HOW TO USE THIS MANUAL

010B2–24

GENERAL INFORMATION

1. GENERAL DESCRIPTION

(a) This manual is made in accordance with SAE J2008.

(b) Generally repair operations can be separated in the following 3 main processes:
1. Diagnosis
2. Removing and Installing, Replacing, Disassembling, Installing and Checking, Adjusting
3. Final Inspection

(c) This manual explains ”Removing and Installing, Replacing, Disassembling, Installing and Checking, Adjusting”, but ”Final Inspection” is omitted.

(d) The following essential operations are not written in this manual, however these operations must be done in the practical situation.
(1) Operation with a jack or lift
(2) Cleaning of a removed part when necessary
(3) Visual check

2. INDEX

(a) An alphabetical INDEX is provided as a section on the end of the book to guide you to the item to be repaired.

3. PREPARATION

(a) Use of special service tools (SST) and special service materials (SSM) may be required, depending on the repairing condition. Be sure to use SST and SSM when they are required and follow the working procedure properly. A list of SST and SSM is in the Preparation section of this manual.

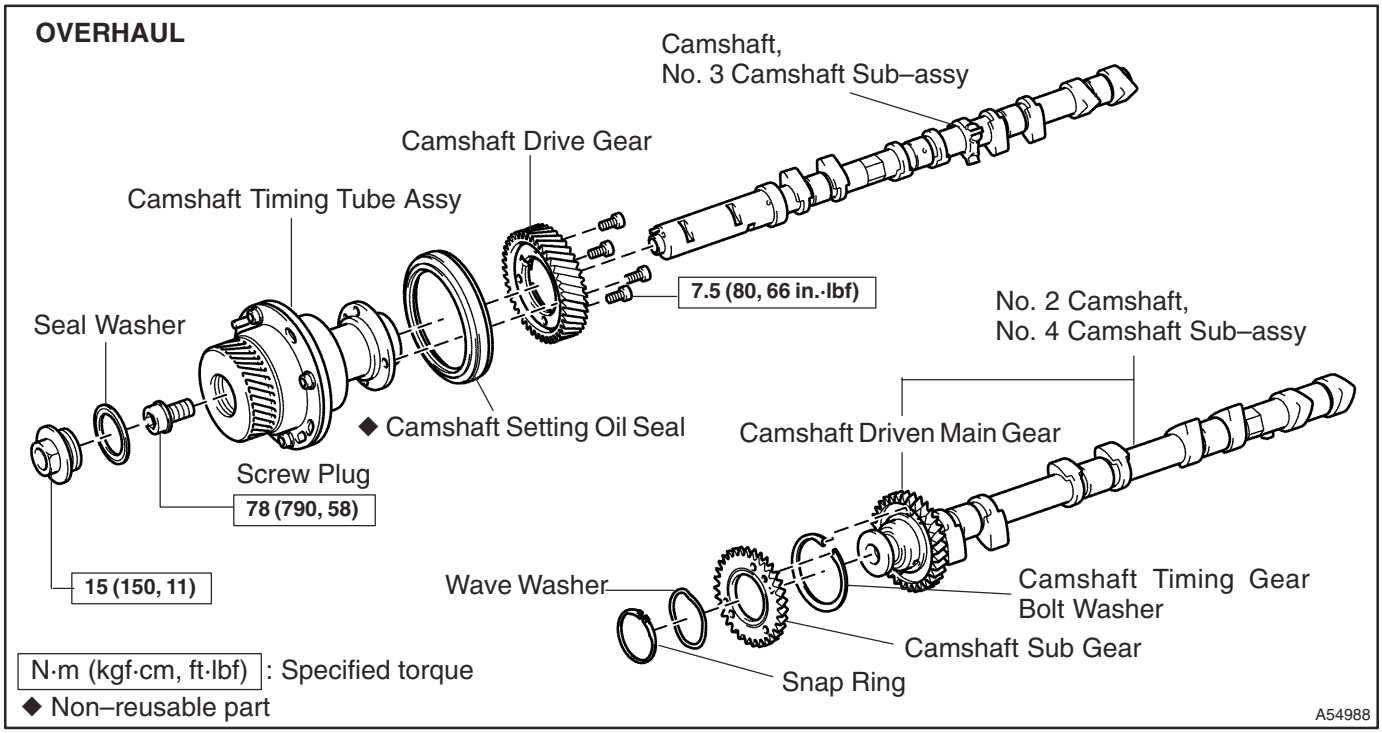
4. REPAIR PROCEDURES

(a) Component drawing is placed as the section or title when necessary.

(b) Illustrations of the parts catalog are placed as the ”disassembled parts drawing” so that it enables you to understand the fitting condition of the components.

(c) Non–reusable parts, grease applied parts, precoated parts and tightening torque are specified in the components drawing.

Example:



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(d) Tightening torque, oil applying position, and non–reusable parts are described as important points in the procedure.

NOTICE:

There are cases where such information can only be indicated by an illustration. In that case, all the information such as torque, oil, etc. are described in the illustration.

(e) Installing procedure of operation items is performed in the reverse order of the removing, and only the important points are described.

(f) Only items with points are described in the procedure, and the operational portion and content are placed using an illustration. In the explanations, details of the operational method, standard value and notice are placed.

(g) There may be a case where the illustrations of similar models are used. In that case the details may be different from the actual vehicle.

(h) The procedures are presented in a step–by–step format:

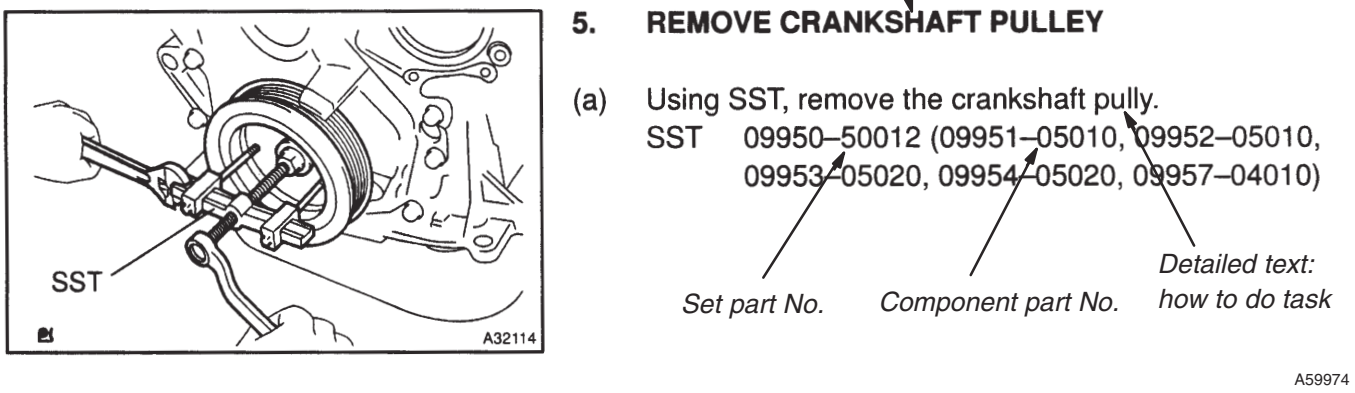
(1) The illustration shows what to do and where to do it.

(2) The task heading tells what to do.

(3) The detailed text tells how to perform the task and gives other information such as specifications and warnings.

Example:

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HINT:

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

5. SERVICE SPECIFICATIONS

(a) Specifications are presented in bold type throughout the manual. You never have to leave the procedure to look up your specifications. The specifications are also found in the Service Specifications section for a quick reference.

6. TERMS DEFINITION

CAUTION	Indicate the possibility of injury to you or other people.
NOTICE	Indicate the possibility of damage to the components being repaired.
HINT	Provide additional information to help you perform the repair efficiently.

7. SI UNIT

(a) The UNITS given in this manual are primarily expressed according to the SI UNIT (International System of Unit), and alternately expressed in the metric system and in the English System.

Example:

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

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REPAIR INSTRUCTION

010X0–01

PRECAUTION

1. TO PREVENT FROM ENTERING FOREIGN SUBSTANCES

(a) When foreign substances such as dust, grain of sand or metallic dust enter inside of engine, it often causes functional failure of the engine.
  (1) Precaution before disassembly.
    • Remove adequately all sand and mud adhere to the outside of engine .
  (2) Precaution at reassembly.
    • Protect disassembled parts from dust by using vinyl sheet to cover.

2. TO PREVENT SCRATCHES ON THE PARTS

(a) The existence of scratches on the contact and revolving surfaces often causes oil leak and seisure.
  (1) Precautions at disassembly and reassembly.
    • When disassemble the contact surface of the parts, use plastic hummer striking lightly. (Do not pry out by screwdriver).
    • When fix the parts to the vise, do not directly catch it in the vise. Fix the parts through aluminum bar.

3. TO CLEAN AND WASH THE PARTS

(a) Each parts needs to be well cleaned, washed, and dried by air, and apply specified oil before reassembly.
  (1) Cleaning and washing by alkaline solvent is prohibited:
    • Parts made of aluminum and rubber. (ex. cylinder head cover gasket etc.)
  (2) Cleaning and washing by flushing oil (ex. kerosene, white gasoline etc.) is prohibited:
    • Parts made of rubber. (ex. cylinder head cover gasket etc.)

4. POSITION AND DIRECTION OF EACH PARTS

(a) Each parts needs to be reassembled as the same position and direction as it disassembled.
  (1) Precautions at disassembly and reassembly.
    • Follow the directions when the manual designates to mark the matchmark and/or direction mark.
    • Disassembled parts needs to be put in order as disassembled, not to change position and/or direction.
    • Follow the directions when the manual instructs the position and direction.

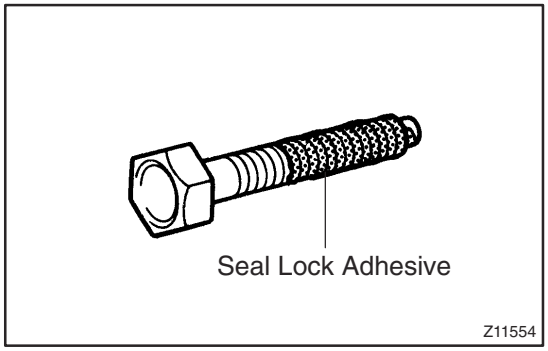
5. INSTALL ENGINE ASSEMBLY TO OVERHAUL STAND WHEN OVERHAUL THE ENGINE

6. PUT THE DISASSEMBLED PARTS IN ORDER AS THEY DISASSEMBLED

7. APPLY ENGINE OIL TO THE SLIDING AND ROTATING SURFACES

8. NON–REUSABLE PARTS SUCH AS GASKET AND SEAL NEEDS TO BE CHANGED TO THE NEW PARTS

9. BASIC REPAIR HINT



(a) Precoated Parts:
  (1) Precoated parts are bolts, nuts, etc. that are coated with a seal lock adhesive at the factory.
  (2) If a precoated part is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.
  (3) 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.

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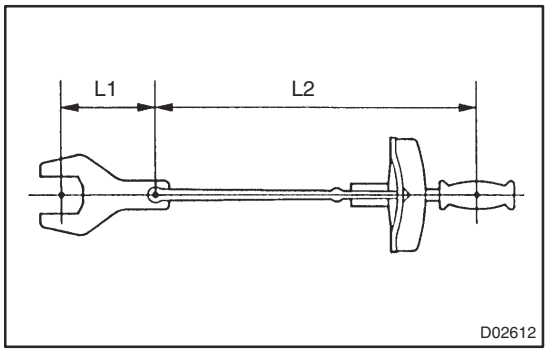
NOTICE:

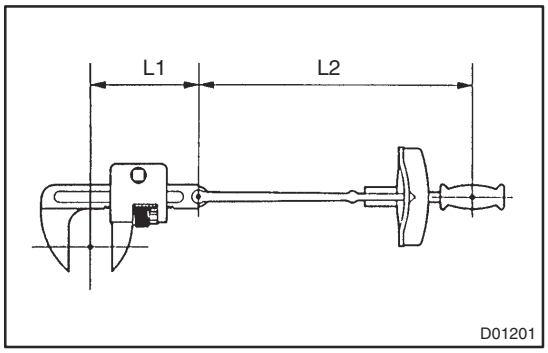
Do the torque checking with the lower limit value of the torque tolerance.

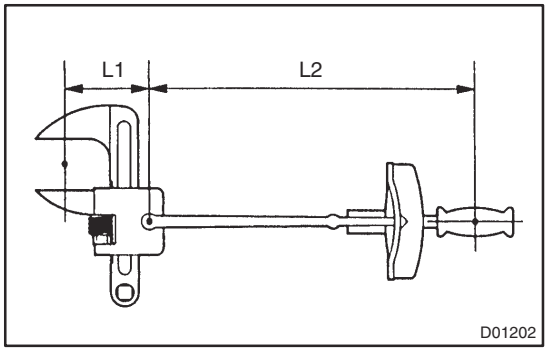
(4) Depending on the seal lock agent to apply, there may be a case where it is necessary to leave it for a specified time until it hardens.

(b) Gaskets:
When necessary, use a sealer on gaskets to prevent leaks.

(c) Bolts, Nuts and Screws:
Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.







(d) Torque When Using Extension Tool with Torque Wrench:

(1) In case of tightening by extending the entire length of the torque wrench combined with SST or tool, if you tighten until the reading of the torque wrench reached the specified torque value, the actual torque becomes excessive.

(2) In this text, only the specified torque is described. In case of using SST or extension tool, find the reading of the torque wrench by the formula.

(3) Formula T' = T x L2/(L1 + L2)

T'	Reading of torque wrench {N·m (kgf·cm, ft·lbf)}
T	Torque {N·m (kgf·cm, ft·lbf)}
L1	Length of SST or tool (cm)
L2	Length of torque wrench (cm)

10. REMOVAL AND INSTALLATION OF FUEL CONTROL PARTS

(a) Place for Removing and Installing Fuel System Parts:

(1) Place with good air ventilation and without anything flammable such as welder, grinder, drill, electric motor or stove in the surroundings.

(2) Never work in a place like a pit or nearby pit as there is a possibility that vaporized fuel fills those places.

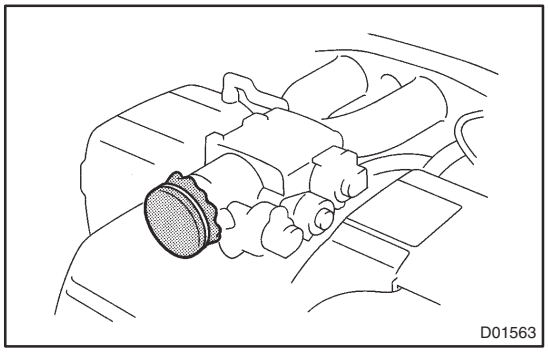
(b) Removing and Installing of Fuel System Parts:

(1) Prepare a fire extinguisher before starting the operation.

(2) For prevention of the static electricity, install a ground on the fuel changer, vehicle and fuel tank, and do not spray much water so as to prevent slipping.

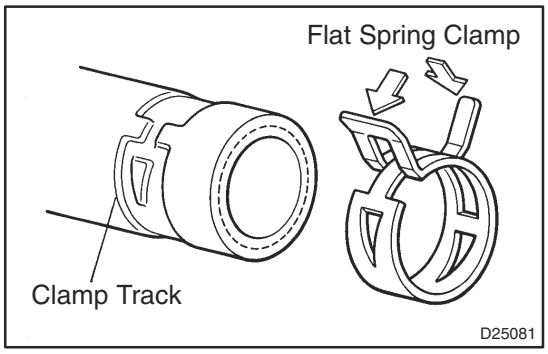
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(3) Never use any electric equipment like an electric motor or a working light as they may cause spark or high temperature.
(4) Never use an iron hammer as it may cause spark.
(5) Dispose the shop lag separately from any fuel deposit.



11. REMOVAL AND INSTALLATION OF ENGINE INTAKE PARTS

(a) If any metal tip is mixed in the inlet pass, that may give a bad effect to the engine and turbo charger.
(b) When removing and installing of the inlet system parts, close the opening of the removed inlet system parts and the engine with a clean shop lag or gum tape.
(c) When installing the inlet system parts, check that there is no mixing of a metal tip.



12. HANDLING OF HOSE CLAMPS

(a) Before removing the hose, check the depth of inserting portion and the clamp position to restore it surely.
(b) Change a deformed or dented into a new one.
(c) In case of reusing the hose, install the clamp on the hose where it has a clamp track.
(d) For a flat spring type clamp, make it adjust by adding force to the arrow mark direction after the installation.

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TERMS

ABBREVIATIONS USED IN THIS MANUAL

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Abbreviations	Meaning
ABS	Anti–Lock Brake System
A/C	Air Conditioner
AC	Alternating Current
ACC	Accessory
ACIS	Acoustic Control Induction System
ACSD	Automatic Cold Start Device
A.D.D.	Automatic Disconnecting Differential
A/F	Air–Fuel Ratio
AHC	Active Height Control Suspension
ALR	Automatic Locking Retractor
ALT	Alternator
AMP	Amplifier
ANT	Antenna
Approx.	Approximately
ASSY	Assembly
A/T, ATM	Automatic Transmission (Transaxle)
ATF	Automatic Transmission Fluid
AUTO	Automatic
AUX	Auxiliary
AVG	Average
AVS	Adaptive Variable Suspension
B+	Battery Voltage
BA	Brake Assist
BACS	Boost Altitude Compensation System
BAT	Battery
BDC	Bottom Dead Center
B/L	Bi–Level
B/S	Bore–Stroke Ratio
BTDC	Before Top Dead Center
BVSV	Bimetallic Vacuum Switching Valve
CAN	Controller Area Network
CB	Circuit Breaker
CCo	Catalytic Converter For Oxidation
CD	Compact Disc
CF	Cornering Force
CG	Center Of Gravity
CH	Channel
CKD	Complete Knock Down
COMB.	Combination
CPE	Coupe
CPS	Combustion Pressure Sensor
CPU	Central Processing Unit
CRS	Child Restraint System
CTR	Center
C/V	Check Valve
CV	Control Valve
CW	Curb Weight
DC	Direct Current

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Abbreviations	Meaning
DEF	Defogger
DFL	Deflector
DIFF.	Differential
DIFF. LOCK	Differential Lock
D/INJ	Direct Injection
DLC	Data Link Connector
DLI	Distributorless Ignition
DOHC	Double Overhead Camshaft
DP	Dash Pot
DS	Dead Soak
DSP	Digital Signal Processor
DTC	Diagnostic Trouble Code
DVD	Digital Versatile Disc
EBD	Electric Brake Force Distribution
ECAM	Engine Control And Measurement System
ECD	Electronic Controlled Diesel
ECDY	Eddy Current Dynamometer
ECT	Electronic Control Transmission
ECU	Electronic Control Unit
ED	Electro–DepositedCoating
EDU	Electronic Driving Unit
EDIC	Electric Diesel Injection Control
EFI	Electronic Fuel Injection
E/G	Engine
EGR	Exhaust Gas Recirculation
EGR–VM	EGR–Vacuum Modulator
ELR	Emergency Locking Retractor
EMPS	Electric Motor Power Steering
ENG	Engine
ESA	Electronic Spark Advance
ETCS–i	Electronic Throttle Control System–intelligent
EVAP	Evaporative Emission Control
EVP	Evaporator
E–VRV	Electric Vacuum Regulating Valve
EX	Exhaust
FE	Fuel Economy
FF	Front–EngineFront–Wheel–Drive
F/G	Fuel Gauge
FIPG	Formed In Place Gasket
FL	Fusible Link
F/P	Fuel Pump
FPU	Fuel Pressure Up
Fr	Front
F/W	Flywheel
FW/D	Flywheel Damper
FWD	Front–Wheel–Drive
GAS	Gasoline
GND	Ground
GPS	Global Positioning System
HAC	High Altitude Compensator
H/B	Hatchback

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Abbreviations	Meaning
H–FUSE	High Current Fuse
HI	High
HID	High Intensity Discharge (Head Lamp)
HSG	Housing
HT	Hard Top
HWS	Heated Windshield System
IC	Integrated Circuit
IDI	Indirect Diesel Injection
IFS	Independent Front Suspension
IG	Ignition
IIA	Integrated Ignition Assembly
IN	Intake (Manifold, Valve)
INT	Intermittent
I/P	Instrument Panel
IRS	Independent Rear Suspension
ISC	Idle Speed Control
J/B	Junction Block
J/C	Junction Connector
KD	Kick–Down
LAN	Local Area Network
LB	Liftback
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left–Hand
LHD	Left–Hand Drive
L/H/W	Length, Height, Width
LLC	Long–Life Coolant
LNG	Liquified Natural Gas
LO	Low
LPG	Liquified Petroleum Gas
LSD	Limited Slip Differential
LSP & PV	Load Sensing Proportioning And Bypass Valve
LSPV	Load Sensing Proportioning Valve
MAP	Manifold Absolute Pressure
MAX.	Maximum
MIC	Microphone
MIL	Malfunction Indicator Lamp
MIN.	Minimum
MG1	Motor Generator No.1
MG2	Motor Generator No.2
MP	Multipurpose
MPI	Multipoint Electronic Injection
MPX	Multiplex Communication System
M/T, MTM	Manual Transmission (Transaxle)
MT	Mount
MTG	Mounting
N	Neutral
NA	Natural Aspiration
No.	Number
O2S	Oxygen Sensor
O/D	Overdrive

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Abbreviations	Meaning
OEM	Original Equipment Manufacturing
OHC	Overhead Camshaft
OHV	Overhead Valve
OPT	Option
ORVR	On–board Refilling Vapor Recovery
O/S	Oversize
P & BV	Proportioning And Bypass Valve
PCS	Power Control System
PCV	Positive Crankcase Ventilation
PKB	Parking Brake
PPS	Progressive Power Steering
PTC	Positive Temperature Coefficient
PS	Power Steering
PTO	Power Take–Off
P/W	Power Window
R & P	Rack And Pinion
RAM	Random Access Memory
R/B	Relay Block
RBS	Recirculating Ball Type Steering
R/F	Reinforcement
RFS	Rigid Front Suspension
RH	Right–Hand
RHD	Right–Hand Drive
RLY	Relay
ROM	Read Only Memory
Rr	Rear
RRS	Rigid Rear Suspension
RWD	Rear–Wheel Drive
SDN	Sedan
SEN	Sensor
SICS	Starting Injection Control System
SOC	State Of Charge
SOHC	Single Overhead Camshaft
SPEC	Specification
SPI	Single Point Injection
SRS	Supplemental Restraint System
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
STJ	Cold–Start Fuel Injection
SW	Switch
SYS	System
T/A	Transaxle
TACH	Tachometer
TBI	Throttle Body Electronic Fuel Injection
TC	Turbocharger
TCCS	TOYOTA Computer–Controlled System
TCV	Timing Control Valve
TDC	Top Dead Center
TEMP.	Temperature
TEMS	TOYOTA Electronic Modulated Suspension

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Abbreviations	Meaning
TFT	Toyota Free–Tronic
TIS	Total Information System For Vehicle Development
T/M	Transmission
TMC	TOYOTA Motor Corporation
TMMK	TOYOTA Motor Manufacturing Kentucky, Inc.
TRC	Traction Control System
TURBO	Turbocharge
TWC	Three–Way Catalyst
U/D	Underdrive
U/S	Undersize
VCV	Vacuum Control Valve
VENT	Ventilator
VIN	Vehicle Identification Number
VPS	Variable Power Steering
VSC	Vehicle Stability Control
VSV	Vacuum Switching Valve
VTV	Vacuum Transmitting Valve
VVT–i	Variable Valve Timing–intelligent
w/	With
WGN	Wagon
W/H	Wire Harness
w/o	Without
WU–TWC	Warm Up Three–way Catalytic Converter
WU–OC	Warm Up Oxidation Catalytic Converter
1st	First
2nd	Second
2WD	Two Wheel Drive Vehicle (4 x 2)
3rd	Third
4th	Fourth
4WD	Four Wheel Drive Vehicle (4 x 4)
4WS	Four Wheel Steering System
5th	Fifth

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GLOSSARY OF SAE AND TOYOTA TERMS

This glossary lists all SAE–J1930 terms and abbreviations used in this manual in compliance with SAE recommendations, as well as their TOYOTA equivalents.

SAE ABBREVIATIONS	SAE TERMS	TOYOTA TERMS ( )—ABBREVIATIONS
A/C	Air Conditioning	Air Conditioner
ACL	Air Cleaner	Air Cleaner, A/CL
AIR	Secondary Air Injection	Air Injection (AI)
AP	Accelerator Pedal	–
B+	Battery Positive Voltage	+B, Battery Voltage
BARO	Barometric Pressure	HAC
CAC	Charge Air Cooler	Intercooler
CARB	Carburetor	Carburetor
CFI	Continuous Fuel Injection	–
CKP	Crankshaft Position	Crank Angle
CL	Closed Loop	Closed Loop
CMP	Camshaft Position	Cam Angle
CPP	Clutch Pedal Position	–
CTOX	Continuous Trap Oxidizer	–
CTP	Closed Throttle Position	LL ON, Idle ON
DFI	Direct Fuel Injection (Diesel)	Direct Injection (DI/INJ)
DI	Distributor Ignition	–
DLC1 DLC2 DLC3	Data Link Connector 1 Data Link Connector 2 Data Link Connector 3	1: Check Connector 2: Total Diagnosis Communication Link (TDCL) 3: OBD II Diagnostic Connector
DTC	Diagnostic Trouble Code	Diagnostic Trouble Code
DTM	Diagnostic Test Mode	–
ECL	Engine Control Level	–
ECM	Engine Control Module	Engine ECU (Electronic Control Unit)
ECT	Engine Coolant Temperature	Coolant Temperature, Water Temperature (THW)
EEPROM	Electrically Erasable Programmable Read Only Memory	Electrically Erasable Programmable Read Only Memory (EEPROM), Erasable Programmable Read Only Memory (EPROM)
EFE	Early Fuel Evaporation	Cold Mixture Heater (CMH), Heat Control Valve (HCV)
EGR	Exhaust Gas Recirculation	Exhaust Gas Recirculation (EGR)
EI	Electronic Ignition	Distributorless Ignition (DLI)
EM	Engine Modification	Engine Modification (EM)
EPROM	Erasable Programmable Read Only Memory	Programmable Read Only Memory (PROM)
EVAP	Evaporative Emission	Evaporative Emission Control (EVAP)
FC	Fan Control	–
FEEPROM	Flash Electrically Erasable Programmable Read Only Memory	–
FEPROM	Flash Erasable Programmable Read Only Memory	–
FF	Flexible Fuel	–
FP	Fuel Pump	Fuel Pump
GEN	Generator	Alternator
GND	Ground	Ground (GND)

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HO2S	Heated Oxygen Sensor	Heated Oxygen Sensor (HO_2S)
IAC	Idle Air Control	Idle Speed Control (ISC)
IAT	Intake Air Temperature	Intake or Inlet Air Temperature
ICM	Ignition Control Module	–
IFI	Indirect Fuel Injection	Indirect Injection (IDL)
IFS	Inertia Fuel–Shutoff	–
ISC	Idle Speed Control	–
KS	Knock Sensor	Knock Sensor
MAF	Mass Air Flow	Air Flow Meter
MAP	Manifold Absolute Pressure	Manifold Pressure Intake Vacuum
MC	Mixture Control	Electric Bleed Air Control Valve (EBCV) Mixture Control Valve (MCV) Electric Air Control Valve (EACV)
MDP	Manifold Differential Pressure	–
MFI	Multiport Fuel Injection	Electronic Fuel Injection (EFI)
MIL	Malfunction Indicator Lamp	Check Engine Lamp
MST	Manifold Surface Temperature	–
MVZ	Manifold Vacuum Zone	–
NVRAM	Non–Volatile Random Access Memory	–
O2S	Oxygen Sensor	Oxygen Sensor, O_2 Sensor (O_2S)
OBD	On–Board Diagnostic	On–Board Diagnostic System (OBD)
OC	Oxidation Catalytic Converter	Oxidation Catalyst Convert (OC) Catalytic Converter for Oxidation (CCo)
OP	Open Loop	Open Loop
PAIR	Pulsed Secondary Air Injection	Air Suction (AS)
PCM	Powertrain Control Module	–
PNP	Park/Neutral Position	–
PROM	Programmable Read Only Memory	–
PSP	Power Steering Pressure	–
PTOX	Periodic Trap Oxidizer	Diesel Particulate Filter (DPF) Diesel Particulate Trap (DPT)
RAM	Random Access Memory	Random Access Memory (RAM)
RM	Relay Module	–
ROM	Read Only Memory	Read Only Memory (ROM)
RPM	Engine Speed	Engine Speed
SC	Supercharger	Supercharger
SCB	Supercharger Bypass	E–ABV
SFI	Sequential Multiport Fuel Injection	Electronic Fuel Injection (EFI), Sequential Injection
SPL	Smoke Puff Limiter	–
SRI	Service Reminder Indicator	–
SRT	System Readiness Test	–
ST	Scan Tool	–
TB	Throttle Body	Throttle Body
TBI	Throttle Body Fuel Injection	Single Point Injection Central Fuel Injection (Ci)
TC	Turbocharger	Turbocharger
TCC	Torque Converter Clutch	Torque Converter

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TCM	Transmission Control Module	Transmission ECU, ECT ECU
TP	Throttle Position	Throttle Position
TR	Transmission Range	–
TVV	Thermal Vacuum Valve	Bimetallic Vacuum Switching Valve (BVSV) Thermostatic Vacuum Switching Valve (TVSV)
TWC	Three–Way Catalytic Converter	Three–Way Catalytic (TWC) Manifold Converter CC_{RO}
TWC+OC	Three–Way + Oxidation Catalytic Converter	CC_R + CCo
VAF	Volume Air Flow	Air Flow Meter
VR	Voltage Regulator	Voltage Regulator
VSS	Vehicle Speed Sensor	Vehicle Speed Sensor
WOT	Wide Open Throttle	Full Throttle
WU–OC	Warm Up Oxidation Catalytic Converter	–
WU–TWC	Warm Up Three–Way Catalytic Converter	–
3GR	Third Gear	–
4GR	Fourth Gear	–

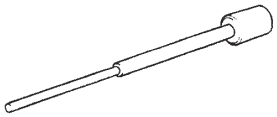
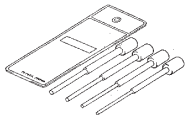
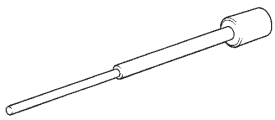
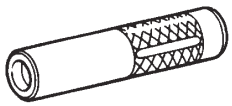
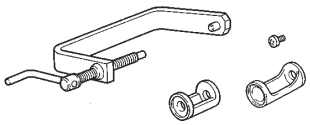
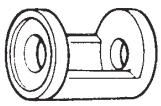
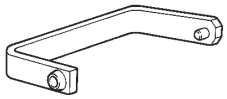
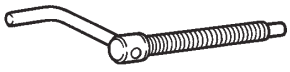
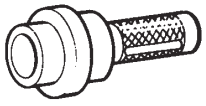
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ENGINE MECHANICAL

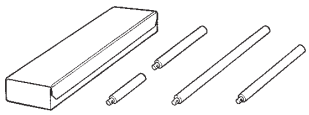
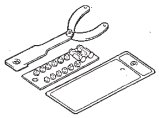
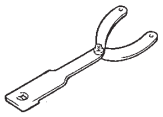
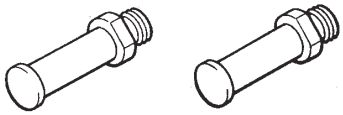
PREPARATION

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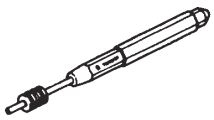
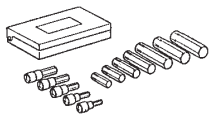
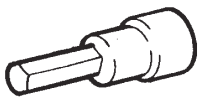
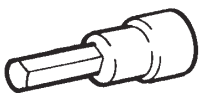
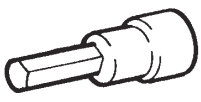
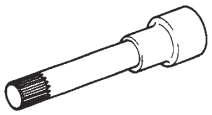
SST

	09032–00100	Oil Pan Seal Cutter	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	09201–01055	Valve Guide Bushing Remover & Replacer 5.5	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09201–10000	Valve Guide Bushing Remover & Replacer Set	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09201–01050)	Valve Guide Bushing Remover & Replacer 5	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09201–41020	Valve Stem Oil Seal Replacer	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09202–70020	Valve Spring Compressor	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09202–00010)	Attachment	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09202–01010)	Arm	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09202–01020)	Set Bolt	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09205–16010	Cylinder Head Bolt Wrench	CYLINDER BLOCK ASSY(1ZZ–FE/3ZZ–FE)
	09223–15020	Oil Seal & Bearing Replacer	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	09223–22010	Crankshaft Front Oil Seal Replacer	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)

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	09228–06501	Oil Filter Wrench	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	09950–70010	Handle Set	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE) CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09951–07100)	Handle 100	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE) CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09960–10010	Variable Pin Wrench Set	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	(09962–01000)	Variable Pin Wrench Arm Assy	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	(09963–01000)	Pin 10	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)

Recomended Tools

	09031–00040	Pin Punch .	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	09040–00011	Hexagon Wrench Set	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE) CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09043–20100)	Socket Hexagon Wrench 10	CYLINDER HEAD ASSY(1ZZ–FE/3ZZ–FE)
	(09043–20120)	Socket Hexagon Wrench 12	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	(09043–20120)	Socket Hexagon Wrench 12	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)
	09043–50100	Bi–hexagon Wrench 10 mm	PARTIAL ENGINE ASSY(1ZZ–FE/3ZZ–FE)

Equipment

Piston ring expander	
Valve seal cutter set	
Micro meter	

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Dial indicator	
Spring tensjon gauge	
Feeler gauge	
Torque wrench	
Slide calipers	
V–block	
Piston heater	
Plastigage	

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LUBRICATION

PREPARATION

023VE–01

Equipment

Feeler gauge	
Straight edge	
Torque wrench	

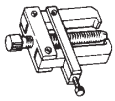
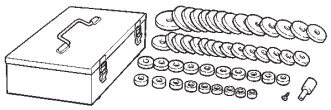
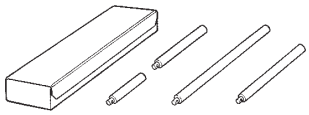
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STARTING & CHARGING

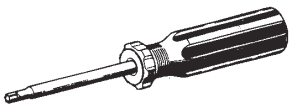
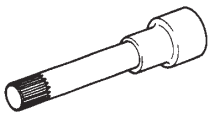
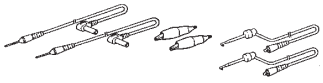
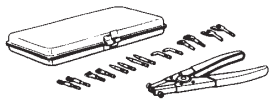
PREPARATION

023YJ–01

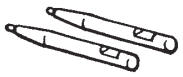
SST

	09285–76010	Injection Pump Camshaft Bearing Cone Replacer	GENERATOR ASSY(BOSCH MADE) (1ZZ–FE/3ZZ–FE)
	09286–46011	Injection Pump Spline Shaft Puller	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	09950–60010	Replacer Set	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	(09951–00250)	Replacer 25	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	(09951–00470)	Replacer 47	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	09950–70010	Handle Set	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	(09951–07100)	Handle 100	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)

Recommended Tools

	09041–00020	Torx Driver T25	STARTER ASSY(1ZZ–FE/3ZZ–FE)
	09043–50100	Bi–hexagon Wrench 10 mm	GENERATOR ASSY(BOSCH MADE) (1ZZ–FE/3ZZ–FE)
	09082–00040	TOYOTA Electrical Tester	GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	(09083–00150)	Test Lead Set	STARTER ASSY(1ZZ–FE/3ZZ–FE) GENERATOR ASSY(DENSO MADE) (1ZZ–FE/3ZZ–FE)
	09904–00010	Expander Set	STARTER ASSY(1ZZ–FE/3ZZ–FE)

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(09904–00050) No. 4 Claw 	STARTER ASSY(1ZZ–FE/3ZZ–FE)

Equipment

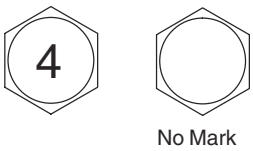
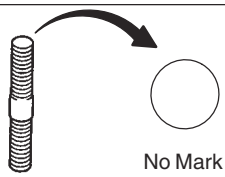
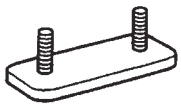
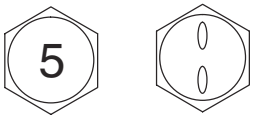
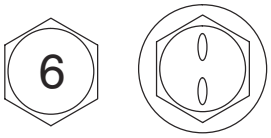
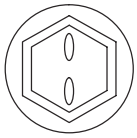
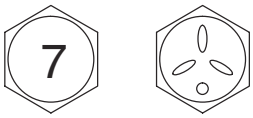
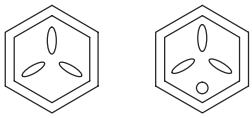
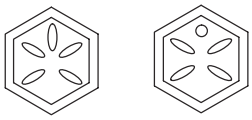
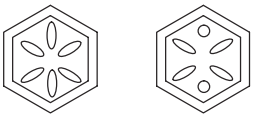
29 mm socket wrench	
Dial indicator	
Long hexagon wrench 8 mm	
Ohmmeter	
Slide calipers	
Torque wrench	
Vernier caliper	
V–block	

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STANDARD BOLT

HOW TO DETERMINE BOLT STRENGTH

030LK–10

Bolt Type				Class
Hexagon Head Bolt		Stud Bolt	Weld Bolt	
Normal Recess Bolt	Deep Recess Bolt			
 No Mark	 No Mark	 No Mark		4T
				5T
 w/ Washer	 w/ Washer			6T
				7T
				8T
				9T
				10T
				11T

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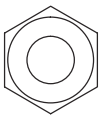
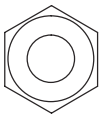
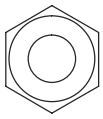
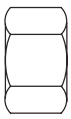
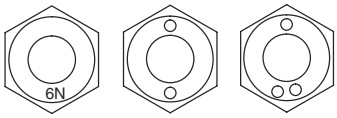
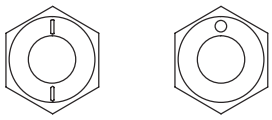
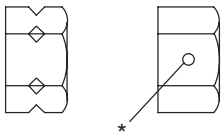
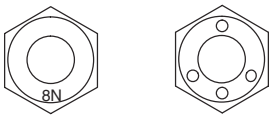
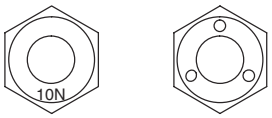
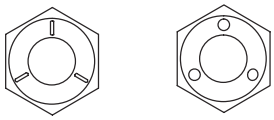
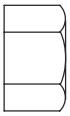
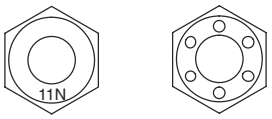
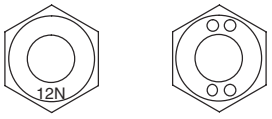
SPECIFIED TORQUE FOR STANDARD BOLTS

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

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030LM–10

HOW TO DETERMINE NUT STRENGTH

Nut Type			Class
Present Standard Hexagon Nut	Old Standard Hexagon Nut		
	Cold Forging Nut	Cutting Processed Nut	
 No Mark			4N
 No Mark (w/ Washer)	 No Mark (w/ Washer)	 No Mark	5N (4T)
 6N			6N
		 *	7N (5T)
 8N			8N
 10N		 No Mark	10N (7T)
 11N			11N
 12N			12N

*: Nut with 1 or more marks on one side surface of the nut.

B06432

HINT:

Use the nut with the same number of the nut strength classification or the greater than the bolt strength classification number when tightening parts with a bolt and nut.

Example: Bolt = 4T

Nut = 4N or more

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ENGINE MECHANICAL

SERVICE DATA

031H1–05

Chain sub–assy		
Length at 15 links	Maximum	115.3 mm (4.539 in.)
Camshaft timing gear or sprocket		
Diameter (w/ chain)	Minimum	96.8 mm (3.811 in.)
Crankshaft timing gear or sprocket		
Diameter (w/ chain)	Minimum	51.0 mm (2.008 in.)
Chain tensioner slipper		
Wear	Maximum	1.0 mm (0.039 in.)
Chain vibration damper No. 1		
Wear	Maximum	1.0 mm (0.039 in.)
Cylinder head set bolt		
Length	Standard	146.8 to 148.2 mm (5.780 to 5.835 in.)
	Maximum	148.5 mm (5.846 in.)
Camshaft		
Circle runout	Maximum	0.03 mm (0.0012 in.)
Lobe height	Standard	
	Intake	44.333 to 44.433 mm (1.7454 to 1.7493 in.)
	Exhaust	43.761 to 43.861 mm (1.7229 to 1.7268 in.)
	Minimum	
	Intake	44.18 mm (1.7394 in.)
	Exhaust	43.61 mm (1.7169 in.)
Journal diameter	No. 1	34.449 to 34.465 mm (1.3563 to 1.3569 in.)
	Others	22.949 to 22.965 mm (0.9035 to 0.9041 in.)
Thrust clearance	Standard	0.040 to 0.095 mm (0.0009 to 0.0023 in.)
	Maximum	0.110 mm (0.0043 in.)
Oil clearance	Standard	0.035 to 0.072 mm (0.0014 to 0.0028 in.)
	Maximum	0.10 mm (0.0039 in.)
Valve clearance (Cold)	Intake	0.15 to 0.25 mm (0.0059 to 0.0098 in.)
	Exhaust	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
Cylinder head sub–assy		
Warpage	Maximum	
	Cylinder block side	0.05 mm (0.0020 in.)
	Intake manifold side	0.10 mm (0.0039 in.)
	Exhaust manifold side	0.10 mm (0.0039 in.)
Valve guide bushing		
Inside diameter		5.510 to 5.530 mm (0.2169 to 0.2177 in.)
Oil clearance	Standard	
	Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
	Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)
	Maximum	
	Intake	0.08 mm (0.0031 in.)
	Exhaust	0.10 mm (0.0039 in.)
Bore diameter		10.285 to 10.306 mm (0.4049 to 0.4058 in.)
Protrusion height		8.7 to 9.1 mm (0.342 to 0.358 in.)
Valve stem		
Diameter	Intake	5.470 to 5.485 mm (0.2154 to 0.2159 in.)
	Exhaust	5.465 to 5.480 mm (0.2152 to 0.2158 in.)
Inner compression spring		
Free length		43.40 mm (1.7087 in.)
Deviation	Maximum	1.6 mm (0.063 in.)
Angle (reference)	Maximum	2°

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Valve		
Overall length	Standard	
	Intake	88.65 mm (3.4902 in.)
	Exhaust	88.69 mm (3.4917 in.)
	Minimum	
	Intake	88.35 mm (3.4784 in.)
	Exhaust	88.39 mm (3.4799 in.)
Head margin thickness	Standard	1.0 mm (0.039 in.)
	Minimum	0.7 mm (0.028 in.)
Valve lifter		
Diameter		30.966 to 30.976 mm (1.2191 to 1.2195 in.)
Bore diameter		31.000 to 31.025 mm (1.2205 to 1.2215 in.)
Oil clearance	Standard	0.024 to 0.059 mm (0.0009 to 0.0023 in.)
	Maximum	0.079 mm (0.0031 in.)
Straight pin		
Protrusion height		5 mm (0.20 in.)
Union protrusion		
Protrusion height	Standard	
	A	14 mm (0.551 in.)
	B	23.2 mm (0.913 in.)
	C	9 mm (0.354 in.)
Connecting rod sub–assy		
Thrust clearance	Standard	0.160 to 0.342 mm (0.063 to 0.0135 in.)
	Maximum	0.342 mm (0.0135 in.)
Oil clearance	Standard	0.028 to 0.060 mm (0.0011 to 0.0024 in.)
	Maximum	0.080 mm (0.0031 in.)
Out–of alignment	Maximum per/100 mm (3.94 in.)	0.05 mm (0.0020 in.)
Twist	Maximum per/100 mm (3.94 in.)	0.05 mm (0.0020 in.)
Connecting rod bearing		
Center wall thickness	Reference Mark 1	1.486 to 1.490 mm (0.0585 to 0.0587 in.)
	Mark 2	1.491 to 1.494 mm (0.0587 to 0.0588 in.)
	Mark 3	1.495 to 1.498 mm (0.0589 to 0.0590 in.)
Crankshaft		
Thrust clearance	Standard	0.04 to 0.24 mm (0.0016 to 0.0094 in.)
	Maximum	0.30 mm (0.0118 in.)
Circle runout	Maximum	0.03 mm (0.0012 in.)
Main journal diameter		47.988 to 48.000 mm (1.8893 to 1.8898 in.)
	Maximum taper and out–of–round	0.02 mm (0.0008 in.)
Oil clearance	Standard	0.015 to 0.032 mm (0.0006 – 0.0012 in.)
	Maximum	0.05 mm (0.0020 in.)
Cylinder block sub–assy		
Warpage	Maximum	0.05 mm (0.0020 in.)
Bore diameter	Standard	79.000 to 79.013 mm (3.1073 to 3.1107 in.)
	Maximum	79.133 mm (3.1155 in.)
Piston		
Diameter (at 29.8 mm (1.173 in.) from the piston head)	1ZZ–FE	78.955 to 78.965 mm (3.1085 to 3.1089 in.)
	3ZZ–FE	78.960 to 78.975 mm (3.1087 to 3.1091 in.)
Oil clearance	Standard	0.073 to 0.096 mm (0.0029 to 0.0038 in.)
	Maximum	0.10 mm (0.0039 in.)
Piston ring		
Groove clearance	No. 1	0.020 to 0.070 mm (0.0008 to 0.0028 in.)
	No. 2	0.030 to 0.070 mm (0.0012 to 0.0028 in.)
	Oil	0.03 to 0.011 mm (0.0012 to 0.0043 in.)
End gap	Standard	
	No. 1	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
	No. 2	0.35 to 0.50 mm (0.0138 to 0.0197 in.)
	Oil	0.15 to 0.40 mm (0.0059 to 0.0157 in.)
	Maximum	
	No. 1	0.74 mm (0.029 in.)
	No. 2	0.89 mm (0.035 in.)
Piston pin		
Diameter		20.006 to 20.015 mm (0.7876 to 0.7880 in.)

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Connecting rod bolt		
Diameter	Standard	6.6 to 6.7 mm (0.260 to 0.264 in.)
	Maximum	6.4 mm (0.252 in.)
Crank pin		
Diameter		43.992 to 44.000 mm (1.7320 to 1.7323 in.)
	Maximum taper and out–of–round	0.02 mm (0.0008 in.)
Crankshaft bearing cap set bolt		
Diameter	Standard	7.3 to 7.5 mm (0.287 to 0.295 in.)
	Maximum	7.3 mm (0.287 in.)
Connecting rod small end bush		
Oil clearance	Standard	0.005 to 0.011 mm (0.0002 to 0.0004 in.)
	Maximum	0.011 mm (0.0004 in.)

