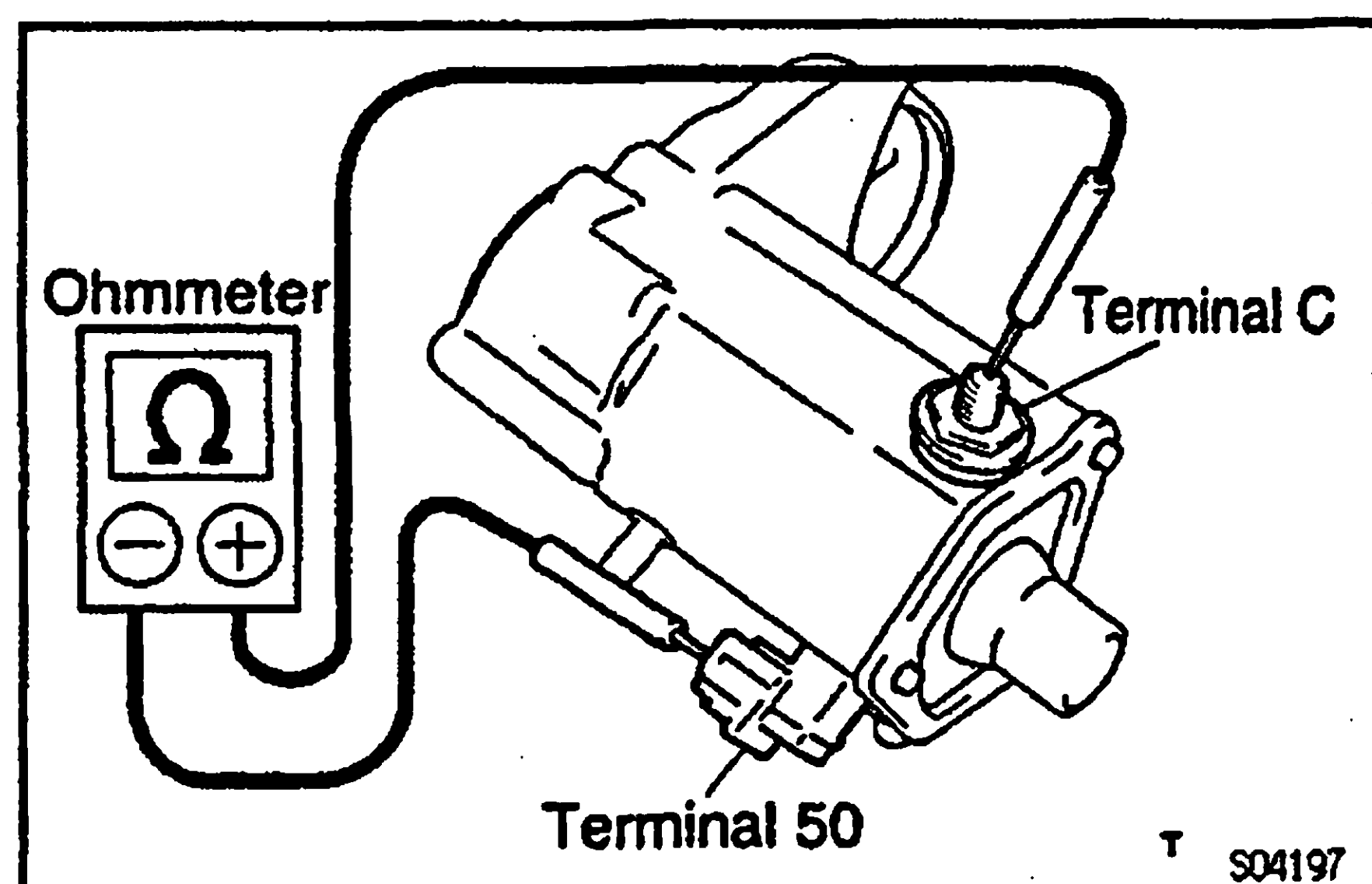
2. IF NECESSARY, REPLACE BEARINGS

- (a) Using SST, remove the bearing.
SST 09286-46011





- (b) Using SST and a press, press in a new front bearing.
SST 09820-00030
- (c) Using a press, press in a new rear bearing.
Notice: Be careful of the bearing installation direction.



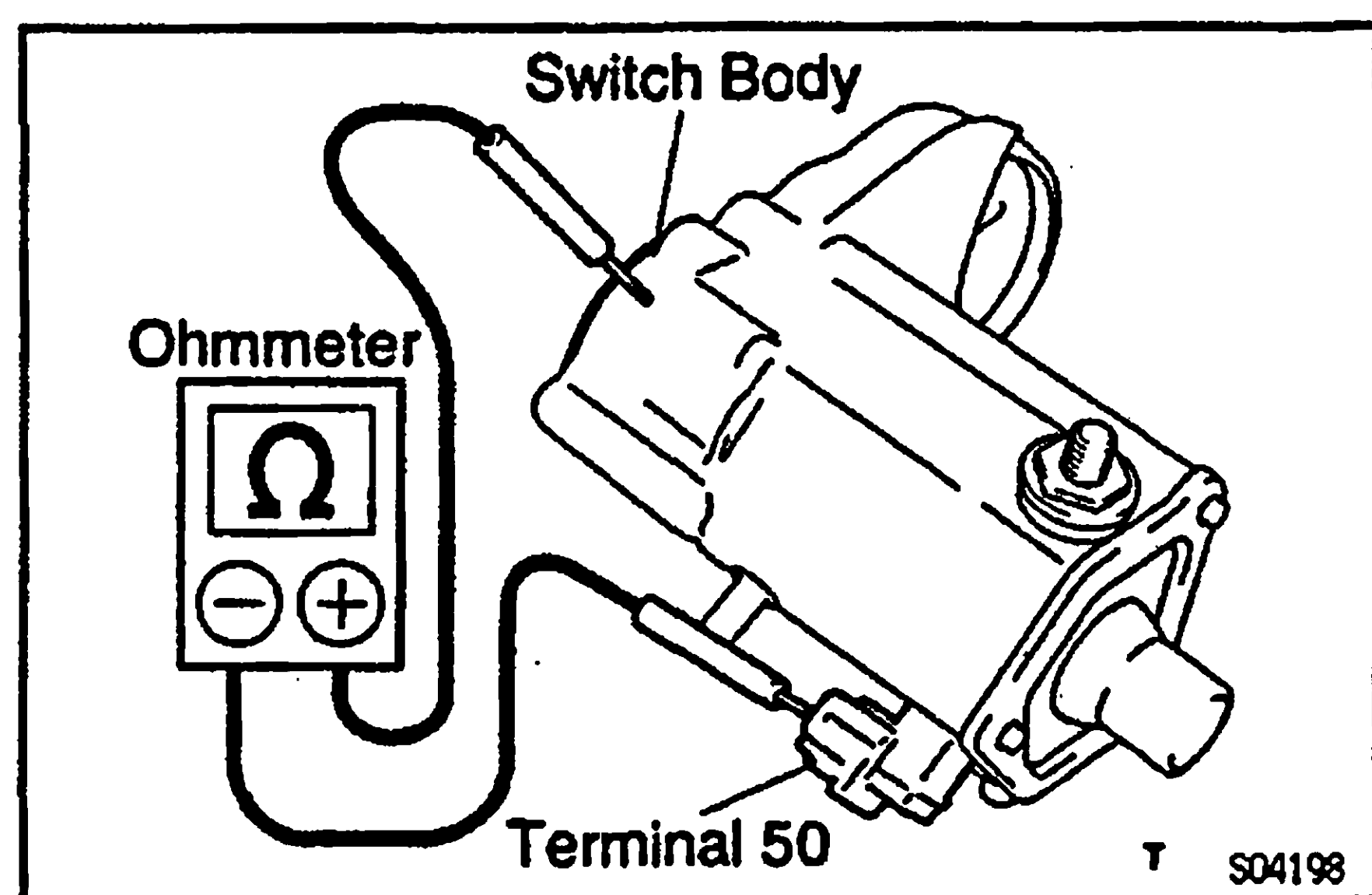
Magnetic Switch

1. DO PULL-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C.
If there is no continuity, replace the magnetic switch.

2. DO HOLD-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.
If there is no continuity, replace the magnetic switch.



MAGNETIC SWITCH TERMINAL KIT PARTS REPLACEMENT

ST0C2-08

1. REMOVE MAGNETIC SWITCH END COVER

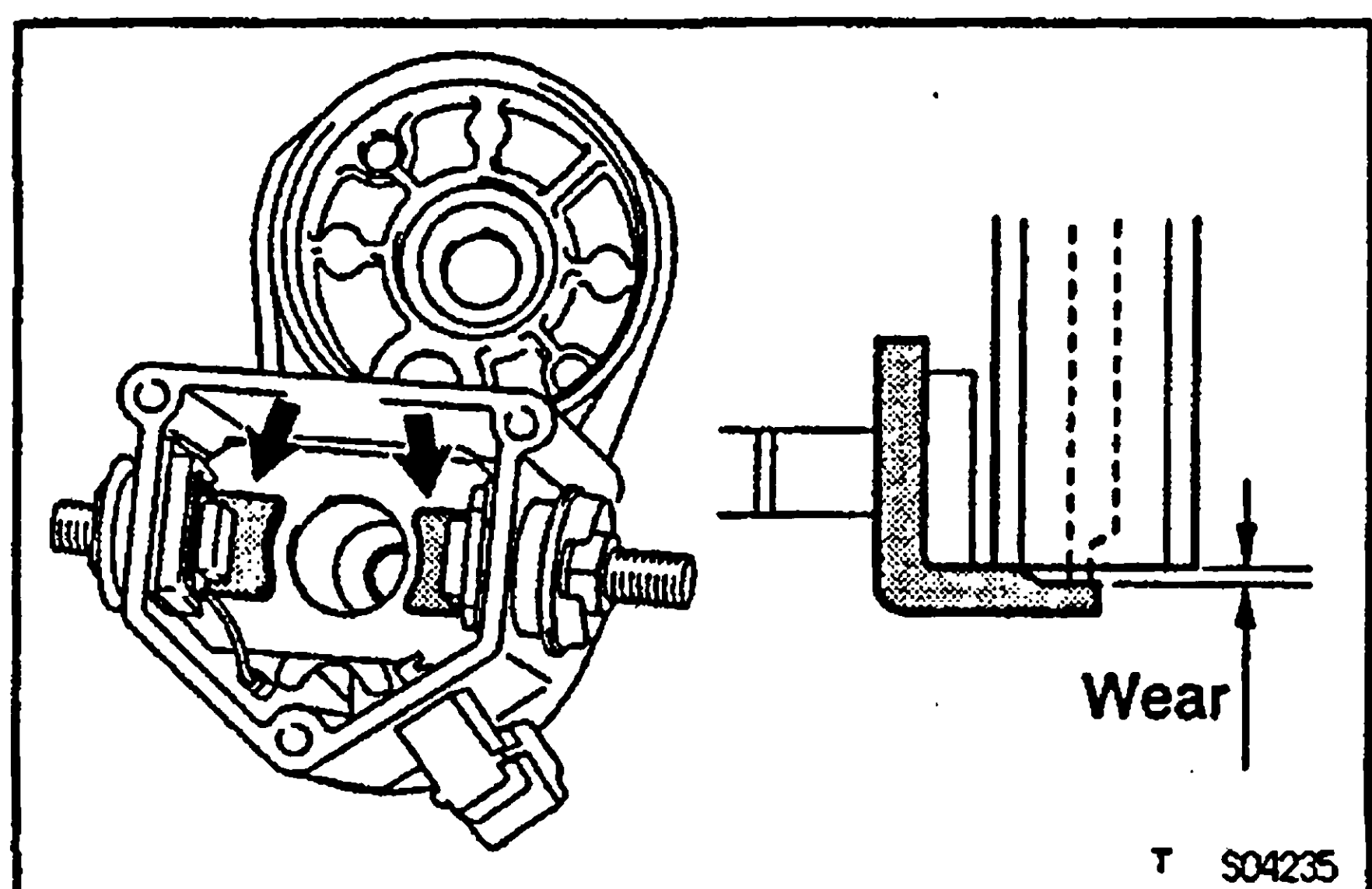
Remove the 3 bolts, end cover, gasket and plunger.

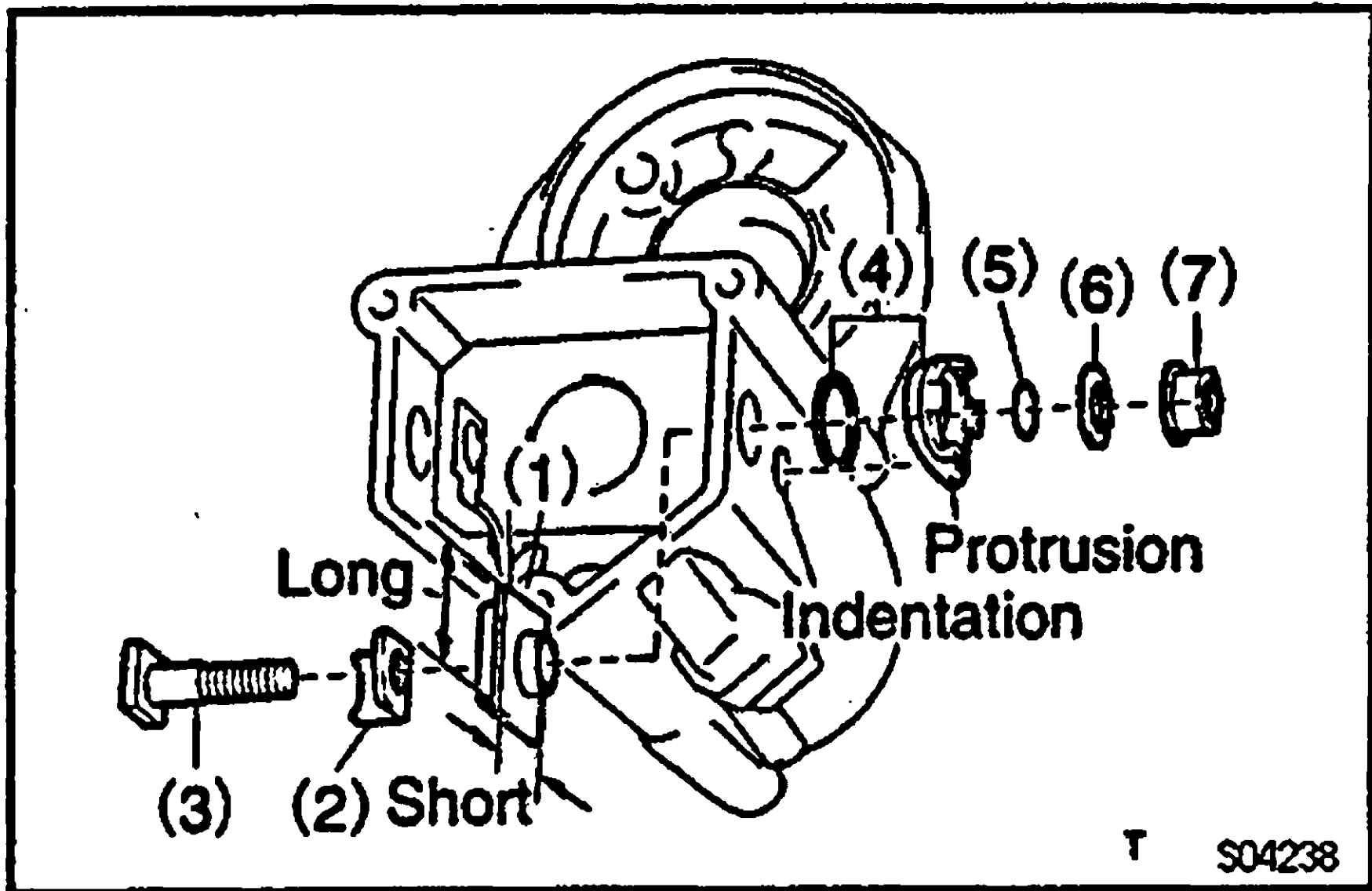
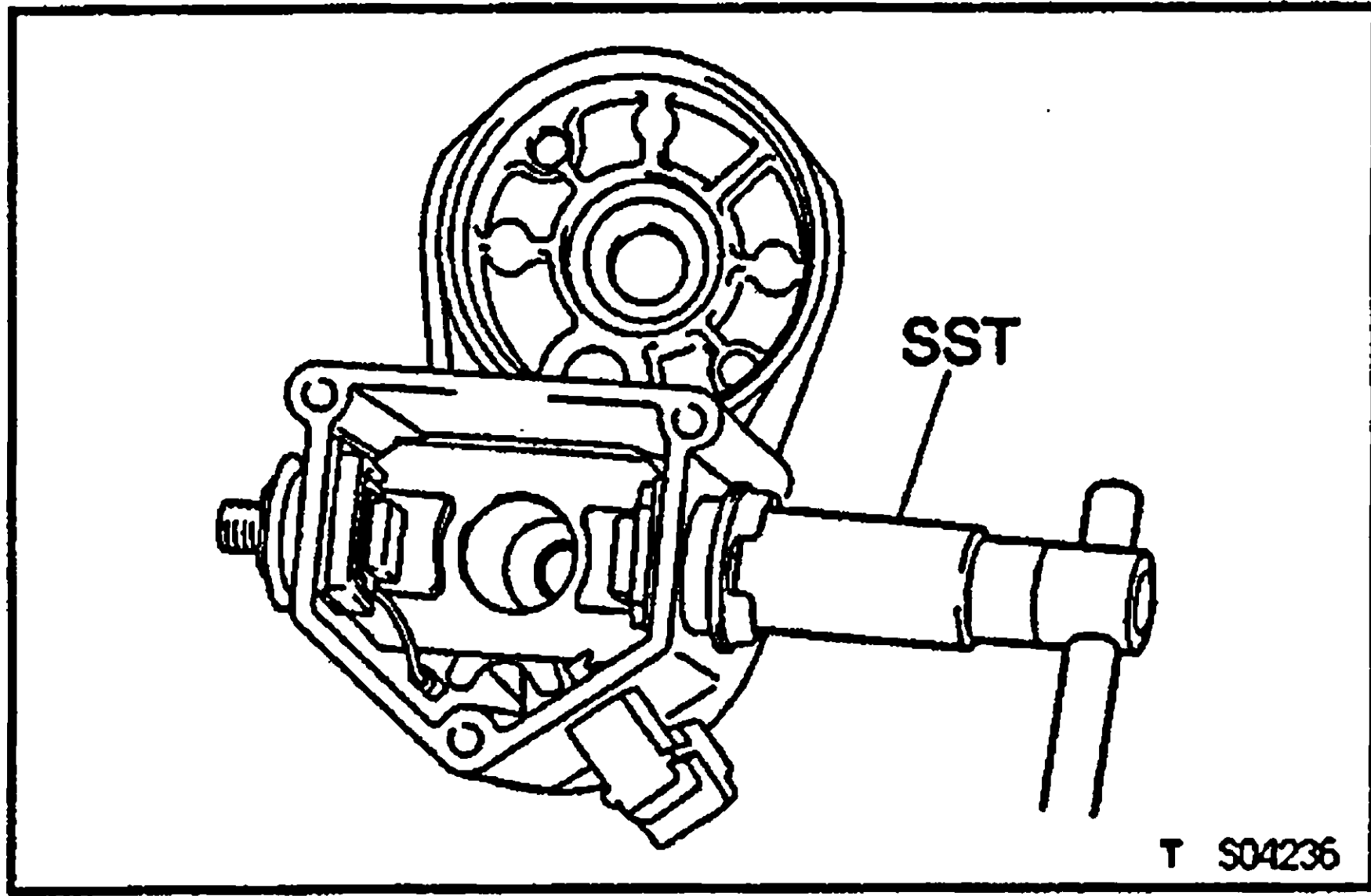
2. INSPECT CONTACT PLATE FOR WEAR

Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear: 1.6 mm (0.063 in.)

If the depth of wear is greater than the maximum, replace the contact plate.





3. REMOVE TERMINAL KIT PARTS

- (a) Using SST, loosen the terminal nuts.
SST 09810-38170
- (b) Terminal C:
Remove the terminal nut, wave washer, terminal insulator (outside), O-ring, terminal bolt, contact plate and terminal insulator (inside).
- (c) Terminal 30:
Remove the terminal nut, washer, terminal insulator (outside), packing, O-ring, terminal bolt, contact plate, terminal insulator (inside) and insulation paper.

4. REINSTALL TERMINAL KIT PARTS

- (a) Install these new parts:

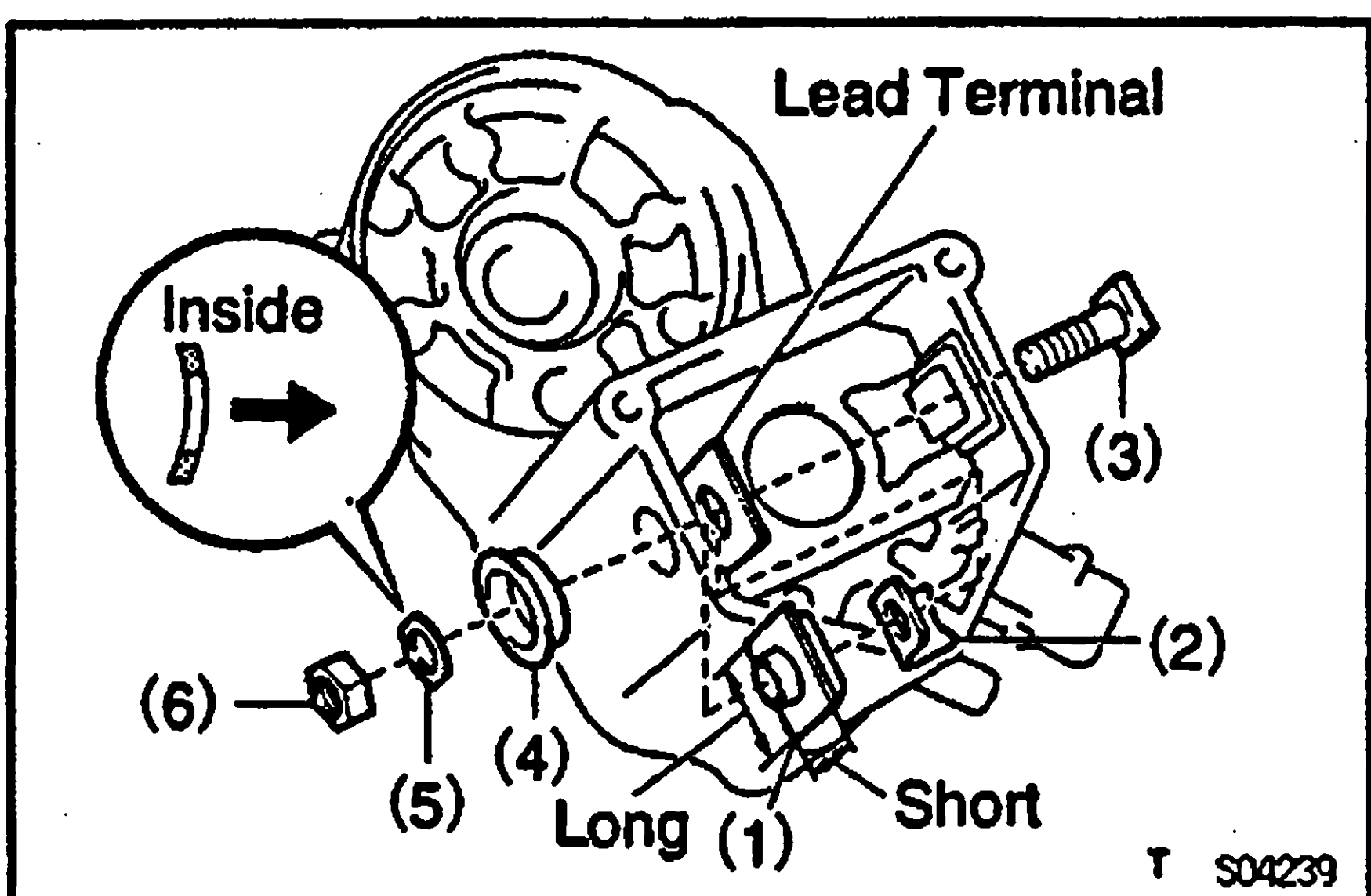
Terminal 30:

- (1) Terminal insulator (inside)
- (2) Contact plate
- (3) Terminal bolt
- (4) Packing and terminal insulator (outside)
- (5) O-ring
- (6) Washer

HINT: Match the protrusion of the insulator with the indentation of the housing.

- (7) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) in the correct direction.



Terminal C:

- (1) Terminal insulator (inside)
- (2) Contact plate
- (3) Terminal bolt
- (4) Terminal insulator (outside)
- (5) Wave washer
- (6) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) and wave washer in the correct direction.

- (b) Temporarily tighten the terminal nuts.

5. TIGHTEN TERMINAL NUT

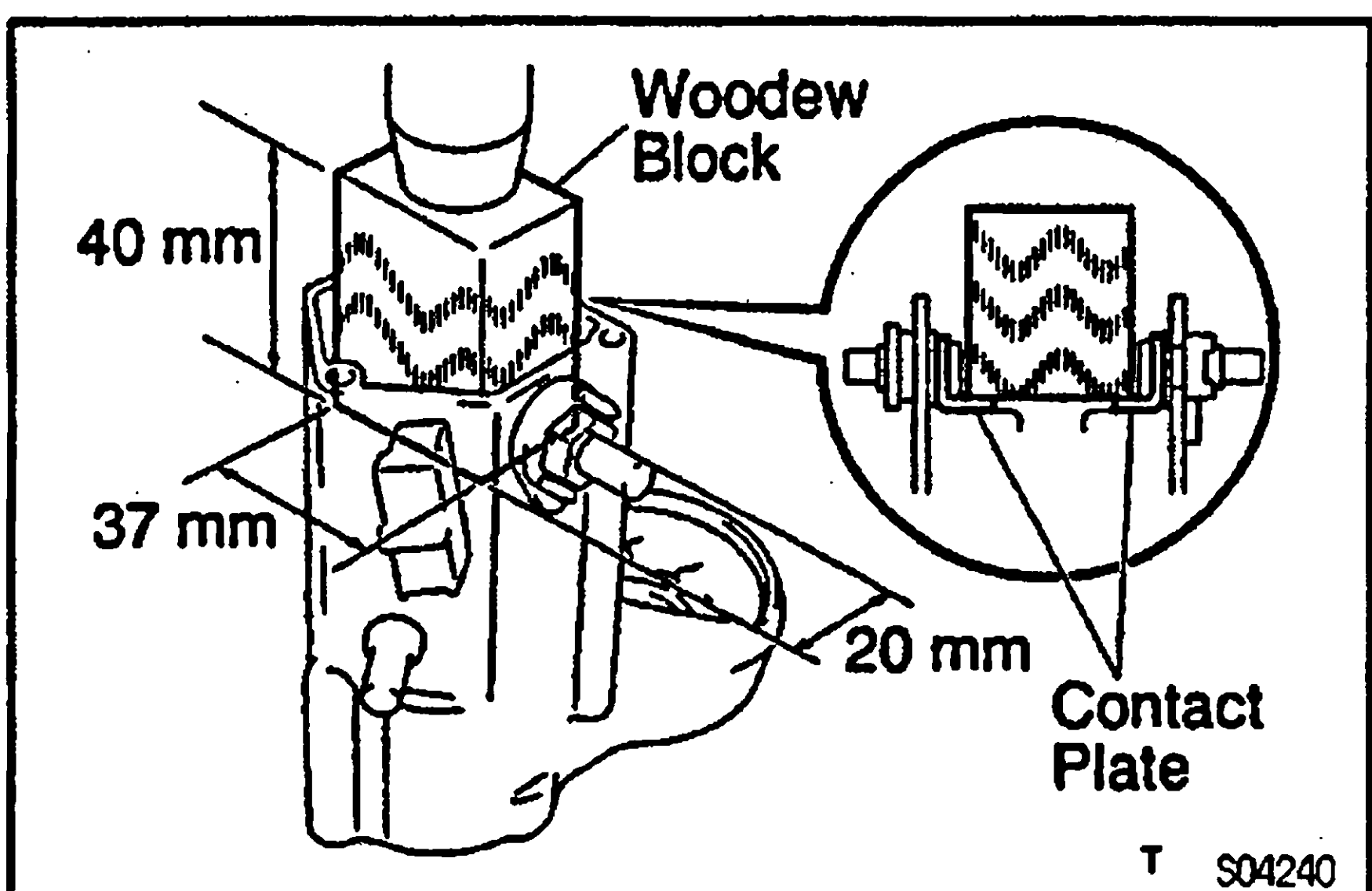
- (a) Put a wood block on the contact plate and press it down with a hand press.

Dimensions of wood block:

20 x 37 x 40 mm (0.97 x 1.46 x 1.57 in.)

Press force:

981 N (100 kgf, 221 lbf)



NOTICE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.

Gauge Pressure

$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

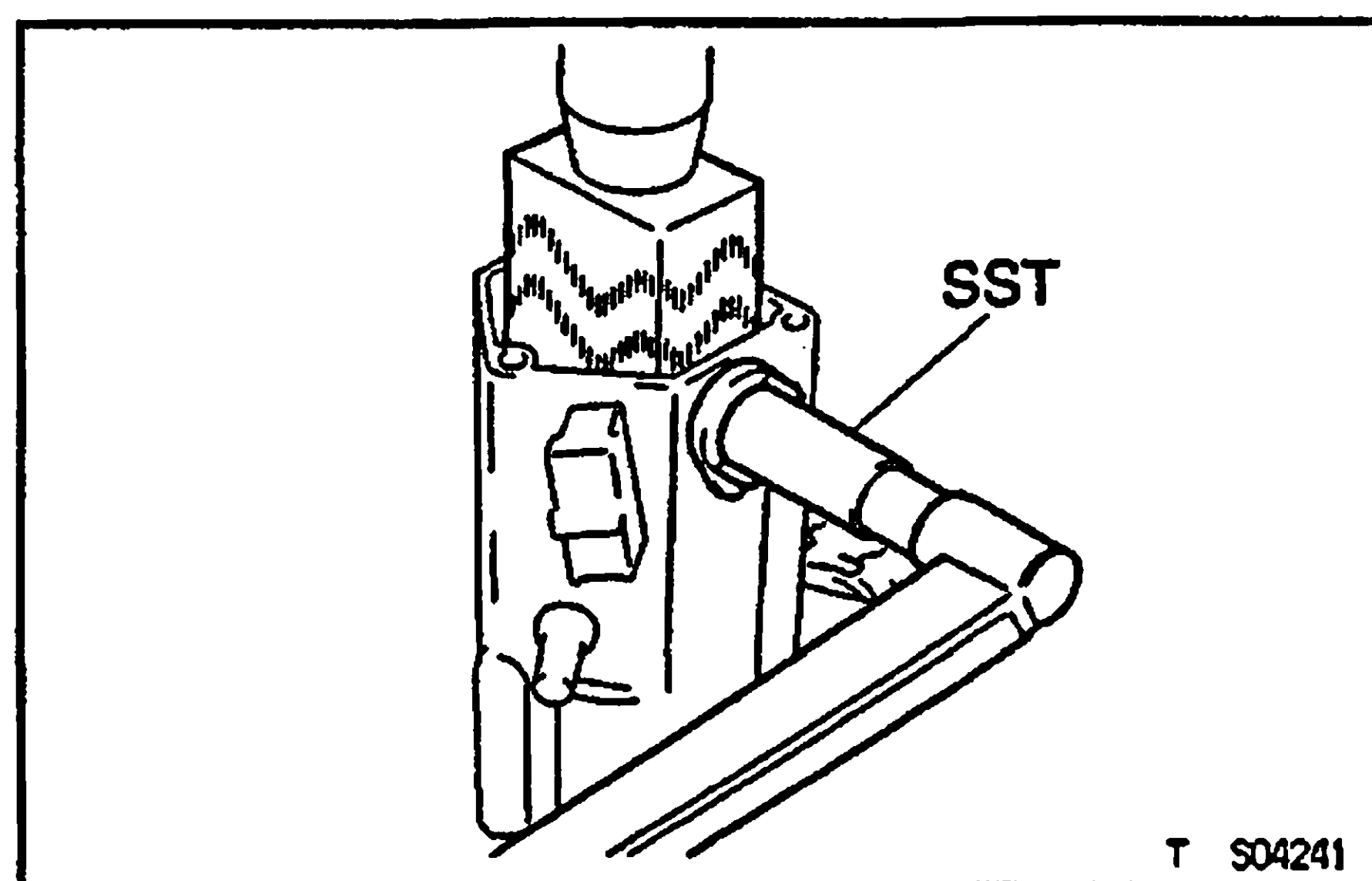
$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

$$(\text{kPa}) = (\text{psi}) \times 6.9$$

V06796

- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.

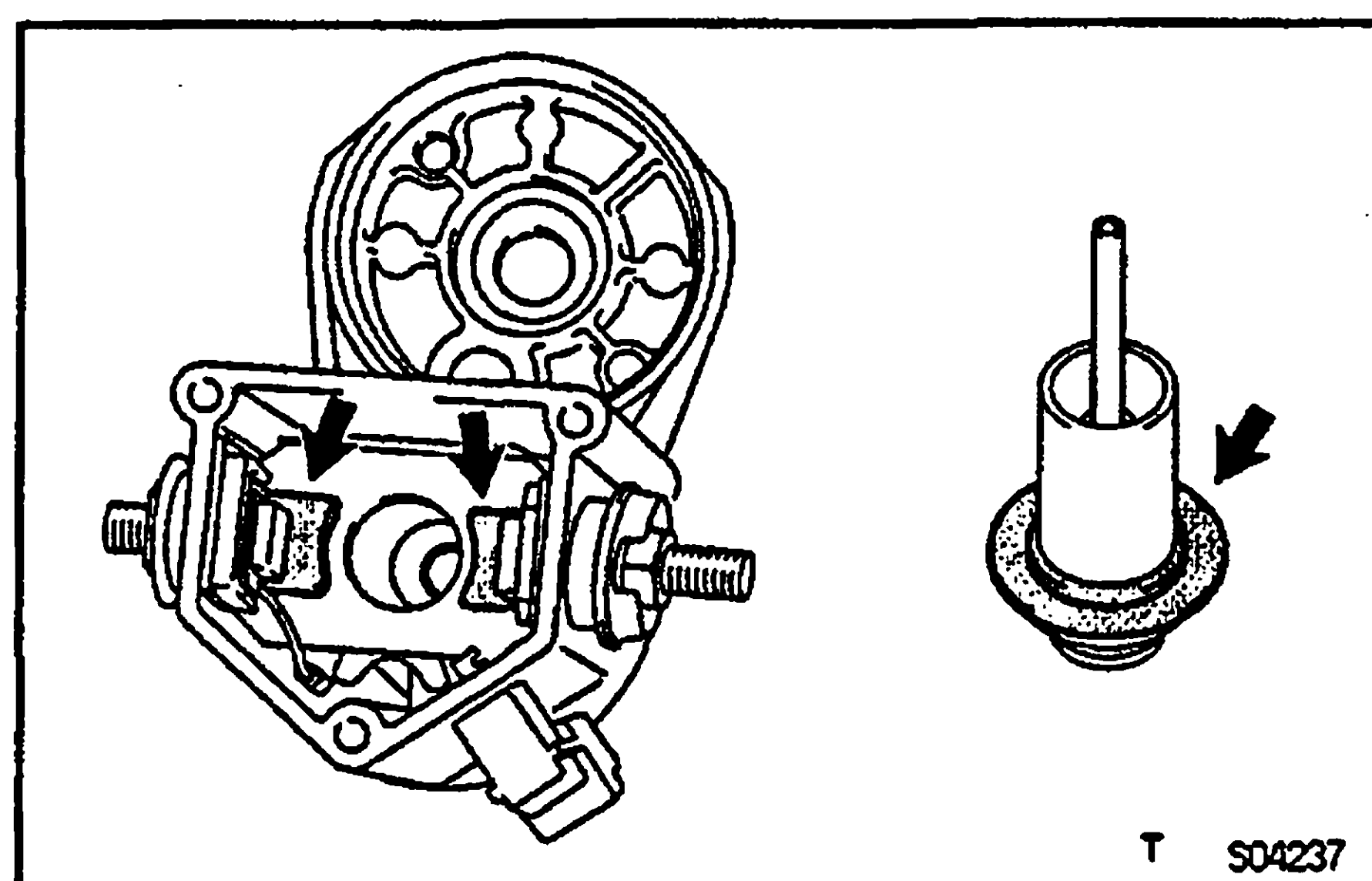


- (b) Using SST, tighten the nuts to the specified torque.

SST 09810–38170

Torque: 17 N·m (170 kgf·cm, 12 ft·lbf)

NOTICE: If the nut is over tightened, it may cause cracks on the inside of the insulator.



6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

7. REINSTALL MAGNETIC SWITCH END COVER

Install the plunger, new gasket, end cover with the 3 bolts.

Torque: 3.6 N·m (36 kgf·cm, 32 in·lbf)

STARTER ASSEMBLY

ST000-01

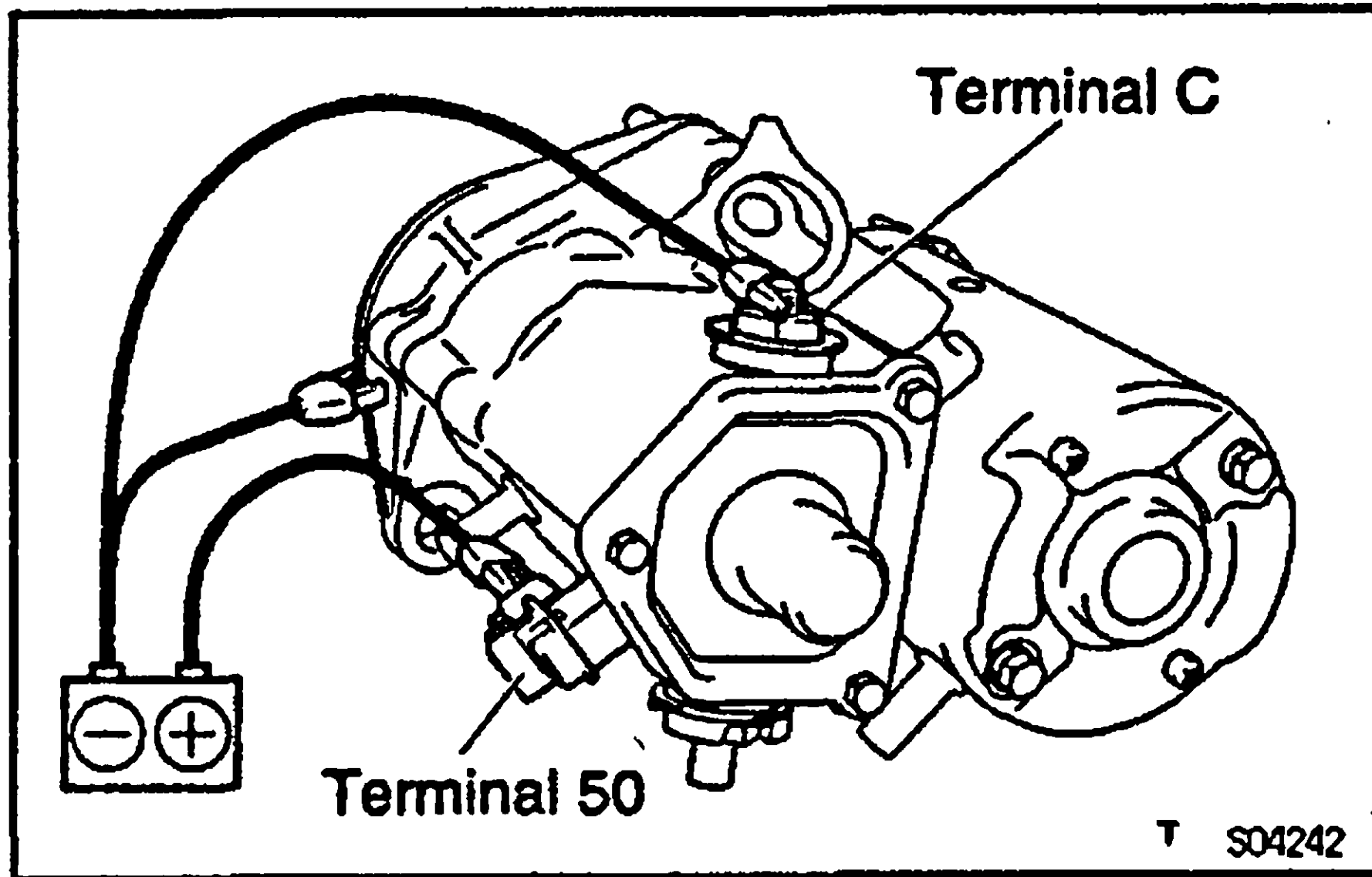
Assembly is in the reverse order of disassembly.

STARTER PERFORMANCE TEST

NOTICE: These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

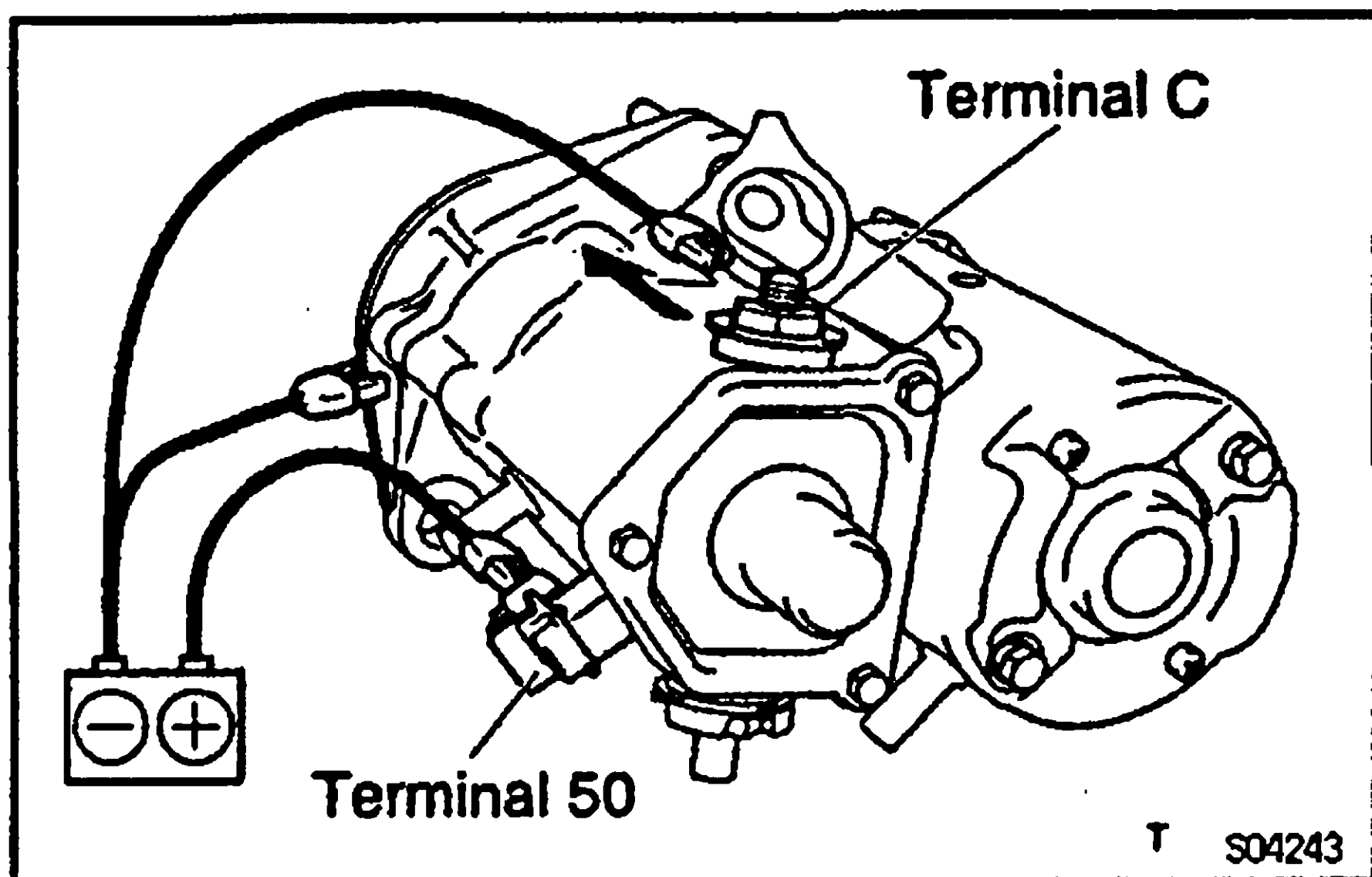
1. DO PULL-IN TEST

- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward. If the clutch pinion gear does not move, replace the magnetic switch assembly.



2. DO HOLD-IN TEST

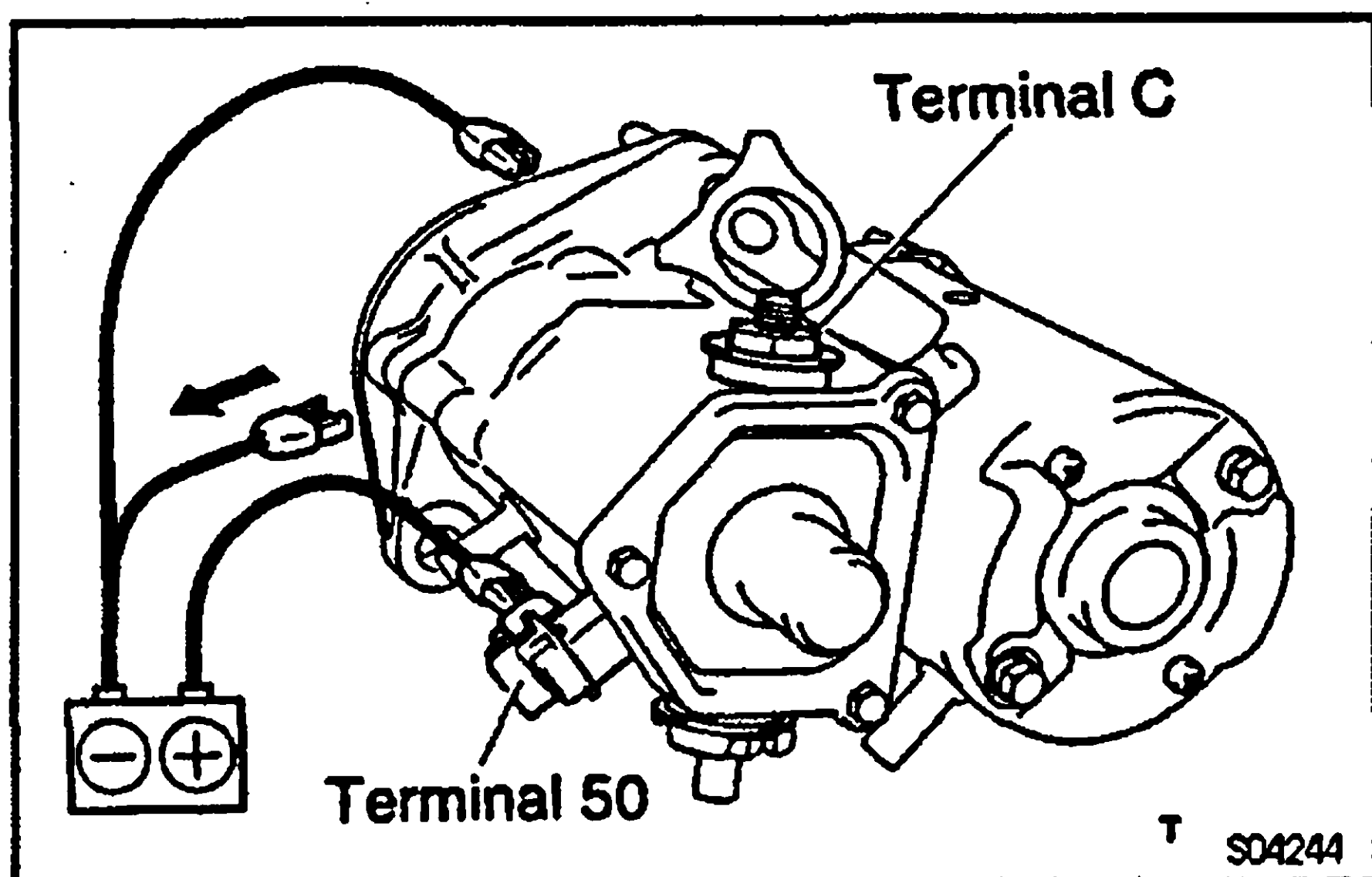
With battery connected as above with the clutch pinion gear out, disconnect the negative (—) lead from terminal C. Check that the pinion gear remains out. If the clutch pinion gear returns inward, replace the magnetic switch assembly.



3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (—) lead from the switch body.

Check that the clutch pinion gear returns inward. If the clutch pinion gear does not return, replace the magnetic switch assembly.

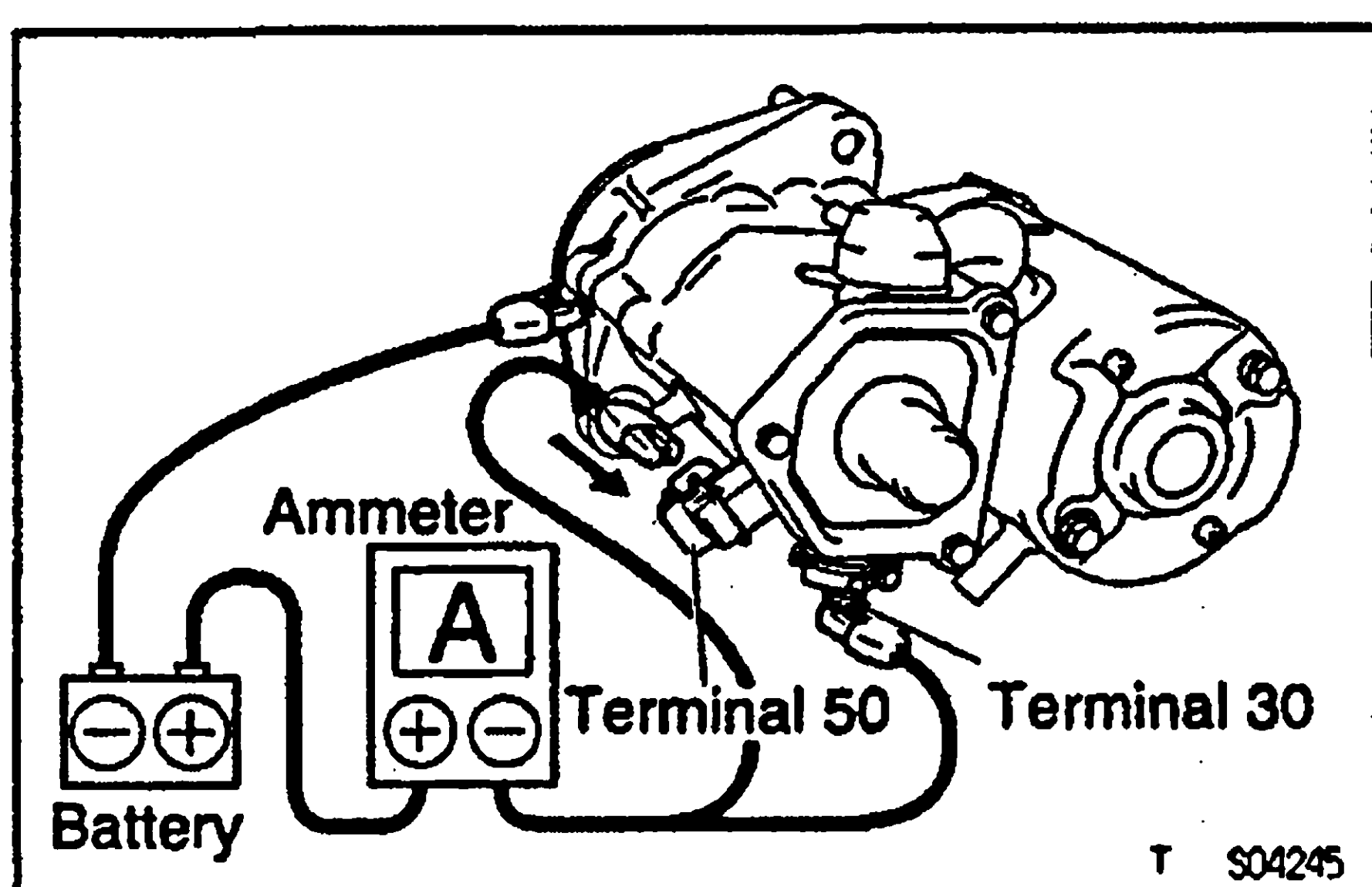


4. DO NO-LOAD PERFORMANCE TEST

- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

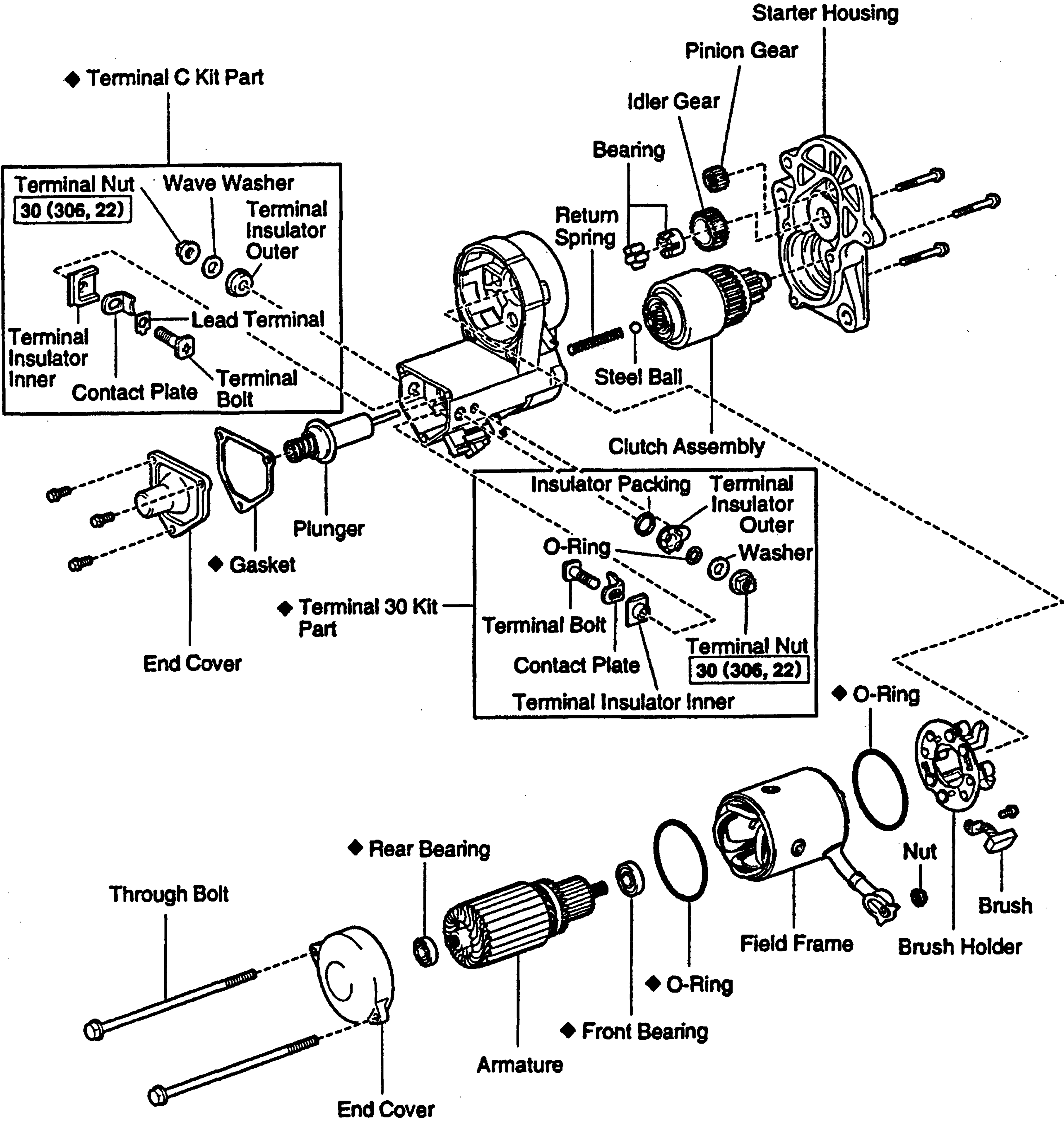
180 A or less at 11.0 V



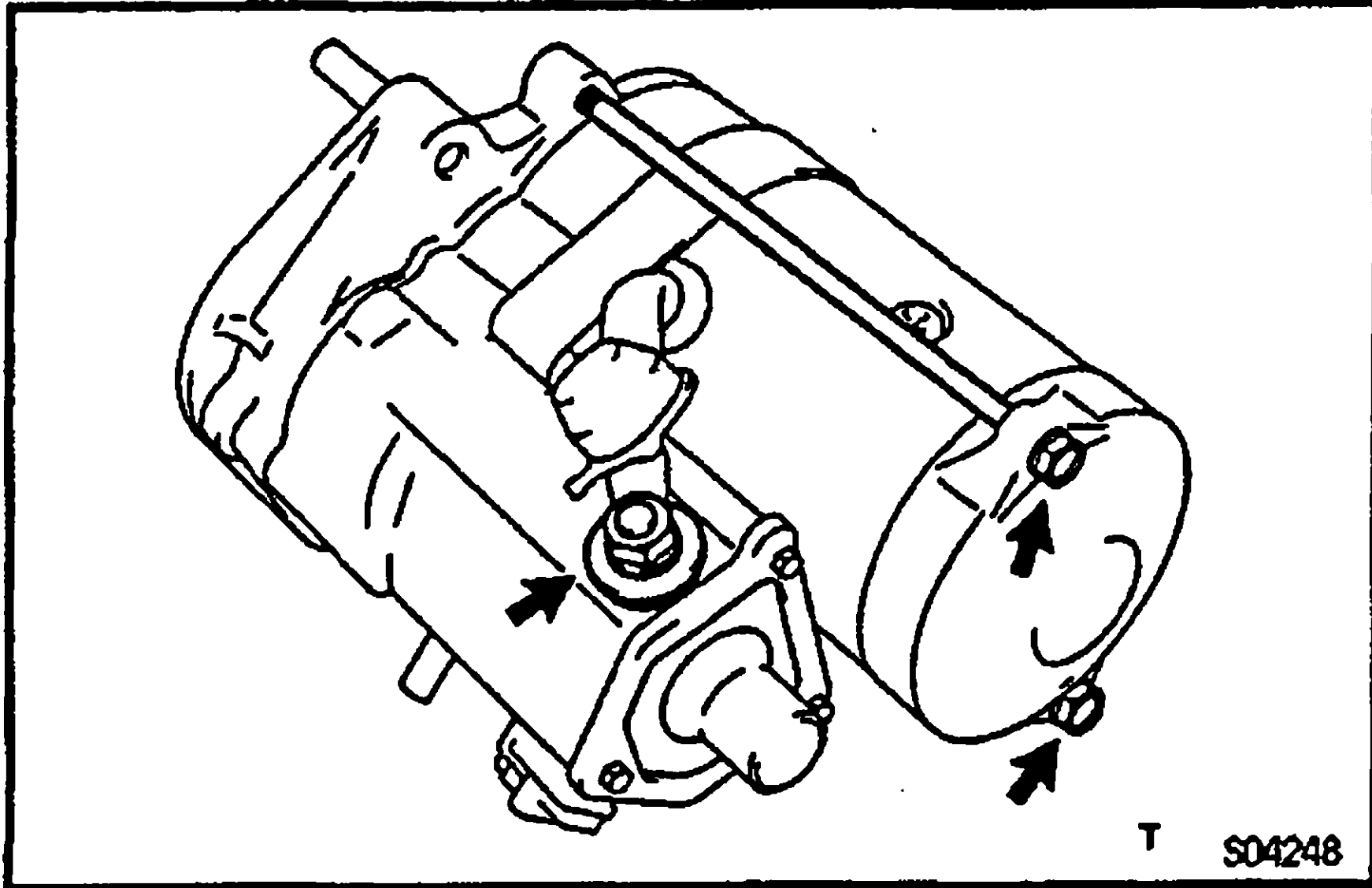
STARTER
(3.0 kW)
COMPONENTS FOR DISASSEMBLY AND
ASSEMBLY