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031H2–05

TORQUE SPECIFICATION

Part Tightened		N·m	kgf·cm	ft·lbf
Cylinder block water drain cock sub–assy x Cylinder block sub–assy		25	255	18
Oil strainer sub–assy x Cylinder block sub–assy		9.0	92	80 in.·lbf
Oil pan sub–assy x Cylinder block sub–assy		9.0	92	80 in.·lbf
Oil pan drain plug x Oil pan sub–assy		37	377	27
Oil filter union x Cylinder block sub–assy		30	306	22
Oil pump assy x Cylinder block sub–assy		9.0	92	80 in.·lbf
Cylinder head sub–assy x Cylinder block sub–assy	1st 2nd	49 Turn 90°	500 Turn 90°	36 Turn 90°
Oil control valve filter x Cylinder head sub–assy		30	306	22
Camshaft timing oil control valve assy x Cylinder head sub–assy		9.0	92	80 in.·lbf
Camshaft timing gear assy x Camshaft		54	551	40
Camshaft timing gear or sprocket x Camshaft No. 2		54	551	40
Camshaft, Camshaft No. 2 x Cylinder head sub–assy	Bearing cap No. 1 Bearing cap No. 3	23 13	235 133	17 10
Chain vibration damper No. 1 x Cylinder head sub–assy		9.0	92	80 in.·lbf
Chain vibration damper No. 1 x Cylinder block sub–assy		9.0	92	80 in.·lbf
Chain tensioner slipper x Cylinder block sub–assy		19	189	14
Timing chain or belt cover sub–assy x Cylinder head sub–assy		13	133	10
Timing chain or belt cover sub–assy x Cylinder block sub–assy	M6 M8	13 19	133 189	10 14
Chain tensioner assy No. 1 x Cylinder head sub–assy		9.0	92	80 in.·lbf
Crankshaft pulley x Crankshaft		138	1,407	102
Water pump assy x Cylinder block sub–assy		11	112	8
Water pump assy x Timing chain or belt cover sub–assy		9.0	92	80 in.·lbf
Cylinder head cover sub–assy x Cylinder head sub–assy	w/o washer w/ washer	11 9.0	112 92	8 80 in.·lbf
Cylinder head cover sub–assy x Timing chain or belt cover sub–assy		11	112	8
Spark plug x Cylinder head sub–assy		25	255	18
Stud bolt Timing chain or belt cover sub–assy x Cylinder head sub–assy length 93.5 mm (3.68 in.) length 53.5 mm (2.11 in.) Cylinder head cover sub–assy x Cylinder head sub–assy Intake manifold x Cylinder head sub–assy Exhaust manifold x Cylinder head sub–assy		 9.5 5.0 5.0 9.5 9.5	 97 51 51 97 97	 84 in.·lbf 44 in.·lbf 44 in.·lbf 84 in.·lbf 84 in.·lbf
W/ Head taper screw plug No. 2 x Cylinder head sub–assy		44	449	33
Crankshaft bearing cap sub–assy x Cylinder block sub–assy	M10 1st 2nd M8	44 Turn 90° 19	449 Turn 90° 194	33 Turn 90° 14
Connecting rod x Connecting rod cap	1st 2nd	20 Turn 90°	204 Turn 90°	15 Turn 90°
Stud bolt Water by–pass pipe No. 1 x Cylinder block sub–assy Water inlet x Cylinder block sub–assy Oil strainer sub–assy x Cylinder block sub–assy Oil pan sub–assy x Cylinder block sub–assy Knock control sensor x Cylinder block sub–assy		 5.0 5.0 5.0 5.0 11	 51 51 51 51 112	 44 in.·lbf 44 in.·lbf 44 in.·lbf 44 in.·lbf 8

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LUBRICATION

SERVICE DATA

031H5–05

Rotor tip clearance	Standard	0.040 to 0.160 mm (0.0016 to 0.0063 in.)
	Maximum	0.160 mm (0.0063 in.)
Rotor side clearance	Standard	0.025 to 0.071 mm (0.0010 to 0.0028 in.)
	Maximum	0.071 mm (0.0028 in.)
Body clearance	Standard	0.260 to 0.325 mm (0.0102 to 0.0128 in.)
	Maximum	0.325 mm (0.0128 in.)

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031H6–04

TORQUE SPECIFICATION

Part Tightened	N·m	kgf·cm	ft·lbf
Oil pump relief valve plug x Oil pump body	37	377	27
Oil pump cover x Oil pump body	10	102	7

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STARTING & CHARGING

031E6–07

SERVICE DATA

STARTER:

Magnetic switch resistance	Terminal 50 – C	Below 1 Ω
	Terminal 50 – Switch body	Below 1.5 Ω
Starter armature resistance	Segments	Below 1 Ω
	Commutator – Armature coil	10 kΩ or higher
Starter armature assy		
Circle runout	Standard	0.02 mm (0.0008 in.)
	Maximum	0.05 mm (0.0020 in.)
Commutatordiameter	Standard	29 mm (1.142 in.)
	Minimum	28 mm (1.102 in.)
Starter brush holder assy		
Brush length	Standard	15.5 mm (0.610 in.)
	Minimum	9.0 mm (0.354 in.)
Resistance (See page 19–2)	Standard	
	A – B	10 kΩ or higher
	A – C	10 kΩ or higher
	A – D	Below 1 Ω
	B – C	Below 1 Ω
	B – D	10 kΩ or higher
	C – D	10 kΩ or higher

GENERATOR (DENSO MADE):

Generator regulator assy		
Resistance	B and F	When the positive and negative poles of terminals F and B are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction
	E and F	When the positive and negative poles of terminals F and E are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction
Generator holder w/ rectifier		
Resistance	Positive (+) and each rectifier terminal	When the positive and negative poles of the positive (+) terminal and each rectifier terminal are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction
	Negative (–) and each rectifier terminal	When the positive and negative poles of the negative (–) terminal and each rectifier terminal are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction
Generator rotor assy		
Resistance	Slip rings	2.55 to 2.95 Ω at 20°C (68°F)
	Slip ring and rotor	10 kΩ or higher
Slip ring diameter	Standard	14.2 to 14.4 mm (0.559 to 0.567 in.)
	Minimum	14 mm (0.551 in.)
Generator drive end frame		
Resistance	Coil wires	Below 1 Ω
	Coil wire and body	10 kΩ or higher

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GENERATOR (BOSCH MADE):

Generator rotor assy		
Rotor coil resistance	at 20°C (68°F)	2.27 to 2.53 Ω
Slip ring diameter	Standard	15.3 to 15.5 mm (0.602 to 0.610 in.)
	Minimum	14.3 mm (0.561 in.)
Stator sub–assy generator with rectifier		
Positive rectifier	Positive (+) tester probe – Positive (+) terminal Negative (–) tester probe – Rectifier terminal	Below 1 Ω
	Negative (–) tester probe – Positive (+) terminal Positive (+) tester probe – Rectifier terminal	10 kΩ or higher
Negative rectifier	Positive (+) tester probe – Negative (–) terminal Negative (–) tester probe – Rectifier terminal	10 kΩ or higher
	Negative (–) tester probe – Negative (–) terminal Positive (+) tester probe – Rectifier terminal	Below 1 Ω
Stator for open circuit	Between rectifier terminals	Below 1 Ω
Generator brush holder assy		
Brush exposed length	Standard	11.0 to 13.6 mm (0.433 to 0.535 in.)
	Minimum	6.0 mm (0.236 in.)

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031E7–08

TORQUE SPECIFICATION

STARTER:

Part Tightened	N·m	kgf·cm	ft·lbf
Magnetic switch x Starter housing assy	2.3	23	20 in.·lbf
Starter commutator end frame assy x Starter drive housing assy	6.0	61	53 in.·lbf
Lead wire x Starter magnetic switch	5.9	60	52 in.·lbf

GENERATOR (DENSO MADE):

Part Tightened		N·m	kgf·cm	ft·lbf
Bearing retainer plate x Generator drive end frame		2.94	30	26 in.·lbf
Generator rectifier end frame x Generator drive end frame		4.75	50	42 in.·lbf
Generator holder w/ rectifier x Generator drive end frame		2.94	30	26 in.·lbf
Generator regulator x Generator rectifier end frame		1.96	20	17 in.·lbf
Generator brush holder assy x Generator rectifier end frame		1.96	20	17 in.·lbf
Generator rear end cover x Generator rectifier end frame		4.4	45	39 in.·lbf
Terminal plate	Screw	3.85	40	34 in.·lbf
	Nut	4.4	45	39 in.·lbf
Terminal insulator x Generator holder w/ rectifier		4.1	40	37 in.·lbf
Generator pulley x Generator rotor assy		87.5	890	65

GENERATOR (BOSCH MADE):

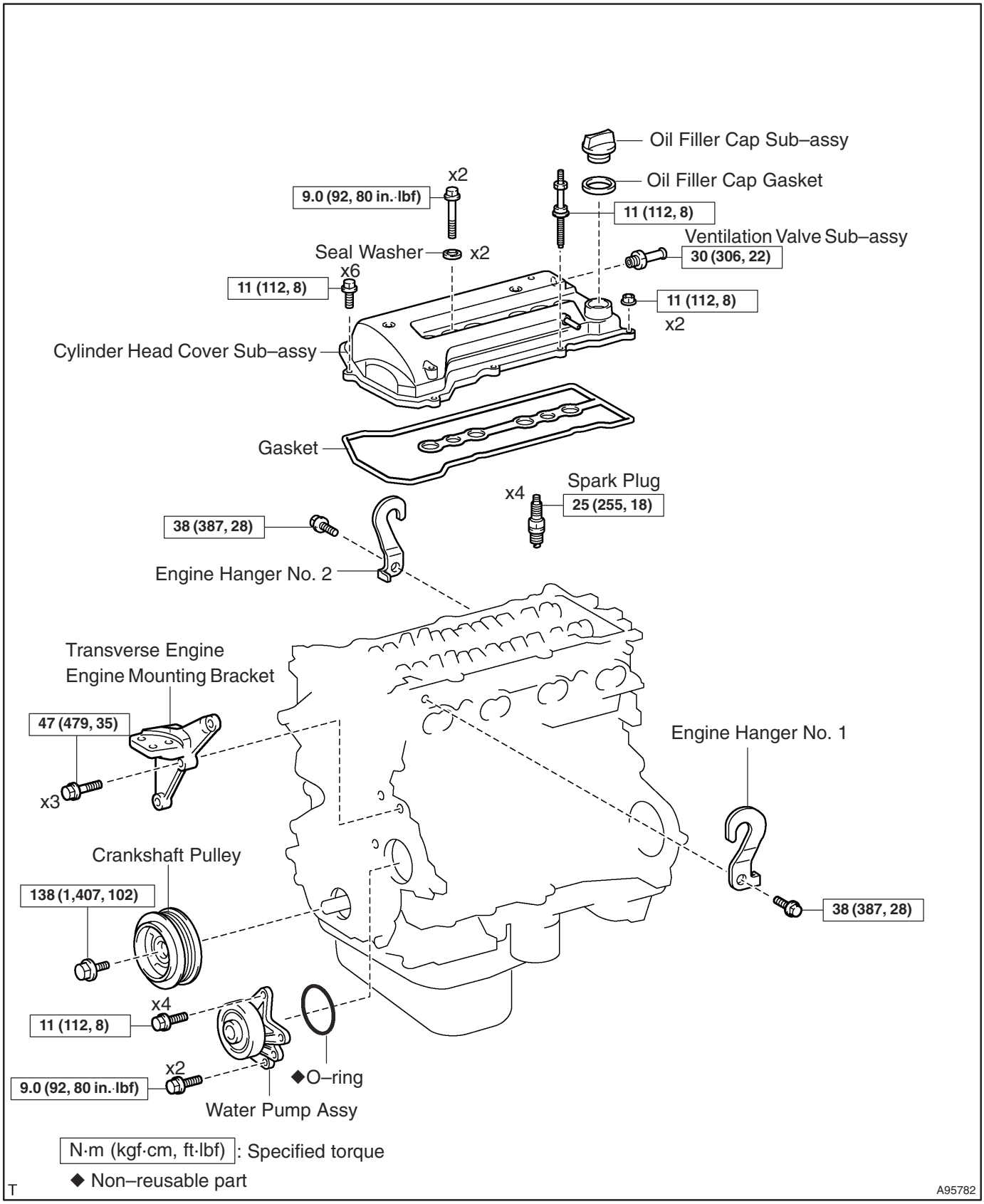
Part Tightened		N·m	kgf·cm	ft·lbf
Pulley x Generator rotor assy		68	688	50
Stator sub–assy generator w/ rectifier x Drive end frame assy		3.5	36	31 in.·lbf
Regulator sub–assy generator w/ brush x Stator sub–assy generator w/ rectifier (See page 19–22)	Screw A	2.2	22	19 in.·lbf
	Screw B	1.2	12	11 in.·lbf
Generator rear end cover x Stator sub–assy generator w/ rectifier (See page 19–22)	Nut A	19.5	199	14
	Nut B	12	122	9.0
	Screw	2.4	24	21 in.·lbf

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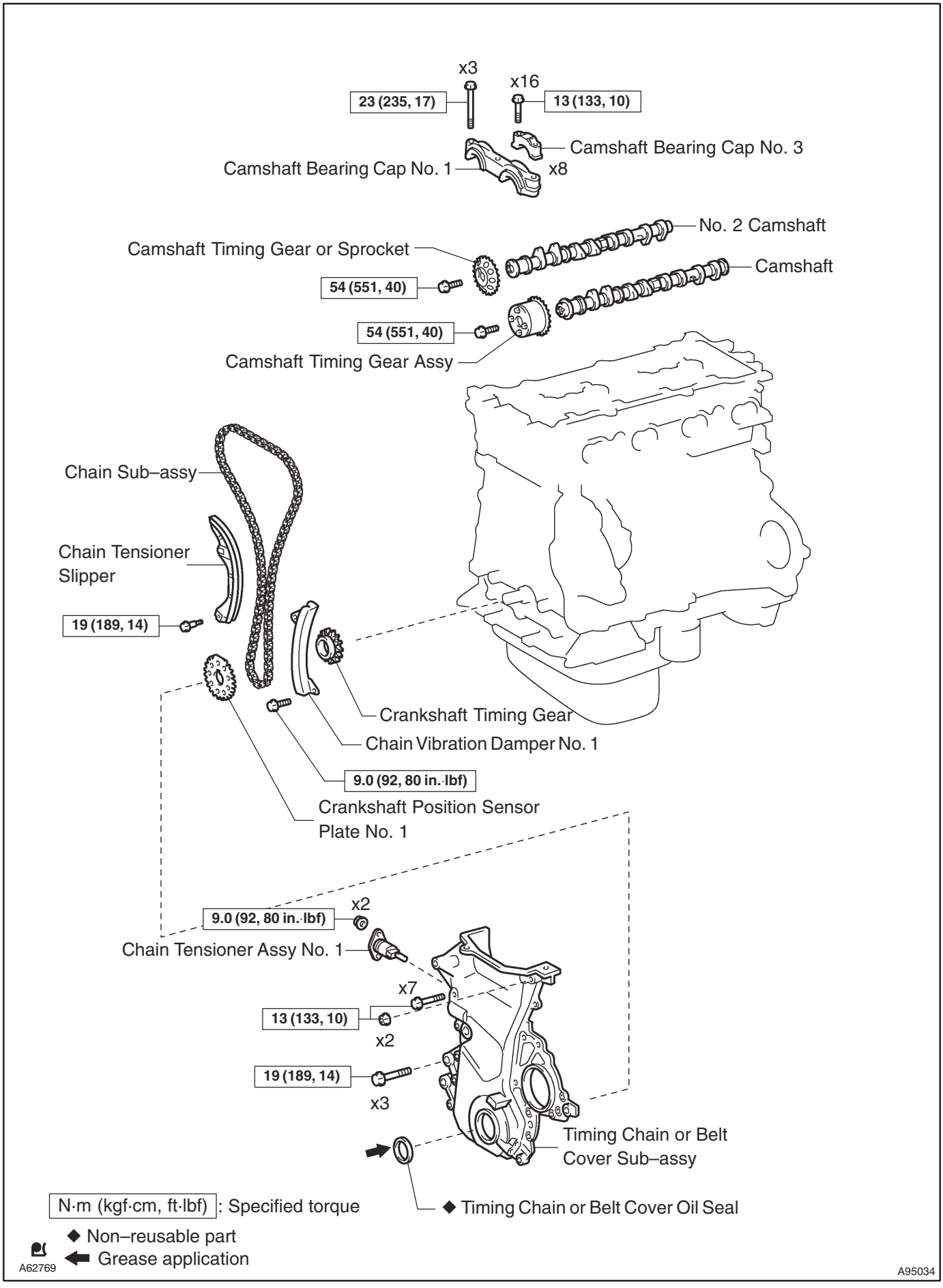
PARTIAL ENGINE ASSY (1ZZ–FE/3ZZ–FE)

141TL–01

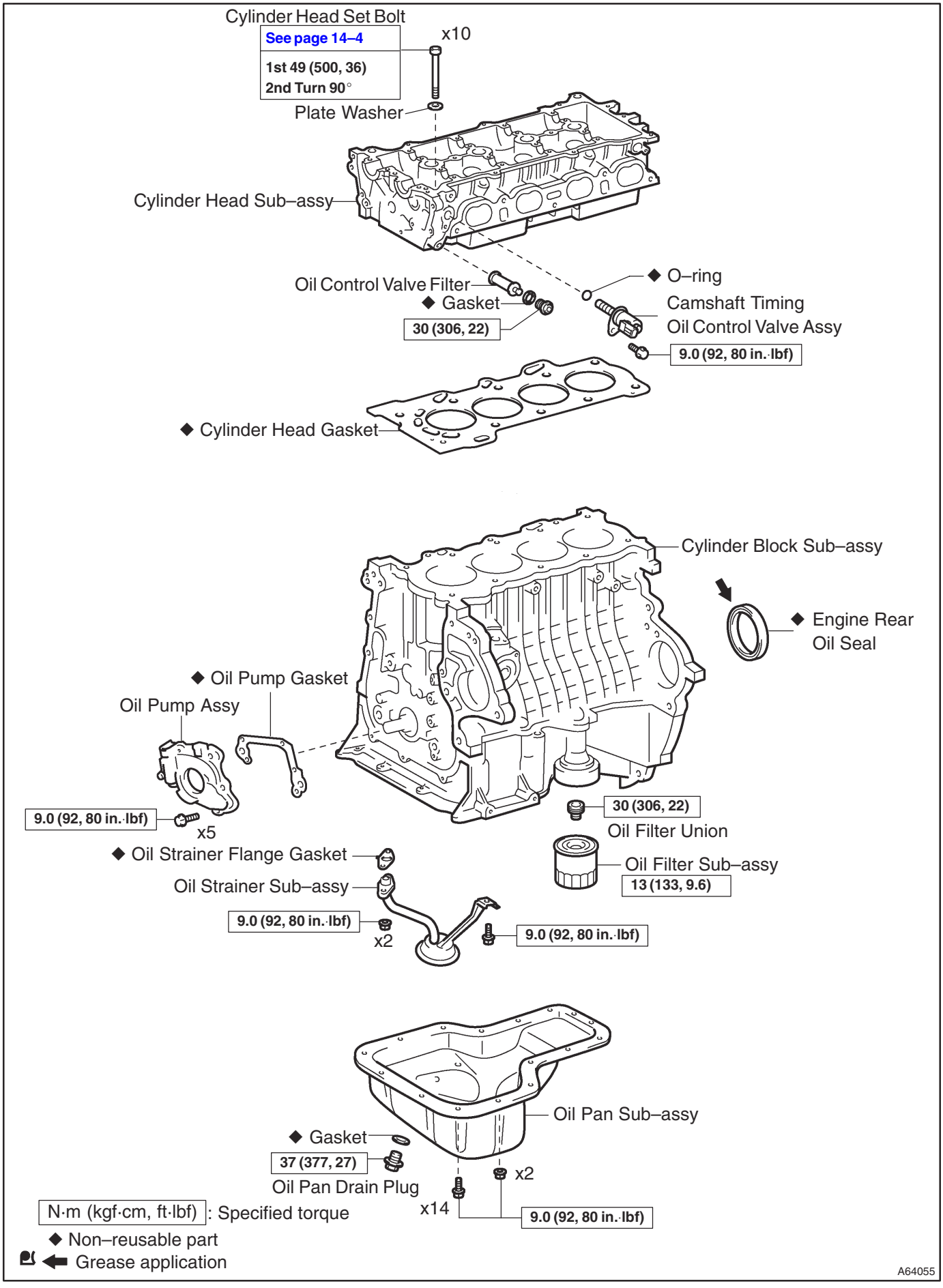
COMPONENTS



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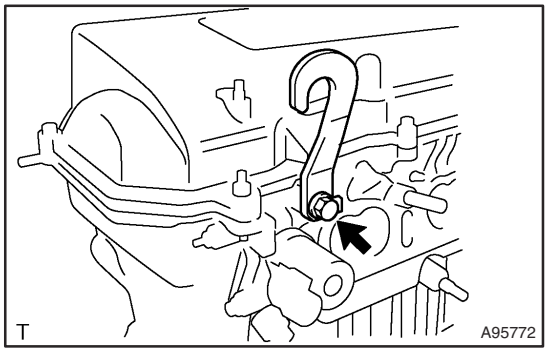
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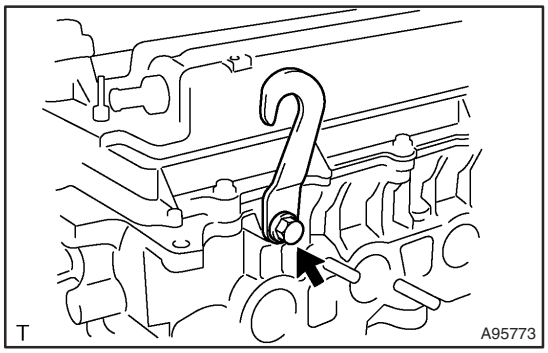
141TM–01

OVERHAUL



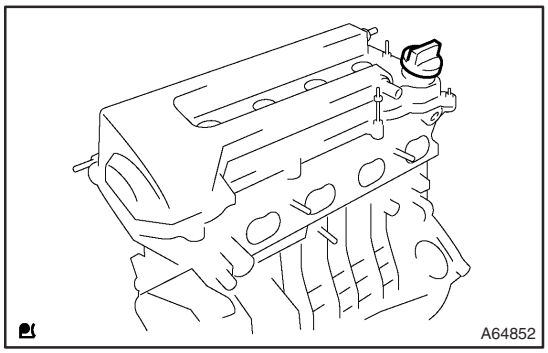
1. REMOVE ENGINE HANGER NO.1

(a) Remove the bolt, then remove engine hanger No. 1.



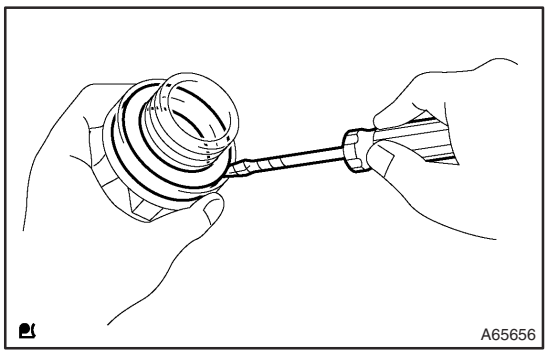
2. REMOVE ENGINE HANGER NO.2

(a) Remove the bolt, then remove engine hanger No. 2.



3. REMOVE OIL FILLER CAP SUB–ASSY

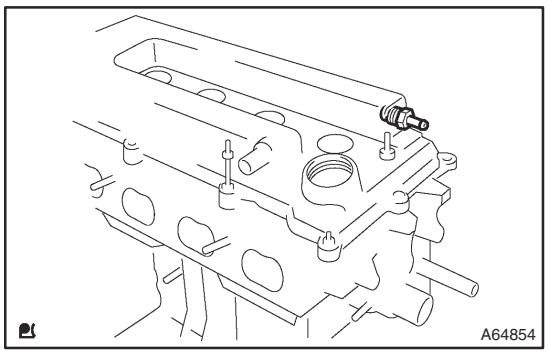
(a) Remove the oil filler cap from the cylinder head cover.



4. REMOVE OIL FILLER CAP GASKET

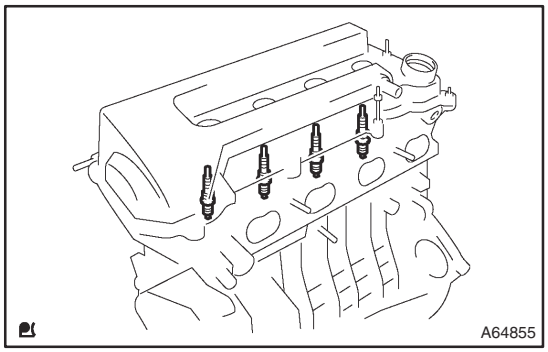
(a) Using a screwdriver, remove the oil filler cap gasket from the oil filler cap.

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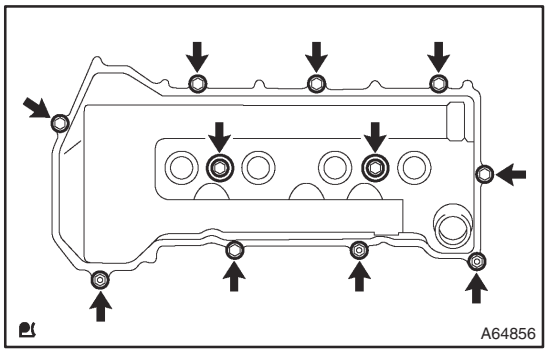
5. REMOVE VENTILATION VALVE SUB–ASSY

(a) Remove the ventilation valve from the cylinder head cover.



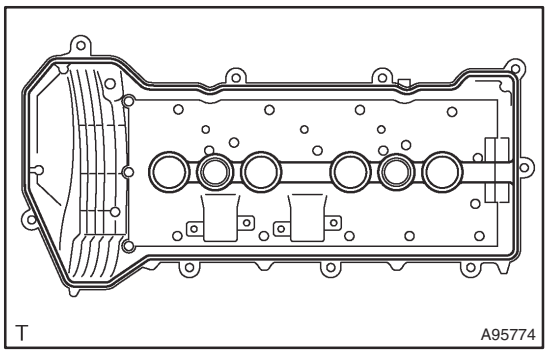
6. REMOVE SPARK PLUG

(a) Using a spark plug wrench, remove the 4 spark plugs.



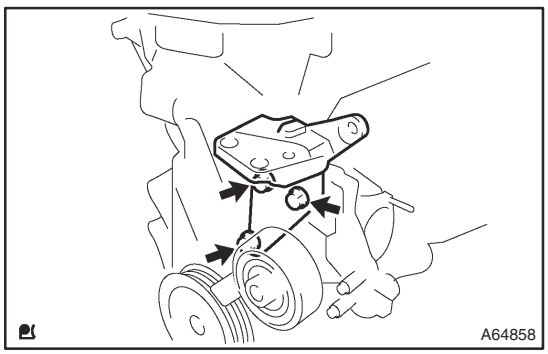
7. REMOVE CYLINDER HEAD COVER SUB–ASSY

(a) Remove the 9 bolts, 2 seal washers, and 2 nuts, then remove the cylinder head cover.



8. REMOVE CYLINDER HEAD COVER GASKET

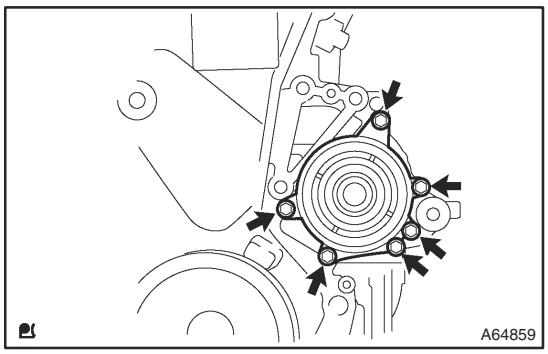
(a) Remove the cylinder head cover gasket from the cylinder head cover.



9. REMOVE TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

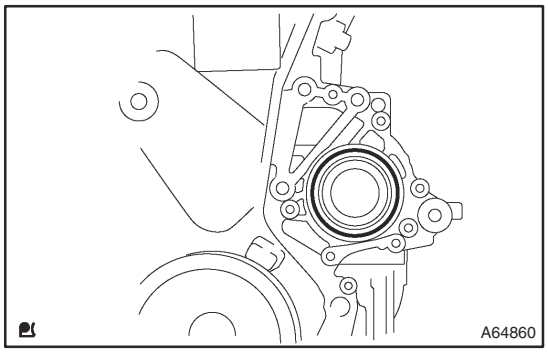
(a) Remove the 3 bolts, then remove the transverse engine engine mounting bracket.

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10. REMOVE WATER PUMP ASSY

(a) Remove the 6 bolts, then remove the water pump.



11. REMOVE WATER PUMP O–RING

(a) Remove the water pump O–ring from the timing chain cover.

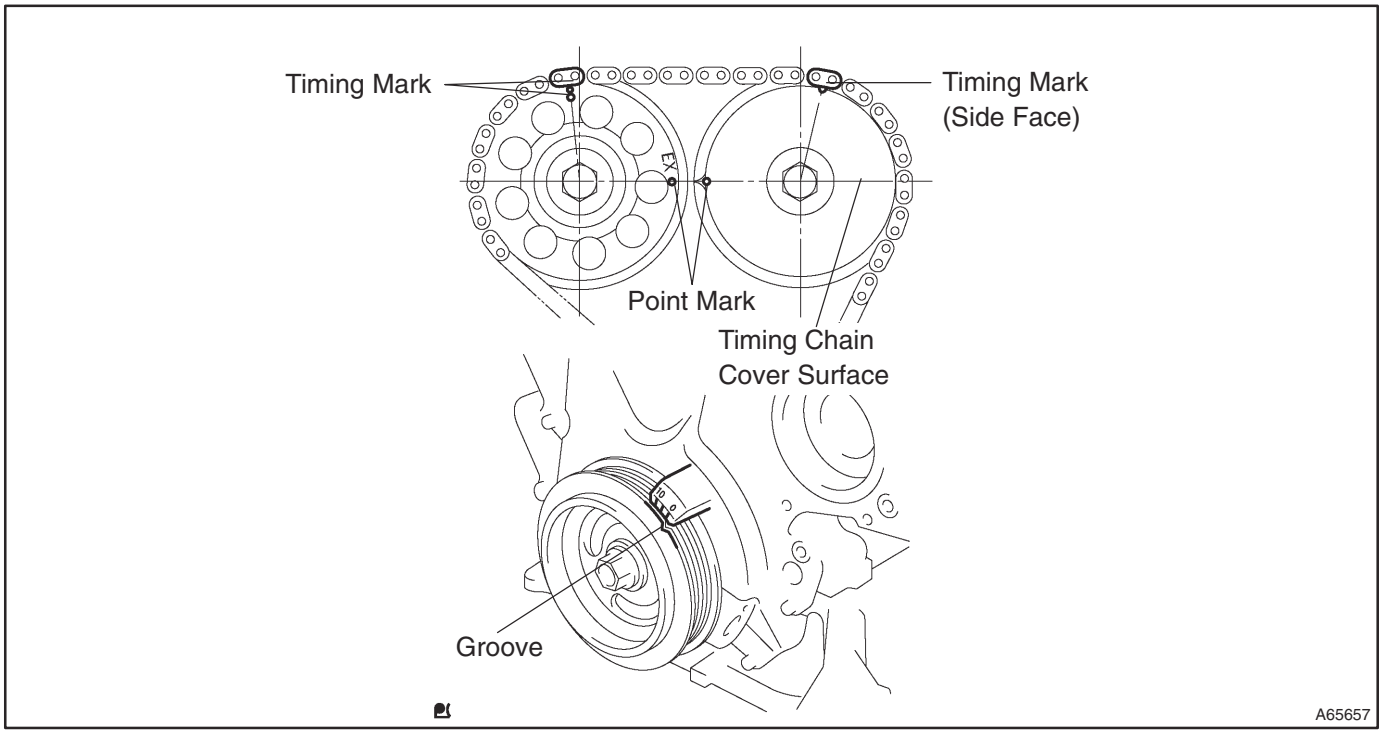
12. REMOVE CRANKSHAFT PULLEY

(a) Set the No. 1 cylinder to the TDC/compression.

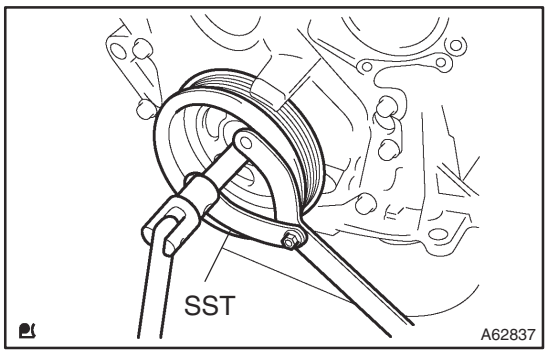
(1) Turn the crankshaft pulley, then adjust the crankshaft so that the groove and the timing mark ”0” of the timing chain are aligned.

(2) Check that the point marks of the camshaft timing gears are in a straight line on the timing chain cover surface as shown in the illustration.

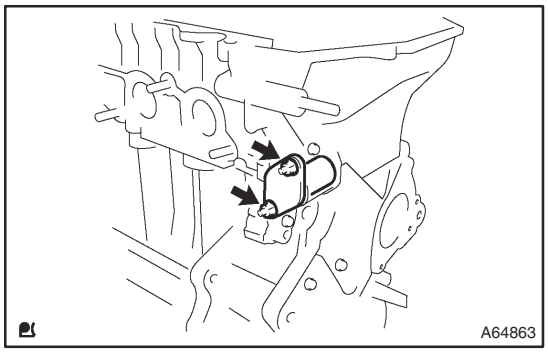
If not, turn the crankshaft 1 revolution (360°), then adjust the crankshaft so that the marks are aligned as above.



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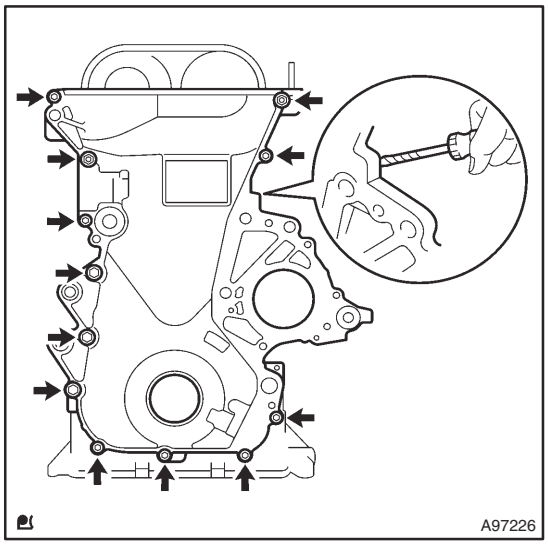


(b) Using SST, remove the crankshaft pulley bolt.
SST 09960–10010 (09962–01000, 09963–01000)
(c) Remove the crankshaft pulley from the crankshaft.



13. REMOVE CHAIN TENSIONER ASSY NO.1

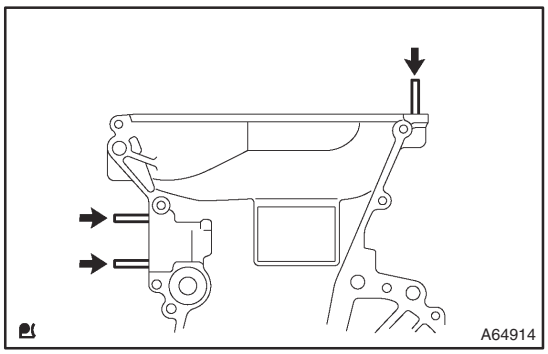
(a) Remove the 2 nuts, then remove chain tensioner No. 1.



14. REMOVE TIMING CHAIN OR BELT COVER SUB–ASSY

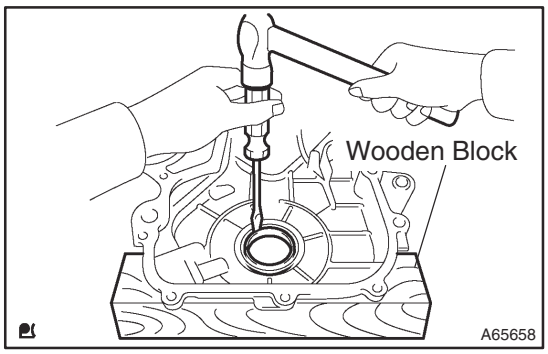
(a) Remove the 10 bolts and 2 nuts.
(b) Remove the timing chain cover by prying the portions between the timing chain cover, cylinder head and cylinder block with a screwdriver.

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



(c) Using a Torx socket wrench E5, remove the 3 stud bolts.

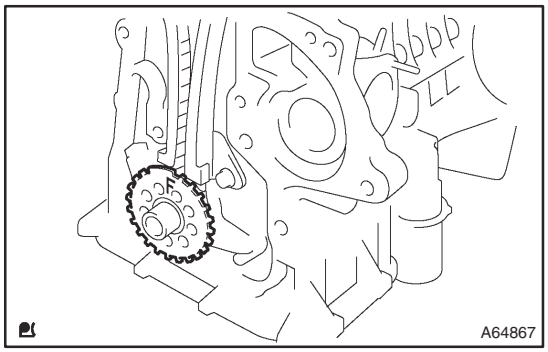
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15. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL

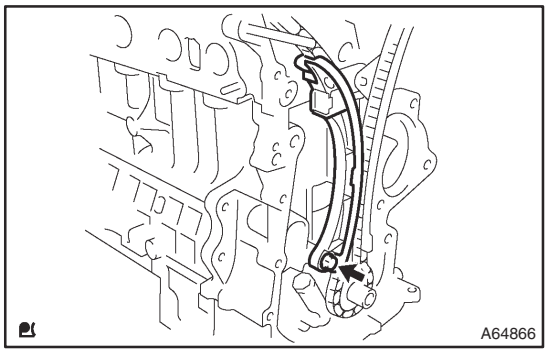
(a) Place the timing chain cover on wooden blocks.

(b) Using a screwdriver, remove the timing chain or belt cover oil seal.



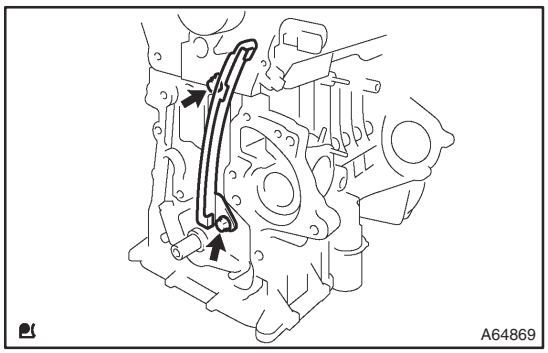
16. REMOVE CRANKSHAFT POSITION SENSOR PLATE NO.1

(a) Remove crankshaft position sensor plate No. 1 from the crankshaft.



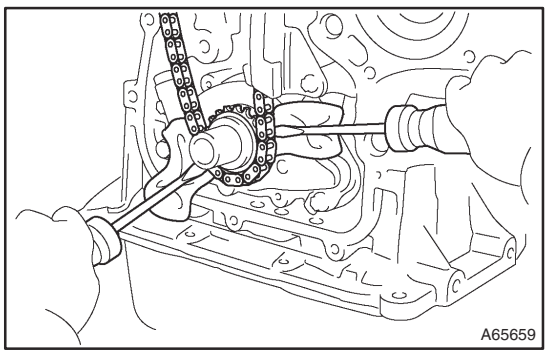
17. REMOVE CHAIN TENSIONER SLIPPER

(a) Remove the bolt, then remove the chain tensioner slipper.



18. REMOVE CHAIN VIBRATION DAMPER NO.1

(a) Remove the 2 bolts, then remove chain vibration damper No. 1.



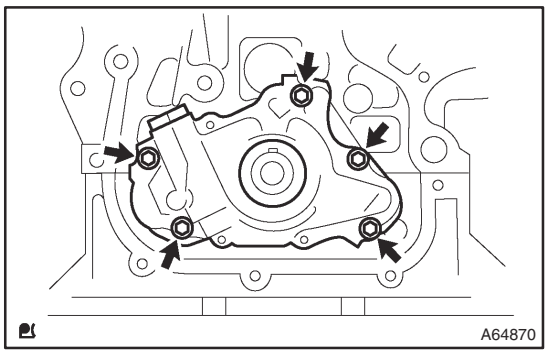
19. REMOVE CHAIN SUB–ASSY

(a) Using 2 screwdrivers, pry out the chain together with the crankshaft timing gear as shown in the illustration.

NOTICE:

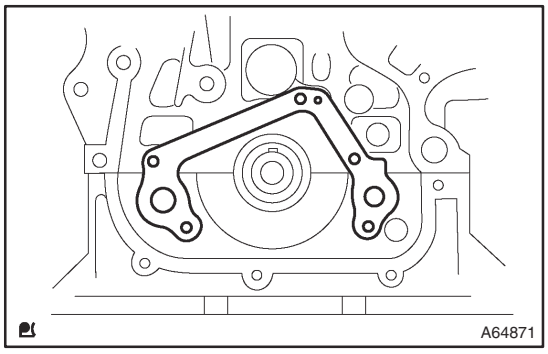
- **Put a shop rag to protect the engine.**
- **In case of revolving the camshafts with the chain off the gears, turn the crankshaft 1/4 revolution to prevent contact of the valves with the pistons.**

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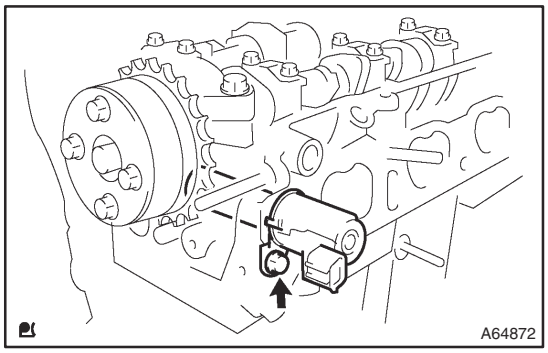
20. REMOVE OIL PUMP ASSY

(a) Remove the 5 bolts, then remove the oil pump.



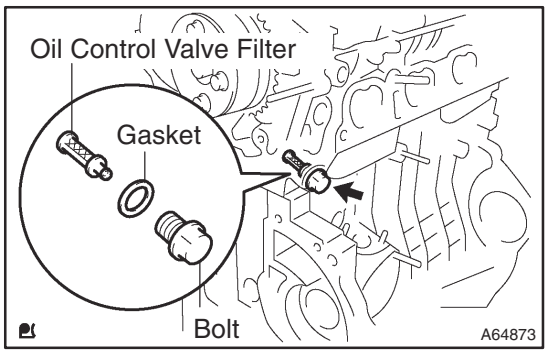
21. REMOVE OIL PUMP GASKET

(a) Remove the oil pump gasket from the cylinder block.



22. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

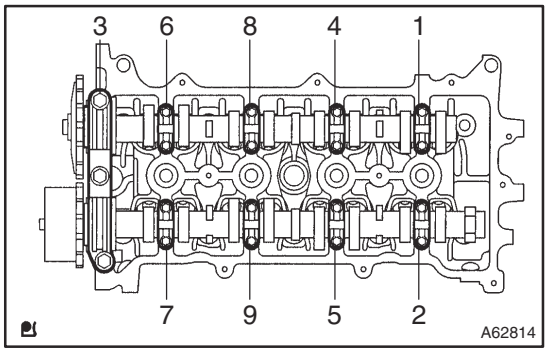
(a) Remove the bolt, then remove the camshaft timing oil control valve.



23. REMOVE OIL CONTROL VALVE FILTER

(a) Remove the bolt with the gasket and oil control valve filter.

(b) Remove the gasket and oil control valve filter from the bolt.

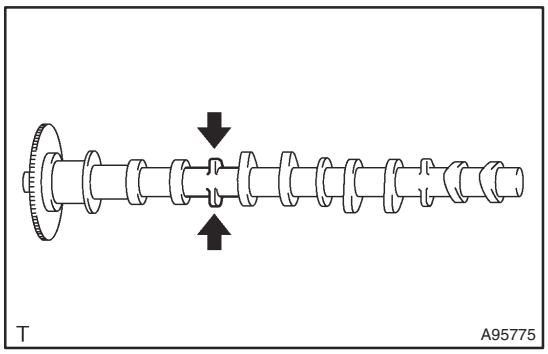


24. REMOVE CAMSHAFT

(a) Using several steps, loosen and remove the 19 bolts uniformly in the sequence shown in the illustration.

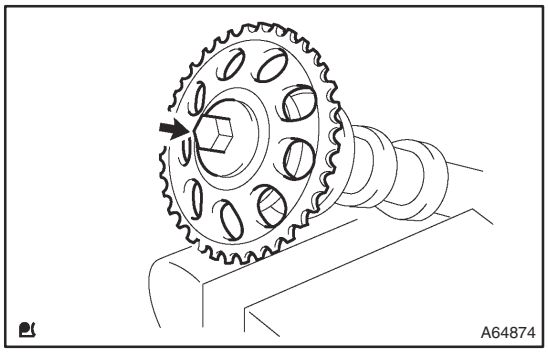
(b) Remove the 2 camshafts from the cylinder head.

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25. REMOVE CAMSHAFT TIMING GEAR OR SPROCKET

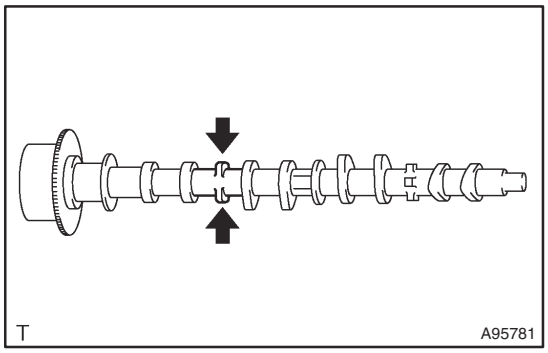
(a) Clamp the portion of the No. 2 camshaft indicated with arrow in a vise.



(b) Remove the bolt, then remove the camshaft timing gear or sprocket.

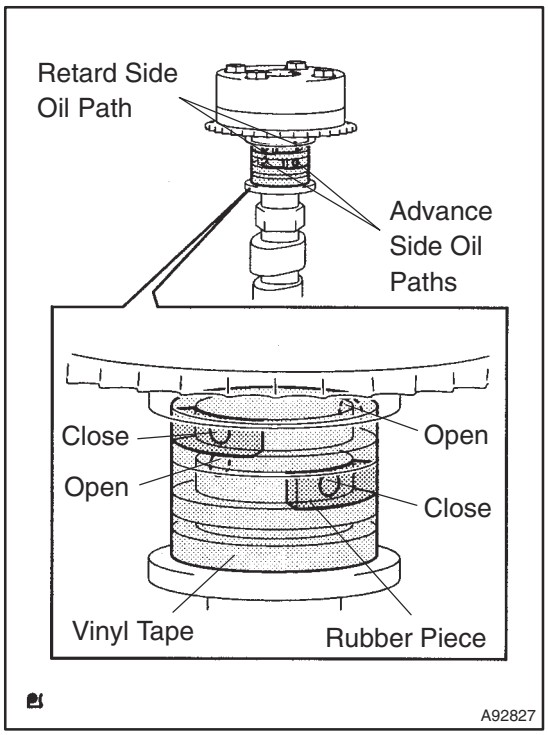
NOTICE:

Be careful not to damage the camshaft.



26. REMOVE CAMSHAFT TIMING GEAR ASSY

(a) Clamp the portion of the camshaft indicated with arrow in a vise.



(b) Check that the camshaft timing gear assembly does not rotate.

NOTICE:

Do not damage the camshaft by clamping it in a vise too tightly.

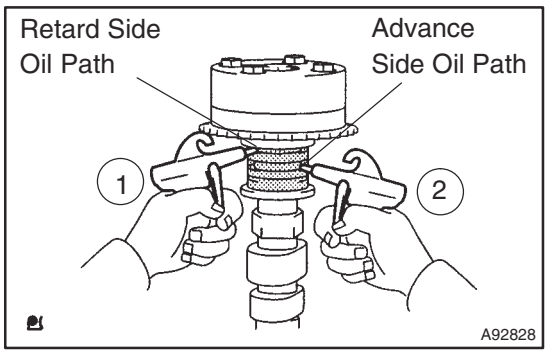
(c) Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

HINT:

One of the 2 grooves located on the cam journal is for retarding cam timing (upper) and the other is for advancing cam timing (lower). Each groove has 2 oil paths. Plug one of the 2 oil paths for each groove with rubber pieces before wrapping the cam journal with the tape.

(d) Punctuate the tape which covers the advance side path and retard side path on the opposite side.

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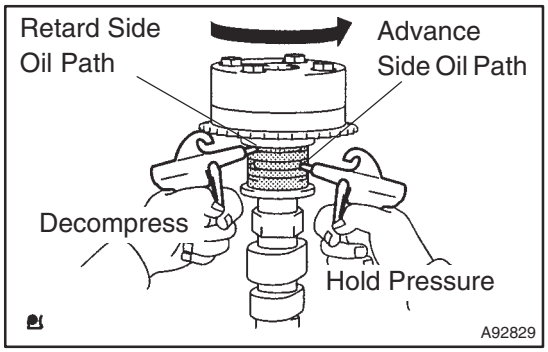


(e) Apply approximately 150 kPa (1.5 kgf/cm^2) of air pressure into the retard side oil path.