ST00W-23

ST



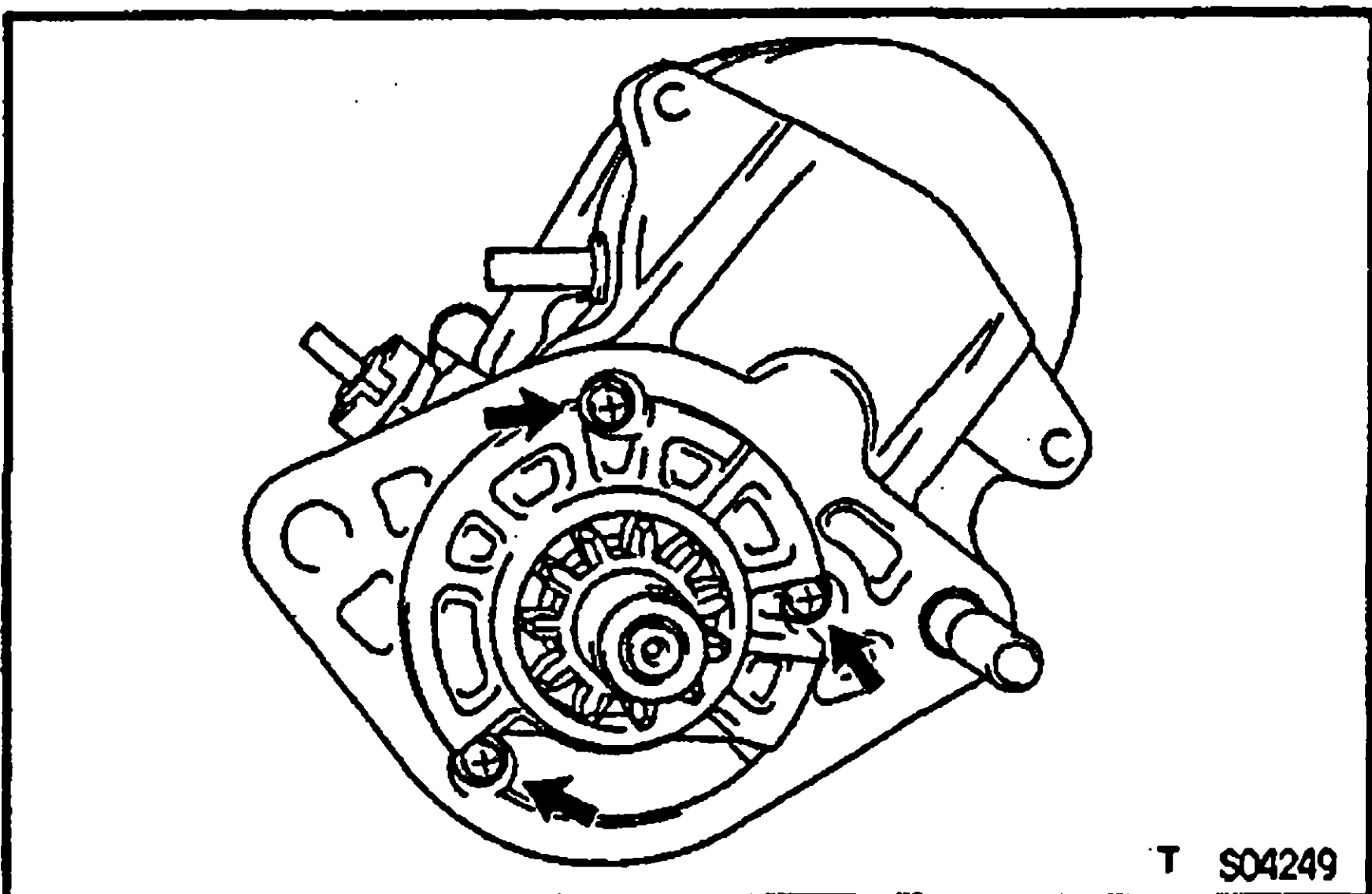
N·m (kgf·cm, ft·lbf): Specified torque
◆ Non-reusable part



STARTER DISASSEMBLY

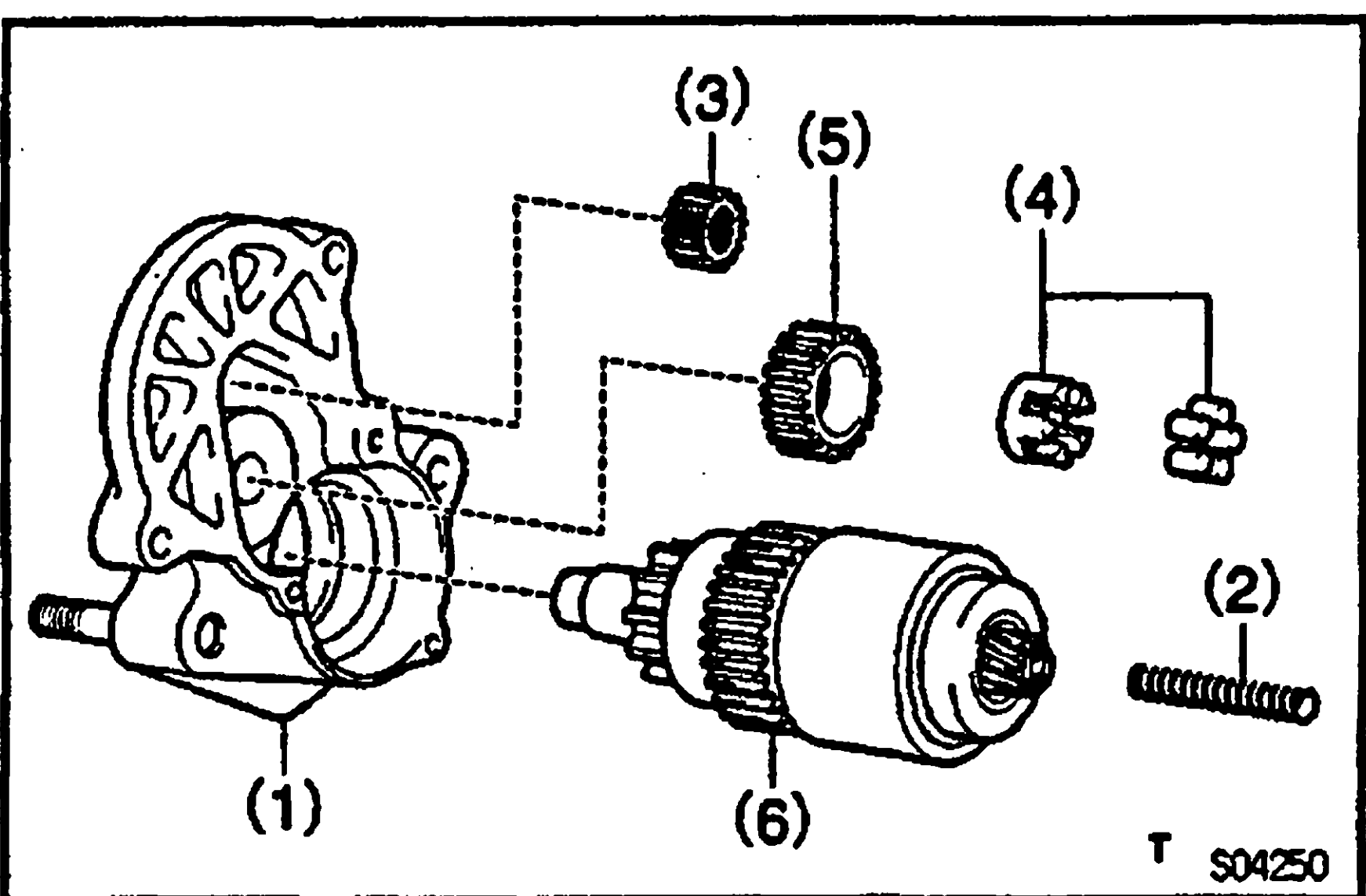
1. REMOVE FIELD FRAME AND ARMATURE

- Remove the nut, and disconnect the lead wire from the magnetic switch terminal.
- Remove the 2 through bolts.
- Pull out the field frame with the armature from the magnetic switch assembly.
- Remove the O—ring from the field frame.



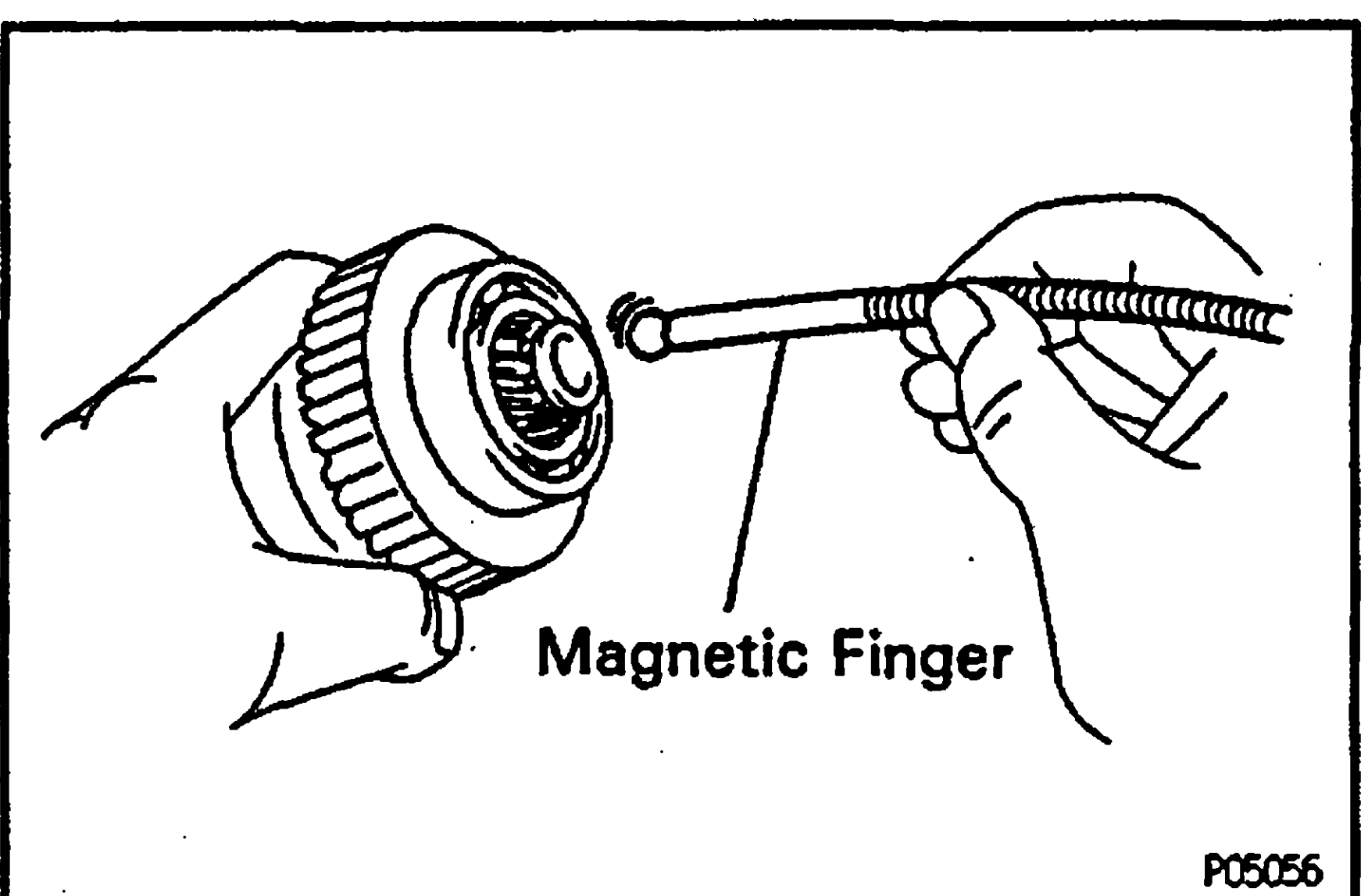
2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- Remove the 3 screws.



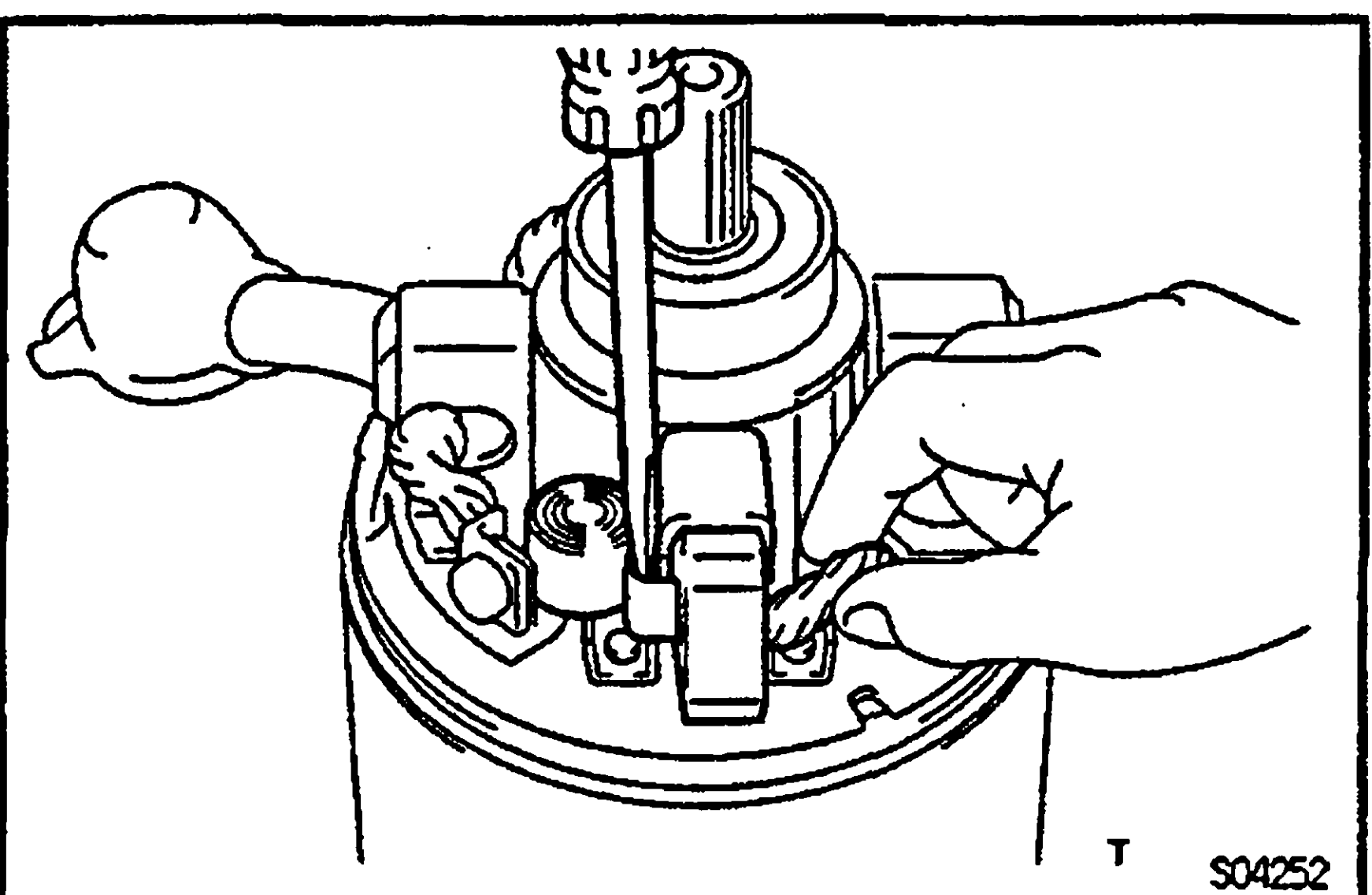
- Remove these parts from the magnetic switch assembly:

- Starter housing
- Return spring
- Pinion gear
- Bearing
- Idler gear
- Clutch assembly



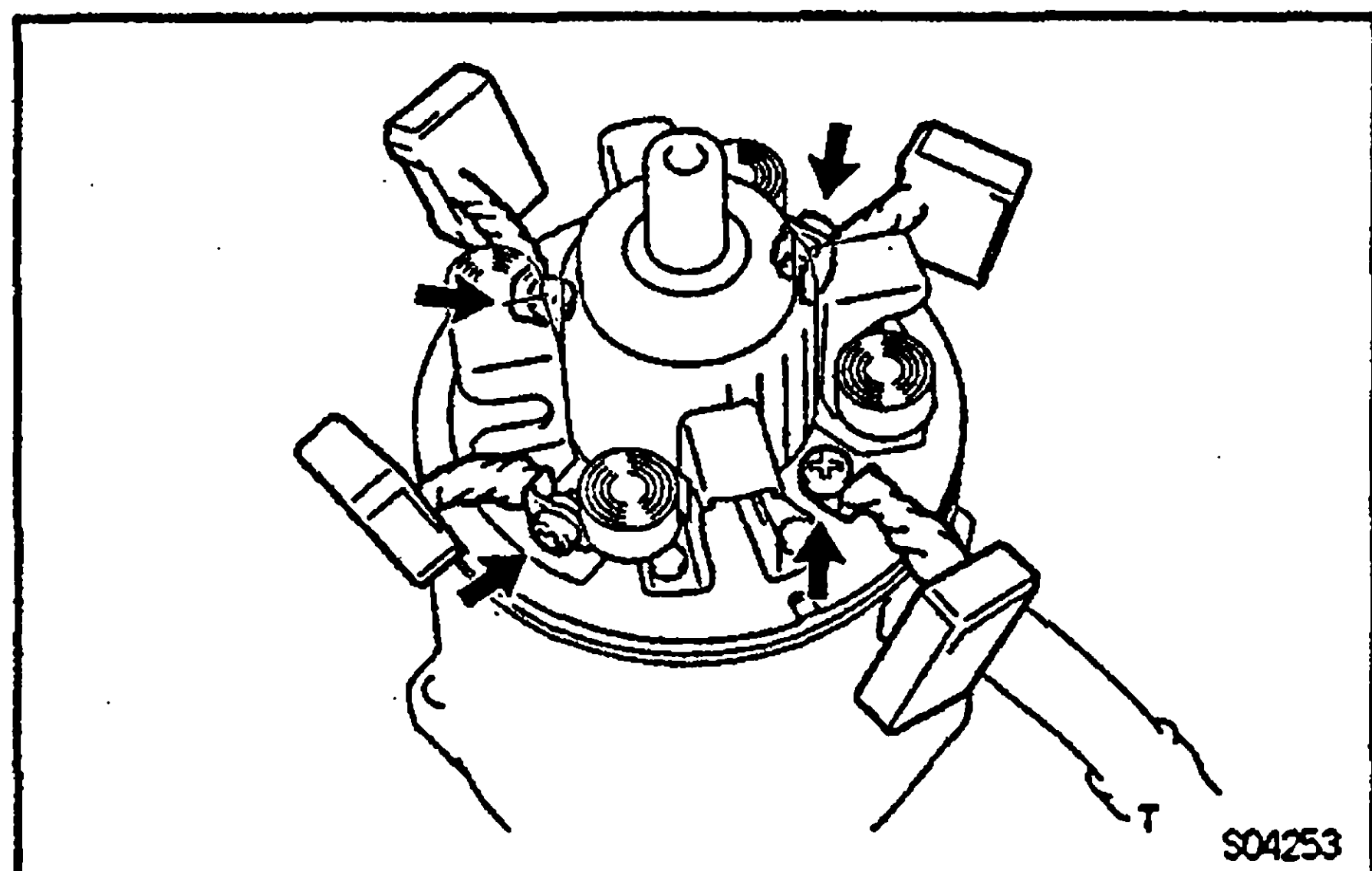
3. REMOVE STEEL BALL

Using a magnetic finger, remove the steel ball from the clutch shaft hole.

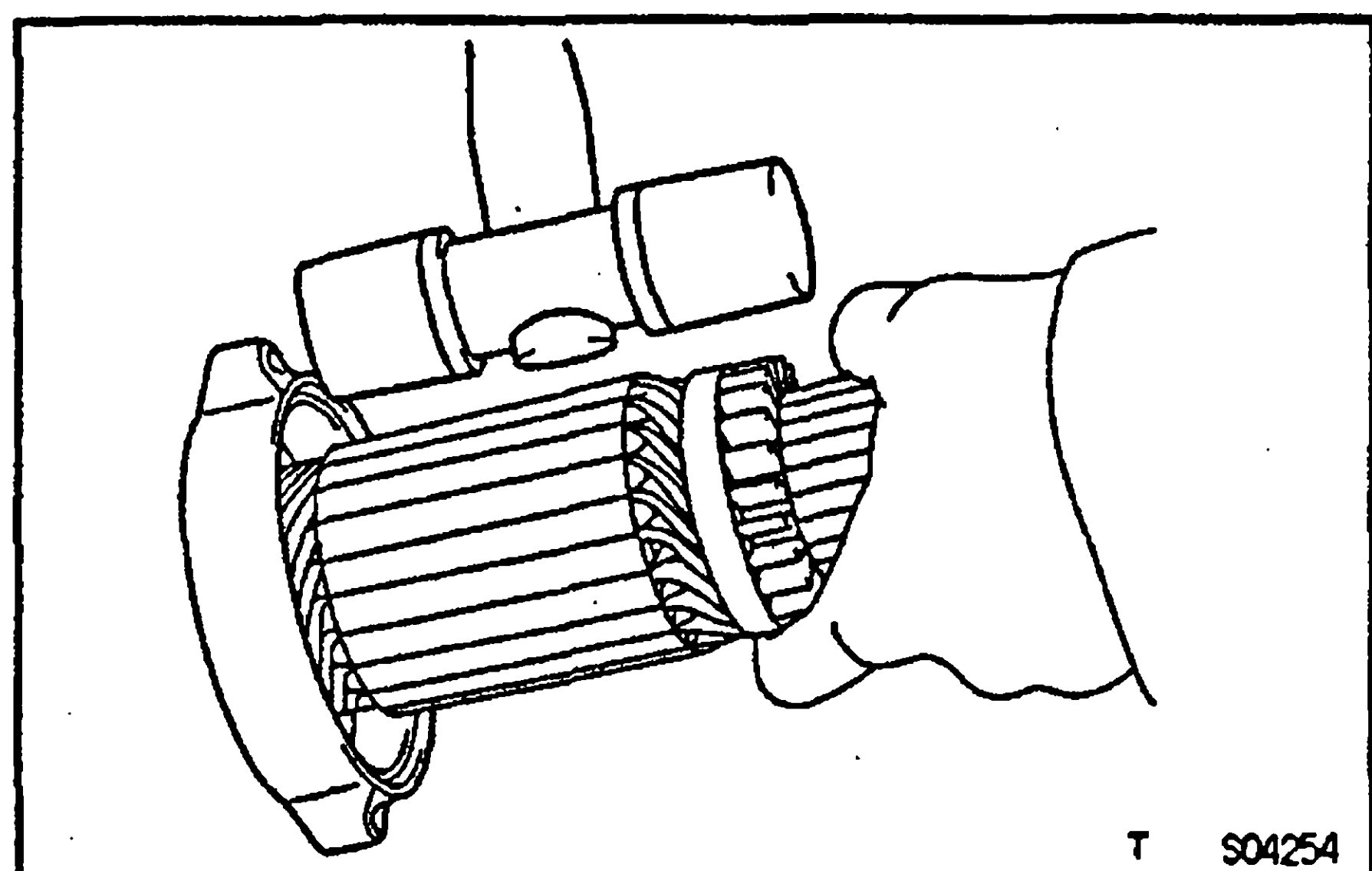


4. REMOVE BRUSH HOLDER

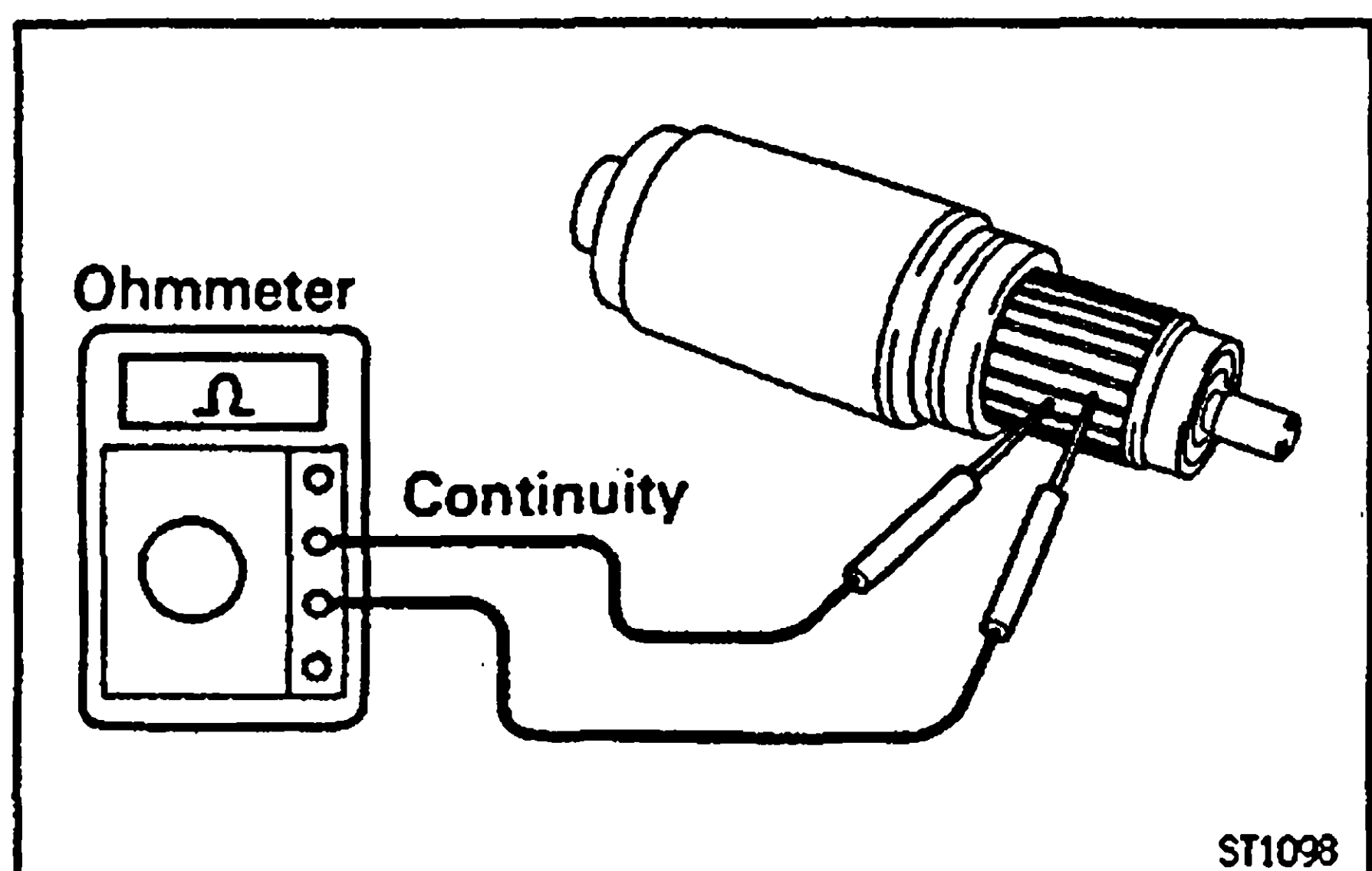
- Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the 4 brushes.



- (b) Remove the 4 screws and 4 brushes.
 (c) Remove the brush holder from the field frame.
5. REMOVE ARMATURE WITH END COVER FROM FIELD FRAME



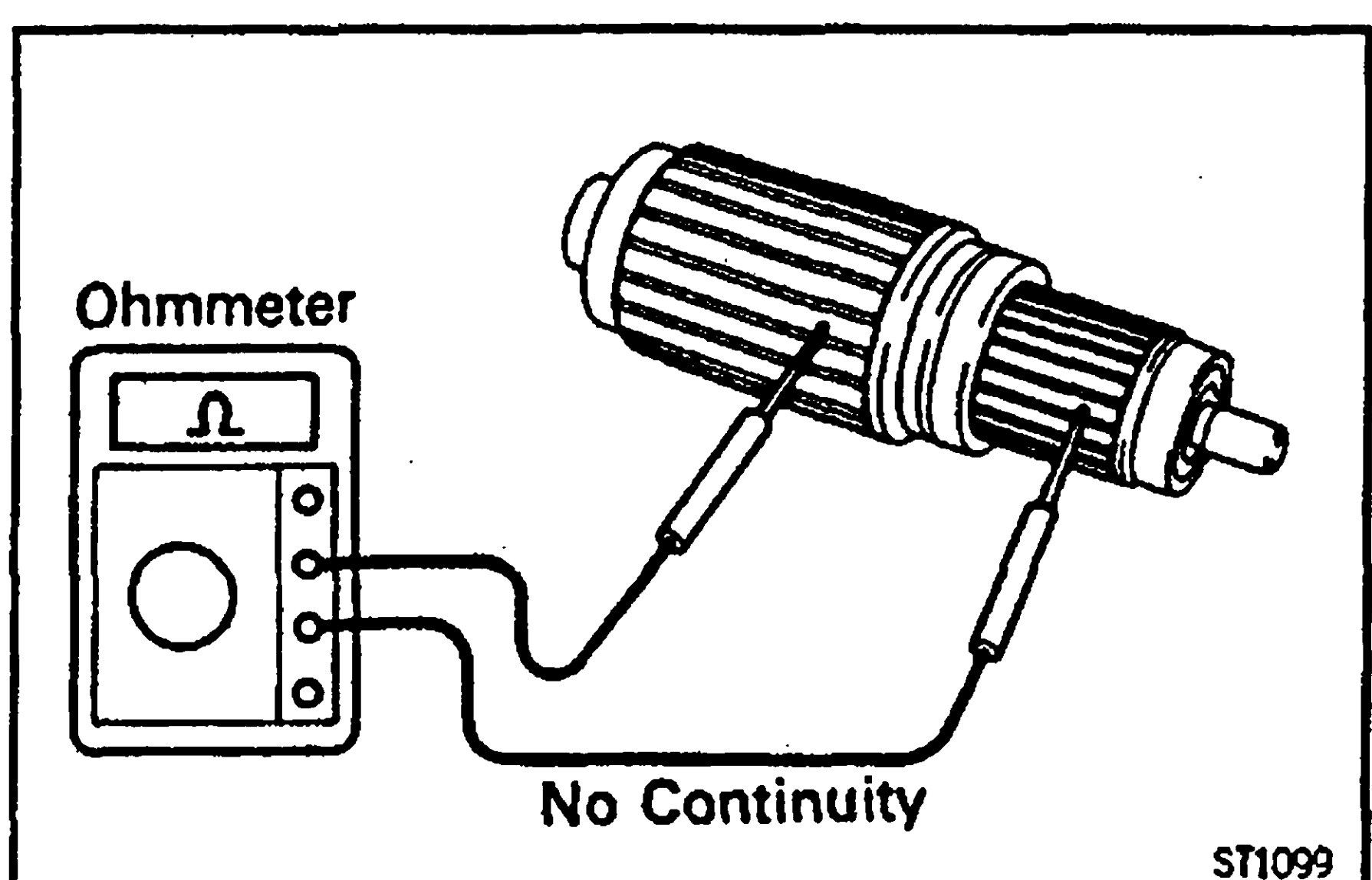
- 6. REMOVE ARMATURE FROM END COVER**
 Using a plastic hammer, tap the end cover to remove the armature from the end cover.



STARTER INSPECTION AND REPAIR

Armature Coil

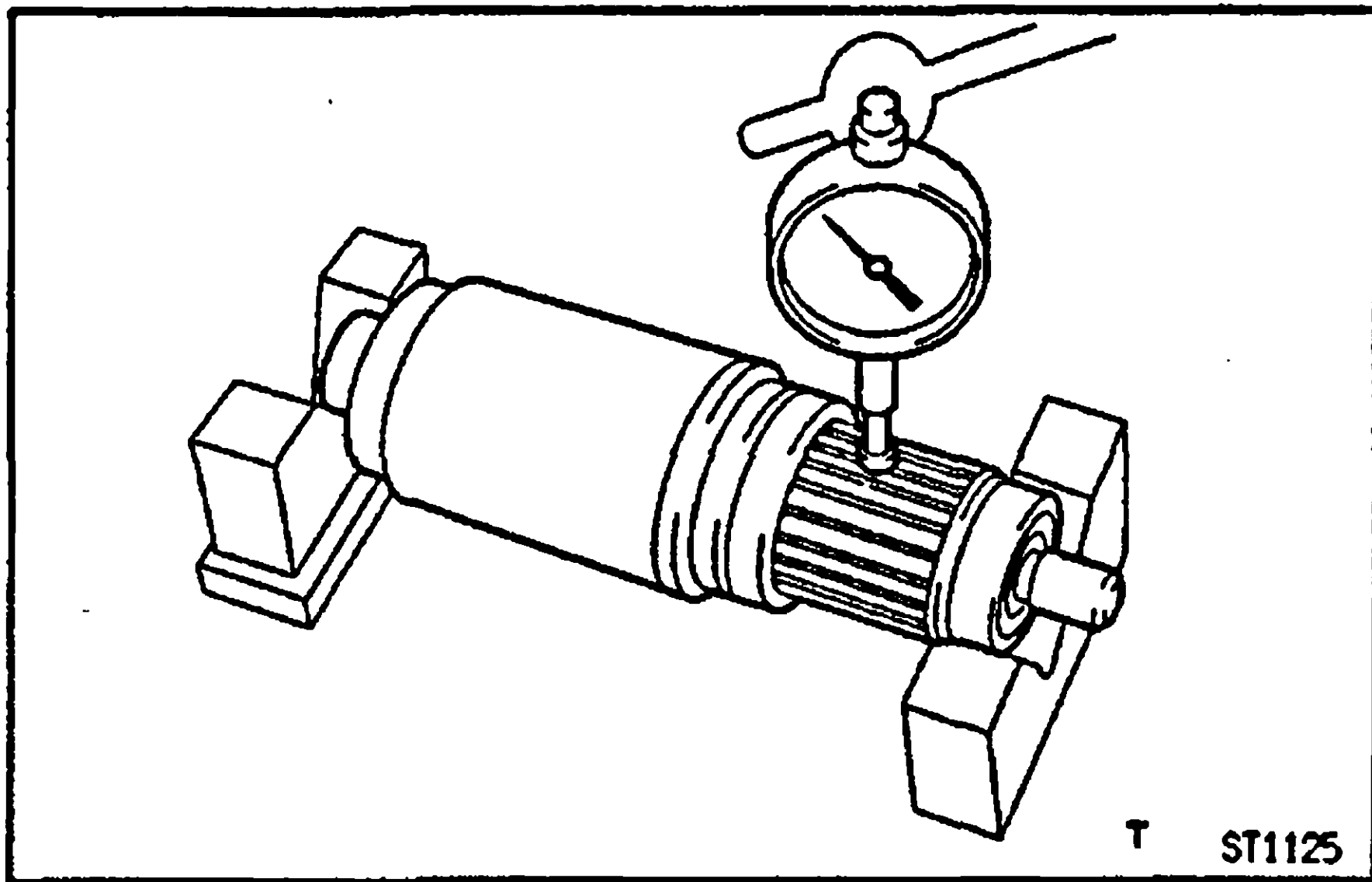
- 1. INSPECT COMMUTATOR FOR OPEN CIRCUIT**
 Using an ohmmeter, check that there is continuity between the segments of the commutator. If there is no continuity between any segment, replace the armature.



- 2. INSPECT COMMUTATOR FOR GROUND**
 Using an ohmmeter, check that there is no continuity between the commutator and armature coil core. If there is continuity, replace the armature.

Commutator

- 1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES**
 If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.



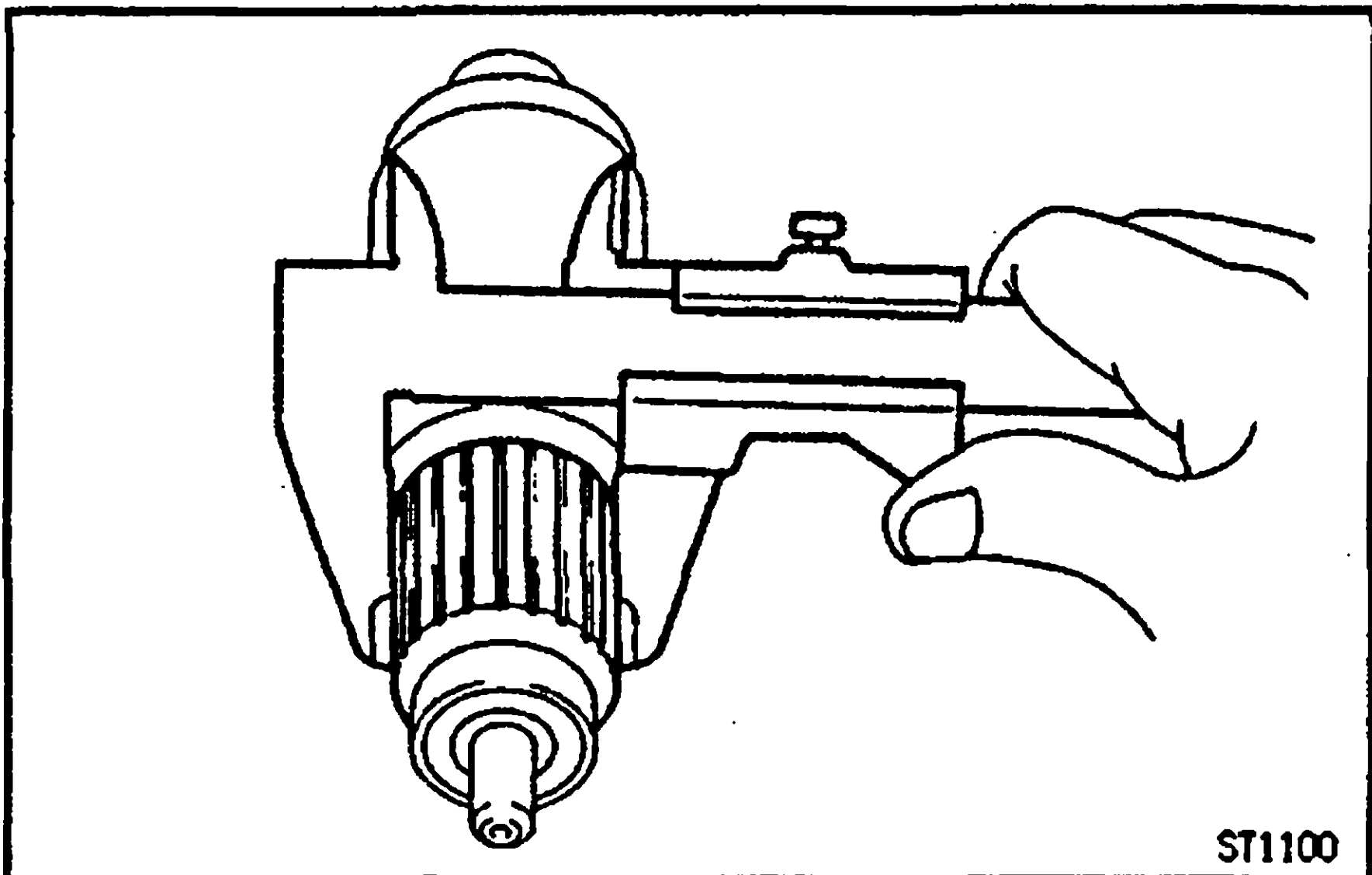
2. INSPECT COMMUTATOR CIRCLE RUNOUT

- (a) Place the commutator on V—blocks.
- (b) Using a dial gauge, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

If the circle runout is greater than maximum, correct it on a lathe.



3. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, measure the commutator diameter.

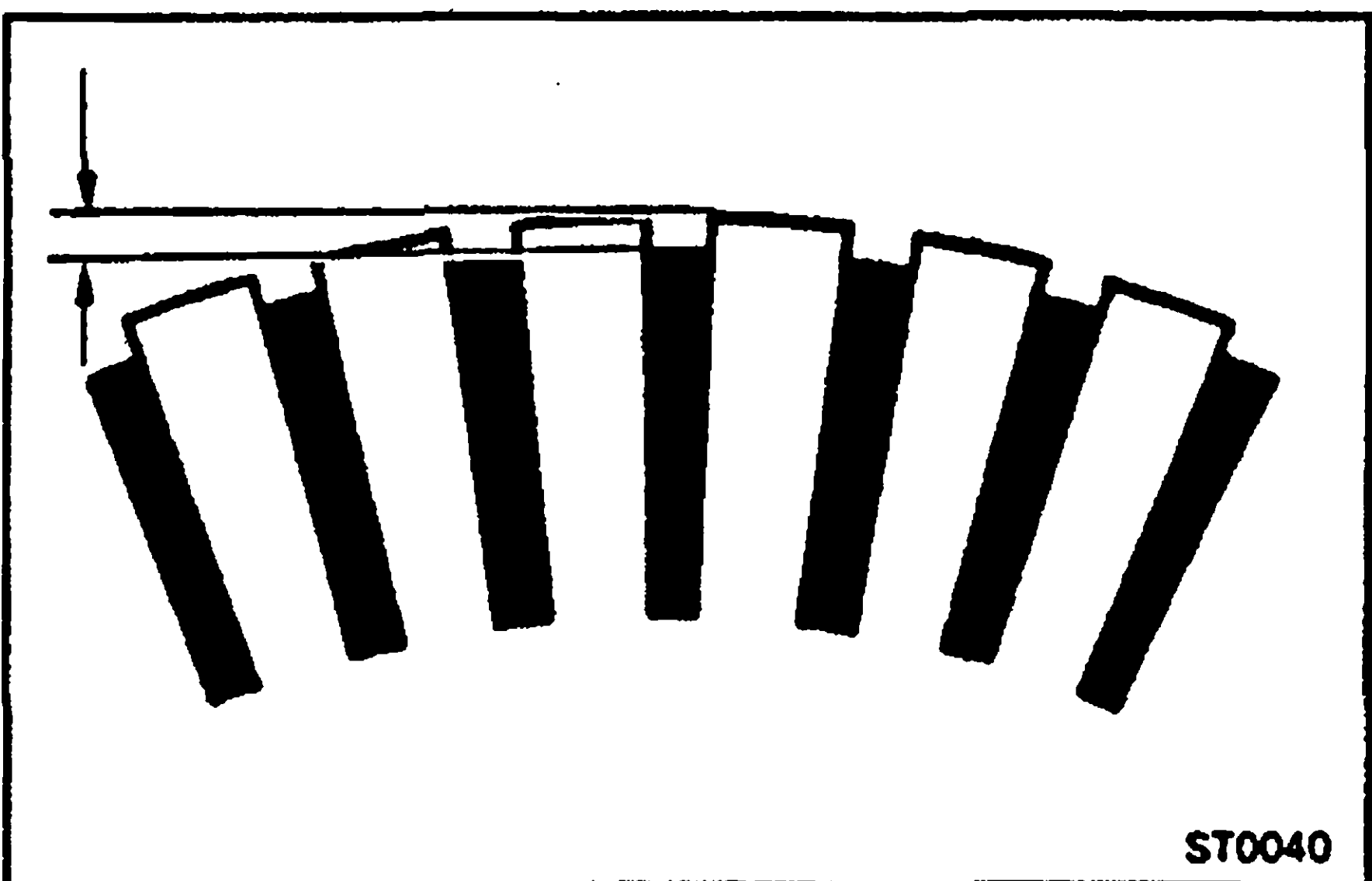
Standard diameter:

43 mm (1.69 in.)

Minimum diameter:

42 mm (1.65 in.)

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



4. INSPECT UNDERCUT DEPTH

Check that the undercut depth is clean and free of foreign materials. Smooth out the edge.

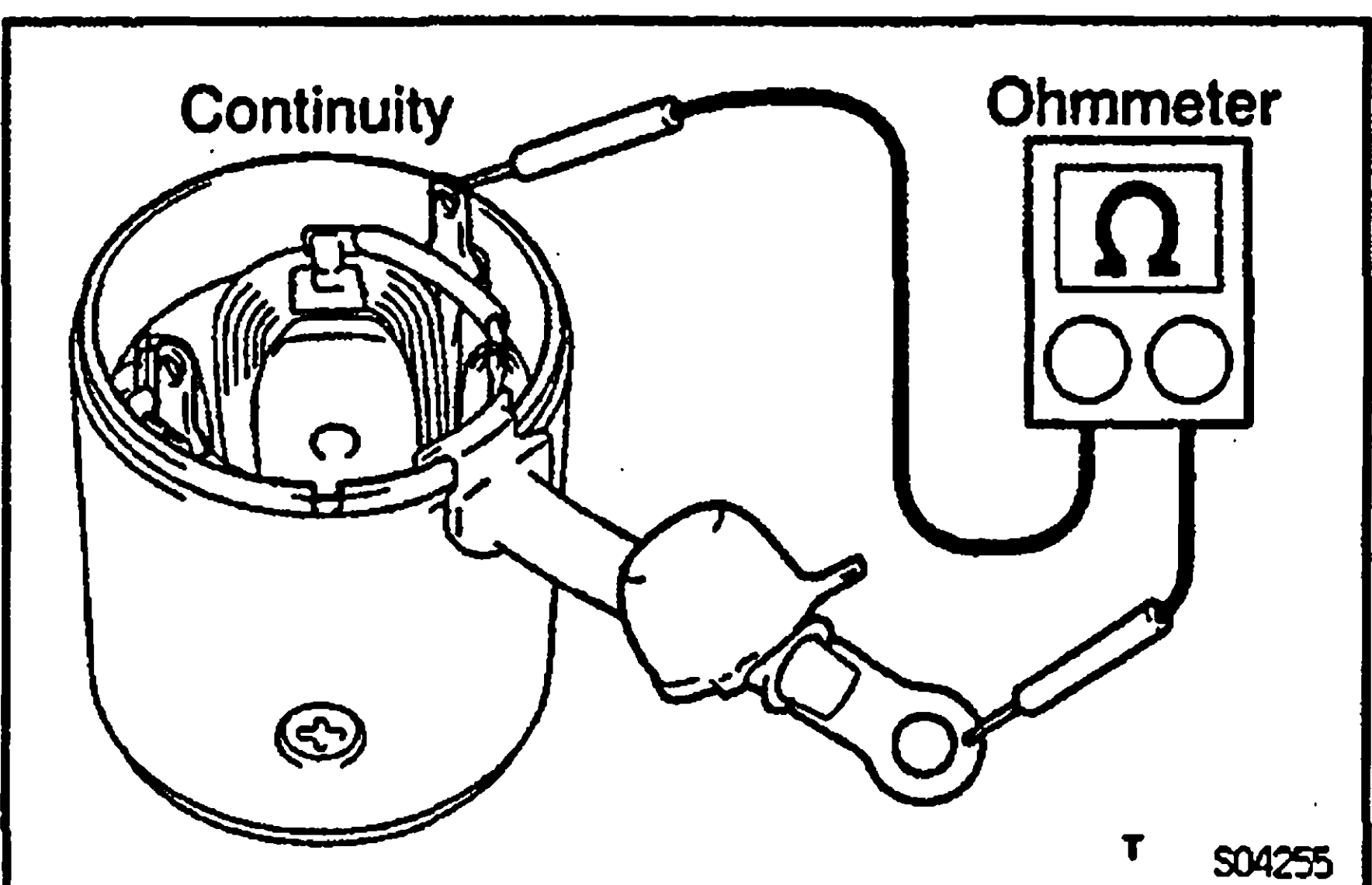
Standard undercut depth:

0.7 mm (0.028 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

If the undercut depth is less than minimum, correct it with a hacksaw blade.

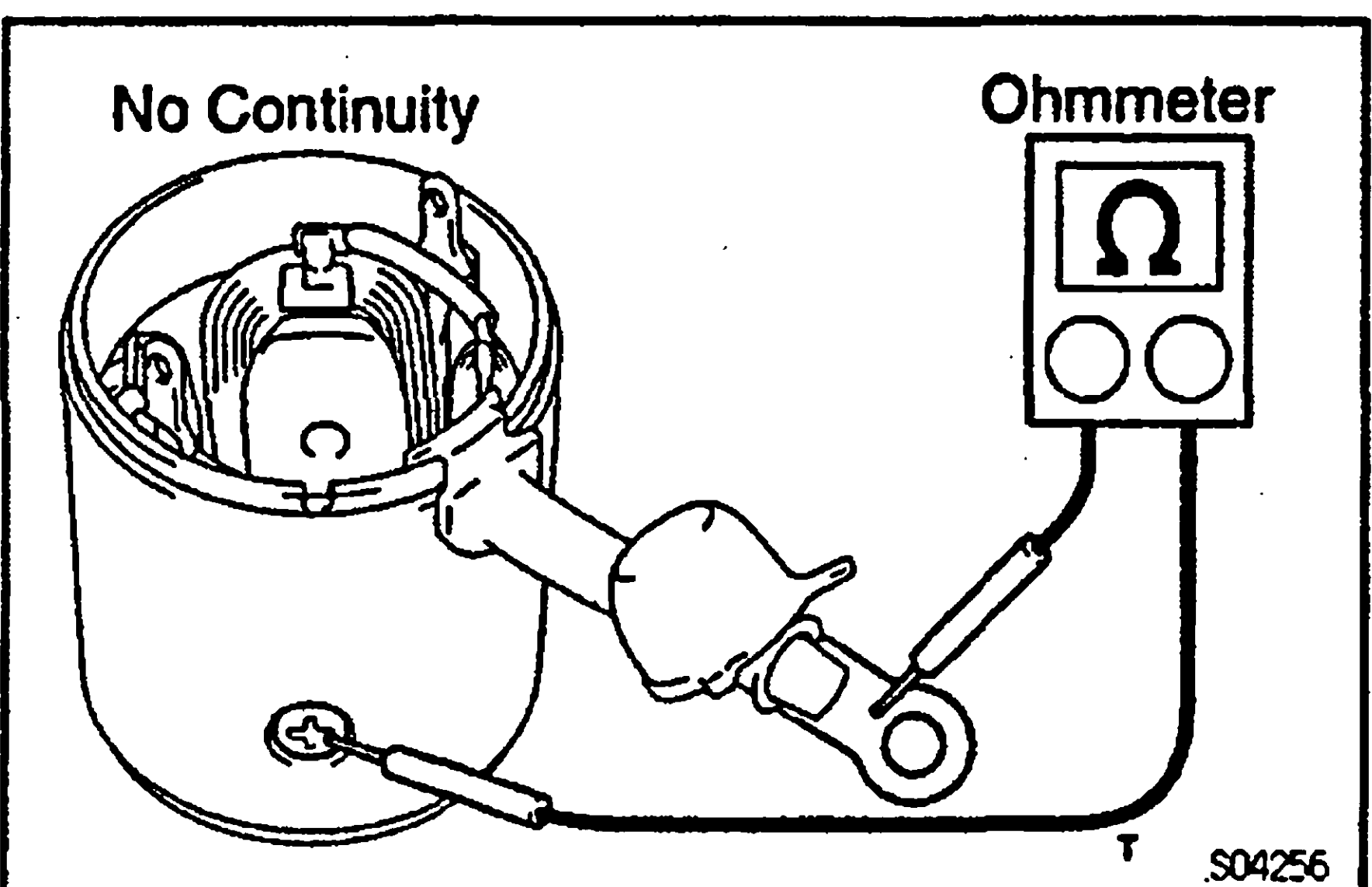


Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

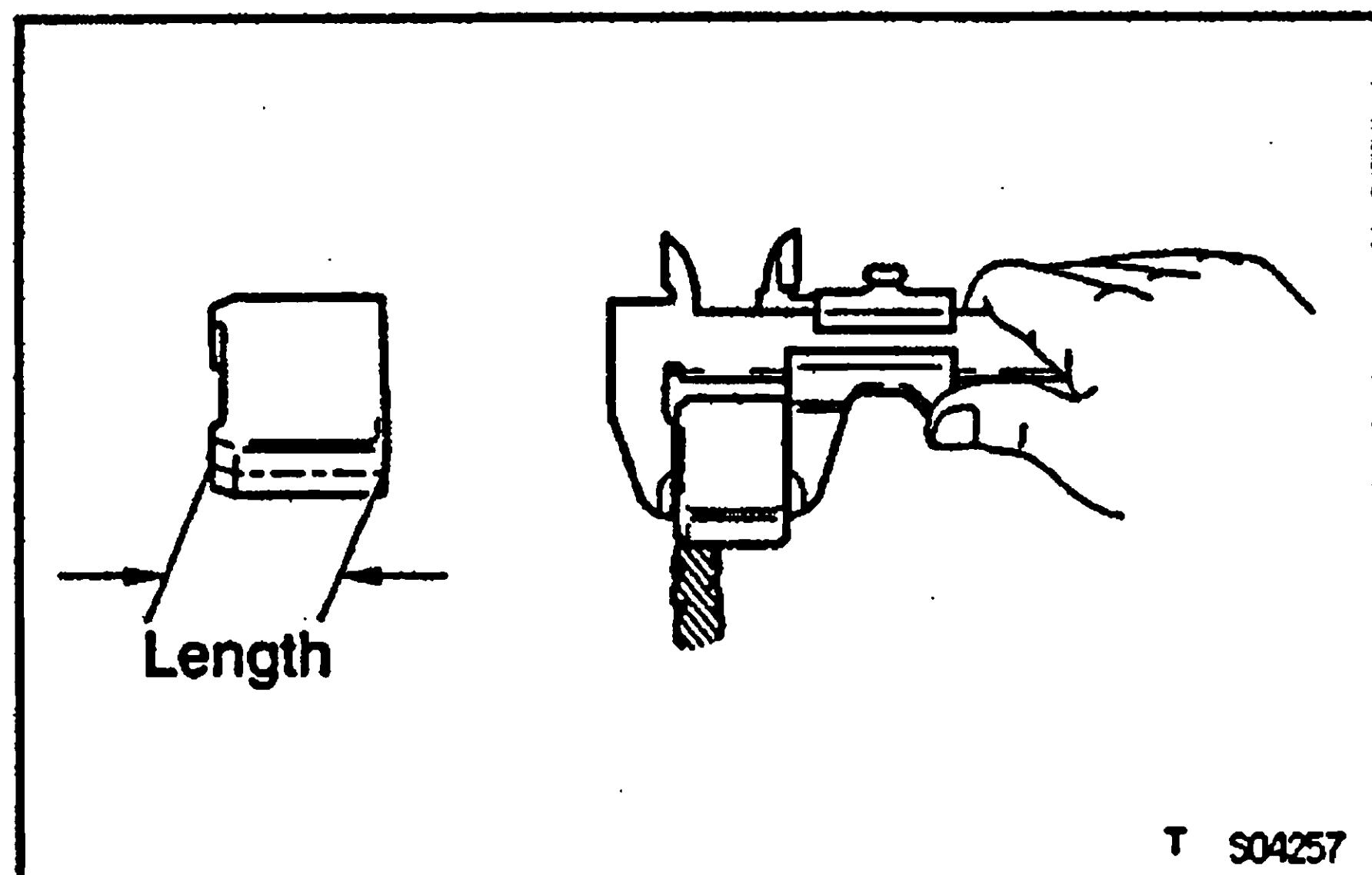
If there is no continuity, replace the field frame.



2. INSPECT FIELD COIL FOR GROUND

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

If there is continuity, repair or replace the field frame.



Brushes

INSPECT BRUSH LENGTH

Using a vernier caliper, measure the brush length.

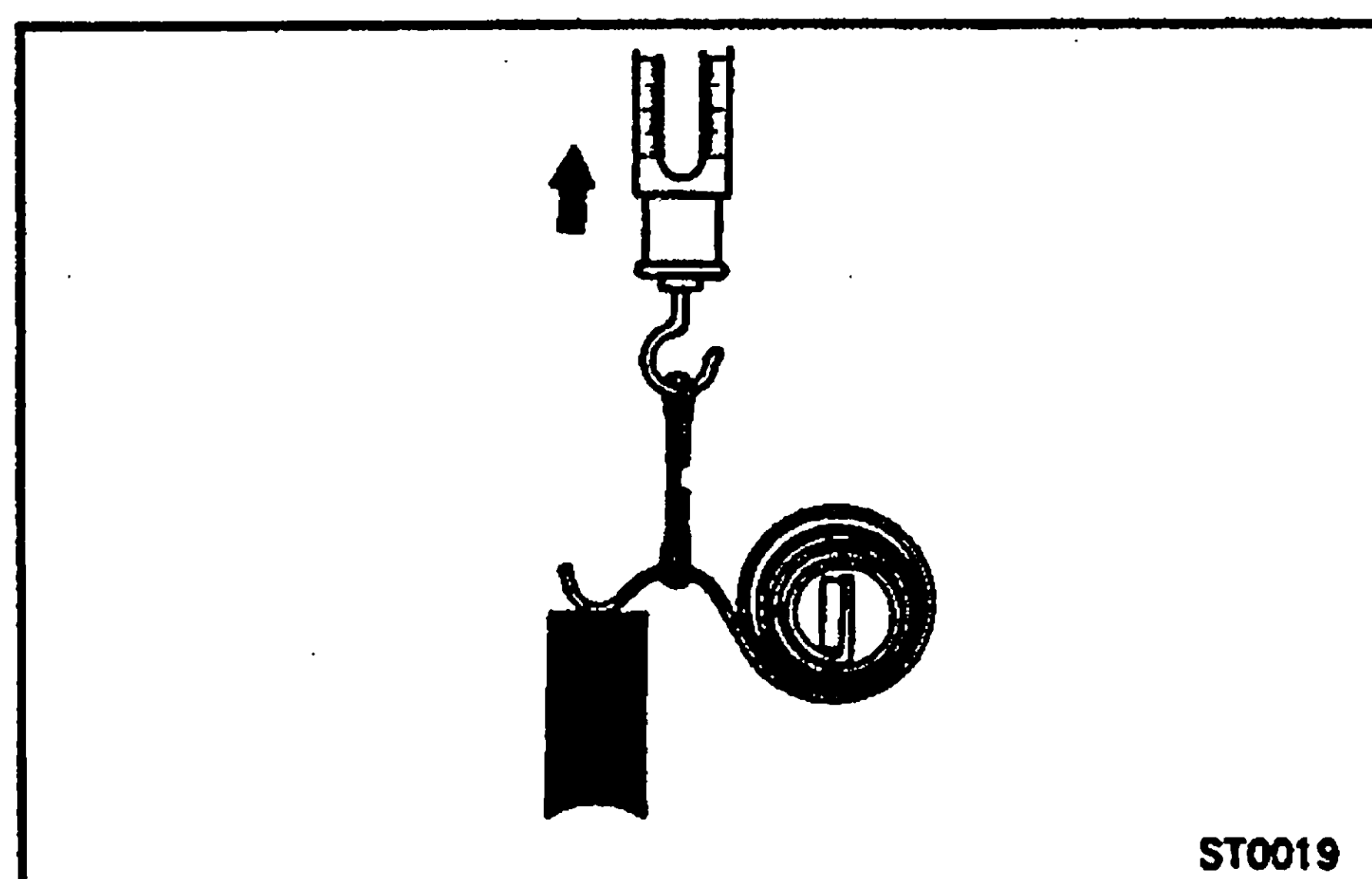
Standard length:

21.0 mm (0.828 in.)

Minimum length:

12.0 mm (0.472 in.)

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



Brush Springs

INSPECT BRUSH SPRING LOAD

Take the pull scale reading the instant the brush spring separates from the brush.

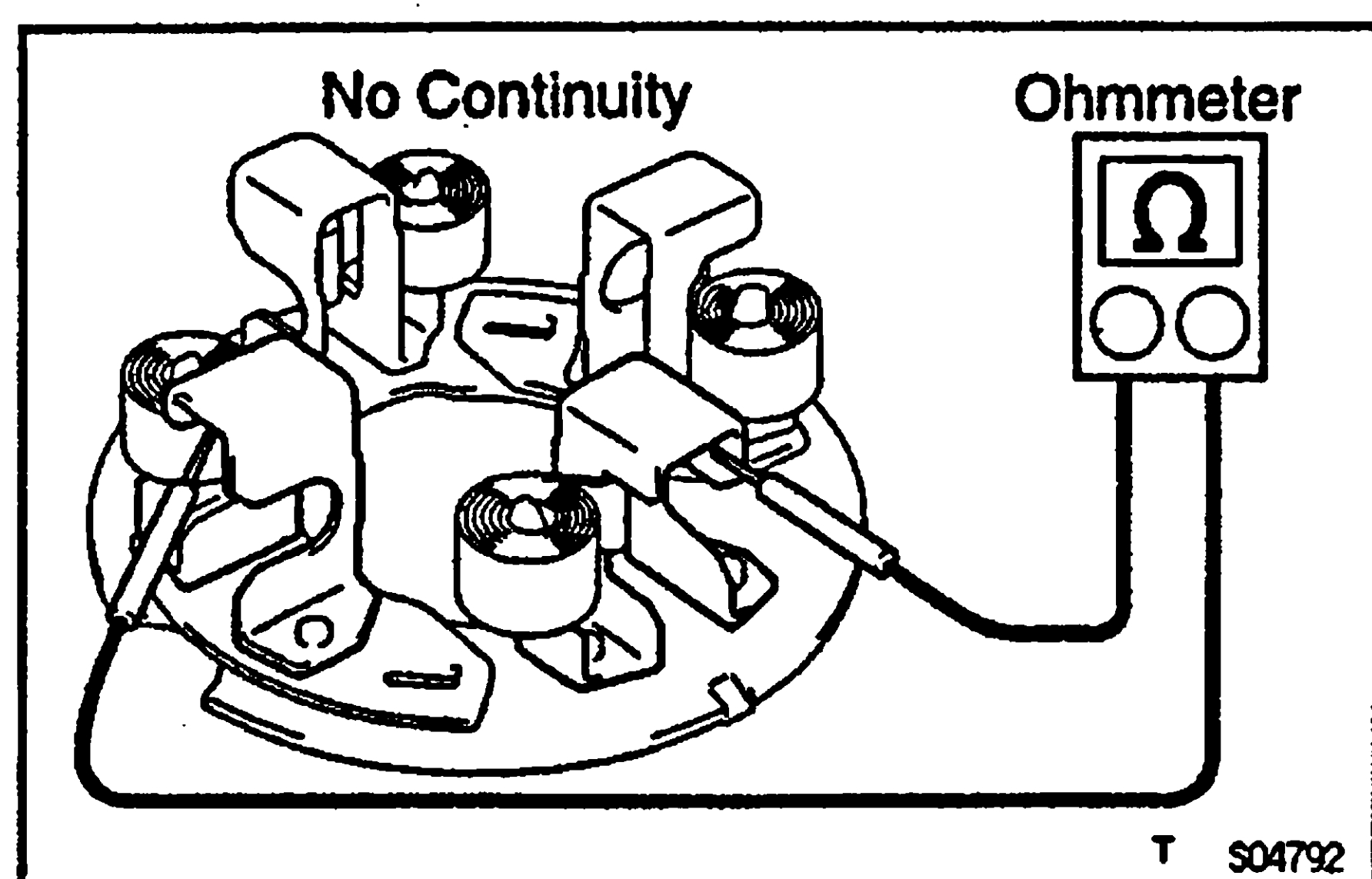
Standard spring installed load:

27.5 — 37.3 N (2.8 — 3.8 kgf, 6.1 — 8.3 lbf)

Minimum spring installed load:

14.7 N (1.5 kgf, 3.3 lbf)

If the installed load is less than minimum replace the brush springs.



Brush Holder

INSPECT BRUSH HOLDER INSULATION

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (−) brush holders.

If there is continuity, repair or replace the brush holder.

Clutch and Gears

1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idle gear and clutch assembly for wear or damage.

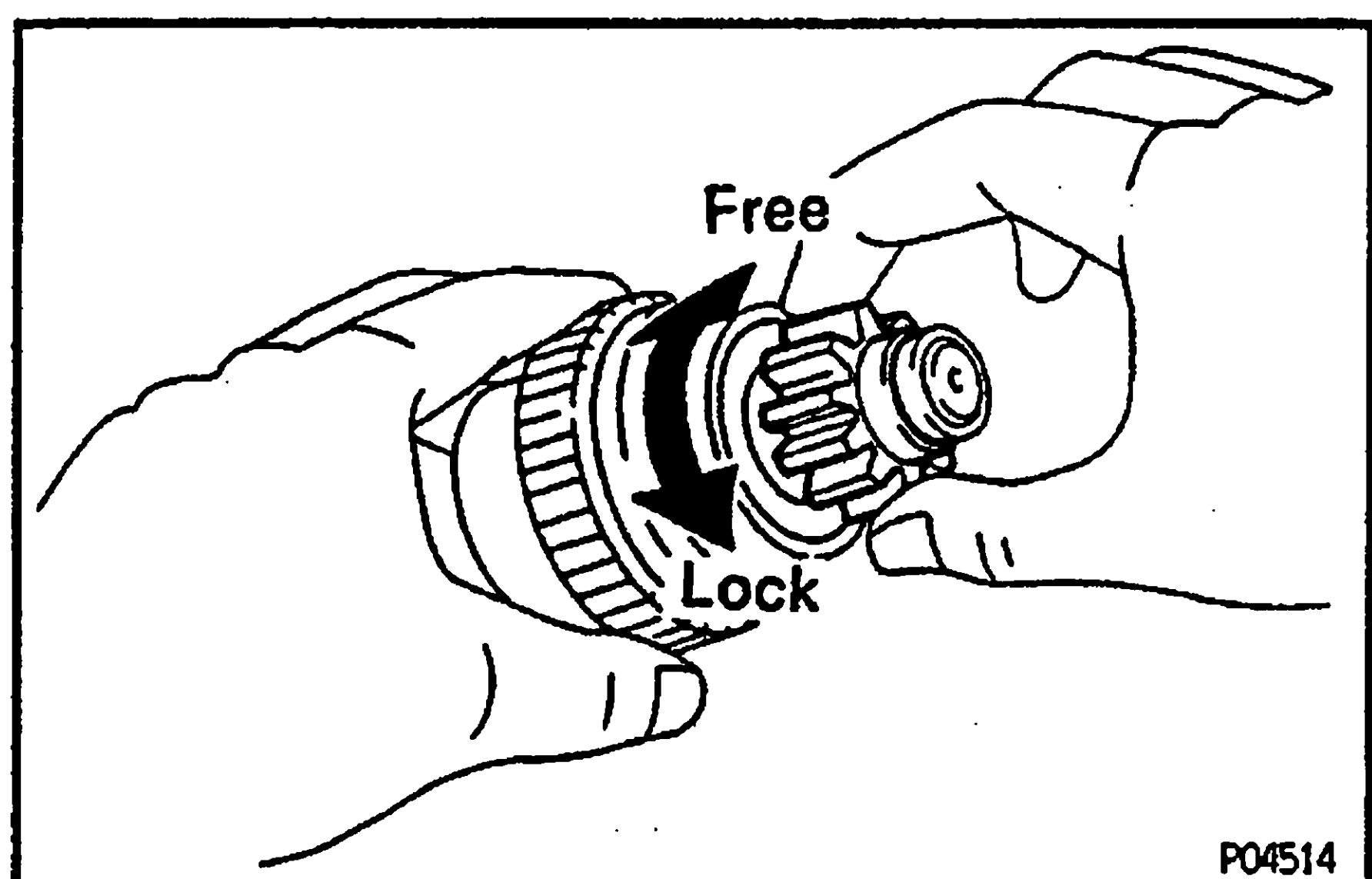
If damaged, replace the gear or clutch assembly.

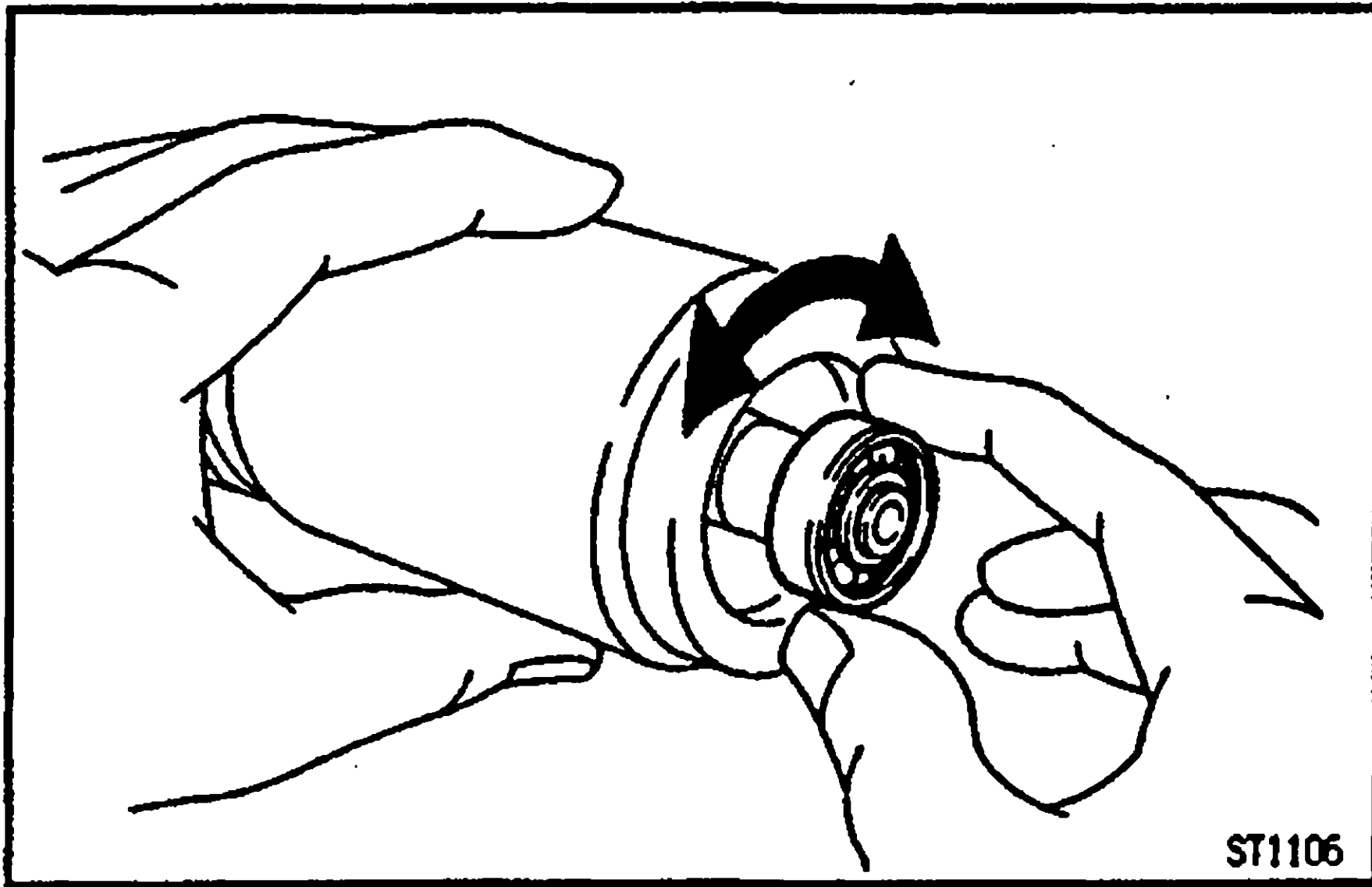
If damaged, also check the drive plate ring gear for wear or damage.

2. INSPECT CLUTCH PINION GEAR

Hold the starter clutch and rotate the pinion gear clockwise, and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

If necessary, replace the clutch assembly.

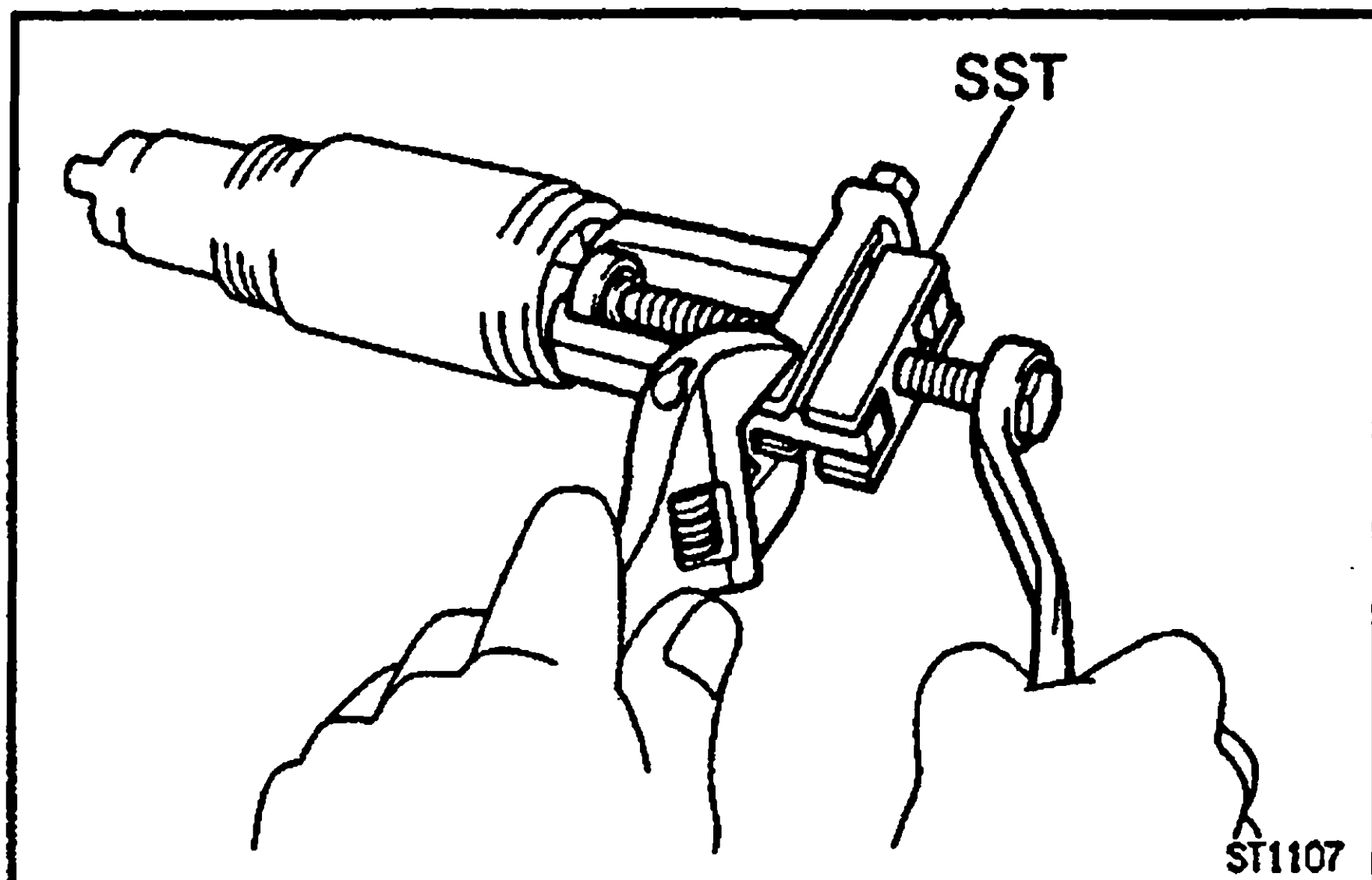




Bearings

1. INSPECT REAR BEARING

Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.



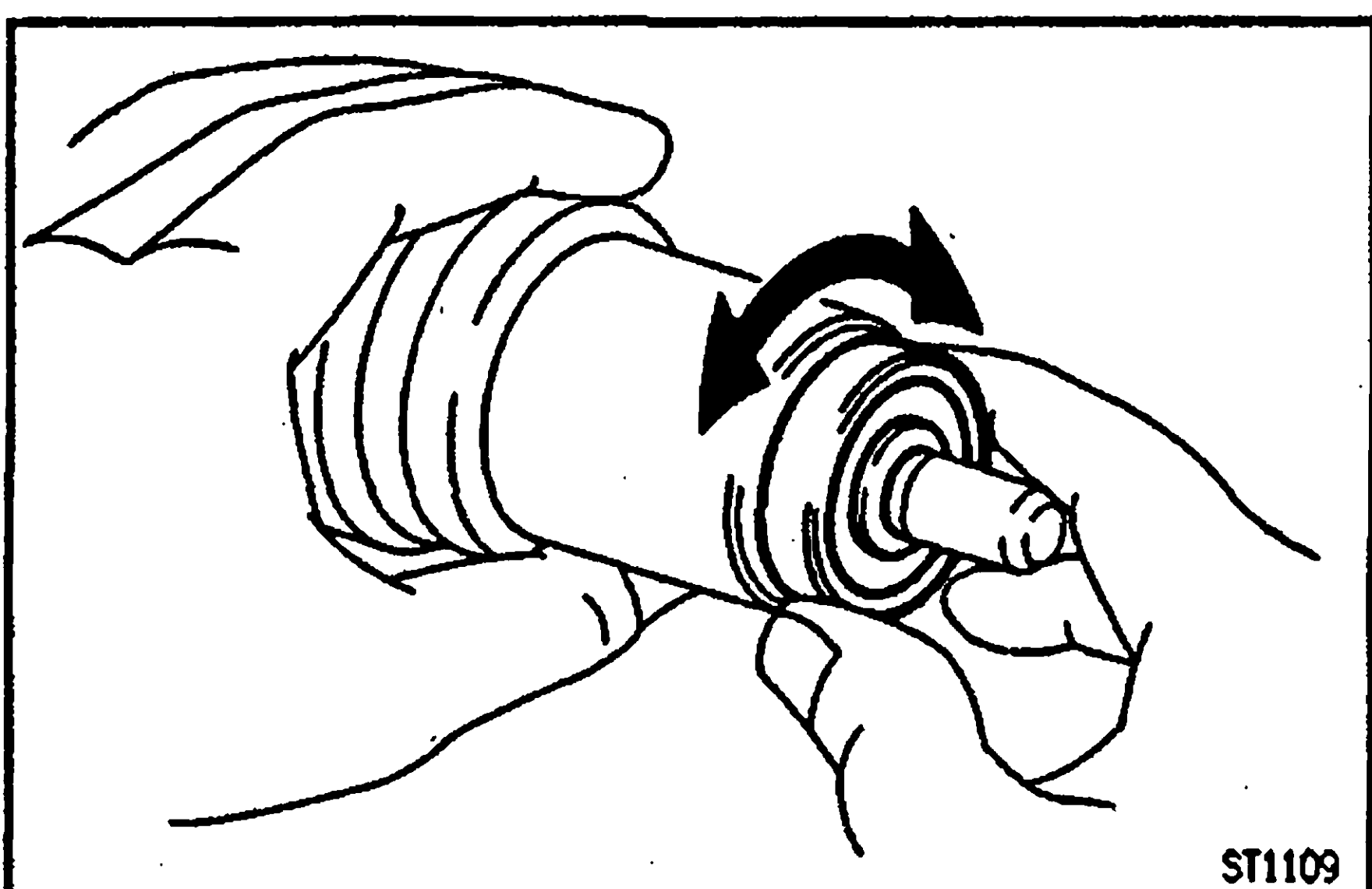
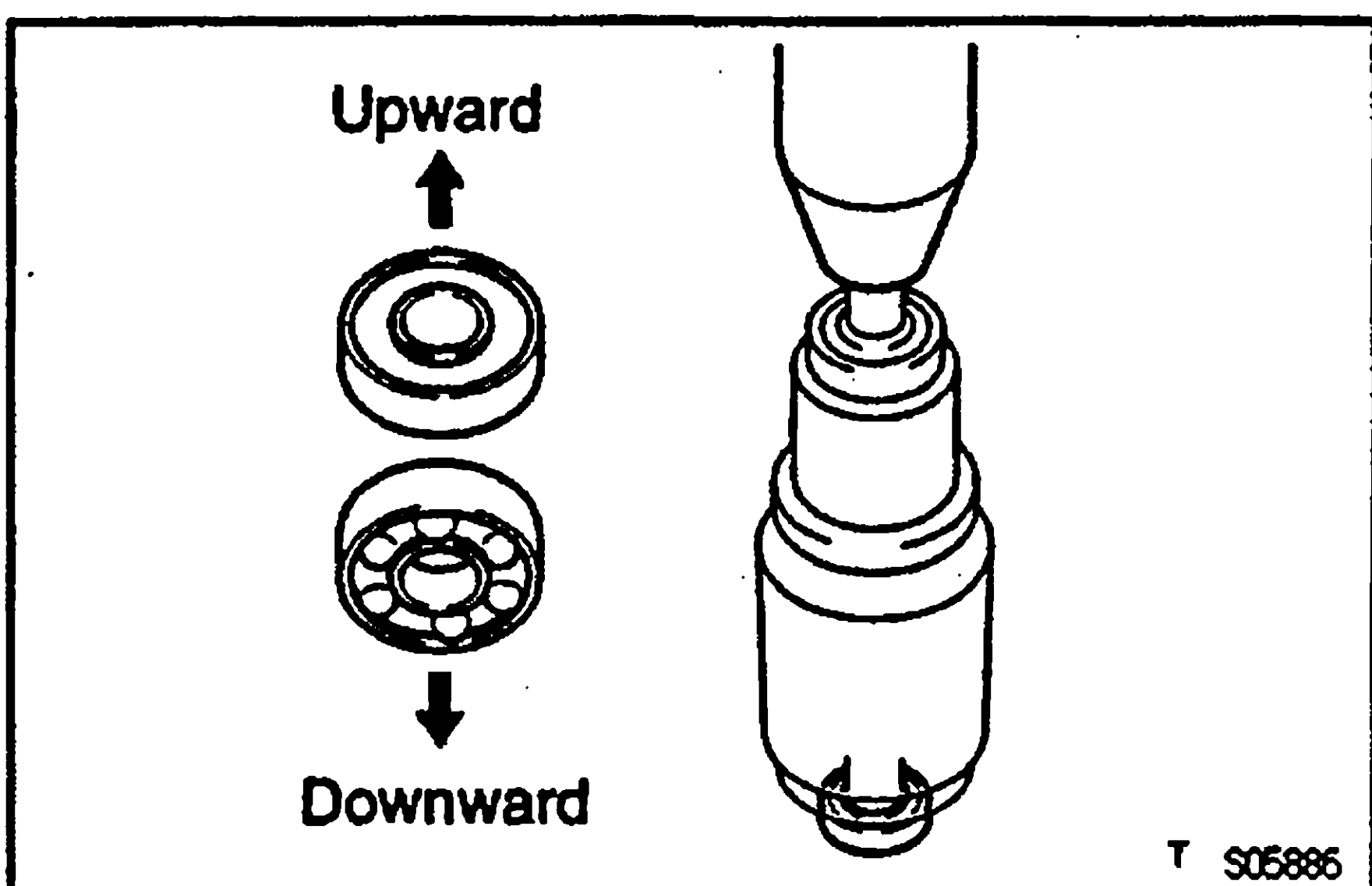
2. IF NECESSARY, REPLACE REAR BEARING

(a) Using SST, remove the bearing.

SST 09286-46011

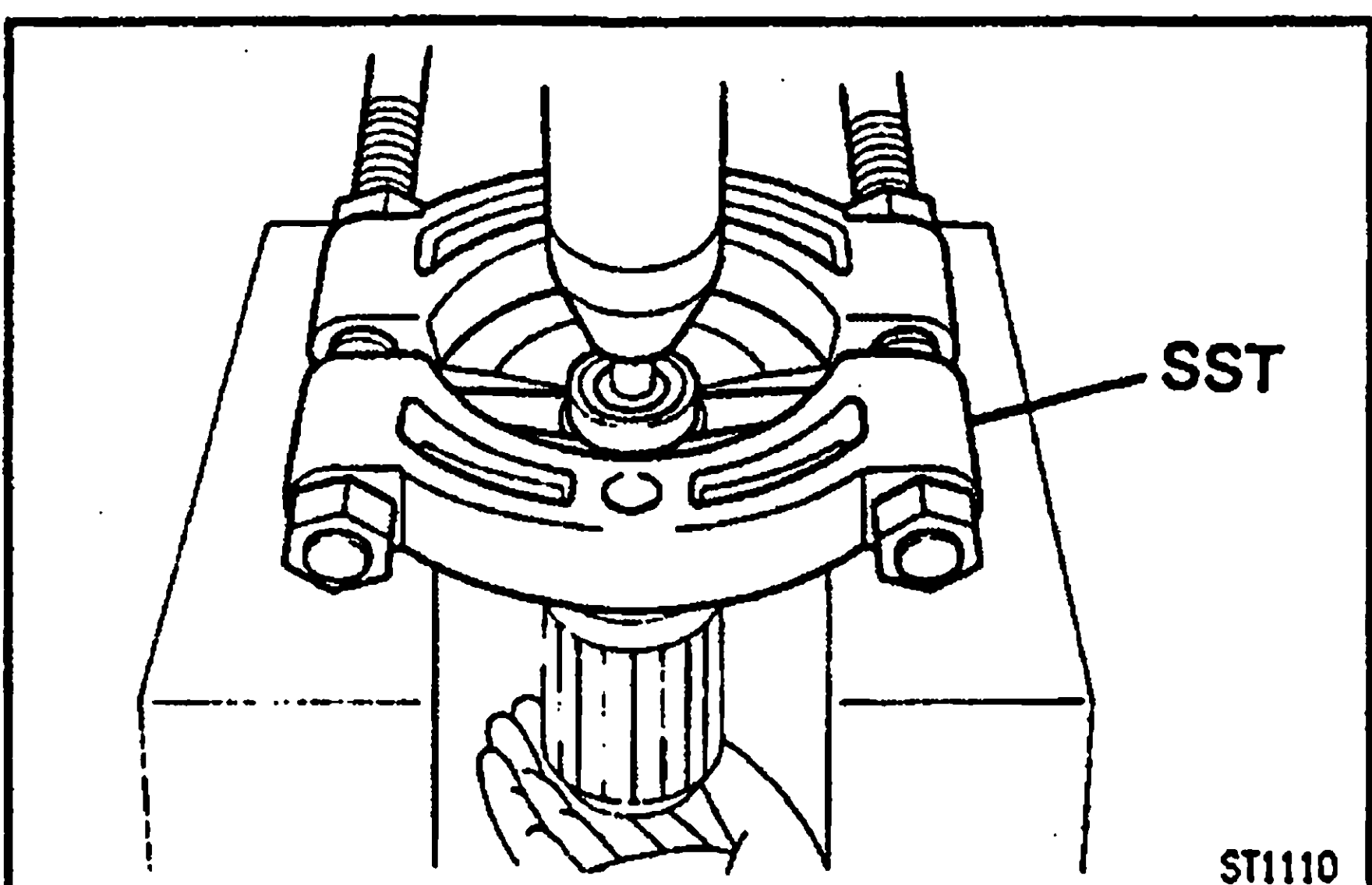
(b) Using a press, press in a new bearing.

NOTICE: Be careful of the bearing installation direction.



3. INSPECT FRONT BEARING

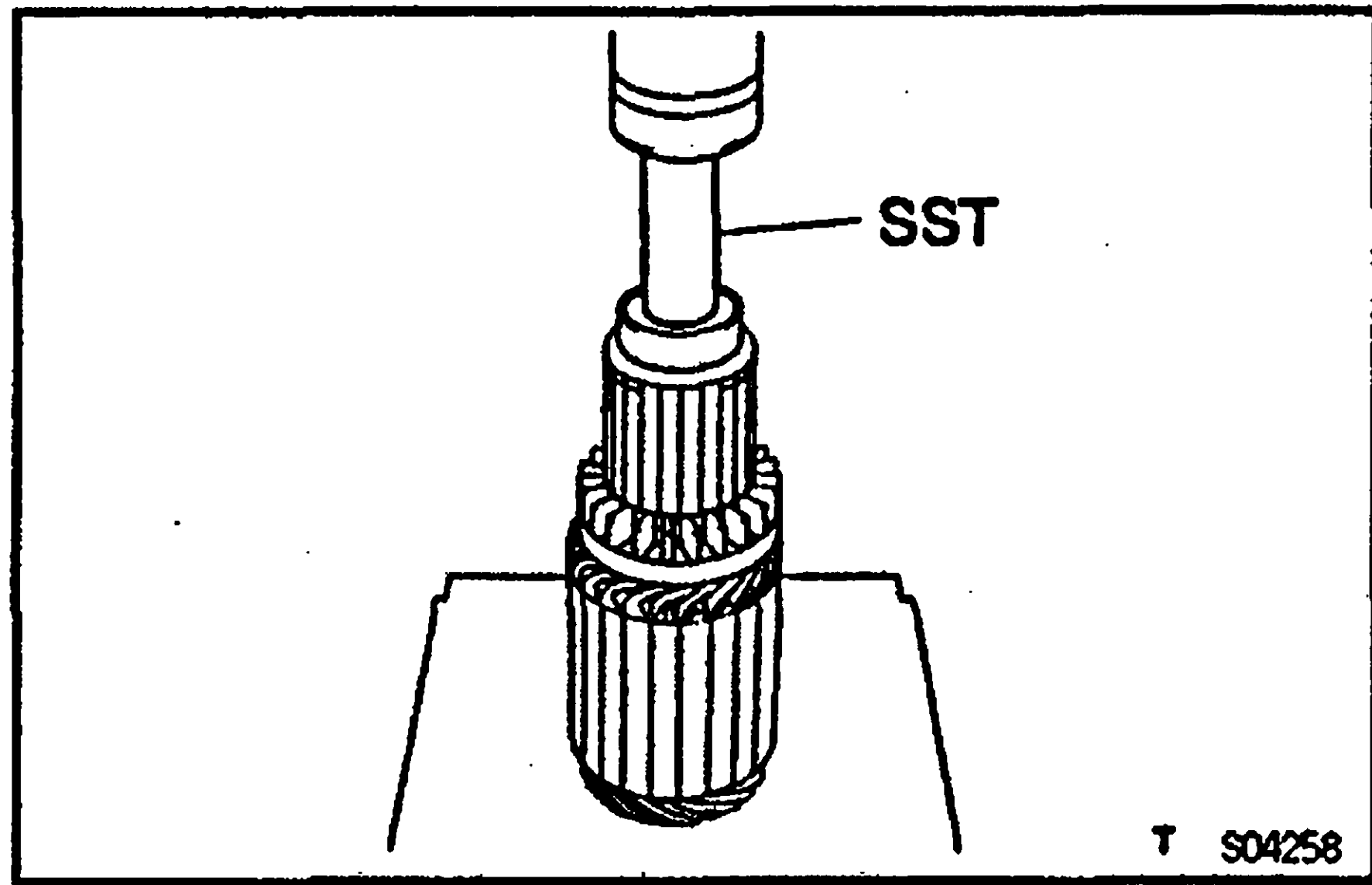
Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.



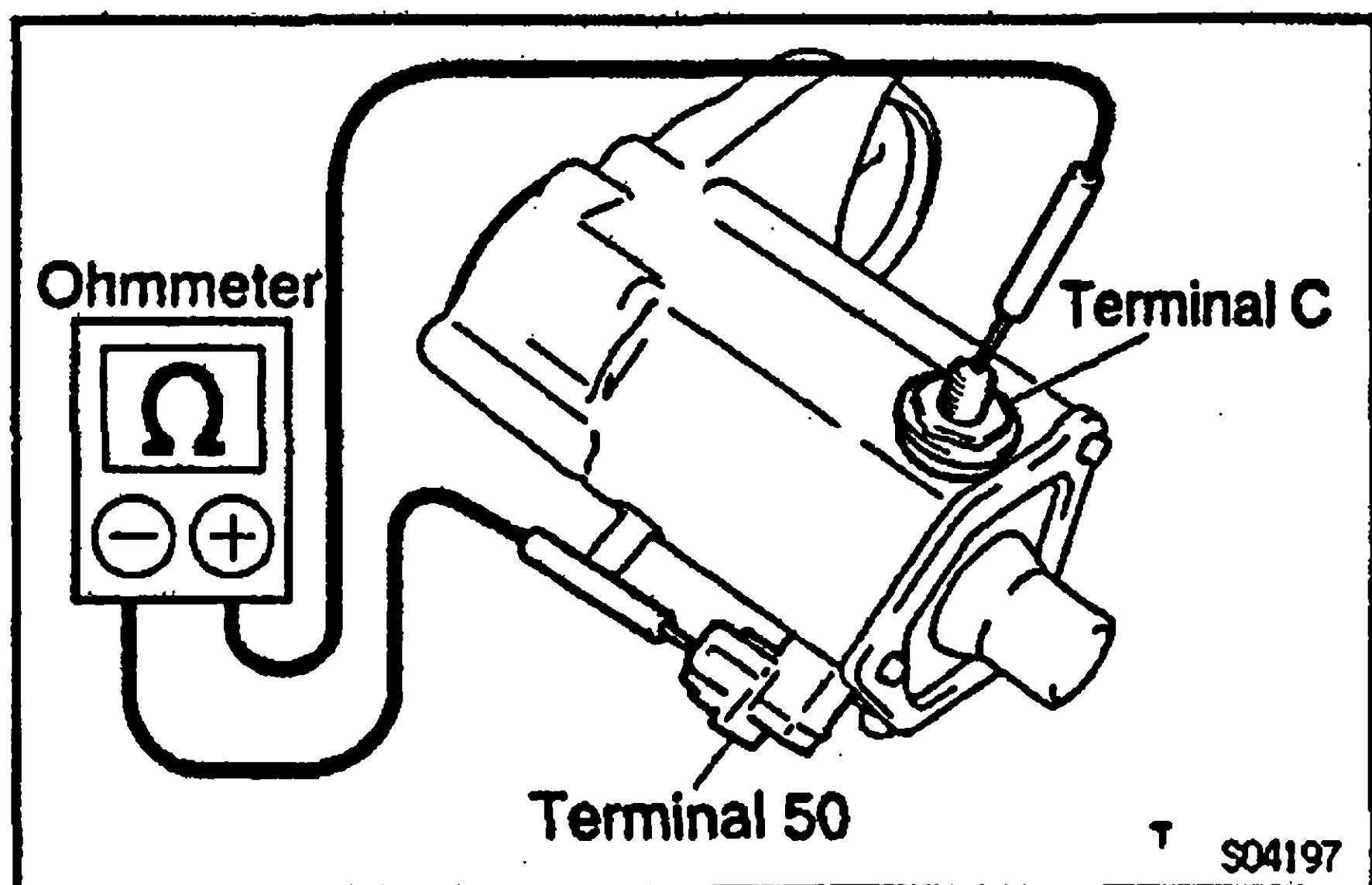
4. IF NECESSARY, REPLACE FRONT BEARING

(a) Using SST and a press, press out the bearing.

SST 09950-00020



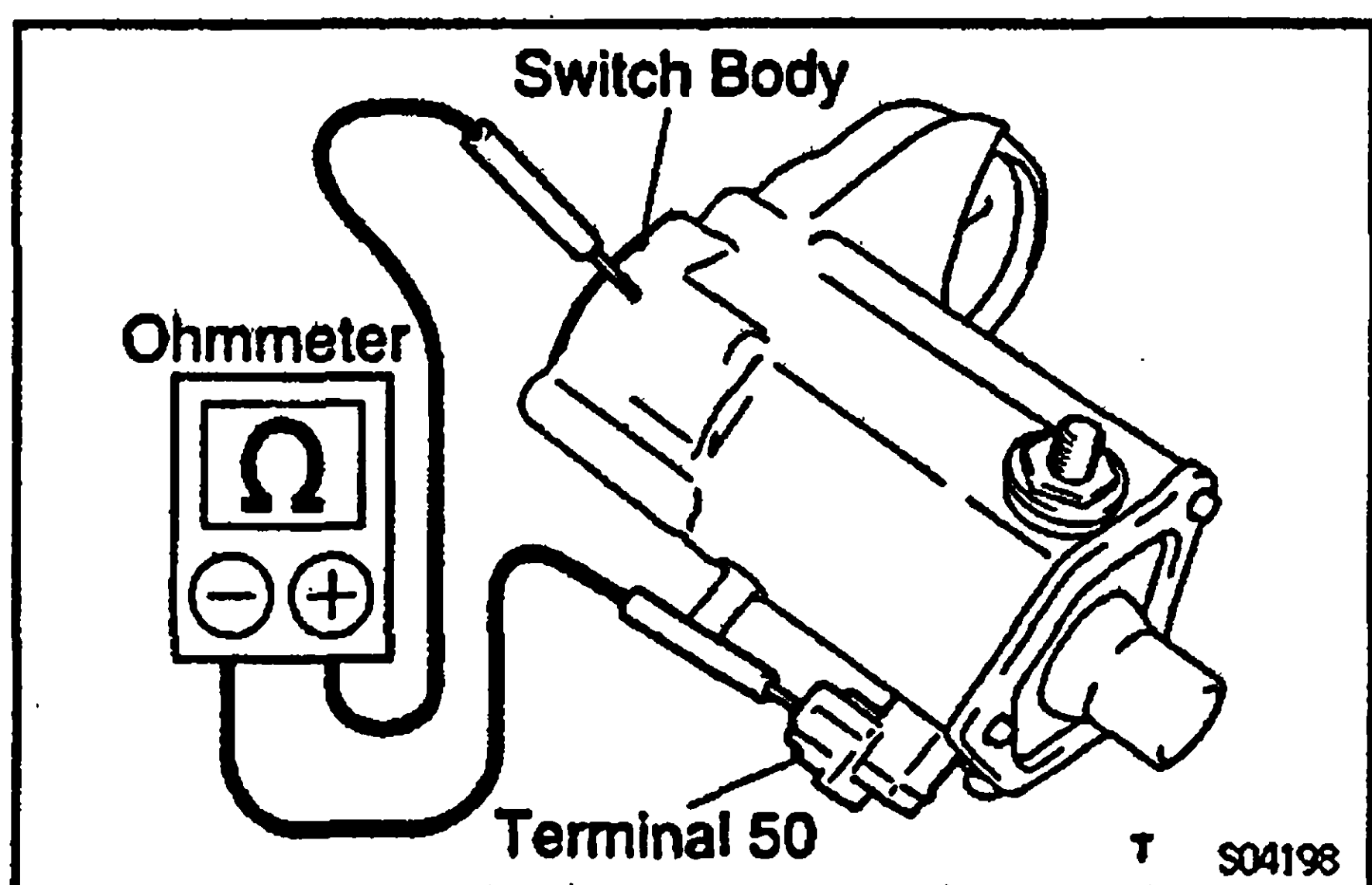
- (b) Using SST and a press, press in a new bearing.
SST 09820-00030



Magnetic Switch

1. DO PULL-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C.
If there is no continuity, replace the magnetic switch.



2. DO HOLD-IN COIL OPEN CIRCUIT TEST

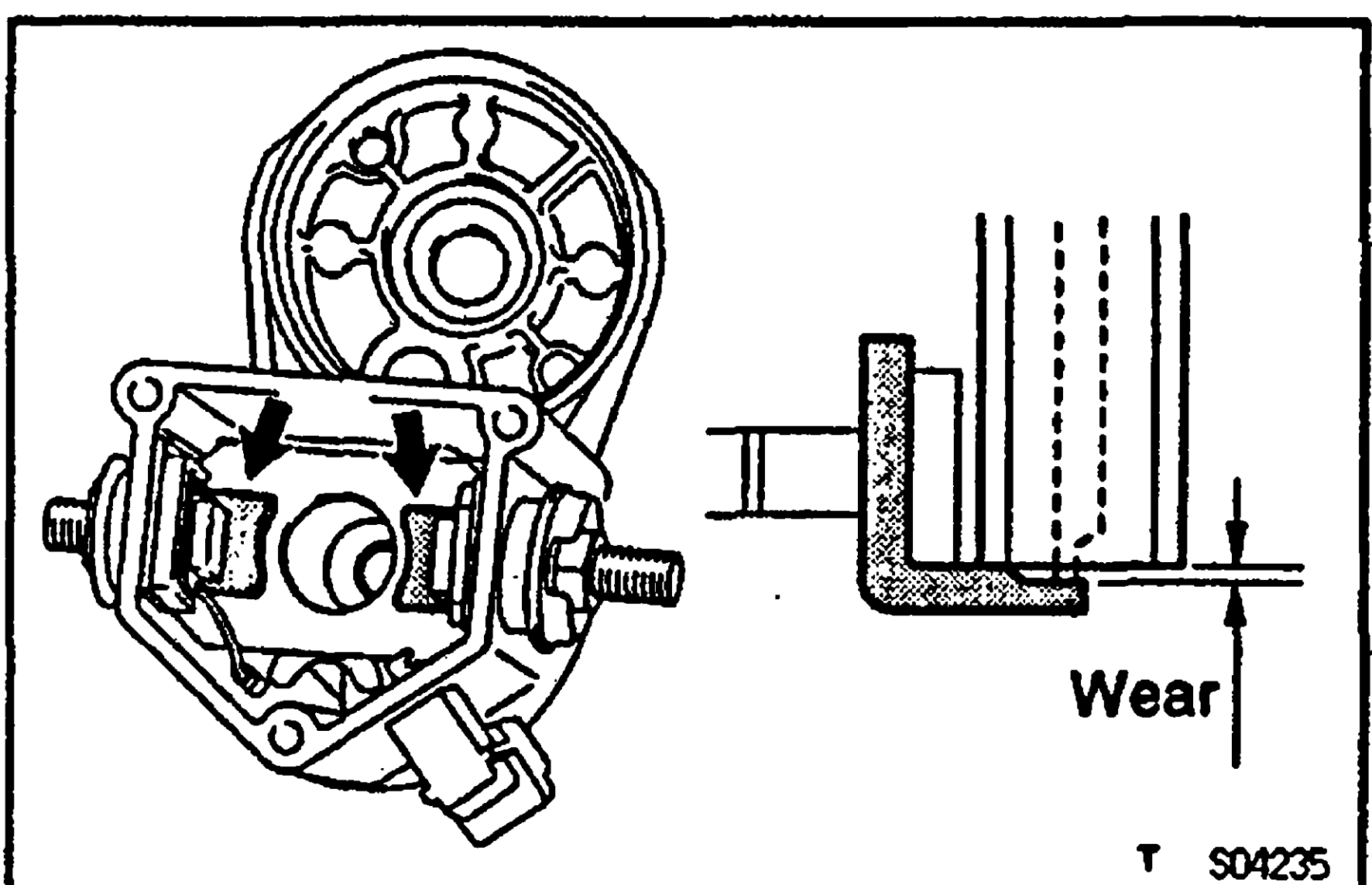
Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.
If there is no continuity, replace the magnetic switch.

MAGNETIC SWITCH TERMINAL KIT PARTS REPLACEMENT

ST06J-01

1. REMOVE MAGNETIC SWITCH END COVER

Remove the 3 bolts, end cover, gasket, and plunger.

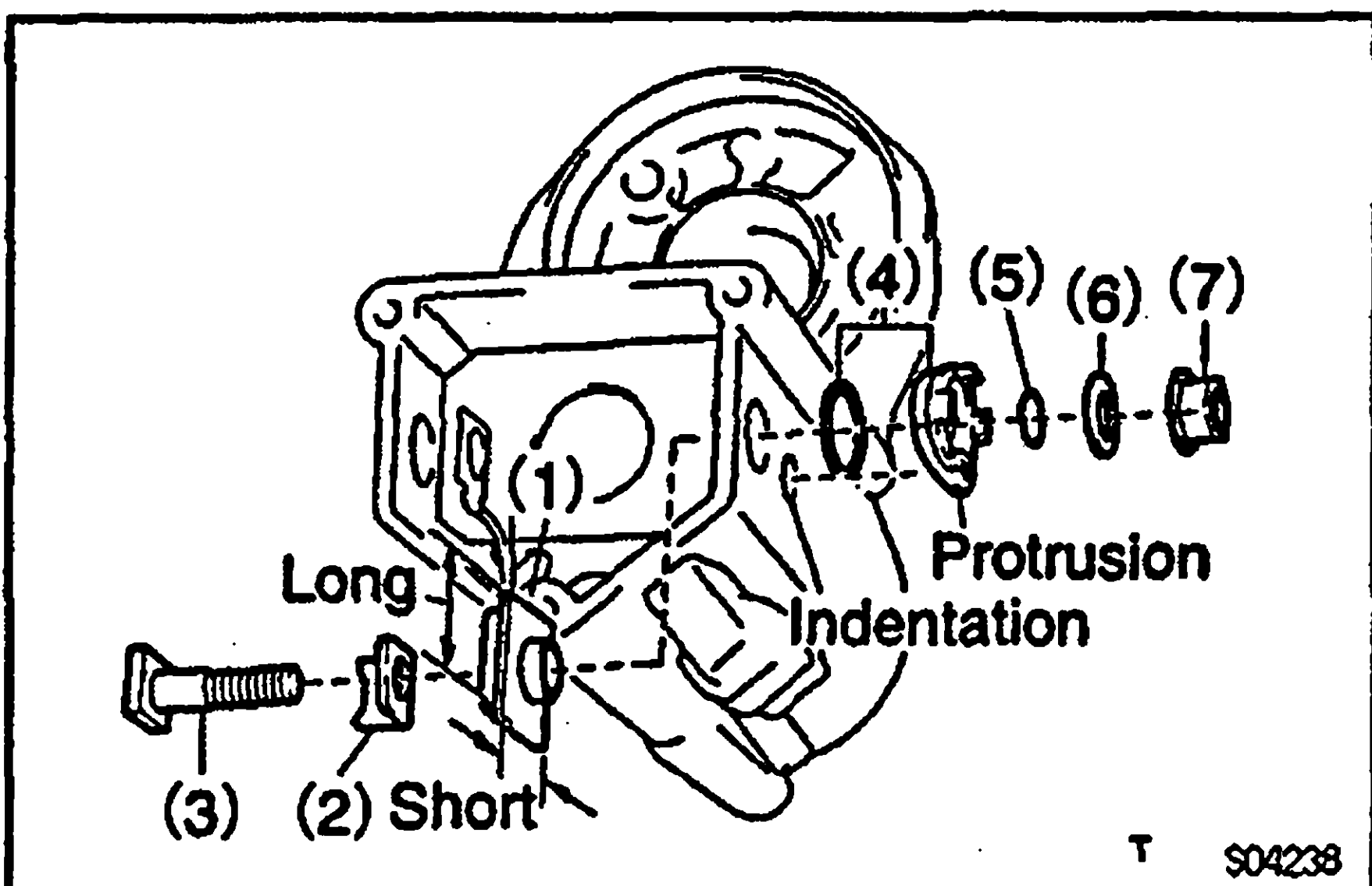
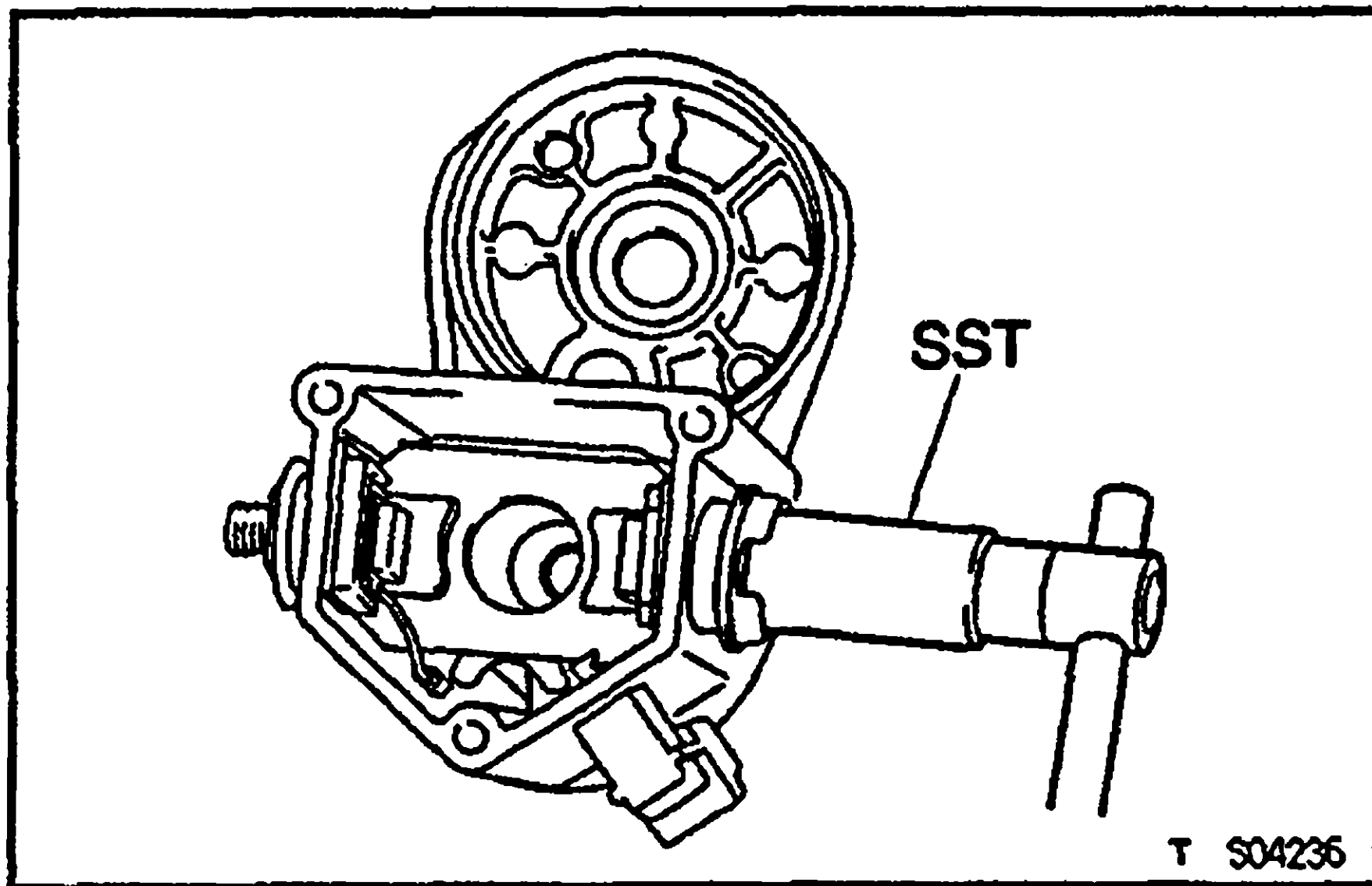


2. INSPECT CONTACT PLATE FOR WEAR

Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear: 1.6 mm (0.063 in.)

If the depth of wear is greater than the maximum, replace the contact plate.



3. REMOVE TERMINAL KIT PARTS

- (a) Using SST, loosen the terminal nuts.
SST 09810-38170
- (b) Terminal C:
Remove the terminal nut, wave washer, terminal insulator (outside), O-ring, terminal bolt, contact plate and terminal insulator (inside).
- (c) Terminal 30:
Remove the terminal nut, washer, terminal insulator (outside), Packing, O-ring, terminal bolt, contact plate, terminal insulator (inside) and insulation paper.

4. REINSTALL TERMINAL KIT PARTS

- (a) Install these new parts:

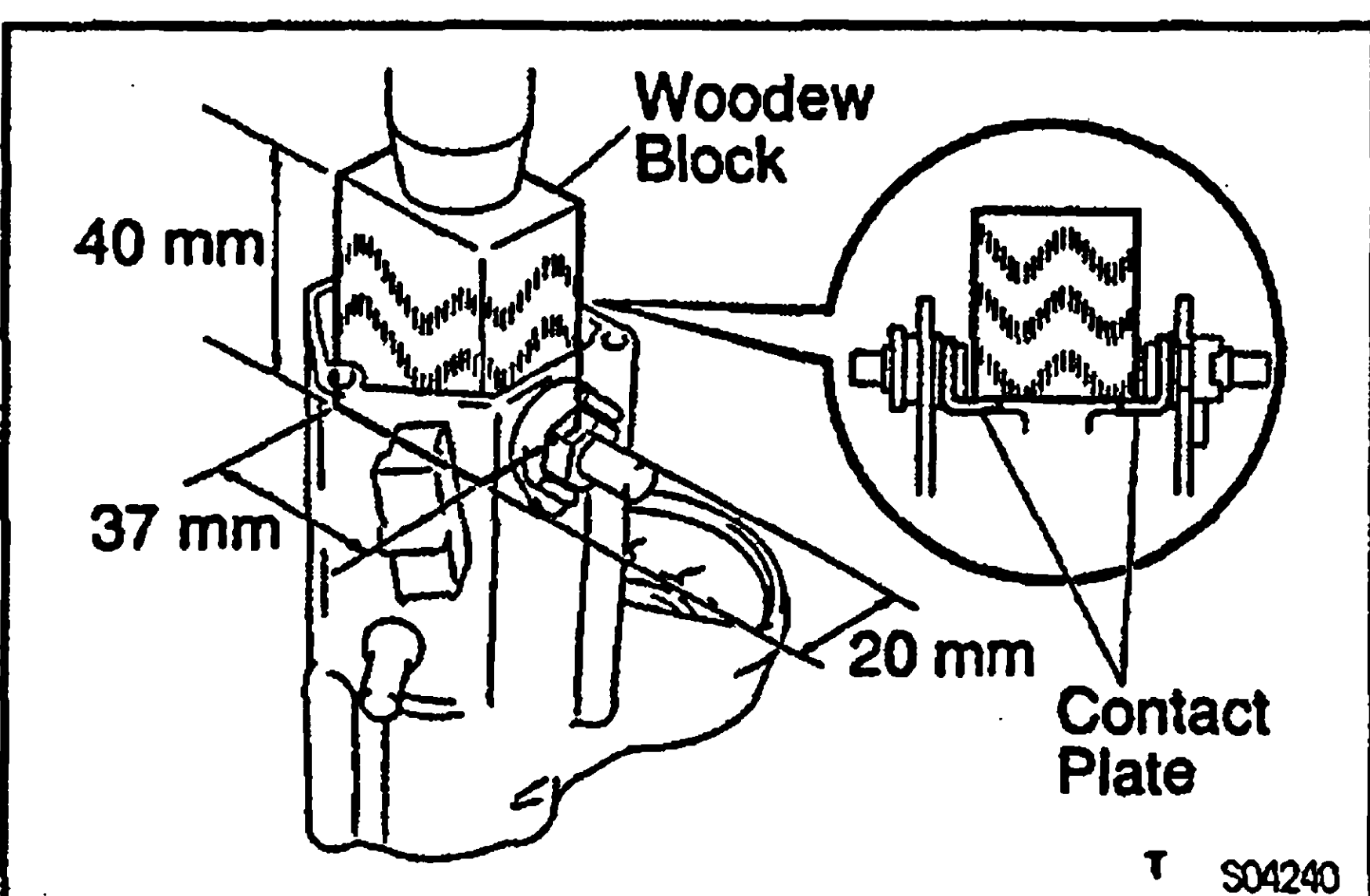
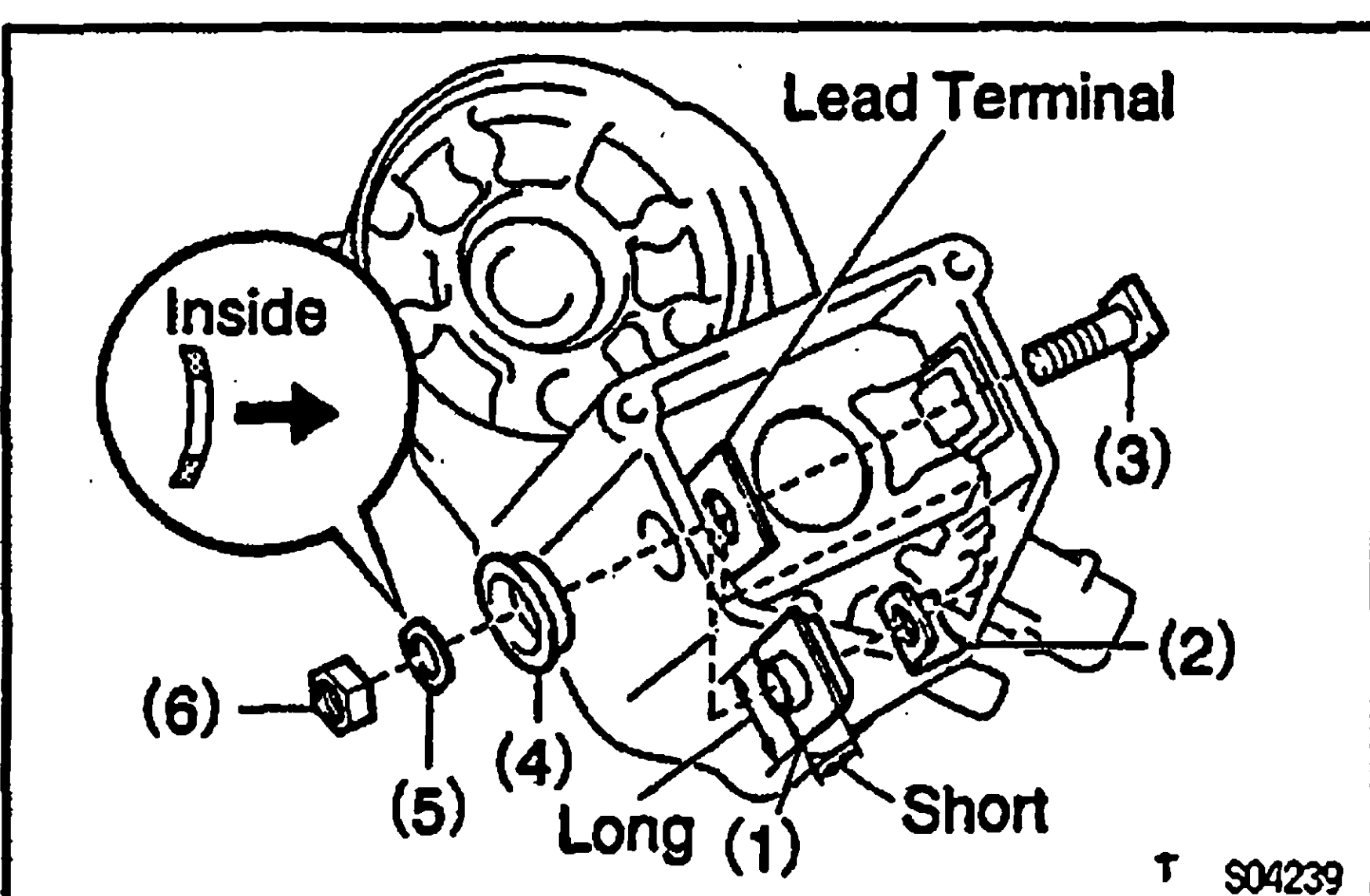
Terminal 30:

- (1) Terminal insulator (inside)
- (2) Contact plate
- (3) Terminal bolt
- (4) Packing and terminal insulator (outside)
- (5) O-ring
- (6) Washer

HINT: Match the protrusion of the insulator with the indentation of the housing.