NOTICE:

When applying air pressure, cover the paths with a shop rag to prevent oil splashes.

(f) Apply approximately 150 kPa (1.5 kgf/cm^2) of air pressure into the advance side oil path.



(g) Confirm that the camshaft timing gear assembly revolves in the advance direction when reducing the air pressure of the retard side path.

HINT:

- If the timing gear assembly does not revolve in the advance direction by air pressure, turn it forcibly by hand after air pressure is applied to both oil pathes. When revolving, first turn it in the retard direction, then in the advance direction.
- The lock pin is released, and the camshaft timing gear revolves in the advance direction.

(h) When the camshaft timing gear assembly reaches the most advanced position, release the air pressure of the retard side path, then release the air pressure of the advance side path.

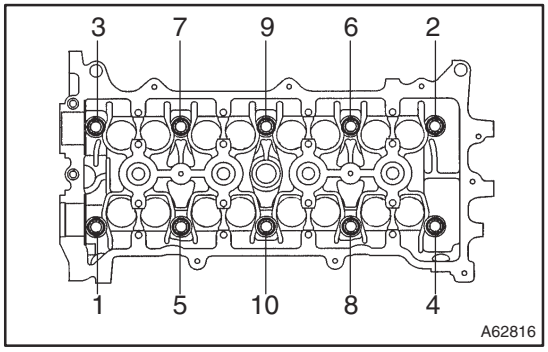
NOTICE:

If the air pressure of the advance side path is released first, the camshaft timing gear assembly occasionally shifts in the retard direction abruptly, which may damage the lock pin. Be sure to release the air pressure of the retard side path first.

(i) Remove the bolt and camshaft timing gear assembly.

NOTICE:

- **Do not remove the other 4 bolts.**
- **If reusing the camshaft timing gear assembly, unlock the lock pin inside the camshaft timing gear first.**



27. REMOVE CYLINDER HEAD SUB–ASSY

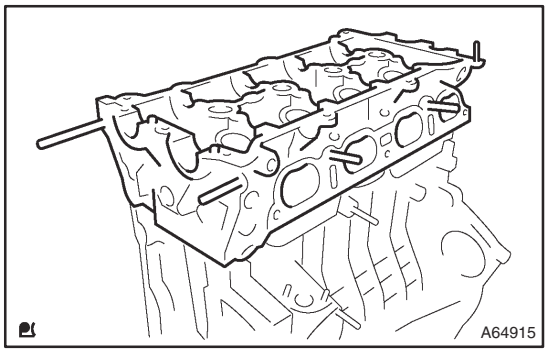
(a) Using a bi–hexagon wrench 10, uniformly loosen the 10 cylinder head bolts, in several passes, in the sequence shown.

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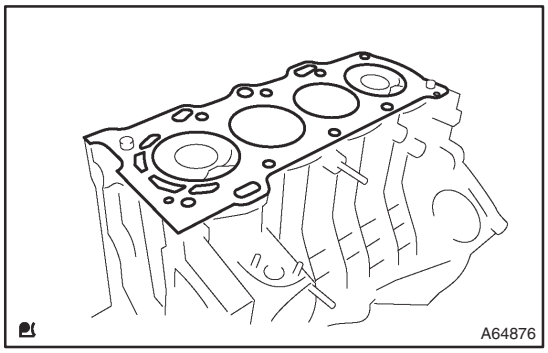
(b) Remove the 10 cylinder head bolts and 10 plate washers.

NOTICE:

- **Be careful not to drop the plate washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in the wrong order.**

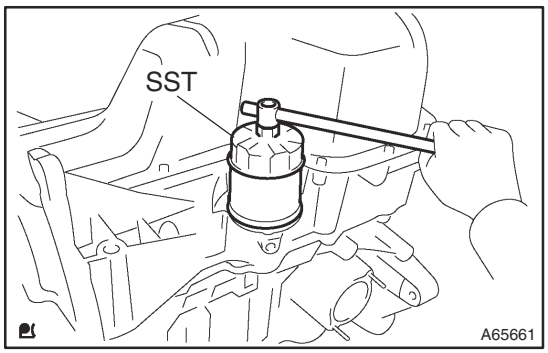


(c) Remove the cylinder head from the cylinder block.



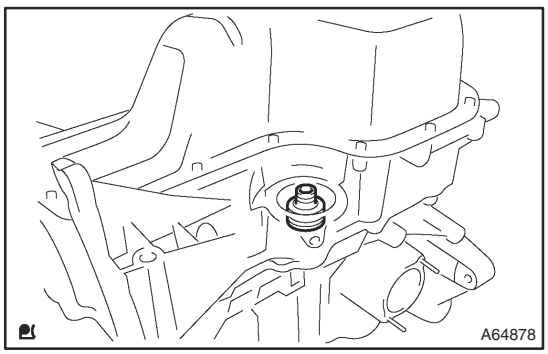
28. REMOVE CYLINDER HEAD GASKET

(a) Remove the cylinder head gasket from the cylinder block.



29. REMOVE OIL FILTER SUB–ASSY

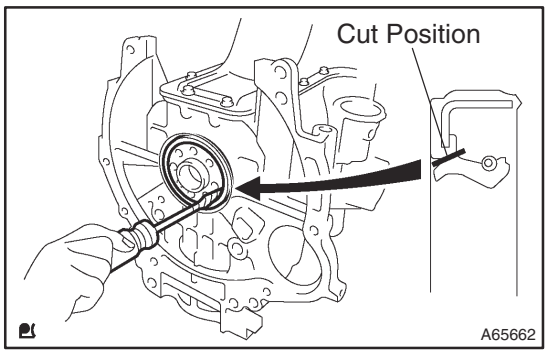
(a) Using SST, remove the oil filter.
SST 09228–06501



30. REMOVE OIL FILTER UNION

(a) Using a socket hexagon wrench 12, remove the oil filter union.

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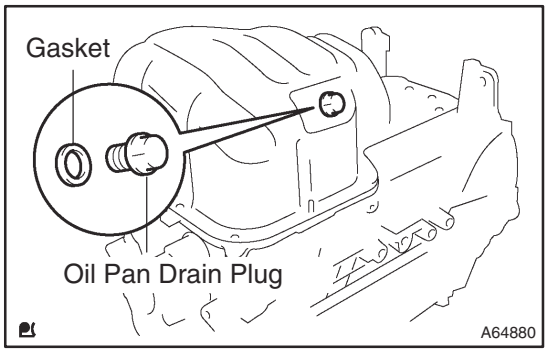
31. REMOVE ENGINE REAR OIL SEAL

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver with its tip taped, pry out the oil seal.

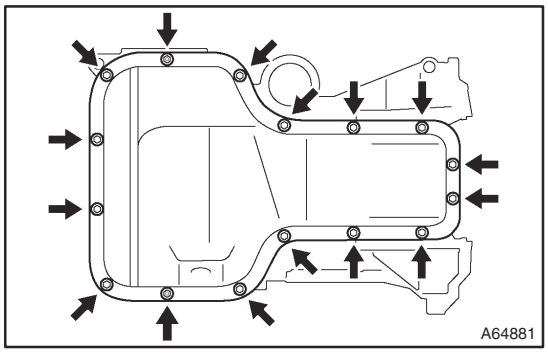
NOTICE:

After the removal, check if the crankshaft is not damaged. If damaged, smooth the surface with a 400–grit sandpaper.



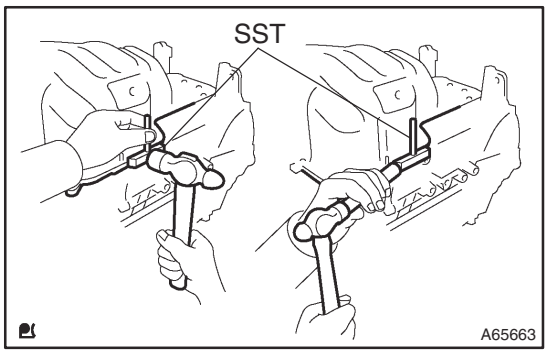
32. REMOVE OIL PAN DRAIN PLUG

(a) Remove the oil pan drain plug and gasket from the oil pan.



33. REMOVE OIL PAN SUB–ASSY

(a) Remove the 14 bolts and 2 nuts.

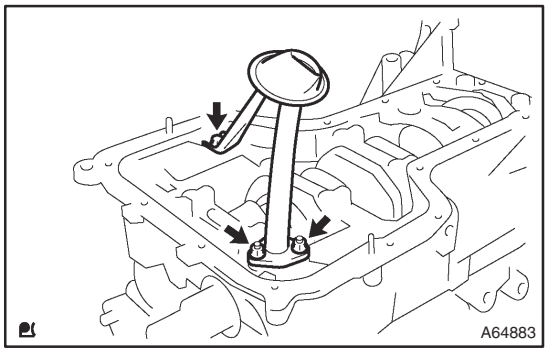


(b) Insert the blade of SST between the bearing cap and oil pan, then cut off the applied sealer and remove the oil pan.

SST 09032–00100

NOTICE:

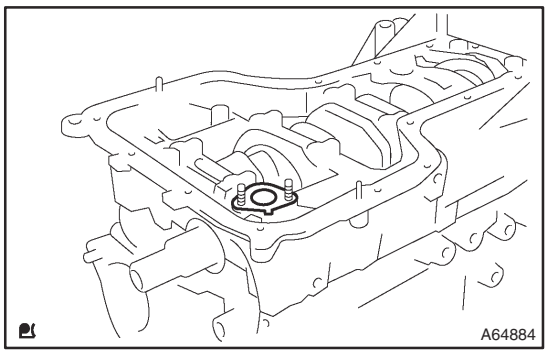
Be careful not to damage the oil pan contact surface of the bearing cap and oil pan.



34. REMOVE OIL STRAINER SUB–ASSY

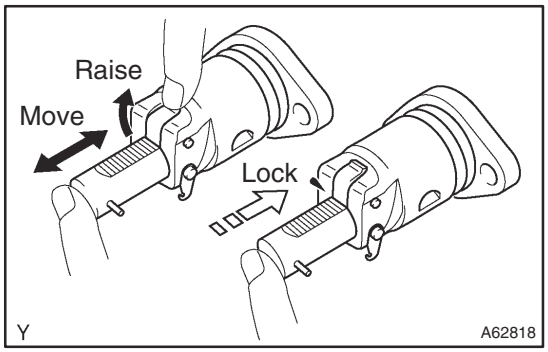
(a) Remove the bolt and 2 nuts, then remove the oil strainer.

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35. REMOVE OIL STRAINER FLANGE GASKET

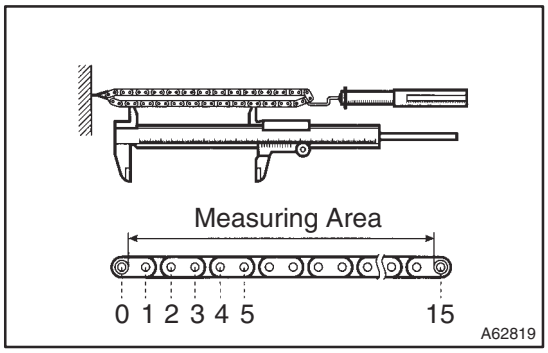
(a) Remove the oil strainer flange gasket from the cylinder block.



36. INSPECT CHAIN TENSIONER ASSY NO.1

(a) Check that the plunger moves smoothly when the ratchet pawl is raised with your finger.

(b) Release the ratchet pawl, then check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.



37. INSPECT CHAIN SUB–ASSY

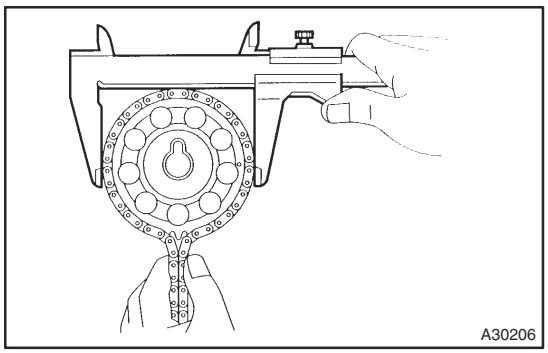
(a) Using a spring tension gauge and vernier calipers, pull the timing chain with 140 N (14.3 kgf, 31.5 lb), then measure its length.

Maximum chain elongation: 115.3 mm (4.539 in.)

If the chain elongation is greater than maximum, replace the chain.

HINT:

Take the same measurements by pulling at 3 or more places selected at random.



38. INSPECT CAMSHAFT TIMING GEAR OR SPROCKET

(a) Wrap the chain around the camshaft timing gear.

(b) Using vernier calipers, measure the camshaft timing gear diameter with the chain.

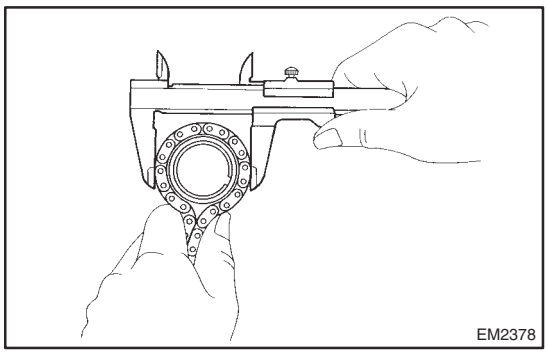
Minimum gear diameter (w/ chain): 96.8 mm (3.811 in.)

NOTICE:

Vernier calipers must be in contact with the chain rollers when measuring.

If the gear diameter is less than minimum, replace the chain and camshaft timing gear.

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39. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Wrap the chain around the crankshaft timing gear.

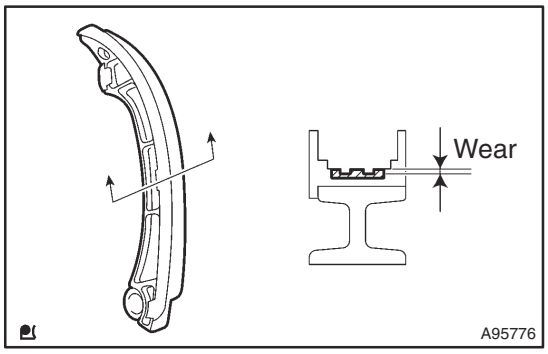
(b) Using vernier calipers, measure the crankshaft timing gear diameter with the chain.

Minimum gear diameter (w/ chain): 51.0 mm (2.008 in.)

NOTICE:

Vernier calipers must be in contact with the chain rollers when measuring

If the gear diameter is less than minimum, replace the chain and crankshaft timing gear.

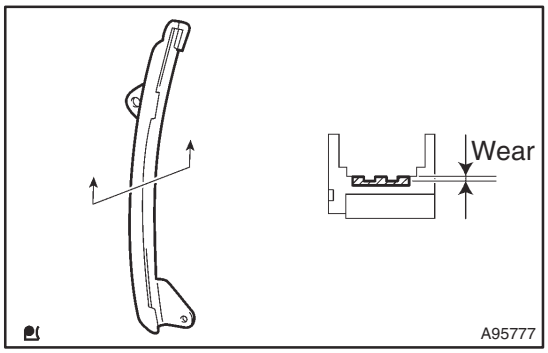


40. INSPECT CHAIN TENSIONER SLIPPER

(a) Using vernier calipers, measure the chain tensioner slipper wear.

Maximum wear: 1.0 mm (0.039 in.)

If the wear is greater than maximum, replace the chain tensioner slipper.

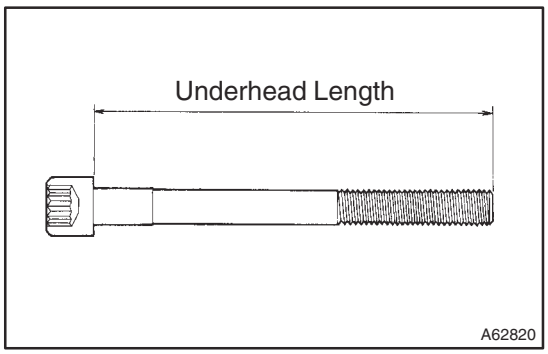


41. INSPECT CHAIN VIBRATION DAMPER NO.1

(a) Using vernier calipers, measure the vibration damper wear.

Maximum wear: 1.0 mm (0.039 in.)

If the wear is greater than maximum, replace the chain vibration damper.



42. INSPECT CYLINDER HEAD SET BOLT

(a) Using vernier calipers, measure the length of the cylinder head bolts from the seat to end.

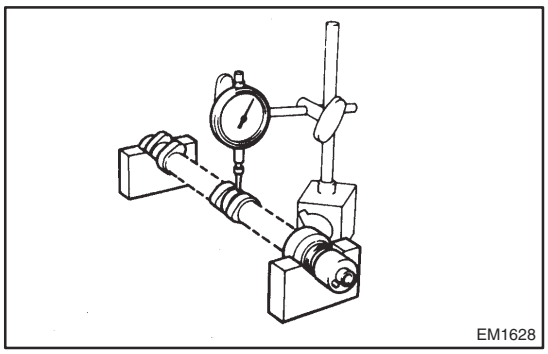
Standard bolt length:

146.8 to 148.2 mm (5.780 to 5.835 in.)

Maximum bolt length: 148.5 mm (5.846 in.)

If the bolt length is greater than maximum, replace the cylinder head set bolt.

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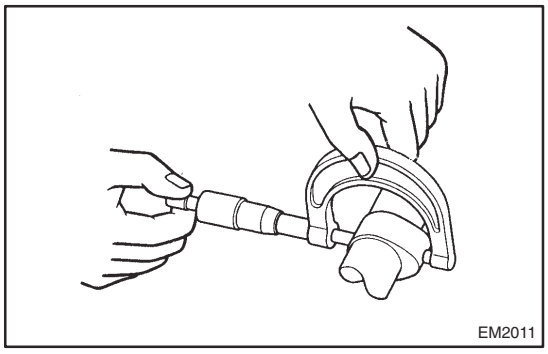


43. INSPECT CAMSHAFT

(a) Inspect the camshaft for runout.
  (1) Place the camshaft on V–blocks.
  (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.03 mm (0.0012 in.)

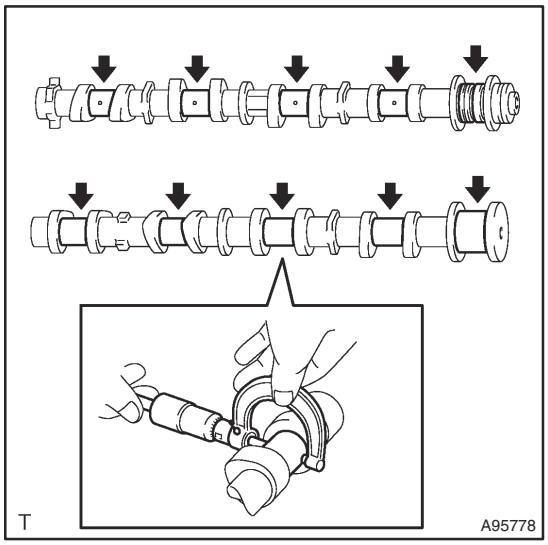
If the circle runout is greater than maximum, replace the camshaft.



(b) Inspect the cam lobes.
  (1) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:
44.333 to 44.433 mm (1.7454 to 1.7493 in.) for intake
43.761 to 43.861 mm (1.7229 to 1.7268 in.) for exhaust
Minimum cam lobe height:
44.18 mm (1.7394 in.) for intake
43.61 mm (1.7169 in.) for exhaust

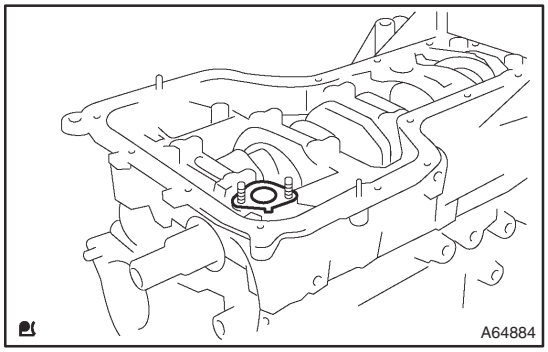
If the cam lobe height is less than minimum, replace the camshaft.



(c) Inspect the camshaft journals.
  (1) Using a micrometer, measure the journal diameter.

No. 1 journal diameter:
34.449 to 34.465 mm (1.3563 to 1.3569 in.)
Other journal diameter:
22.949 to 22.965 mm (0.9035 to 0.9041 in.)

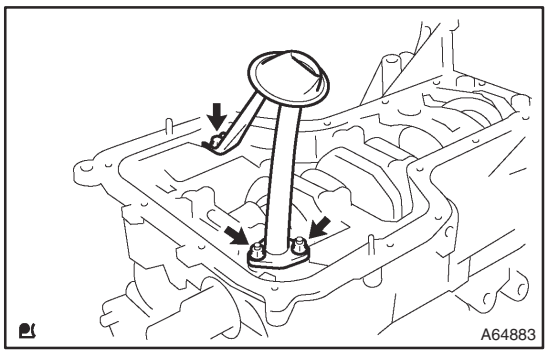
If the journal diameter is not as specified, check the oil clearance.



44. INSTALL OIL STRAINER FLANGE GASKET

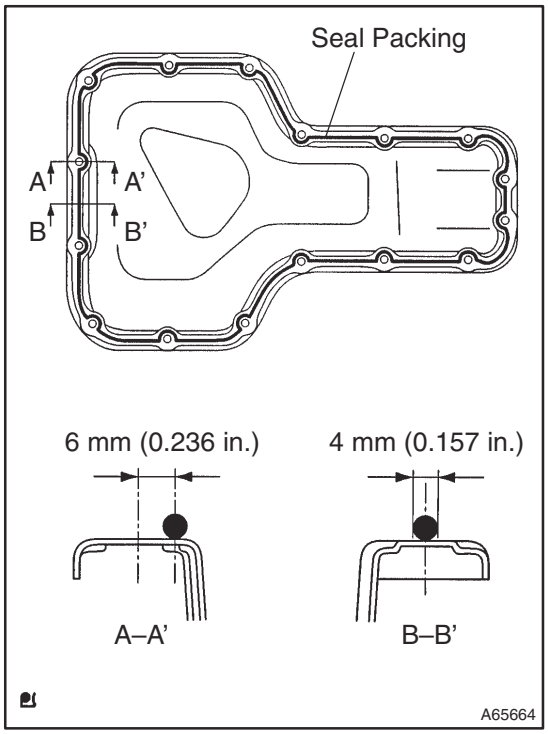
(a) Install a new oil strainer flange gasket onto the cylinder block.

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45. INSTALL OIL STRAINER SUB–ASSY

(a) Install the oil strainer with the 2 nuts and bolt.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



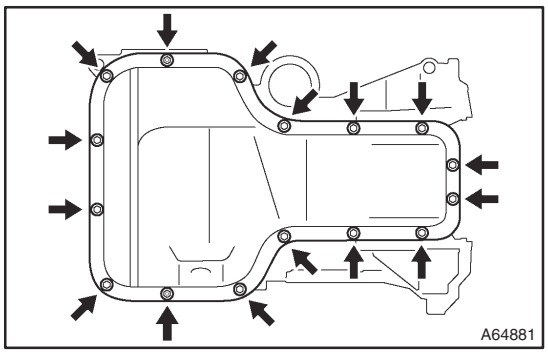
46. INSTALL OIL PAN SUB–ASSY

(a) Remove any old packing material from the contact surface and thread holes.

(b) Apply a continuous bead of seal packing (Diameter 3.5 to 4.5 mm (0.138 to 0.177 in.)) as shown in the illustration.
Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

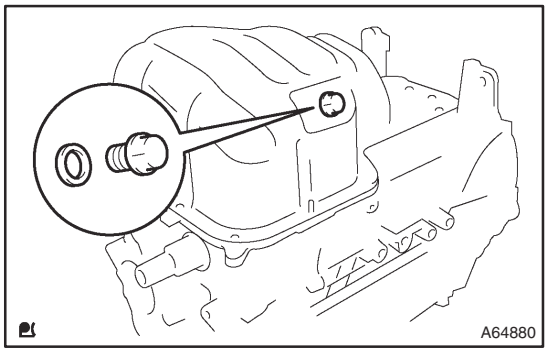
- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **Do not put into engine oil for at least 2 hours after installation.**



(c) Install the oil pan with the 14 bolts and 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

NOTICE:

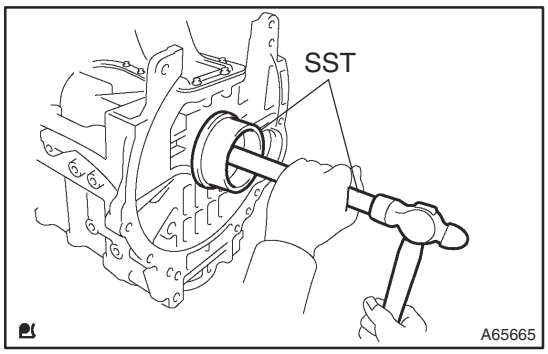
- **Tighten the bolts and nuts in twice to the specified torque.**
- **Tighten bolts and nuts within 15 minutes after applying sealant (if possible within 3 minutes).**



47. INSTALL OIL PAN DRAIN PLUG

(a) Place a new gasket on the oil pan drain plug, then install it onto the oil pan.
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)

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48. INSTALL ENGINE REAR OIL SEAL

(a) Apply a light coat of multi–purpose grease to a new oil seal lip.

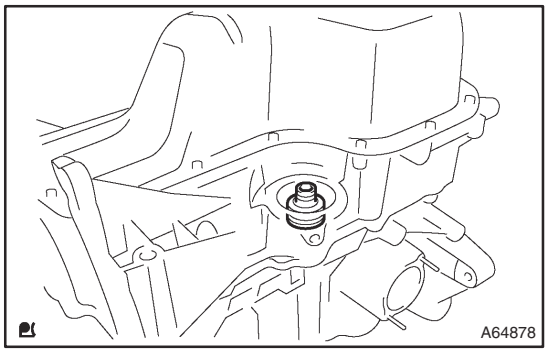
NOTICE:

Keep the lip free of foreign materials.

(b) Using SST, tap in the oil seal until its surface is flush with the oil seal retainer edge.
SST 09223–15020, 09950–70010 (09951–07100)

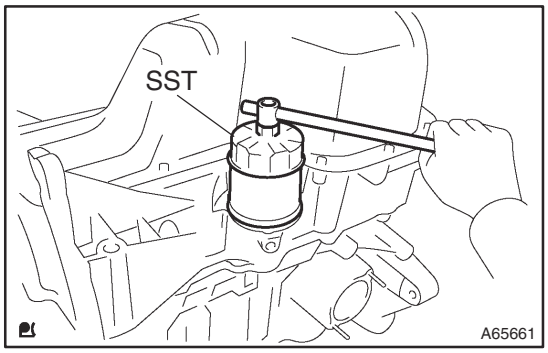
NOTICE:

Wipe off extra grease on the crankshaft.



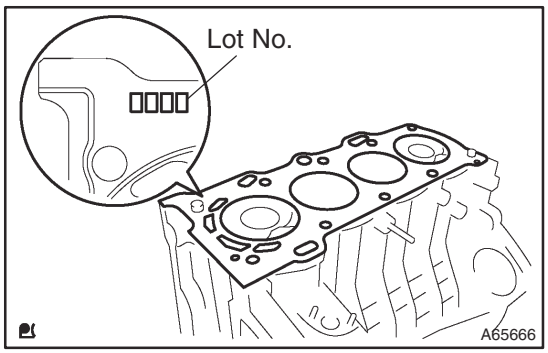
49. INSTALL OIL FILTER UNION

(a) Using a socket hexagon wrench 12, install the oil filter union.
Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)



50. INSTALL OIL FILTER SUB–ASSY

(a) Check and clean the oil filter installation surface.
(b) Apply clean engine oil to the gasket of a new oil filter.
(c) Lightly screw the oil filter into place, then tighten it until the gasket comes into contact with the seat.
(d) Using SST, tighten it an additional 3/4 turn.
SST 09228–06501
Torque: 13 N·m (133 kgf·cm, 9.6 ft·lbf)

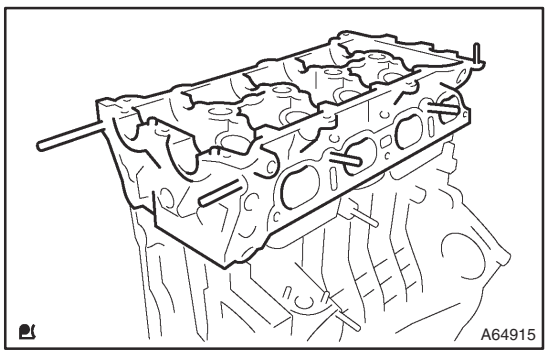


51. INSTALL CYLINDER HEAD GASKET

(a) Place a new cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.

NOTICE:

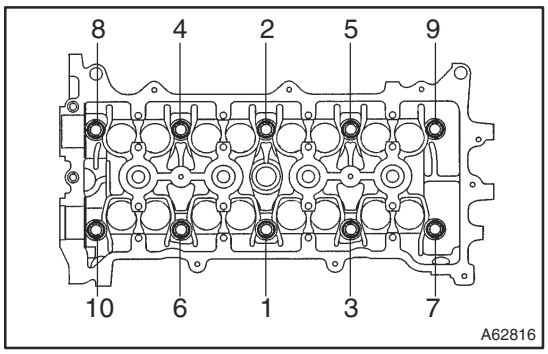
- **Pay attention to the installation direction.**
- **Place the cylinder head gently in order not to damage the gasket.**



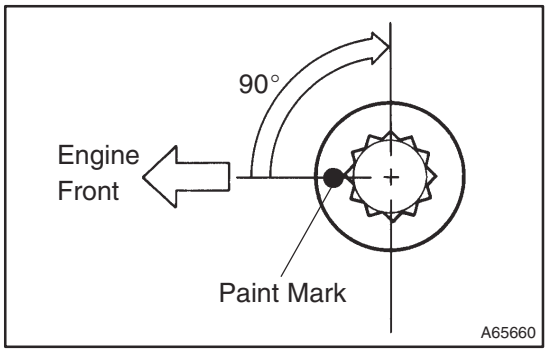
52. INSTALL CYLINDER HEAD SUB–ASSY

(a) Place the cylinder head on the cylinder block.
(b) Apply a light coat of engine oil to the threads and the bottom of the heads of the cylinder head bolts.

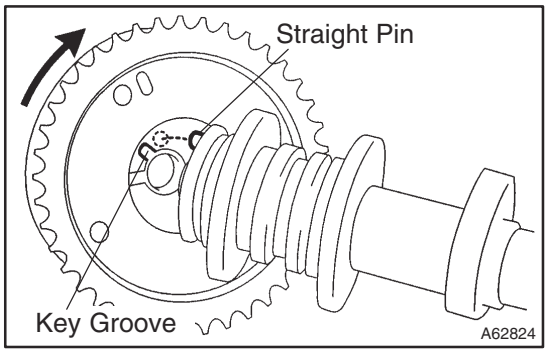
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(c) Using a bi–hexagon wrench 10, install and uniformly tighten the 10 cylinder head bolts with plate washers, in several passes, in the sequence shown.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)



(d) Mark the front of the cylinder head bolt with paint.
(e) Retighten the cylinder head bolts by an additional 90° in the numerical order shown.
(f) Check that the point mark of each bolt is at a 90° angle to the front.

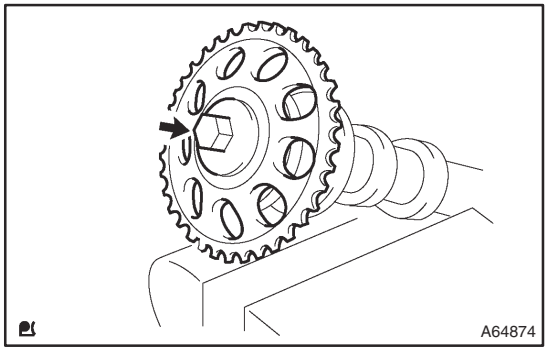


53. INSTALL CAMSHAFT TIMING GEAR ASSY

(a) Put the camshaft timing gear together with the camshaft with the straight pin off the key groove.
(b) Turn the camshaft timing gear in the left direction as shown in the illustration while pushing it lightly against the camshaft. Push the camshaft timing gear until its pin is fitted into the key.

CAUTION:
Be sure not to turn the camshaft timing gear to the retard angle side (the right angle).

(c) Check that there is no clearance between the gear's fringe and camshaft.
(d) Tighten the fringe bolt with the camshaft timing gear fixed.
Torque: 54 N·m (551 kgf·cm 40 ft·lbf)
(e) Check that the camshaft timing gear assembly can move to the retard angle side (the right angle), and is locked at the most retarded position.

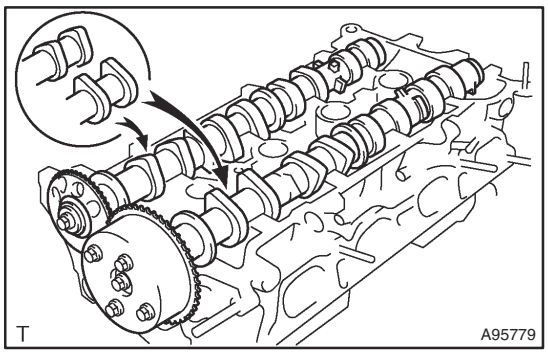


54. INSTALL CAMSHAFT TIMING GEAR OR SPROCKET

(a) Clamp the camshaft in a vise, then install the camshaft timing gear with the bolt.
Torque: 54 N·m (551 kgf·cm 40 ft·lbf)

NOTICE:
Be careful not to damage the camshaft.

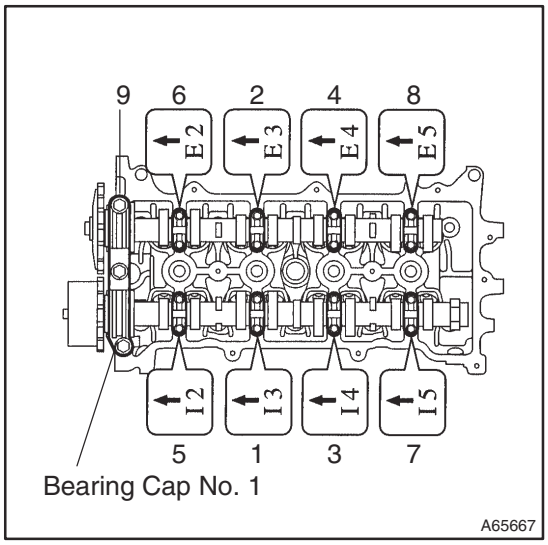
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55. INSTALL CAMSHAFT

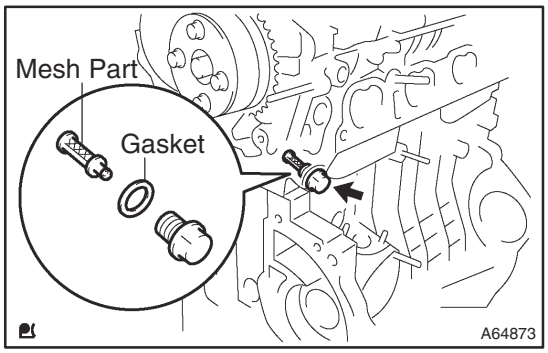
(a) Apply a light coat of engine oil to the camshaft journals.

(b) Place the 2 camshafts on the cylinder head with the No. 1 cylinder cam lobes facing as shown in the illustration.



(c) Examine the front marks and numbers, then tighten the bolts in the order shown in the illustration.

Torque:
23 N·m (235 kgf·cm, 17 ft·lbf) for bearing cap No. 1
13 N·m (133 kgf·cm, 10 ft·lbf) for the other bearing caps

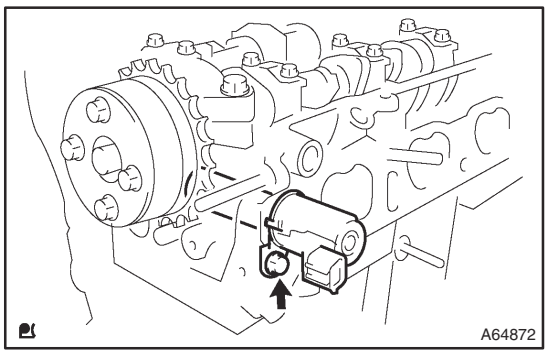


56. INSTALL OIL CONTROL VALVE FILTER

(a) Check that there is no foreign objects on the mesh part of the oil control valve filter.

(b) Install a new gasket and the oil control valve filter onto the bolt, then install it.

Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)



57. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSY

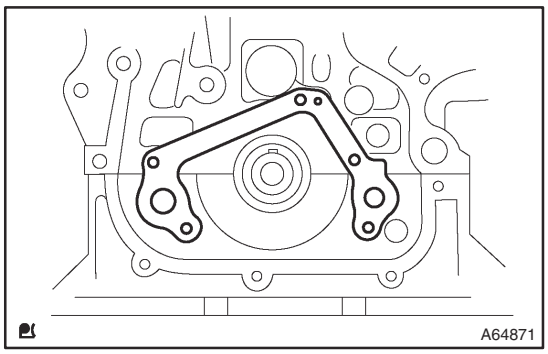
(a) Apply a light coat of engine oil to a new O–ring, then install it onto the camshaft timing oil control valve.

(b) Install the camshaft timing oil control valve with the bolt.

Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

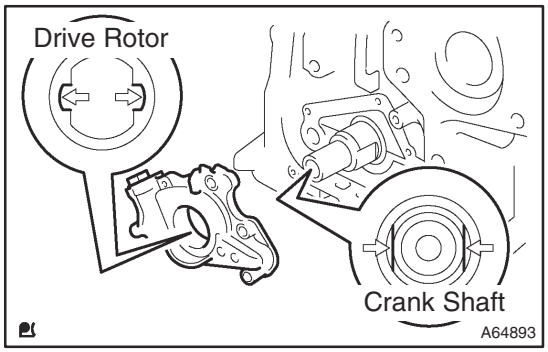
NOTICE:
Be careful not to twist the O–ring.

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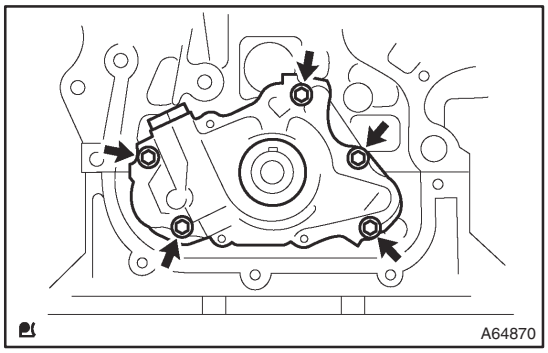
58. INSTALL OIL PUMP GASKET

(a) Install a new gasket onto the cylinder block.

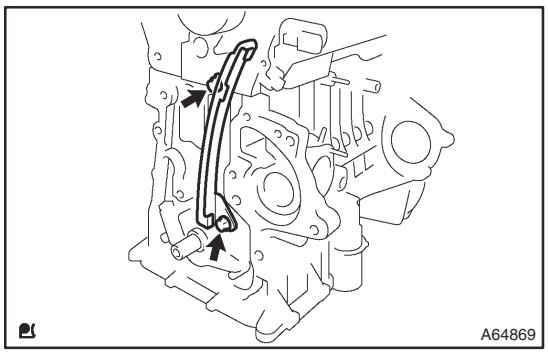


59. INSTALL OIL PUMP ASSY

(a) Align the spline teeth of the oil pump drive rotor with the large teeth of the crankshaft, then slide the oil pump.

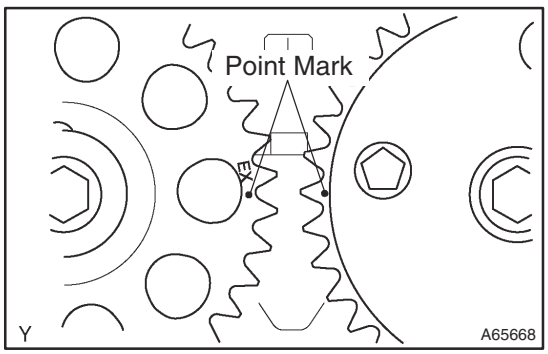


(b) Install the oil pump with the 5 bolts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



60. INSTALL CHAIN VIBRATION DAMPER NO.1

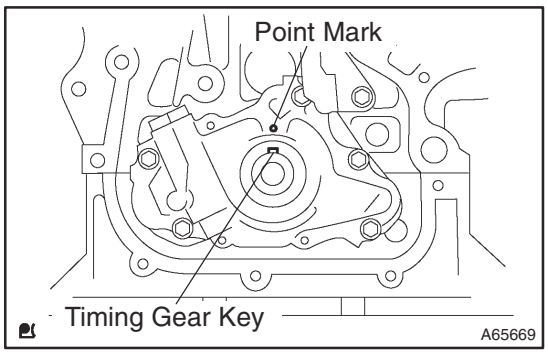
(a) Install chain vibration damper No. 1 with the 2 bolts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



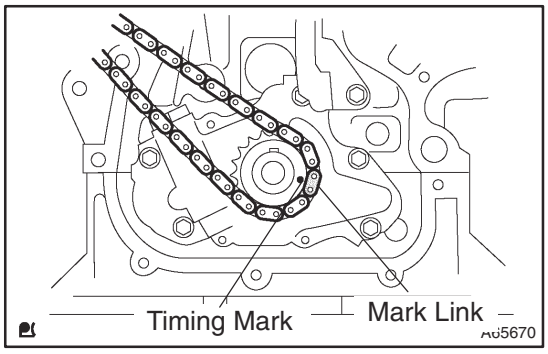
61. INSTALL CHAIN SUB–ASSY

(a) Set No. 1 cylinder to the TDC/compression.
(1) Turn the hexagonal wrench head portion of the camshafts until the point marks of the camshaft timing gears are aligned.

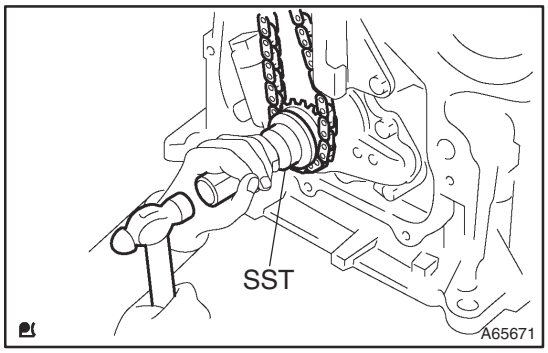
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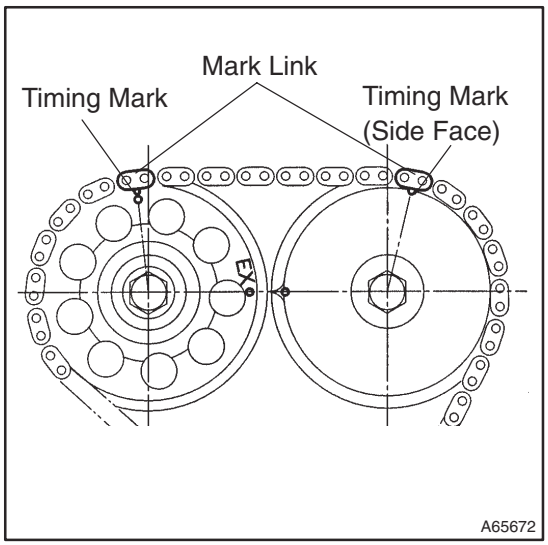
(2) Using a crankshaft pulley bolt, turn the crankshaft to align the timing gear key with the point mark on the oil pump.



(b) Install the chain onto the crankshaft timing gear with the yellow mark link aligned with the timing mark on the crankshaft timing gear.

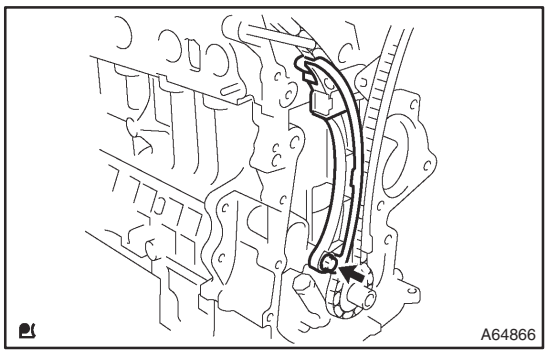


(c) Using SST, install the crankshaft timing gear.
SST 09223–22010



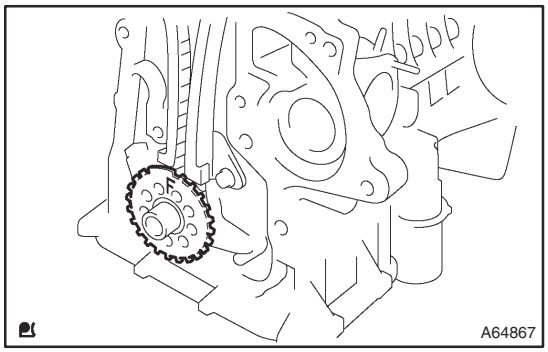
(d) Install the chain onto the camshaft timing gears with the yellow mark links aligned with the timing marks on the camshaft timing gears.

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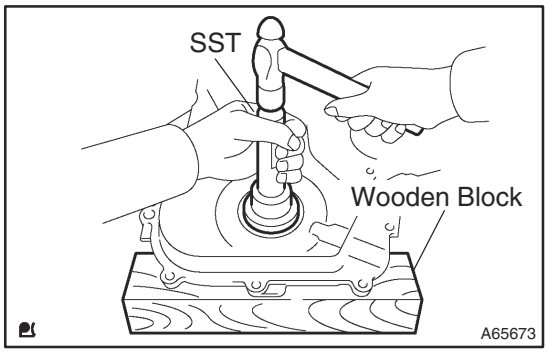
62. INSTALL CHAIN TENSIONER SLIPPER

(a) Install the chain tensioner slipper with the bolt.
Torque: 19 N·m (189 kgf·cm, 14 ft·lbf)



63. INSTALL CRANKSHAFT POSITION SENSOR PLATE NO.1

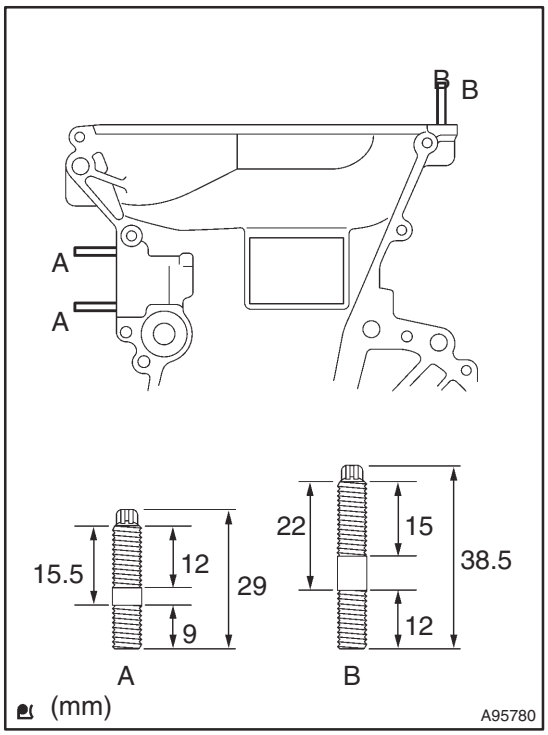
(a) Install the crankshaft position sensor plate with the ”F” mark facing forward.



64. INSTALL TIMING CHAIN OR BELT COVER OIL SEAL

(a) Apply a light coat of multi–purpose grease to a new oil seal lip.
(b) Place the timing chain cover on wooden blocks.
(c) Using SST, tap in the new oil seal until its surface is flush with the timing chain cover edge.
SST 09223–22010

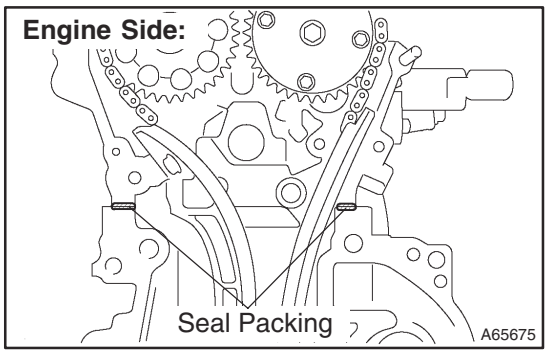
NOTICE:
Keep the lip free of foreign objects.