- (7) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) in the correct direction.



Terminal C:

- (1) Terminal insulator (inside)
- (2) Contact plate
- (3) Terminal bolt
- (4) Terminal insulator (outside)
- (5) Wave washer
- (6) Terminal nut

NOTICE: Be careful to install the terminal insulators (inside) and wave washer in the correct direction.

- (b) Temporarily tighten the terminal nuts.

5. TIGHTEN TERMINAL NUT

- (a) Put a wood block on the contact plate and press it down with a hand press.

Dimensions of wood block:

20 x 37 x 40 mm (0.97 x 1.46 x 1.57 in.)

Press force:

981 N (100 kgf, 221 lbf)

NOTICE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.

Gauge Pressure

$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

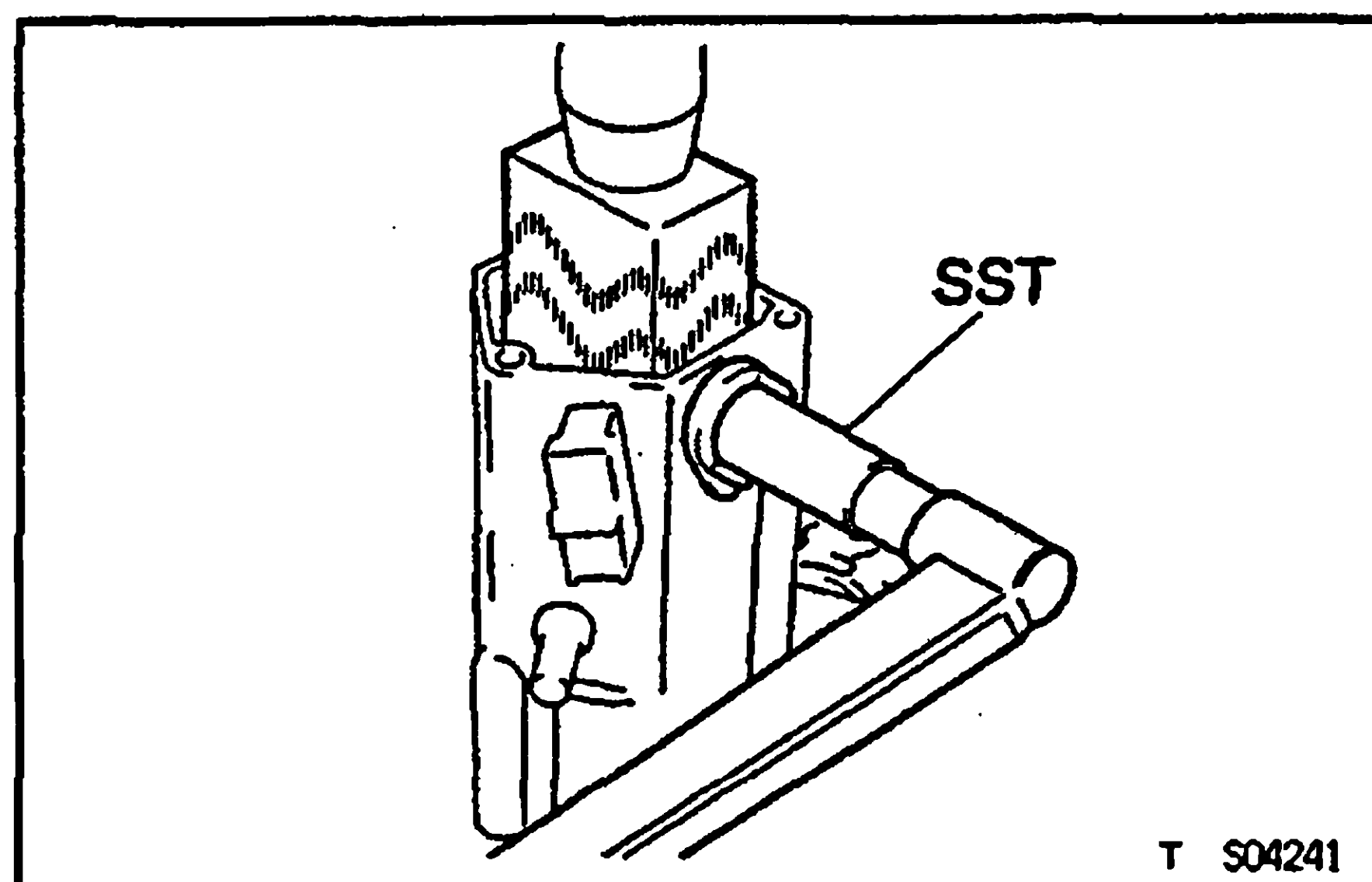
$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

$$(\text{kPa}) = (\text{psi}) \times 6.9$$

V06796

- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.

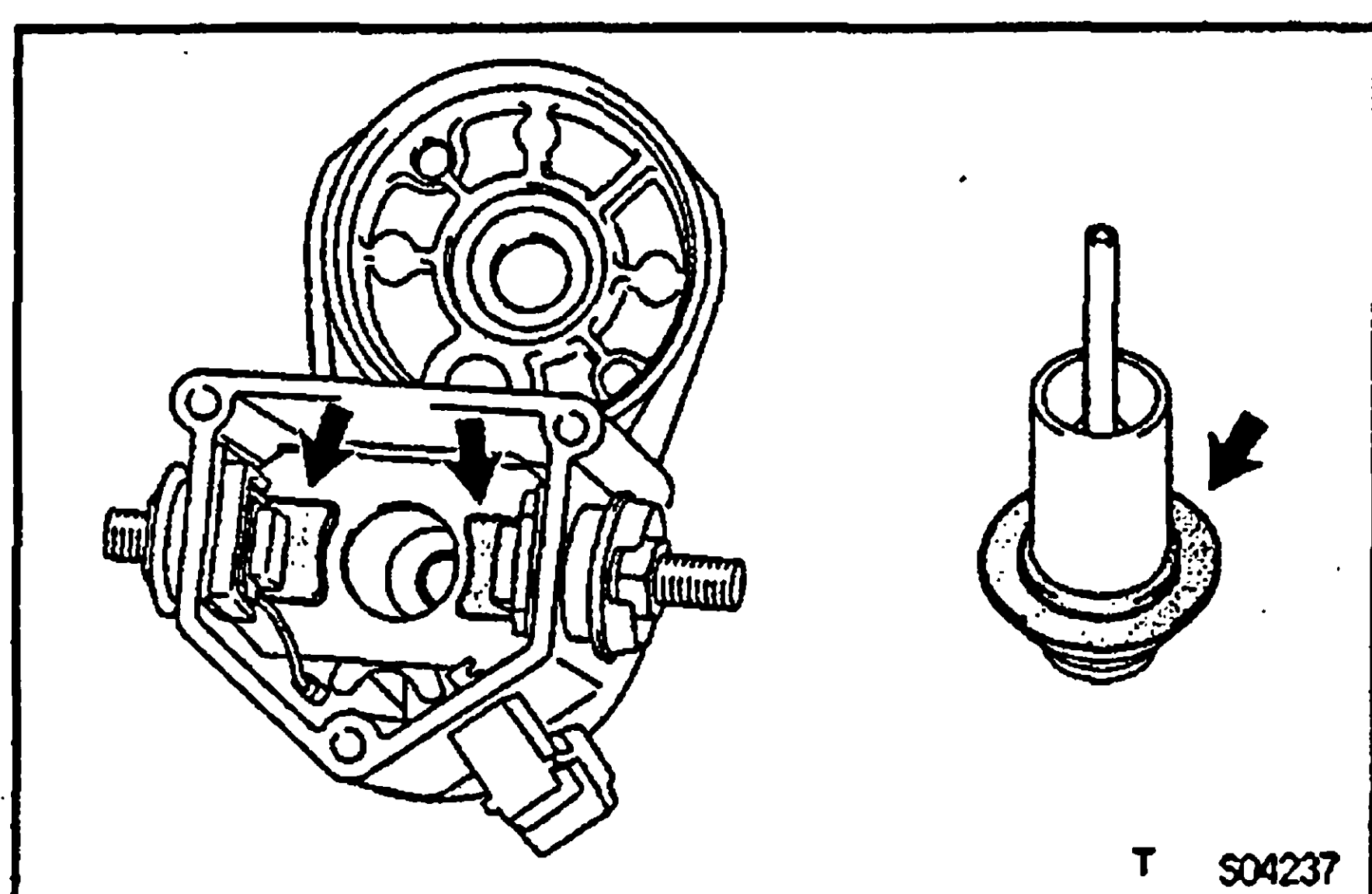


- (b) Using SST, tighten the nuts to the specified torque.

SST 09810–38170

Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)

NOTICE: If the nut is over tightened, it may cause cracks on the inside of the insulator.



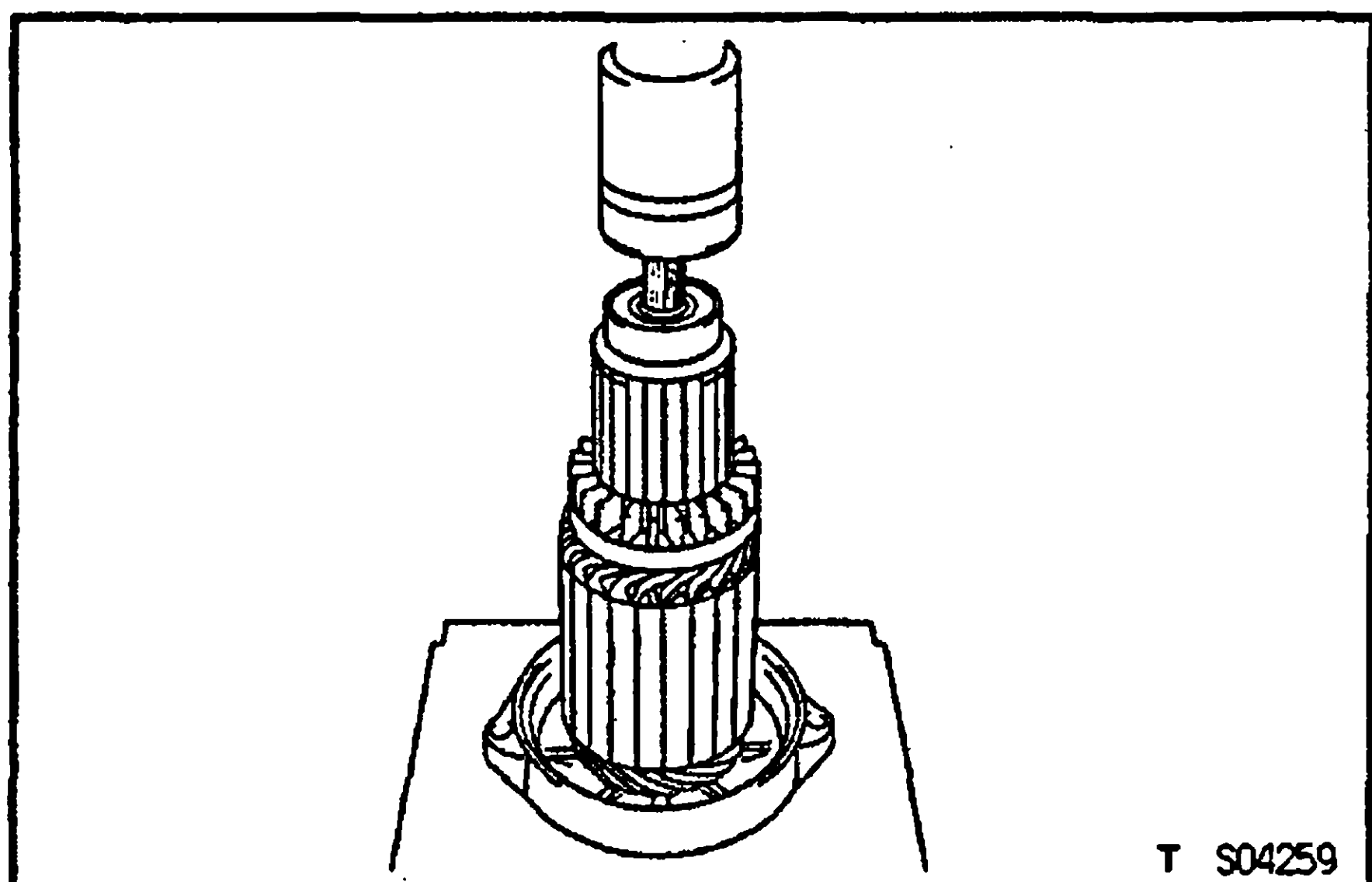
6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

7. REINSTALL MAGNETIC SWITCH END COVER

Install the plunger, new gasket and end cover with the 3 bolts.

Torque: 3.6 N·m (36 kgf·cm, 32 in·lbf)



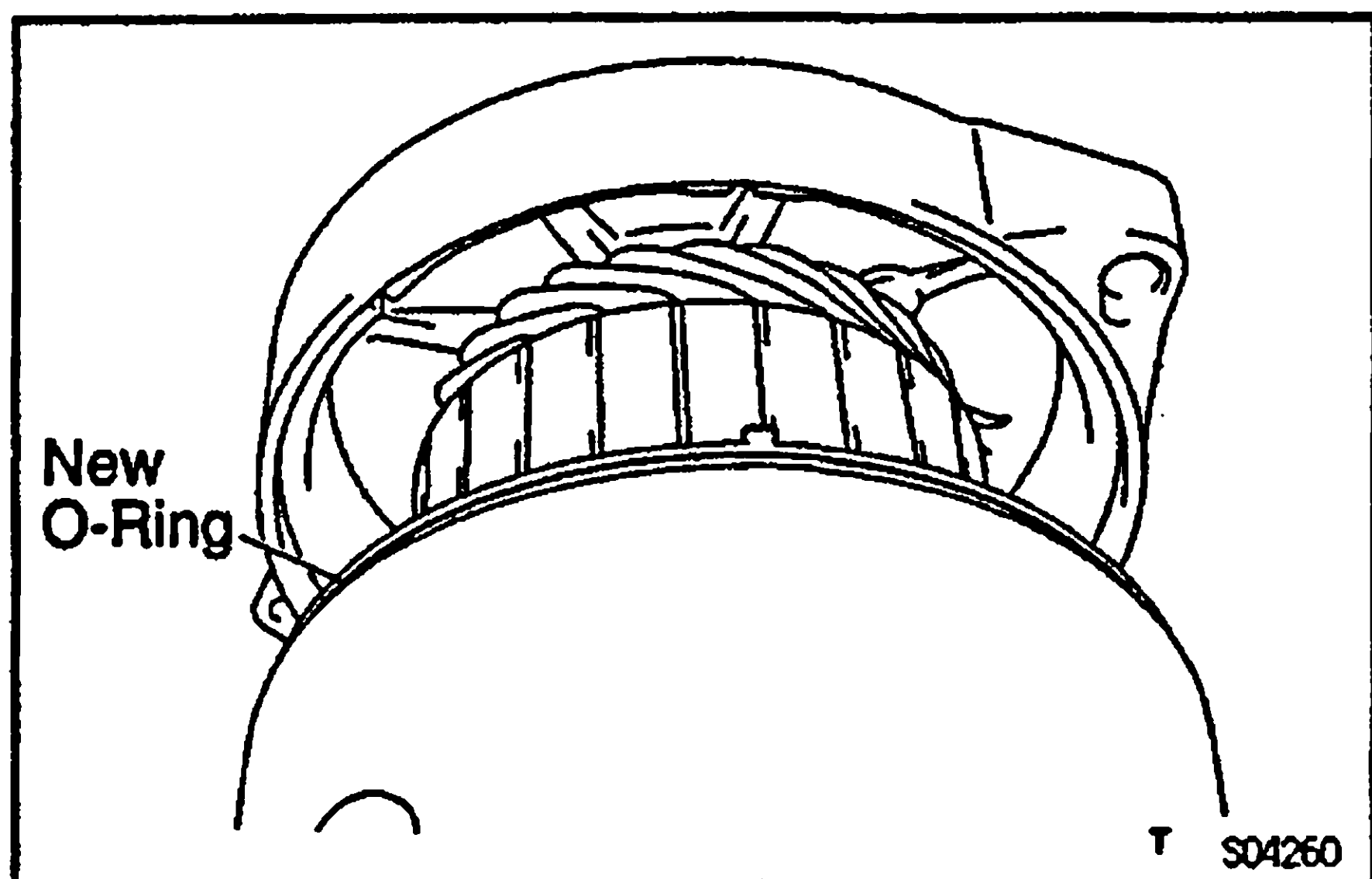
STARTER ASSEMBLY

ST06K-01

HINT: Use high-temperature grease to lubricate the bearings and gears when assembling the starter.

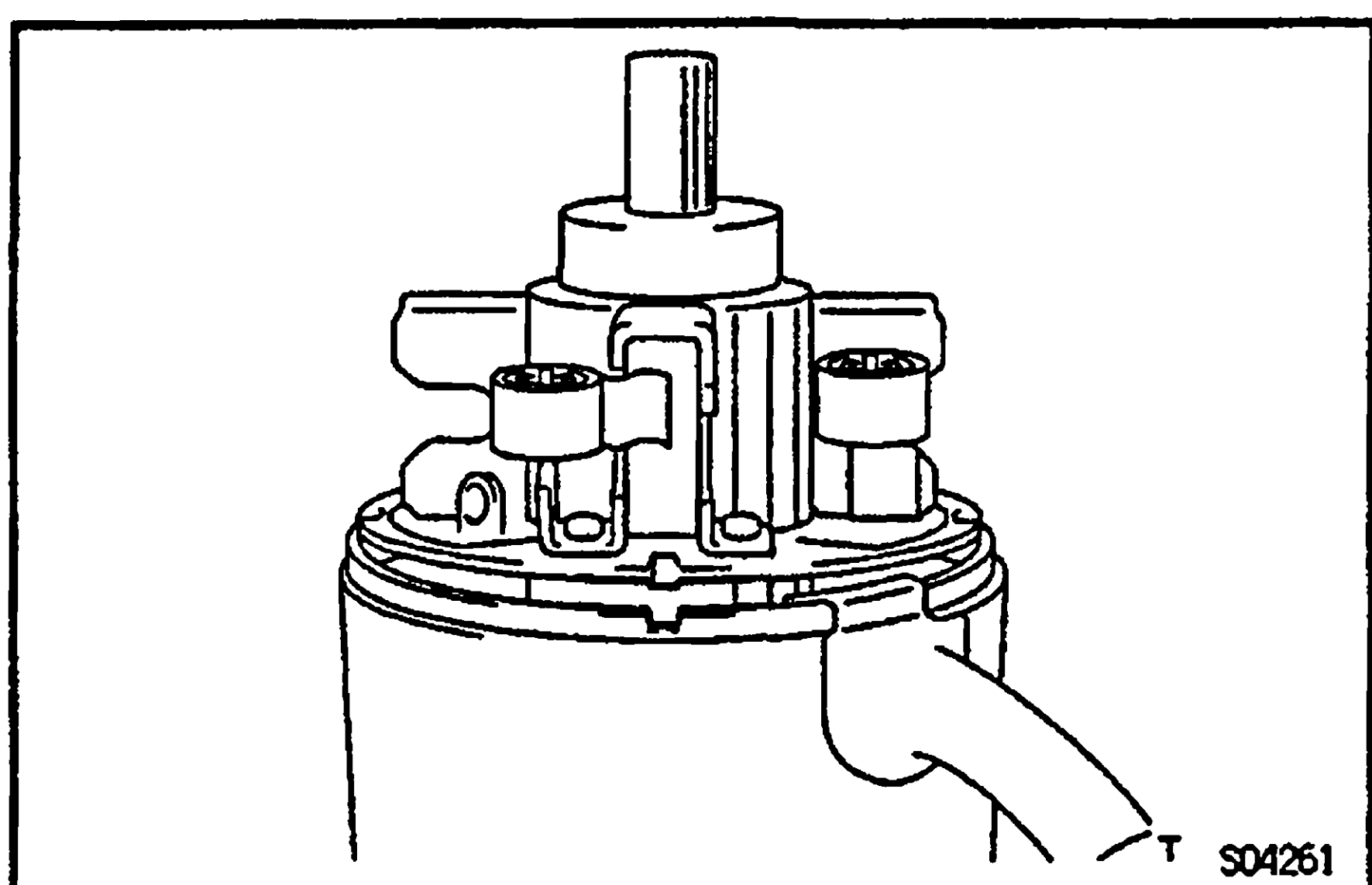
1. PLACE ARMATURE INTO END FRAME

- Apply grease to the armature bearings.
- Using a press, press the armature into the end frame.



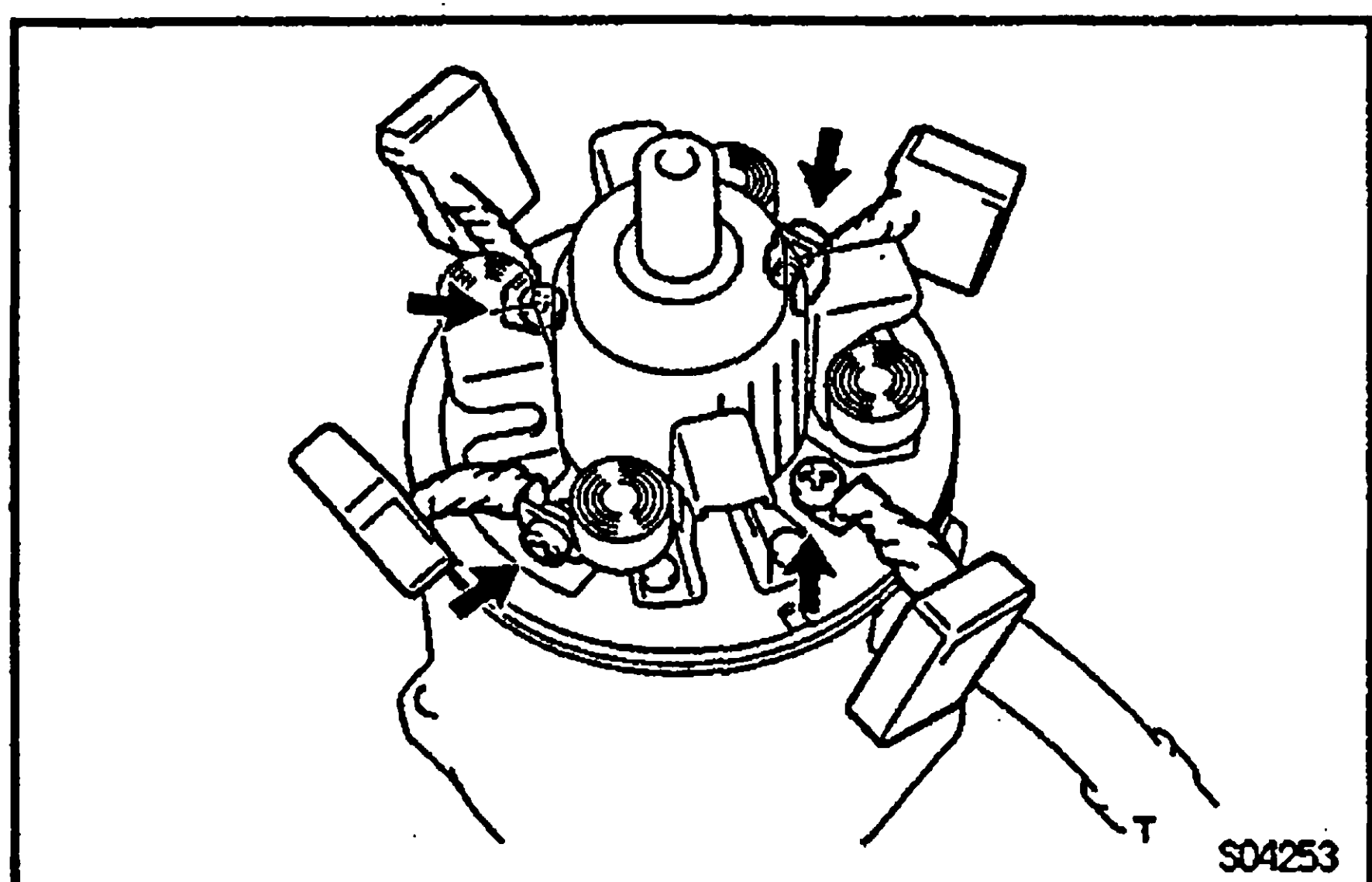
2. INSTALL ARMATURE WITH END FRAME TO FIELD FRAME

- (a) Place a new O—ring in position on the field frame.
- (b) Align the claw of the field frame with the groove of the end frame, install the armature with end frame.

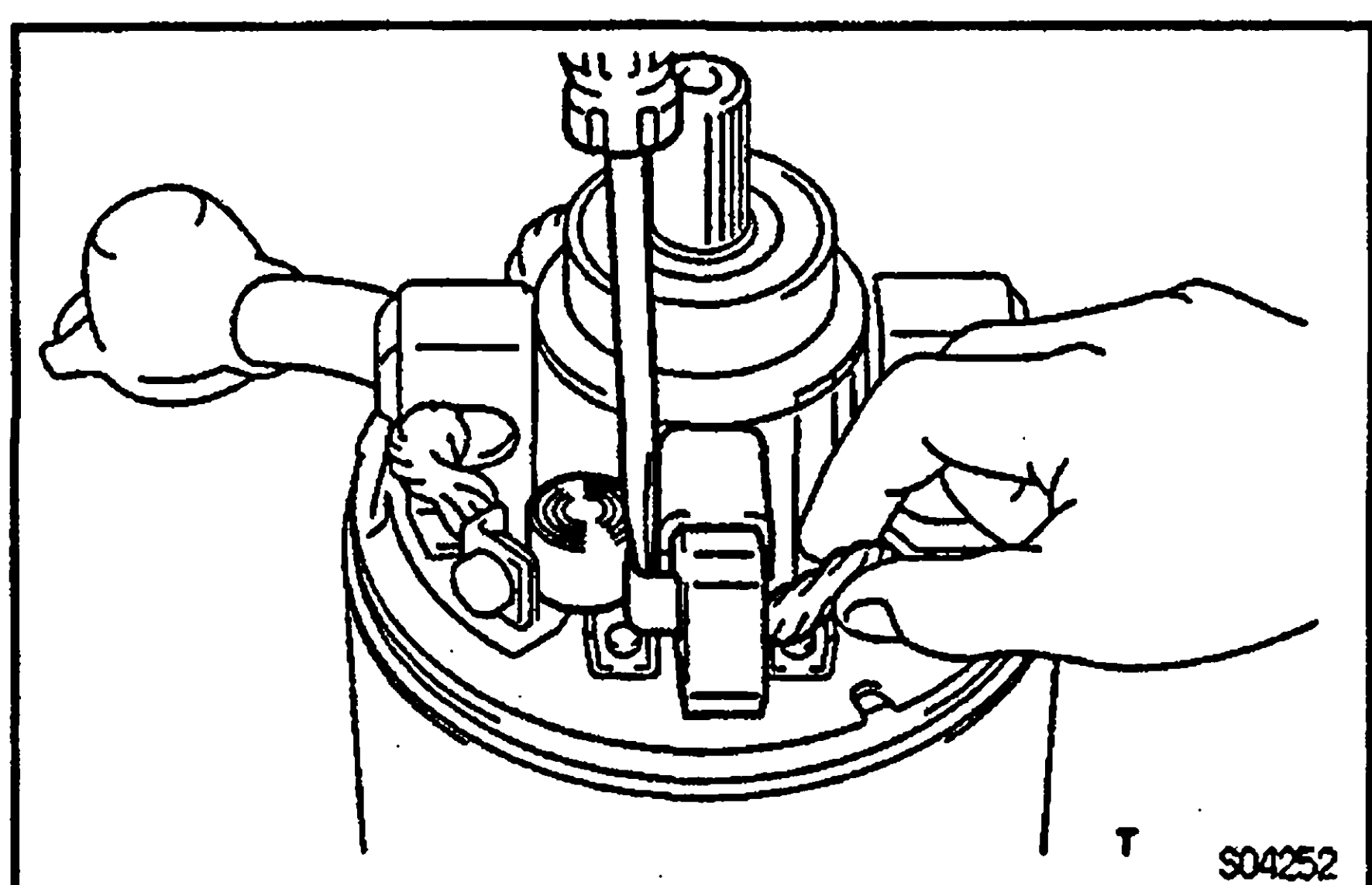


3. INSTALL BRUSH HOLDER

- (a) Align the claw of the brush holder with the claw groove of the field frame.
- (b) Place the brush holder on the field frame.

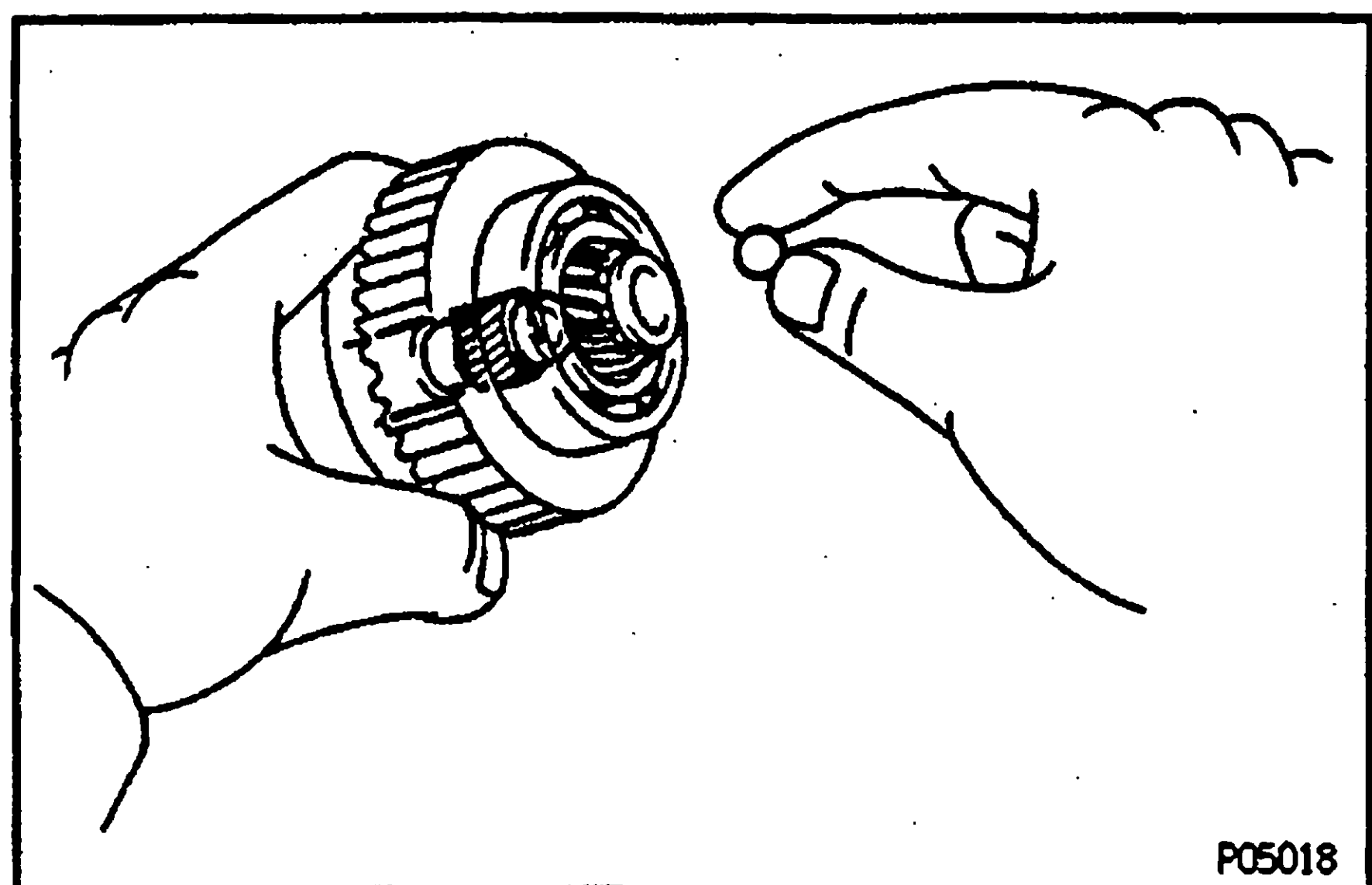


- (c) Install the 4 brushes with the 4 screws.
Torque: 3.6 N·m (37 kgf·cm, 32 in·lbf)



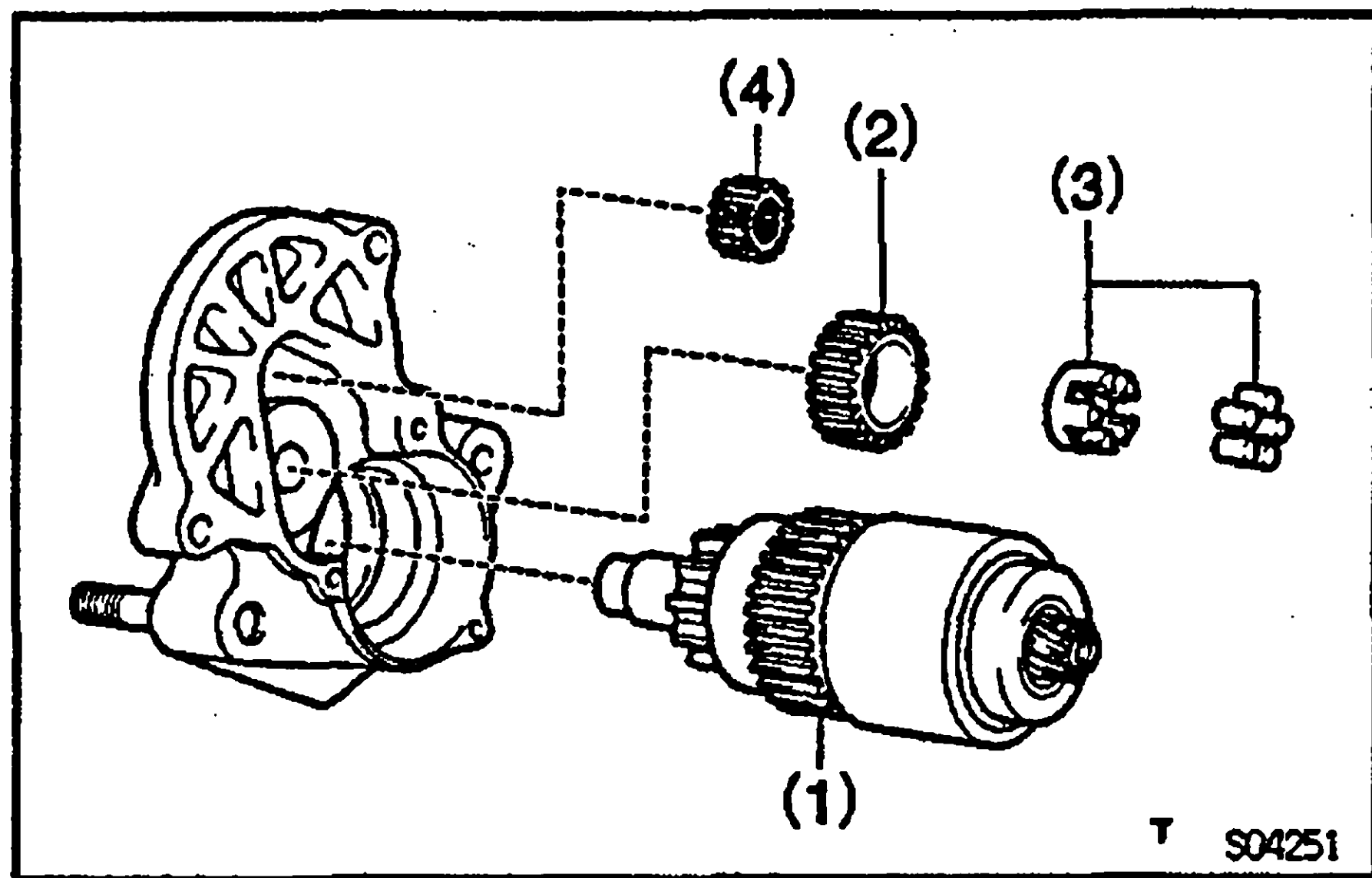
- (d) Using a screwdriver, hold the brush spring back, and connect the brush into the brush holder. Connect the 4 brushes.

NOTICE: Check that the positive (+) lead wires are not grounded.



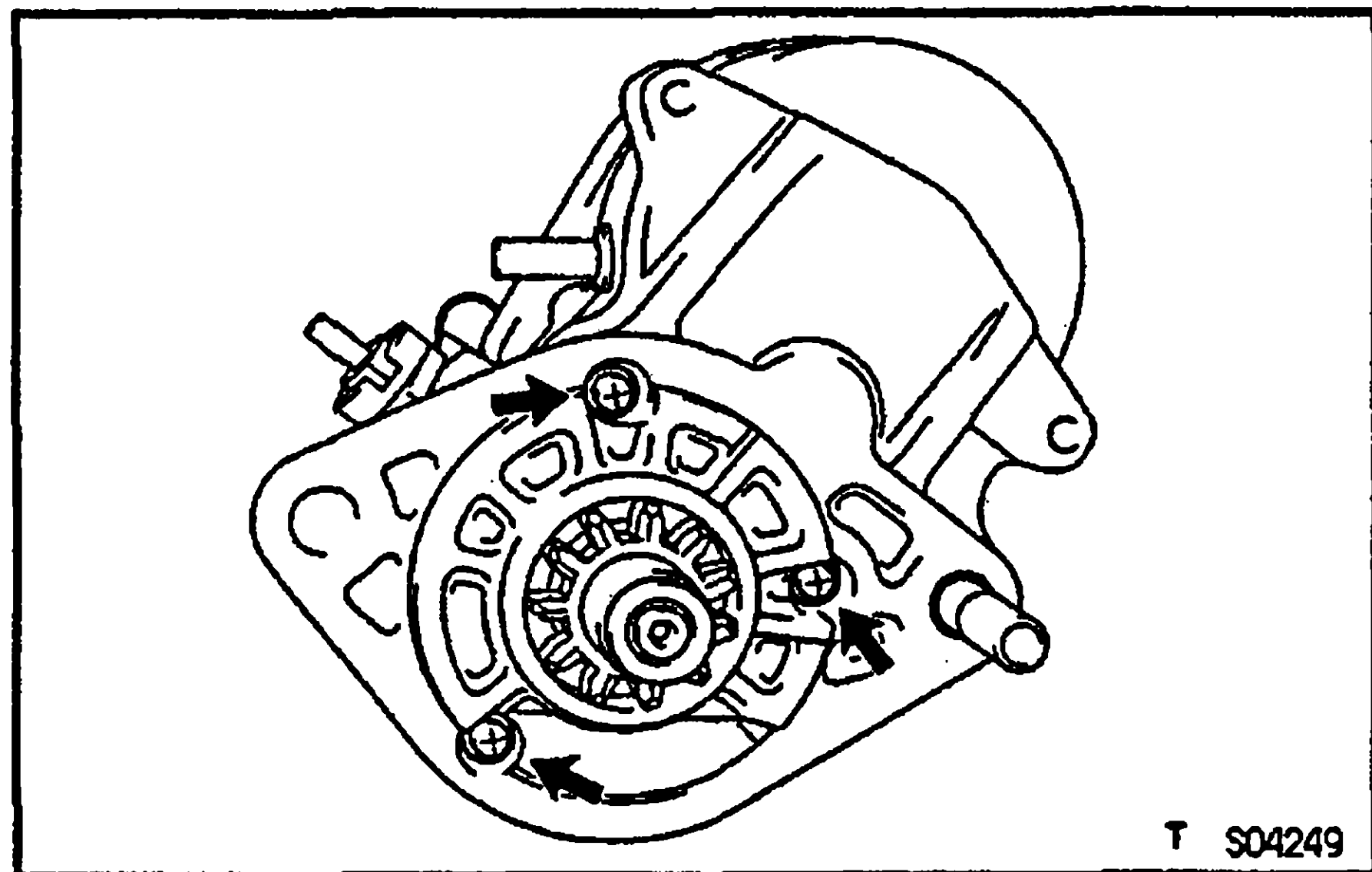
4. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

- (a) Apply grease to the steel ball.
- (b) Insert the steel ball into the clutch shaft hole.

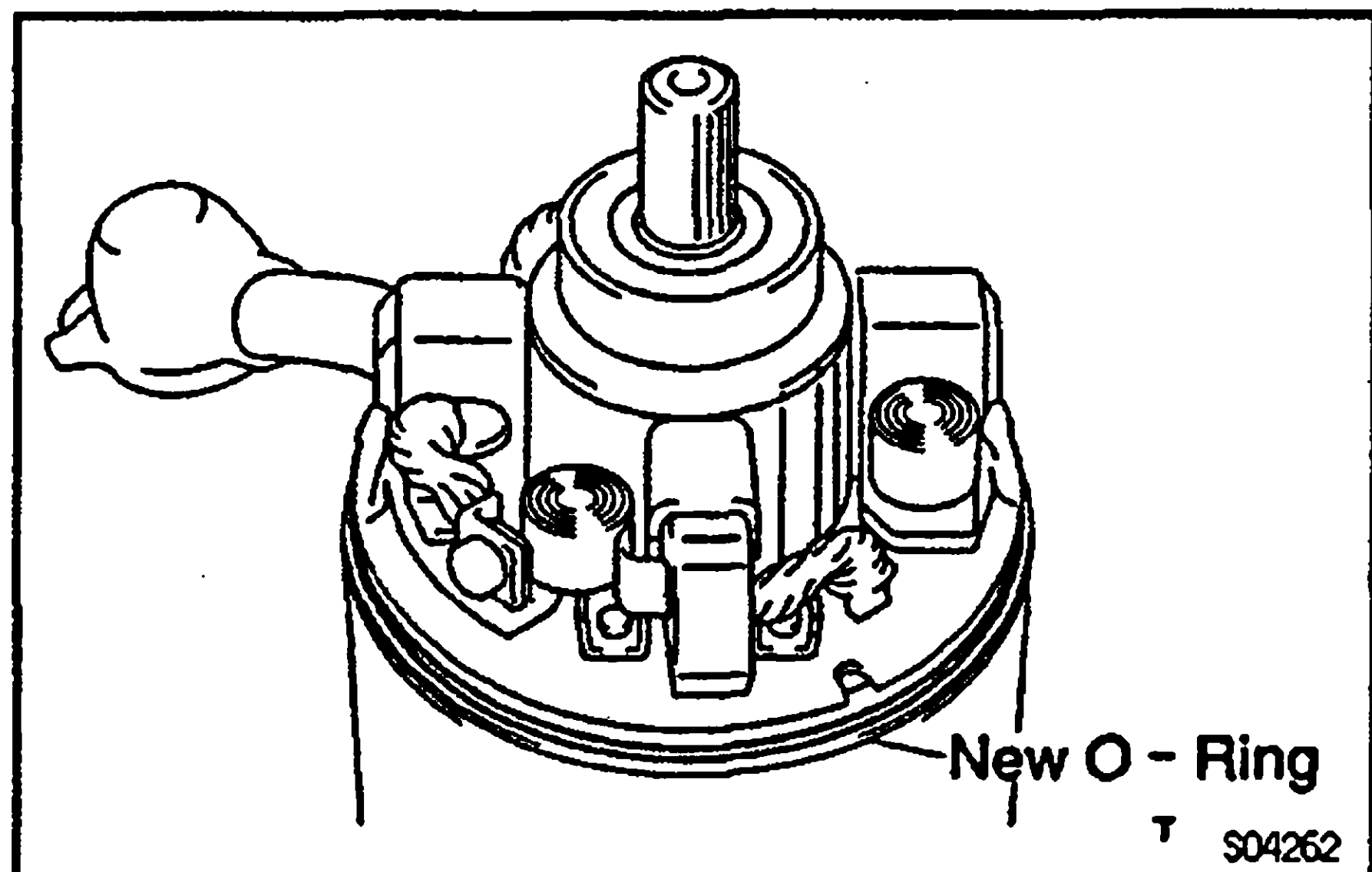


5. INSTALL STARTER HOUSING, CLUTCH ASSEMBLY AND GEARS

- (a) Apply grease to the return spring.
- (b) Insert the return spring into the magnetic switch hole.
- (c) Place these parts in position on the starter housing:
 - (1) Clutch assembly
 - (2) Idler gear
 - (3) Bearing
 - (4) Pinion gear

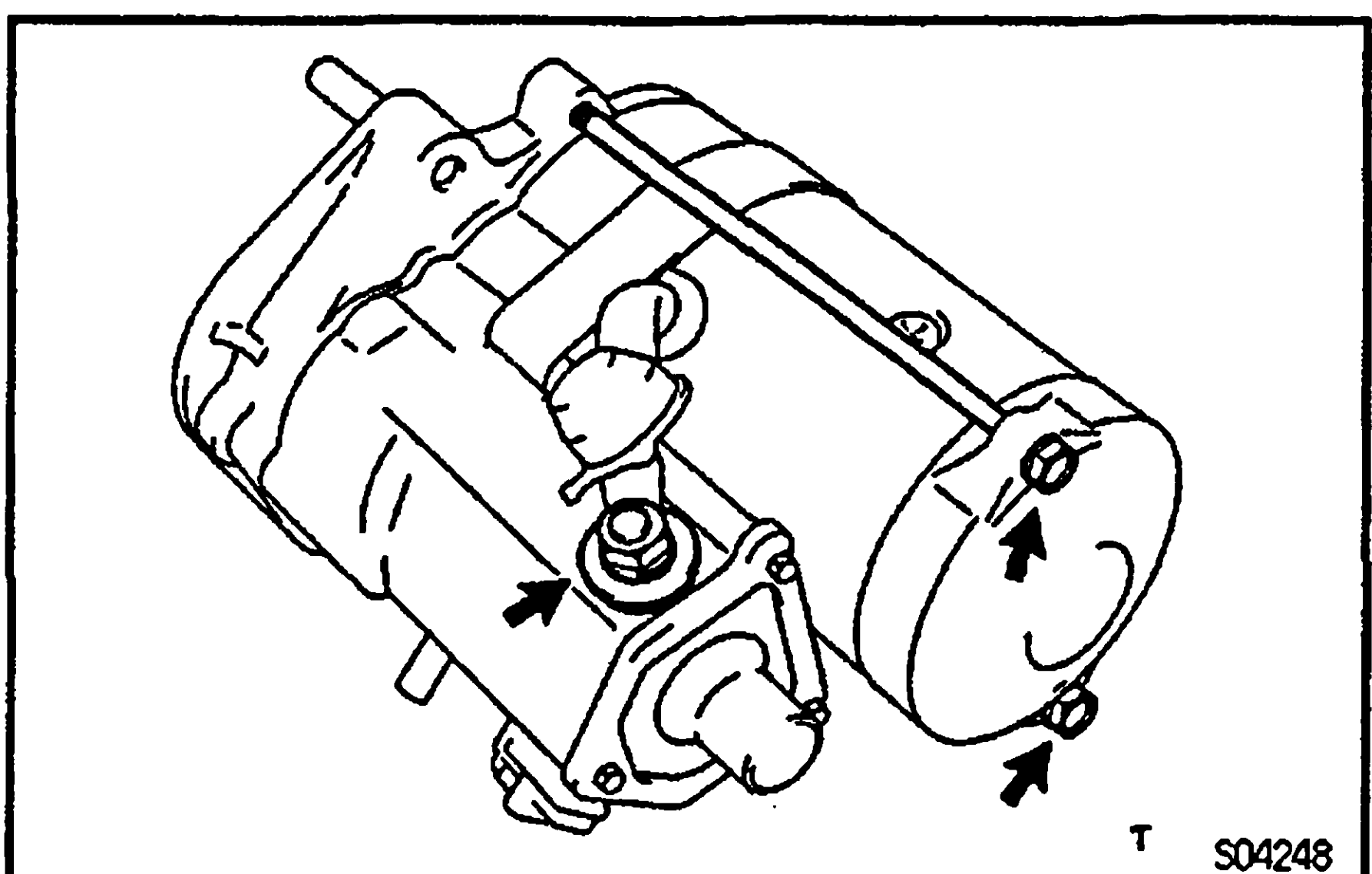
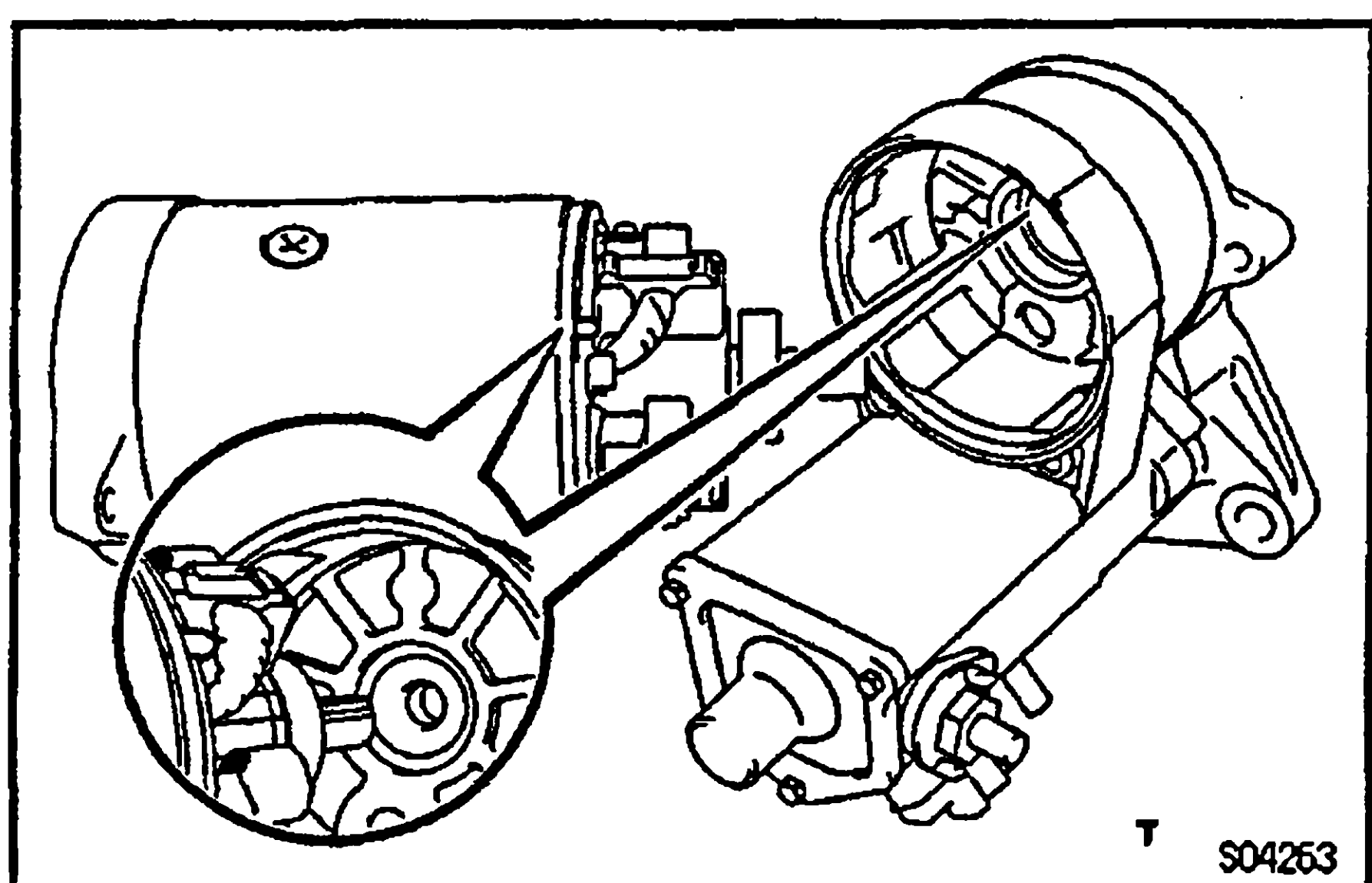


- (d) Assemble the starter housing and magnetic switch assembly and install the 3 screws.
Torque: 11.3 N·m (115 kgf·cm, 99 in·lbf)



6. INSTALL FIELD FRAME AND ARMATURE ASSEMBLY

- (a) Place a new O—ring in position on the field frame.
- (b) Align the claw of the brush holder with the groove of the magnetic switch, and install the field frame and armature shaft assembly.



- (c) Install the field frame and armature assembly with the 2 through bolts.
Torque: 14.2 N·m (145 kgf·cm, 10 ft·lbf)
- (d) Connect the lead wire to terminal C, and install the nut.
Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

STARTER PERFORMANCE TEST

NOTICE: These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

1. DO PULL-IN TEST

- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward. If the clutch pinion gear does not move, replace the magnetic switch assembly.

2. DO HOLD-IN TEST

With battery connected as above with the clutch pinion gear out, disconnect the negative (—) lead from terminal C. Check that the pinion gear remains out. If the clutch pinion gear returns inward, replace the magnetic switch assembly.

3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (—) lead from the switch body.