65. INSTALL TIMING CHAIN OR BELT COVER SUB–ASSY

(a) Remove any old packing material from the contact surface.
(b) Using a Torx socket wrench E5, install the 3 stud bolts.
Torque: 5.0 N·m (51 kgf·cm, 44 in.·lbf)

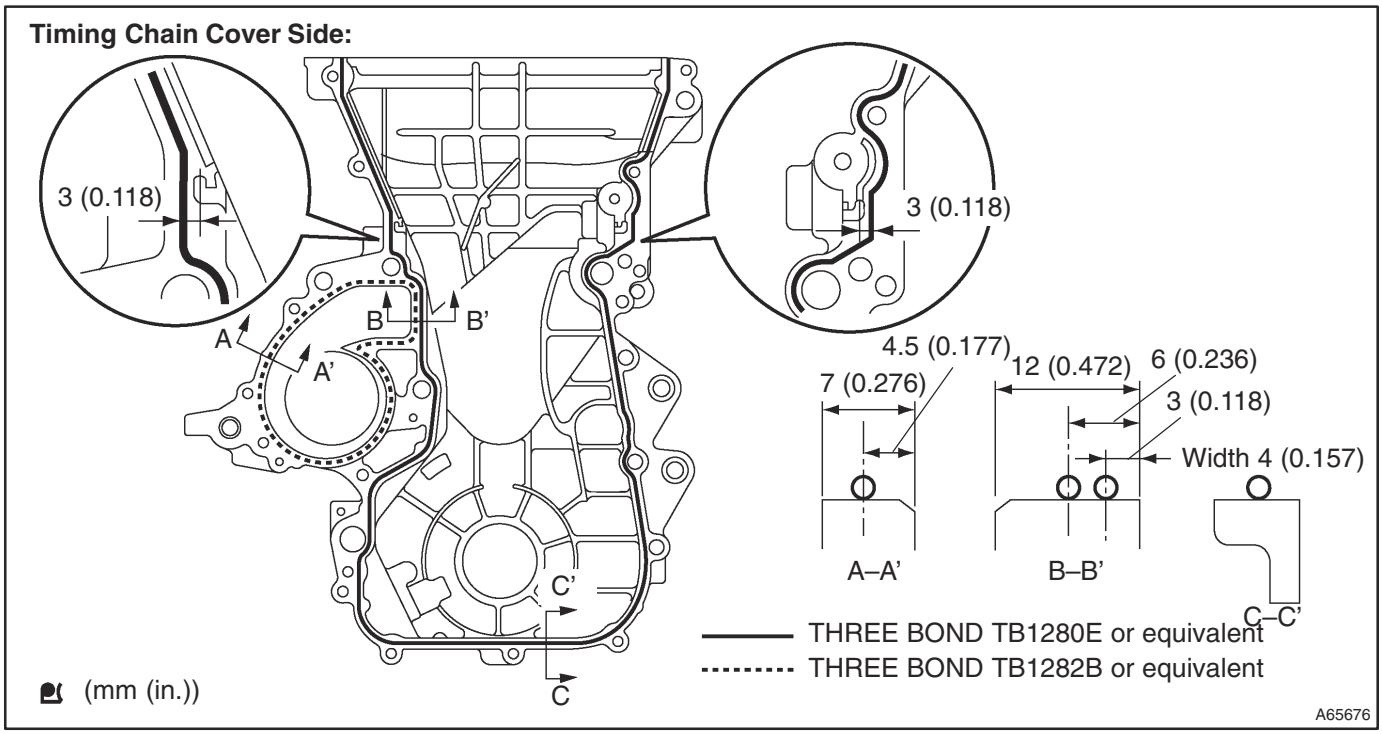
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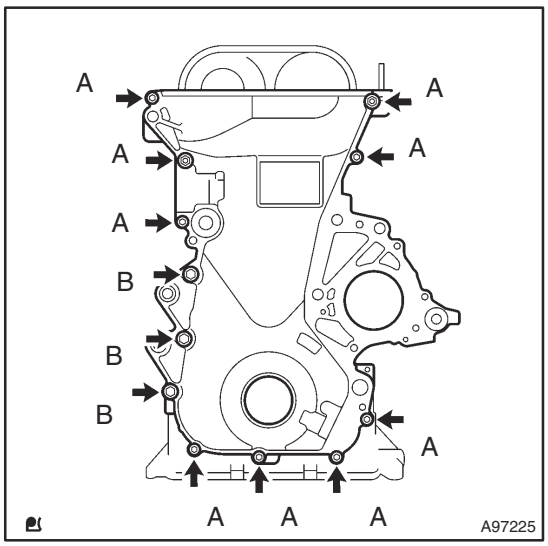


(c) Apply a continuous bead of seal packing (Diameter; 3.5 to 4.5 mm (0.138 to 0.177 in.)) as shown in the illustration.
Seal packing:
Water pump part: THREE BOND TB1282B or equivalent
Other part: THREE BOND TB1280E or equivalent

NOTICE:

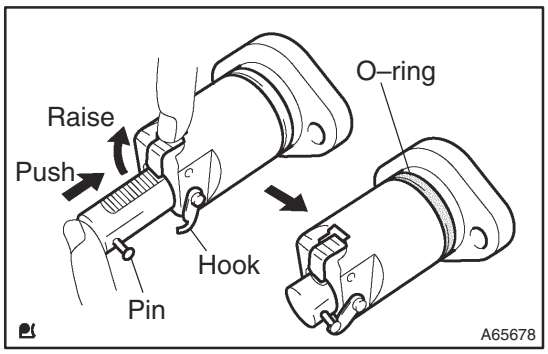
- **Remove any oil from the contact surface.**
- **Install the chain cover within 3 minutes after applying seal packing.**
- **Do not put into engine oil for at least 2 hours after installation.**
- **Be careful to only apply the specified thickness/volume of seal packing.**





(d) Install the timing chain cover with the 10 bolts and 2 nuts.
Torque:
13 N·m (133 kgf·cm, 10 ft·lbf) for A
19 N·m (189 kgf·cm, 14 ft·lbf) for B

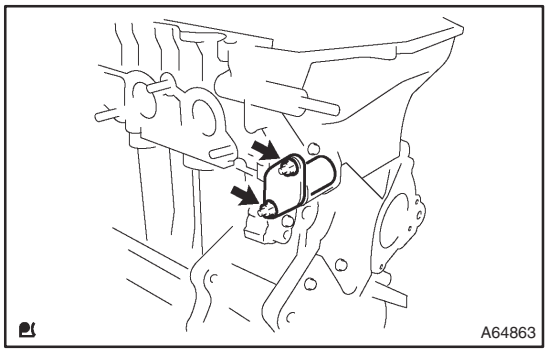
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66. INSTALL CHAIN TENSIONER ASSY NO.1

(a) Check that the O–ring is clean, then set the hook as shown in the illustration.

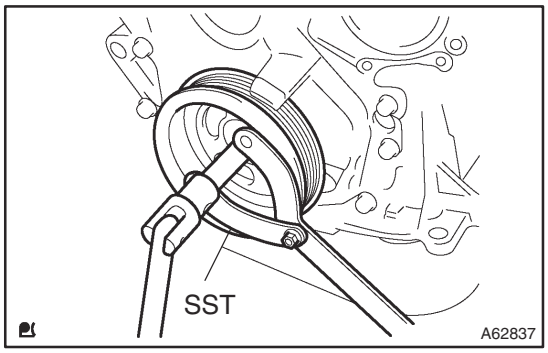
(b) Apply a light coat of engine oil to the O–ring.



(c) Install the chain tensioner with the 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

NOTICE:

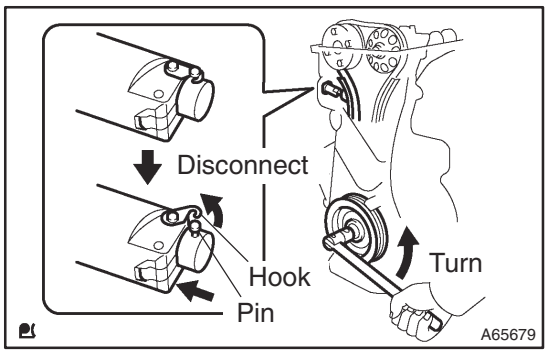
- **Be careful not to twist the O–ring.**
- **When installing the chain tensioner, reset the hook if the hook releases the plunger.**



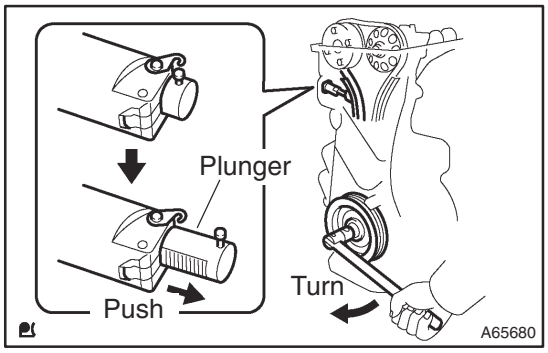
67. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the crankshaft pulley, then slide it on the crankshaft pulley.

(b) Using SST, install the crankshaft pulley bolt.
SST 09960–10010 (09962–01000, 09963–01000)
Torque: 138 N·m (1,407 kgf·cm, 102 ft·lbf)



(c) Turn the crankshaft counterclockwise, then disconnect the plunger knock pin from the hook.

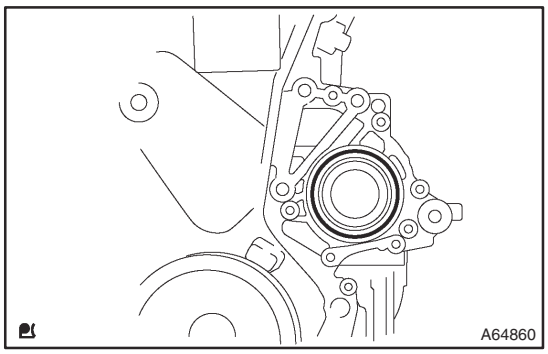


(d) Turn the crankshaft clockwise, then check that the slipper is pushed by the plunger.

HINT:

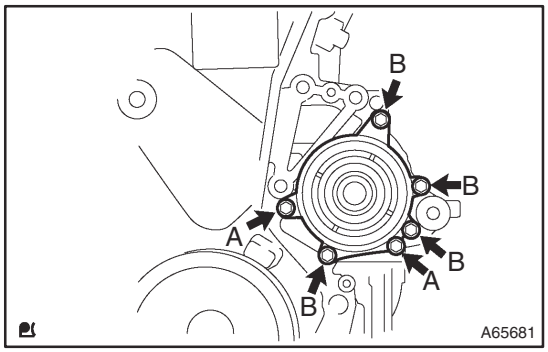
If the plunger is not extended, press the slipper into the chain tensioner using a screwdriver so that the hook is taken from the knock pin and that the plunger can be extended.

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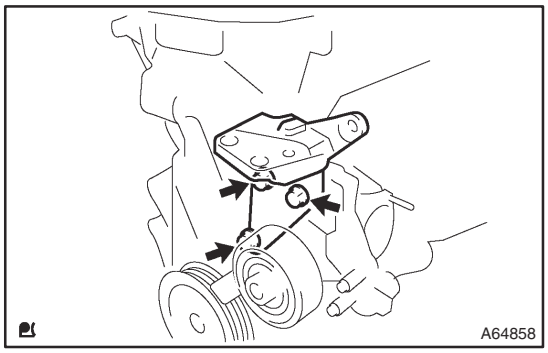
68. INSTALL WATER PUMP O–RING

(a) Install a new water pump O–ring onto the timing chain cover.



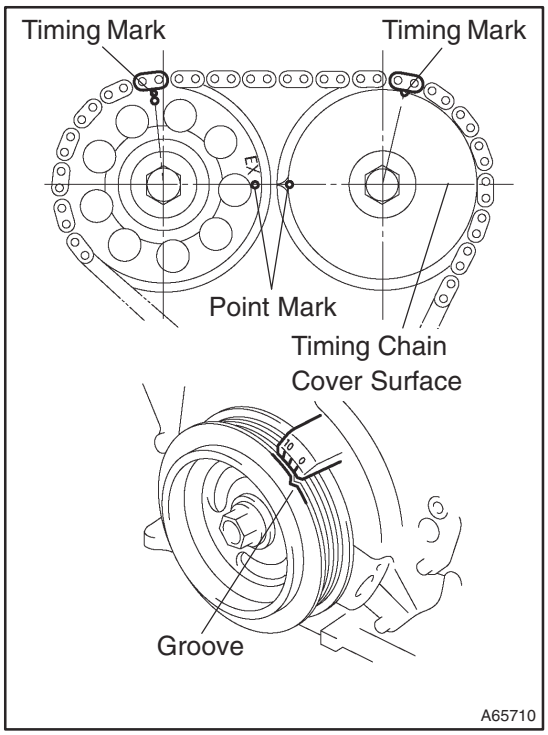
69. INSTALL WATER PUMP ASSY

(a) Install the water pump with the 6 bolts.
Torque:
9.0 N·m (92 kgf·cm, 80 in·lbf) for bolt A
11 N·m (112 kgf·cm, 8 ft·lbf) for bolt B



70. INSTALL TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

(a) Install the transverse engine engine mounting bracket with the 3 bolts.
Torque: 47 N·m (479 kgf·cm, 35 ft·lbf)



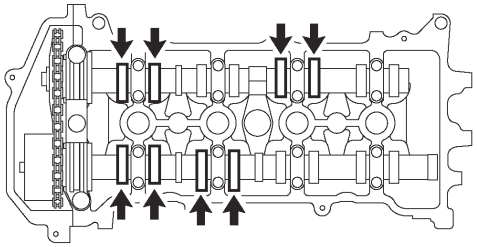
71. INSPECT VALVE CLEARANCE

(a) Set the No. 1 cylinder to the TDC/compression.
(1) Turn the crankshaft pulley until the groove is aligned with the timing mark ”0” of the timing chain cover.
(2) Check that the point marks of the camshaft timing gears are in a straight line on the timing chain cover surface as shown in the illustration.

HINT:
If not, turn the crankshaft 1 revolution (360°) to align the marks as above.

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No. 1 Cylinder TDC/Compression:



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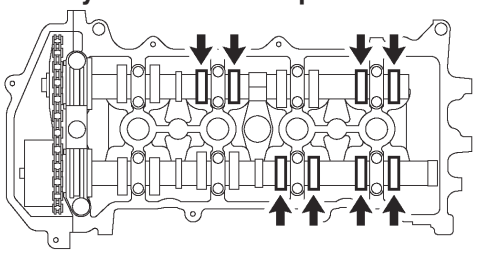
(b) Check the valves indicated with arrow.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
(2) Record the out–of–specification valve clearance measurements. They will be used later to determine the required replacement valve lifters.

Valve clearance (Cold):
0.15 to 0.25 mm (0.0059 to 0.0098 in.) for intake
0.25 to 0.35 mm (0.0098 to 0.0138 in.) for exhaust

If the valve clearance is not as specified, replace the valve lifters.

(c) Turn the crankshaft 1 revolution (360°) and set the No. 4 cylinder to the TDC/compression.

No. 4 Cylinder TDC/Compression:

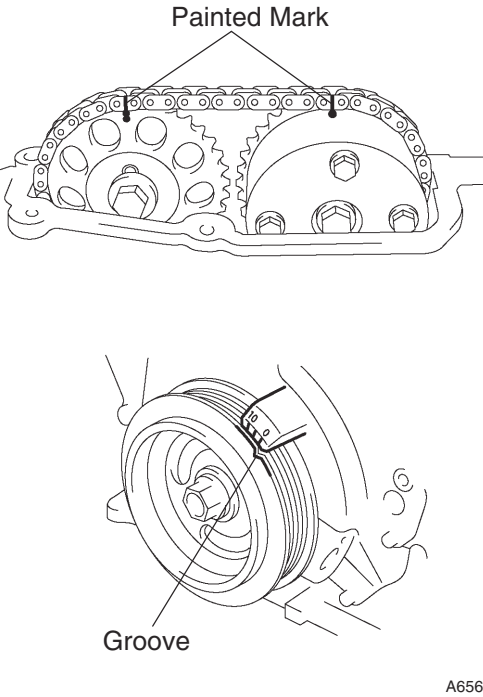


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(d) Check only the valves indicated.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
(2) Record the out–of–specification valve clearance measurements. They will be used later to determine the required replacement valve lifters.

Valve clearance (Cold):
0.15 to 0.25 mm (0.0059 to 0.0098 in.) for intake
0.25 to 0.35 mm (0.0098 to 0.0138 in.) for exhaust

If the valve clearance is not as specified, replace the valve lifters.



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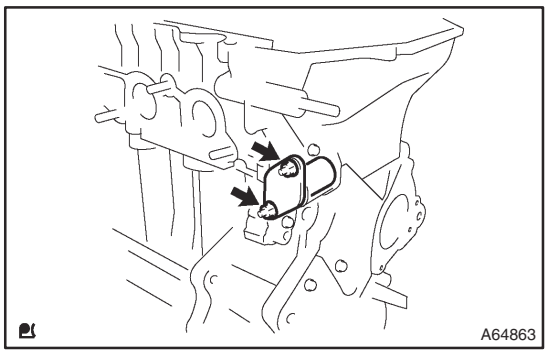
72. ADJUST VALVE CLEARANCE

NOTICE:

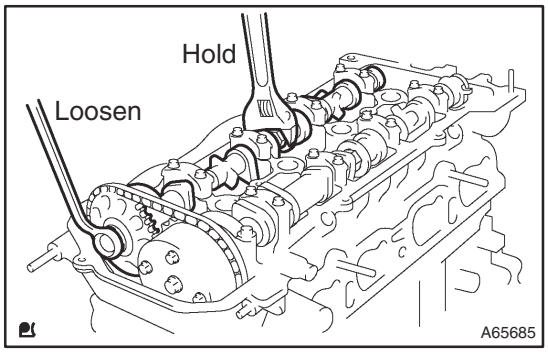
Be sure not to revolve the crankshaft without the chain tensioner.

(a) Set the No. 1 cylinder to the TDC/compression.
(b) Place painted marks on the chain and camshaft timing gears.

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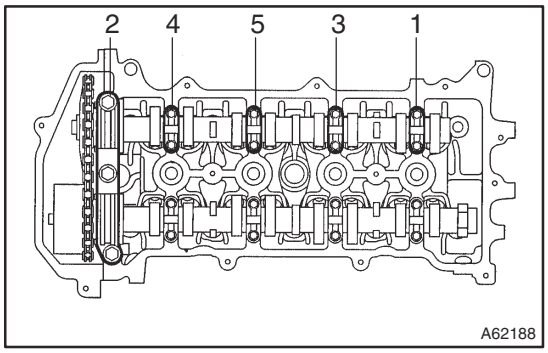


(c) Remove the 2 nuts and chain tensioner.

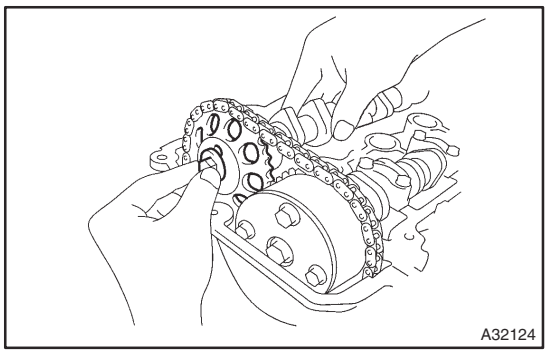


(d) Hold the camshaft with a wrench and so on, then loosen the camshaft timing gear set bolt.

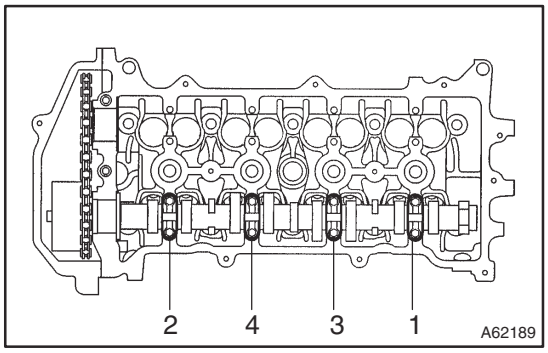
NOTICE:
Be careful not to damage the valve lifter.



(e) Loosen the bearing cap bolts on the No. 2 camshaft in the order as shown in the illustration, in several passes, then remove the bearing caps.

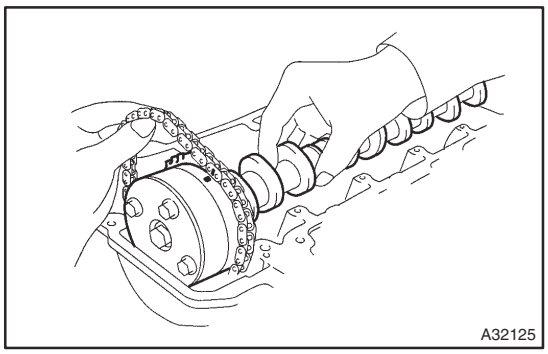


(f) Remove the camshaft timing gear as shown in the illustration.

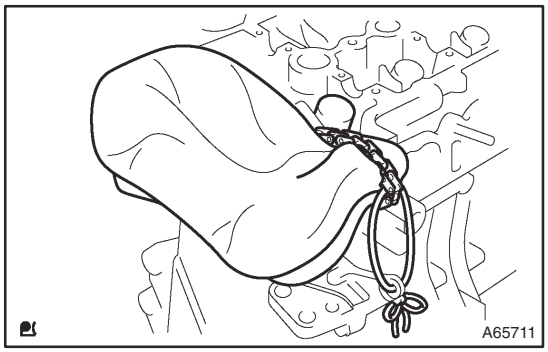


(g) Loosen the bearing cap bolts on the camshaft in the order as shown in the illustration, in several passes, then remove the bearing caps.

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(h) Remove the camshaft while holding the chain.

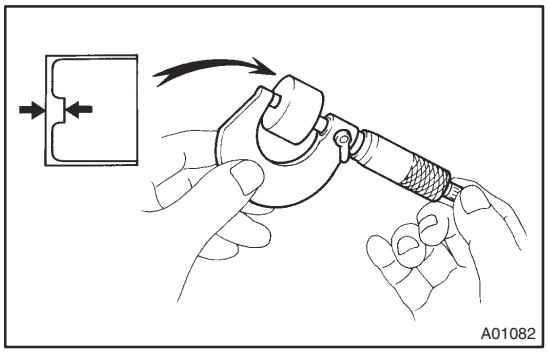


(i) Tie the chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.

(j) Remove the valve lifters.



(k) Using a micrometer, measure the thickness of the removed valve lifters.

(l) Calculate the thickness of a new lifter so that the valve clearance comes within the specified value.

A	Thickness of new lifter
B	Thickness of used lifter
C	Measured valve clearance

Valve clearance:
Intake A = B + (C – 0.20 mm (0.0079 in.))
Exhaust A = B + (C – 0.30 mm (0.0118 in.))

Example (Intake):
Measured intake valve clearance = 0.40 mm (0.0158 in.)
0.40 mm (0.0158 in.) – 0.20 mm (0.0079 in.) = 0.20 mm (0.0079 in.)
(Measured – Specification = Excess clearance)
Used lifter measurement = 5.250 mm (0.2067 in.)
0.20 mm (0.0079 in.) + 5.250 mm (0.2067 in.) = 5.450 mm (0.2146 in.)
(Excess clearance + Used lifter = Ideal new lifter)
Closest new lifter = 5.460 mm (0.2150 in.)
Select No. 46 lifter

HINT:

- Select a new lifter with a thickness as close to the calculated values as possible.
- Lifter are available in 35 sizes in increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).
- Refer to the New Lifter Thickness Table on the next 2 pages.

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Valve Lifter Selection Chart (Intake)

Measured Clearance mm (in.) \ Installed Lifter Thickness mm (in.)	5.060 (0.1992)	5.080 (0.2000)	5.100 (0.2008)	5.120 (0.2016)	5.140 (0.2024)	5.160 (0.2031)	5.180 (0.2039)	5.200 (0.2047)	5.210 (0.2051)	5.220 (0.2055)	5.230 (0.2059)	5.240 (0.2063)	5.250 (0.2067)	5.260 (0.2071)	5.270 (0.2075)	5.280 (0.2079)	5.290 (0.2083)	5.300 (0.2087)	5.310 (0.2091)	5.320 (0.2094)	5.330 (0.2098)	5.340 (0.2102)	5.350 (0.2106)	5.360 (0.2110)	5.370 (0.2114)	5.380 (0.2118)	5.390 (0.2122)	5.400 (0.2126)	5.410 (0.2130)	5.420 (0.2134)	5.430 (0.2138)	5.440 (0.2142)	5.450 (0.2146)	5.460 (0.2150)	5.470 (0.2154)	5.480 (0.2157)	5.490 (0.2161)	5.500 (0.2165)	5.510 (0.2169)	5.520 (0.2173)	5.530 (0.2177)	5.540 (0.2181)	5.550 (0.2185)	5.560 (0.2189)	5.570 (0.2193)	5.580 (0.2197)	5.590 (0.2201)	5.600 (0.2205)	5.620 (0.2213)	5.640 (0.2220)	5.660 (0.2228)	5.680 (0.2236)	5.700 (0.2244)	5.720 (0.2252)	5.740 (0.2260)
0.000 – 0.030 (0.0000 – 0.0012)									06	06	06	06	06	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	46	48	50	52	54	56
0.031 – 0.050 (0.0012 – 0.0020)							06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58
0.051 – 0.070 (0.0020 – 0.0028)						06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	50	52	54	56	58	60
0.071 – 0.090 (0.0028 – 0.0035)					06	06	06	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62
0.091 – 0.110 (0.0036 – 0.0043)				06	06	06	08	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	54	56	58	60	62	64
0.111 – 0.130 (0.0044 – 0.0051)			06	06	06	08	10	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	56	58	60	62	64	66
0.131 – 0.149 (0.0052 – 0.0059)		06	06	06	08	10	12	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	58	60	62	64	66	68
0.150 – 0.250 (0.0059 – 0.0098)																																																								
0.251 – 0.270 (0.0099 – 0.0106)	12	14	16	18	20	22	24	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	70	72	74	74	74
0.271 – 0.290 (0.0107 – 0.0114)	14	16	18	20	22	24	26	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	72	74	74	74	
0.291 – 0.310 (0.0115 – 0.0122)	16	18	20	22	24	26	28	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	74	74	74		
0.311 – 0.330 (0.0122 – 0.0130)	18	20	22	24	26	28	30	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74			
0.331 – 0.350 (0.0130 – 0.0138)	20	22	24	26	28	30	32	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74					
0.351 – 0.370 (0.0138 – 0.0146)	22	24	26	28	30	32	34	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74						
0.371 – 0.390 (0.0146 – 0.0154)	24	26	28	30	32	34	36	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74						
0.391 – 0.410 (0.0154 – 0.0161)	26	28	30	32	34	36	38	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74	74							
0.411 – 0.430 (0.0162 – 0.0169)	28	30	32	34	36	38	40	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74	74								
0.431 – 0.450 (0.0170 – 0.0177)	30	32	34	36	38	40	42	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74												
0.451 – 0.470 (0.0178 – 0.0185)	32	34	36	38	40	42	44	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74														
0.471 – 0.490 (0.0185 – 0.0193)	34	36	38	40	42	44	46	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																
0.491 – 0.510 (0.0193 – 0.0201)	36	38	40	42	44	46	48	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																		
0.511 – 0.530 (0.0201 – 0.0209)	38	40	42	44	46	48	50	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																			
0.531 – 0.550 (0.0209 – 0.0217)	40	42	44	46	48	50	52	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																				
0.551 – 0.570 (0.0217 – 0.0224)	42	44	46	48	50	52	54	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.571 – 0.590 (0.0225 – 0.0232)	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.591 – 0.610 (0.0233 – 0.0240)	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.611 – 0.630 (0.0241 – 0.0248)	48	50	52	54	56	58	60	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.631 – 0.650 (0.0248 – 0.0256)	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74	74	74																					
0.651 – 0.670 (0.0256 – 0.0264)	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	74	74	74	74	74																								
0.671 – 0.690 (0.0264 – 0.0272)	54	56	58	60	62	64	66	68	70	70	72	72	74	74	74	74	74	74																											
0.691 – 0.710 (0.0272 – 0.0280)	56	58	60	62	64	66	68	70	72	72	74	74	74	74	74	74																											
0.711 – 0.730 (0.0280 – 0.0287)	58	60	62	64	66	68	70	72	74	74	74	74	74	74																											
0.731 – 0.750 (0.0288 – 0.0295)	60	62	64	66	68	70	72	74	74	74	74	74																													
0.751 – 0.770 (0.0296 – 0.0303)	62	64	66	68	70	72	74	74	74	74																													
0.771 – 0.790 (0.0304 – 0.0311)	64	66	68	70	72	74	74	74																															
0.791 – 0.810 (0.0311 – 0.0319)	66	68	70	72	74	74	74																																
0.811 – 0.830 (0.0319 – 0.0327)	68	70	72	74	74	74																																	
0.831 – 0.850 (0.0327 – 0.0335)	70	72	74	74	74																																		
0.851 – 0.870 (0.0335 – 0.0343)	72	74	74	74																																			
0.871 – 0.890 (0.0343 – 0.0350)	74	74	74																																				
0.891 – 0.910 (0.0351 – 0.0358)	74	74																																					
0.911 – 0.930 (0.0359 – 0.0366)	74																																						

Intake valve clearance (Cold):
0.15 to 0.25 mm (0.006 to 0.010 in.)

EXAMPLE: The 5.250 mm (0.2067 in.) lifter is installed, and the measured clearance is 0.400 mm (0.0157 in.).
Replace the 5.250 mm (0.2067 in.) lifter with a new No. 46 lifter.

New Lifter Thickness mm (in.)

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)	54	5.540 (0.2181)
08	5.080 (0.2000)	32	5.320 (0.2094)	56	5.560 (0.2189)
10	5.100 (0.2008)	34	5.340 (0.2102)	58	5.580 (0.2197)
12	5.120 (0.2016)	36	5.360 (0.2110)	60	5.600 (0.2205)
14	5.140 (0.2024)	38	5.380 (0.2118)	62	5.620 (0.2213)
16	5.160 (0.2031)	40	5.400 (0.2126)	64	5.640 (0.2220)
18	5.180 (0.2039)	42	5.420 (0.2134)	66	5.660 (0.2228)
20	5.200 (0.2047)	44	5.440 (0.2142)	68	5.680 (0.2236)
22	5.220 (0.2055)	46	5.460 (0.2150)	70	5.700 (0.2244)
24	5.240 (0.2063)	48	5.480 (0.2157)	72	5.720 (0.2252)
26	5.260 (0.2071)	50	5.500 (0.2165)	74	5.740 (0.2260)
28	5.280 (0.2079)	52	5.520 (0.2173)		

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Valve Lifter Selection Chart (Exhaust)

Measured Clearance mm (in.) \ Installed Lifter Thickness mm (in.)	5.060 (0.1992)	5.080 (0.2000)	5.100 (0.2008)	5.120 (0.2016)	5.140 (0.2024)	5.160 (0.2031)	5.180 (0.2039)	5.200 (0.2047)	5.210 (0.2051)	5.220 (0.2055)	5.230 (0.2059)	5.240 (0.2063)	5.250 (0.2067)	5.260 (0.2071)	5.270 (0.2075)	5.280 (0.2079)	5.290 (0.2083)	5.300 (0.2087)	5.310 (0.2091)	5.320 (0.2094)	5.330 (0.2098)	5.340 (0.2102)	5.350 (0.2106)	5.360 (0.2110)	5.370 (0.2114)	5.380 (0.2118)	5.390 (0.2122)	5.400 (0.2126)	5.410 (0.2130)	5.420 (0.2134)	5.430 (0.2138)	5.440 (0.2142)	5.450 (0.2146)	5.460 (0.2150)	5.470 (0.2154)	5.480 (0.2157)	5.490 (0.2161)	5.500 (0.2165)	5.510 (0.2169)	5.520 (0.2173)	5.530 (0.2177)	5.540 (0.2181)	5.550 (0.2185)	5.560 (0.2189)	5.570 (0.2193)	5.580 (0.2197)	5.590 (0.2201)	5.600 (0.2205)	5.620 (0.2213)	5.640 (0.2220)	5.660 (0.2228)	5.680 (0.2236)	5.700 (0.2244)	5.720 (0.2252)	5.740 (0.2260)
0.000 – 0.030 (0.0000 – 0.0012)																			06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	36	38	40	42	44	46
0.031 – 0.050 (0.0012 – 0.0020)																06	06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	38	40	42	44	46	48
0.051 – 0.070 (0.0020 – 0.0028)														06	06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	40	42	44	46	48	50
0.071 – 0.090 (0.0028 – 0.0035)												06	06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	42	44	46	48	50	52
0.091 – 0.110 (0.0036 – 0.0043)											06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	44	46	48	50	52	54
0.111 – 0.130 (0.0044 – 0.0051)									06	06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	46	48	50	52	54	56
0.131 – 0.150 (0.0052 – 0.0059)								06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58
0.151 – 0.170 (0.0059 – 0.0067)						06	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	50	52	54	56	58	60
0.171 – 0.190 (0.0067 – 0.0075)					06	06	06	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62
0.191 – 0.210 (0.0075 – 0.0083)				06	06	06	08	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62	64
0.211 – 0.230 (0.0083 – 0.0091)			06	06	06	08	10	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	56	58	60	62	64	66
0.231 – 0.249 (0.0091 – 0.0098)		06	06	06	08	10	12	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	58	60	62	64	66	68
0.250 – 0.350 (0.0098 – 0.0138)																																																									
0.351 – 0.370 (0.0138 – 0.0146)	12	14	16	18	20	22	24	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	70	72	74	74	74
0.371 – 0.390 (0.0146 – 0.0154)	14	16	18	20	22	24	26	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	72	74	74	74	
0.391 – 0.410 (0.0154 – 0.0161)	16	18	20	22	24	26	28	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	74	74	74		
0.411 – 0.430 (0.0162 – 0.0169)	18	20	22	24	26	28	30	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74			
0.431 – 0.450 (0.0170 – 0.0177)	20	22	24	26	28	30	32	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74				
0.451 – 0.470 (0.0178 – 0.0185)	22	24	26	28	30	32	34	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74					
0.471 – 0.490 (0.0185 – 0.0193)	24	26	28	30	32	34	36	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74						
0.491 – 0.510 (0.0193 – 0.0201)	26	28	30	32	34	36	38	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74								
0.511 – 0.530 (0.0201 – 0.0209)	28	30	32	34	36	38	40	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74										
0.531 – 0.550 (0.0209 – 0.0217)	30	32	34	36	38	40	42	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74												
0.551 – 0.570 (0.0217 – 0.0224)	32	34	36	38	40	42	44	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74														
0.571 – 0.590 (0.0225 – 0.0232)	34	36	38	40	42	44	46	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																
0.591 – 0.610 (0.0233 – 0.0240)	36	38	40	42	44	46	48	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																		
0.611 – 0.630 (0.0241 – 0.0248)	38	40	42	44	46	48	50	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																				
0.631 – 0.650 (0.0248 – 0.0256)	40	42	44	46	48	50	52	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																						
0.651 – 0.670 (0.0256 – 0.0264)	42	44	46	48	50	52	54	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																								
0.671 – 0.690 (0.0264 – 0.0272)	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.691 – 0.710 (0.0272 – 0.0280)	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.711 – 0.730 (0.0280 – 0.0287)	48	50	52	54	56	58	60	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.731 – 0.750 (0.0288 – 0.0295)	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.751 – 0.770 (0.0296 – 0.0303)	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.771 – 0.790 (0.0304 – 0.0311)	54	56	58	60	62	64	66	68	70	70	72	72	74	74	74	74	74	74																											
0.791 – 0.810 (0.0311 – 0.0319)	56	58	60	62	64	66	68	70	72	72	74	74	74	74	74	74																											
0.811 – 0.830 (0.0319 – 0.0327)	58	60	62	64	66	68	70	72	74	74	74	74	74	74																											
0.831 – 0.850 (0.0327 – 0.0335)	60	62	64	66	68	70	72	74	74	74	74	74																											
0.851 – 0.870 (0.0335 – 0.0343)	62	64	66	68	70	72	74	74	74	74																											
0.871 – 0.890 (0.0343 – 0.0350)	64	66	68	70	72	74	74	74																													
0.891 – 0.910 (0.0351 – 0.0358)	66	68	70	72	74	74	74																														
0.911 – 0.930 (0.0359 – 0.0366)	68	70	72	74	74	74																															
0.931 – 0.950 (0.0367 – 0.0374)	70	72	74	74	74																																
0.951 – 0.970 (0.0374 – 0.0382)	72	74	74	74																																	
0.971 – 0.990 (0.0382 – 0.0390)	74	74	74																																		
0.991 – 1.010 (0.0390 – 0.0398)	74	74																																			
1.011 – 1.030 (0.0398 – 0.0406)	74																																				

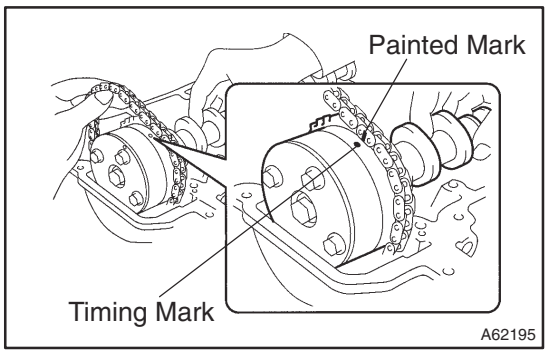
Exhaust valve clearance (Cold):
0.25 to 0.35 mm (0.010 to 0.014 in.)

EXAMPLE: The 5.340 mm (0.2102 in.) lifter is installed, and the measured clearance is 0.440 mm (0.0173 in.).
Replace the 5.340 mm (0.2102 in.) lifter with a new No. 48 lifter.

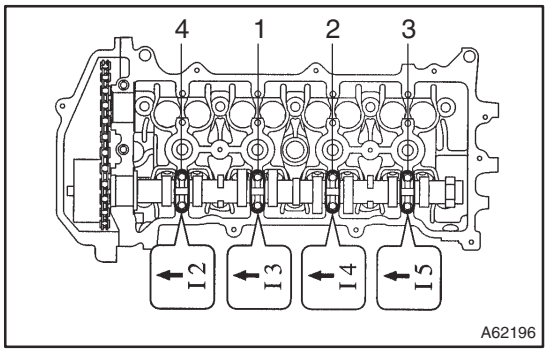
New Lifter Thickness mm (in.)

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)	54	5.540 (0.2181)
08	5.080 (0.2000)	32	5.320 (0.2094)	56	5.560 (0.2189)
10	5.100 (0.2008)	34	5.340 (0.2102)	58	5.580 (0.2197)
12	5.120 (0.2016)	36	5.360 (0.2110)	60	5.600 (0.2205)
14	5.140 (0.2024)	38	5.380 (0.2118)	62	5.620 (0.2213)
16	5.160 (0.2031)	40	5.400 (0.2126)	64	5.640 (0.2220)
18	5.180 (0.2039)	42	5.420 (0.2134)	66	5.660 (0.2228)
20	5.200 (0.2047)	44	5.440 (0.2142)	68	5.680 (0.2236)
22	5.220 (0.2055)	46	5.460 (0.2150)	70	5.700 (0.2244)
24	5.240 (0.2063)	48	5.480 (0.2157)	72	5.720 (0.2252)
26	5.260 (0.2071)	50	5.500 (0.2165)	74	5.740 (0.2260)
28	5.280 (0.2079)	52	5.520 (0.2173)		

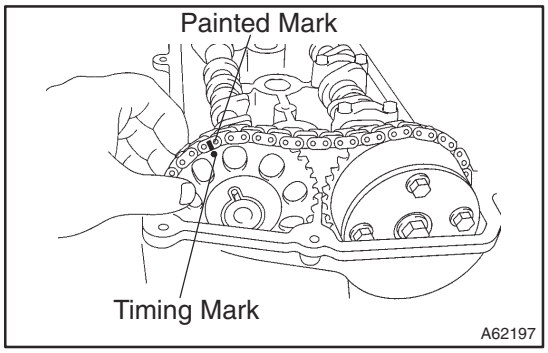
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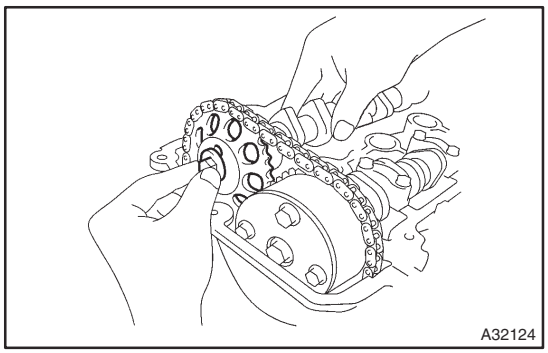
(m) As shown in the illustration, install the chain onto the camshaft timing gear with the painted mark aligned with the timing mark on the camshaft timing gear.



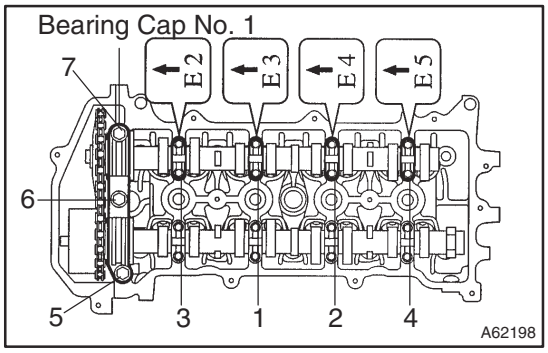
(n) Examine the front marks and numbers, then tighten the bolts in the order shown in the illustration.
Torque: 13 N·m (133 kgf·cm, 10 ft·lbf)



(o) Put the camshaft No. 2 on the cylinder head with the painted mark of the chain aligned with the timing mark on the camshaft timing gear.

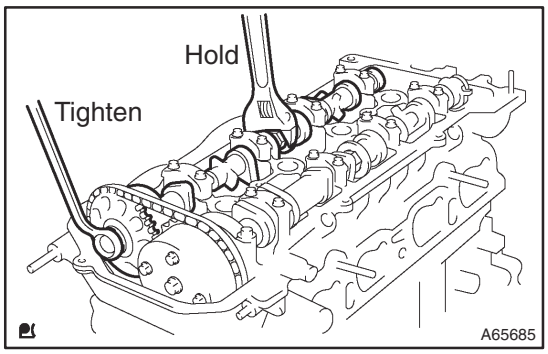


(p) Tighten the set bolt temporarily while raising the camshaft.



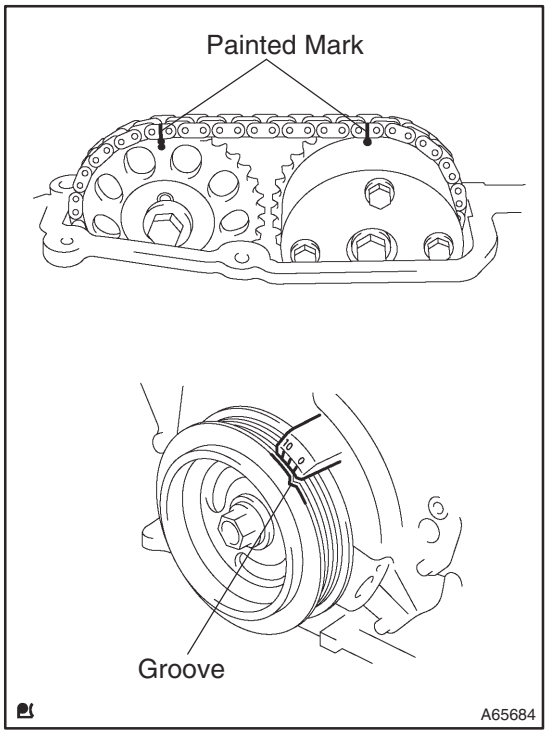
(q) Examine the front marks and numbers, then tighten the bolts in the order shown in the illustration.
Torque:
23 N·m (235 kgf·cm, 17 ft·lbf) for bearing cap No. 1
13 N·m (133 kgf·cm, 10 ft·lbf) for the other bearing caps.

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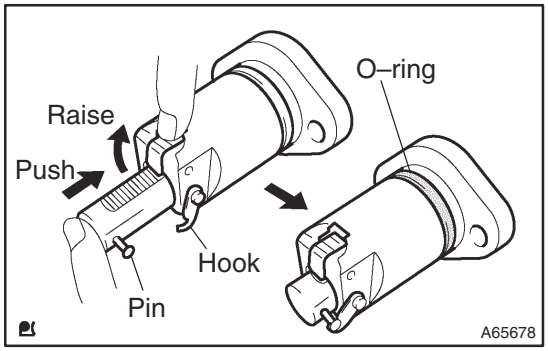


(r) Hold the camshaft with a wrench and so on, then tighten the camshaft timing gear set bolt.
Torque: 54 N·m (551 kgf·cm, 40 ft·lbf)

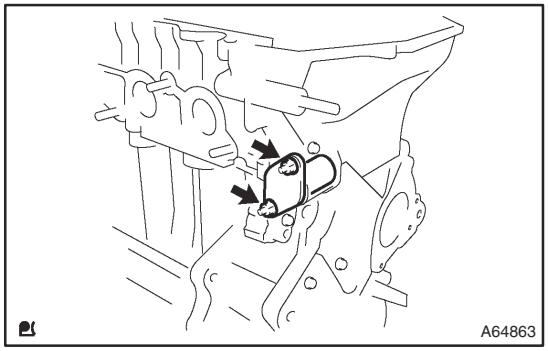
NOTICE:
Be careful not to damage the valve lifter.



(s) Check the painted marks on the chain and camshaft timing gears, and that the camshaft pulley groove is aligned with the timing mark ”0” of the timing chain cover.



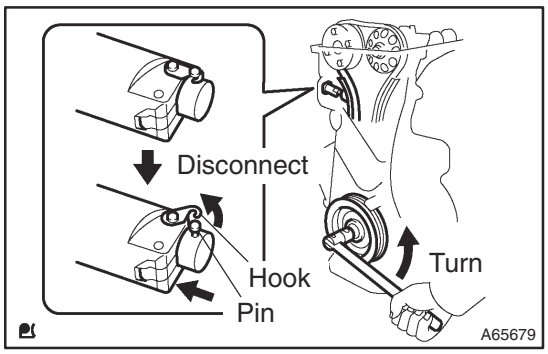
(t) Check the chain tensioner.
(1) Check that the O–ring is clean, then set the hook as shown in the illustration.
(2) Apply a light coat of engine oil to the O–ring.



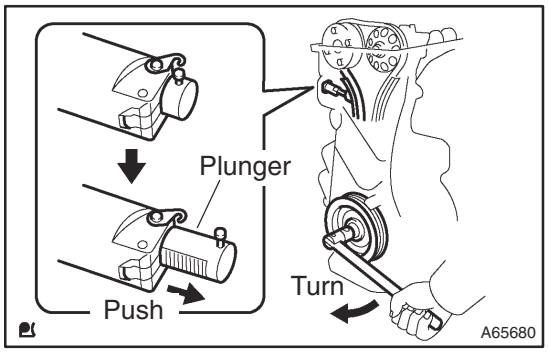
(3) Install the chain tensioner with the 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in·lbf)

NOTICE:
- **Be careful not to twist the O–ring.**
- **When installing the tensioner, reset the hook if the hook releases the plunger.**

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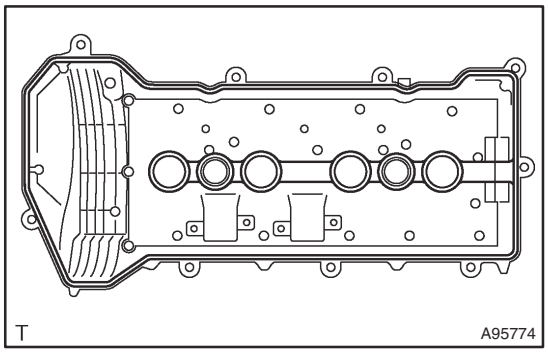


(4) Turn the crankshaft counterclockwise, then disconnect the plunger knock pin from the hook.