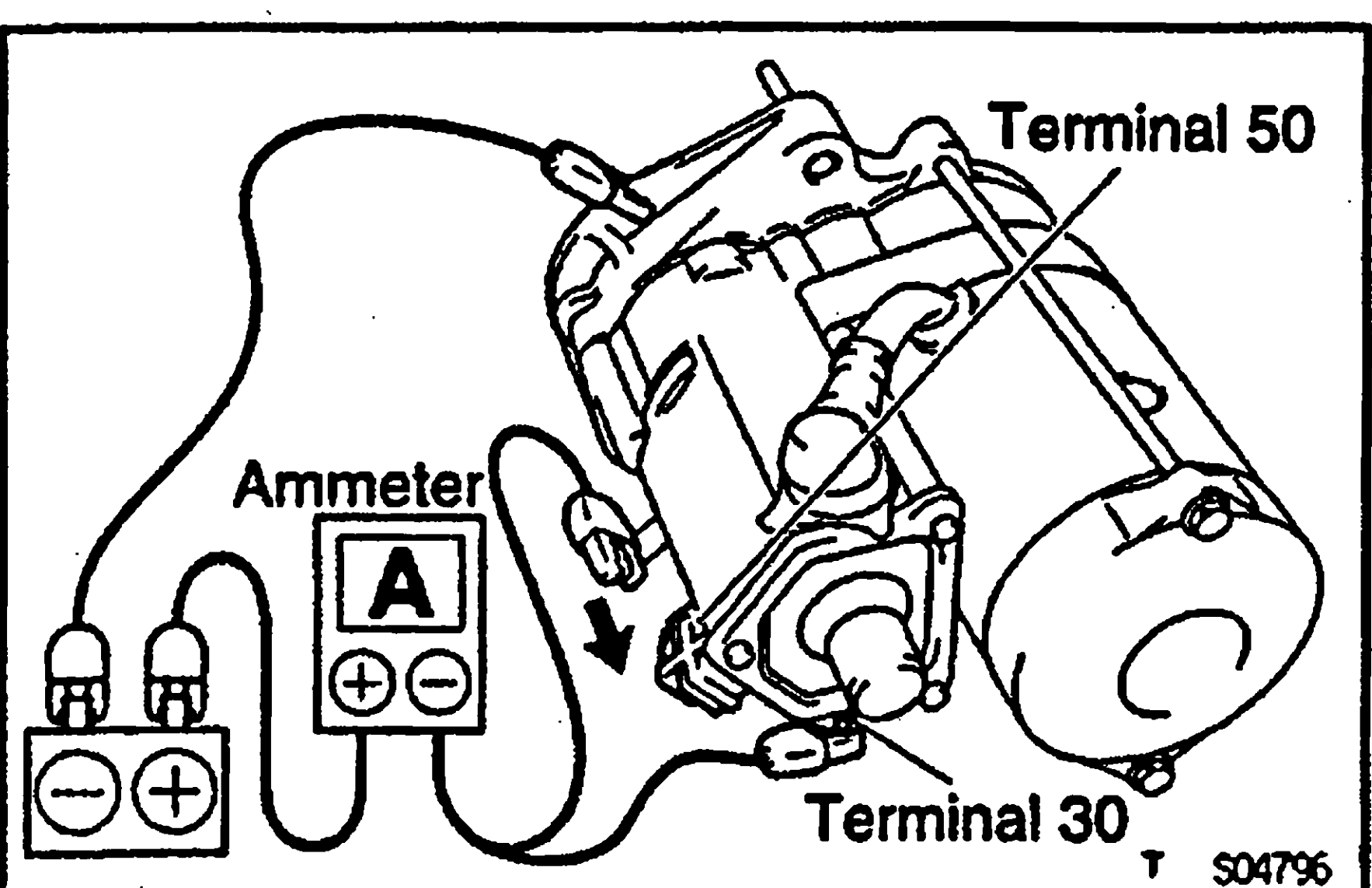
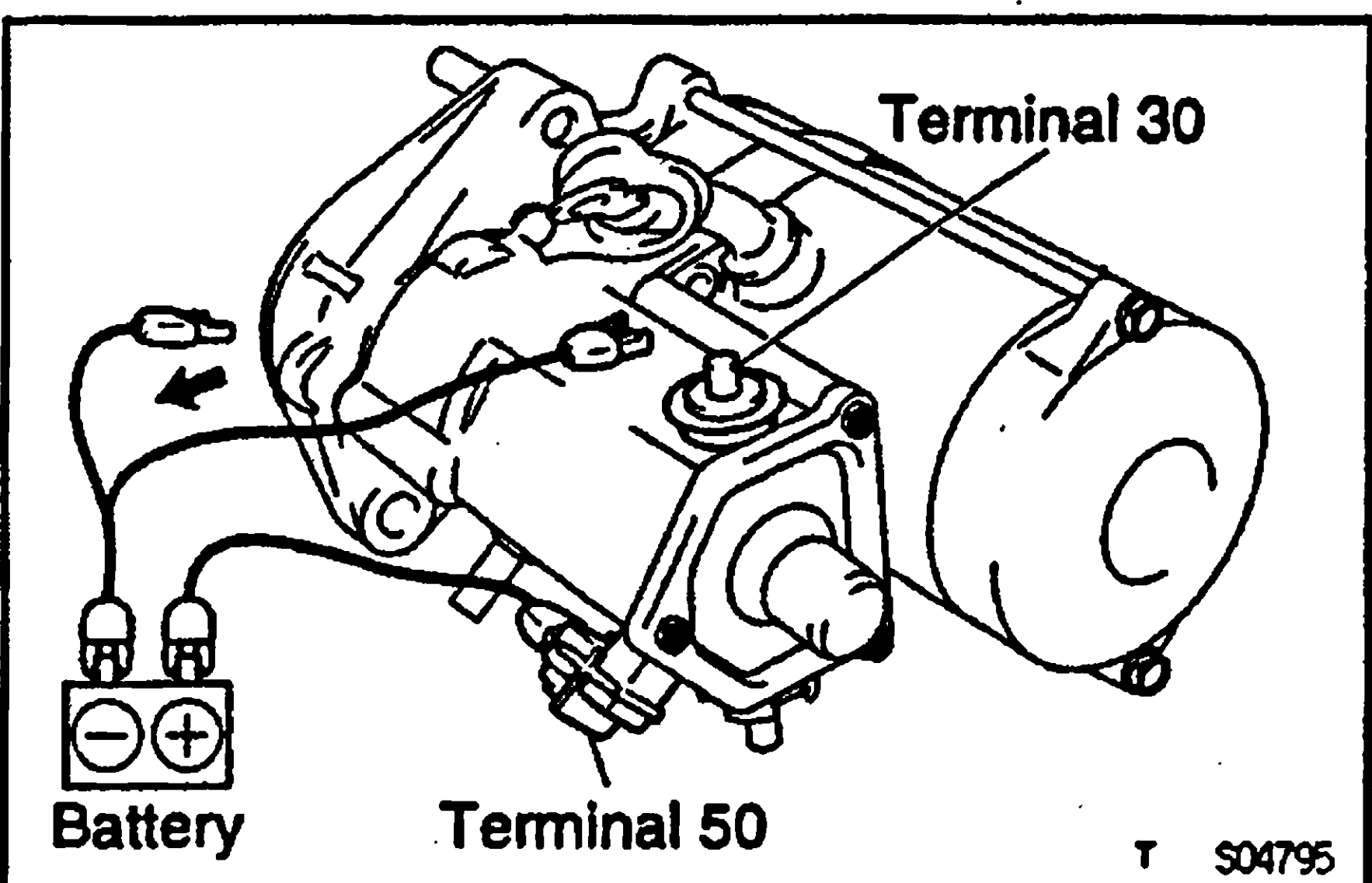
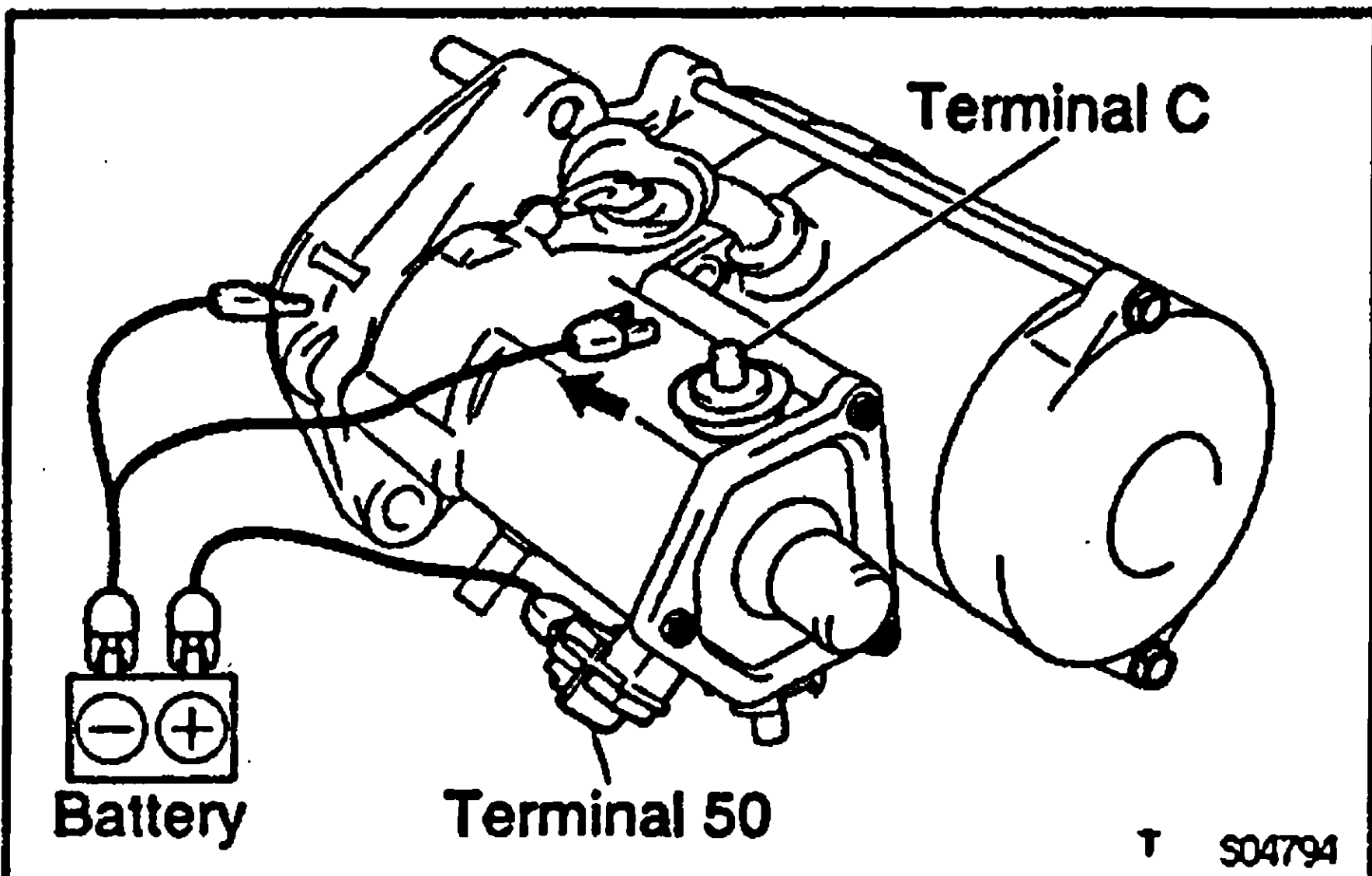
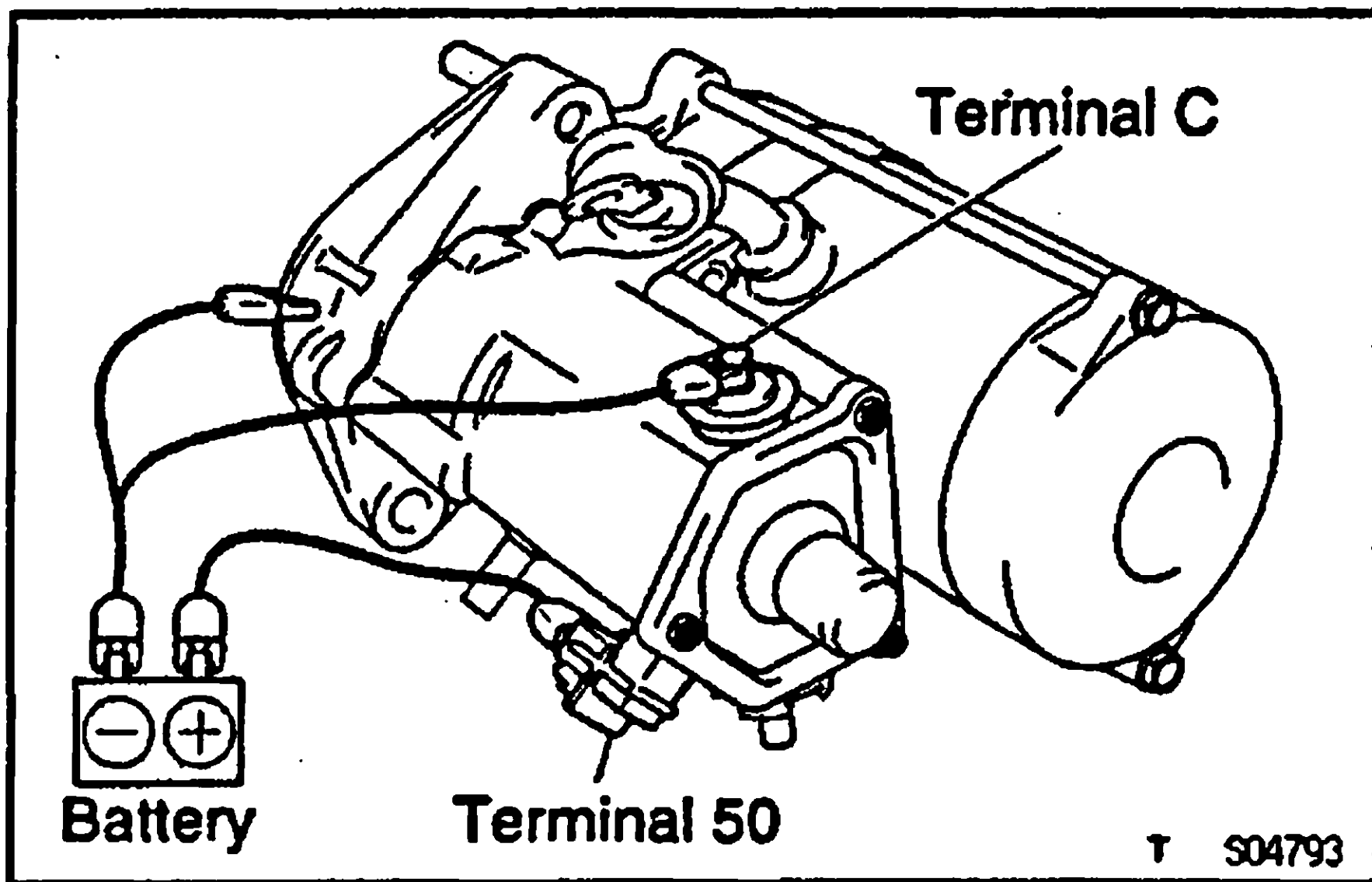
Check that the clutch pinion gear returns inward. If the clutch pinion gear does not return, replace the magnetic switch assembly.

4. DO NO-LOAD PERFORMANCE TEST

- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

220 A or less at 11.0 V



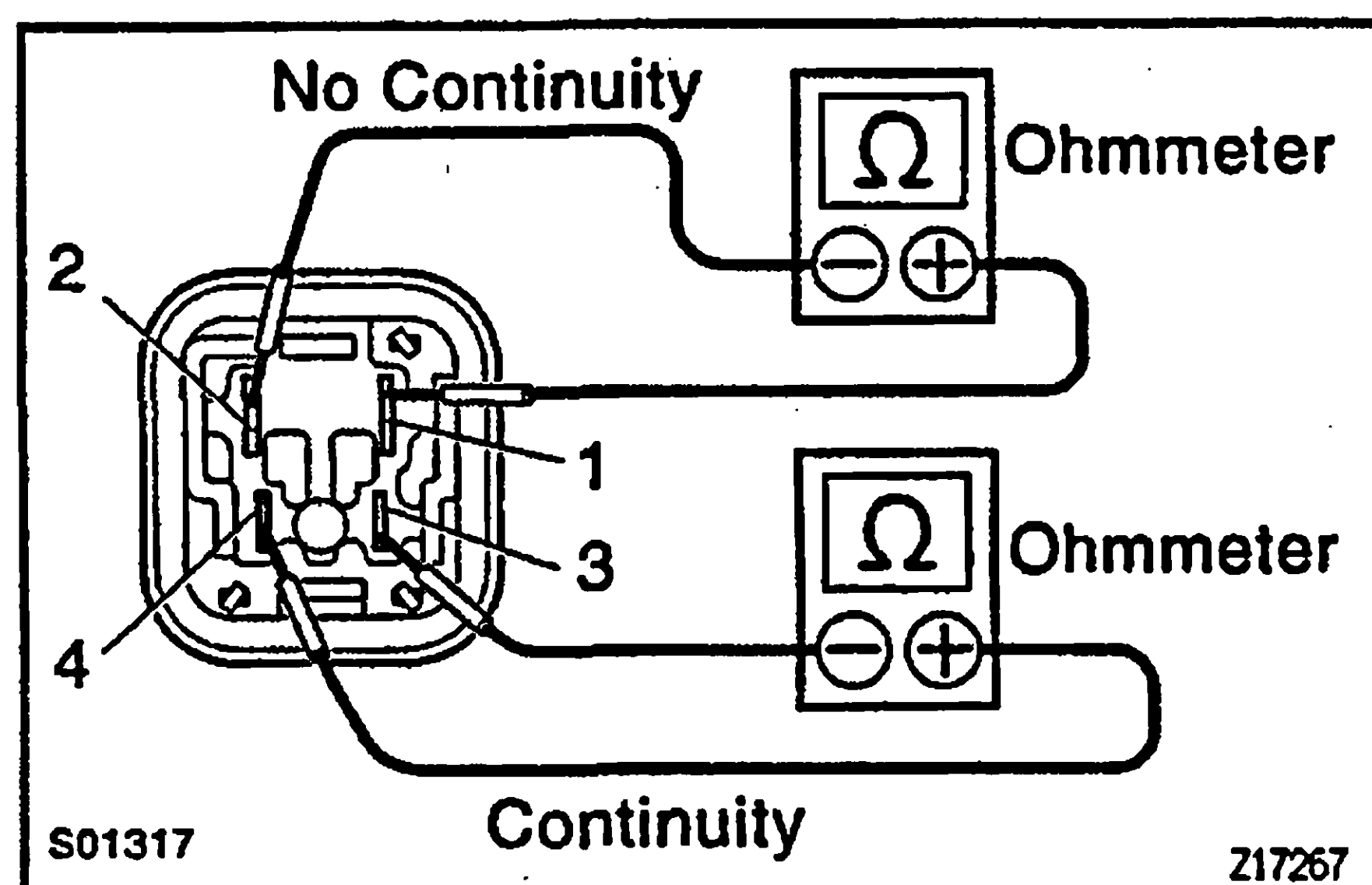
STARTER RELAY

STARTER RELAY (Marking: "ST")

INSPECTION

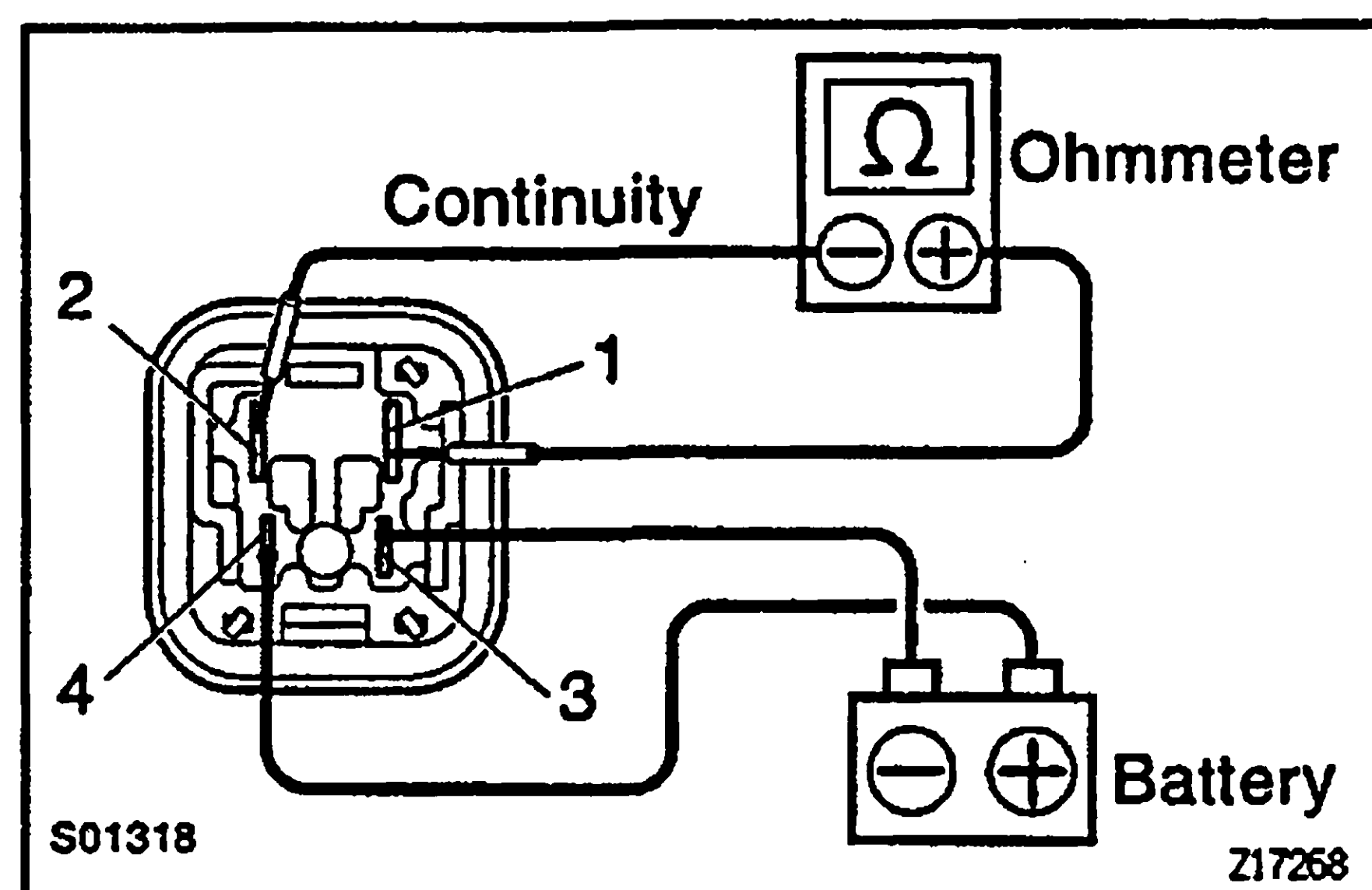
ST0CL-01

1. REMOVE STARTER RELAY
2. INSPECT STARTER RELAY



3. INSPECT RELAY CONTINUITY

- (a) Using an ohmmeter, check that there is continuity between terminals 3 and 4.
If there is no continuity, replace the relay.
- (b) Check that there is no continuity between terminals 1 and 2.
If there is continuity, replace the relay.



4. INSPECT RELAY OPERATION

- (a) Apply battery voltage across terminals 3 and 4.
- (b) Using an ohmmeter, check that there is continuity between terminals 1 and 2.
If there is no continuity, replace the relay.

5. REINSTALL STARTER RELAY

SERVICE SPECIFICATIONS

SERVICE DATA

ST018-1V

Starter (2.2 kW type)	Rated voltage and output power		12 V 2.2 kW
	No—load characteristics	Current	120 A or less at 11.5 V
		rpm	4,000 rpm or more
	Brush length	STD	16.5 mm (0.650 in.)
		Minimum	9.0 mm (0.354 in.)
	Spring installed load	STD	26.5 — 32.3 N (2.7 — 3.3 kgf, 5.9 — 7.3 lbf)
		Minimum	17.6 N (1.8 kgf, 4.0 lbf)
	Commutator Diameter	STD	35 mm (1.38 in.)
		Minimum	34 mm (1.34 in.)
	Under cut depth	STD	0.7 mm (0.027 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
Starter (2.7 kW type)	Rated voltage and output power		12 V 2.7 kW
	No—load characteristics	Current	180 A or less at 11.0 V
		rpm	3,500 rpm or more
	Brush length	STD	20.5 mm (0.807 in.)
		Minimum	11 mm (0.433 in.)
	Spring installed load	STD	34.3 — 42.1 N (3.5 — 4.3 kgf, 7.7 — 9.5 lbf)
		Minimum	18.6 N (1.9 kgf, 4.2 lbf)
	Commutator Diameter	STD	36 mm (1.42 in.)
		Minimum	35 mm (1.38 in.)
	Under cut depth	STD	0.7 mm (0.028 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
Starter (3.0 kW type)	Rated voltage and output power		12 V 3.0 kW
	No—load characteristics	Current	220 A or less at 11.0 V
		rpm	4,200 rpm or more
	Brush length	STD	21.0 mm (0.828 in.)
		Minimum	12.0 mm (0.472 in.)
	Spring installed load	STD	27.5 — 37.3 N (2.8 — 3.8 kgf, 6.1 — 8.3 lbf)
		Minimum	14.7 N (1.5 kgfcm, 3.3 lbf)
	Commutator Diameter	STD	43 mm (1.69 in.)
		Minimum	42 mm (1.65 in.)
	Under cut depth	STD	0.7 mm (0.028 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)

TORQUE SPECIFICATIONS

Part tightened		N·m	kgf·cm	ft·lbf
Brush holder x Brush	3.0 kW type	3.6	37	32 in·lbf
Field frame x Brush	3.0 kW type	3.6	37	32 in·lbf
Starter housing x Clutch assembly	2.2 kW, 2.7 kW types	9.3	95	82 in·lbf
	3.0 kW type	11.3	115	99 in·lbf
Field frame x Starter housing	2.2 kW type	12.7	130	9
	2.7 kW type	9.3	95	82 in·lbf
	3.0 kW type	14.2	145	10
Lead wire x Terminal C	2.2 kW type	5.9	60	52 in·lbf
	2.7 kW, 3.0 kW types	24	245	18
Terminal nut x Terminal 30 of starter, Terminal C of starter				
		17	170	12
		30	306	22
End cover x Magnetic switch housing		3.6	41	35 in·lbf

ST

CHARGING

PRECAUTION CH- 2

PREPARATION CH- 2

ON-VEHICLE INSPECTION CH- 3

ALTERNATOR CH- 6

SERVICE SPECIFICATIONS..... CH- 15

CH

PRECAUTION

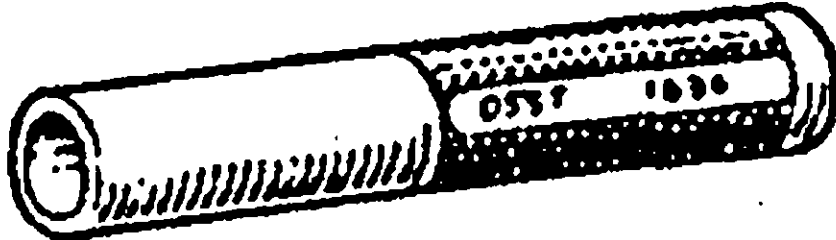
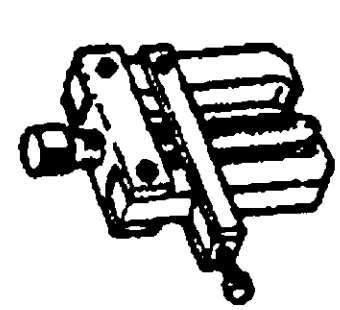
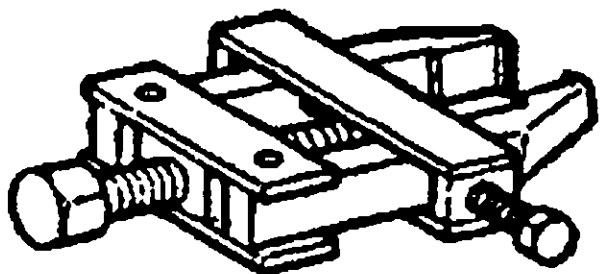
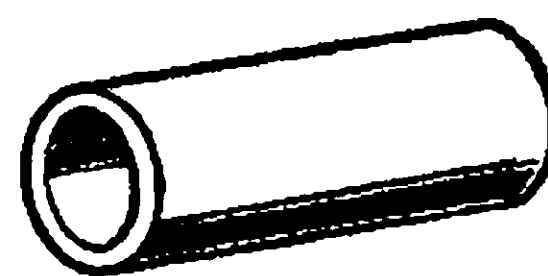
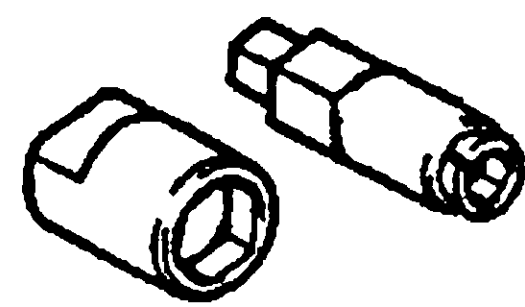
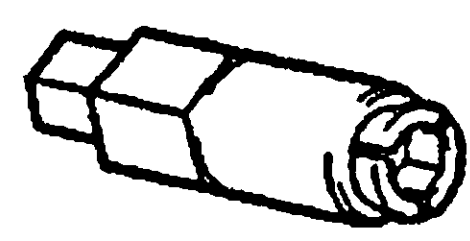
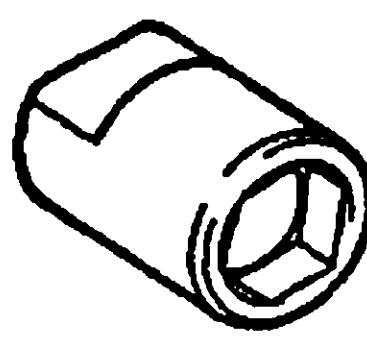
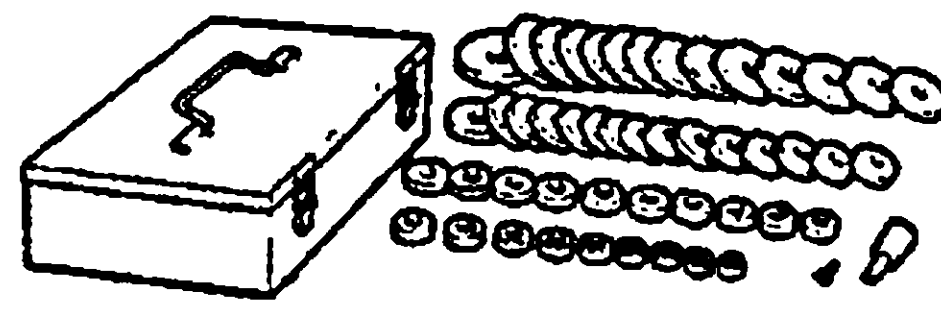
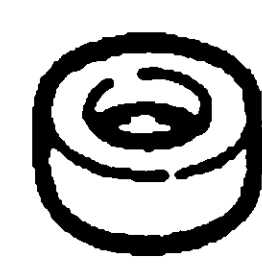
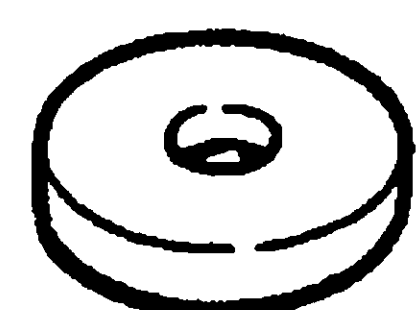
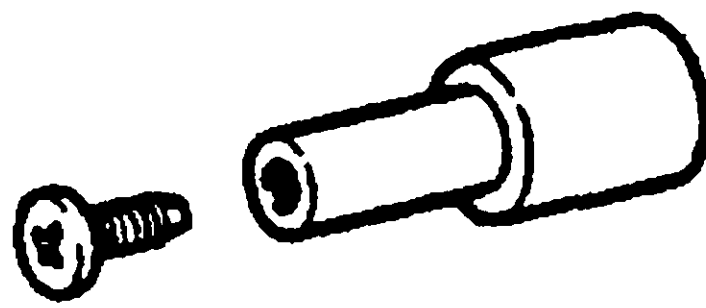
CH00J-0T

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

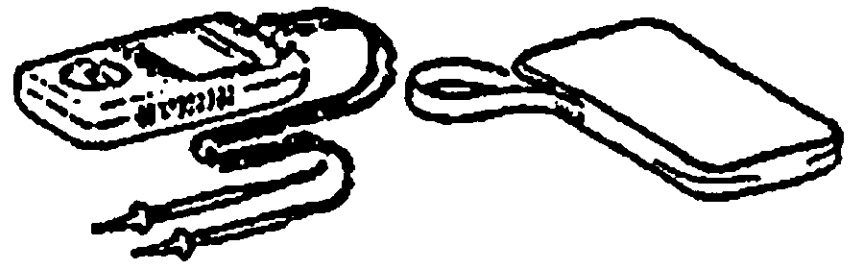
PREPARATION

CH00Q-1A

SST (SPECIAL SERVICE TOOLS)

	09285-76010 Injection Pump Camshaft Bearing Cone Replacer	Rotor rear bearing cover
	09286-46011 Injection Pump Spline Shaft Puller	Rectifier end frame
	09820-00021 Alternator Rear Bearing Puller	
	09820-00030 Alternator Rear Bearing Replacer	Rotor rear bearing
	09820-63010 Alternator Pulley Set Nut Wrench Set	
	(09820-06010) Alternator Rotor Shaft Wrench	
	09820-06021 Alternator Pulley Set Nut Wrench	
	09950-60010 Replacer Set	
	(09951-00260) Replacer 26	Rotor front bearing
	(09951-00500) Replacer 50	Rotor front bearing
	(09952-06010) Adapter	Rotor front bearing

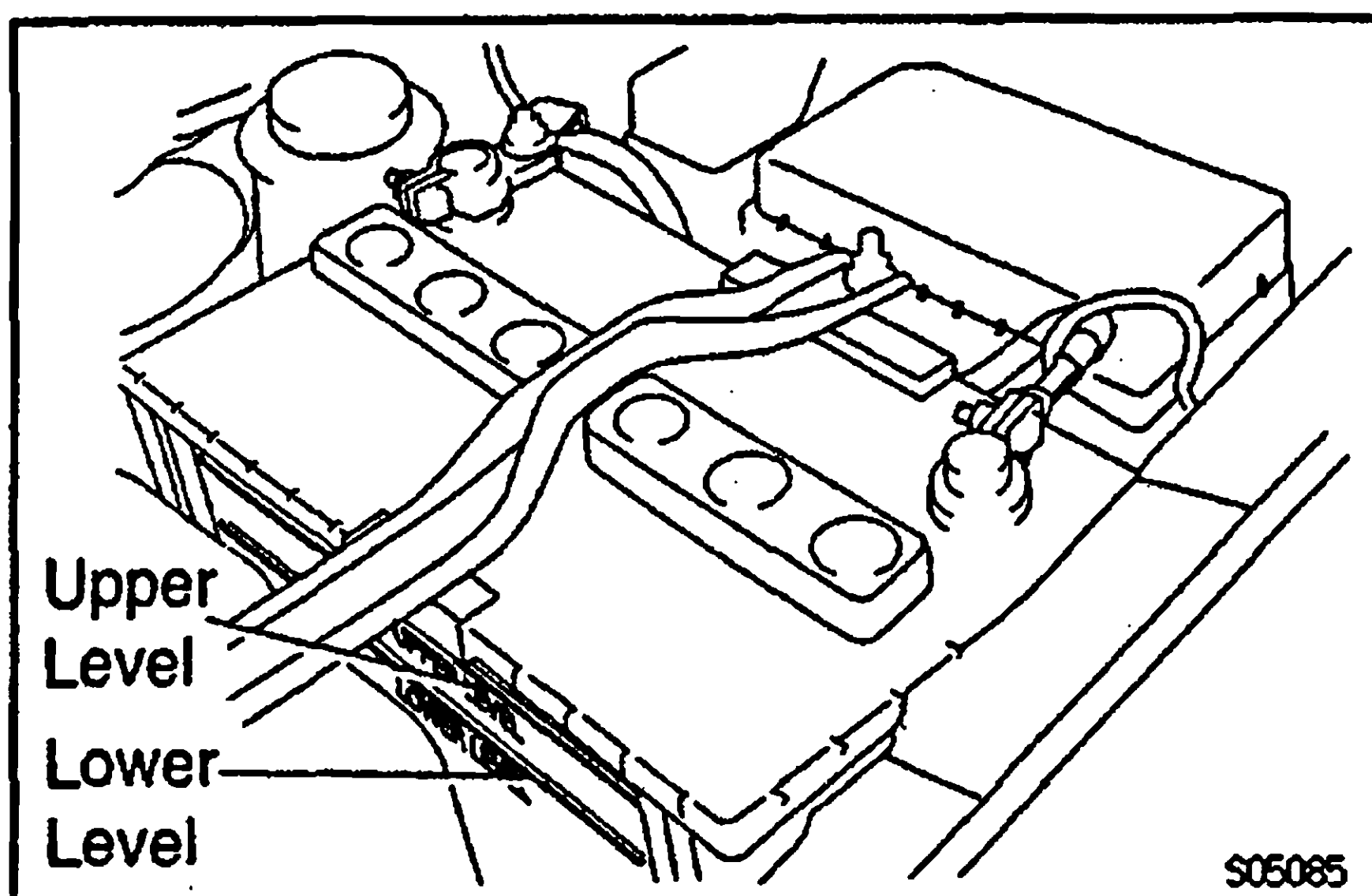
RECOMMENDED TOOLS



09082-00040 TOYOTA Electrical Tester.

EQUIPMENT

Battery specific gravity gauge	
Belt tension gauge	
Torque wrench	
Vernier calipers	Rotor (Slip ring), Brush



S05085

ON—VEHICLE INSPECTION

1. CHECK BATTERY ELECTROLYTE LEVEL

Check the electrolyte quantity of each cell.

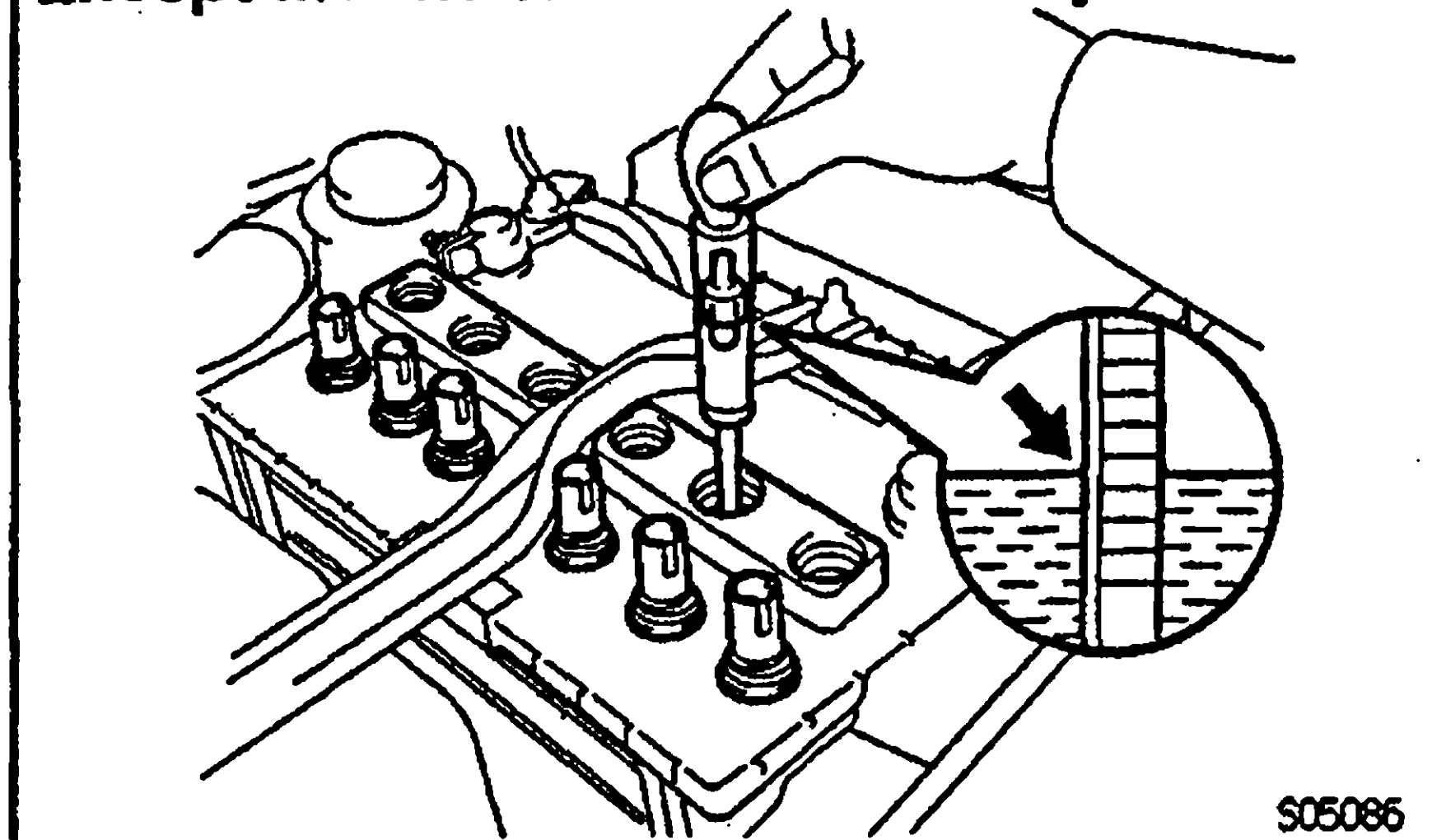
Maintenance—Free Battery:

If under the lower level, replace the battery (or add distilled water if possible). Check the charging system.

Except Maintenance—Free Battery

If under the lower level, add distilled water.

Except Maintenance-Free Battery



S05086

2. Except Maintenance—Free Battery:

CHECK BATTERY SPECIFIC GRAVITY

Check the specific gravity of each cell.

Standard specific gravity:

1.25 — 1.29 at 20°C (68°F)

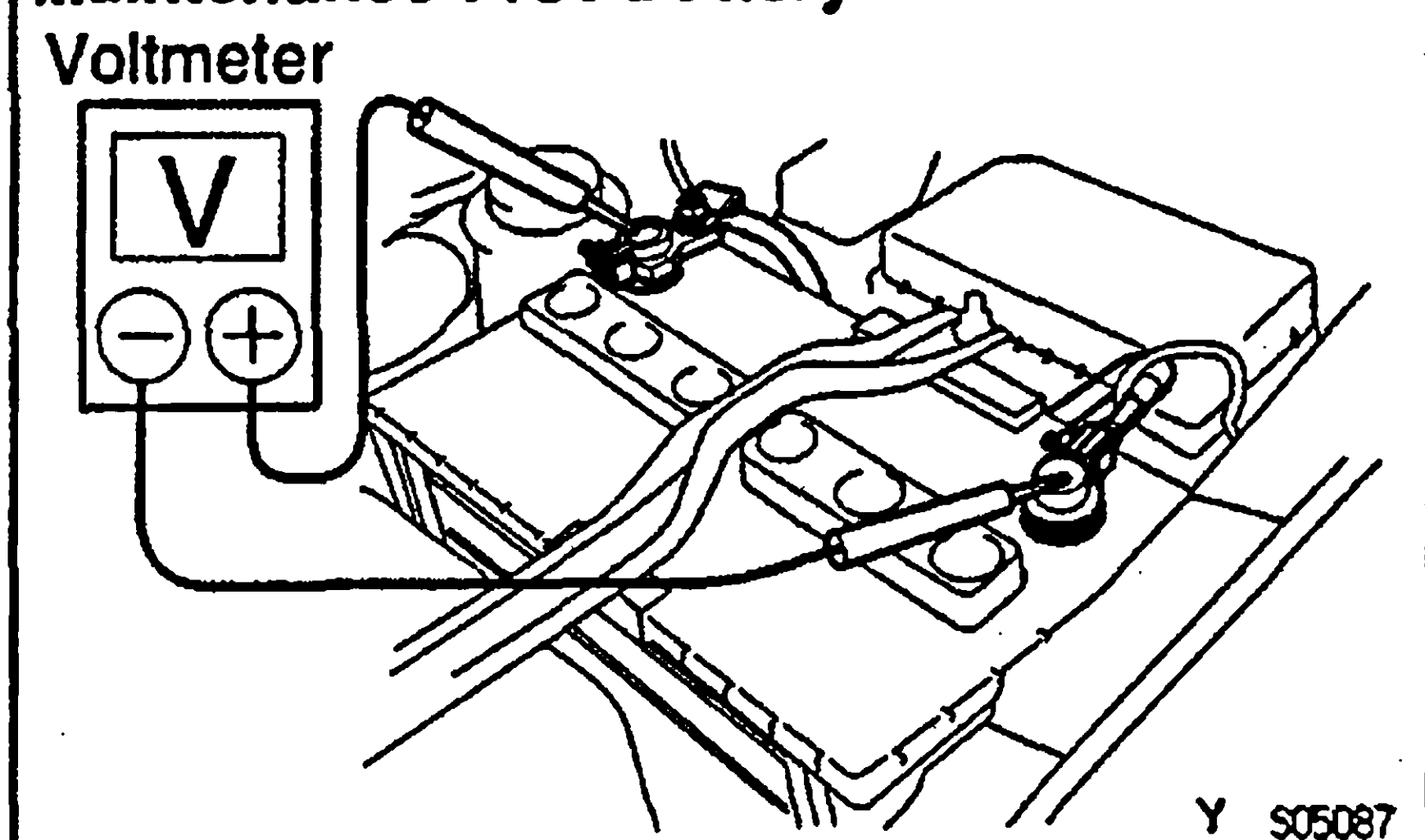
If the specific gravity is less than specification, charge the battery.

3. Maintenance—Free Battery:

CHECK BATTERY VOLTAGE

- After having driven the vehicle and in the case that 20 minutes have not passed after having stopped the engine, turn the ignition switch ON and turn on the electrical system (headlight, blower motor, rear defogger etc.) for 60 seconds to remove the surface charge.
- Turn the ignition switch OFF and turn off the electrical systems.
- Measure the battery voltage between the negative (—) and positive (+) terminals of the battery.

Maintenance-Free Battery



Y S05087

Standard voltage:

12.5 — 12.9 V at 20°C (68°F)

If the voltage is less than specification, charge the battery.

4. CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

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

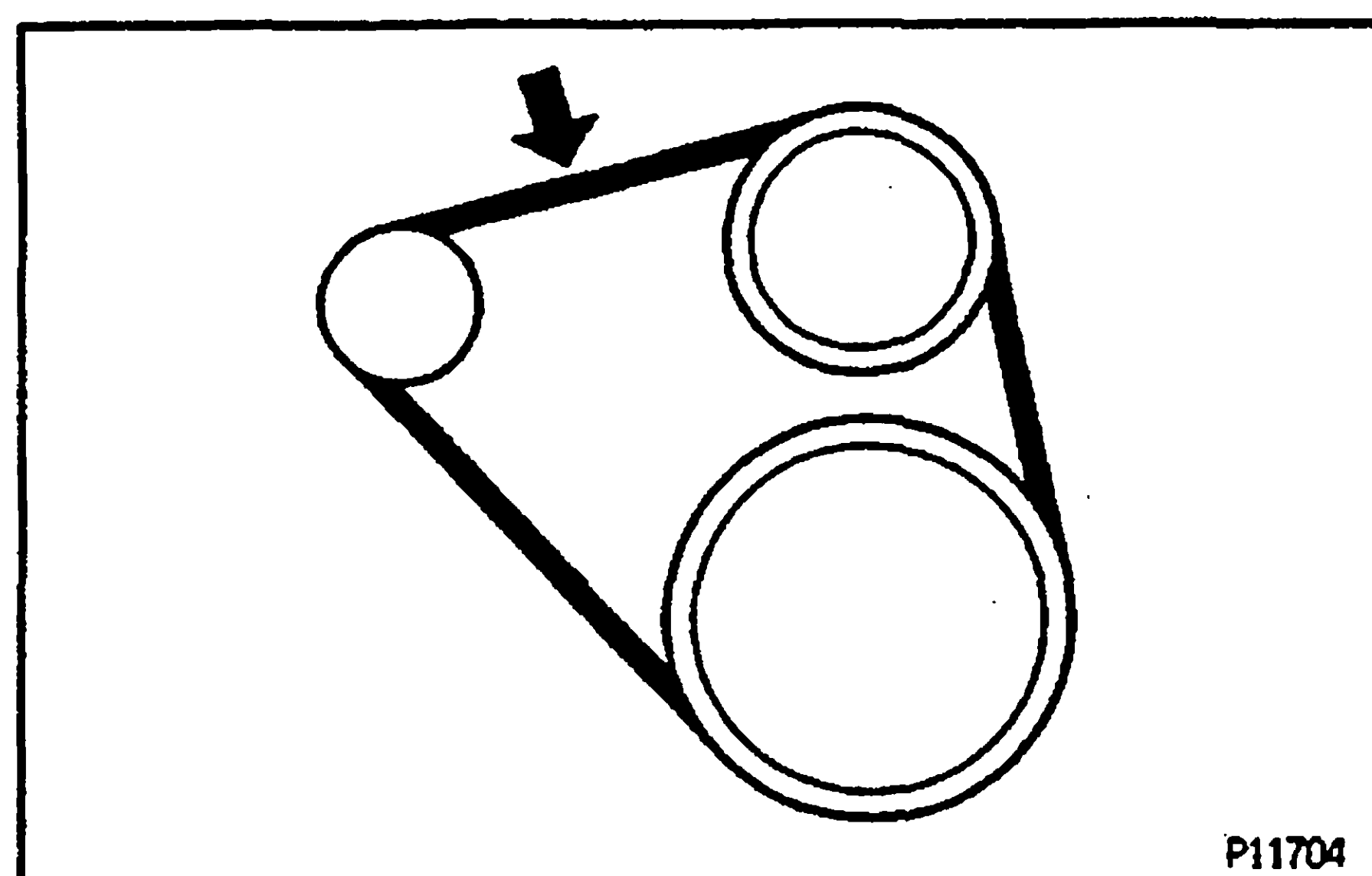
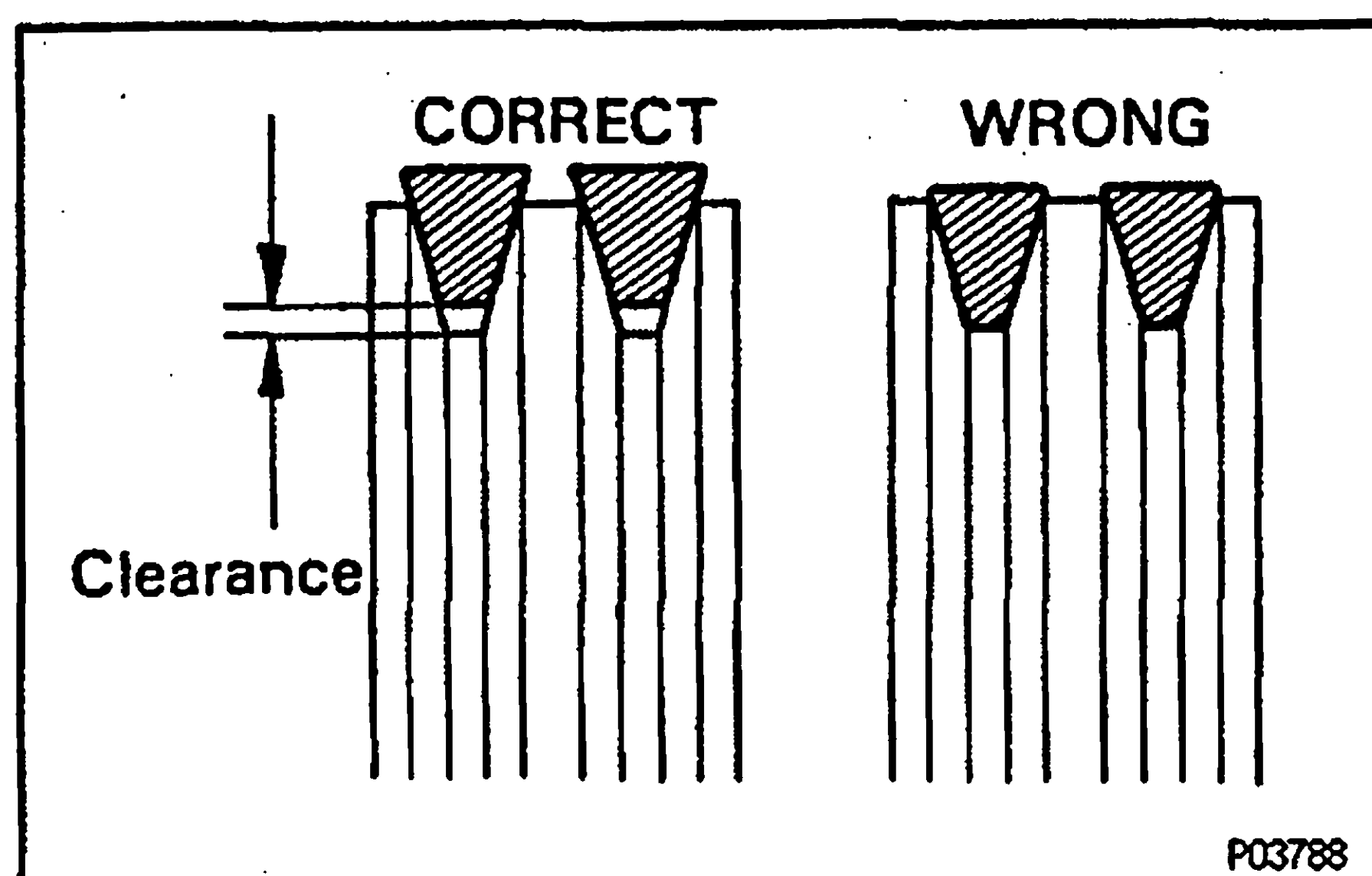
If the terminals are corroded, clean the terminals.

- (b) Check the fusible link and fuses for continuity.

5. INSPECT DRIVE BELTS

- (a) Visually check the drive belt for cracks, oiliness or wear. Check that the belt does not touch the bottom of the pulley groove.

If necessary, replace the drive belts as a set.



- (b) Check the drive belt deflection by pressing on the belt at the points indicated in the illustration with 98 N (10 kgf, 22 lbf) of pressure.

Drive belt deflection:

New belt

6 — 8 mm (0.24 — 0.31 in.)

Used belt

8 — 12 mm (0.31 — 0.47 in.)

If necessary, adjust the drive belt deflection.

Reference

Using a tension gauge, check the drive belt tension.

Drive belt tension:

New belt

400 — 600 N (41 — 61 kgf, 60 — 134 lbf)

Used belt

300 — 500 N (31 — 51 kgf, 98 — 112 lbf)

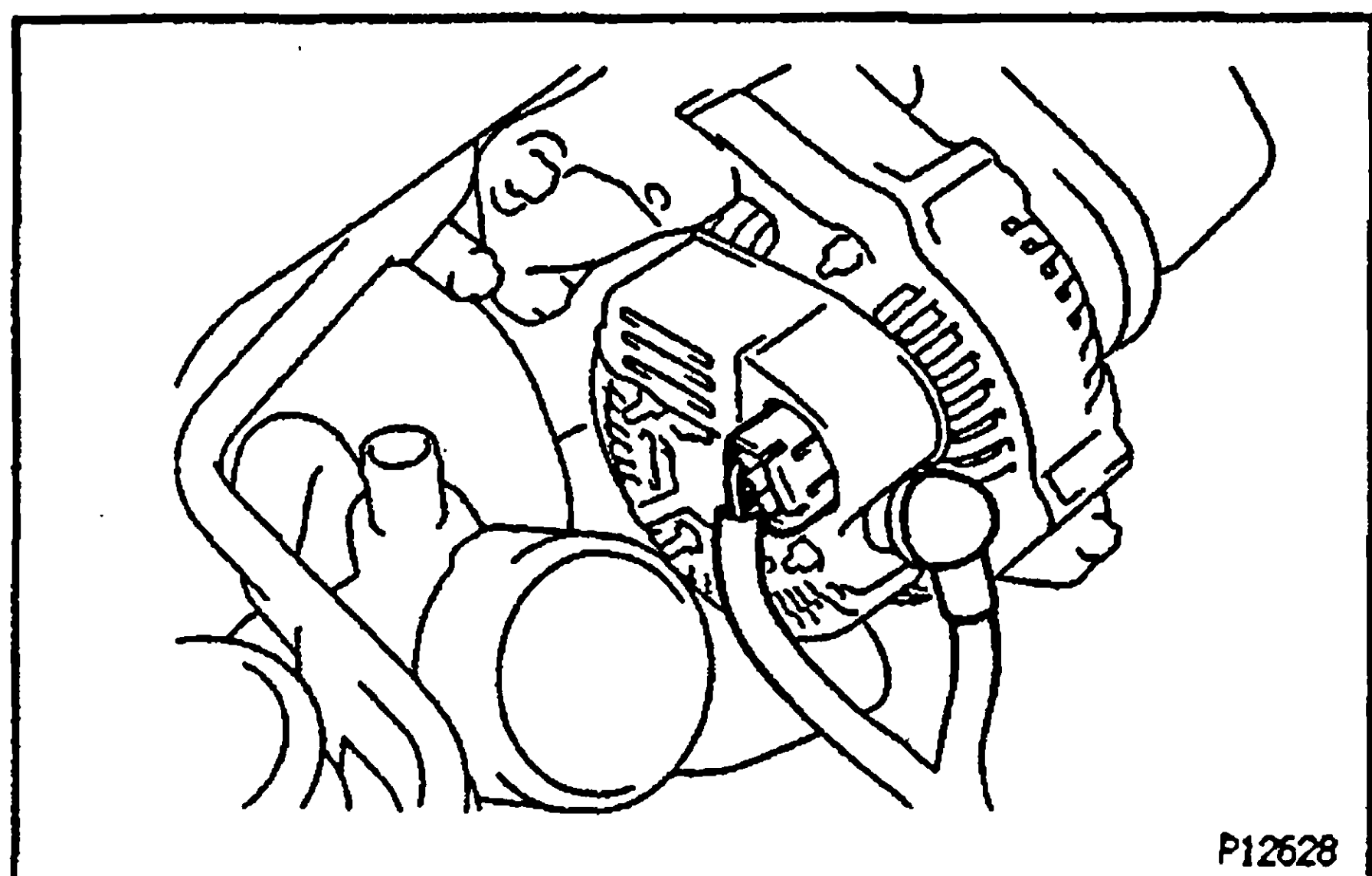
If the belt tension is not as specified, adjust it.

HINT:

- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After installing a new belt, run the engine for about 5 minutes and recheck the deflection.

6. VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

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



7. INSPECT DISCHARGE WARNING LIGHT CIRCUIT

- (a) Turn the ignition switch "ON". Check that the discharge warning light comes on.
- (b) Start the engine. Check that the light goes off.
If the light does not operate as specified, troubleshoot the discharge warning light circuit.

8. INSPECT CHARGING CIRCUIT WITHOUT LOAD

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

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

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

- (b) Check the charging circuit as follows:

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

Standard amperage:

10 A or less

Standard voltage:

12.6 — 14.6 V

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

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

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

9. INSPECT CHARGING CIRCUIT WITH LOAD

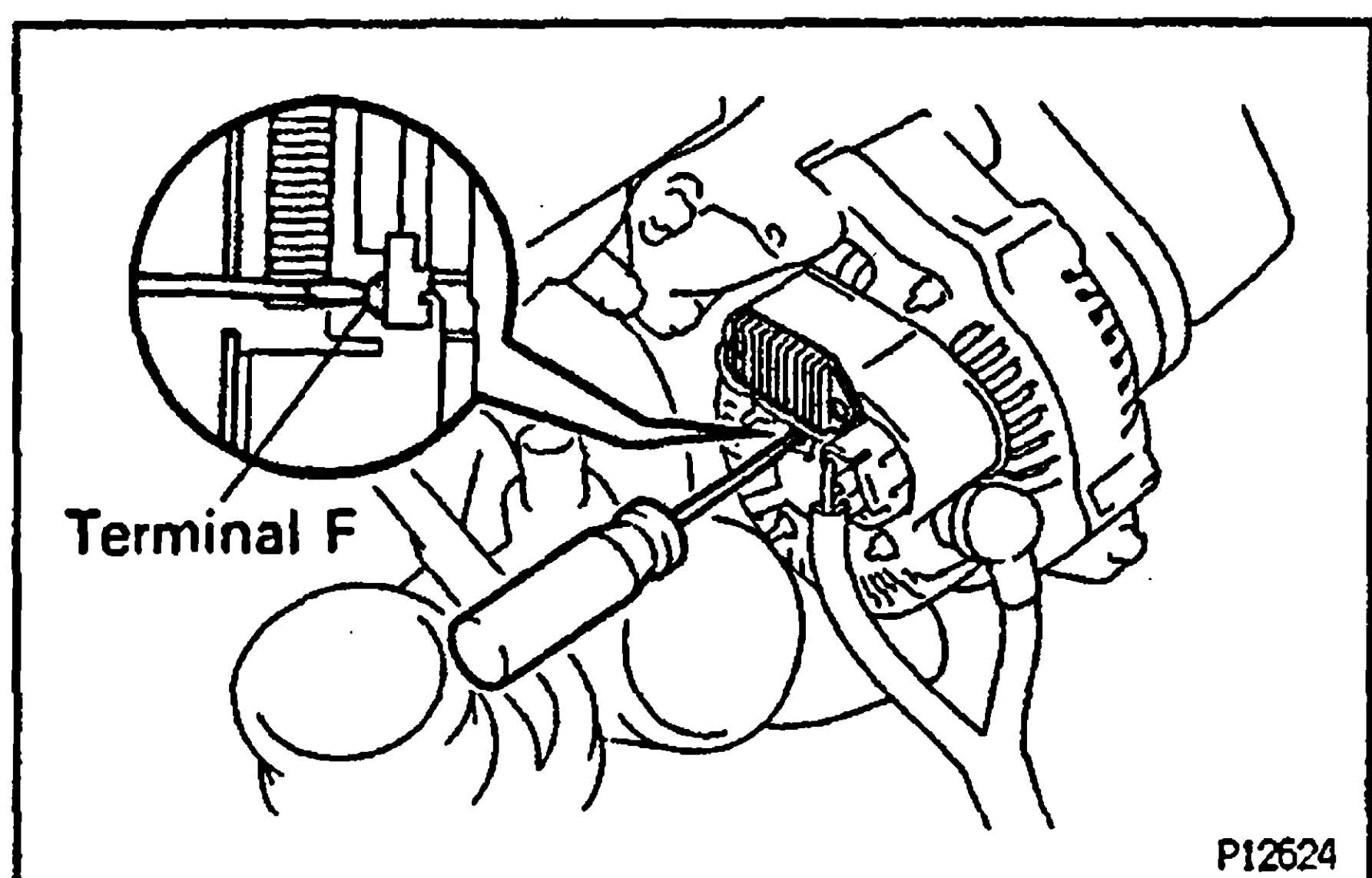
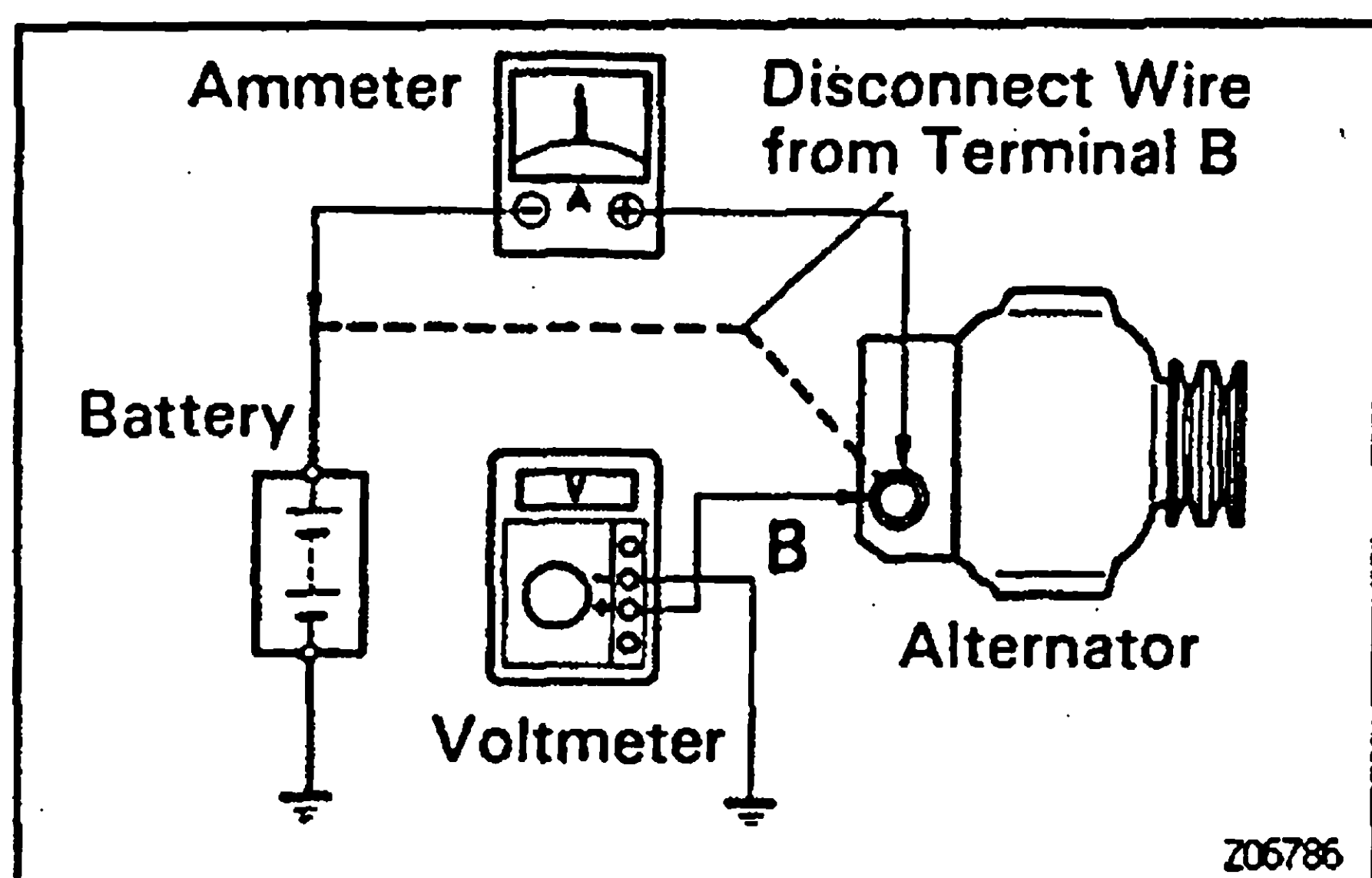
- (a) With the engine running at 2,000 rpm, turn on the high beam headlights and place the heater blower switch at "HI".
- (b) Check the reading on the ammeter.

Standard amperage:

30 A or more

If the ammeter reading is less than standard amperage, repair the alternator.

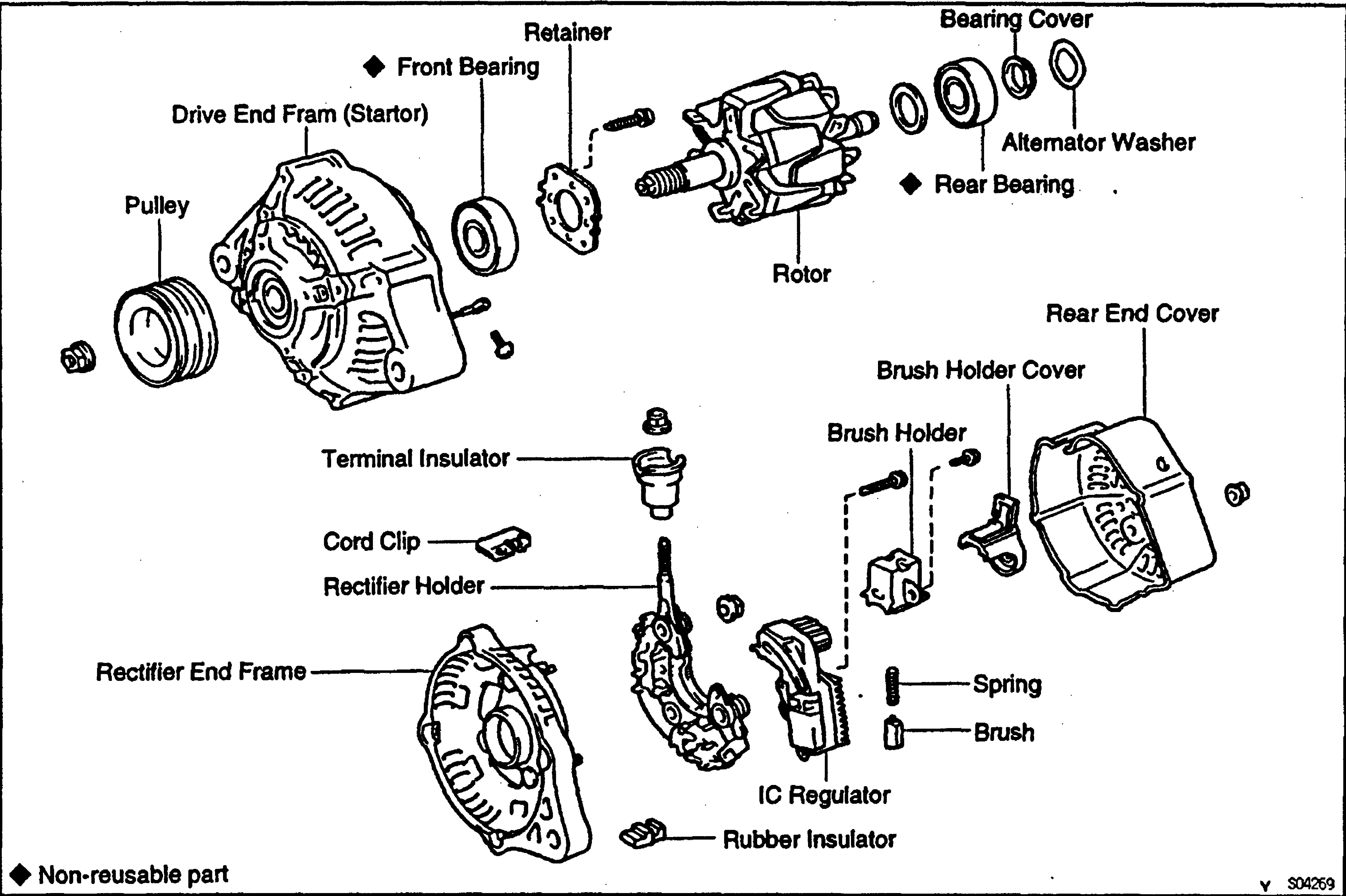
HINT: If the battery is fully charged, the indication will sometimes be less than standard amperage.



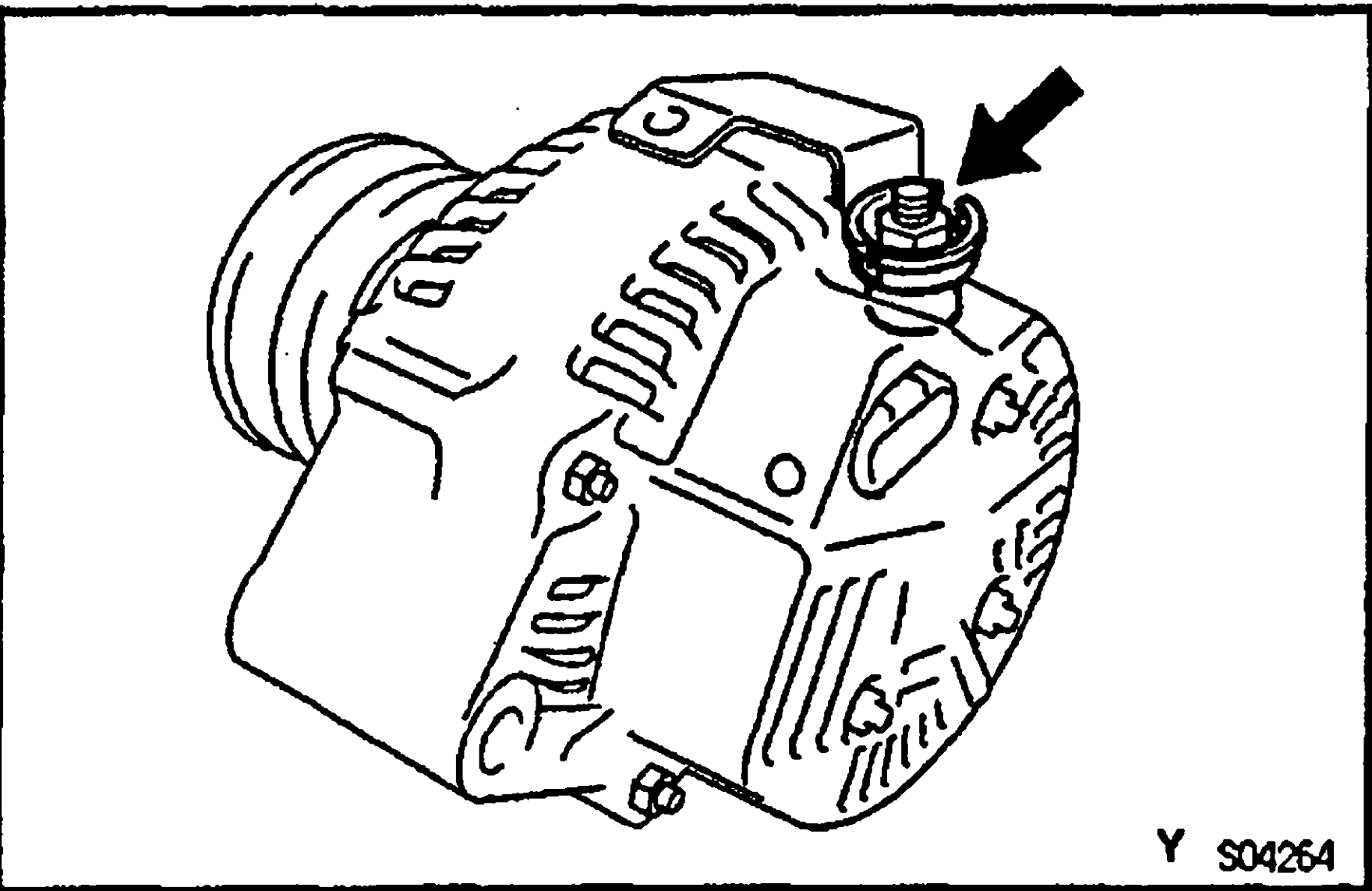
ALTERNATOR COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

CH018-1N

CH

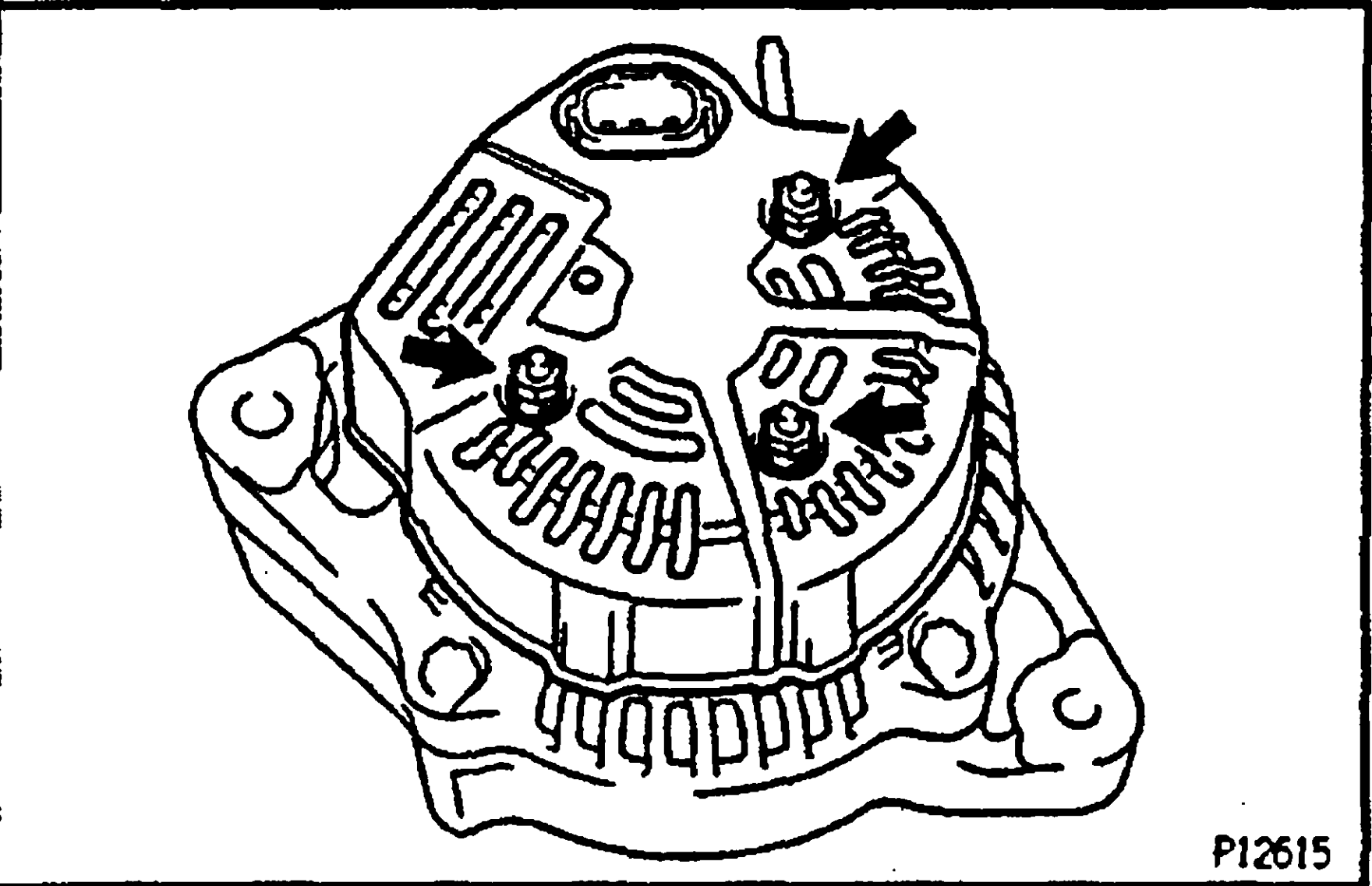


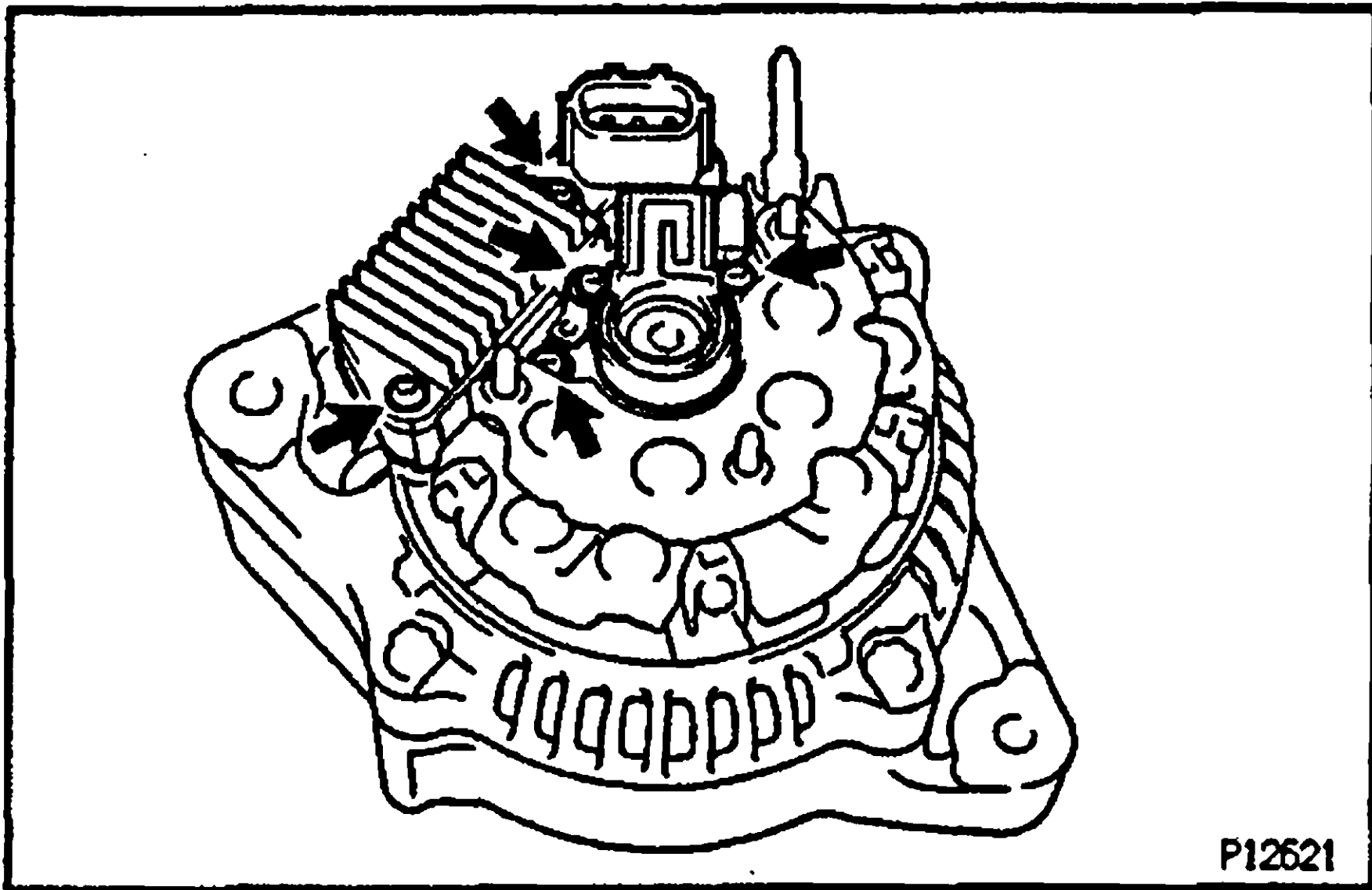
CH018-01



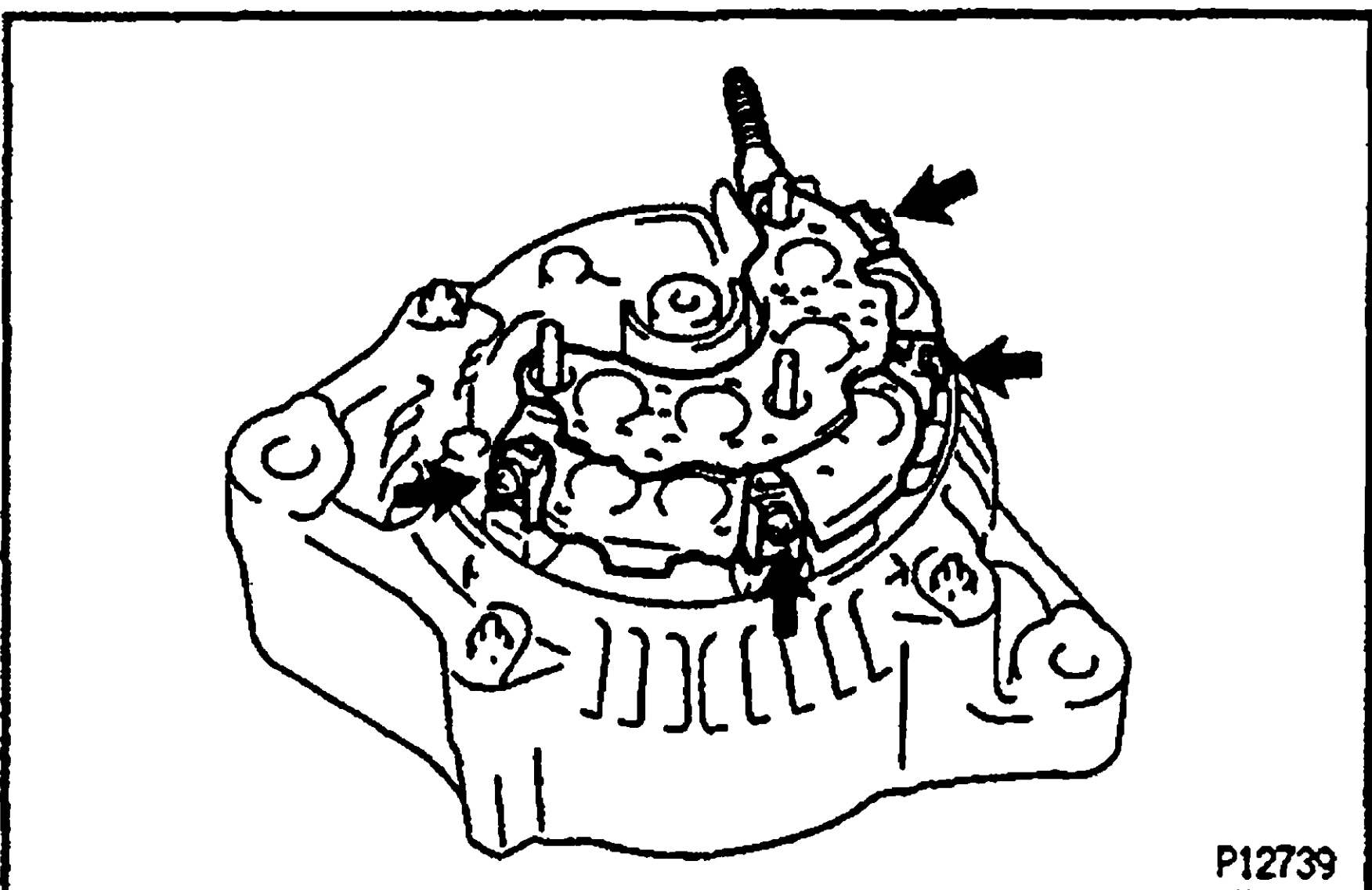
ALTERNATOR DISASSEMBLY

1. REMOVE REAR END COVER
 - (a) Remove the nut and terminal insulator.
- (b) Remove the 3 nuts and end cover.

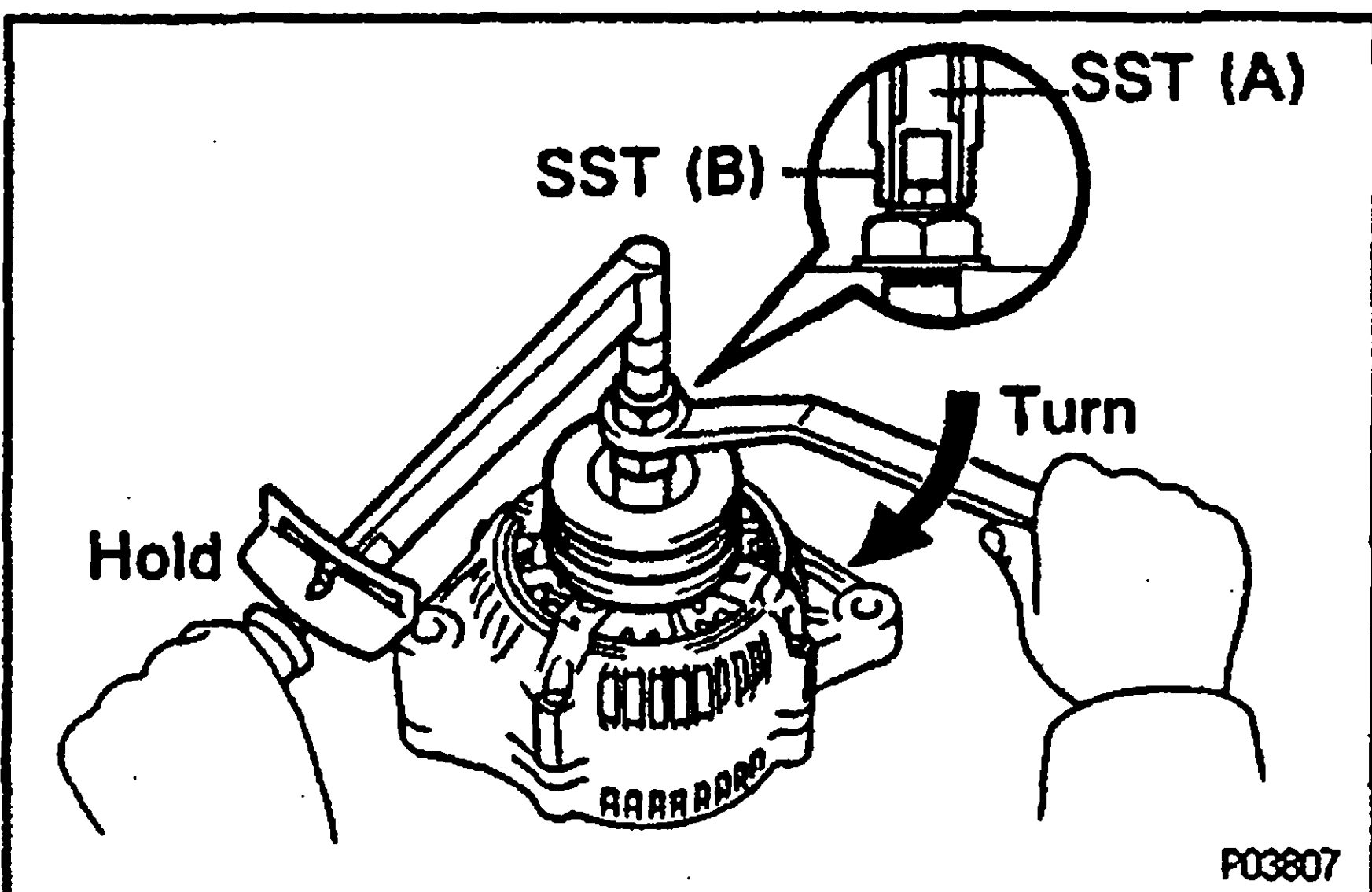


**2. REMOVE BRUSH HOLDER AND IC REGULATOR**

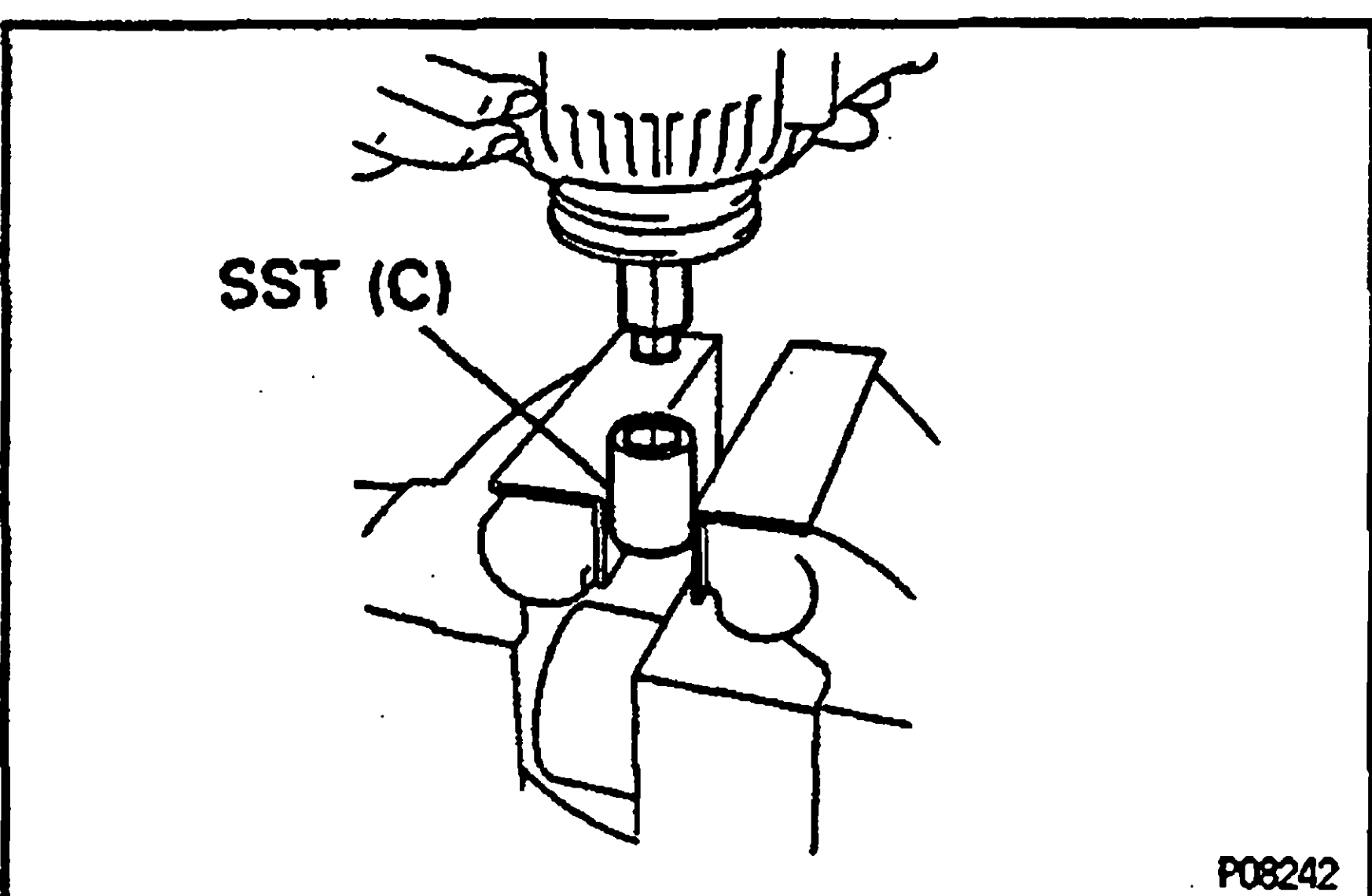
- (a) Remove the 5 screws, brush holder and IC regulator.
- (b) Remove the brush holder cover from the brush holder.

**3. REMOVE RECTIFIER HOLDER**

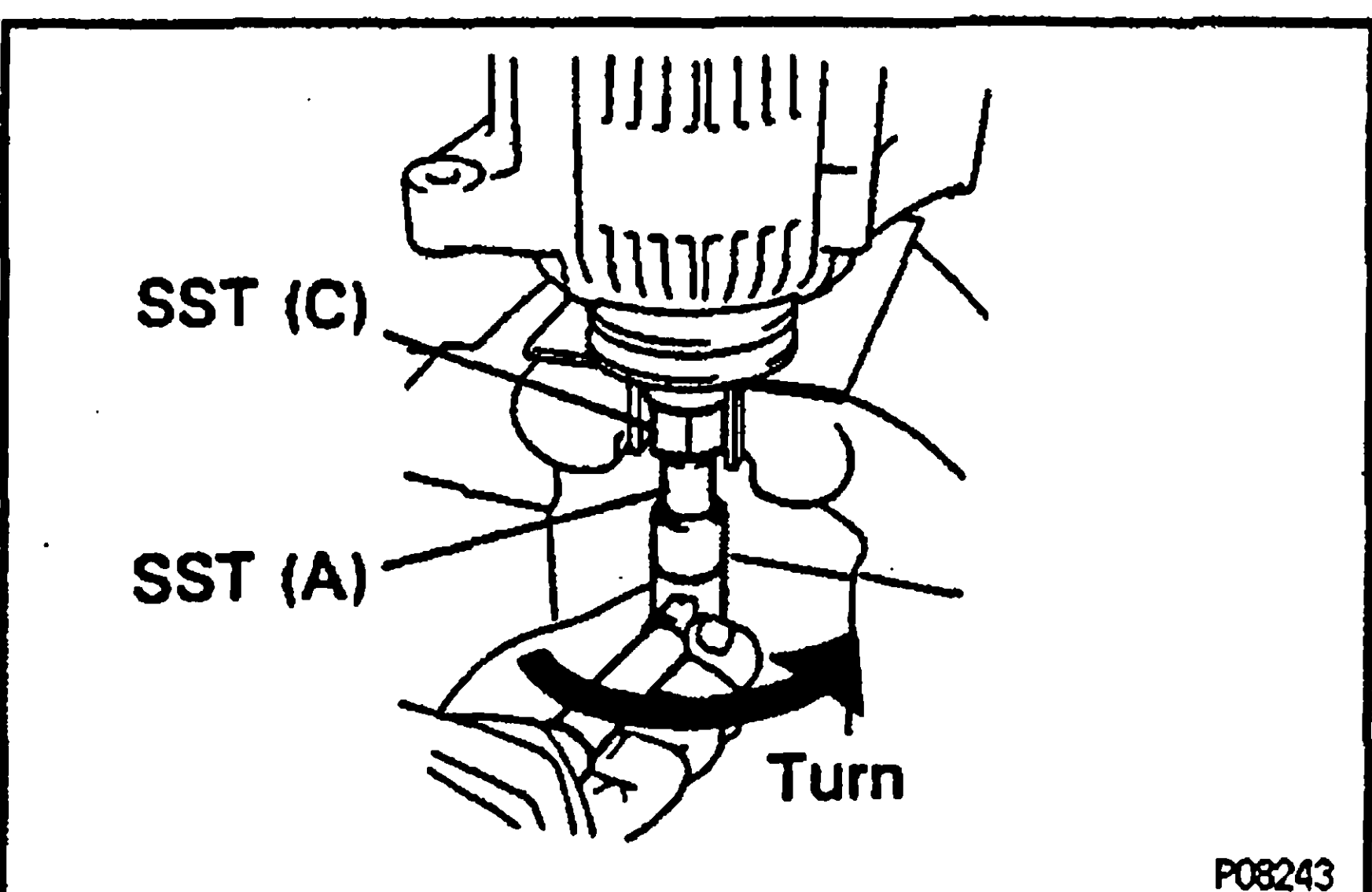
- (a) Remove the 4 screws and rectifier holder.
- (b) Remove the 4 rubber insulators.

**4. REMOVE PULLEY**

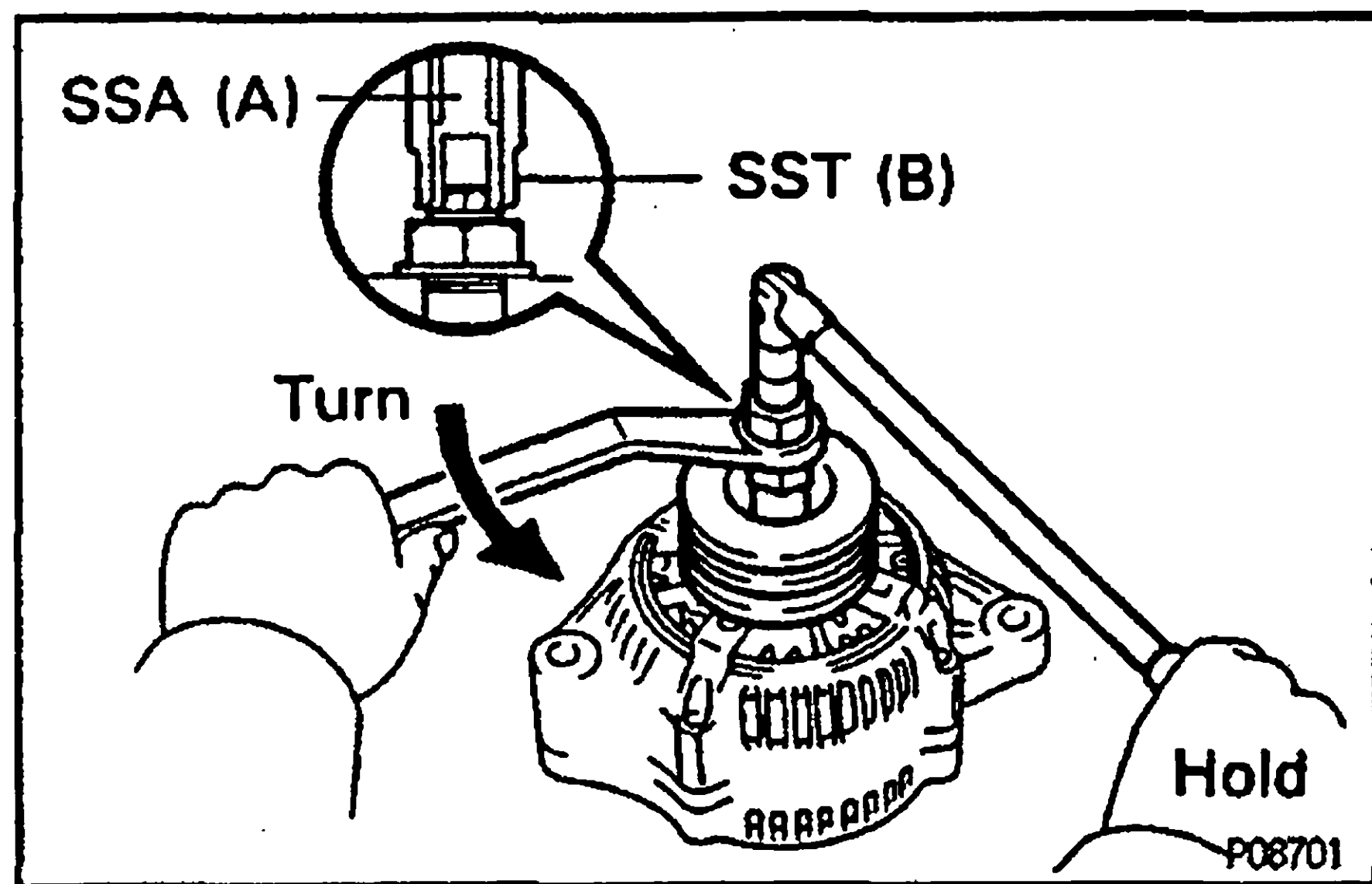
- (a) Hold SST (A) with a torque wrench, and tighten SST (B) clockwise to the specified torque.
SST 09820-63010 (09820-06010)
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)
- (b) Check that SST (A) is secured to the rotor shaft.



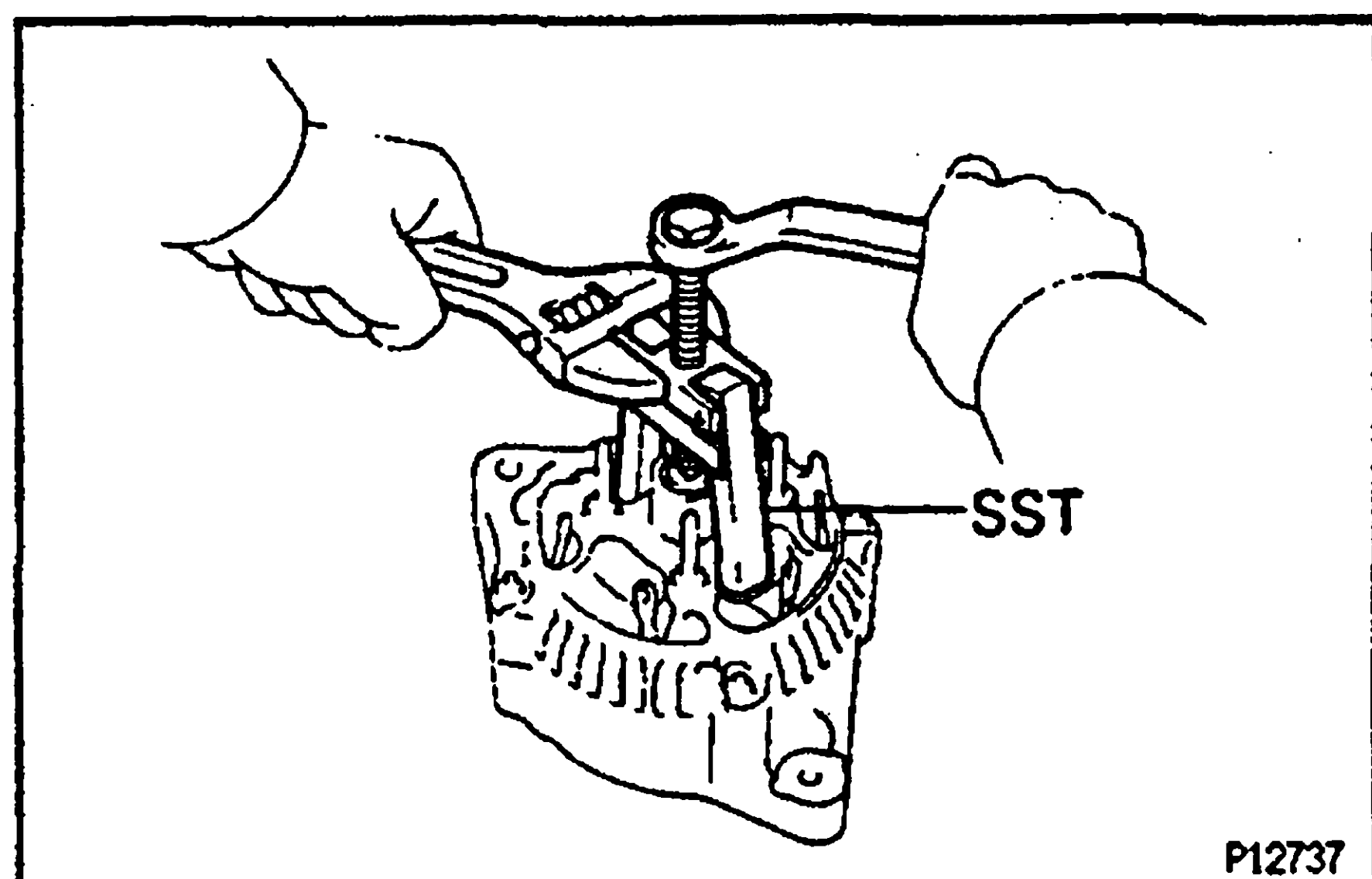
- (c) Mount SST (C) in a vise.
SST 09820-06021
- (d) Install the pulley nut to SST (C).



- (e) To loosen the pulley nut, turn SST (A) in the direction shown in the illustration.
NOTICE: To prevent damage to the rotor shaft, do not loosen the pulley nut more than one-half of a turn.
- (f) Remove the alternator from SST (C).

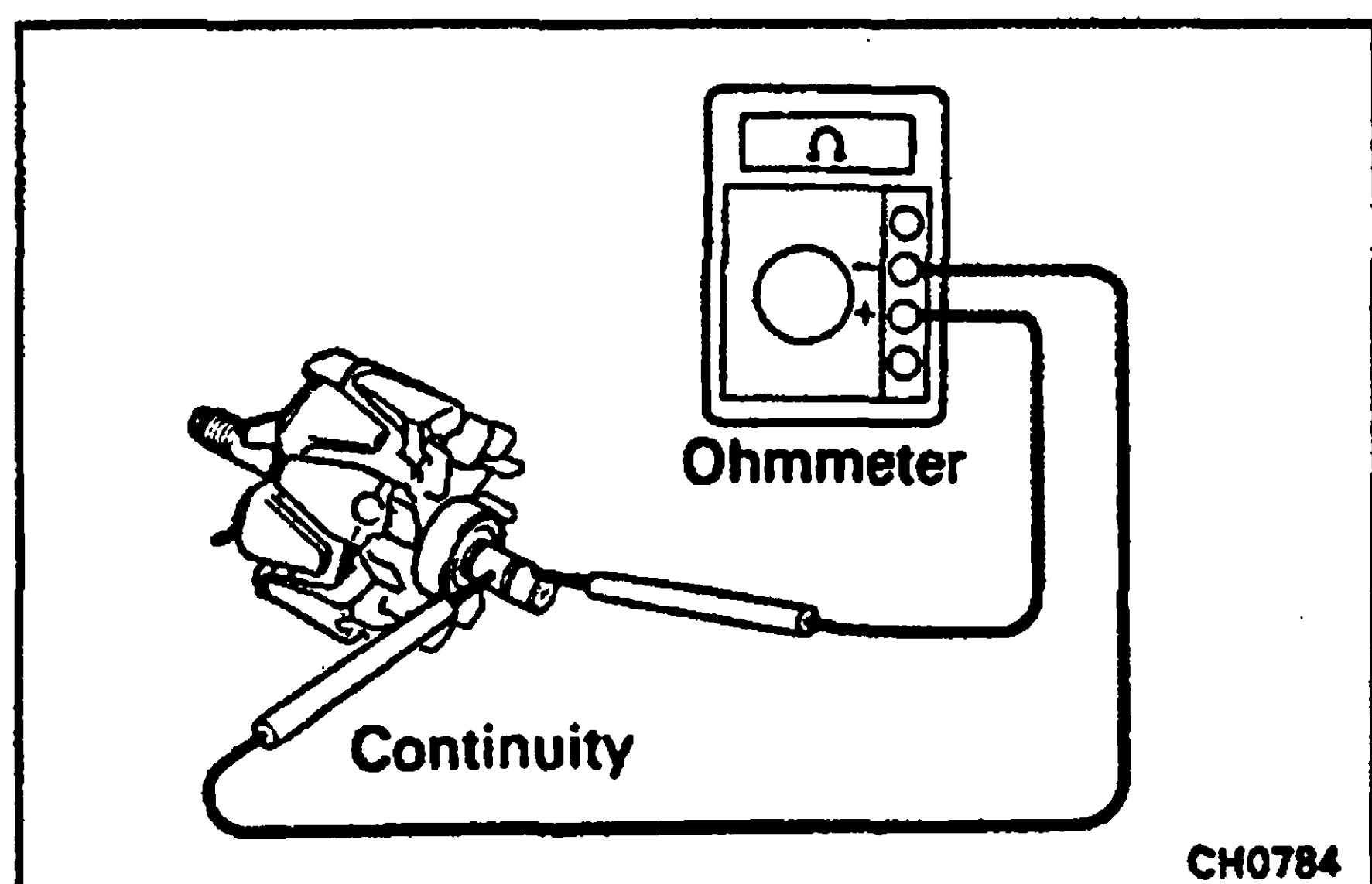


- (g) Turn SST (B), and remove SST (A and B).
- (h) Remove the pulley nut and pulley.



5. REMOVE RECTIFIER END FRAME

- (a) Remove the 4 nuts and cord clip.
 - (b) Using SST, remove the rectifier end frame.
SST 09286-46011
 - (c) Remove the alternator washer from the rotor.
- ## 6. REMOVE ROTOR FROM DRIVE END FRAME



ALTERNATOR INSPECTION AND REPAIR

Rotor

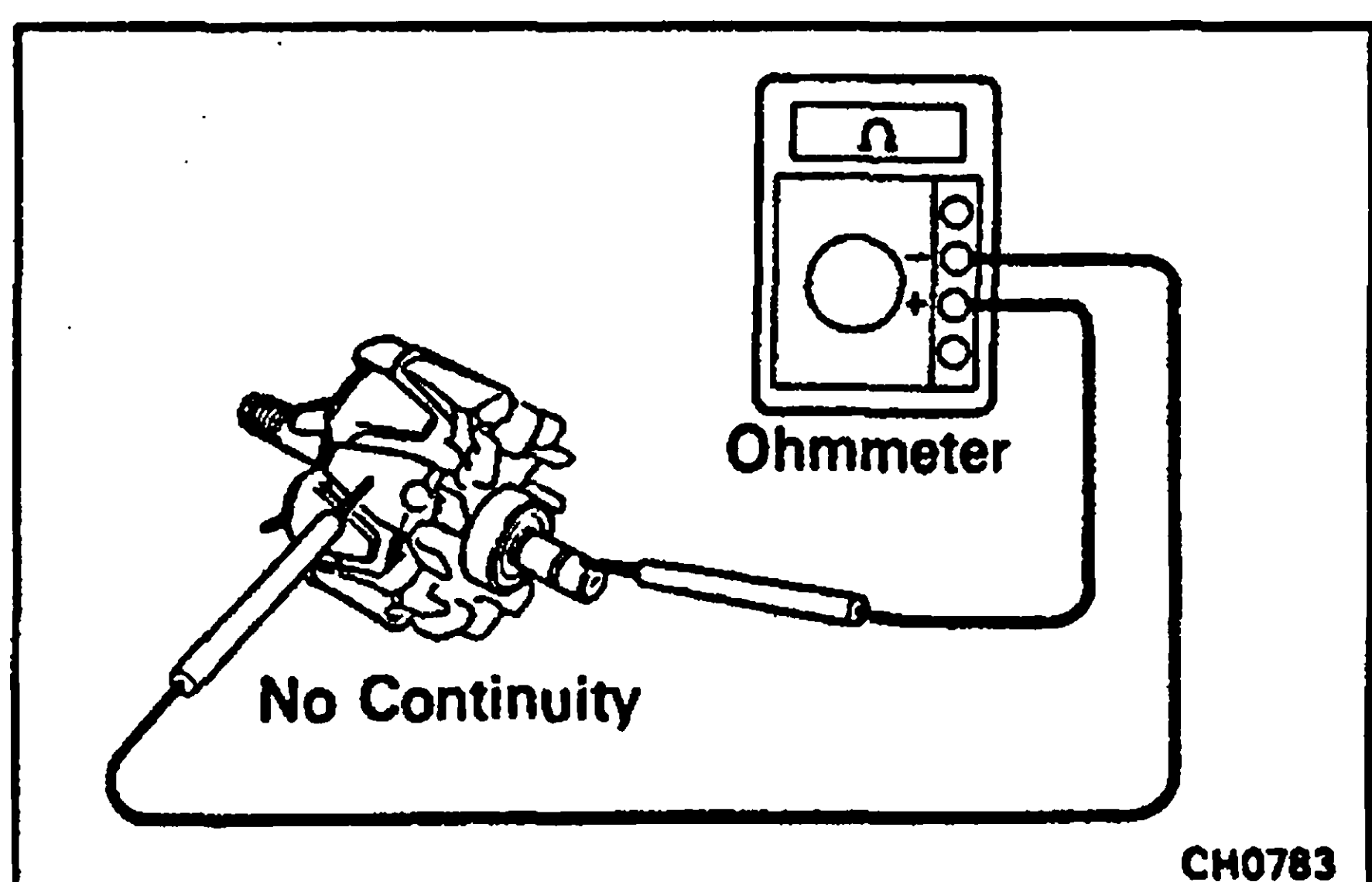
1. INSPECT ROTOR FOR OPEN CIRCUIT

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

Standard resistance (Cold):

2.7 – 3.1 Ω

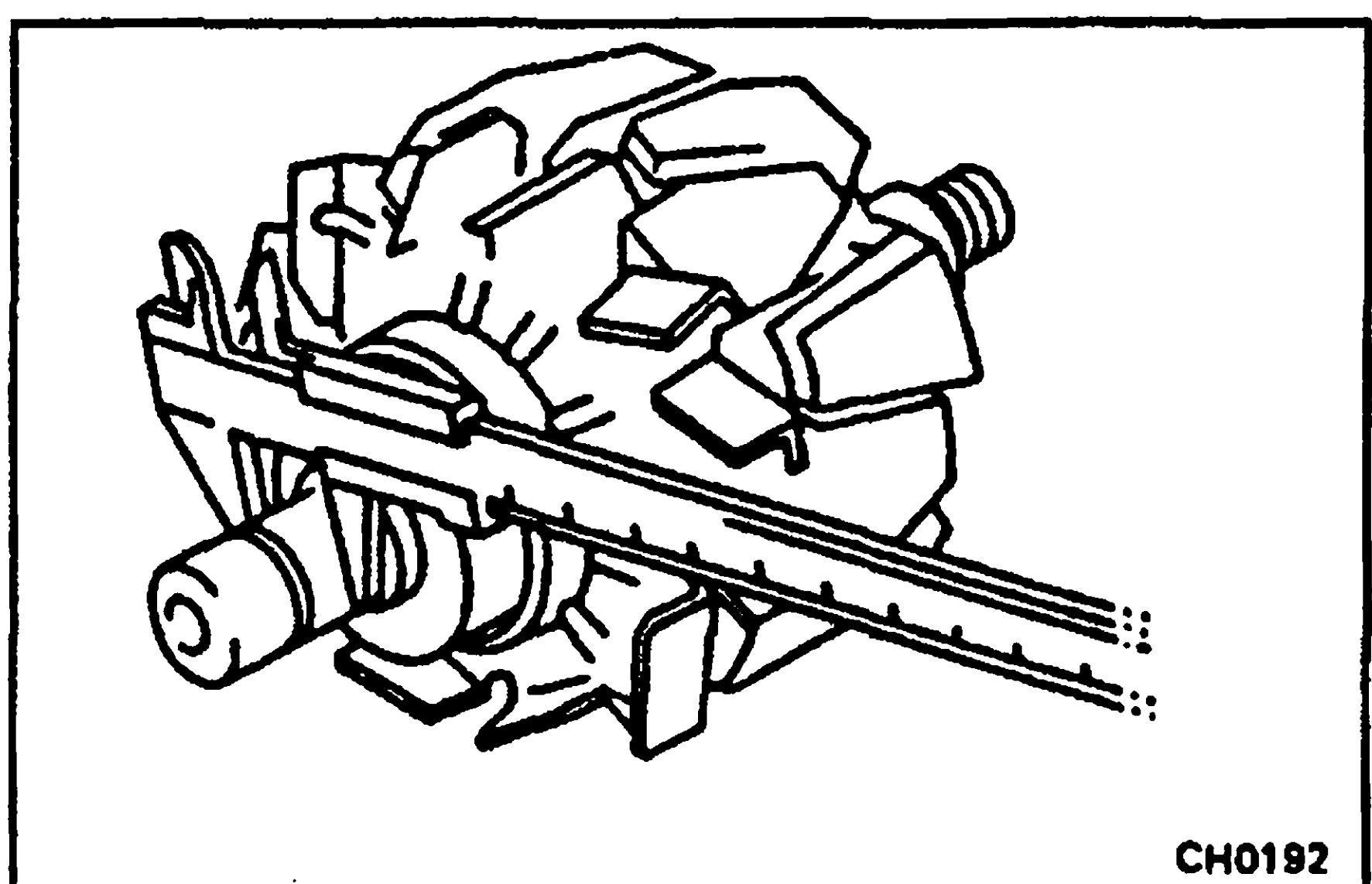
If there is no continuity, replace the rotor.



2. INSPECT ROTOR FOR GROUND

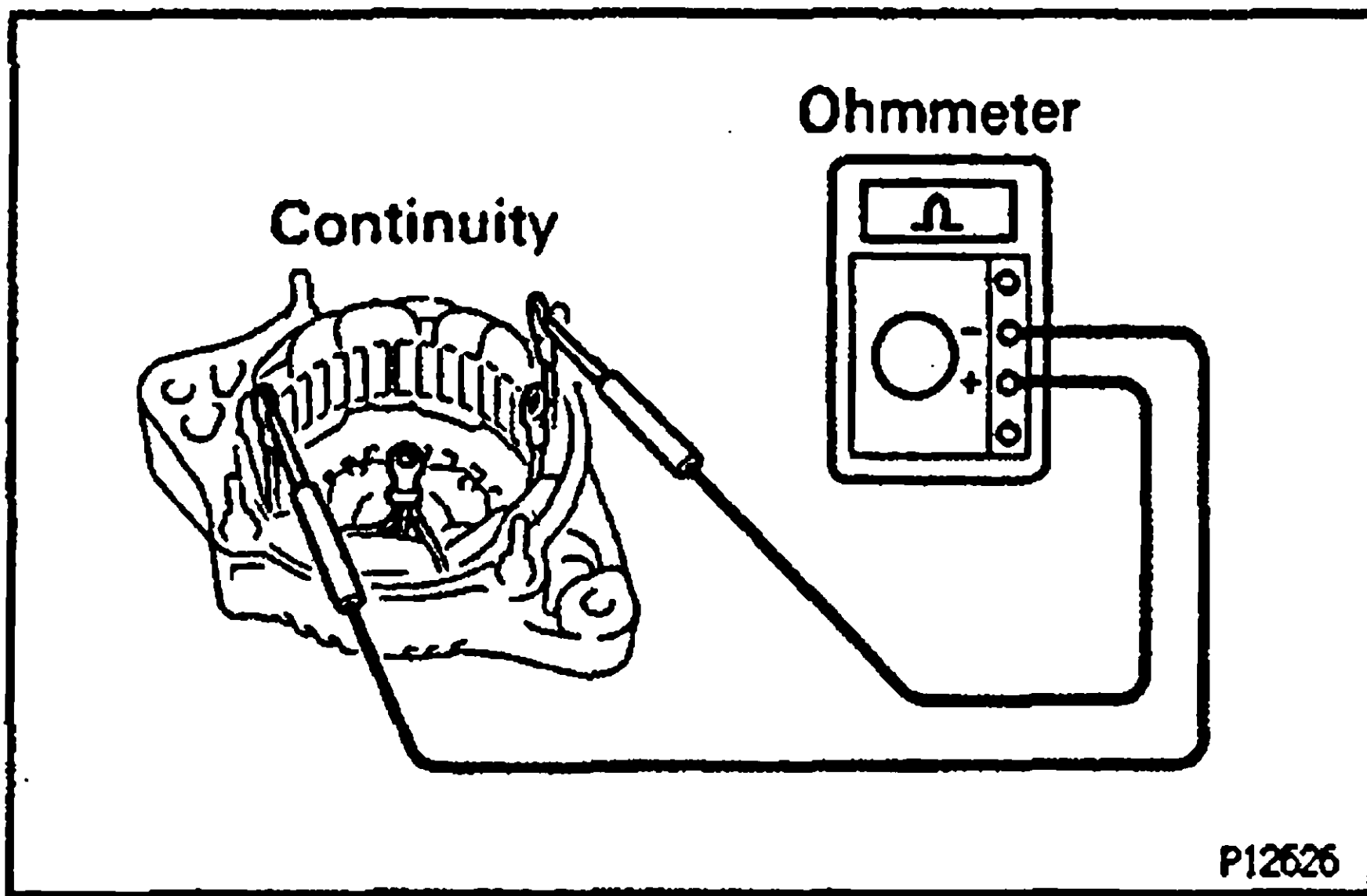
Using an ohmmeter, check that there is no continuity between the slip ring and rotor.