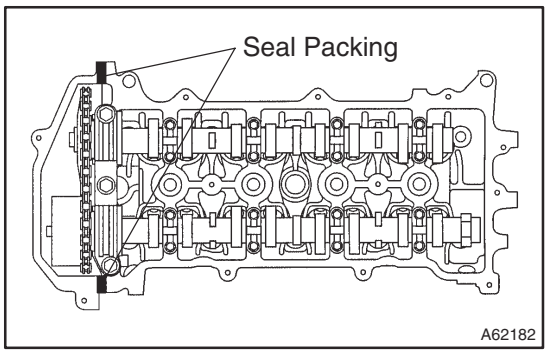
(5) Turn the crankshaft clockwise, then check that the slipper is pushed by the plunger.

HINT:
If the plunger is not extended, press the slipper into the chain tensioner using a screwdriver so that the hook is taken from the knock pin and that the plunger can be extended.



73. INSTALL CYLINDER HEAD COVER GASKET

(a) Install the gasket onto the cylinder head cover.



74. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

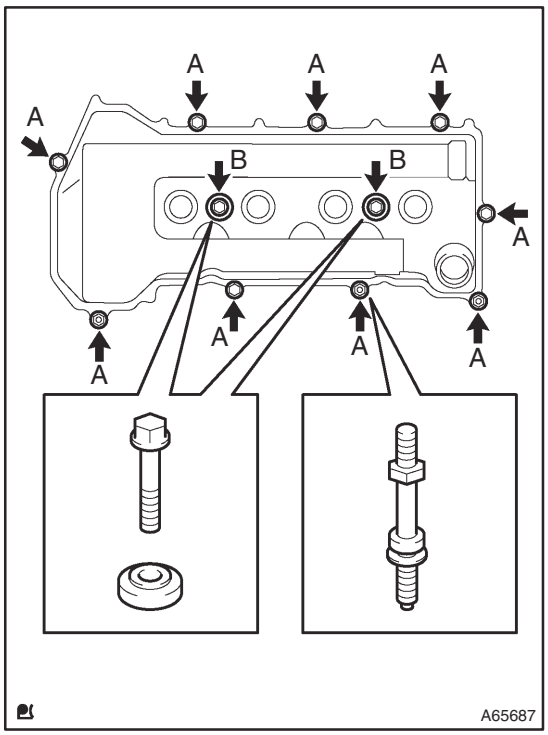
(b) Apply seal packing to 2 locations as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

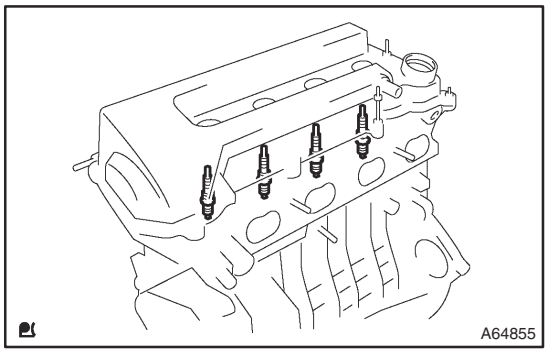
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**
- **Do not put into engine oil for at least 2 hours after installation.**

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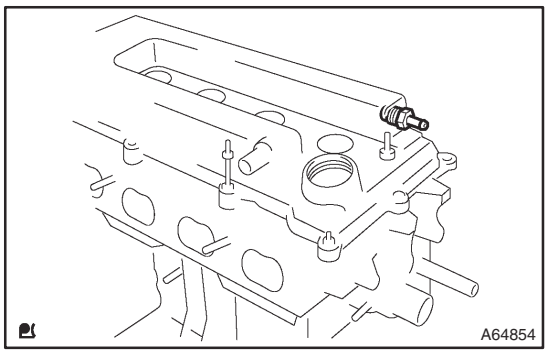


(c) Install the cylinder head cover with the 9 bolts, 2 seal washers and 2 nuts.
Torque:
11 N·m (112 kgf·cm, 8 ft·lbf) for A
9.0 N·m (92 kgf·cm, 80 in·lbf) for B



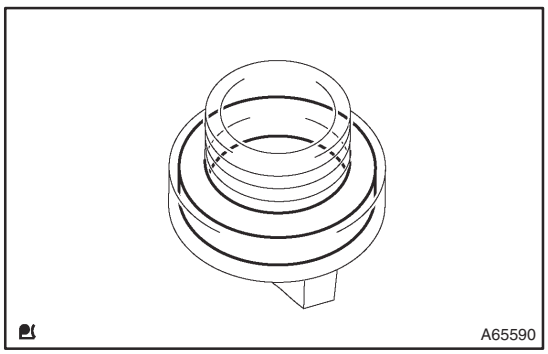
75. INSTALL SPARK PLUG

(a) Using a spark plug wrench, install the 4 spark plugs.
Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)



76. INSTALL VENTILATION VALVE SUB–ASSY

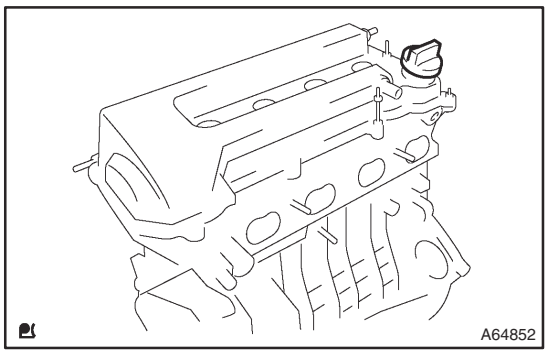
(a) Install the ventilation valve into the cylinder head cover.
Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)



77. INSTALL OIL FILLER CAP GASKET

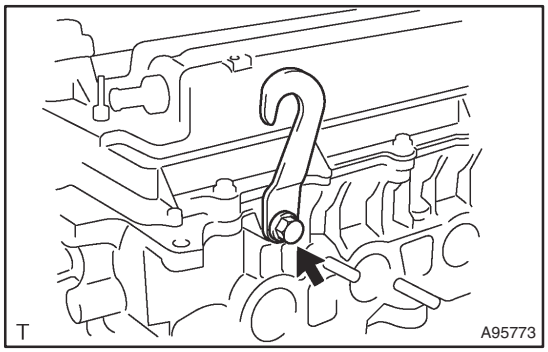
(a) Install the gasket onto the oil filler cap.

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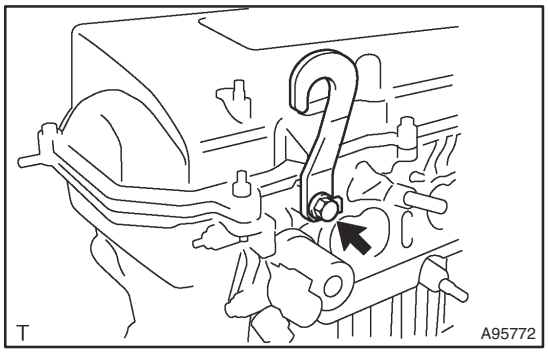
78. INSTALL OIL FILLER CAP SUB–ASSY

(a) Install the oil filler cap onto the cylinder head cover.



79. INSTALL ENGINE HANGER NO.2

(a) Install engine hanger No. 2 with the bolt.
Torque: 38 N·m (387 kgf·cm, 28 ft·lbf)



80. INSTALL ENGINE HANGER NO.1

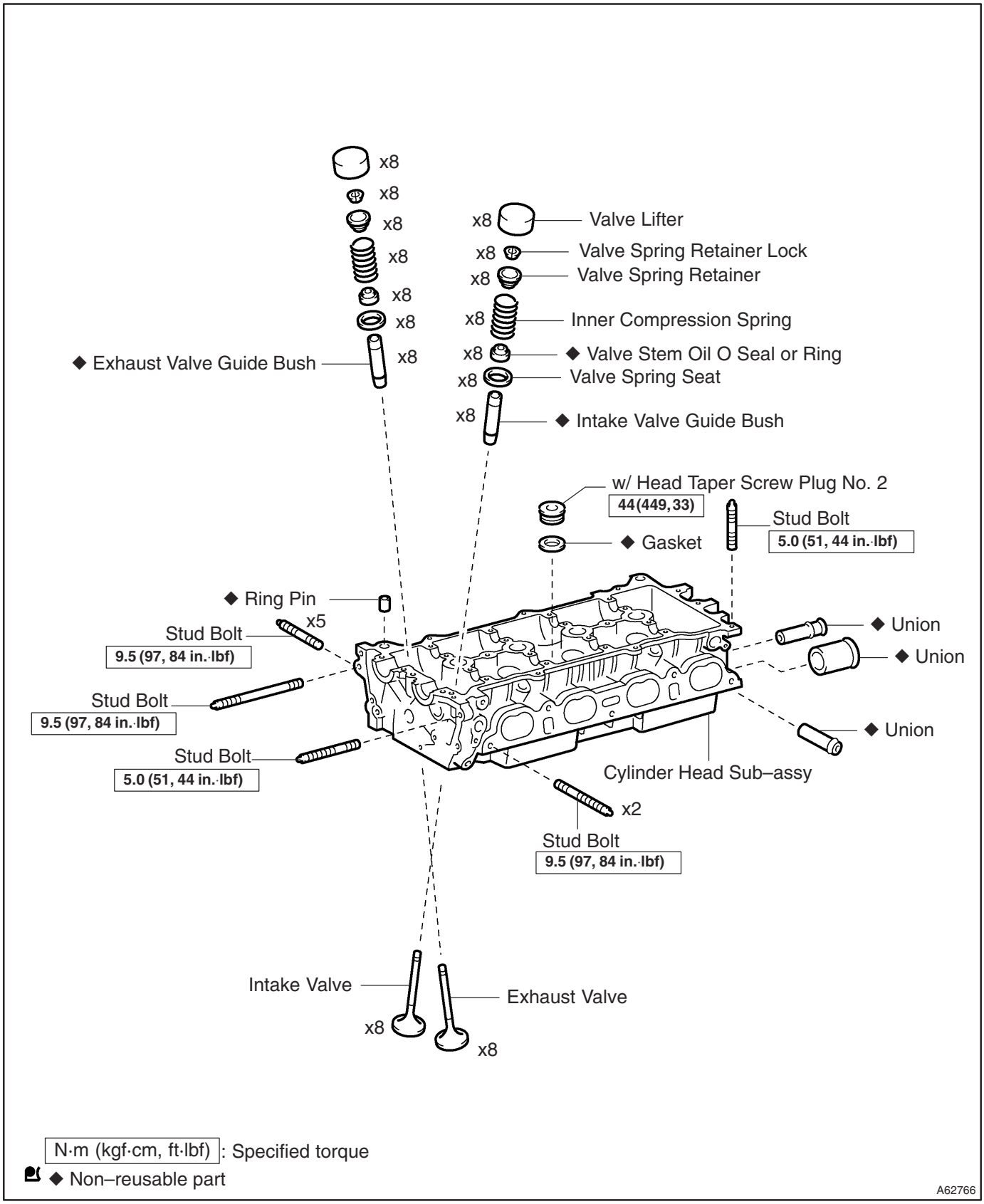
(a) Install engine hanger No. 1 with the bolt.
Torque: 38 N·m (387 kgf·cm, 28 ft·lbf)

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CYLINDER HEAD ASSY (1ZZ–FE/3ZZ–FE)

COMPONENTS

141TN–01

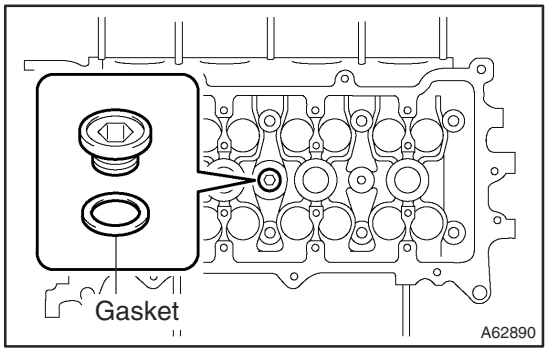


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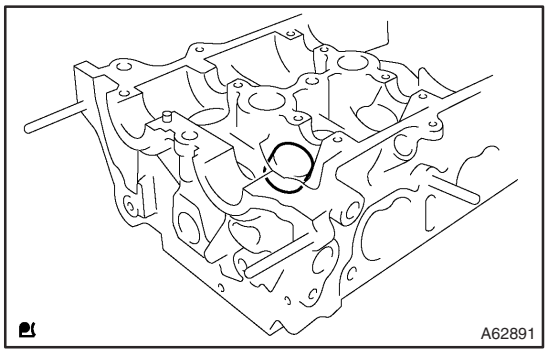
141TO–01

OVERHAUL



1. REMOVE W/HEAD TAPER SCREW PLUG NO.2

(a) Using a socket hexagon wench 10, remove the taper screw plug and gasket.



2. REMOVE VALVE LIFTER

(a) Remove the 16 valve lifters from the cylinder head.

3. REMOVE VALVE

HINT:

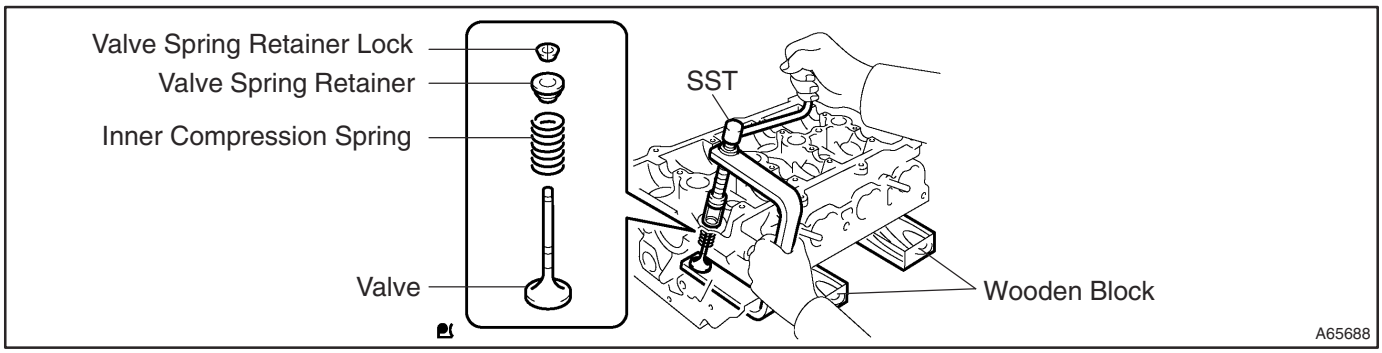
Remove all the valves from the cylinder head according to the procedure below.

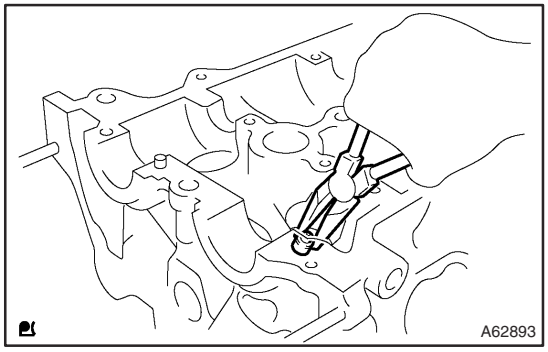
(a) Place the cylinder head on wooden blocks.

(b) Using SST, compress the inner compression spring, then remove the 2 valve spring retainer locks.

SST 09202–70020 (09202–00010, 09202–01010, 09202–01020)

(c) Remove the valve spring retainers, inner compression springs and valves from the cylinder head.

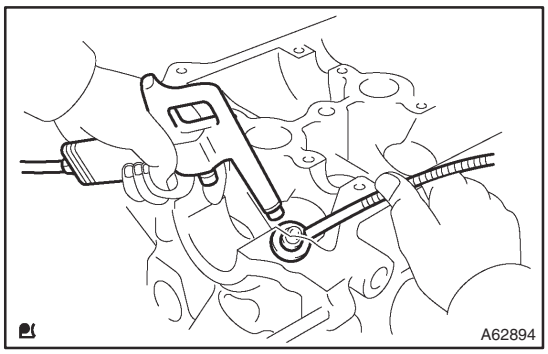




4. REMOVE VALVE STEM OIL O SEAL OR RING

(a) Using needle–nose pliers, remove the 8 valve stem oil seals.

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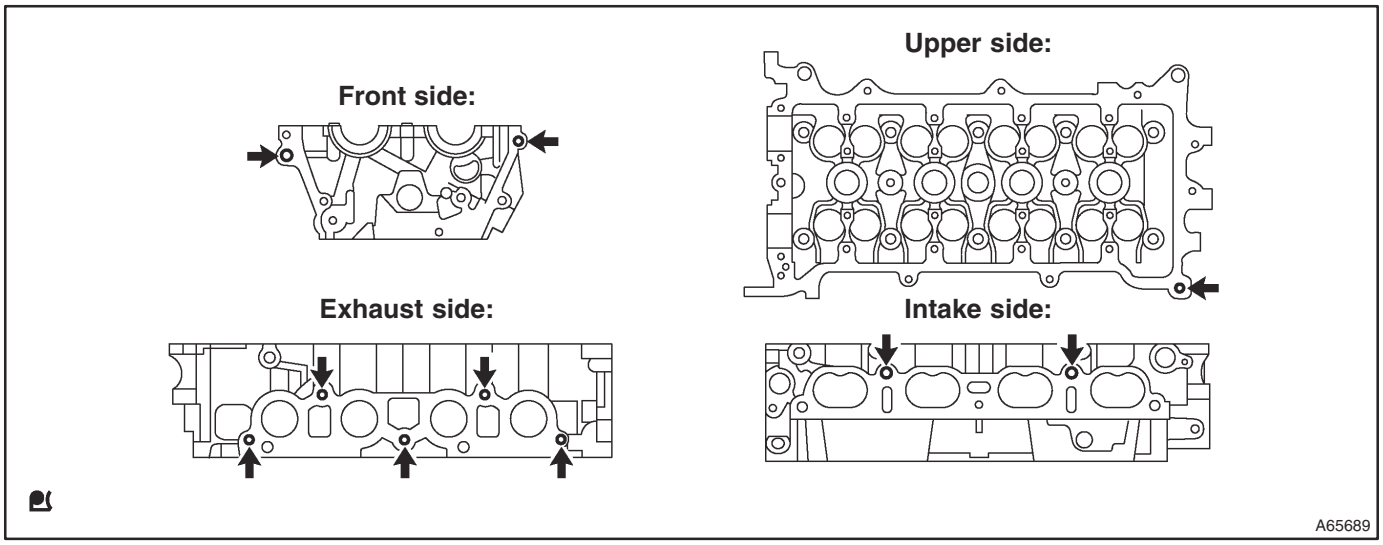


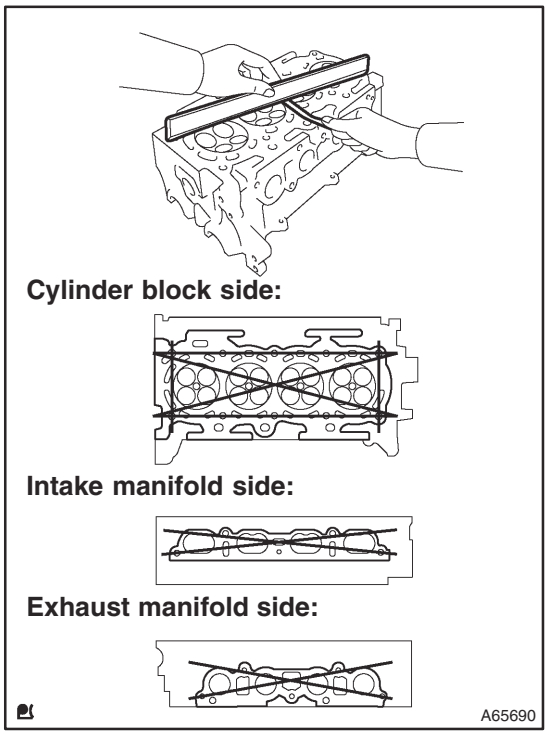
5. REMOVE VALVE SPRING SEAT

(a) Using a compressed air and a magnetic finger, remove the 8 valve spring seats.

6. REMOVE STUD BOLT

(a) Using torx socket wrenches E5 and E7, remove the 10 stud bolts.





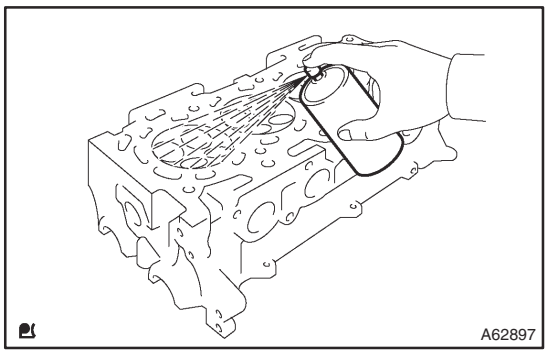
7. INSPECT CYLINDER HEAD FOR FLATNESS

(a) Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder block and the manifolds for warpage.

Maximum warpage:
Cylinder block side 0.05 mm (0.0020 in.)
Intake manifold side 0.10 mm (0.0039 in.)
Exhaust manifold side 0.10 mm (0.0039 in.)

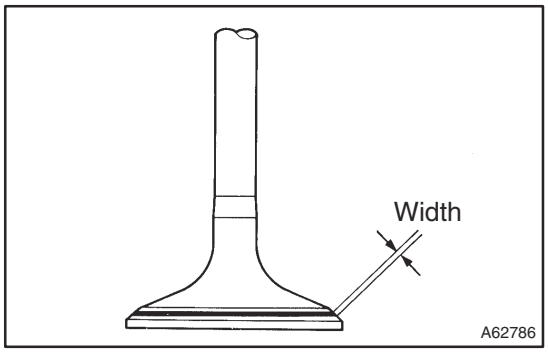
If the warpage is greater than maximum, replace the cylinder head.

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8. INSPECT CYLINDER HEAD FOR CRACKS

(a) Using a dye penetrate, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.



9. INSPECT VALVE SEATS

(a) Apply a light coat of prussian blue (or white lead) to the valve face.

(b) Lightly press the valve against the seat.

NOTICE:

Do not rotate the valve.

(c) Check the valve face and seat according to the following procedure.

(1) If blue appears 360° around the face, the valve is concentric. If not, replace the valve.

(2) If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.

(3) Check that the seat contact is in the middle of the valve face with the width between 1.0 to 1.4 mm (0.039 to 0.055 in.).

10. REPAIR INTAKE VALVE SEATS

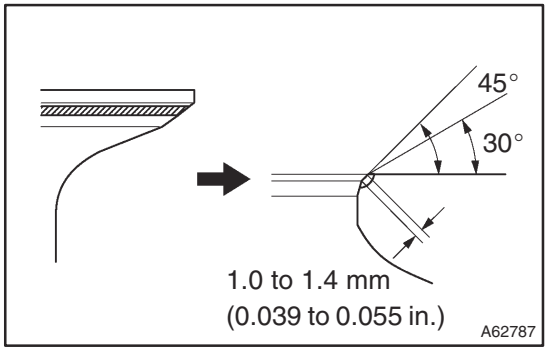
NOTICE:

Releasing the seat cutter pressure makes the valve seat faces smooth.

(a) Using a 45° cutter, cut the valve face of the cylinder head a little wider than the specified valve seating width.

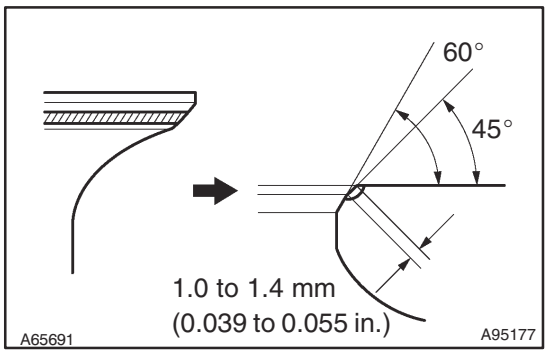
(b) Confirm that the valve fits the valve seat center portion. If not, re–cut the valve face with the 45° cutter.

(c) Adjust the valve face with a 30° or 60° cutter so that the valve seat is in the valve seat center portion.



(1) If the seating is too high on the valve face, use the 30° and 45° cutters to correct the seat.

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(2) If the seating is too low on the valve face, use the 60° and 45° cutters to correct the seat.

(d) Lap the valve and valve seat with an abrasive compound. Do this work by hand.

(e) Recheck the valve seating position.

11. REPAIR EXHAUST VALVE SEATS

NOTICE:

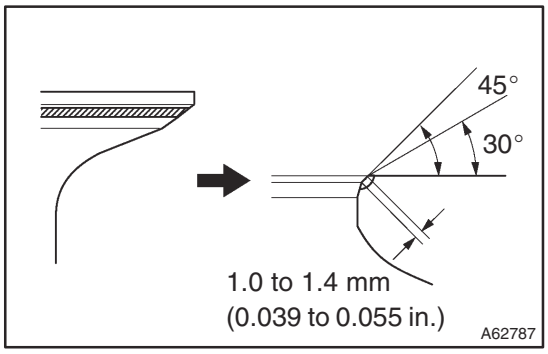
Releasing the seat–cutter pressure gradually make the valve seat faces smooth.

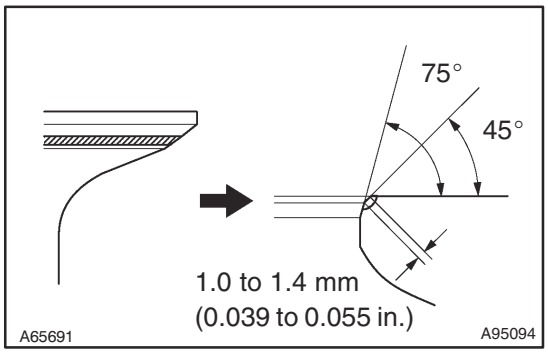
(a) Using the 45° cutter, cut the valve face of the cylinder head a little wider than the specified valve seating width.

(b) Confirm that the valve fits the valve seat center portion. If not, re–cut the valve face with the 45° cutter.

(c) Adjust the valve face with the 30° or 75° cutter to accurately fit the valve seat center portion.

(1) If the seating is too high on the valve face, use the 30° and 45° cutters to correct the seat.

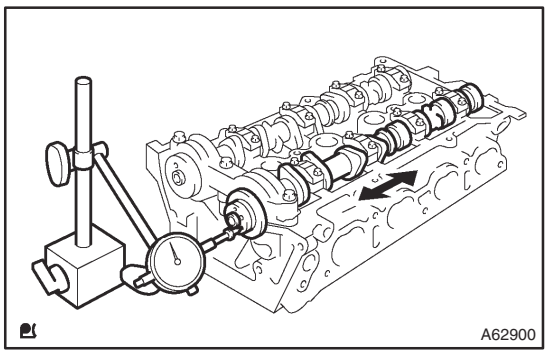




(2) If the seating is too low on the valve face, use the 75° and 45° cutters to correct the seat.

(d) Lap the valve and valve seat with an abrasive compound. Do this work by hand.

(e) Recheck the valve seating position.



12. INSPECT CAMSHAFT THRUST CLEARANCE

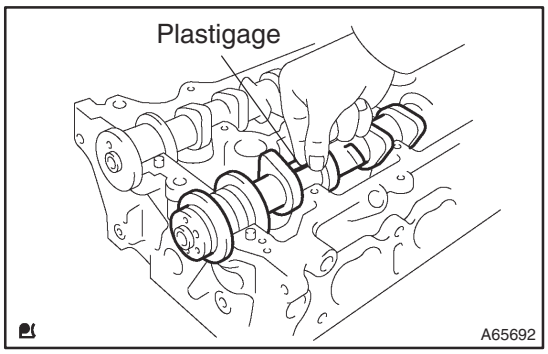
(a) Install the 2 camshafts.

(b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.040 to 0.095 mm (0.0016 to 0.0037 in.)
Maximum thrust clearance: 0.110 mm (0.0043 in.)

If the thrust clearance is greater than maximum, replace the cylinder head. If damages are found on the camshaft thrust surfaces, replace the camshaft.

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13. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the 9 bearing caps and camshaft journals.

(b) Place the camshafts on the cylinder head.

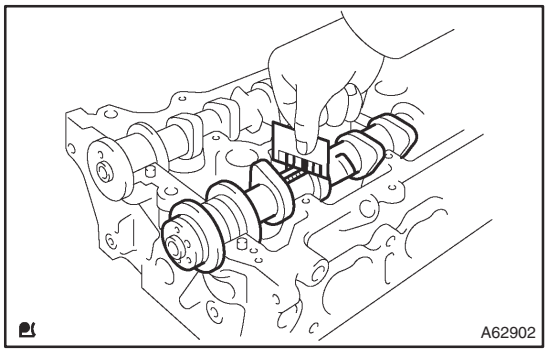
(c) Lay a strip of Plastigage across each of the camshaft journal.

(d) Install the 9 bearing caps. (See page 14–4)

NOTICE:

Do not turn the camshaft.

(e) Remove the 9 bearing caps. (See page 14–4)



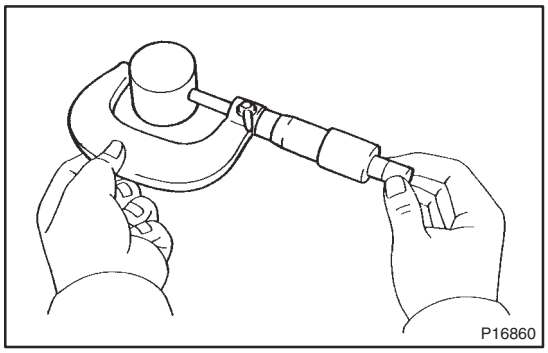
(f) Measure the Plastigage at its widest point.

Standard oil clearance:
0.035 to 0.072 mm (0.0014 to 0.0028 in.)
Maximum oil clearance: 0.10 mm (0.0039 in.)

NOTICE:

Completely remove the Plastigage after measuring.

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

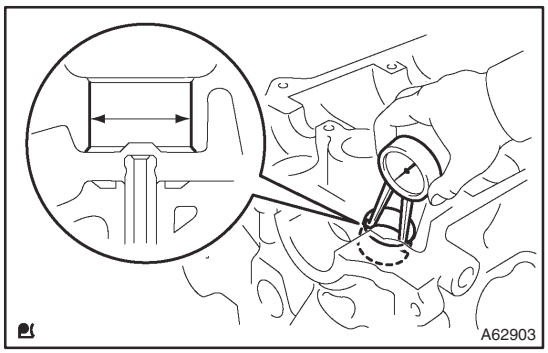


14. INSPECT VALVE LIFTER

(a) Using a micrometer, measure the valve lifter diameter.

Lifter diameter:
30.966 to 30.976 mm (1.2191 to 1.2195 in.)

If the diameter is not as specified, replace the valve lifter.



15. INSPECT VALVE LIFTER OIL CLEARANCE

(a) Using a caliper gauge, measure the valve lifter bore diameter of the cylinder head.

Lifter bore diameter:
31.000 to 31.025 mm (1.2205 to 1.2215 in.)

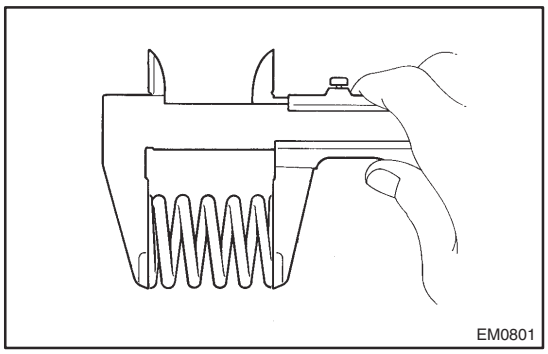
If the diameter is not as specified, replace the cylinder head.

(b) Subtract the valve lifter diameter measurement from the valve lifter bore diameter measurement.

Standard oil clearance:
0.024 to 0.059 mm (0.0009 to 0.0023 in.)
Maximum oil clearance: 0.079 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the valve lifter. If necessary, replace the cylinder head.

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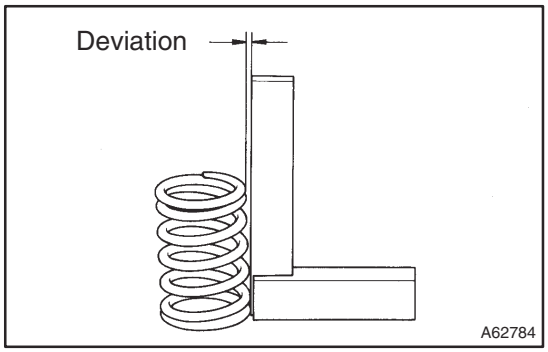

EM0801

16. INSPECT INNER COMPRESSION SPRING

(a) Using a vernier caliper, measure the free length of the inner compression spring.

Free length: 43.40 mm (1.7087 in.)

If the length is not as specified, replace the inner compression spring.



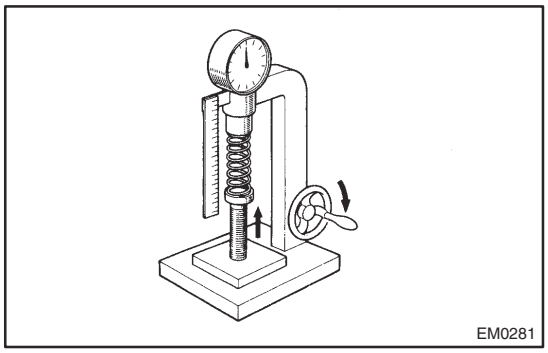
A62784

(b) Using a steel square, measure the deviation of the inner compression spring.

Maximum deviation: 1.6 mm (0.063 in.)

Maximum angle (reference) : 2°

If the deviation is greater than maximum, replace the inner compression spring.

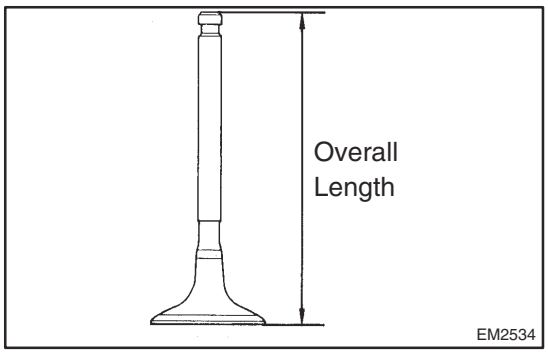

EM0281

(c) Using a spring tester, measure the tension of the inner compression spring at the specified installed length.

Installed tension:
158.6 to 175.4 N (16.2 to 17.9 kgf, 35.7 to 39.5 lbf)
at 33.6 mm (1.323 in.)

Maximum working tension:
335.3 to 370.7 N (34.2 to 37.8 kgf, 75.4 to 83.3 lbf)
at 24.1 mm (0.949 in.)

If the installed tension is not as specified, replace the inner compression spring.



EM2534

17. INSPECT VALVE

(a) Using a vernier calipers, check the valve overall length.

Standard overall length:

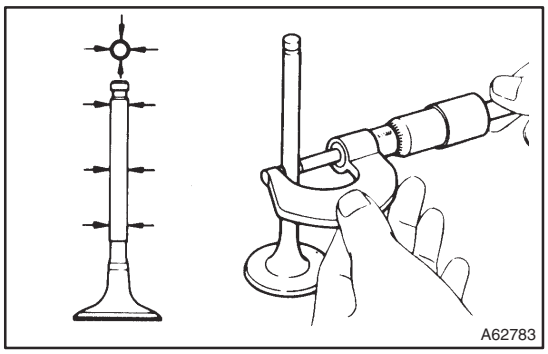
Item	Specification
Intake	88.65 mm (3.4902 in.)
Exhaust	88.69 mm (3.4917 in.)

Minimum overall length:

Item	Specification
Intake	88.35 mm (3.4784 in.)
Exhaust	88.39 mm (3.4799 in.)

If the overall length is less than minimum, replace the valve.

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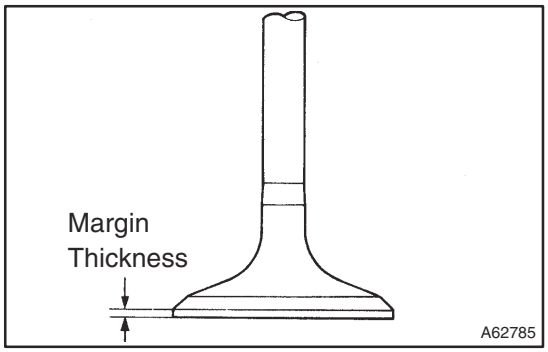


(b) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:

Item	Specification
Intake	5.470 to 5.485 mm (0.2154 to 0.2159 in.)
Exhaust	5.465 to 5.480 mm (0.2152 to 0.2158 in.)

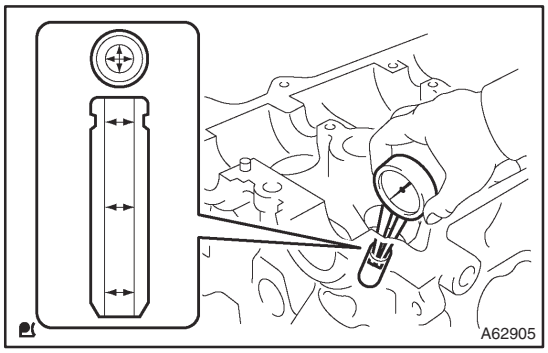
If the diameter is not as specified, replace the valve.



(c) Using a vernier calipers, check the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.7 mm (0.028 in.)

If the overall length is less than minimum, replace the valve.



18. INSPECT VALVE GUIDE BUSHING OIL CLEARANCE

(a) Using a caliper gauge, measure the inside diameter of the valve guide bushing.

Busing inside diameter:
5.510 to 5.530 mm (0.2169 to 0.2177 in.)

If the diameter is not as specified, replace the valve guide bushing.

(b) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.

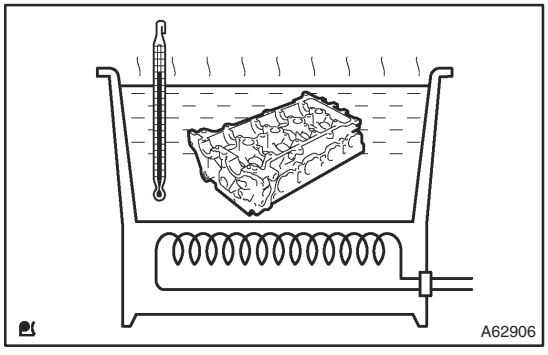
Standard oil clearance:

Item	Specification
Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)

Maximum oil clearance:

Item	Specification
Intake	0.08 mm (0.0032 in.)
Exhaust	0.10 mm (0.0039 in.)

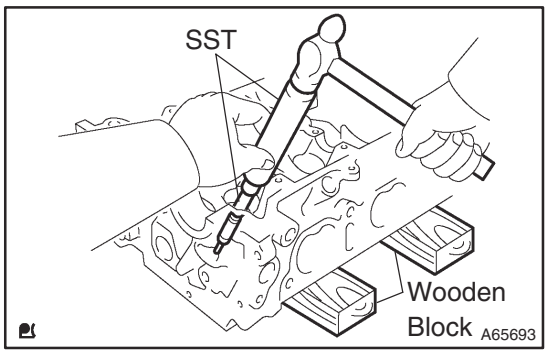
If the oil clearance is greater than maximum, replace the valve and valve guide bushing.



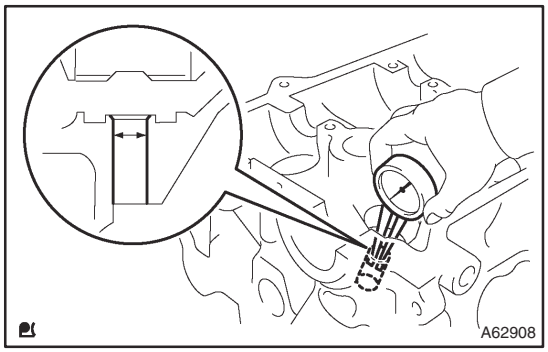
19. REPLACE VALVE GUIDE BUSHING

(a) Heat the cylinder head up to 80 to 100°C (176 to 212°F).

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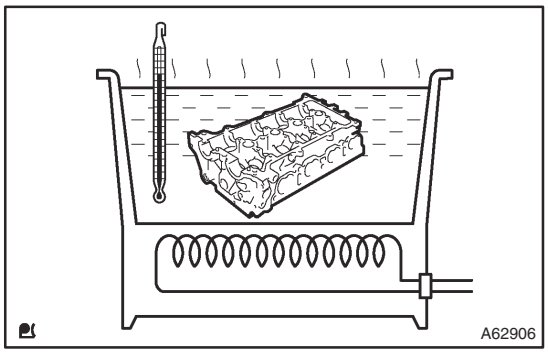


(b) Place the cylinder head on the wooden blocks.
(c) Using SST, tap out the valve guide bushing.
SST 09201–10000 (09201–01050), 09201–01055, 09950–70010 (09951–07100)

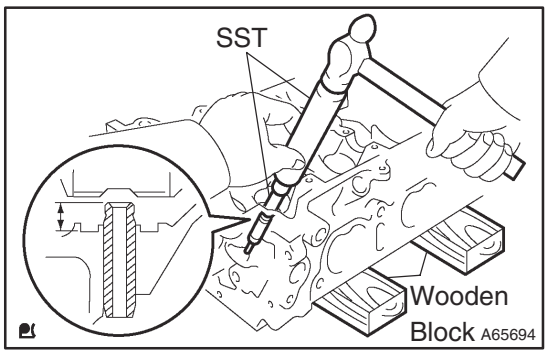


(d) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.
Diameter: 10.285 to 10.306 mm (0.4049 to 0.4058 in.)
If the bushing bore diameter of the cylinder head is greater than 10.306 mm (0.4058 in.), machine the bushing bore to the dimension of 10.335 to 10.356 mm (0.4069 to 0.4077 in.) to install an over size valve guide bushing.
HINT:

Valve guide bushing size	Bushing bore diameter mm (in.)
STD	10.285 to 10.306 (0.4049 to 0.4058)
O/S 0.05	10.335 to 10.356 (0.4069 to 0.4077)

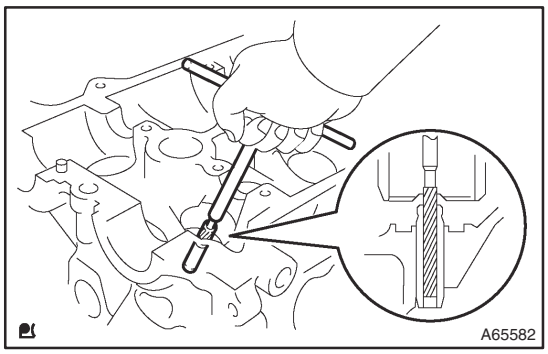


(e) Heat the cylinder head up to 80 to 100°C (176 to 212°F).



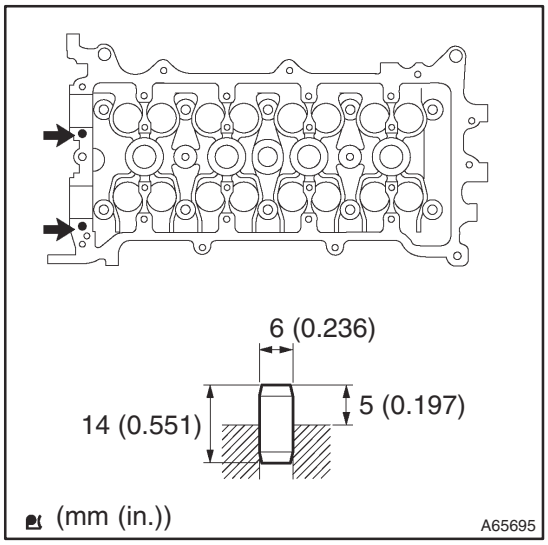
(f) Place the cylinder head on wooden blocks.
(g) Using SST, tap in a new valve guide bushing to the specified height.
SST 09201–10000 (09201–01050), 09201–01055, 09950–70010 (09951–07100)
Height: 8.7 to 9.1 mm (0.343 to 0.358 in.)

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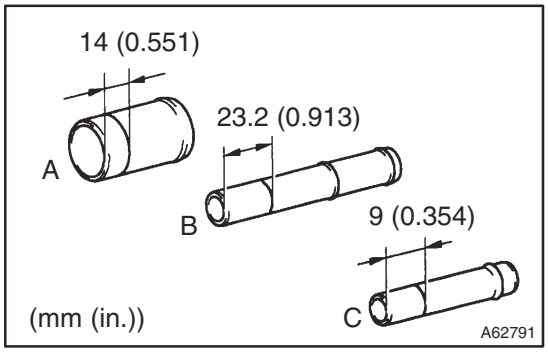
(h) Using a sharp 5.5 mm reamer, ream the valve guide bushing to obtain the standard specified clearance.
Standard oil clearance:

Item	Specification
Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)



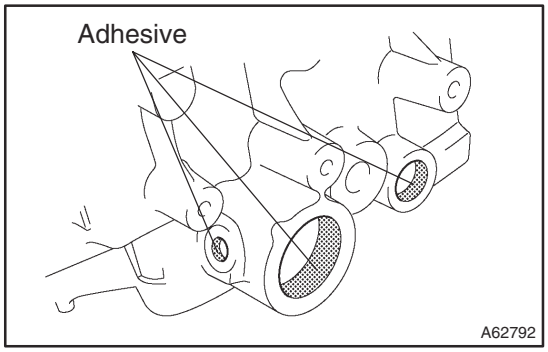
20. INSTALL STRAIGHT PIN

(a) Using a plastic hammer, install the new 2 straight pins.
Standard protrusion: 5 mm (0.197 in.)



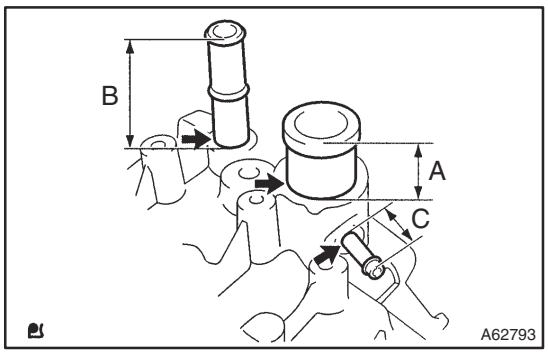
21. INSTALL UNION

(a) Mark the standard position on the union with paint.



(b) Apply adhesive to the union hole of the cylinder head.
Adhesive:
Part No. 08833–00070, THREE BOND 1324 or equivalent.

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(c) Using a press, press in a new union until the standard marks come to the level of the cylinder head surface.

Standard protrusion:

Item	Specification
A	29 mm (1.142 in.)
B	66.5 mm (2.618 in.)
C	24 mm (0.945 in.)

NOTICE:

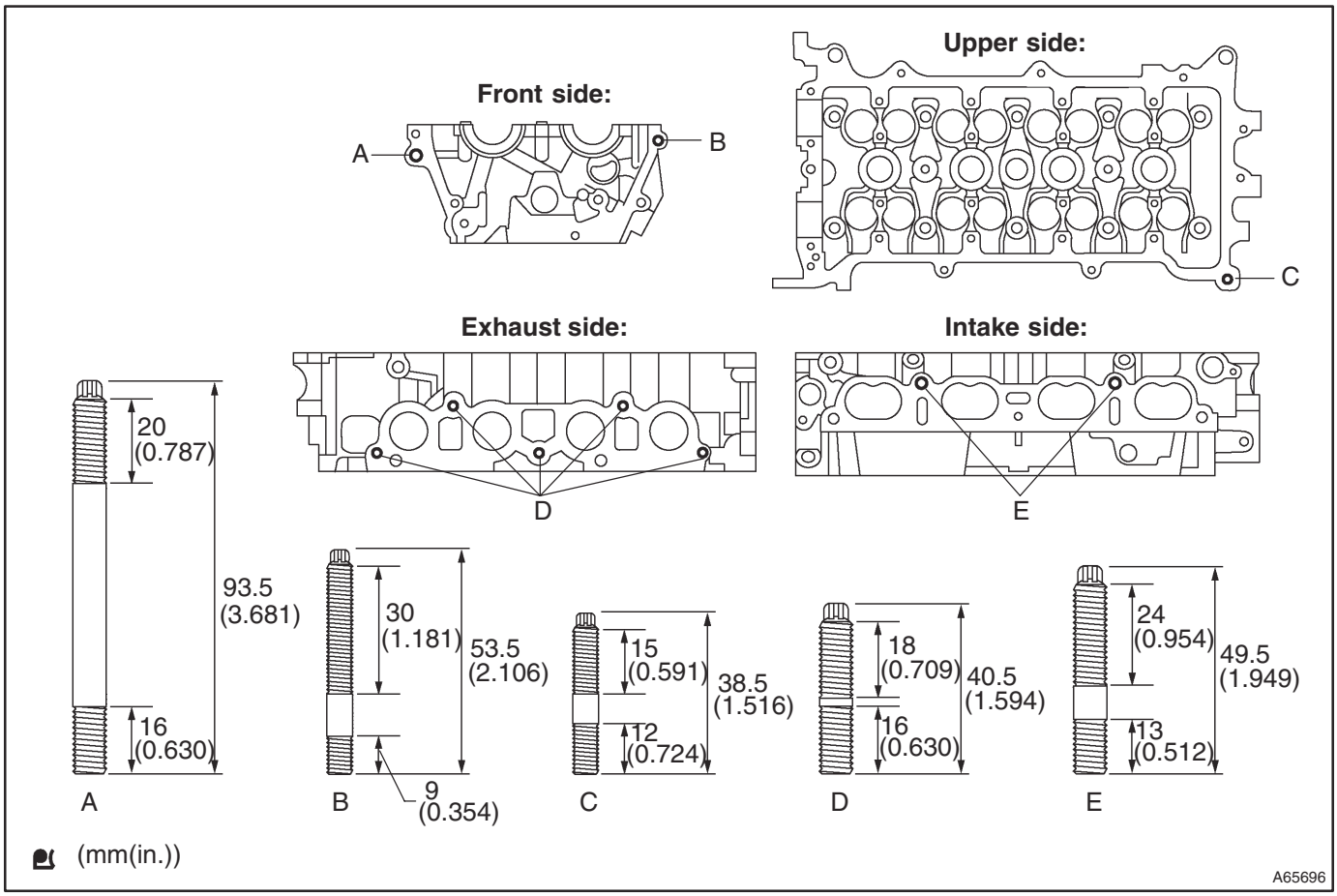
- **Install the union within 3 minutes after applying adhesive.**
- **Do not put into coolant at least for an hour after installation.**

22. INSTALL STUD BOLT

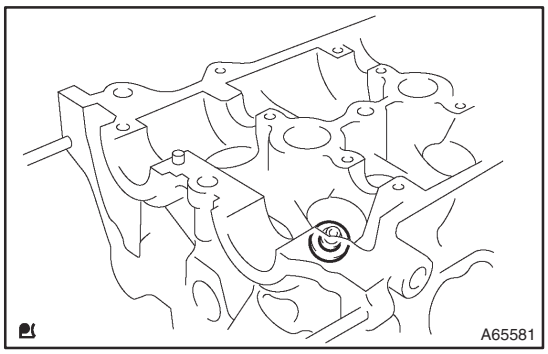
(a) Using torx socket wrenches E5 and E7, install the 11 stud bolts.

Torque:

Item	Specification
A	9.5 N·m (97 kgf·cm, 84 in.·lbf)
B	5.0 N·m (51 kgf·cm, 44 in.·lbf)
C	5.0 N·m (51 kgf·cm, 44 in.·lbf)
D	9.5 N·m (97 kgf·cm, 84 in.·lbf)
E	9.5 N·m (97 kgf·cm, 84 in.·lbf)

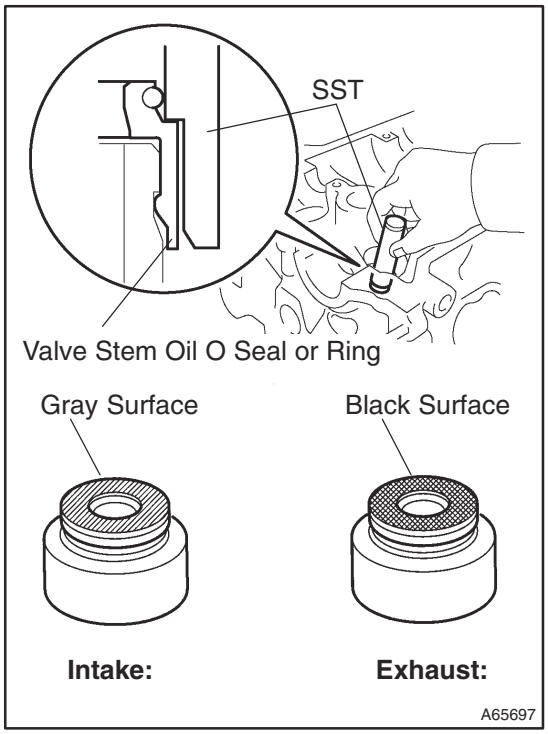


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23. INSTALL VALVE SPRING SEAT

(a) Install the 8 valve spring seats onto the cylinder head.



24. INSTALL VALVE STEM OIL O SEAL OR RING

(a) Apply a light coat of engine oil to a new valve stem oil seals.

NOTICE:

Be careful to assemble the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.

HINT:

The intake valve stem oil seal is gray and exhaust valve stem oil seal is black.

(b) Using SST, push in the valve stem oil seals by hand.
SST 09201–41020

25. INSTALL VALVE

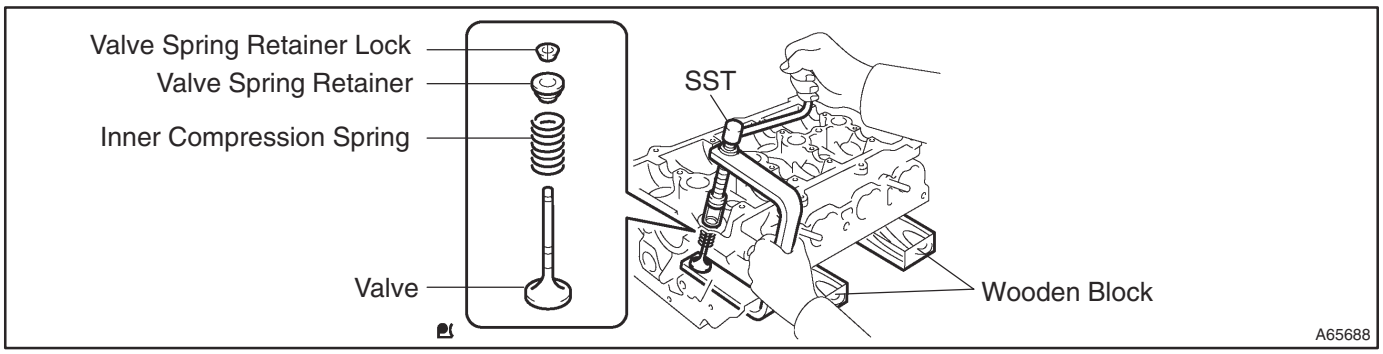
HINT:

Remove all the valves from the cylinder head according to the procedure below.

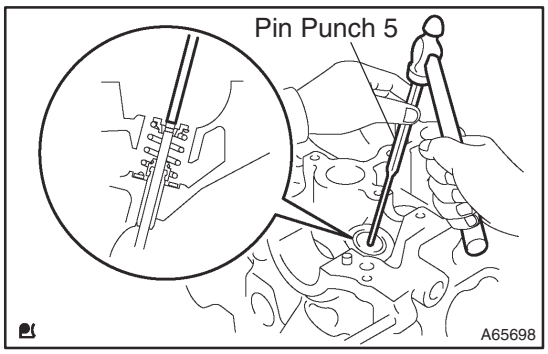
(a) Place the cylinder head on wooden blocks.

(b) Install the valves, inner compression springs and valve spring retainers onto the cylinder head.

(c) Using SST, compress the inner compression spring, and place the 2 valve spring retainer locks around the valve stem.
SST 09202–70020 (09202–00010, 09202–01010, 09202–01020)



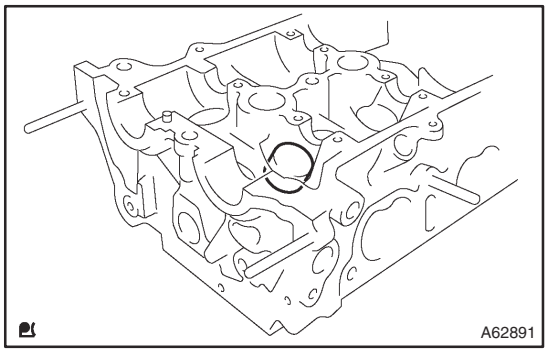
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(d) Using a pin punch 5, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

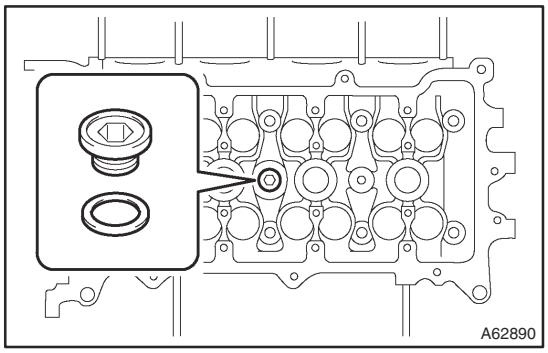
Be careful not to damage the valve stem tip.



26. INSTALL VALVE LIFTER

(a) Apply a light coat of engine oil to the 16 valve lifters.

(b) Install the 16 valve lifters onto the cylinder head.



27. INSTALL W/HEAD TAPER SCREW PLUG NO.2

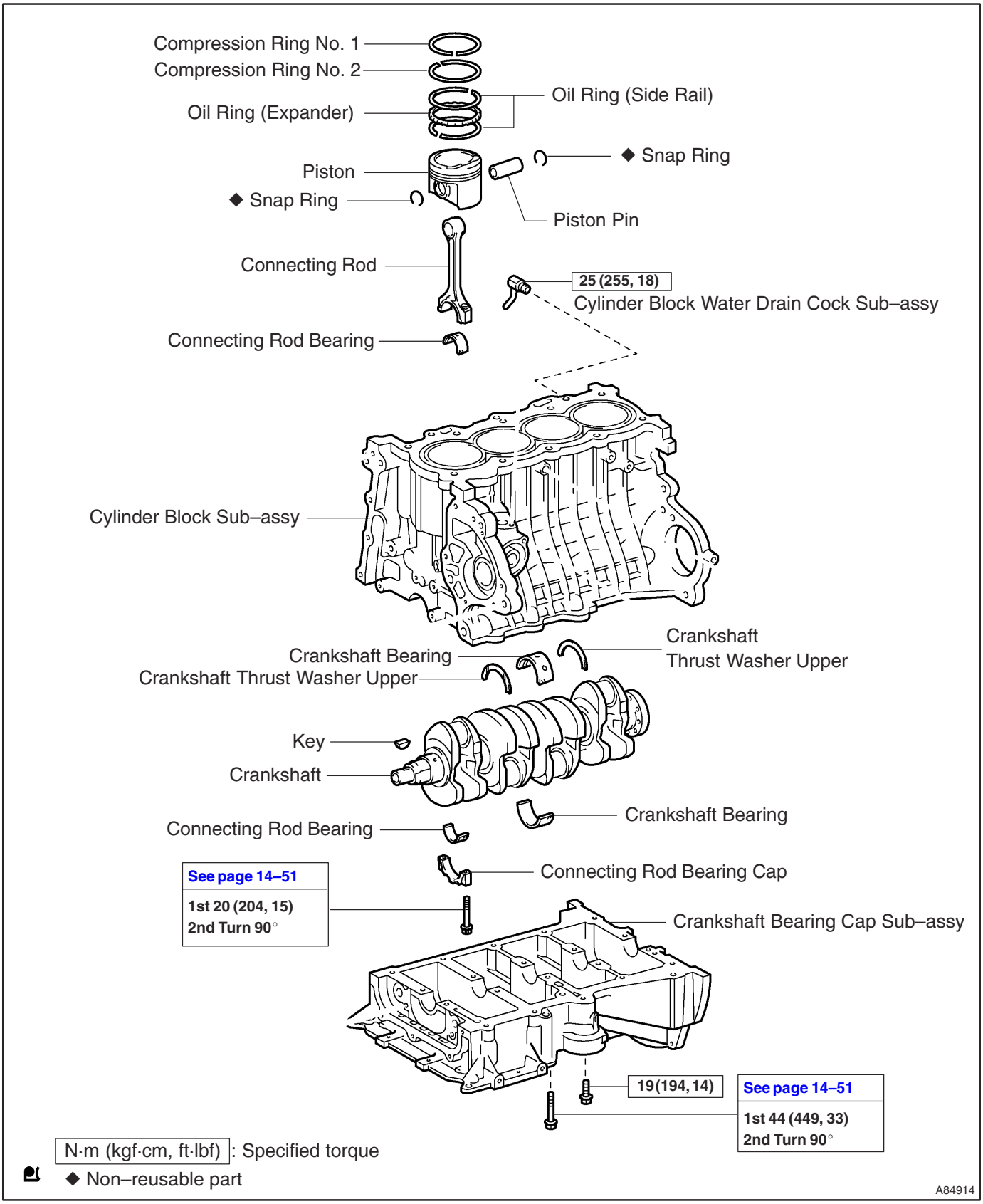
(a) Using a socket hexagon wrench 10, install the taper screw plug with a new gasket.
Torque: 44 N·m (449 kgf·cm, 33 ft·lbf)

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CYLINDER BLOCK ASSY (1ZZ–FE/3ZZ–FE)

141TJ–01

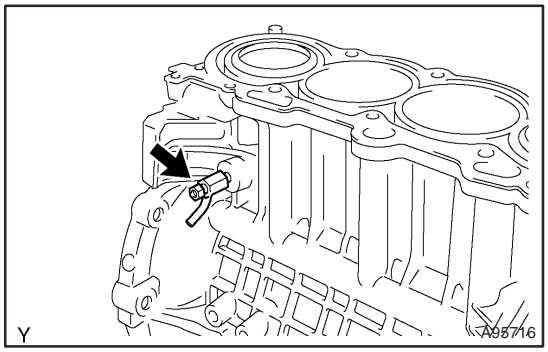
COMPONENTS



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141TK–01

OVERHAUL

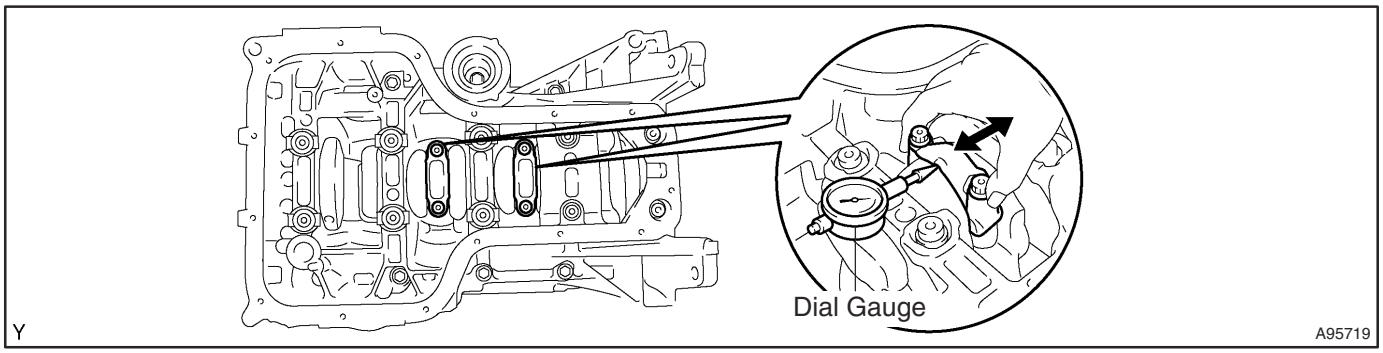


1. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY

(a) Remove the cylinder block water drain cock from the cylinder block.

2. INSPECT CONNECTING ROD THRUST CLEARANCE

(a) Turn the crankshaft and set the No. 1 cylinder to the TDC/compression.

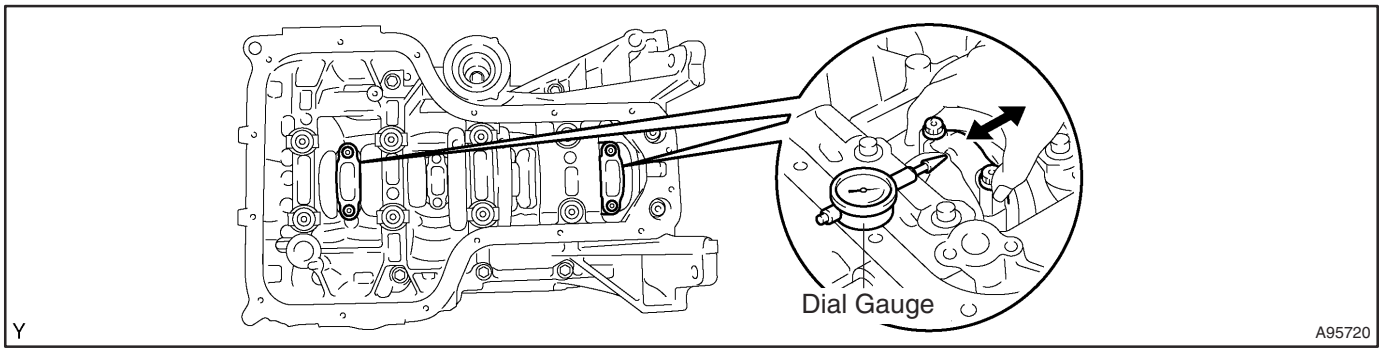


(b) Using a dial indicator, measure the thrust clearance of the No. 2 and No. 3 cylinders while moving the connecting rod back and forth.

Standard thrust clearance:
0.160 to 0.342 mm (0.0063 to 0.0135 in.)
Maximum thrust clearance:
0.342 mm (0.0135 in.)

- If the thrust clearance is greater than maximum, replace the connecting rod.
- If necessary, replace the crankshaft.

(c) Turn the crankshaft and set the No. 2 cylinder to the TDC/compression.



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(d) Using a dial indicator, measure the thrust clearance of the No. 1 and No. 4 cylinders while moving the connecting rod back and forth.

Standard thrust clearance:
0.160 to 0.342 mm (0.0063 to 0.0135 in.)
Maximum thrust clearance:
0.342 mm (0.0135 in.)

- If the thrust clearance is greater than maximum, replace the connecting rod.
- If necessary, replace the crankshaft.

3. INSPECT CONNECTING ROD OIL CLEARANCE

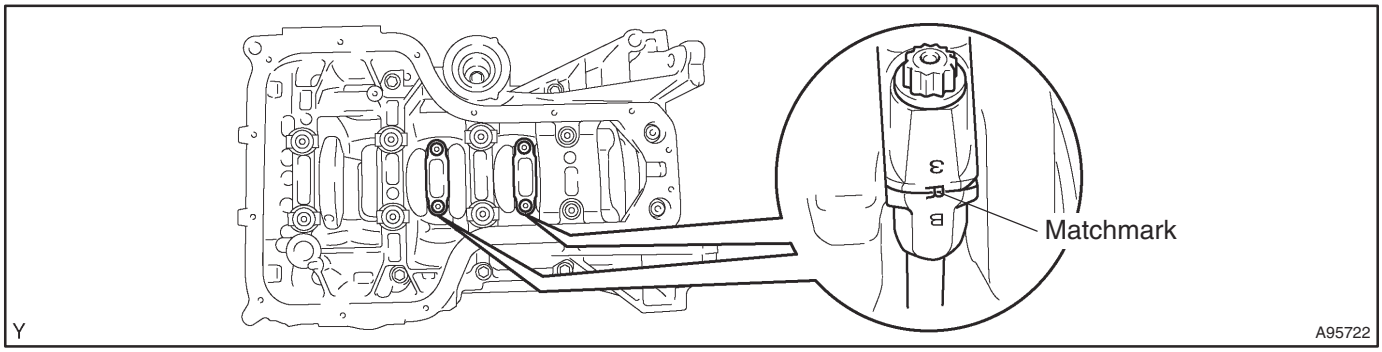
(a) Turn the crankshaft and set the No. 1 cylinder to the TDC/compression.

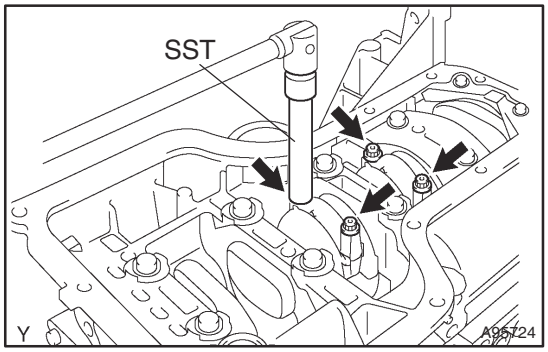
(b) Measure the oil clearance of the No. 2 and No. 3 cylinders.

NOTICE:
Do not turn the crankshaft during the measurement.

(1) Using marking paint, write the matched cylinder number on each connecting rod and cap.

HINT:
The matchmarks on the connecting rods and caps are for ensuring correct reassembling.





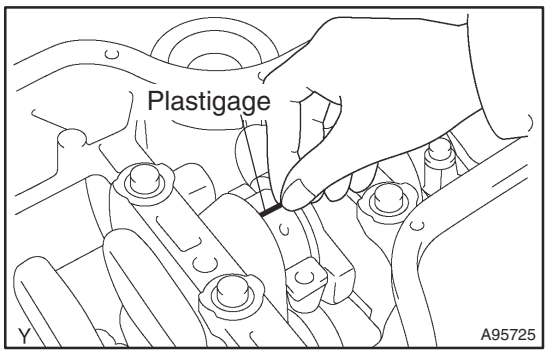
(2) Using SST, remove the 4 bolts and 2 connecting rod caps as shown.

SST 09205–16010

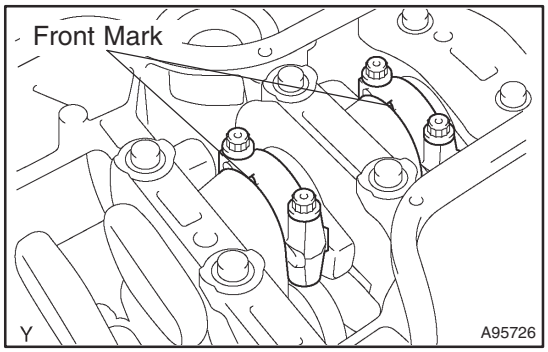
(3) Clean the crank pin and bearing.

(4) Check the crank pin and bearing for pitting and scratches.

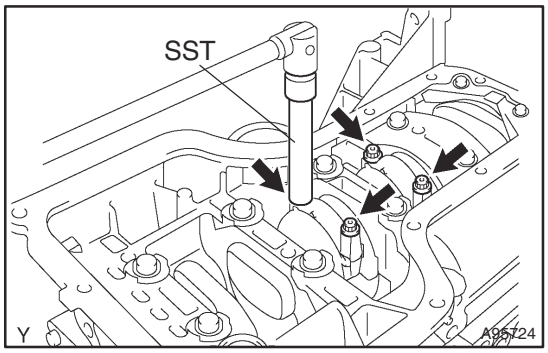
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(5) Lay a strip of Plastigage across the crank pin.



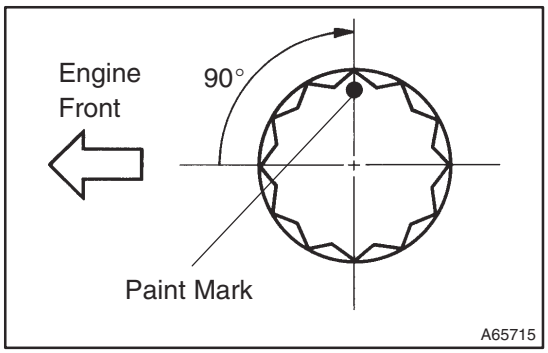
(6) Check that the front marks of the 2connecting rod caps are facing in the correct direction.
(7) Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.



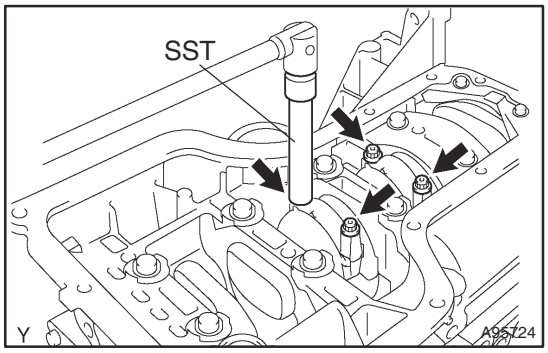
(8) Using SST, tighten the 2 bolts in several passes to the specified torque.

SST 09205–16010

Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

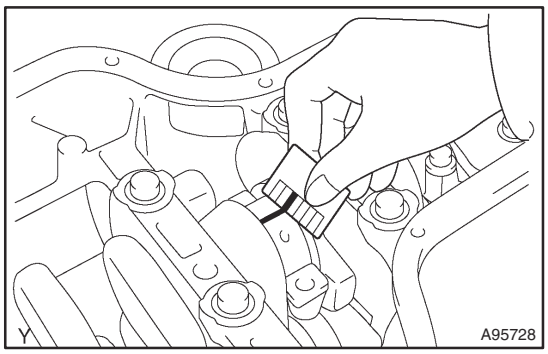


(9) Mark the front of the connecting cap bolts with paint.
(10) Retighten the cap bolts by an additional 90° as shown in the illustration.
(11) Check that the crankshaft turns smoothly.



(12) Remove the 4 bolts and 2 connecting rod caps.

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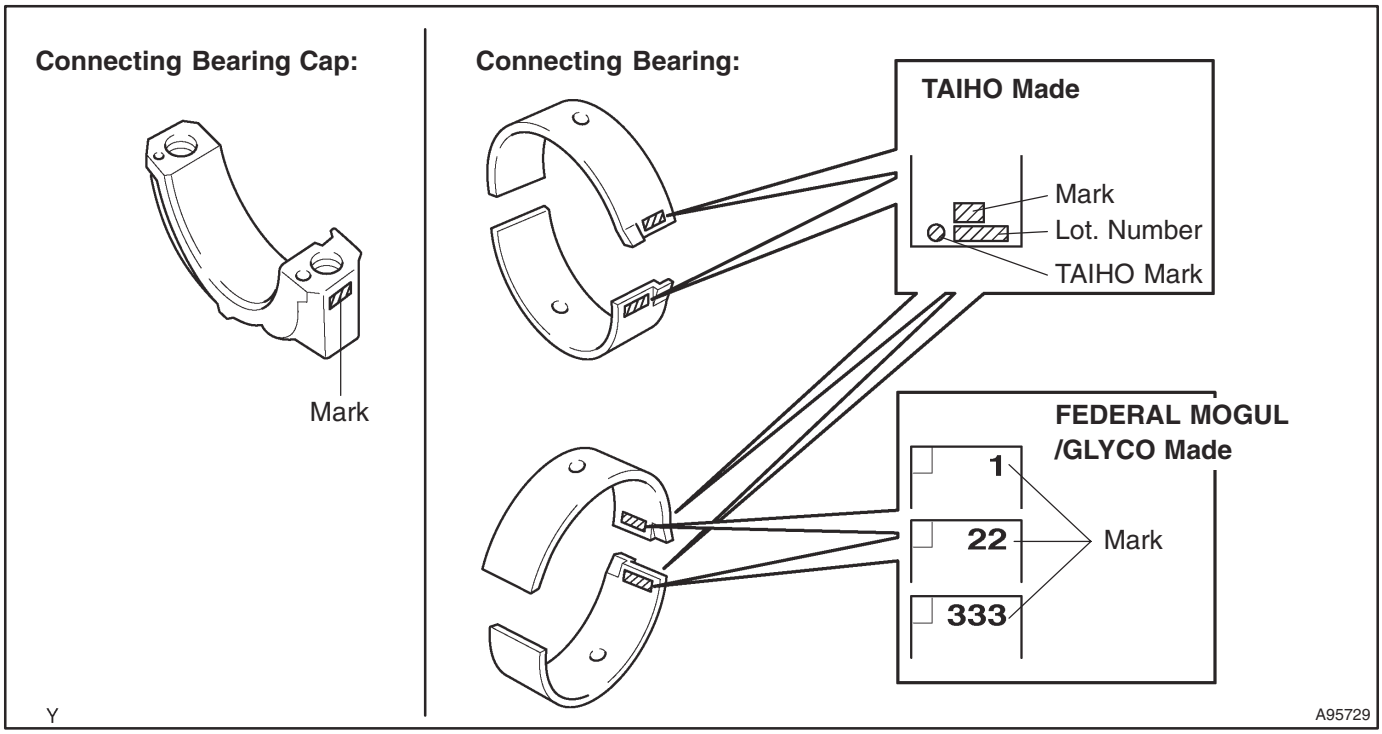


(13) Measure the Plastigage at its widest point.

Standard oil clearance:
0.028 to 0.060 mm (0.0011 to 0.0024 in.)
Maximum oil clearance: 0.080 mm (0.0031 in.)

NOTICE:
Remove the Plastigage completely after the measurement.

- If the oil clearance is greater than maximum, replace the connecting rod bearing.
- If necessary, grind or replace the crankshaft.



HINT:

- The TAIHO mark is either on the claw side or the opposite side.
- If replacing a bearing, select a new one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked ”1”, ”2” and ”3” accordingly.

Item	Mark	Specification
Connecting rod bearing cap bore diameter	1 2 3	47.000 to 47.008 mm (1.8504 to 1.8507 in.) 47.009 to 47.016 mm (1.8507 to 1.8510 in.) 47.017 to 47.024 mm (1.8511 to 1.8513 in.)
Connecting rod bearing thickness	1 2 3	1.486 to 1.490 mm (0.0585 to 0.0587 in.) 1.491 to 1.494 mm (0.0587 to 0.0588 in.) 1.495 to 1.498 mm (0.0589 to 0.0590 in.)
Crankshaft pin outer diameter	–	43.992 to 44.000 mm (1.7320 to 1.7323 in.)

(c) Turn the crankshaft and set the No. 2 cylinder to the TDC/compression.

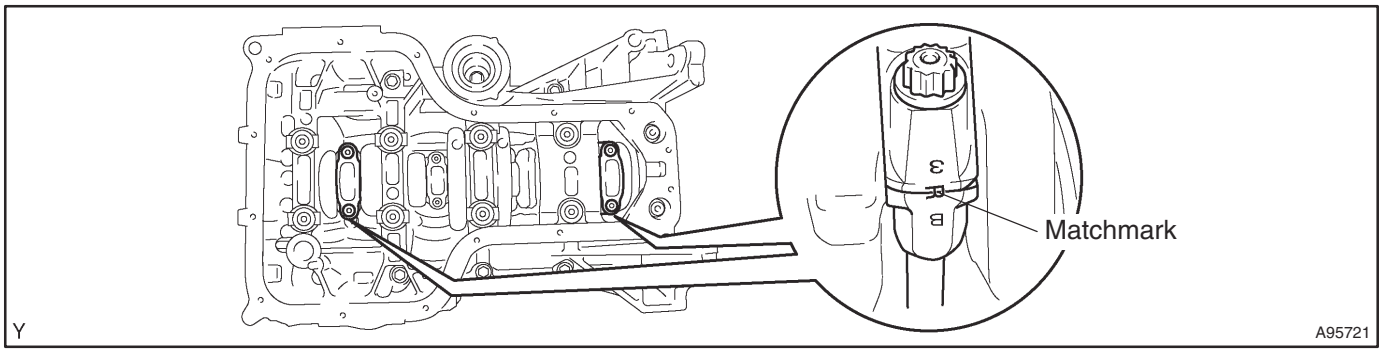
ProCarManuals.com

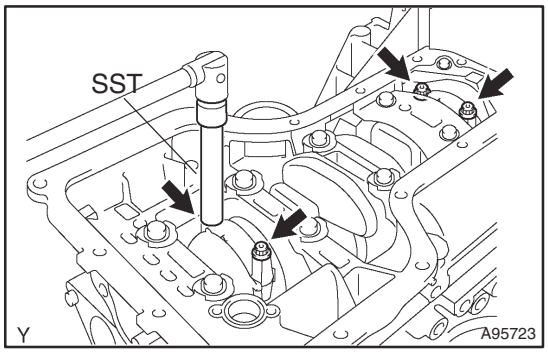
(d) Measure the oil clearance of the No. 1 and No. 4 cylinders.

NOTICE:
Do not turn the crankshaft during the measurement.

(1) Using marking paint, write the matched cylinder number on each connecting rod and cap.

HINT:
The matchmarks on the connecting rods and caps are for ensuring correct reassembling.



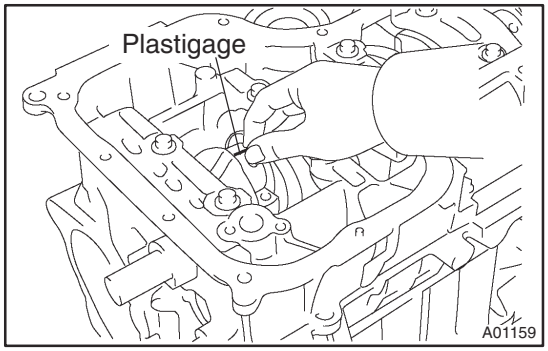


(2) Using SST, remove the 4 bolts and 2 connecting rod caps as shown.

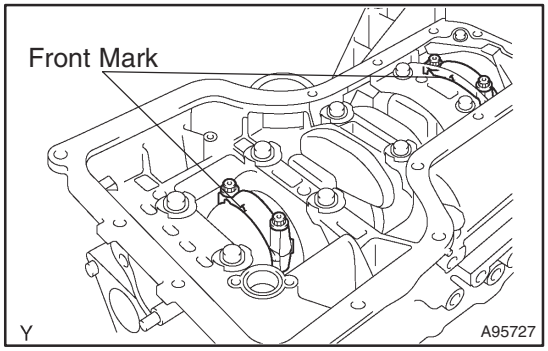
SST 09205–16010

(3) Clean the crank pin and bearing.

(4) Check the crank pin and bearing for pitting and scratches.



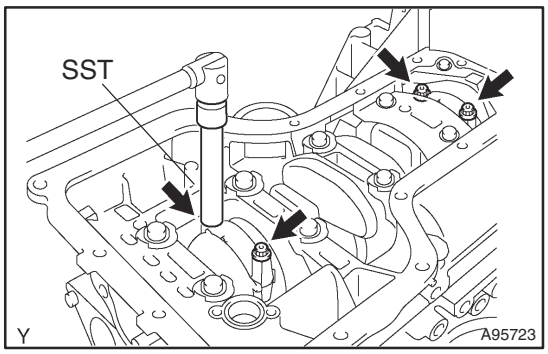
(5) Lay a strip of Plastigage across the crank pin.



(6) Check that the front marks of the connecting rod cap are facing in the correct direction.

(7) Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.

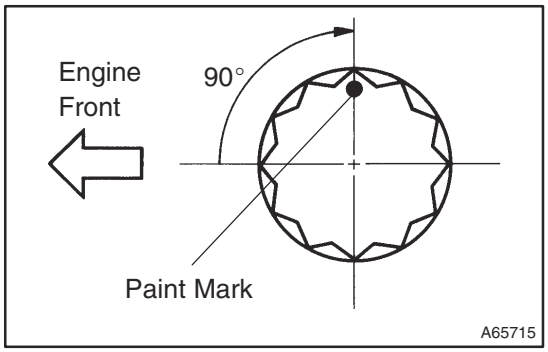
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(8) Using SST, tighten the 2 bolts in several passes to the specified torque.

SST 09205–16010

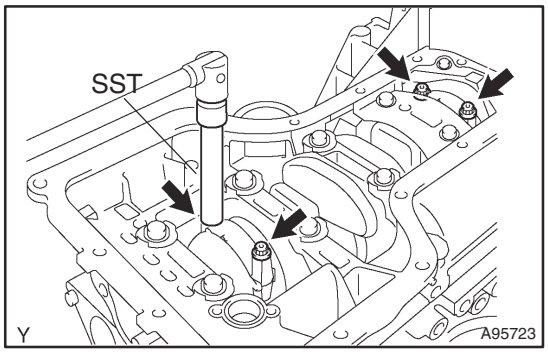
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)



(9) Mark the front of the connecting cap bolts with paint.

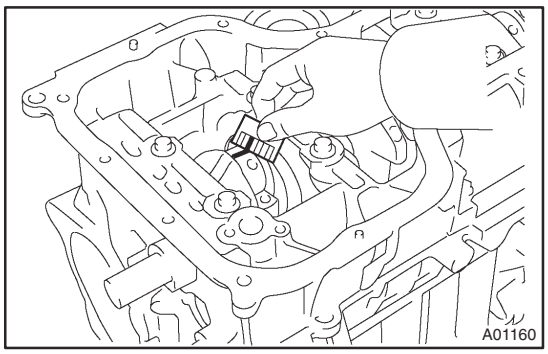
(10) Retighten the cap bolts by an additional 90° as shown in the illustration.

(11) Check that the crankshaft turns smoothly.



(12) Remove the 4 bolts and 2 connecting rod caps.

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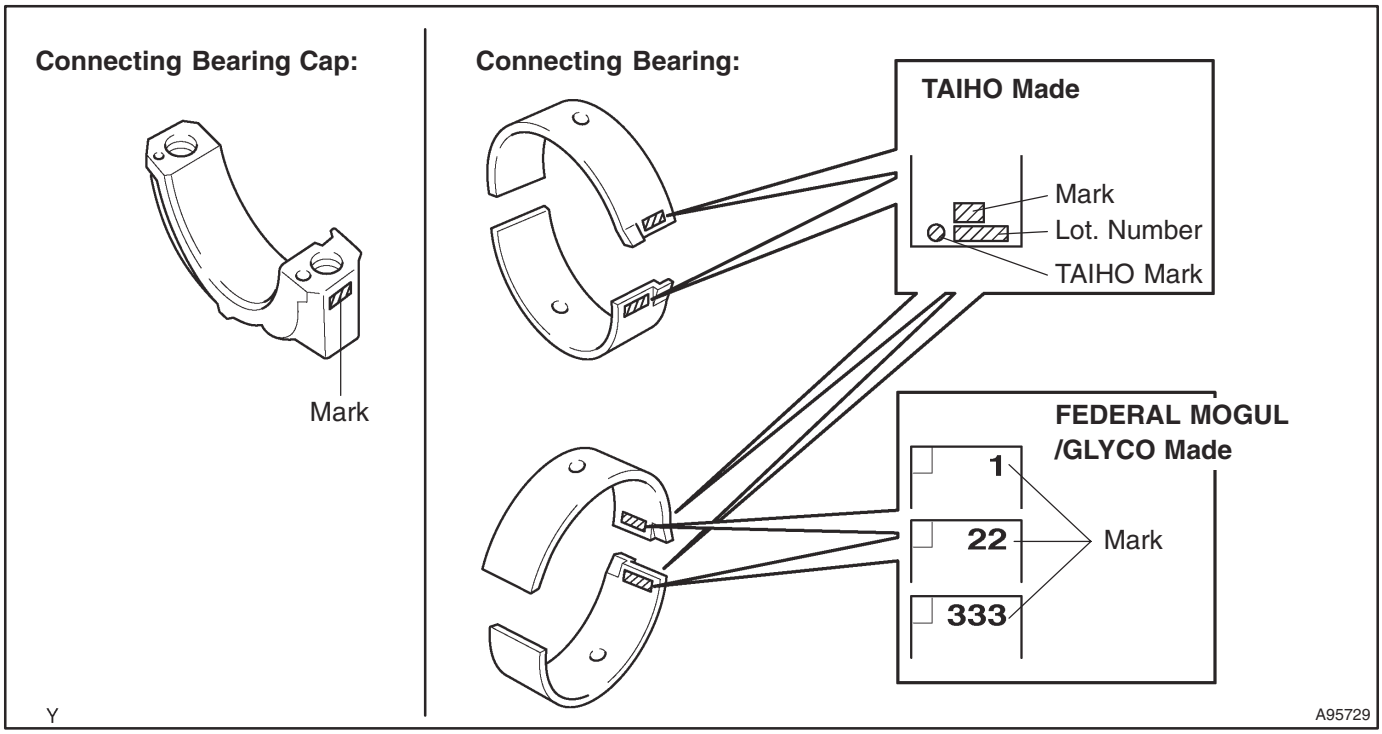


(13) Measure the Plastigage at its widest point.

Standard oil clearance:
0.028 to 0.060 mm (0.0011 to 0.0024 in.)
Maximum oil clearance: 0.080 mm (0.0031 in.)

NOTICE:
Remove the Plastigage completely after the measurement.

- If the oil clearance is greater than maximum, replace the connecting rod bearing.
- If necessary, grind or replace the crankshaft.

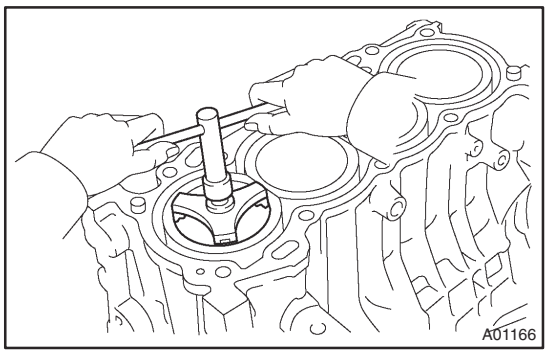


HINT:

- The TAIHO mark is either on the claw side or the opposite side.
- If replacing a bearing, select a new one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked ”1”, ”2” and ”3” accordingly.

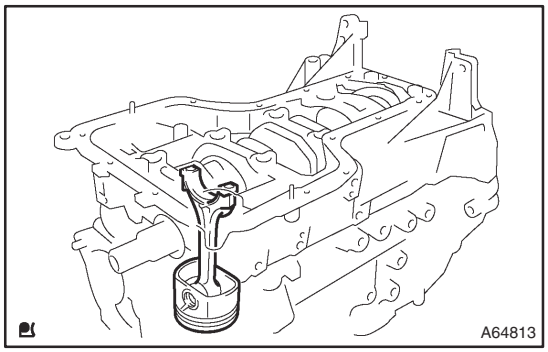
Item	Mark	Specification
Connecting rod bearing cap bore diameter	1 2 3	47.000 to 47.008 mm (1.8504 to 1.8507 in.) 47.009 to 47.016 mm (1.8507 to 1.8510 in.) 47.017 to 47.024 mm (1.8511 to 1.8513 in.)
Connecting rod bearing thickness	1 2 3	1.486 to 1.490 mm (0.0585 to 0.0587 in.) 1.491 to 1.494 mm (0.0587 to 0.0588 in.) 1.495 to 1.498 mm (0.0589 to 0.0590 in.)
Crankshaft pin outer diameter	–	43.992 to 44.000 mm (1.7320 to 1.7323 in.)

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4. REMOVE CONNECTING ROD SUB–ASSY

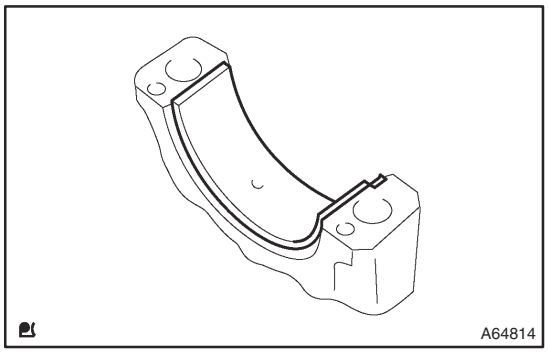
(a) Using a ridge reamer, remove all the carbon from the top of the cylinder.



(b) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

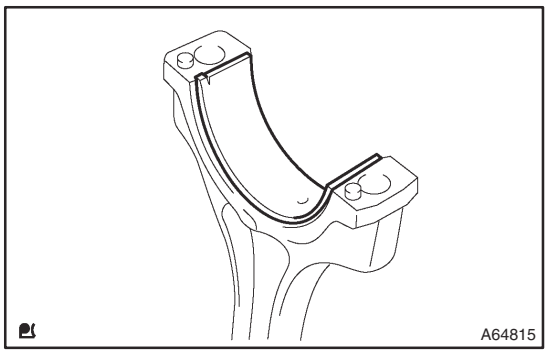
HINT:

- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

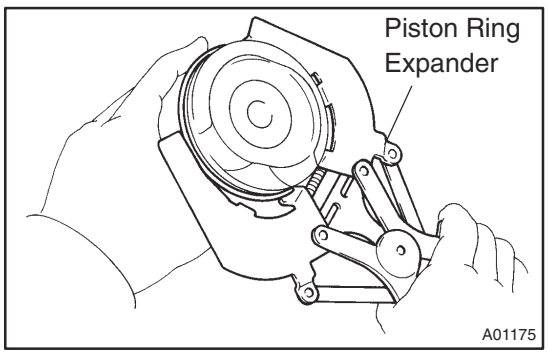


5. REMOVE CONNECTING ROD BEARING

(a) Remove the connecting rod bearing from the connecting rod cap.



(b) Remove the connecting rod bearing from the connecting rod.

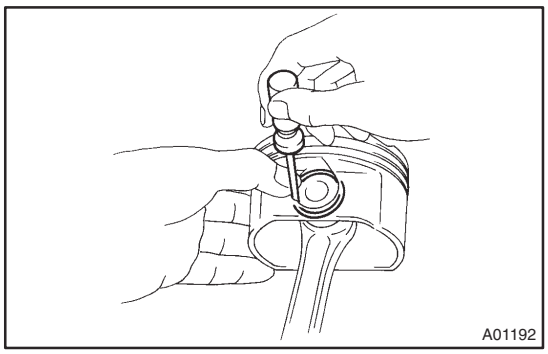


6. REMOVE PISTON RING SET

(a) Using a piston ring expander, remove the 2 compression rings.

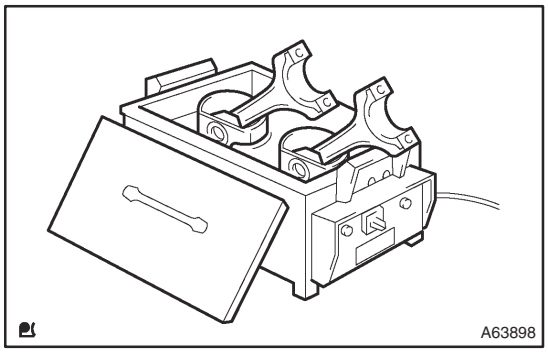
(b) Remove the 2 side rails and oil ring by hand.

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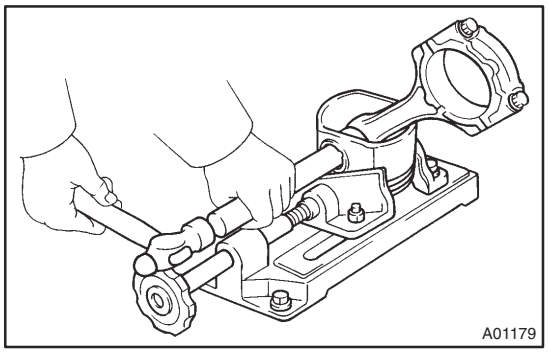


7. REMOVE W/PIN PISTON SUB–ASSY

(a) Using a small screwdriver, pry out the 2 snap rings.



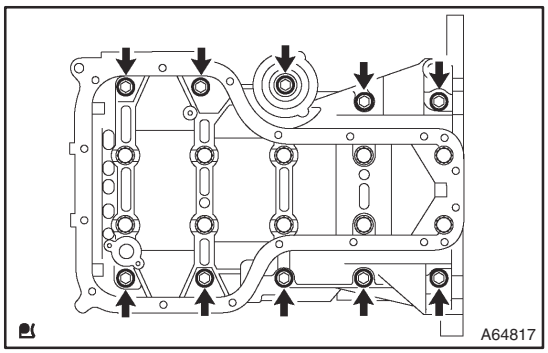
(b) Heat the piston up to 80 to 90°C (176 to 194°F).