If there is continuity, replace the rotor.



3. INSPECT SLIP RINGS

- (a) Check that the slip rings are not rough or scored.
If rough or scored, replace the rotor.
- (b) Using a vernier caliper, measure the slip ring diameter.
Standard diameter:
14.2 – 14.4 mm (0.559 – 0.567 in.)
Minimum diameter:
12.8 mm (0.504 in.)
If the diameter is less than minimum, replace the rotor.

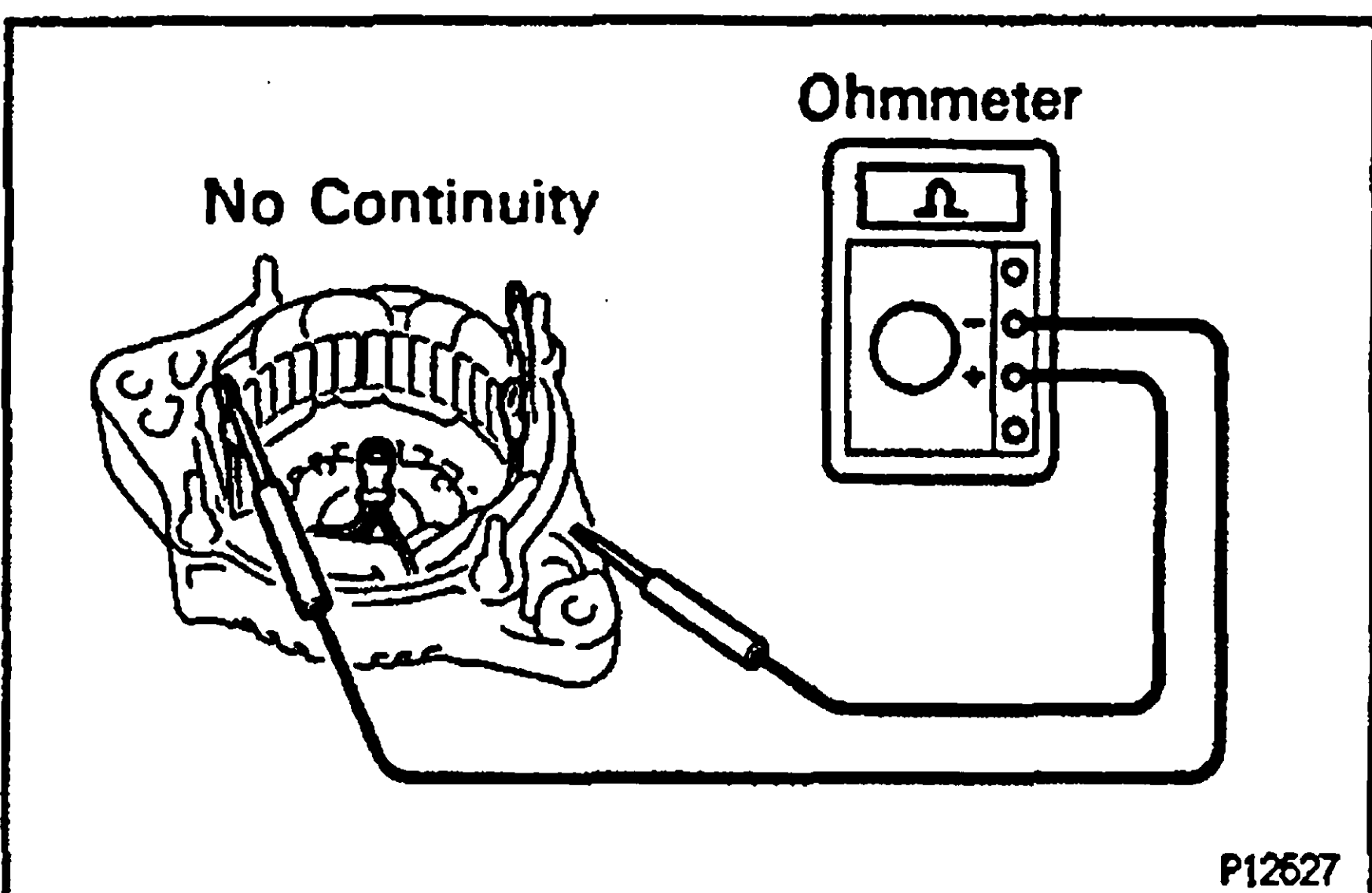


Stator (Drive End Frame)

1. INSPECT STATOR FOR OPEN CIRCUIT

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

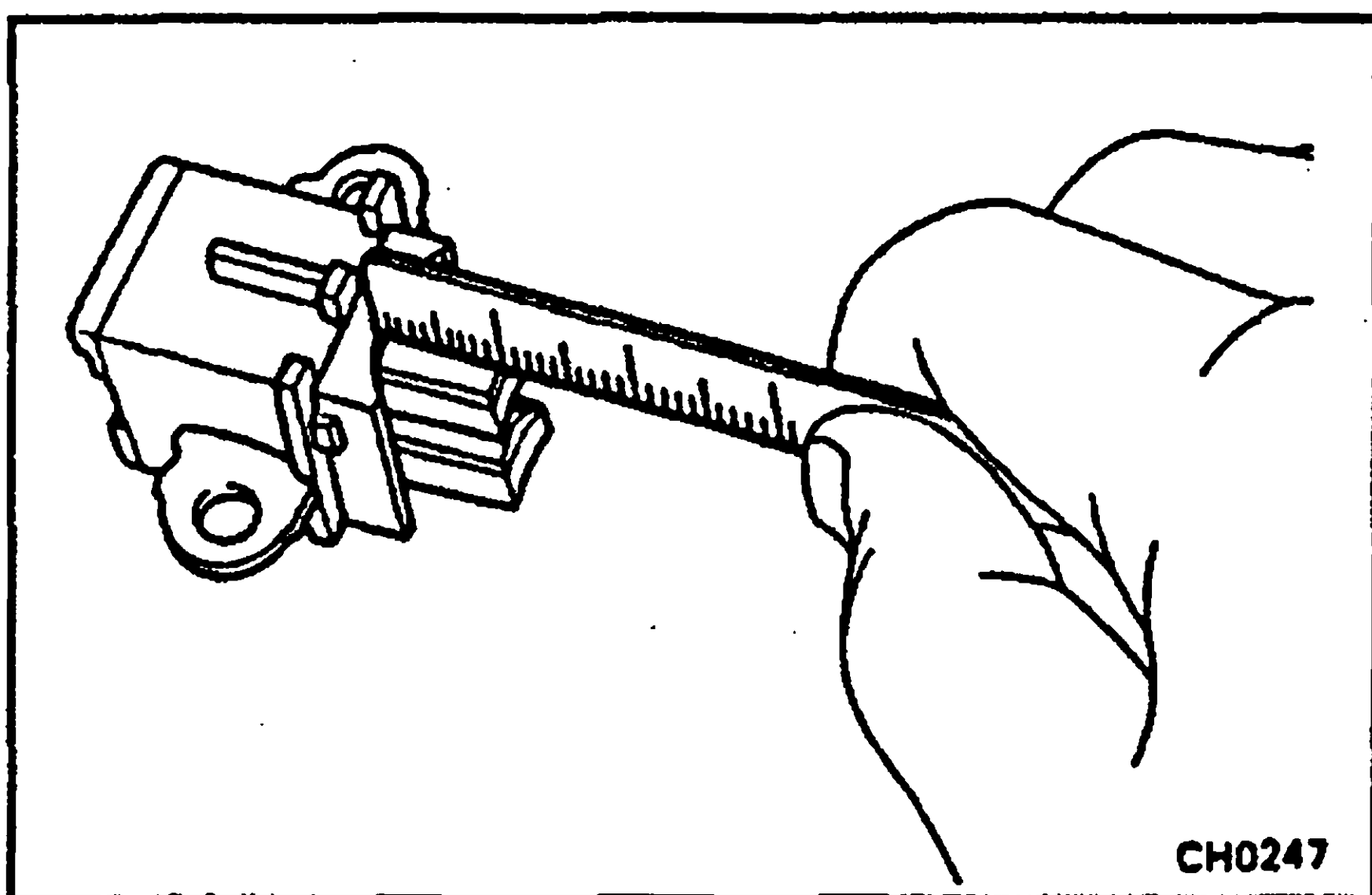
If there is no continuity, replace the drive end frame assembly.



2. INSPECT STATOR FOR GROUND

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

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



Brushes

1. INSPECT EXPOSED BRUSH LENGTH

Using a scale, measure the exposed brush length.

Standard exposed length:

10.5 mm (0.413 in.)

Minimum exposed length:

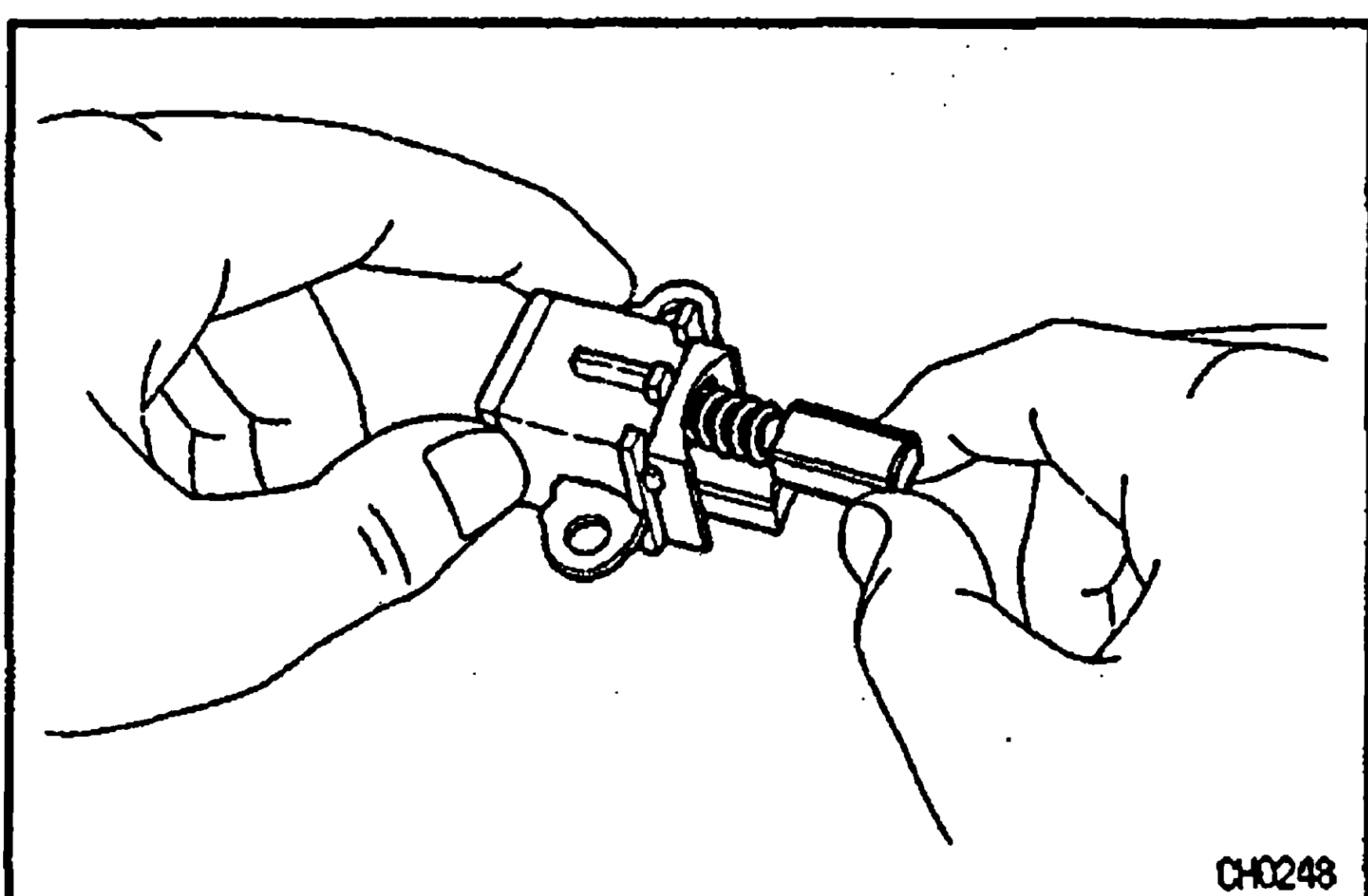
1.5 mm (0.059 in.)

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

2. IF NECESSARY, REPLACE BRUSHES

(a) Unsolder and remove the brush and spring.

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



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

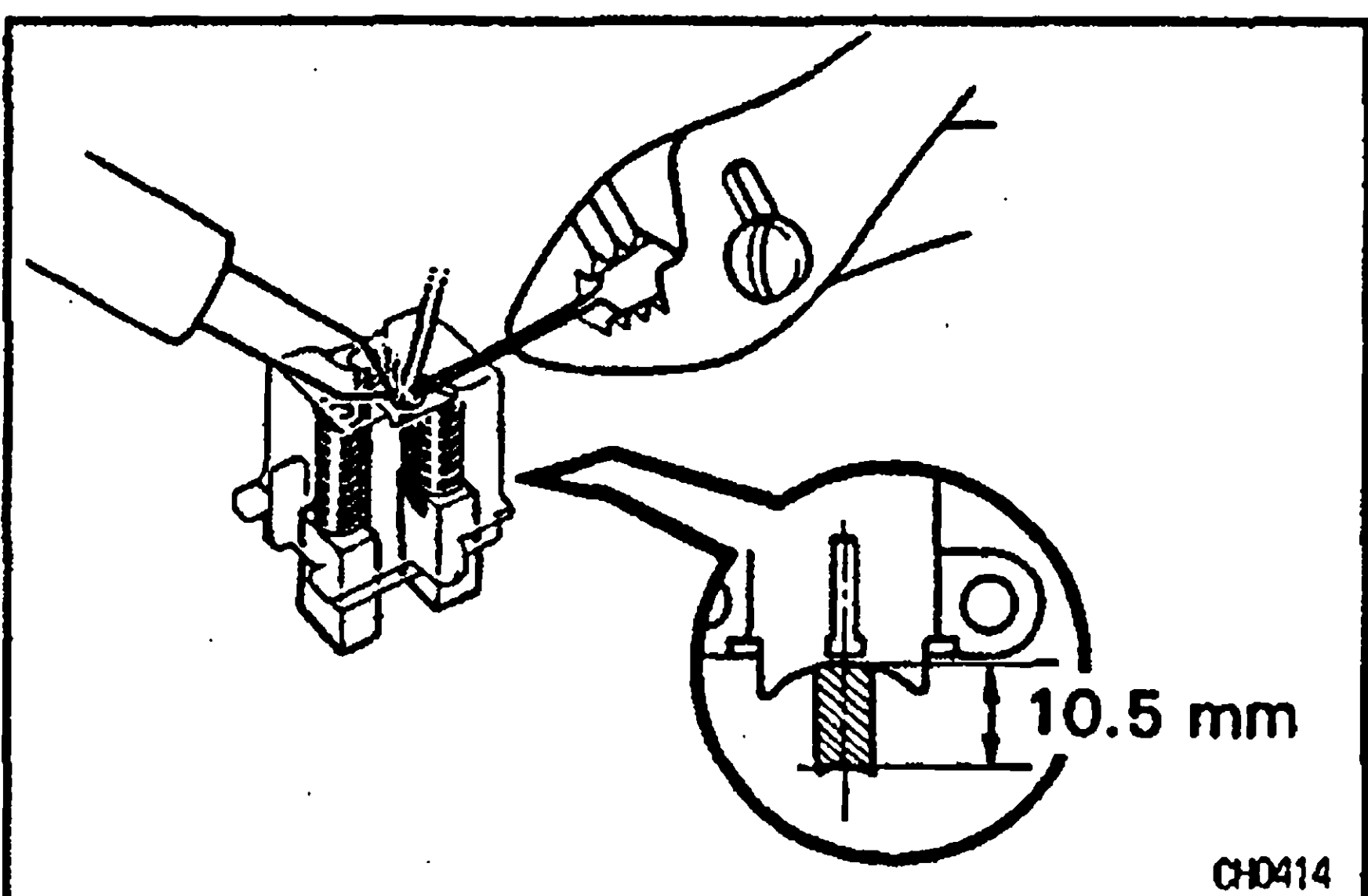
Exposed length:

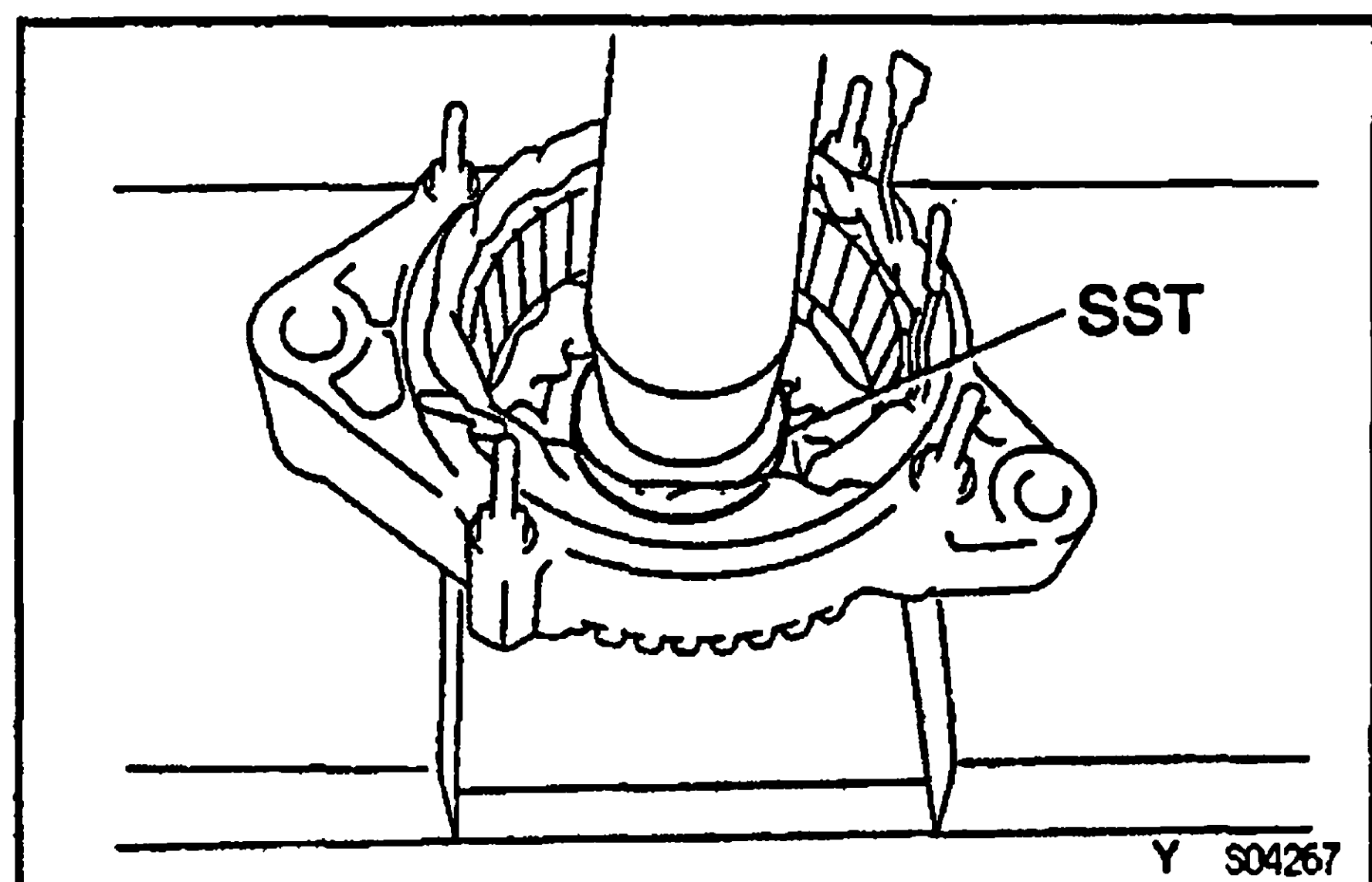
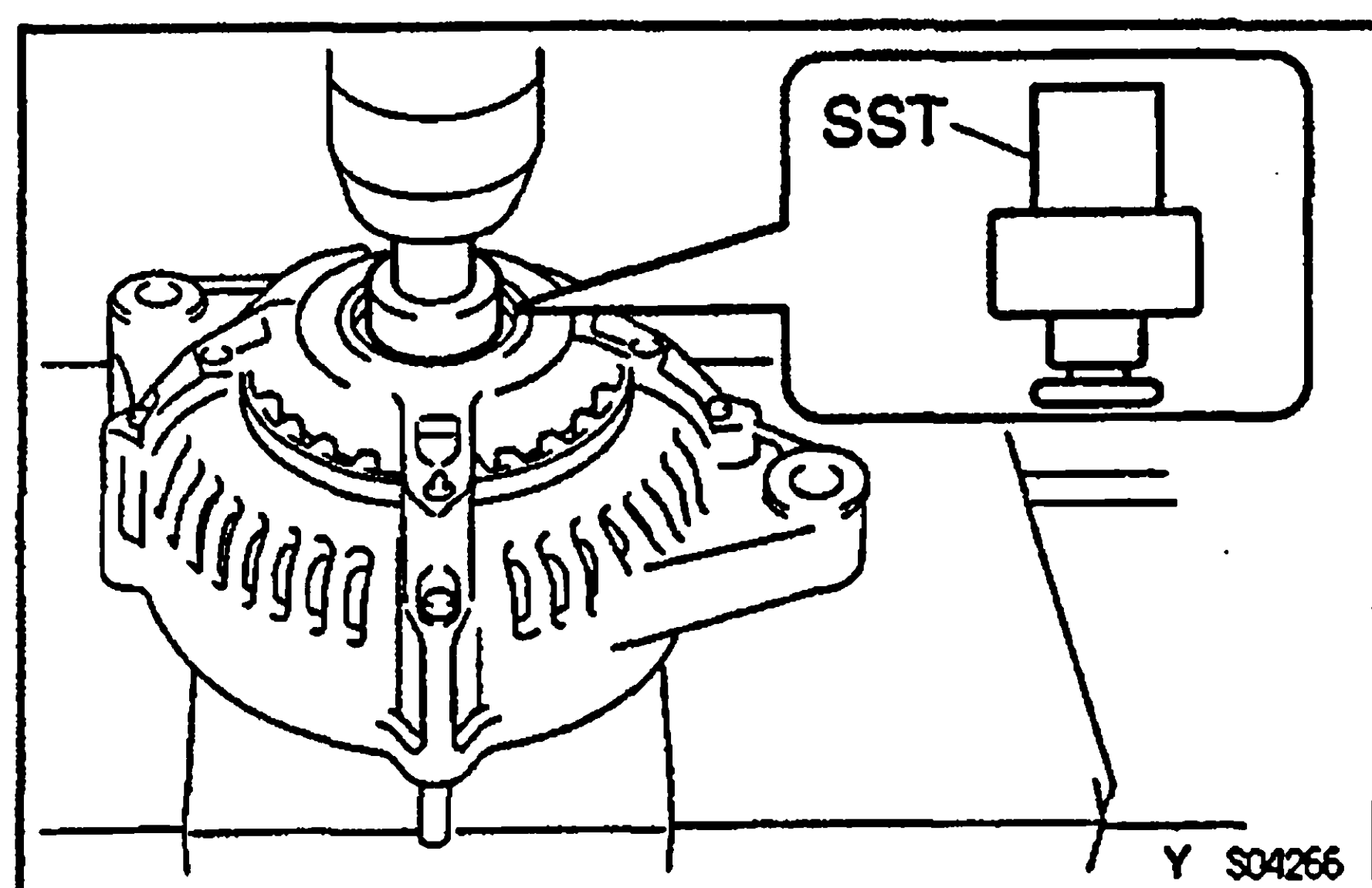
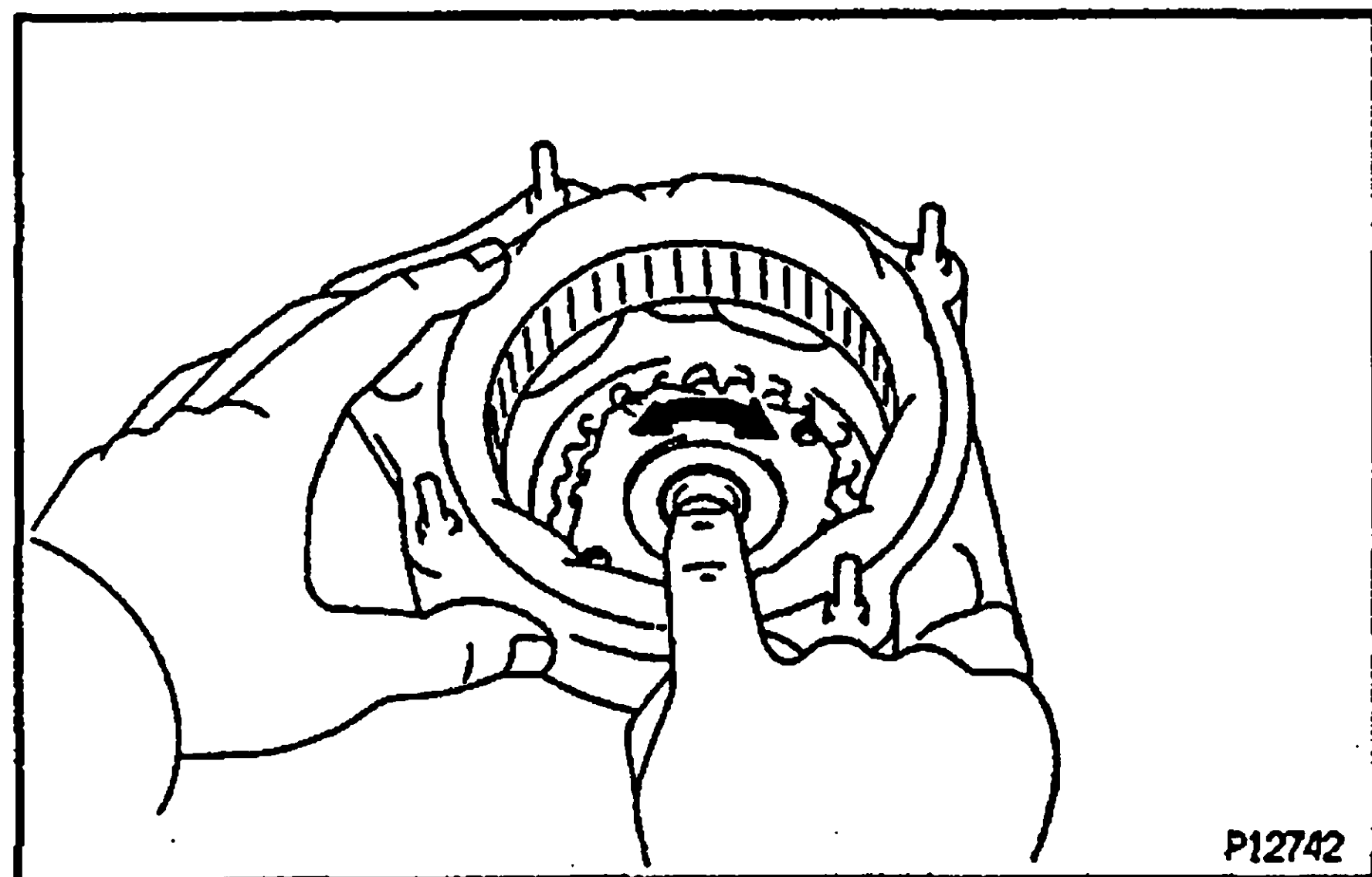
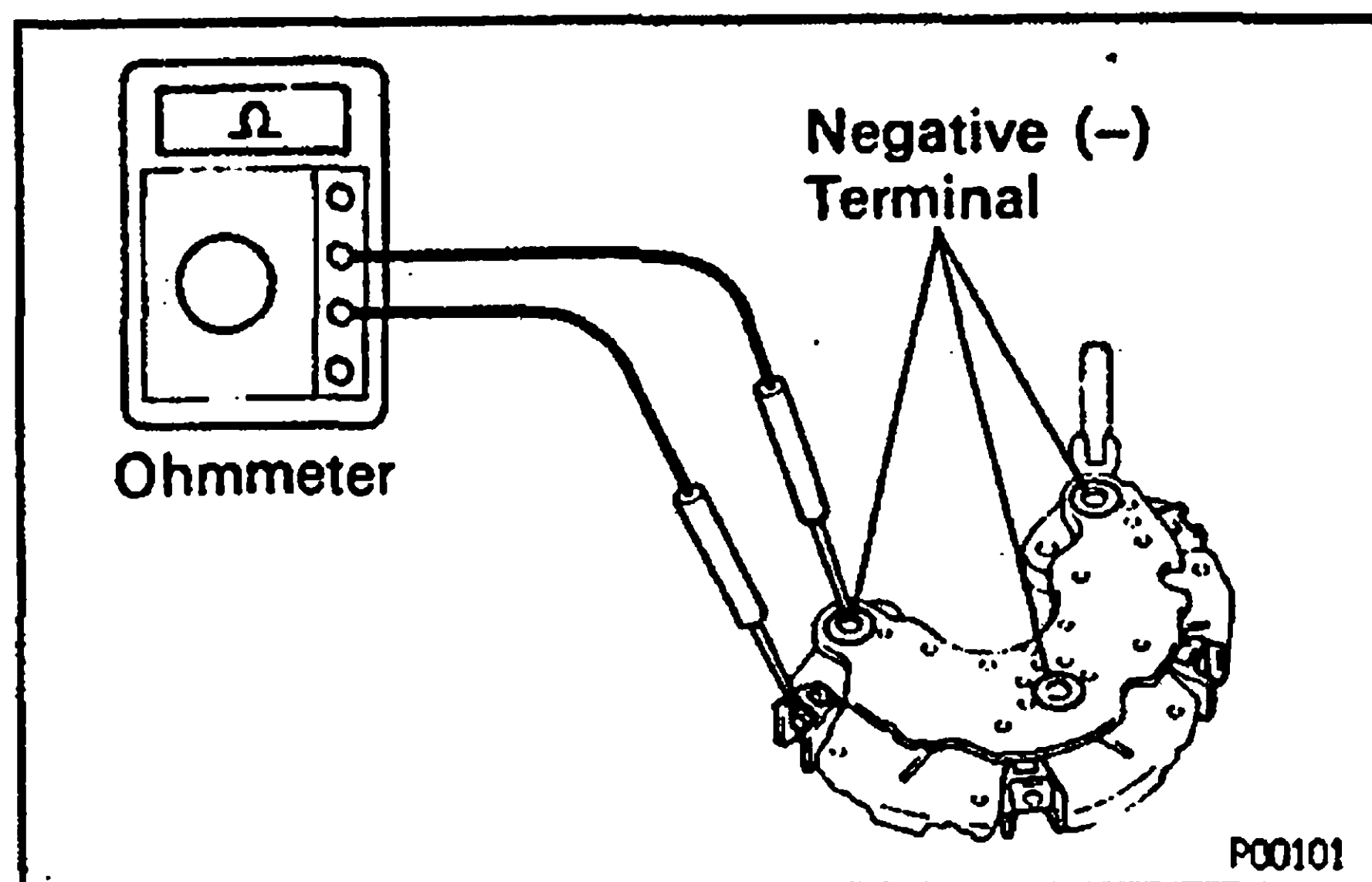
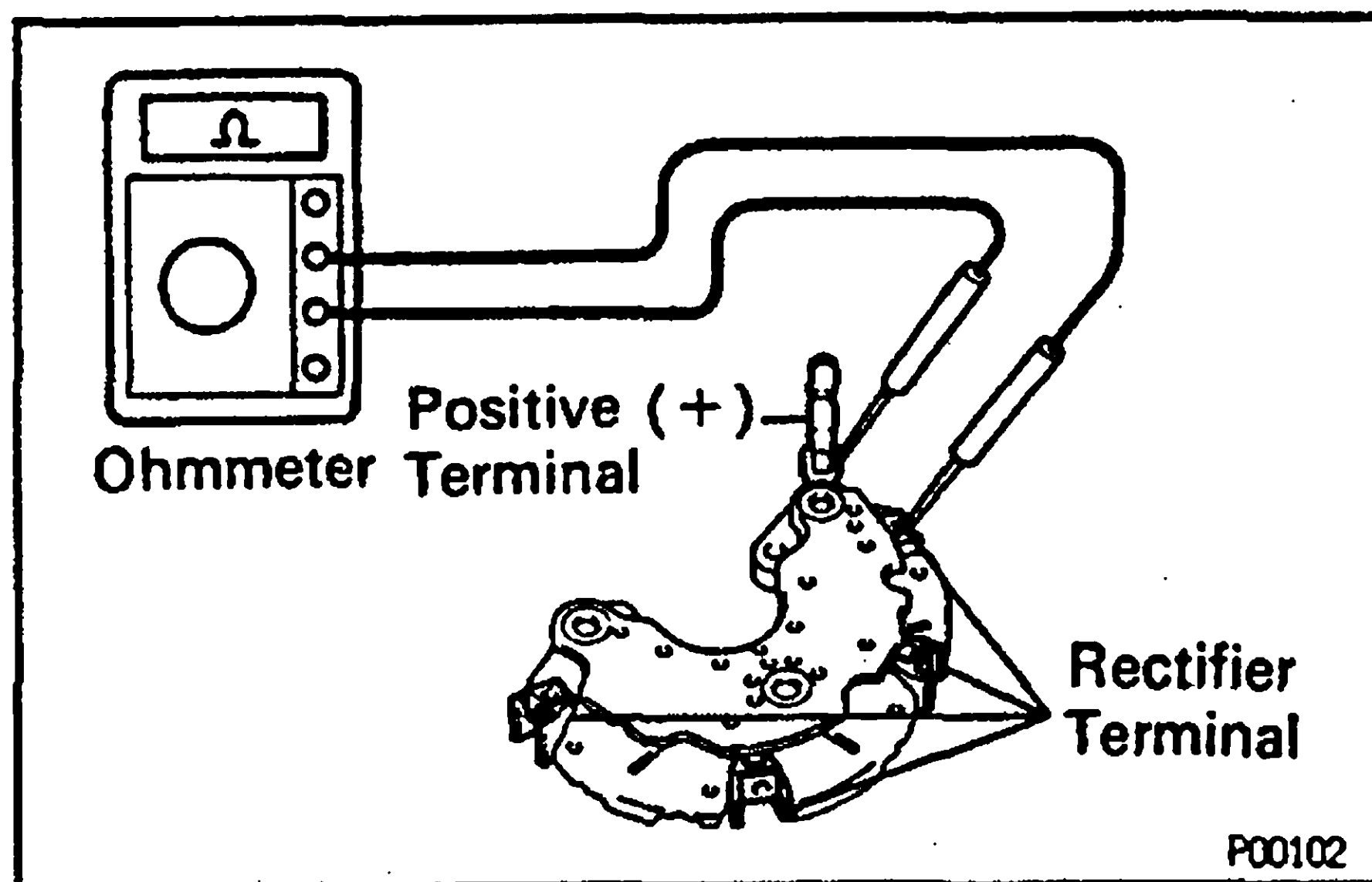
10.5 mm (0.413 in.)

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

(e) Cut off the excess wire.

(f) Apply insulation paint to the soldered area.





Rectifiers (Rectifier Holder)

1. INSPECT POSITIVE RECTIFIER

- Using an ohmmeter, connect one tester probe to the positive (+) terminal and the other to each rectifier terminal.
- Reverse the polarity of the tester probes and repeat step (a).
- Check that one shows continuity and the other shows no continuity.

If continuity is not as specified, replace the rectifier holder.

2. INSPECT NEGATIVE RECTIFIER

- Using an ohmmeter, connect one tester probe to each negative (-) terminal and the other to each rectifier terminal.
- Reverse the polarity of the tester probes and repeat step (a).
- Check that one shows continuity and the other shows no continuity.

If continuity is not as specified, replace the rectifier holder.

Bearings

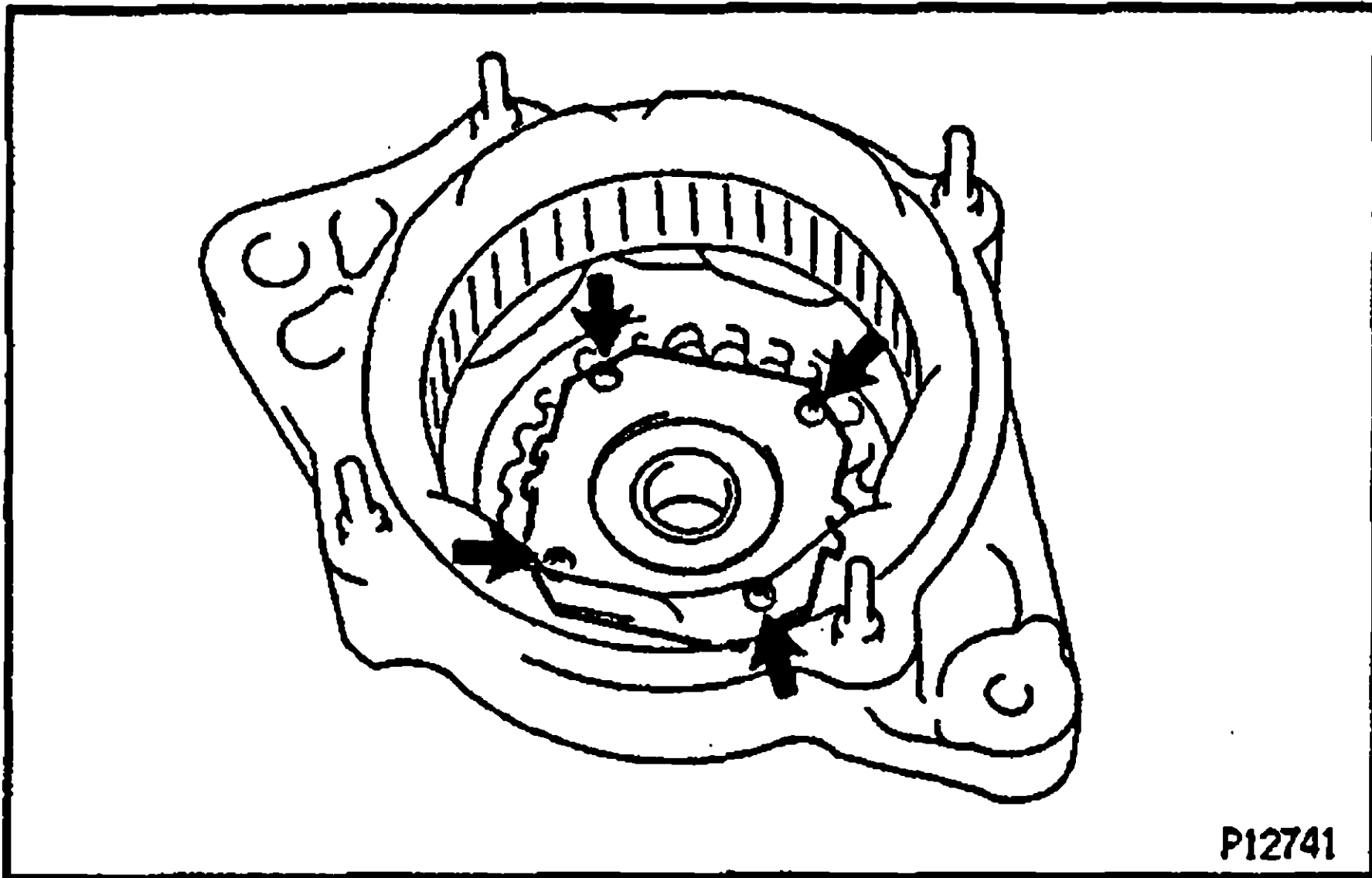
1. INSPECT FRONT BEARING

Check that the bearing is not rough or worn.

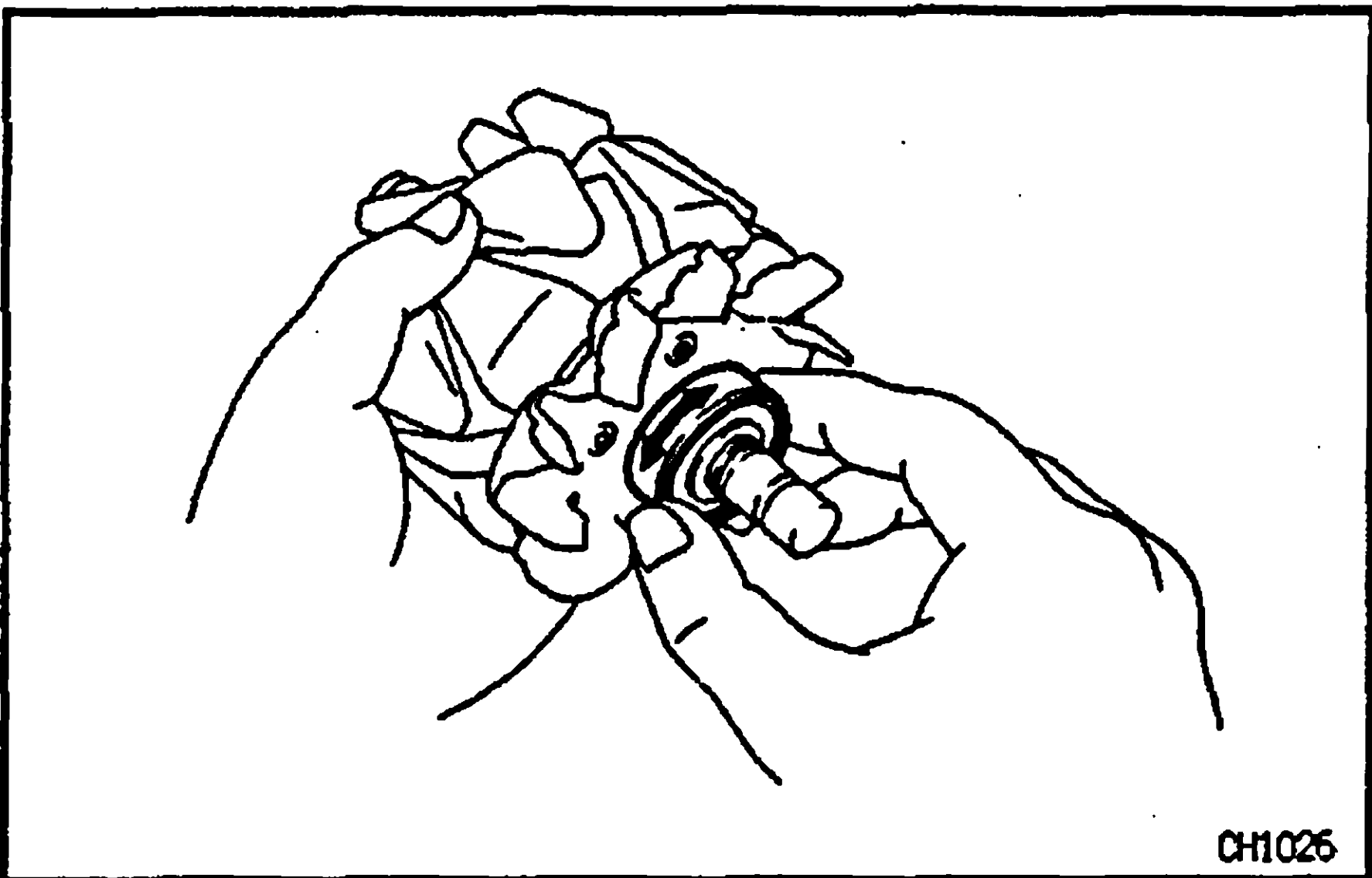
2. IF NECESSARY, REPLACE FRONT BEARING

- Remove the 4 screws, bearing retainer and bearing.
- Using SST and a press, press out the bearing.
SST 09950-60010 (09951-00260, 09952-06010)

- Using SST and a press, press in a new bearing.
SST 09950-60010 (09951-00510)

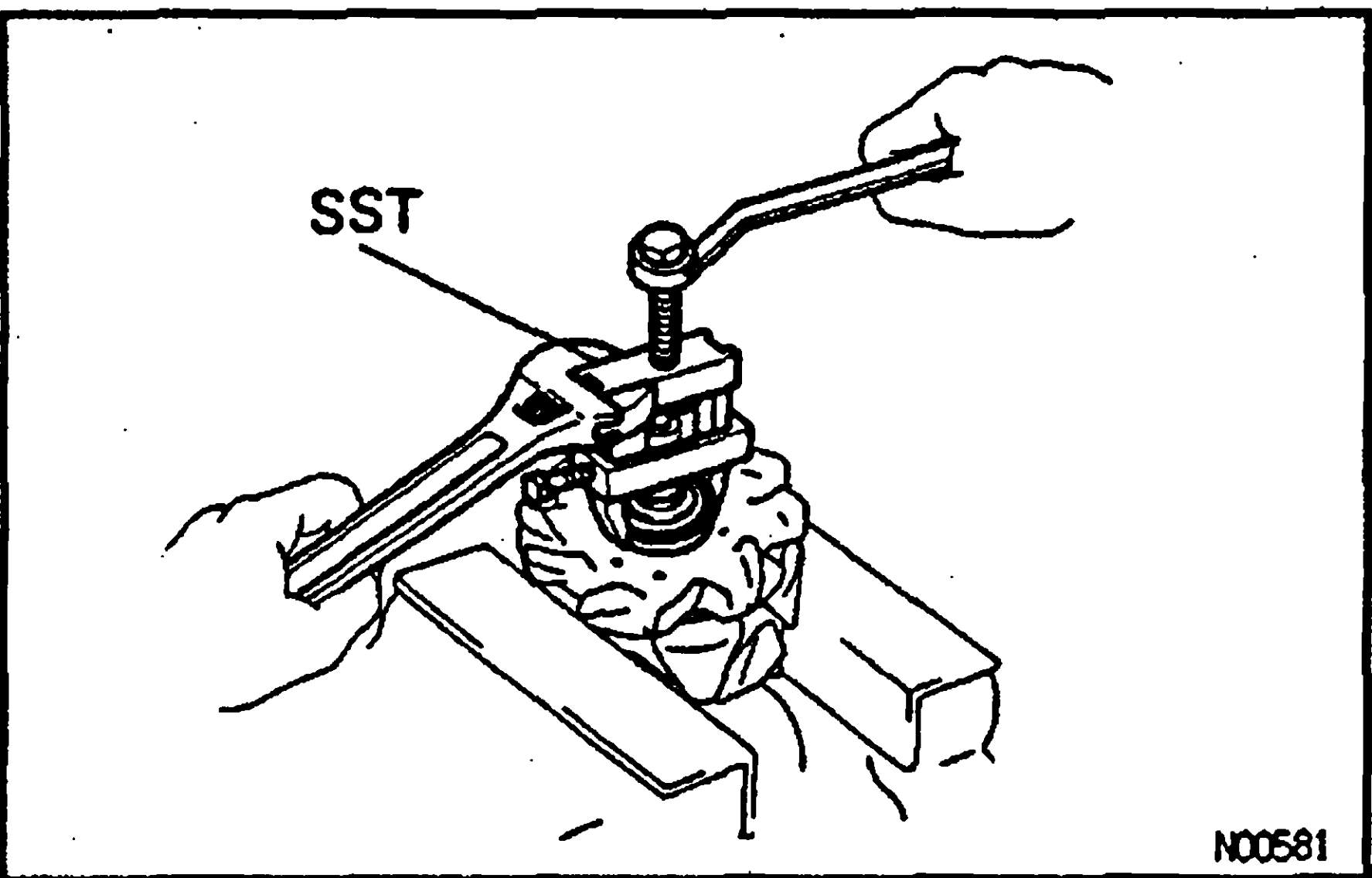


- (d) Install the bearing retainer with the 4 screws.
Torque: 2.6 N·m (26.5 kgf·cm, 23 in·lbf)



3. INSPECT REAR BEARING

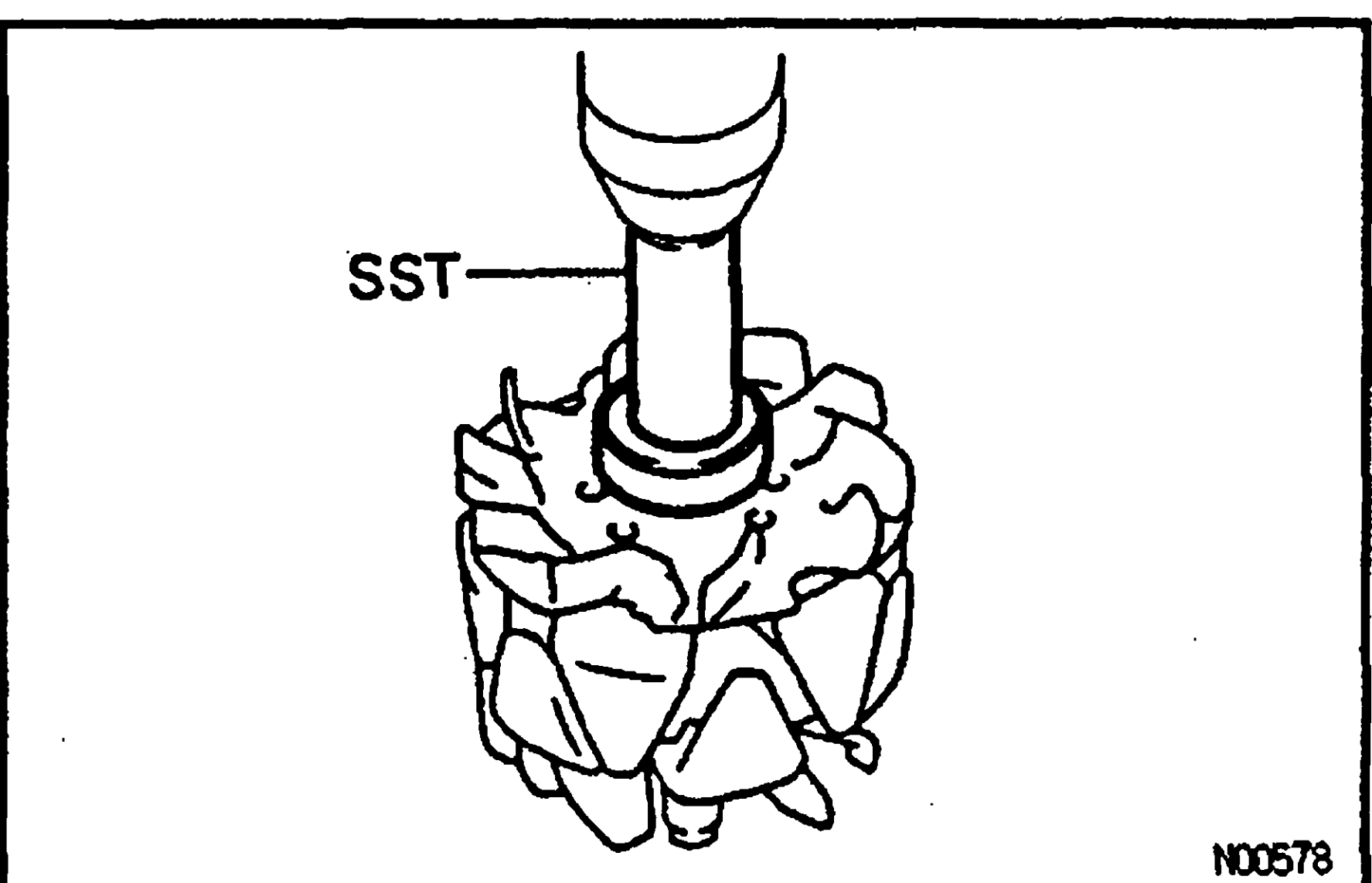
Check that the bearing is not rough or worn.



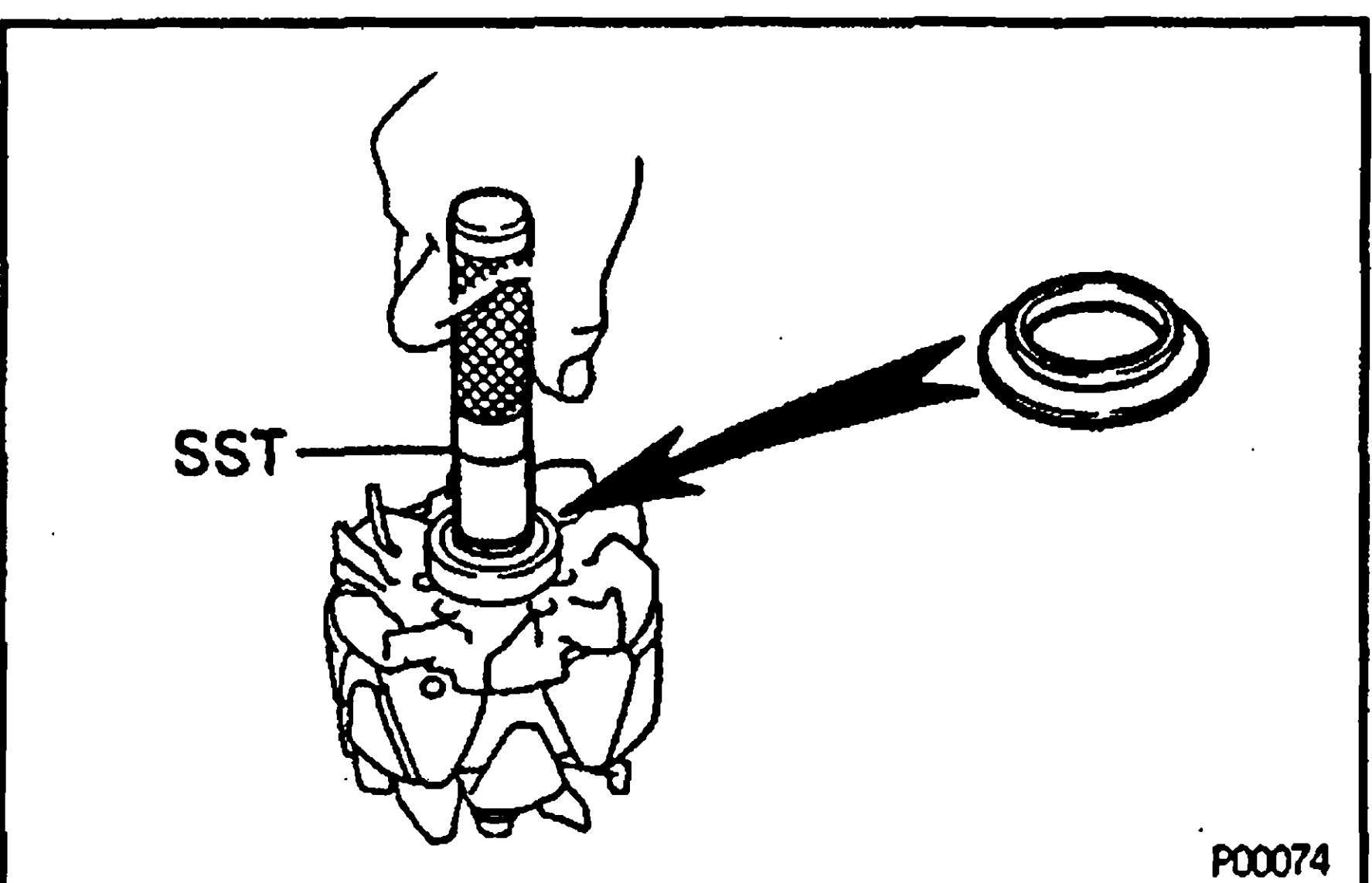
4. IF NECESSARY, REPLACE REAR BEARING

- (a) Using SST, remove the bearing cover and bearing.
SST 09820-00021

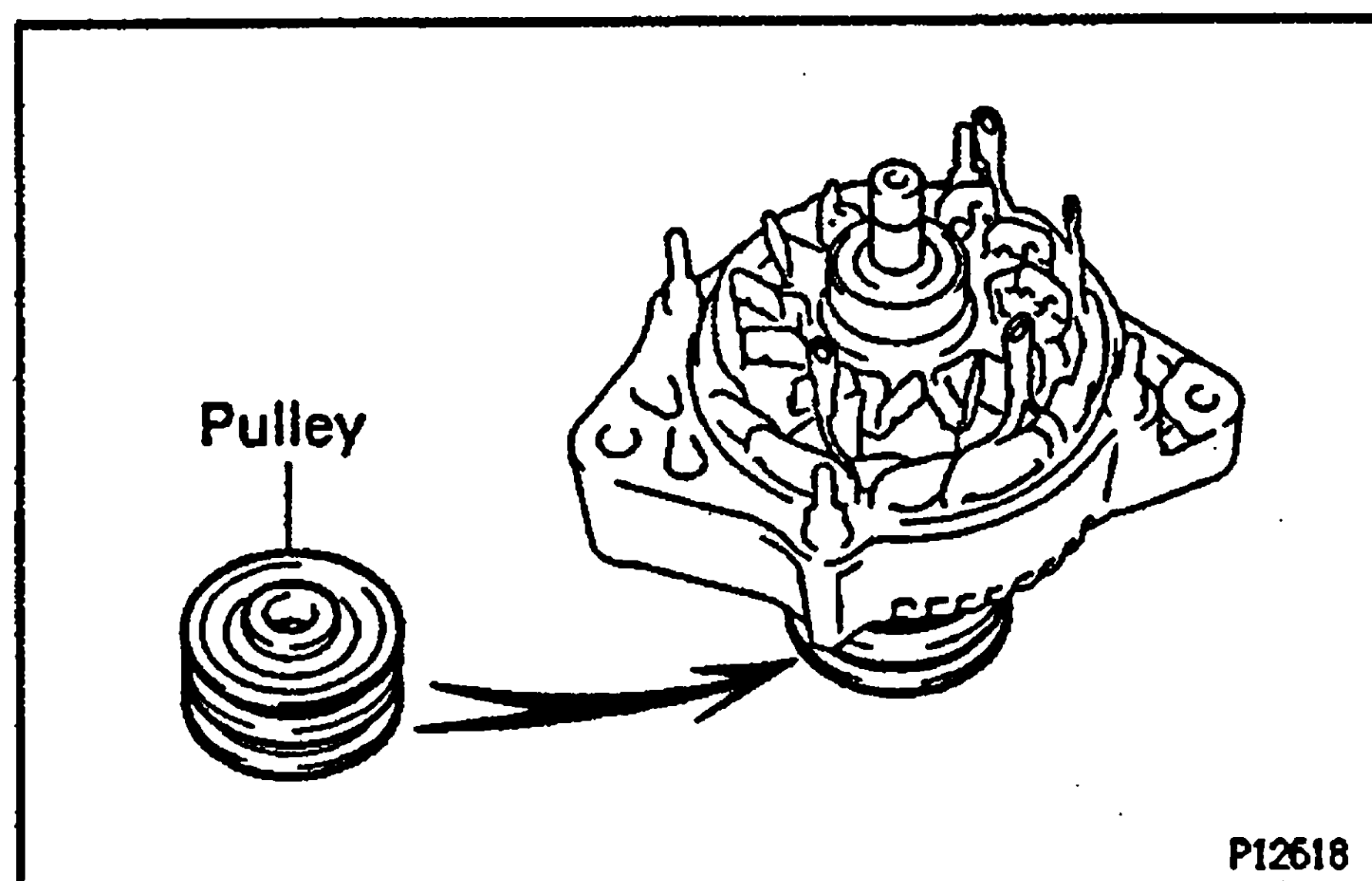
NOTICE: Be careful not to damage the fan.