(c) Using a plastic hammer and brass bar, lightly tap out the piston pin, then remove the connecting rod.

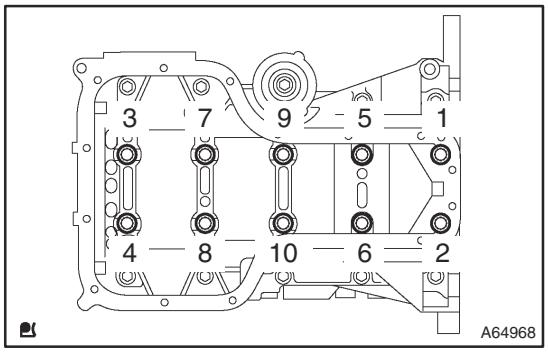
HINT:

- The piston and pin are a matched set.
- Arrange the piston, pins, ring, connecting rod and bearings in the correct order.



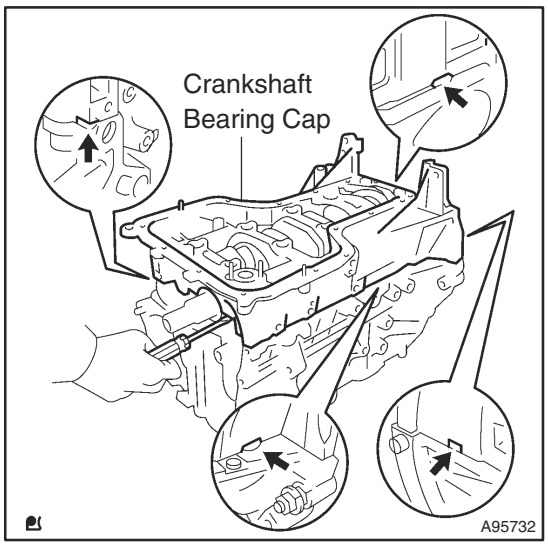
8. REMOVE CRANKSHAFT

(a) Remove the 10 bolts from the crankshaft bearing cap.



(b) Uniformly loosen the 10 bearing cap bolts in several passes in the sequence shown in the illustration.

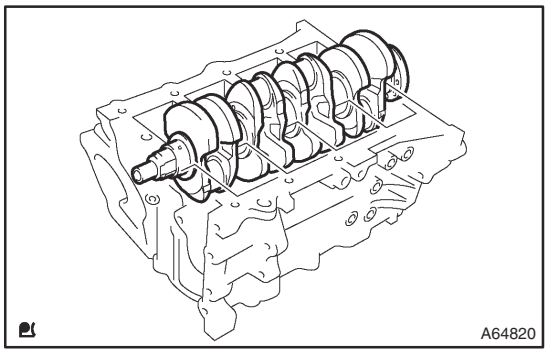
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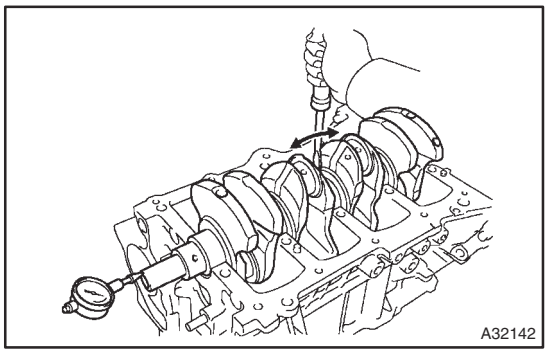
(c) Using a screwdriver, remove the crankshaft bearing cap by prying the indicated portions between the cylinder block and bearing cap.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and bearing cap.



(d) Remove the crankshaft from the cylinder block.



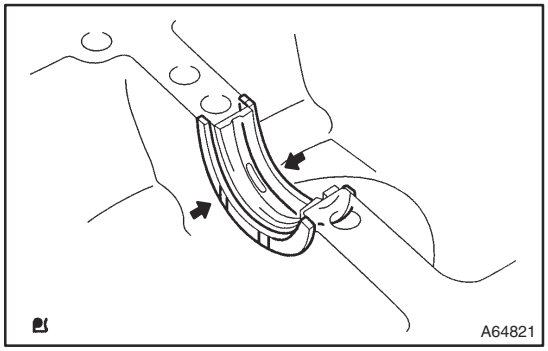
9. INSPECT CRANKSHAFT THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:
0.04 to 0.24 mm (0.0016 to 0.0094 in.)
Maximum thrust clearance: 0.30 mm (0.0118 in.)

- If the thrust clearance is greater than maximum, measure the thrust washer thickness.
- If the thickness is not as specified, replace the thrust washer.

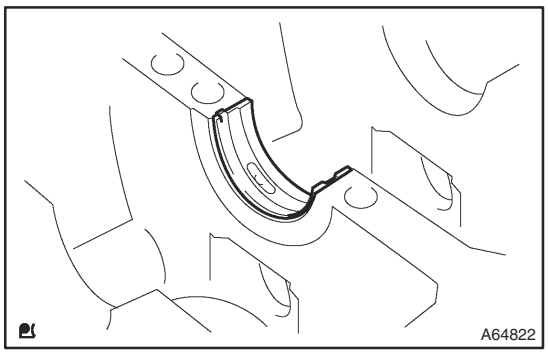
HINT:
Thrust washer thickness: 2.430 to 2.480 mm (0.0957 to 0.0976 in.).



10. REMOVE CRANKSHAFT THRUST WASHER UPPER

(a) Remove the 2 crankshaft thrust washers from the cylinder block.

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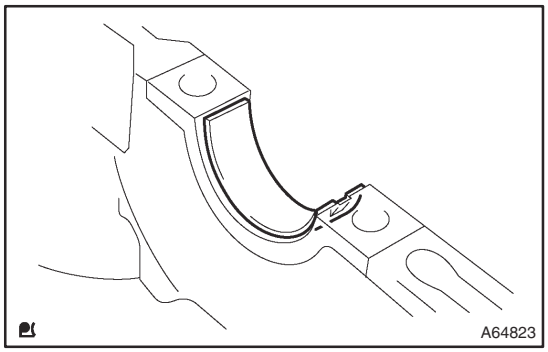


11. REMOVE CRANKSHAFT BEARING

(a) Remove the 5 crankshaft bearings from the cylinder block.

NOTICE:

Arrange the main bearings and thrust washers in the correct order.



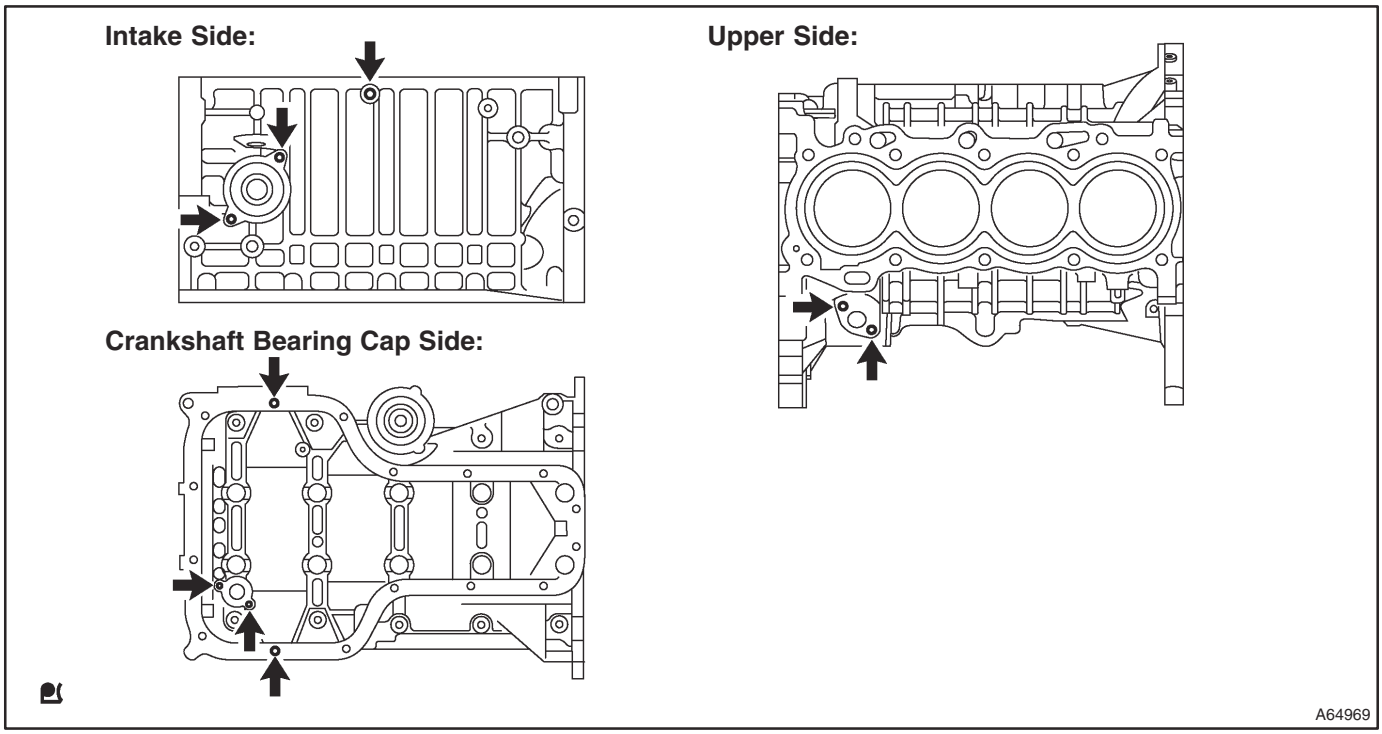
(b) Remove the 5 crankshaft bearings from the crankshaft bearing cap.

NOTICE:

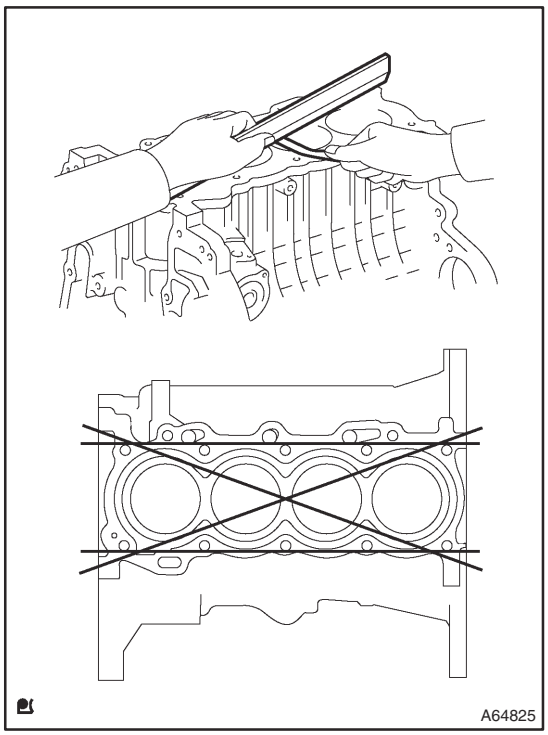
Arrange the main bearings and thrust washers in the correct order.

12. REMOVE STUD BOLT

(a) Using Torx socket wrenches E5 and E7, remove the 9 stud bolts.



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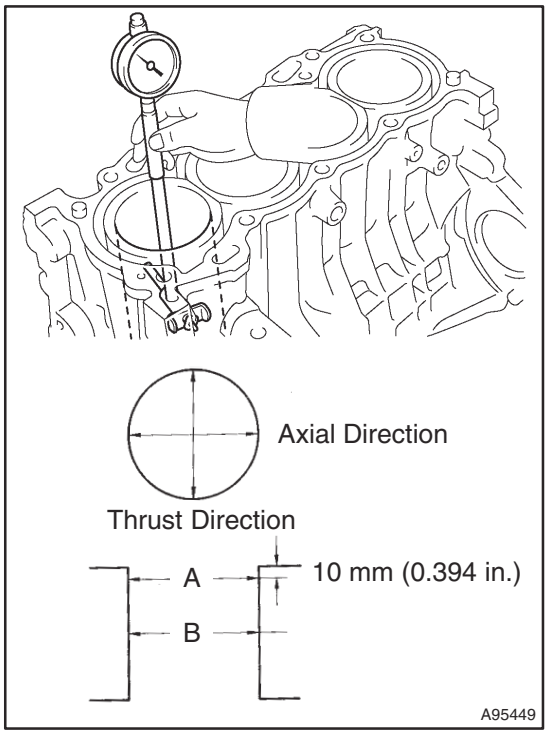


13. INSPECT CYLINDER BLOCK FOR FLATNESS

(a) Using a precision straight edge and feeler gauge, measure the warpage on the surface which comes into contact with the cylinder head gasket.

Maximum warpage: 0.05 mm (0.0020 in.)

If the warpage is greater than maximum, replace the cylinder block.

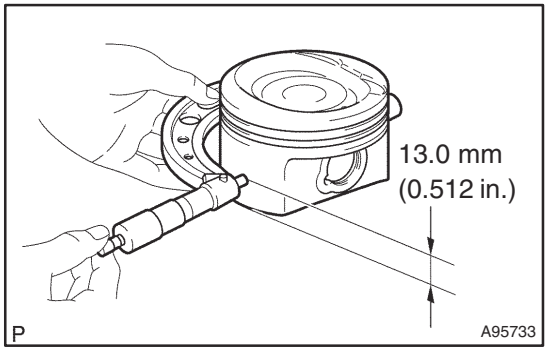


14. INSPECT CYLINDER BORE

(a) Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Standard diameter:
79.000 to 79.013 mm (3.1102 to 3.1107 in.)
Maximum diameter: 79.133 mm (3.1155 in.)

If the average diameter of 4 positions is greater than maximum, replace the cylinder block.



15. INSPECT W/PIN PISTON SUB–ASSY

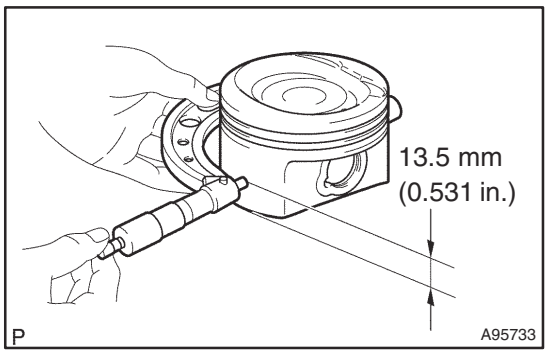
(a) For engine type 1ZZ–FE.

(1) Using a micrometer, measure the diameter of the piston. Align the micrometer so it is 13.0 mm (0.512 in.) from the bottom of the piston and at right angles (90°) to the piston pin holes as illustrated.

Piston diameter:
78.955 to 78.965 mm (3.1085 to 3.1089 in.)

If the diameter is not as specified, replace the piston.

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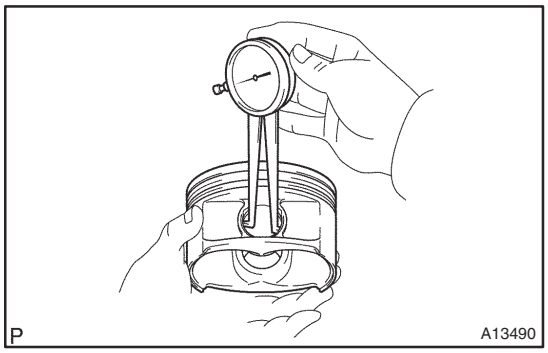
(b) For engine type 3ZZ–FE.
(1) Using a micrometer, measure the diameter of the piston. Align the micrometer so it is 13.5 mm (0.531 in.) from the bottom of the piston and at right angles (90°) to the piston pin holes as illustrated.
Piston diameter:
78.960 to 78.975 mm (3.1087 to 3.1091 in.)

If the diameter is not as specified, replace the piston.

16. INSPECT PISTON OIL CLEARANCE

(a) Subtract the piston diameter measurement from the cylinder bore diameter measurement.
Standard oil clearance: 0.073 to 0.096 mm (0.0029 to 0.0038 in.)
Maximum oil clearance: 0.10 mm (0.0039 in.)
- If the oil clearance is greater than maximum, replace all of the piston assembly.
- If necessary, replace the cylinder block.

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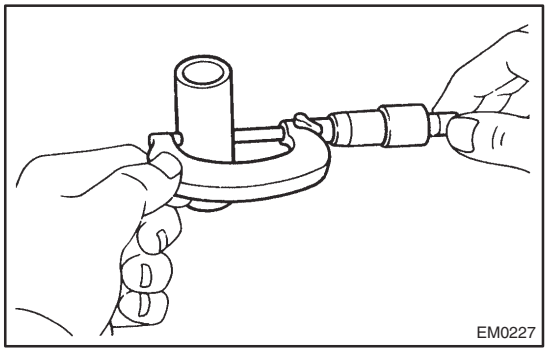


17. INSPECT PISTON PIN OIL CLEARANCE

(a) Using a caliper gauge, measure the piston pin bore diameter.
Piston pin bore diameter:
20.006 to 20.015 mm (0.7876 to 0.7880 in.)

Mark	mm (in.)
A	20.006 to 20.009 (0.7876 to 0.7878)
B	20.010 to 20.012 (0.7878 to 0.7879)
C	20.013 to 20.015 (0.7879 to 0.7880)

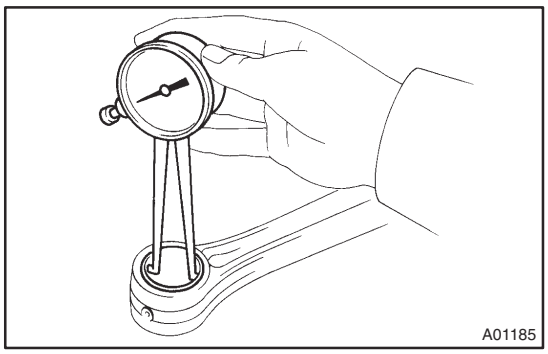
If the diameter is not as specified, replace the piston assembly.



(b) Using a micrometer, measure the piston pin outer diameter.
Piston pin outer diameter:
20.004 to 20.013 mm (0.7876 to 0.7879 in.)

Mark	mm (in.)
A	20.004 to 20.007 (0.7876 to 0.7877)
B	20.008 to 20.010 (0.7877 to 0.7878)
C	20.011 to 20.013 (0.7878 to 0.7879)

If the diameter is not as specified, replace the piston assembly.

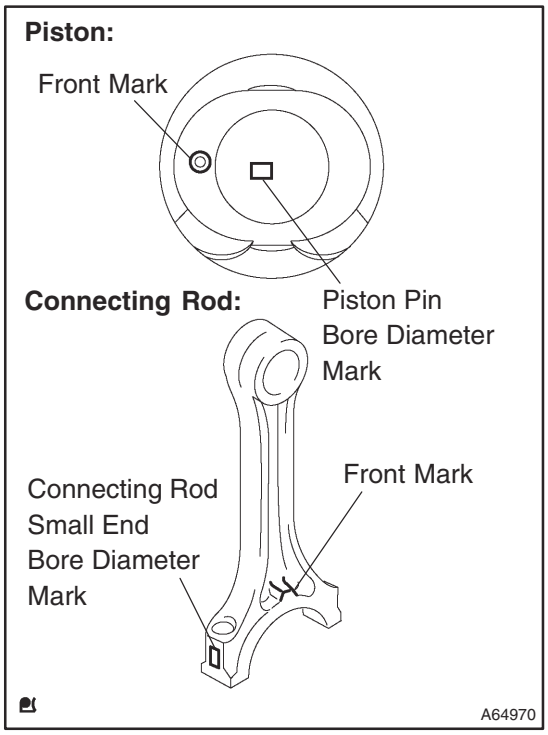


(c) Using a caliper gauge, measure the connecting rod small end bore diameter.

Connecting rod small end bore diameter:
20.012 to 20.021 mm (0.7879 to 0.7882 in.)

Mark	mm (in.)
A	20.012 to 20.015 (0.7879 to 0.7880)
B	20.016 to 20.018 (0.7880 to 0.7881)
C	20.019 to 20.021 (0.7881 to 0.7882)

If the diameter is not as specified, replace the connecting rod assembly.



(d) Subtract the piston pin outer diameter measurement from the piston pin bore diameter measurement.

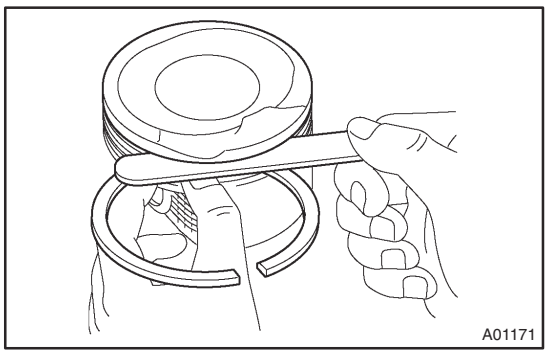
Standard oil clearance:
–0.001 to 0.017 mm (–0.00004 to 0.0007 in.)
Maximum oil clearance: 0.017 mm (0.0007 in.)

- If the oil clearance is greater than maximum, replace the connecting rod assembly.
- If necessary, replace the piston pin.

(e) Subtract the piston pin outer diameter measurement from the connecting rod small end bore diameter measurement.

Standard oil clearance:
0.005 to 0.011 mm (0.0002 to 0.0004 in.)
Maximum oil clearance: 0.011 mm (0.0004 in.)

- If the oil clearance is greater than maximum, replace the connecting rod assembly.
- If necessary, replace the connecting rod and piston pin.



18. INSPECT RING GROOVE CLEARANCE

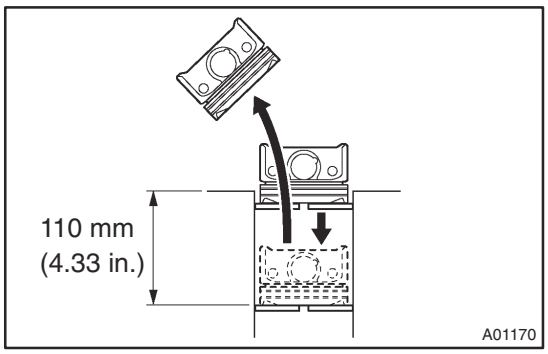
(a) Using a feeler gauge, measure the clearance between the new piston ring and wall of the ring groove.

Ring groove clearance:

Item	Specification
No. 1 ring	0.02 to 0.07 mm (0.0008 to 0.0028 in.)
No. 2 ring	0.03 to 0.07 mm (0.0012 to 0.0028 in.)
Oil ring	0.03 to 0.11 mm (0.0012 to 0.0043 in.)

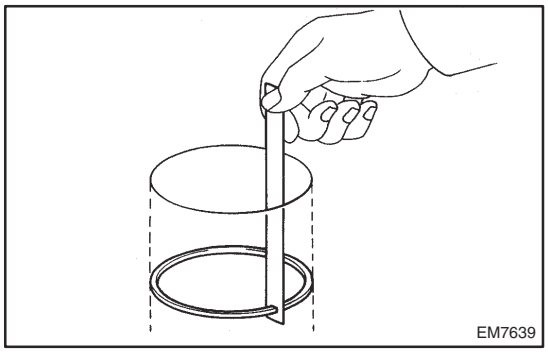
If the groove clearance is not as specified, replace the piston assembly.

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19. INSPECT PISTON RING END GAP

(a) Using a piston, push the piston ring a little beyond the bottom of the ring travel, which is 110 mm (4.33 in.) from the top of the cylinder block.



(b) Using a feeler gauge, measure the end gap.

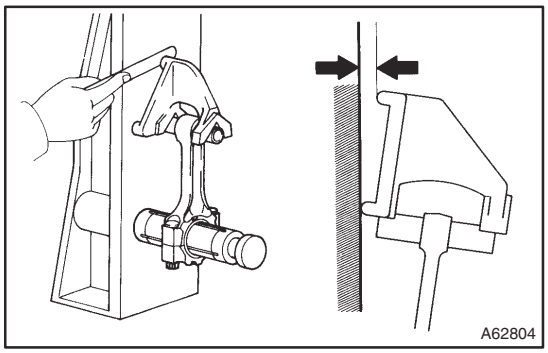
Standard end gap:

Item	Specification
No. 1 ring	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
No. 2 ring	0.35 to 0.50 mm (0.0138 to 0.0197 in.)
Oil ring	0.15 to 0.40 mm (0.0059 to 0.0157 in.)

Maximum end gap:

Item	Specification
No. 1 ring	1.05 mm (0.0413 in.)
No. 2 ring	1.20 mm (0.0472 in.)

- If the end gap is greater than maximum, replace the piston ring.
- If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.



20. INSPECT CONNECTING ROD SUB–ASSY

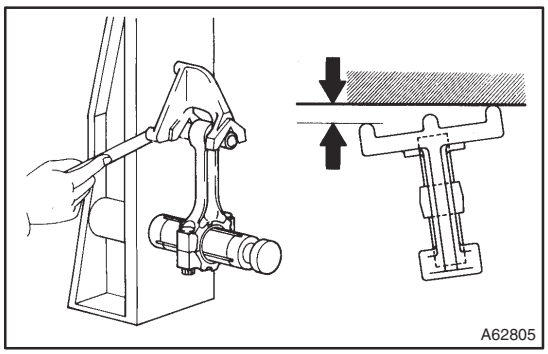
(a) Using a connecting rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for out–of–alignment.

Maximum out–of–alignment:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If the out–of–alignment is greater than maximum, replace the connecting rod assembly.



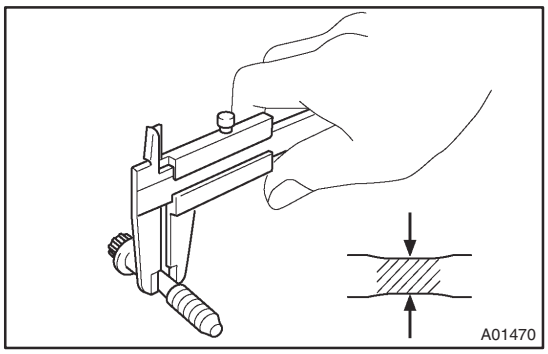
(2) check for twist.

Maximum twist:

0.05mm (0.0020 in.) per 100 mm (3.94 in.)

If the twist is greater than maximum, replace the connecting rod assembly.

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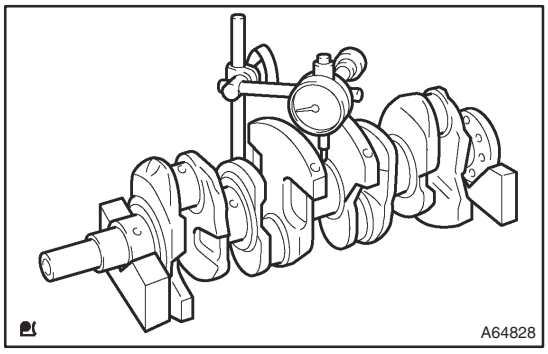


21. INSPECT CONNECTING ROD BOLT

(a) Using vernier calipers, measure the tension portion diameter of the bolts.

Standard diameter:
6.6 to 6.7 mm (0.260 to 0.264 in.)
Minimum diameter: 6.4 mm (0.252 in.)

If the diameter is less than minimum, replace the connecting rod bolt.

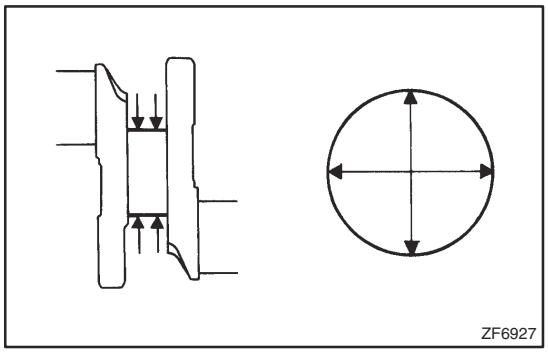


22. INSPECT CRANKSHAFT

(a) Using a dial indicator and V–blocks, measure the circle runout as shown in the illustration.

Maximum circle runout: 0.03 mm (0.0012 in.)

If the circle runout is greater than maximum, replace the crankshaft.



(b) Using a micrometer, measure the diameter of each main journal at the points shown in the illustration.

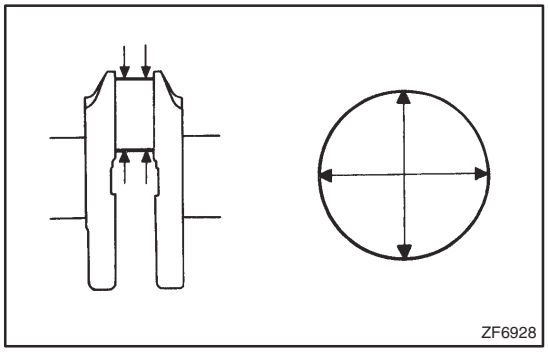
Diameter: 47.988 to 48.000 mm (1.8893 to 1.8898 in.)

If the diameter is not as specified, check the crankshaft oil clearance.

(c) Check each main journal for taper and out–of–round as shown.

Maximum taper and out–of–round:
0.02 mm (0.0008 in.)

If the taper or out–of–round is greater than maximum, replace the crankshaft.



(d) Using a micrometer, measure the diameter of each crank pin at the points shown in the illustration.

Diameter: 43.992 to 44.000 mm (1.7320 to 1.7323 in.)

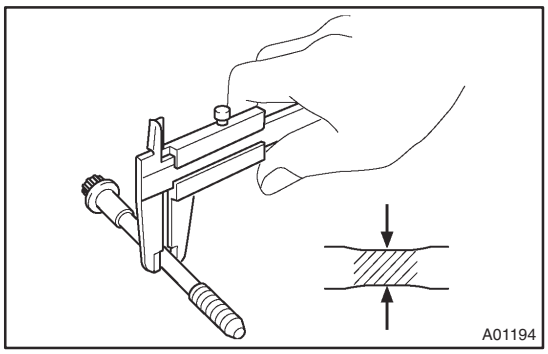
If the diameter is not as specified, check the connecting rod oil clearance.

(e) Check each crank pin for taper and out–of–round as shown.

Maximum taper and out–of–round:
0.02 mm (0.0008 in.)

If the taper or out–of–round is greater than maximum, replace the crankshaft.

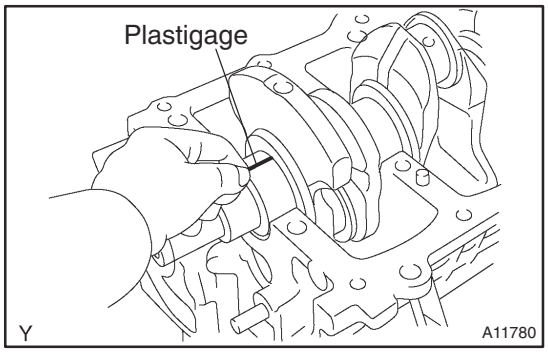
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23. INSPECT CRANKSHAFT BEARING CAP SET BOLT

(a) Using vernier calipers, measure the tension portion diameter of the bolts.
Standard diameter: 7.3 to 7.5 mm (0.287 to 0.295 in.)
Minimum diameter: 7.3 mm (0.287 in.)

If the diameter is greater than minimum, replace the crankshaft bearing cap set bolt.

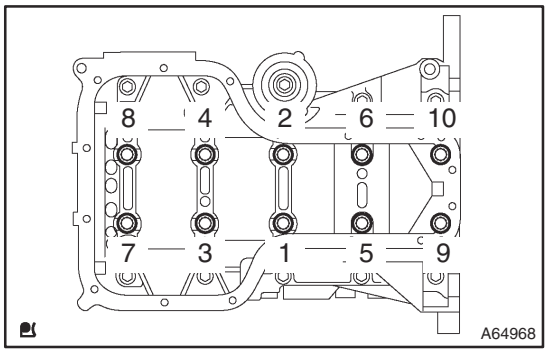


24. INSPECT CRANKSHAFT OIL CLEARANCE

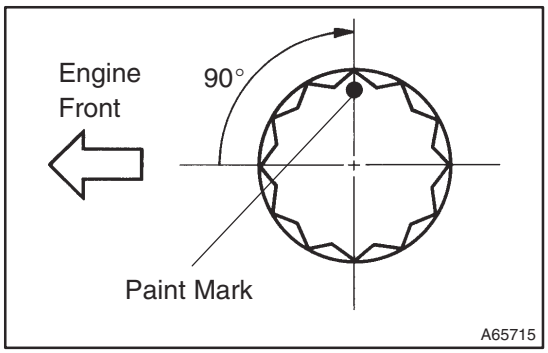
NOTICE:

Do not turn the crankshaft.

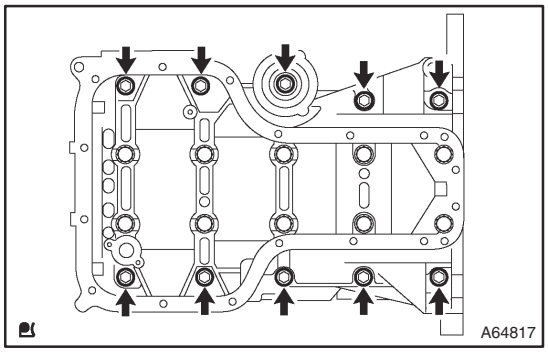
(a) Clean each main journal and bearing.
(b) Place the crankshaft on the cylinder block.
(c) Lay a strip of Plastigage across each journal.



(d) Using SST, tighten the bolts to the specified torque in the several passes in the sequence shown.
Torque: 44 N·m (449 kgf·cm, 33 ft·lbf)

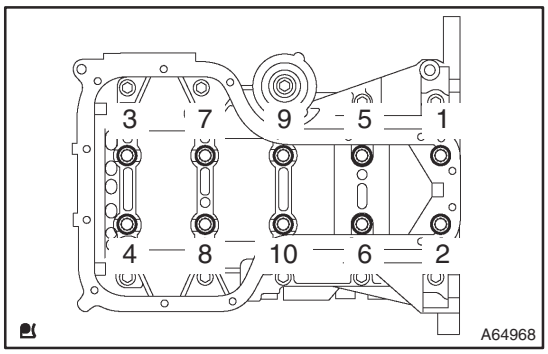


(e) Mark the front of the bearing cap bolts with paint.
(f) Retighten the bearing cap bolts by an additional 90° as shown in the illustration.
(g) Check that the painted mark is now at a 90° angle to the front.

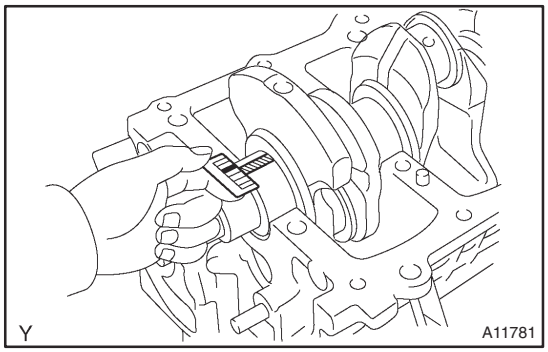


(h) Tighten the 10 other bolts for the bearing cap.
Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)
(i) Remove the 10 bolts.

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(j) Uniformly loosen the 10 bearing cap bolts in several passes in the sequence shown in the illustration.



(k) Measure the Plastigage at its widest point.
Standard oil clearance:
0.015 to 0.032 mm (0.0006 to 0.0012 in.)
Maximum oil clearance: 0.05 mm (0.0020 in.)

NOTICE:
Completely remove the Plastigage.

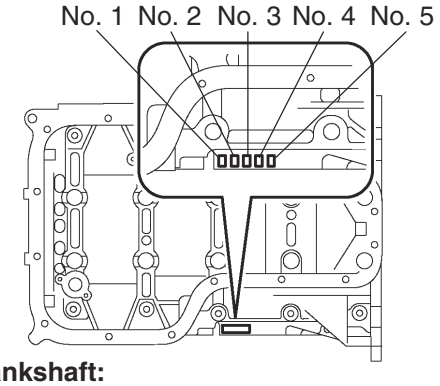
- If the oil clearance is greater than minimum, replace the crankshaft bearing.
- If necessary, replace the crankshaft.

HINT:
If replacing a bearing, select a new one having the same number. If the number of the bearing cannot be determined, calculate the correct use bearing number by adding together the numbers imprinted on the cylinder block and crankshaft, then select a new bearing having the calculated number. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4" accordingly.

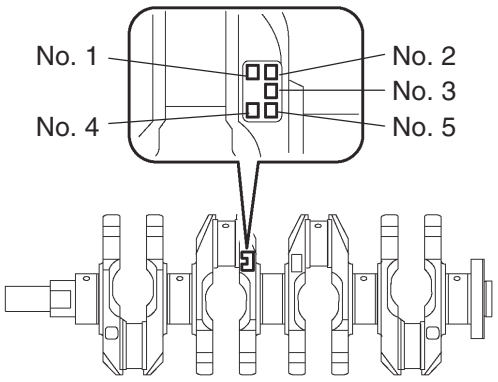
Cylinder block (A) + Crankshaft (B)	0 to 2	3 to 5	6 to 8	9 to 11
Use bearing	"1"	"2"	"3"	"4"

EXAMPLE:
Cylinder block "3" (A) + Crankshaft "4" (B) = Total number 7 (Use bearing "3")

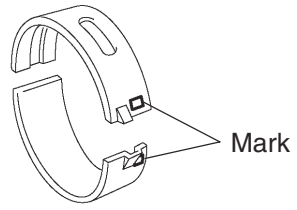
Cylinder Block:



Crankshaft:



Bearing:



Item	Mark	mm (in.)
Cylinder block journal bore diameter (A)	"0"	52.000 to 52.002 (2.0472 to 2.0473)
	"1"	52.003 to 52.004 (2.0474 to 2.0474)
	"2"	52.005 to 52.006 (2.0474 to 2.0475)
	"3"	52.007 to 52.009 (2.0475 to 2.0476)
	"4"	52.010 to 52.011 (2.0476 to 2.0477)
	"5"	52.012 to 52.013 (2.0477 to 2.0478)
	"6"	52.014 to 52.015 (2.0478 to 2.0478)
Crankshaft journal diameter (B)	"0"	47.999 to 48.000 (1.8897 to 1.8898)
	"1"	47.997 to 47.998 (1.8896 to 1.8897)
	"2"	47.995 to 47.996 (1.8896 to 1.8896)
	"3"	47.993 to 47.994 (1.8895 to 1.8895)
	"4"	47.991 to 47.992 (1.8894 to 1.8894)
	"5"	47.988 to 47.990 (1.8893 to 1.8894)
Standard bearing center wall thickness	"1"	1.994 to 1.997 (0.0785 to 0.0786)
	"2"	1.998 to 2.000 (0.0787 to 0.0787)
	"3"	2.001 to 2.003 (0.0788 to 0.0789)
	"4"	2.004 to 2.006 (0.0789 to 0.0790)

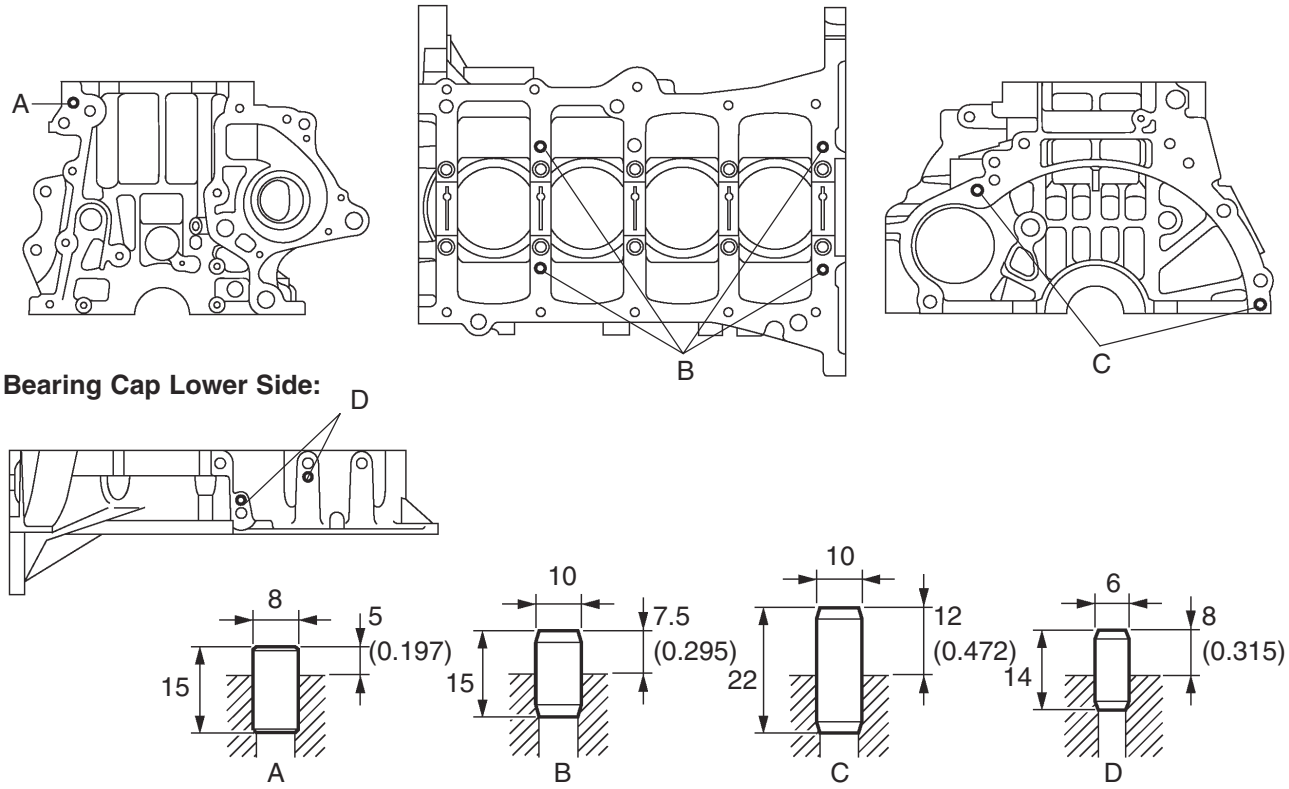
ProCarManuals.com

25. INSTALL STRAIGHT PIN

(a) Using a plastic hammer, install 9 new straight pins into the cylinder block.

Standard protrusion:

Item	Specification
A	5.0 mm (0.197 in.)
B	7.5 mm (0.295 in.)
C	12.0 mm (0.472 in.)
D	8.0 mm (0.315 in.)



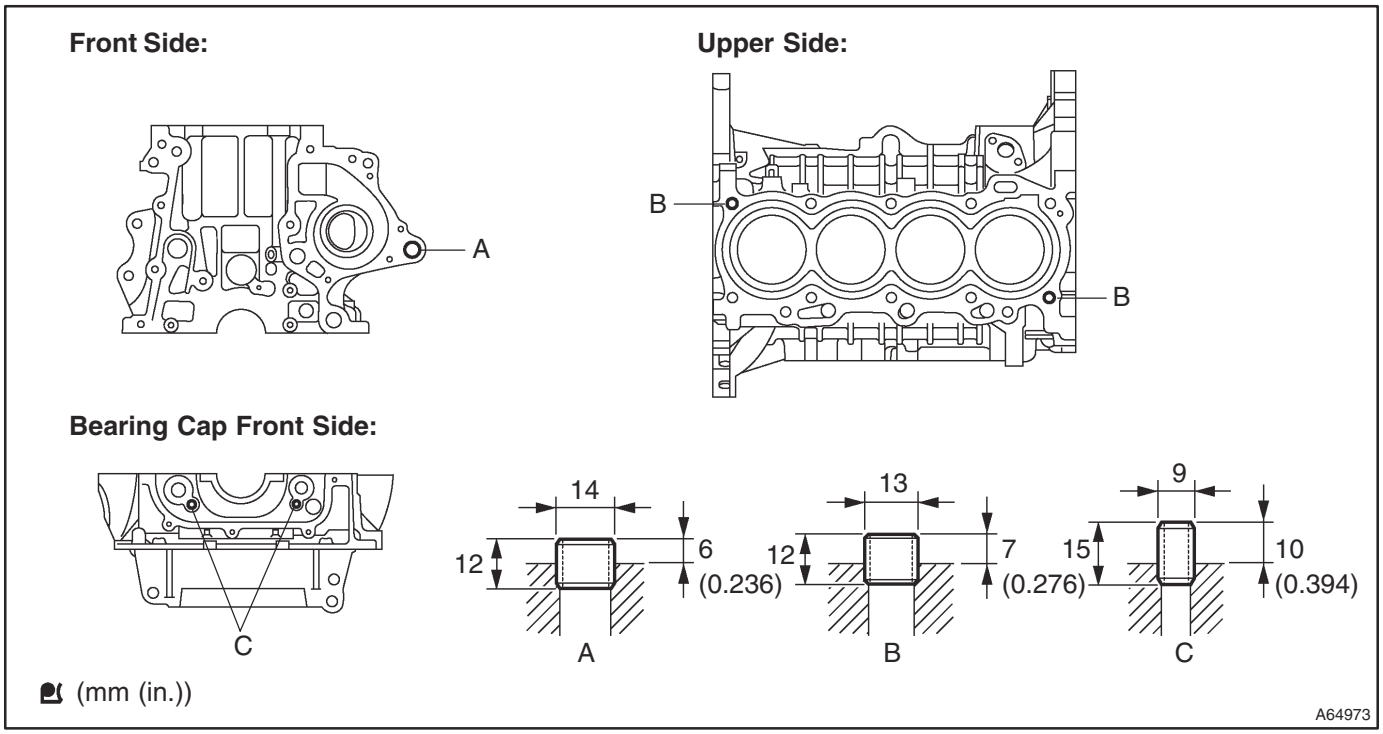
ProCarManuals.com

26. INSTALL RING PIN

(a) Using a plastic hammer, install 5 new ring pins into the cylinder block.

Standard protrusion:

Item	Specification
A	6.0 mm (0.236 in.)
B	7.0 mm (0.276 in.)
C	10.0 mm (0.394 in.)