- (b) Using SST and a press, press in a new bearing.
SST 09820-00030

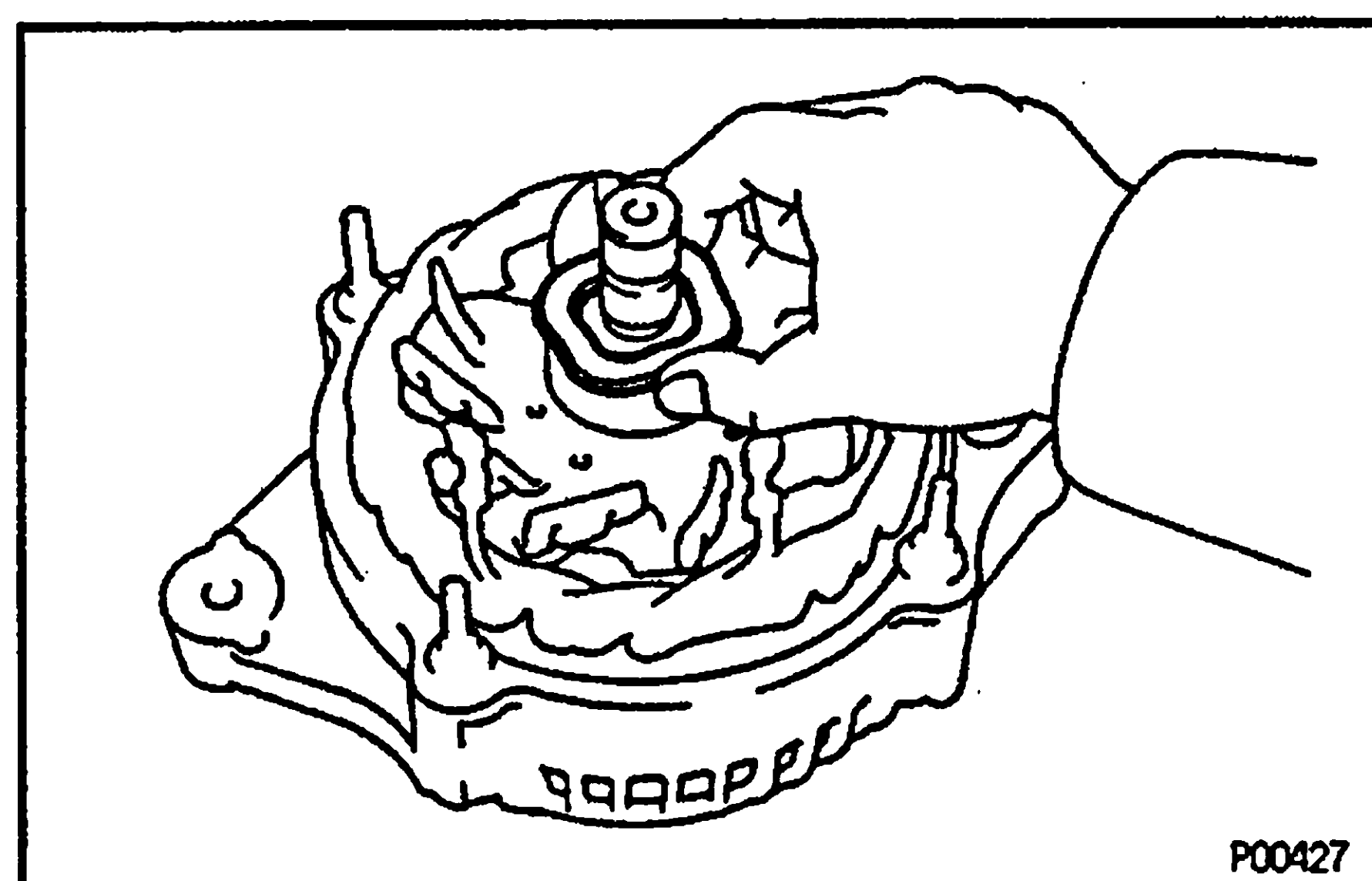


- (c) Using SST, push in the bearing cover.
SST 09285-76010



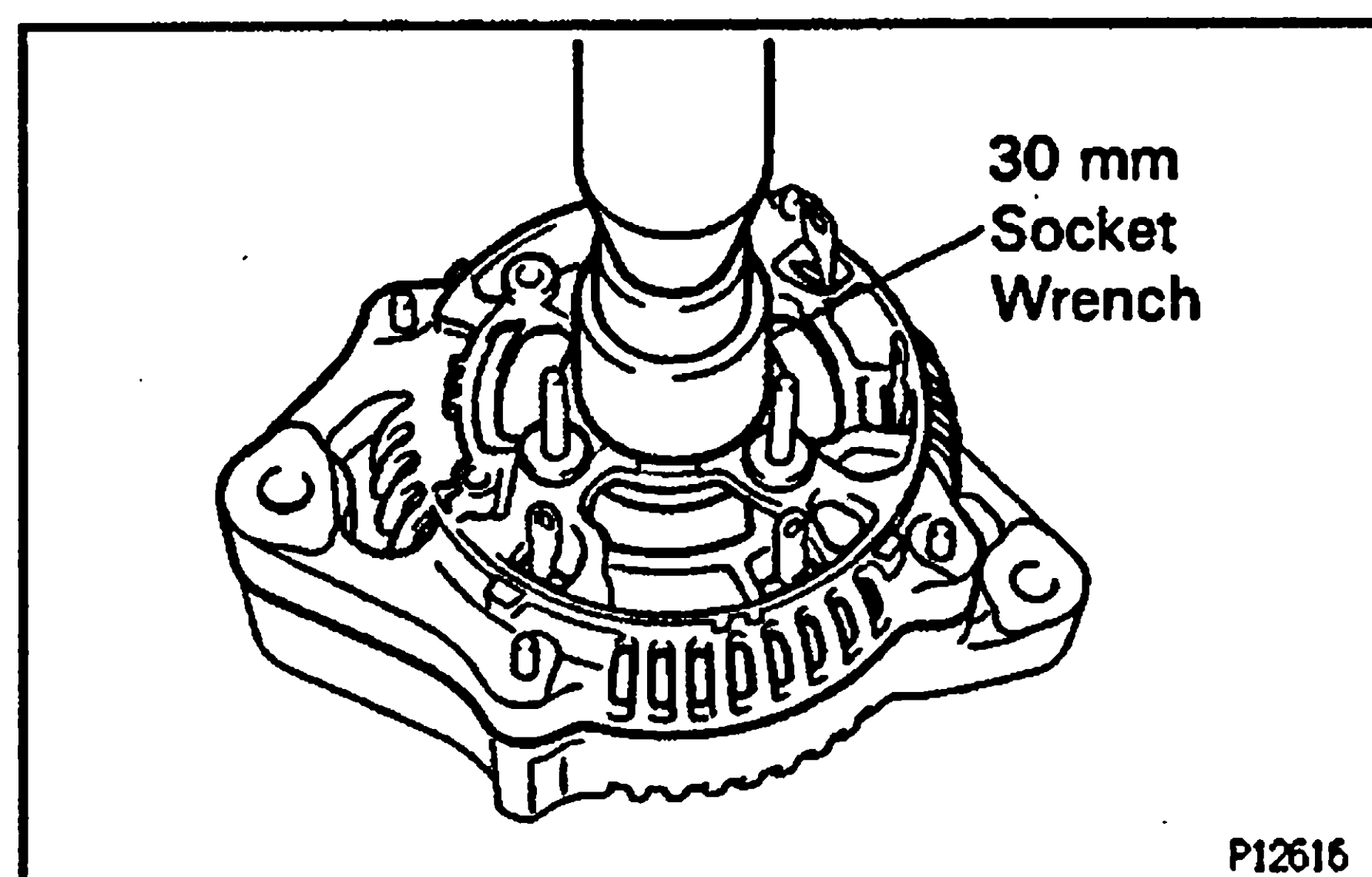
ALTERNATOR ASSEMBLY

1. PLACE DRIVE END FRAME ON PULLEY
2. INSTALL ROTOR TO DRIVE END FRAME

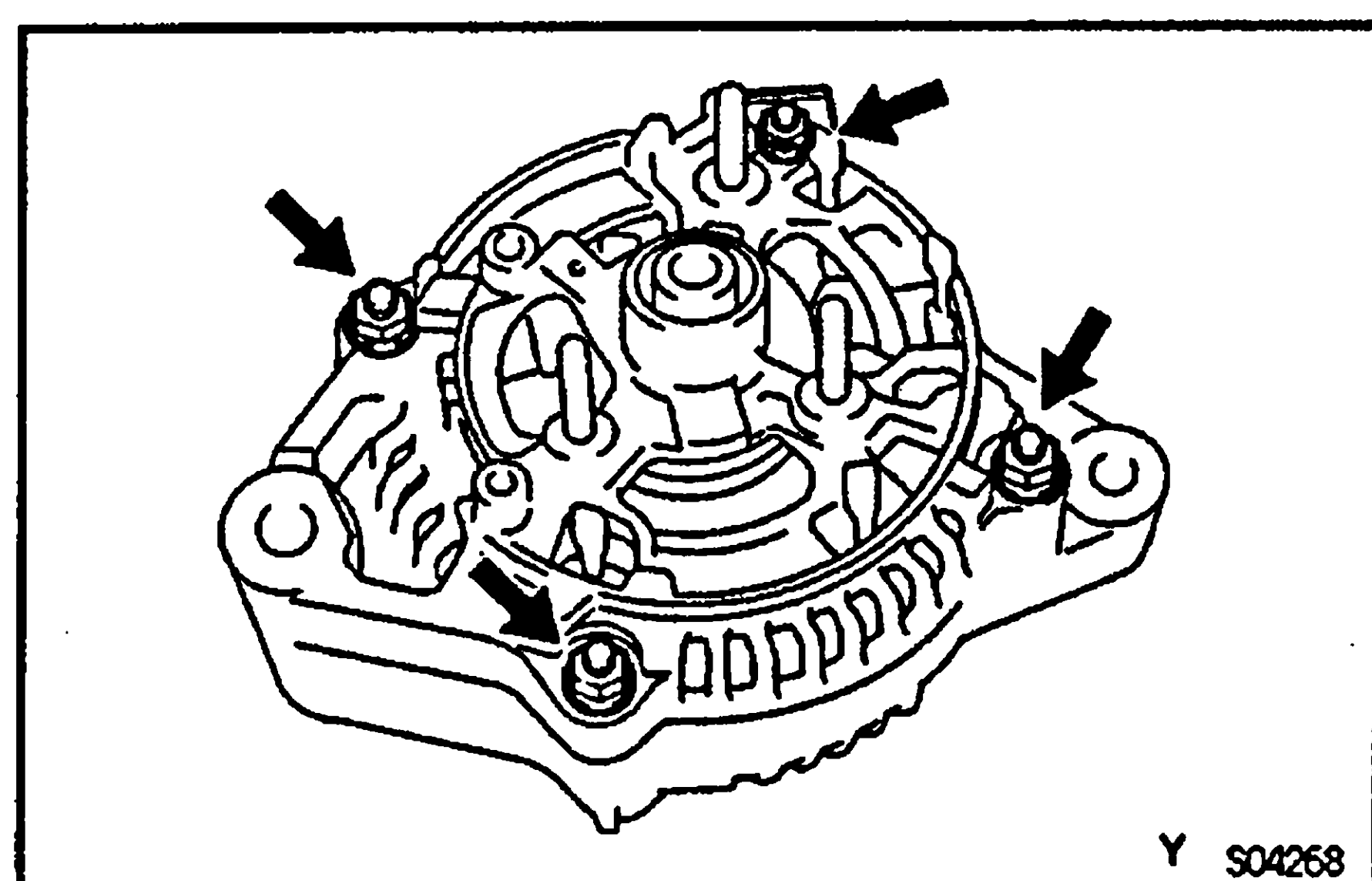


3. INSTALL RECTIFIER END FRAME

- (a) Place the alternator washer on the rotor.



- (b) Using a 30 mm socket wrench and press, slowly press in the rectifier end frame.



- (c) Install the 4 nuts and cord clip.

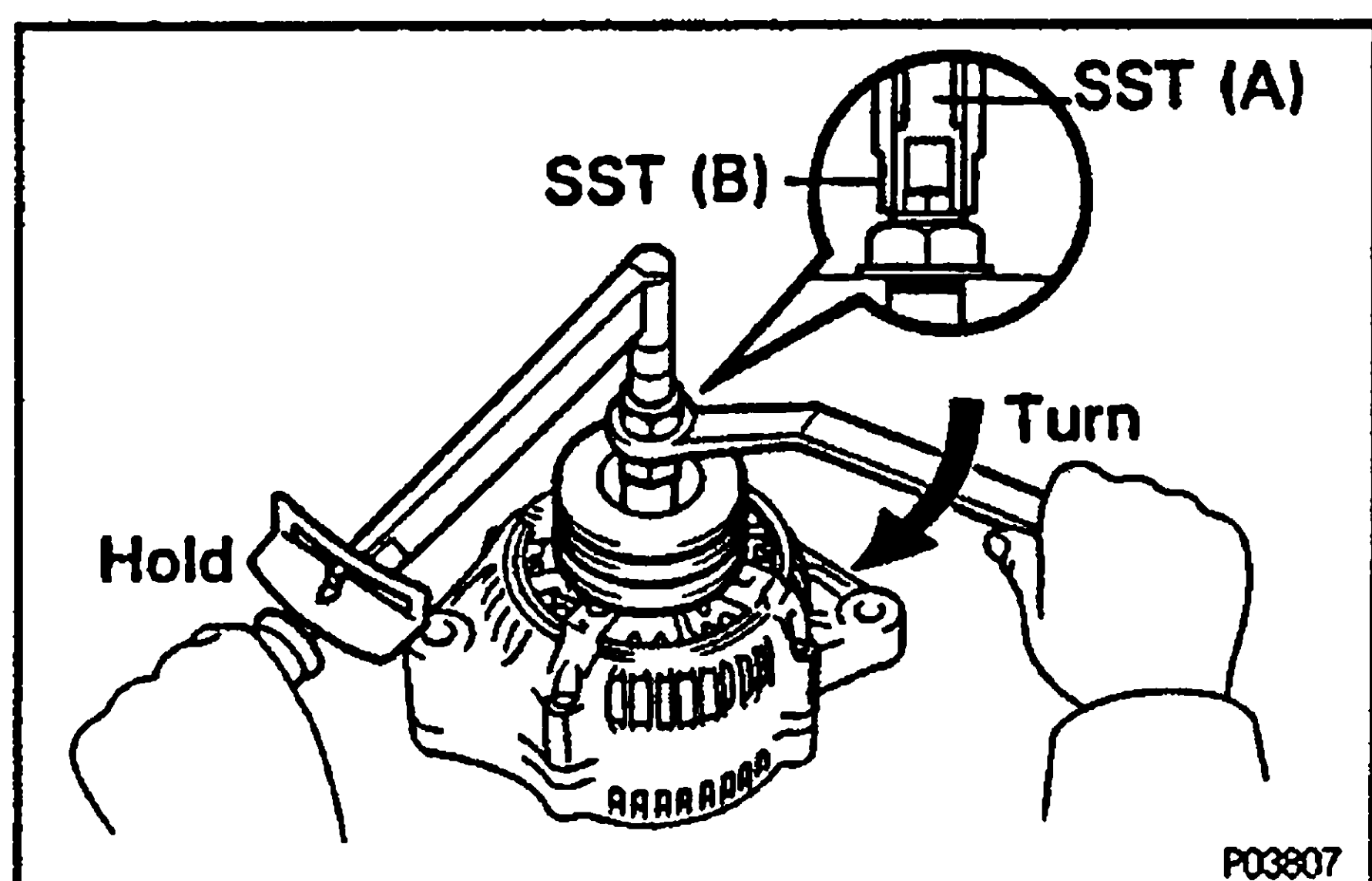
Torque:

Nut:

4.5 N·m (46 kgf·cm, 40 in·lbf)

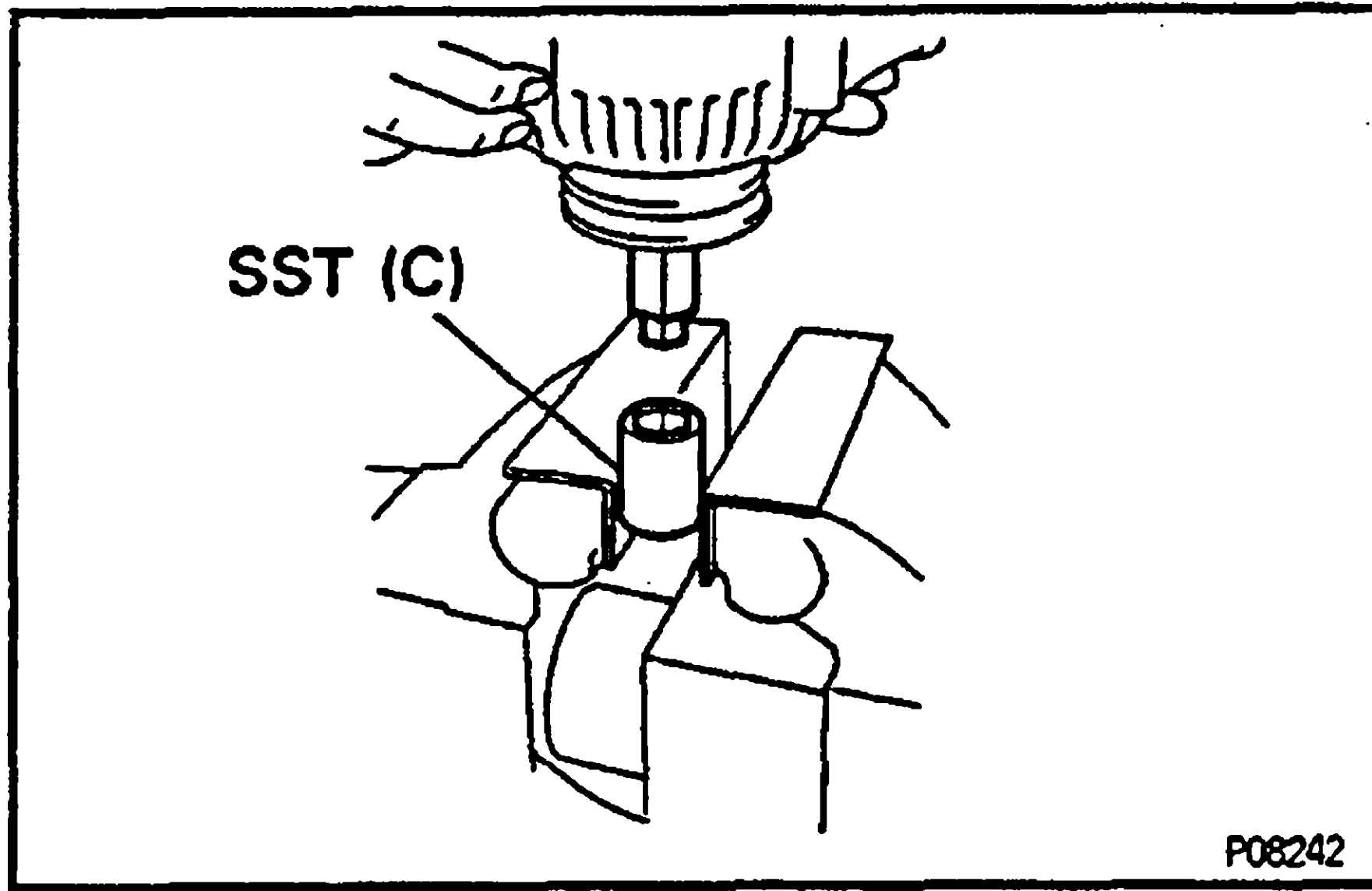
Nut with cord clip:

5.4 N·m (55 kgf·cm, 47 in·lbf)

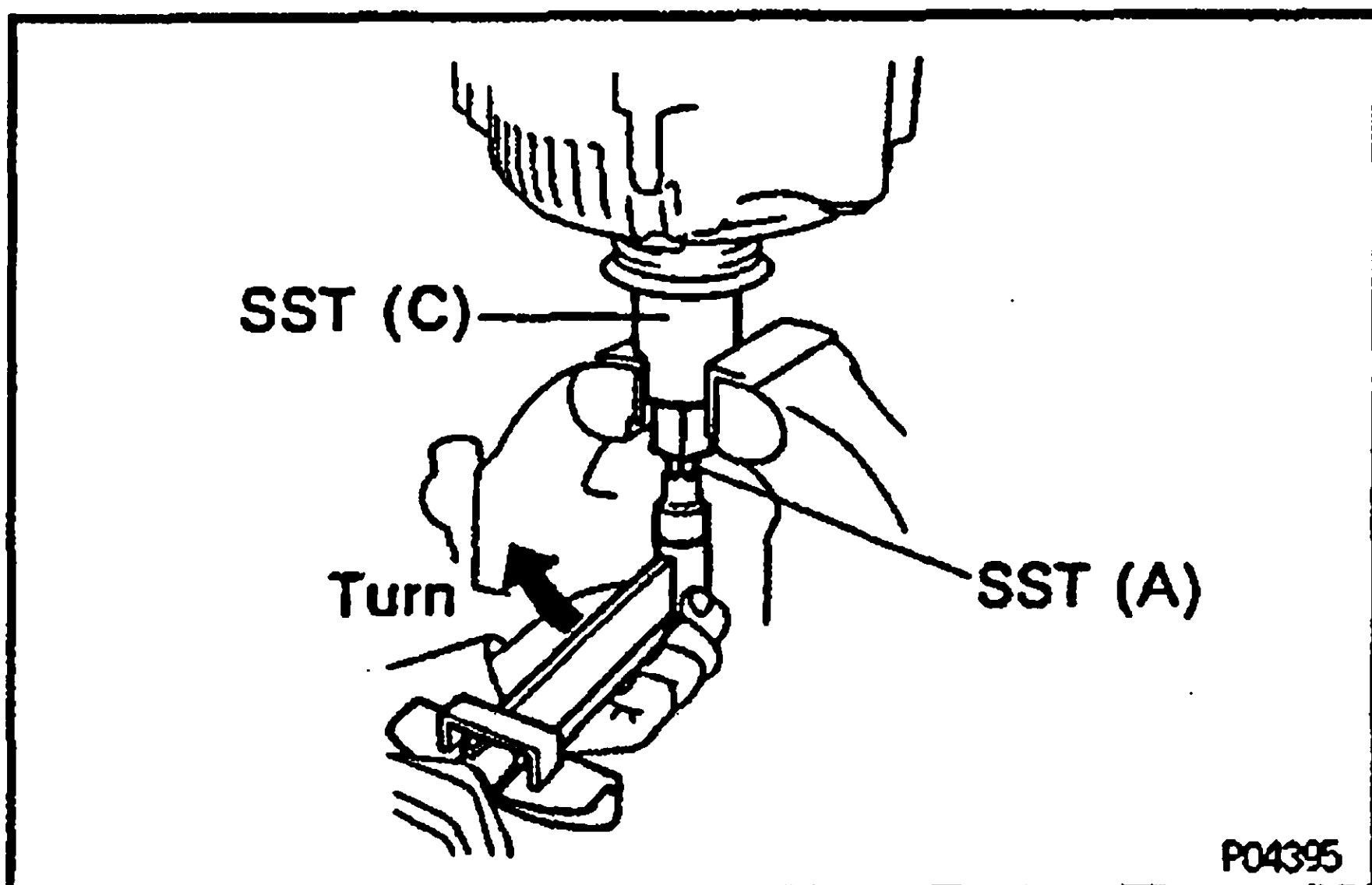


4. INSTALL PULLEY

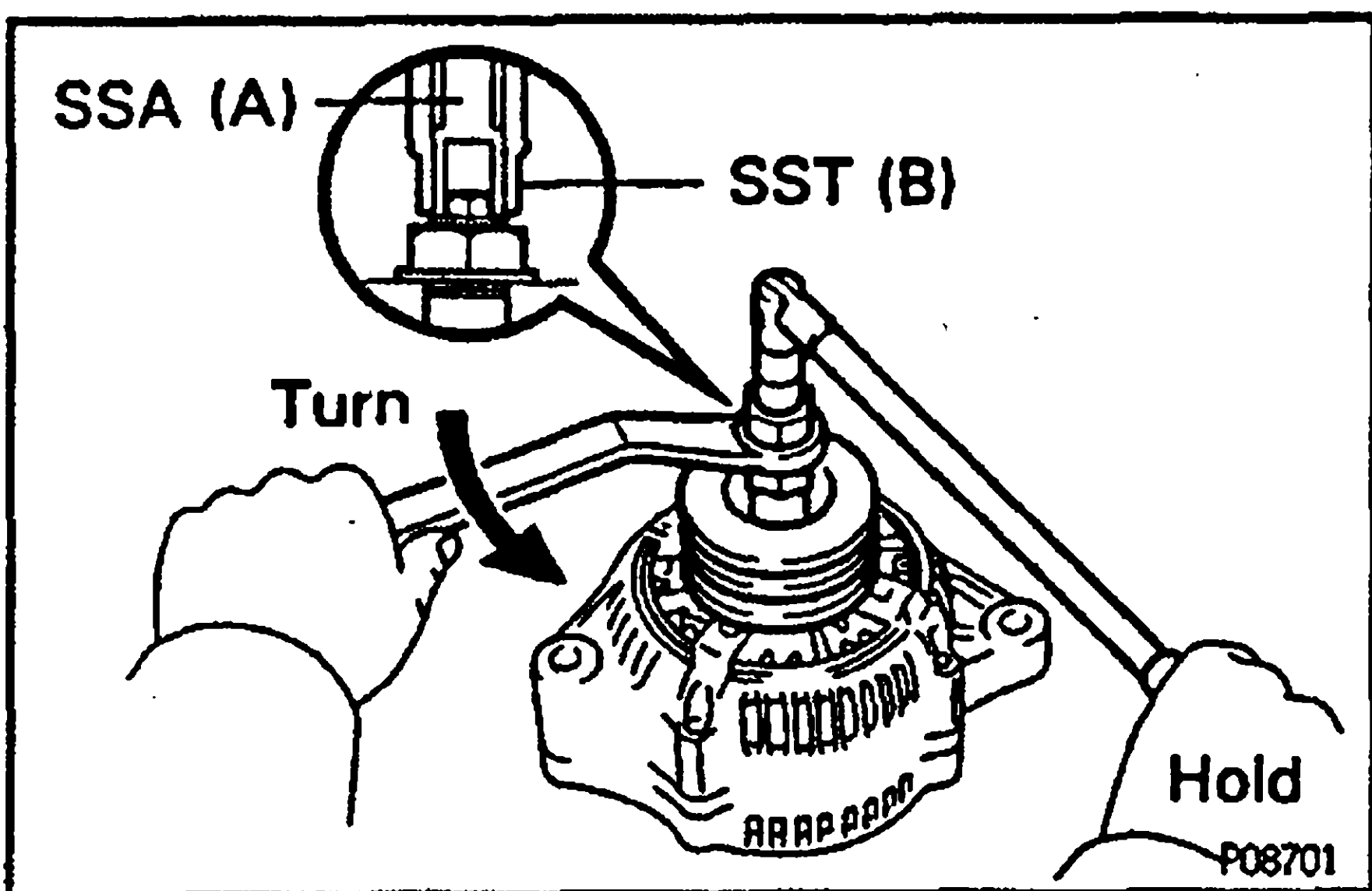
- (a) Install the pulley to the rotor shaft by tightening the pulley nut by hand.
- (b) Hold SST (A) with a torque wrench, and tighten SST (B) clockwise to the specified torque.
SST 09820-63010 (09820-06010)
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)
- (c) Check that SST (A) is secured to the pulley shaft.



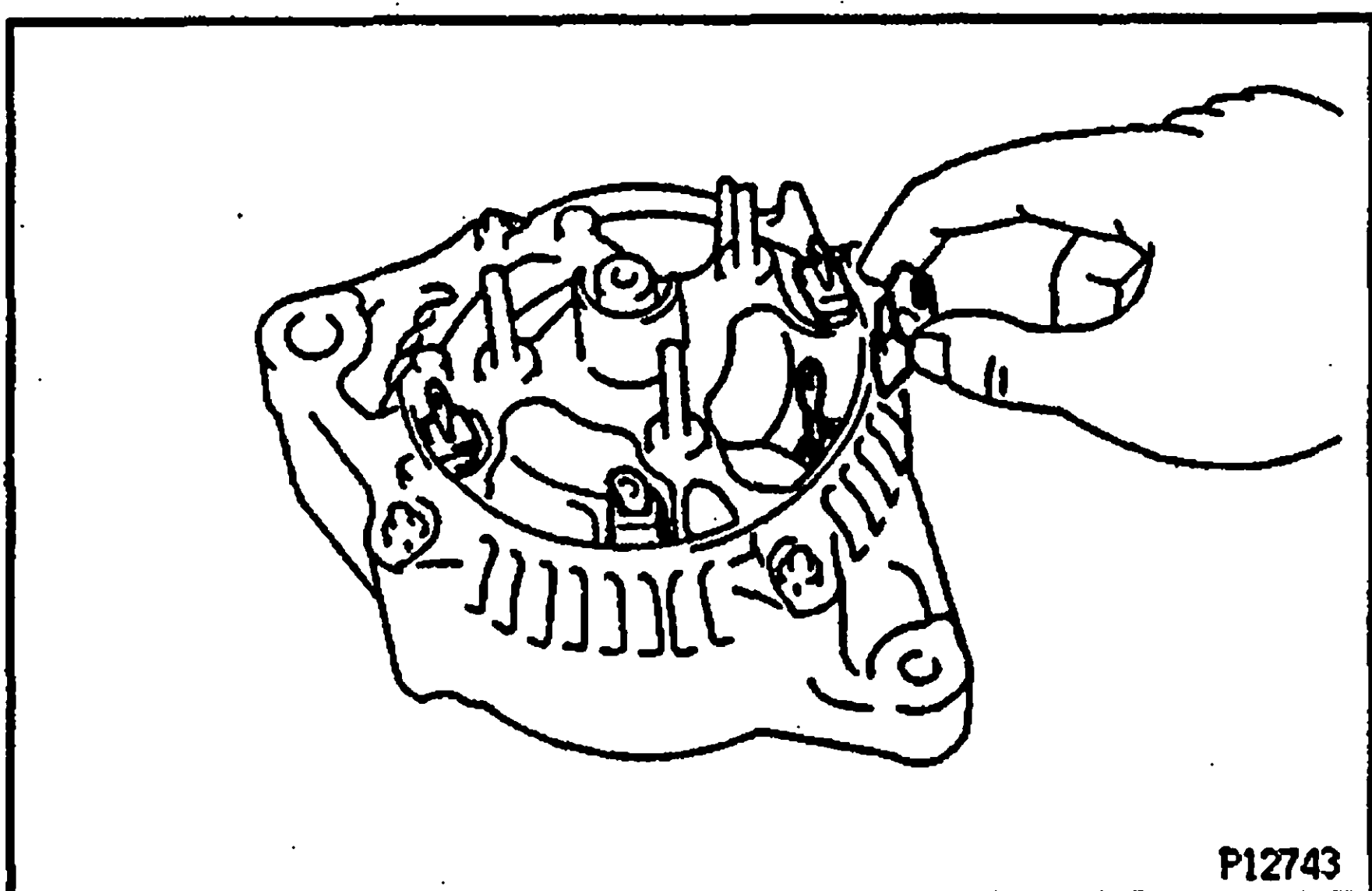
- (d) Mount SST (C) in a vise.
SST 09820-06021
- (e) Install the pulley nut to SST (C).



- (f) To torque the pulley nut turn SST (A) in the direction shown in the illustration.
Torque: 110.5 N·m (1,128 kgf·cm, 81 ft·lbf)
- (g) Remove the alternator from SST (C).

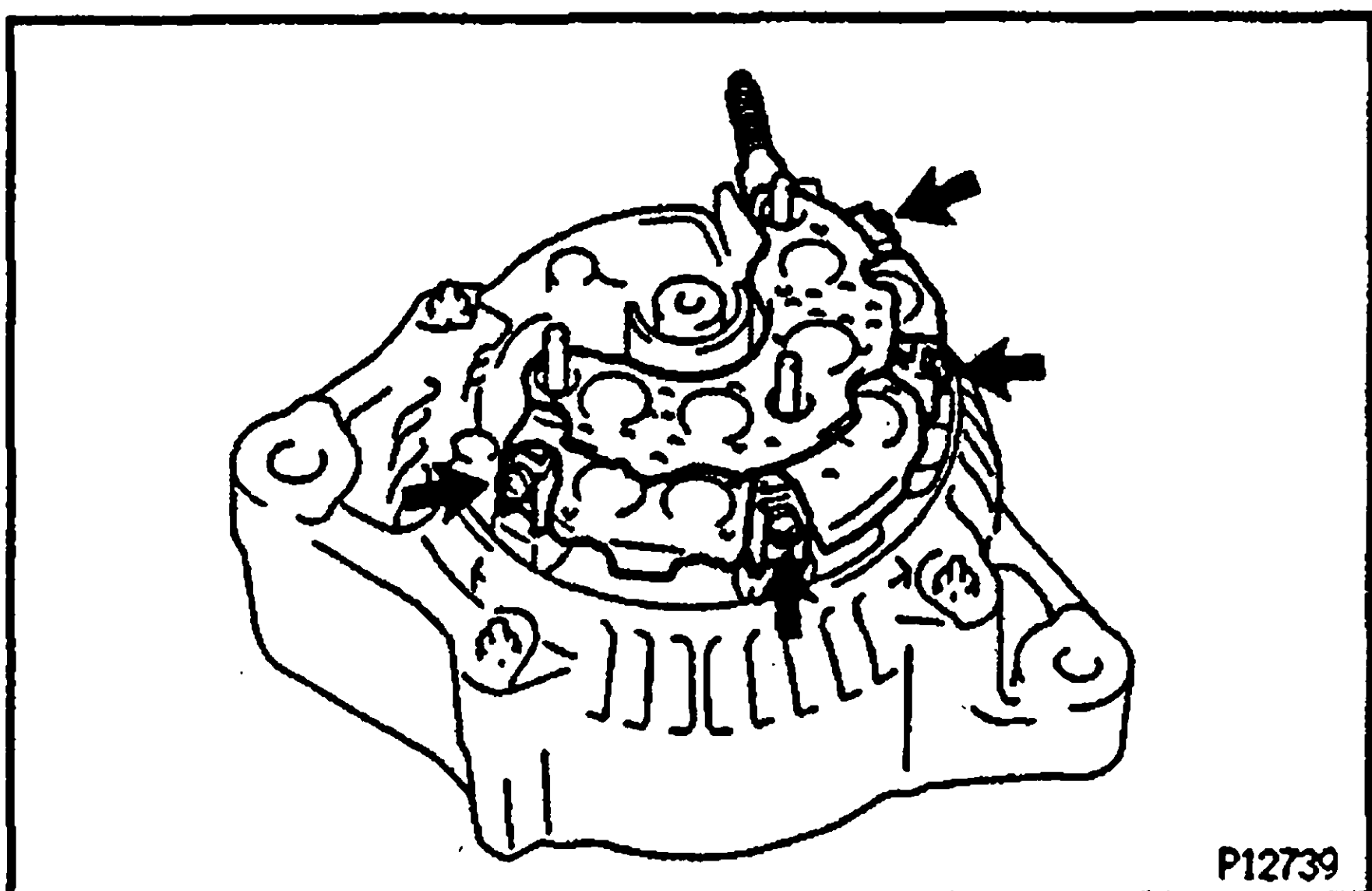


- (h) Turn SST (B) and remove SST (A and B).

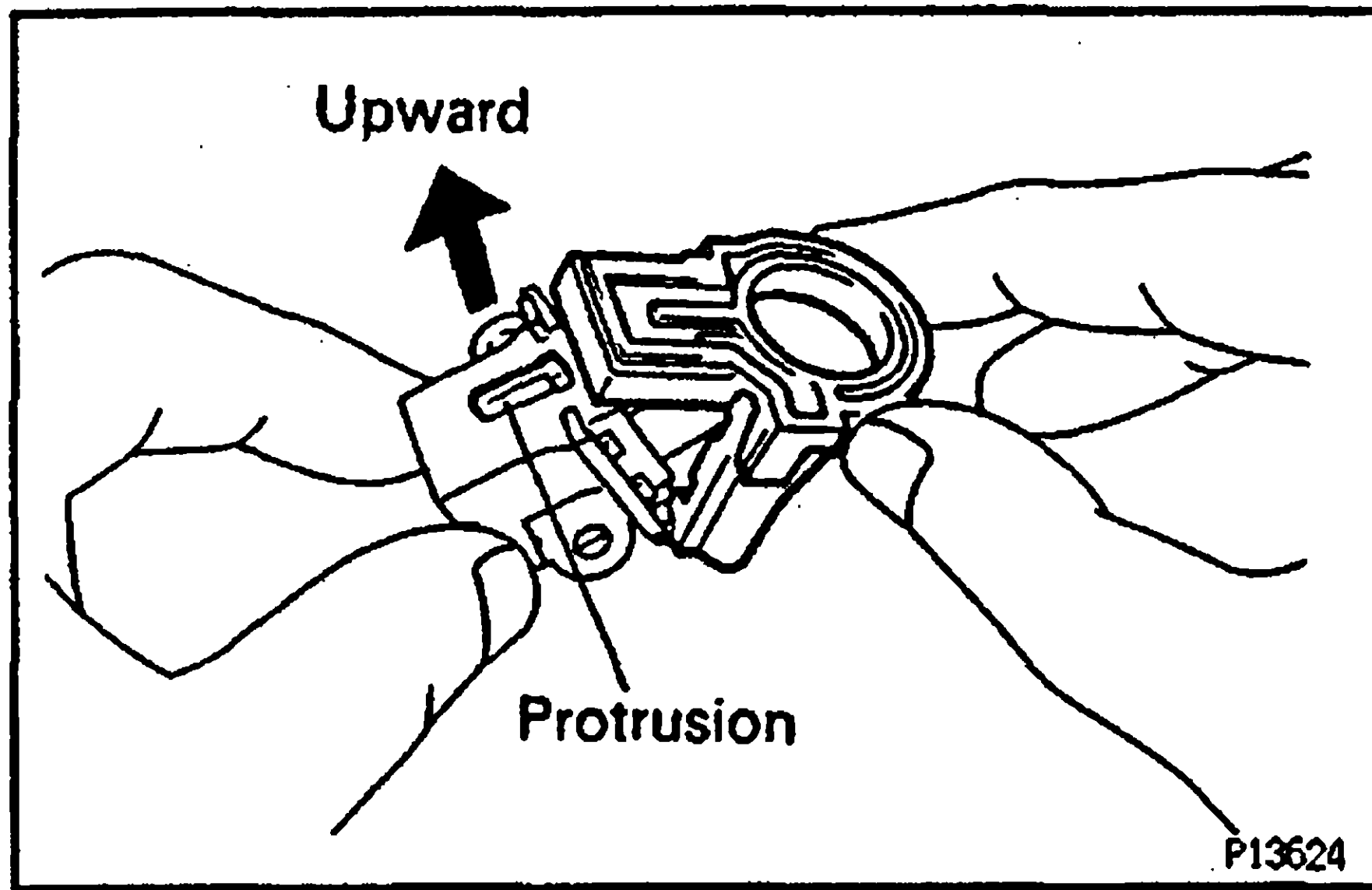


5. INSTALL RECTIFIER HOLDER

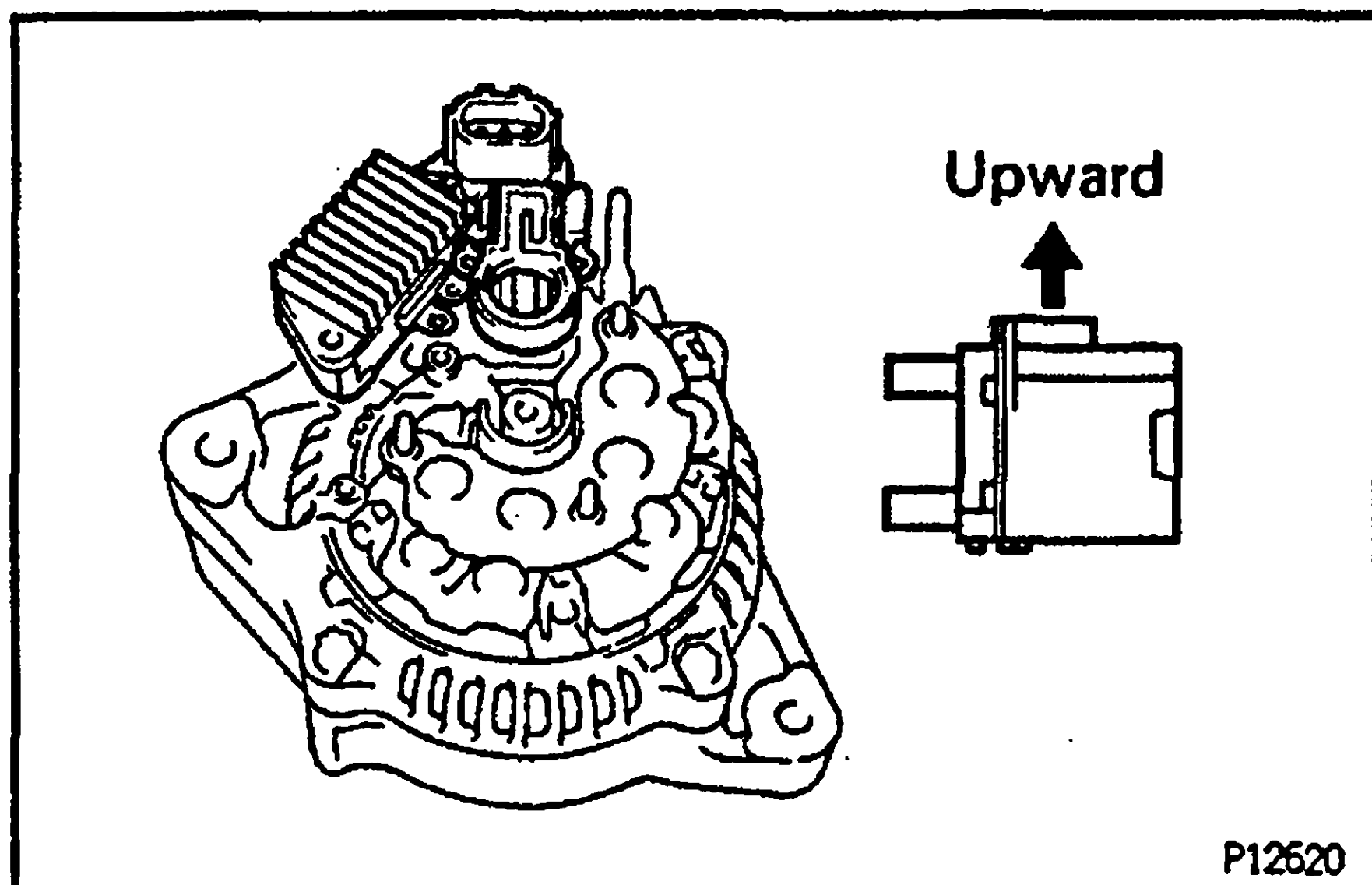
- (a) Install the 4 rubber insulators on the lead wires.



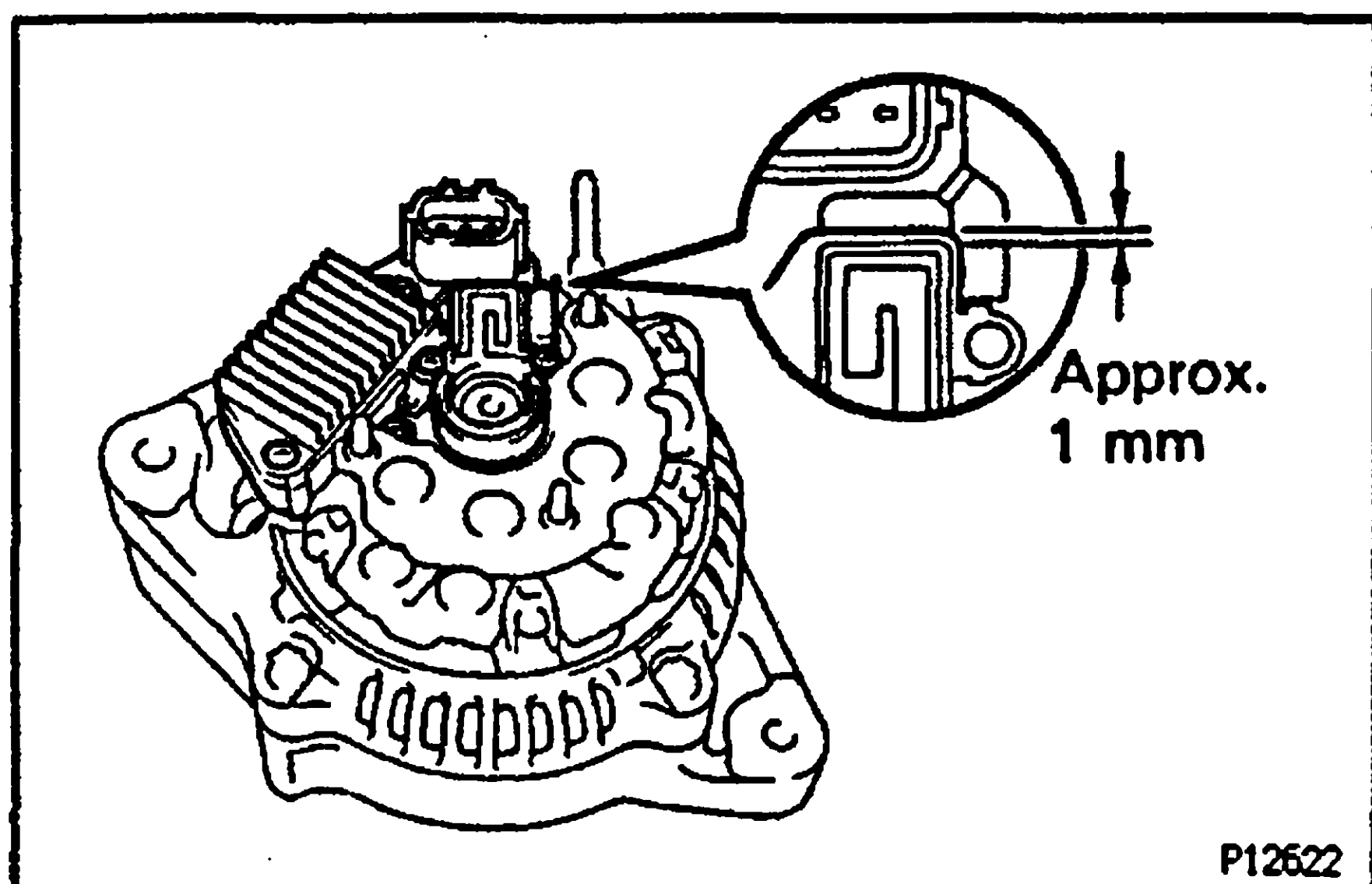
- (b) Install the rectifier holder while pushing it with the 4 screws.
Torque: 1.96 N·m (20 kgf·cm, 17 in·lbf)



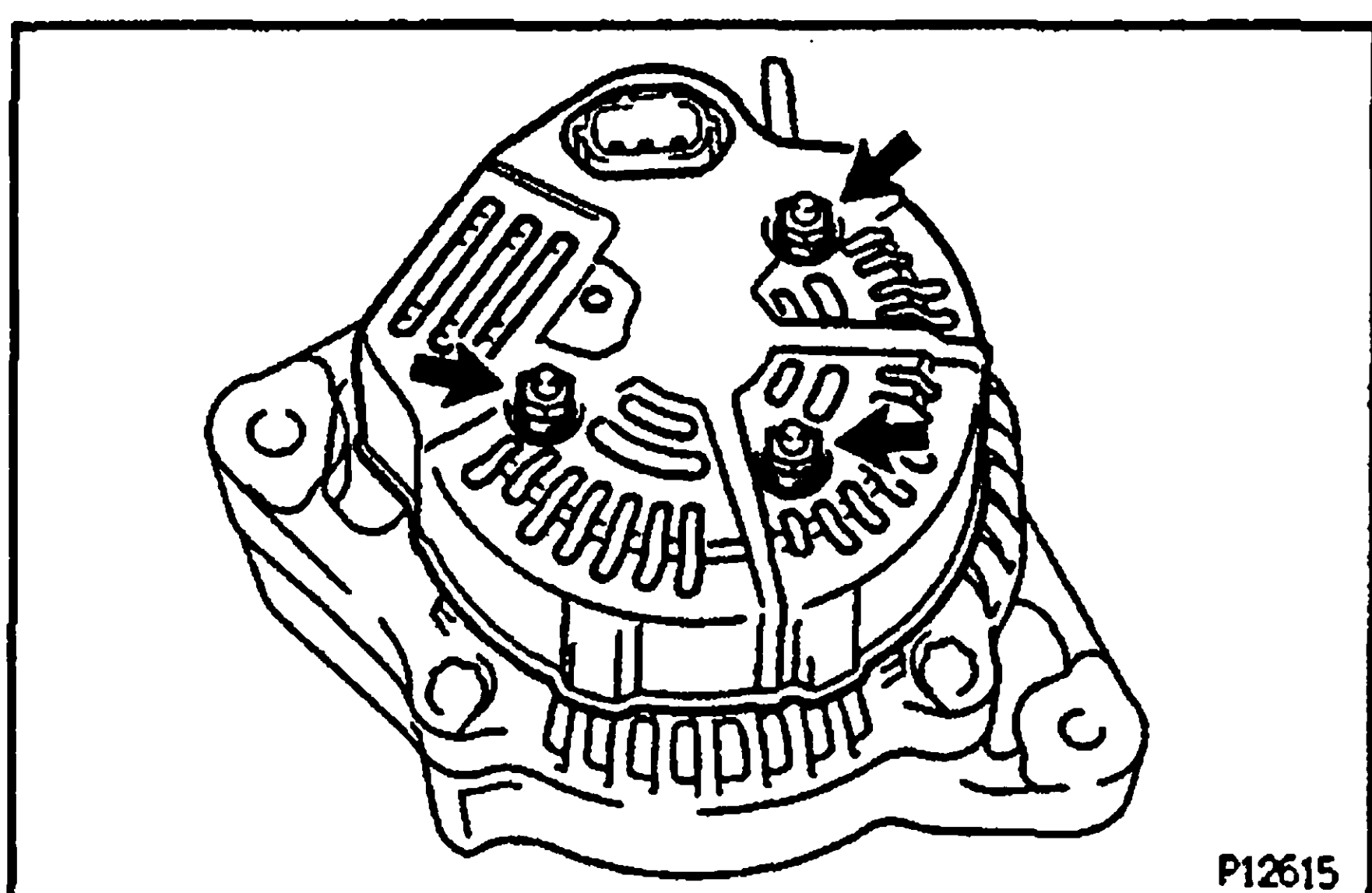
- 6. INSTALL IC REGULATOR AND BRUSH HOLDER**
- (a) Install the brush holder cover to the brush holder.
NOTICE: Be careful of the holder installation direction.



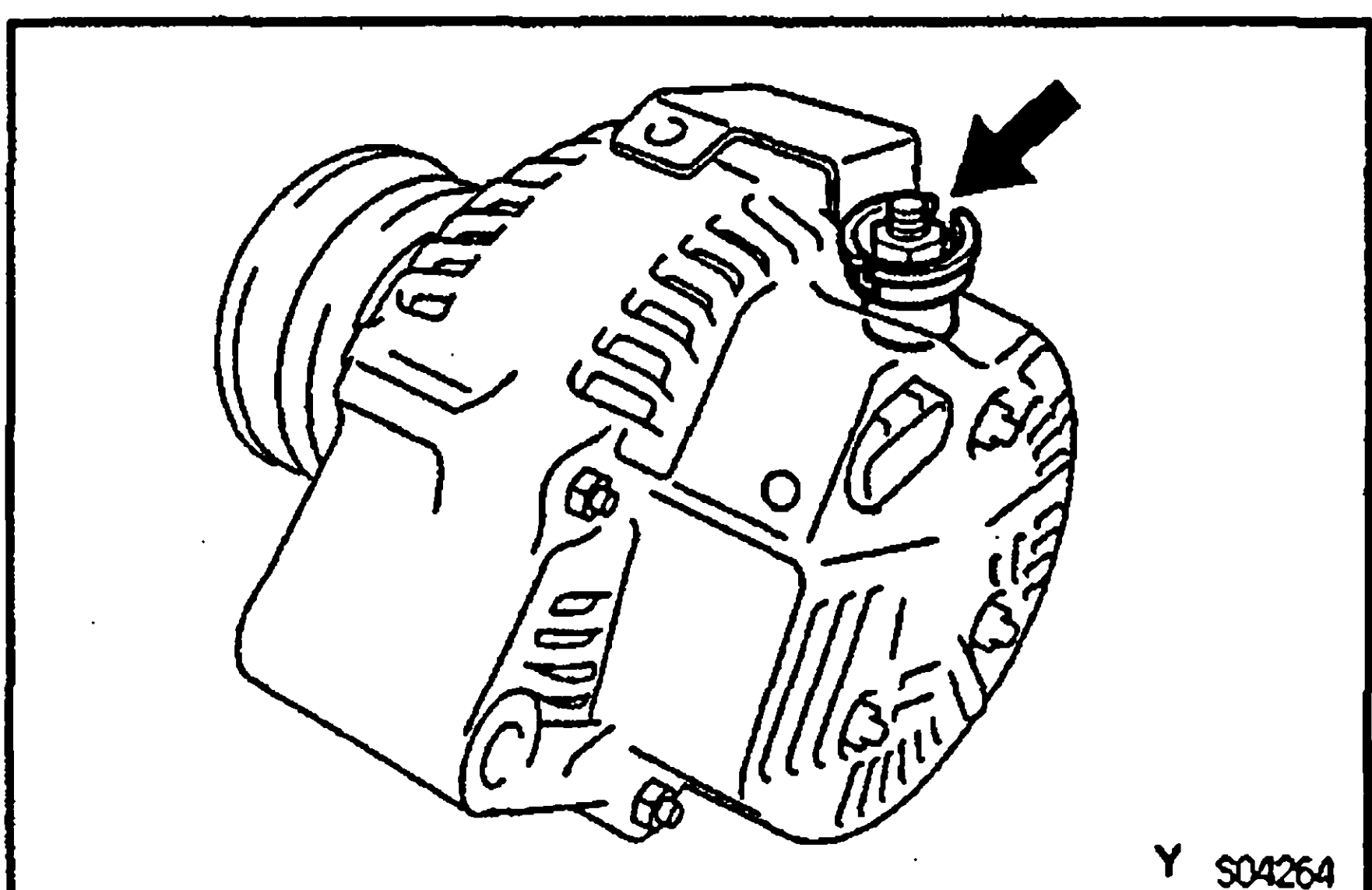
- (b) Place the IC regulator together with the brush holder horizontally on the rectifier end frame.



- (c) Install the 5 screws until there is a clearance of approx. 1 mm (0.04 in.) between the brush holder and connector.
Torque: 1.96 N·m (20 kgf·cm, 17 in·lbf)
- (d) Fit the brush holder cover.



- 7. INSTALL REAR END COVER**
- (a) Install the end cover with the 3 nuts.
Torque: 4.4 N·m (45 kgf·cm, 39 in·lbf)



- (b) Install the terminal insulator with the nut.
Torque: 4.1 N·m (42 kgf·cm, 36 in·lbf)

8. CHECK THAT ROTOR ROTATES SMOOTHLY

SERVICE SPECIFICATIONS

SERVICE DATA

CH01A-18

Battery	Specific gravity (When fully charge at 20°C (68°F))	1.25 — 1.29
Drive belt	Deflection	New belt 6 — 8 mm (0.24 — 0.31 in.) Used belt 8 — 12 mm (0.31 — 0.47 in.)
	Reference	
	Tension	New belt 400 — 600 N (41 — 61 kgf, 90 — 134 lbf) Used belt 300 — 500 N (31 — 51 kgf, 68 — 112 lbf)
Alternator	Rated output	12 V — 60 A, 70 A
	Rotor coil resistance	2.7 — 3.1 Ω
	Slip ring diameter	STD 14.2 mm — 14.4 mm (0.559 — 0.567 in.)
		Minimum 12.8 mm (0.504 in.)
	Brush exposed length	STD 10.5 mm (0.413 in.) Minimum 1.5 mm (0.059 in.)
IC regulator	Regulating voltage	12.6 — 14.6 V

CH

TORQUE SPECIFICATIONS

CH01C-18

Part tightened	N·m	kgf·cm	ft·lbf
Bearing retainer x Drive end frame	2.6	26.5	23 in·lbf
Rectifier end frame x Drive end frame	Nut	4.5	40 in·lbf
	Nut with cord clip	5.4	47 in·lbf
Alternator pulley x Rotor	110.5	1,128	81
Rectifier end frame x Brush holder, IC regulator	1.96	20	17 in·lbf
Rectifier holder x Coil lead on rectifier end frame	1.96	20	17 in·lbf
Rear end cover x Rectifier holder	4.4	45	39 in·lbf
Terminal insulator x Rectifier holder	4.1	42	36 in·lbf