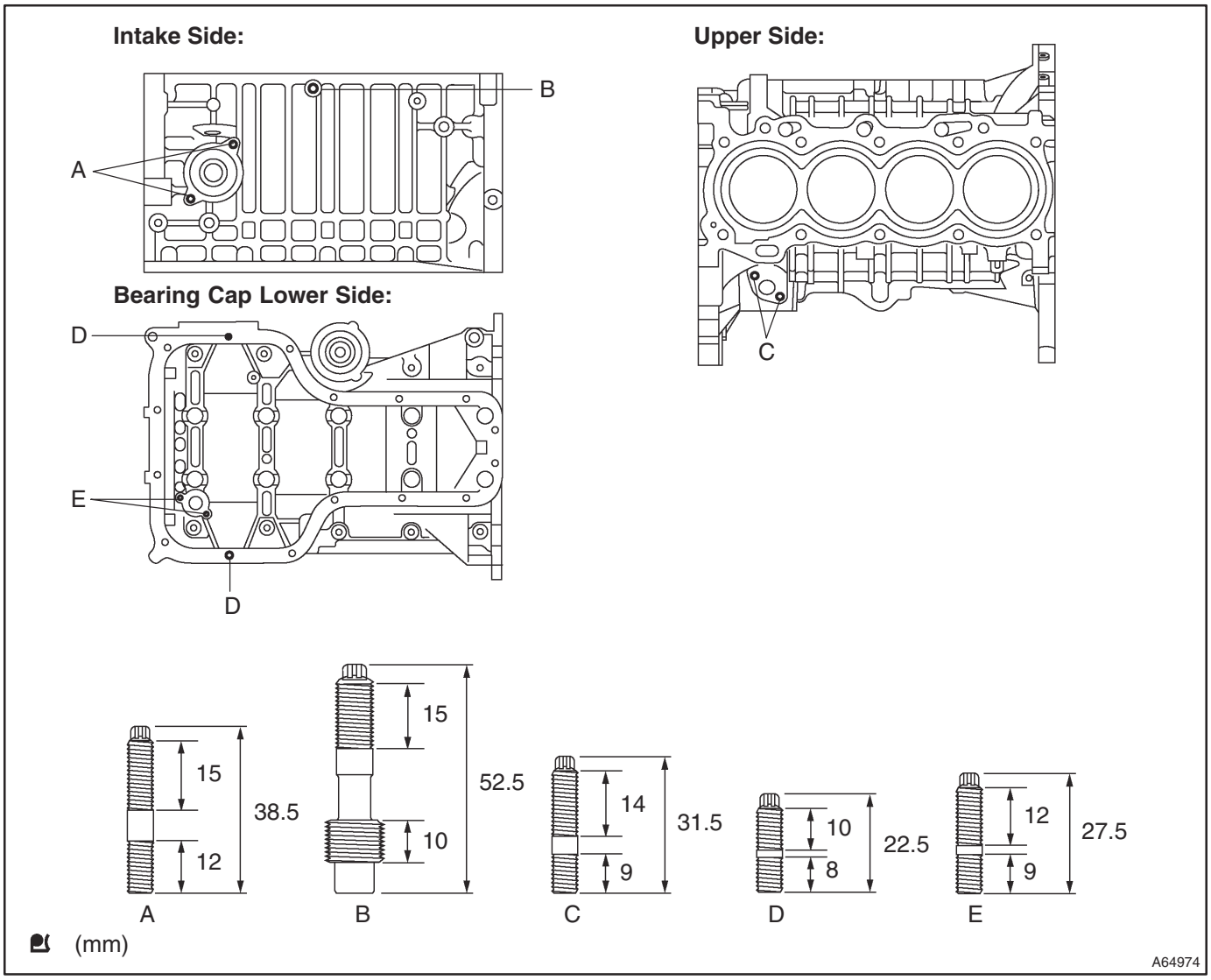


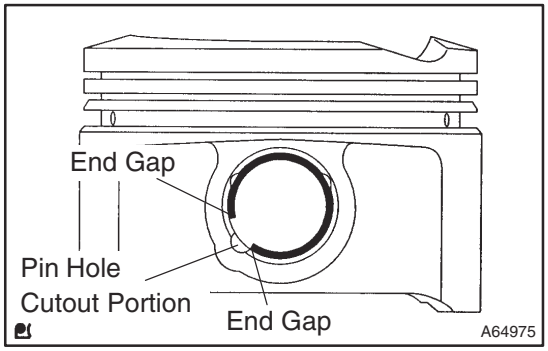
ProCarManuals.com

27. INSTALL STUD BOLT

(a) Using Torx socket wrenches E5 and E7, install the 9 stud bolts into the cylinder block.

Torque:
5.0 N·m (51 kgf·cm, 44 in.·lbf) for A
11 N·m (112 kgf·cm, 8 ft·lbf) for B
5.0 N·m (51 kgf·cm, 44 in.·lbf) for C
5.0 N·m (51 kgf·cm, 44 in.·lbf) for D
5.0 N·m (51 kgf·cm, 44 in.·lbf) for E





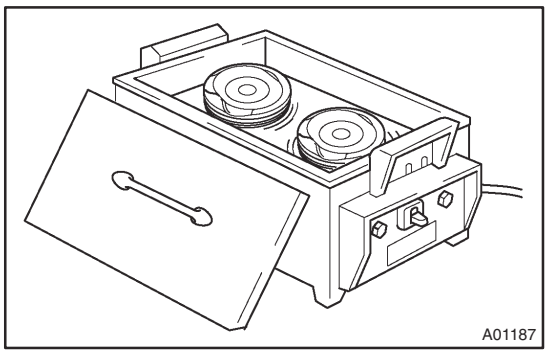
28. INSTALL W/PIN PISTON SUB–ASSY

(a) Using a small screwdriver, install a new snap ring onto one end of the piston pin hole.

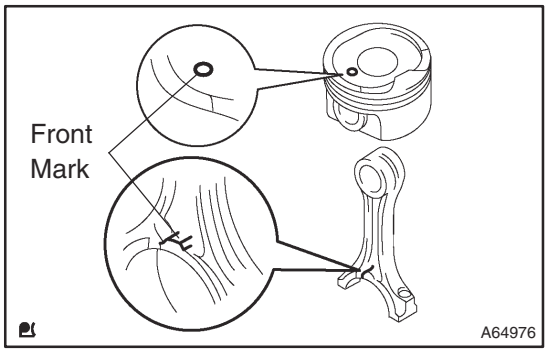
HINT:

Be sure that the end gap of the snap ring is aligned with the pin hole cutout portion of the piston.

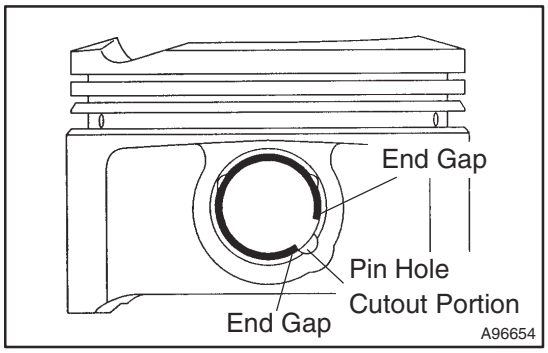
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(b) Gradually heat the piston up to 80 to 90°C (176 to 194°F).



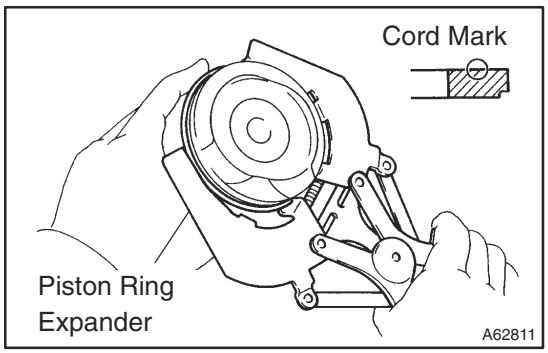
(c) Align the front marks on the piston with the connecting rod, then push in the piston with your thumb.



(d) Using a small screwdriver, install a new snap ring onto one end of the piston pin hole.

HINT:

Be sure that the end gap of the snap ring is aligned with the pin hole cutout portion of the piston.



29. INSTALL PISTON RING SET

HINT:

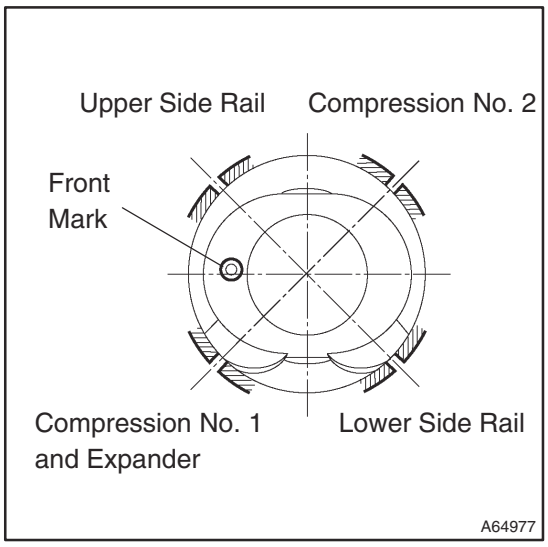
In case of reusing the piston rings, install them onto the matched pistons with the surfaces facing upward correctly.

(a) Install the oil ring expander and 2 side rails by hand.

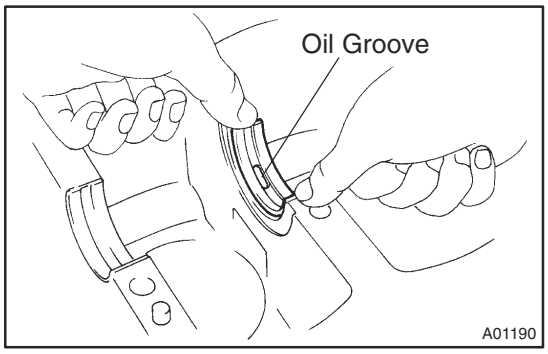
(b) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

Code mark (No. 2 only): 2R

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(c) Position the piston rings so that the ring ends are as shown.

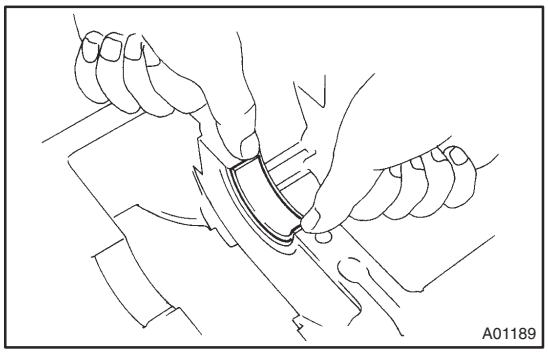


30. INSTALL CRANKSHAFT BEARING

(a) Install the upper bearing with an oil groove onto the cylinder block.

NOTICE:

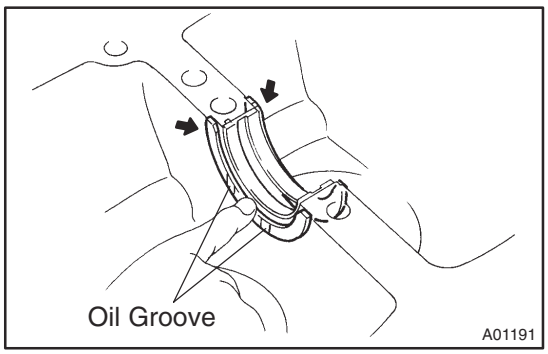
Do not apply engine oil to the bearing and its contact surface.



(b) Install the lower bearing onto the bearing cap.

NOTICE:

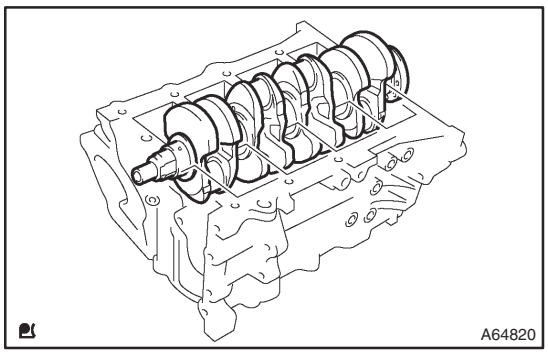
Do not apply engine oil to the bearing and its contact surface.



31. INSTALL CRANKSHAFT THRUST WASHER UPPER

(a) Install the 2 thrust washers onto the No. 3 journal position of the cylinder block with the oil grooves facing outward.

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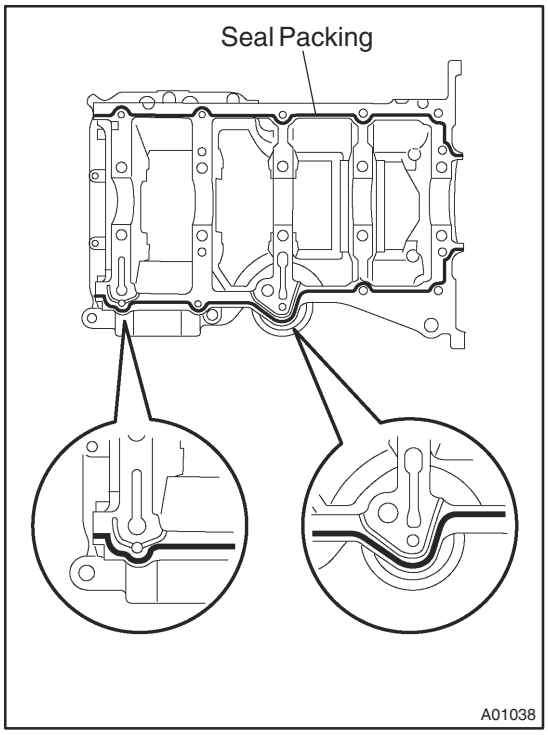


32. INSTALL CRANKSHAFT

(a) Apply engine oil to the upper bearing, then install the crankshaft onto the cylinder block.

(b) Apply a light coat of engine oil to the bolt threads, bolt seats, and bearings of the bearing cap.

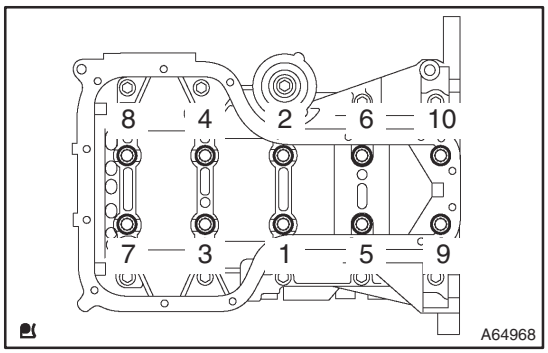
(c) Install the crankshaft onto the cylinder block.



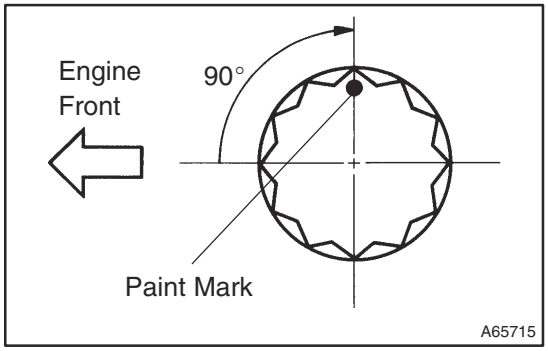
(d) Apply a continuous bead of seal packing (Diameter; 2.5 to 3.5 mm (0.098 to 0.138 in.)) as shown in the illustration.
Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the bearing cap sub–assembly within 3 minutes after applying seal packing.**
- **Do not put into engine oil for at least 2 hours after installation.**



(e) Tighten the bolts in several passes in the sequence shown to the specified torque.
Torque: 44 N·m (449 kgf·cm, 33 ft·lbf)

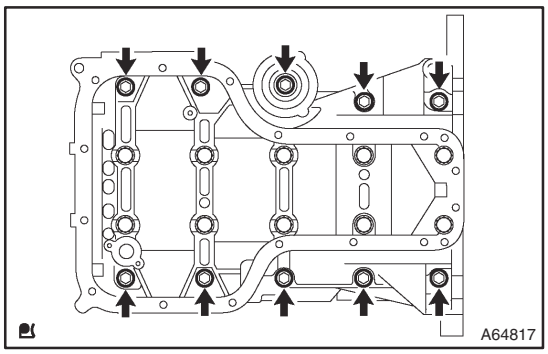


(f) Mark the front of the bearing cap bolts with paint.

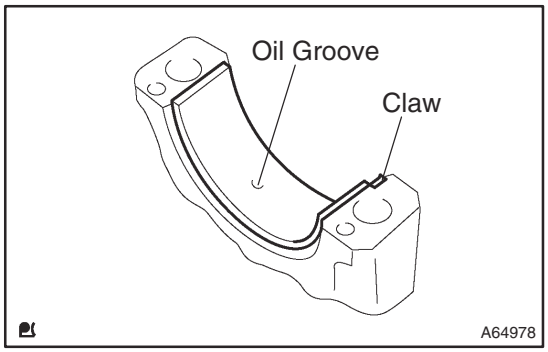
(g) Retighten the bearing cap bolts by an additional 90° as shown in the illustration.

(h) Check that the painted mark is now at a 90° angle to the front.

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(i) Tighten the 10 other bolts for the bearing cap.
Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)

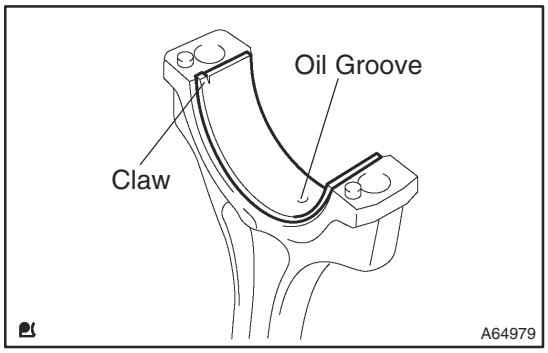


33. INSTALL CONNECTING ROD BEARING

(a) Align the connecting rod bearing claw with the oil groove of the connecting rod cap.

(b) Install the connecting rod bearing onto the connecting rod cap.

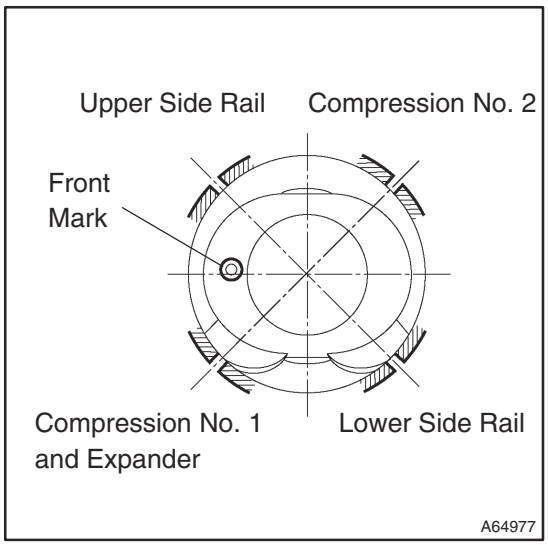
NOTICE:
Do not apply engine oil to the bearing and its contact surface.



(c) Align the connecting rod bearing claw with the oil groove of the connecting rod.

(d) Install the connecting rod bearing onto the connecting rod.

NOTICE:
Do not apply engine oil to the bearing and its contact surface.

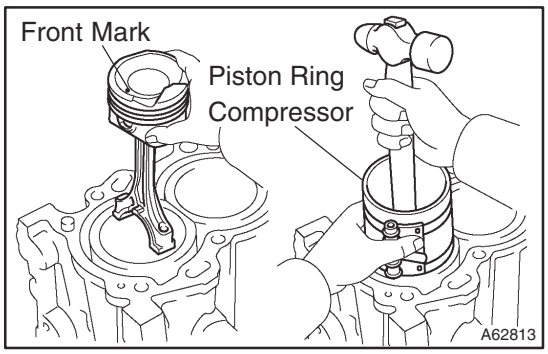


34. INSTALL CONNECTING ROD SUB–ASSY

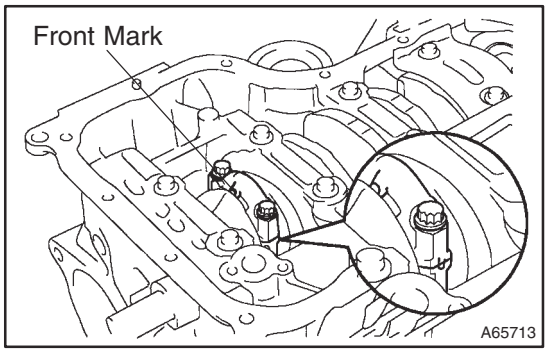
(a) Position the piston rings so that the ring ends are as shown.

(b) Apply engine oil to the cylinder walls, pistons, and surfaces of the connecting rod bearings.

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(c) Using a piston ring compressor, correctly push the numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.



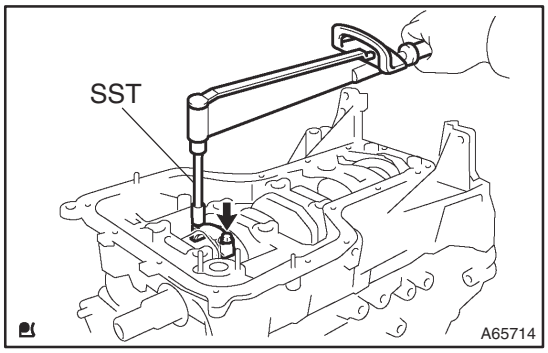
(d) Align the pin dowels of the connecting rod cap with the pins of the connecting rod, then install the connecting rod.

NOTICE:

Match the numbered connecting rod cap with the same numbered connecting rod.

(e) Check that the protrusion of the connecting rod cap is facing in the correct direction.

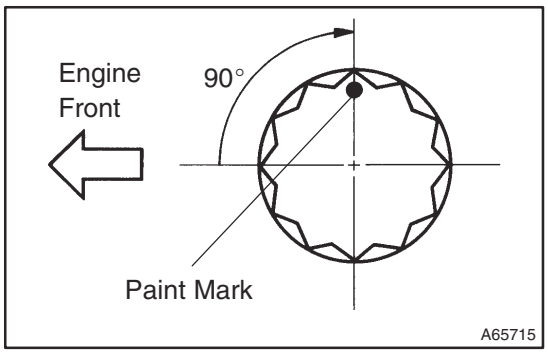
(f) Apply a light coat of engine oil to the threads and the bottom of the heads of the connecting rod cap bolts.



(g) Using SST, tighten the bolts in several passes to the specified torque.

SST 09205–16010

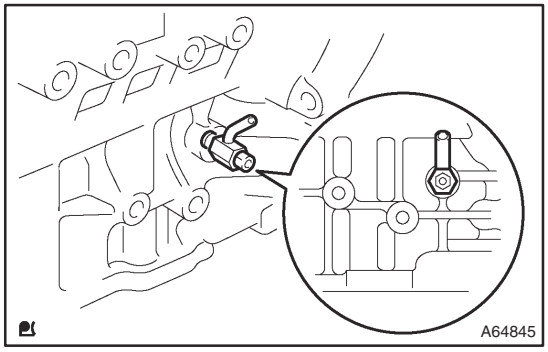
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)



(h) Mark the front of the connecting cap bolts with paint.

(i) Retighten the cap bolts by an additional 90° as shown in the illustration.

(j) Check that the crankshaft turns smoothly.



35. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY

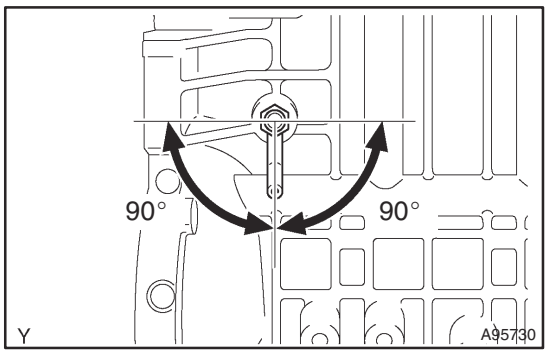
(a) Apply adhesive to 2 or 3 threads of the cylinder block water drain cock, then install it within 3 minutes as shown in the illustration.

Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)

Adhesive:

Part No. 08833–00080, THREE BOND 1344, LOCTITE 242 or equivalent

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(b) After applying the specified torque, rotate the cylinder block water drain cock clockwise until its drain port faces downward.

NOTICE:

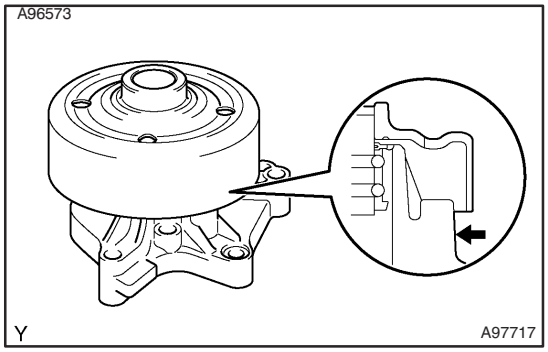
- **Do not put into coolant for at least an hour after installation.**
- **Do not rotate the drain union more than 360° in (b), and never loosen it after setting the union correctly.**

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WATER PUMP ASSY (1ZZ–FE/3ZZ–FE)

160WF–01

INSPECTION



1. INSPECT WATER PUMP ASSY

(a) Check the area of the water pump assembly indicated in the illustration for traces of coolant leakage.

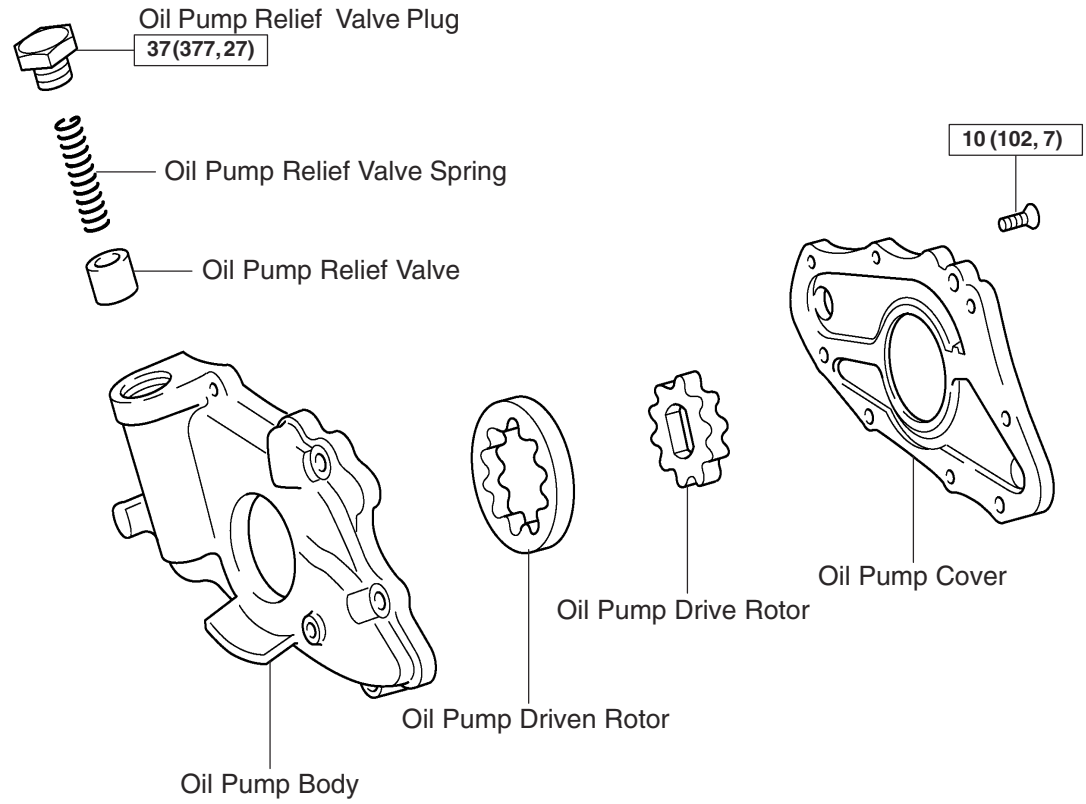
If leakage is found, replace the water pump.

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OIL PUMP ASSY (1ZZ–FE/3ZZ–FE)

170KW–01

COMPONENTS



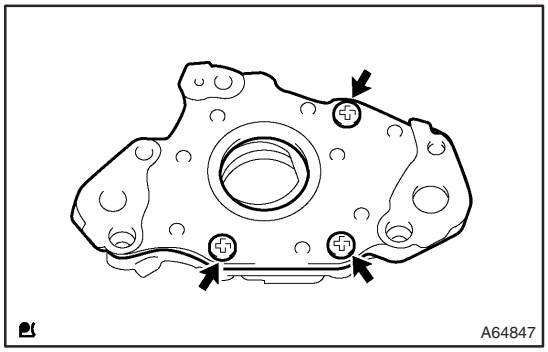
N·m (kgf·cm, ft·lbf) : Specified torque

A62218

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170KX–01

OVERHAUL



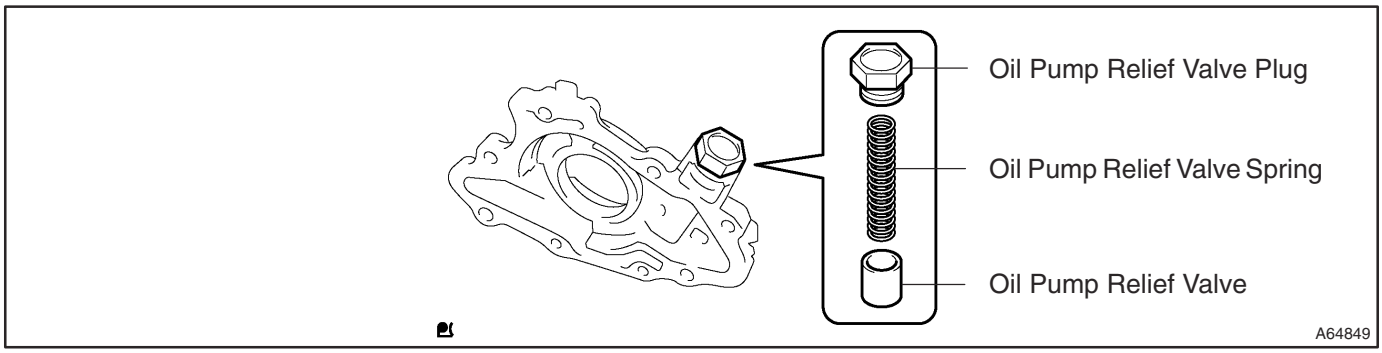
1. REMOVE OIL PUMP DRIVE AND DRIVEN ROTORS

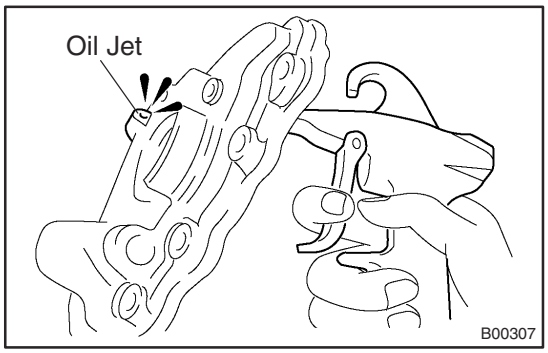
(a) Remove the 3 screws, then remove the oil pump cover.

(b) Remove the oil pump drive and driven rotors from the oil pump.

2. REMOVE OIL PUMP RELIEF VALVE

(a) Remove the oil pump relief valve plug, then remove the oil pump relief valve spring and oil pump relief valve from the oil pump.

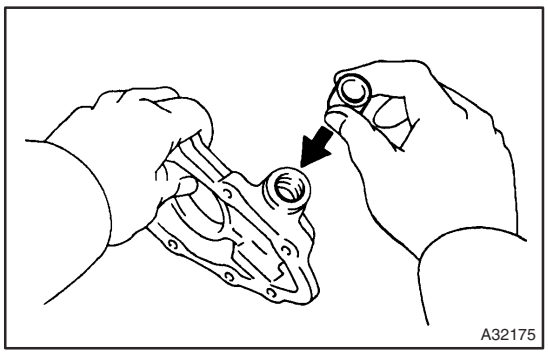




3. INSPECT OIL JET

(a) Apply air pressure to the path in the illustration, then check the oil jet for damage or clogging.

If air does not blow out of the oil jet, replace the oil pump.

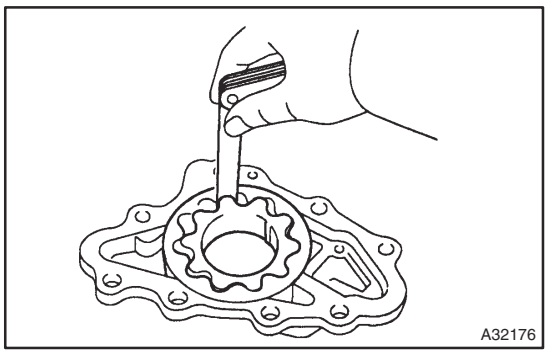


4. INSPECT VALVE, OIL PUMP RELIEF

(a) Coat the oil pump relief valve with engine oil, then check that it falls smoothly into the valve hole under its own weight.

If this does not occur, replace the oil pump.

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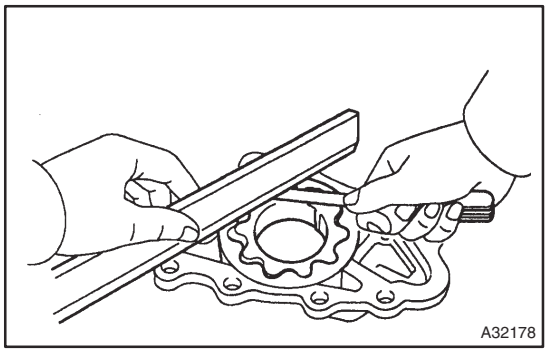


5. INSPECT ROTOR TIP CLEARANCE

(a) Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:
0.040 to 0.160 mm (0.0016 to 0.0063 in.)
Maximum tip clearance: 0.160 mm (0.0063 in.)

If the tip clearance is greater than maximum, then replace the oil pump.

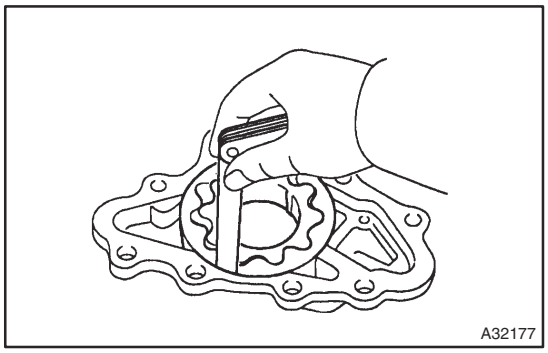


6. INSPECT ROTOR SIDE CLEARANCE

(a) Using a feeler gauge and precision straight edge, measure the clearance between the 2 rotors and precision straight edge.

Standard side clearance:
0.025 to 0.071 mm (0.0010 to 0.0028 in.)
Maximum side clearance: 0.071 mm (0.0028 in.)

If the side clearance is greater than maximum, then replace the oil pump.



7. INSPECT ROTOR BODY CLEARANCE

(a) Using a feeler gauge, measure the clearance between the driven rotor and oil pump body.

Standard body clearance:
0.260 to 0.325 mm (0.0102 to 0.0128 in.)
Maximum body clearance: 0.325 mm (0.0128 in.)

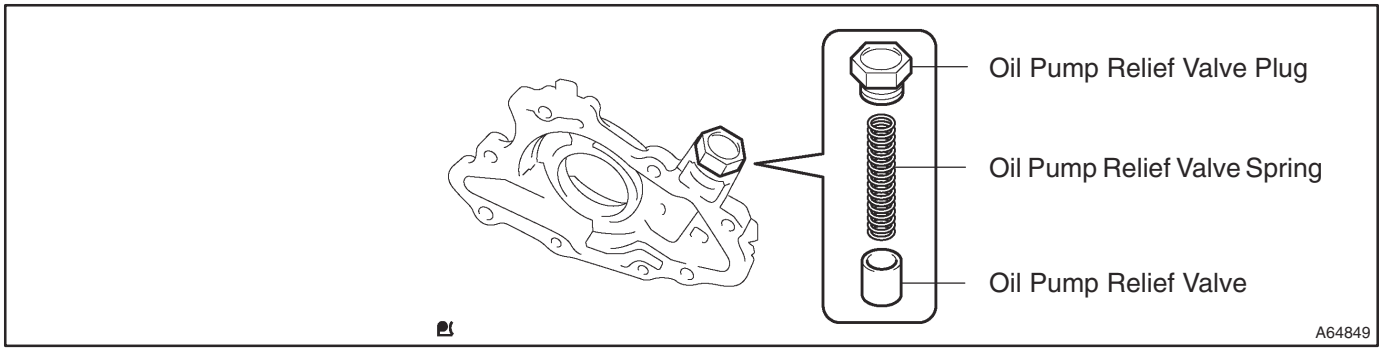
If the body clearance is greater than maximum, then replace the oil pump.

8. INSTALL OIL PUMP RELIEF VALVE

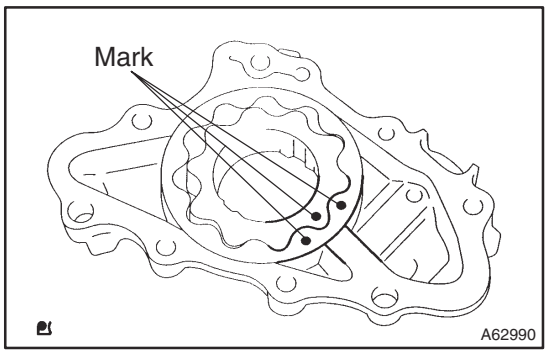
(a) Coat the oil pump relief valve with engine oil, then insert the oil pump relief valve and oil pump relief spring onto the valve hole.

(b) Install the oil pump relief valve plug.

Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)

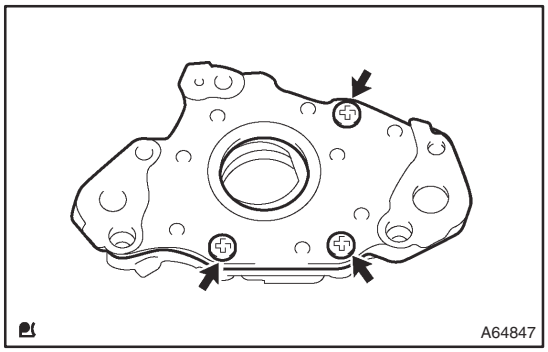


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9. INSTALL OIL PUMP DRIVE AND DRIVEN ROTORS

(a) Coat the oil pump drive and driven rotors with engine oil, and place them into the oil pump with the marks facing the oil pump cover side.



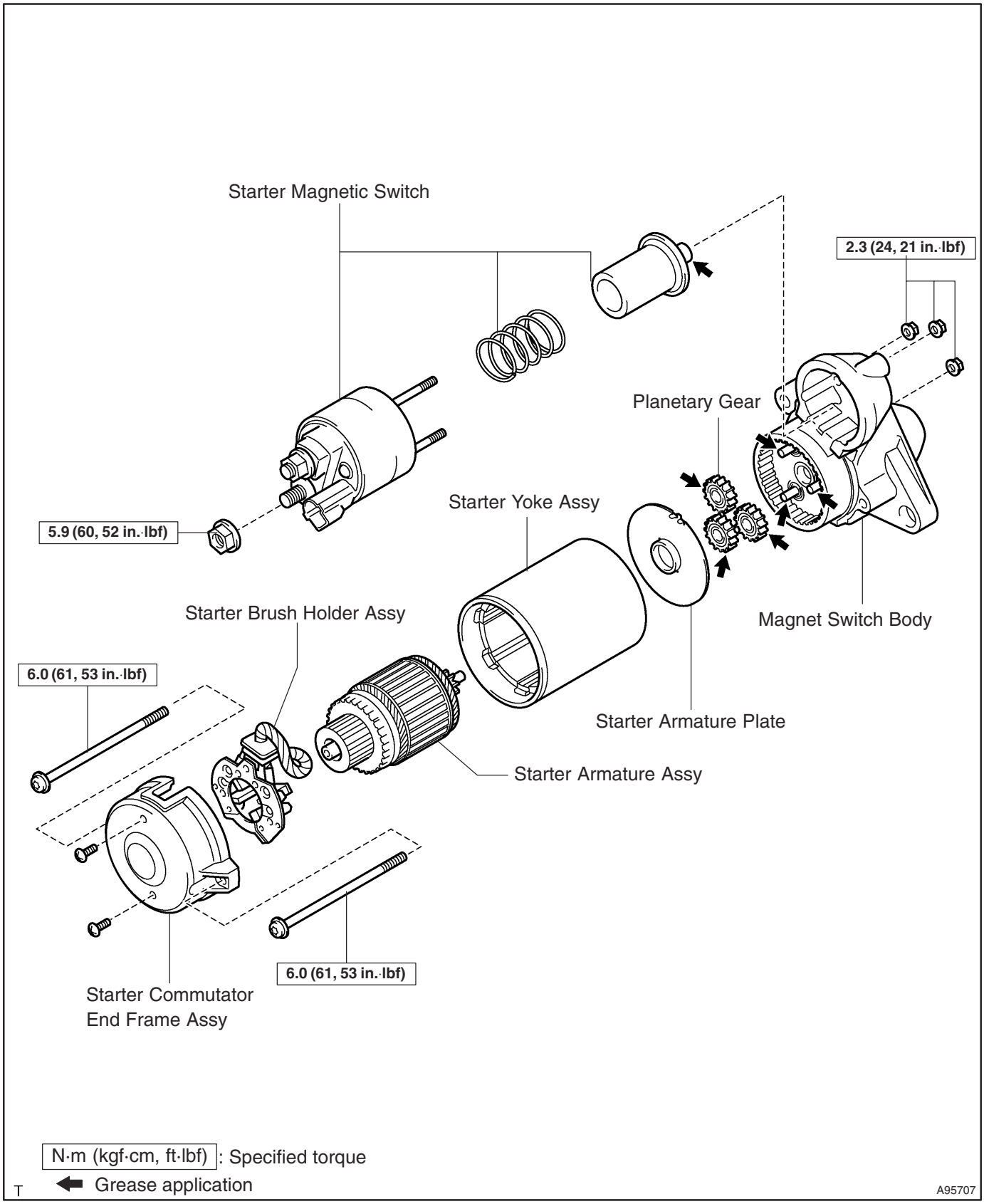
(b) Install the oil pump cover with the 3 screws.
Torque: 10 N·m (102 kgf·cm, 7.0 ft·lbf)

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STARTER ASSY (1ZZ–FE/3ZZ–FE)

COMPONENTS

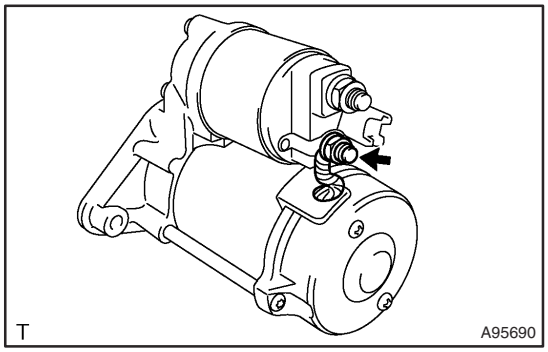
190OH–02



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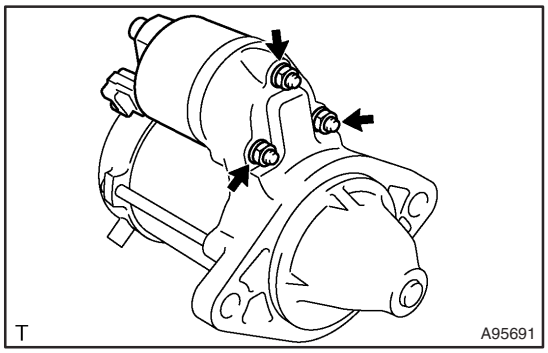
190YB–01

OVERHAUL

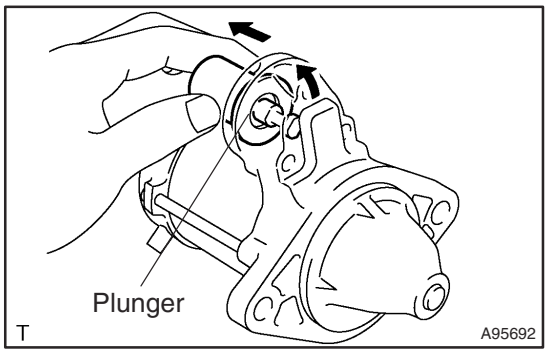


1. REMOVE STARTER MAGNETIC SWITCH ASSY

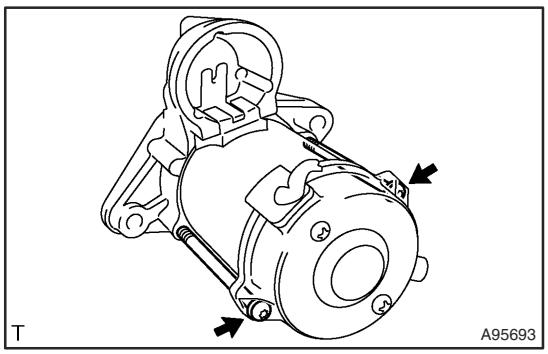
(a) Remove the nut, then disconnect the lead wire from the starter magnetic switch.



(b) Remove the 3 nuts from the magnet switch body while holding the starter magnetic switch.
(c) Remove the starter magnetic switch.
(d) Remove the return spring.



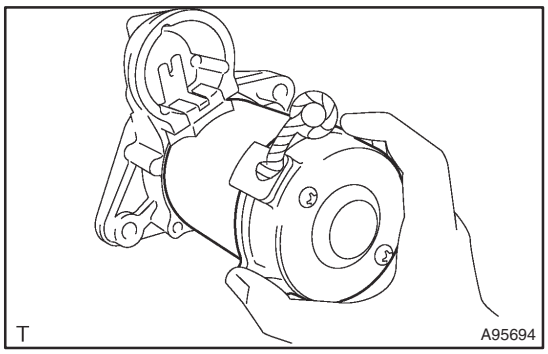
(e) Pull up the housing side of the plunger, then remove the plunger.



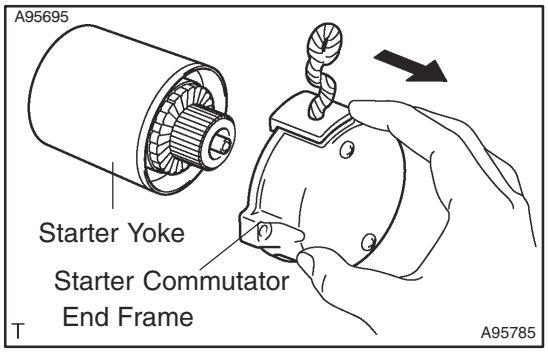
2. REMOVE STARTER YOKE ASSY

(a) Using a torx driver T25, remove the 2 through bolts.

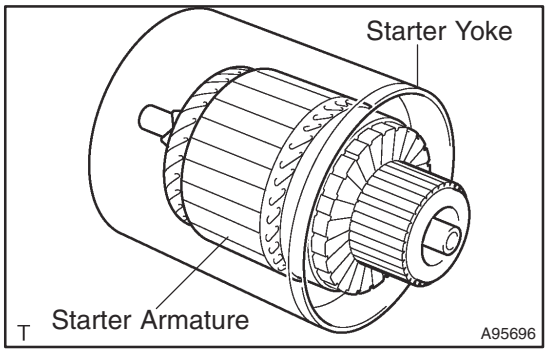
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(b) Pull out the starter yoke together with the starter commutator end frame.



(c) Pull out the starter yoke from the starter commutator end frame.

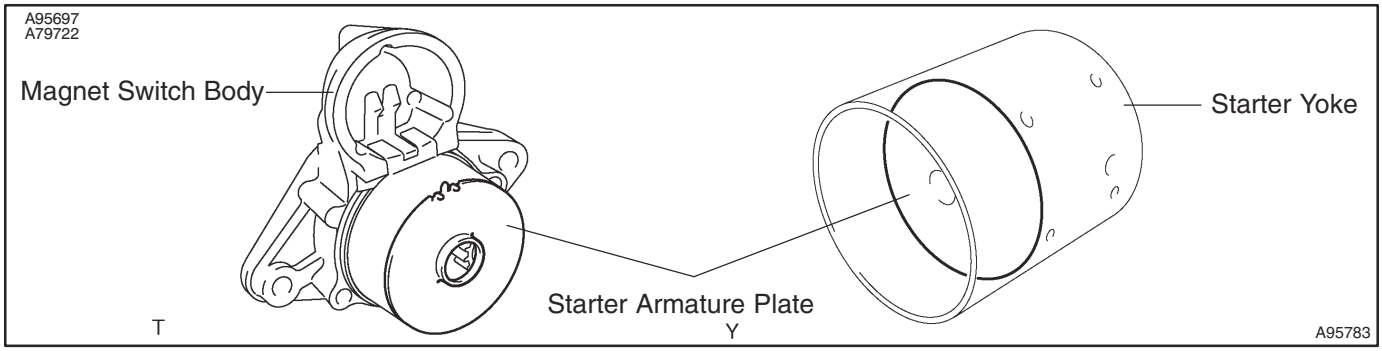


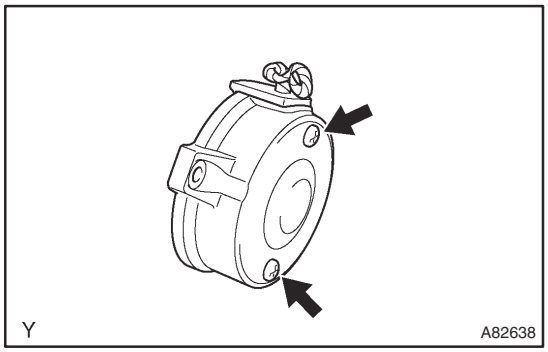
3. REMOVE STARTER ARMATURE ASSY

(a) Remove the starter armature assembly from the starter yoke assembly.

4. REMOVE STARTER ARMATURE PLATE

(a) Remove the armature plate from the magnet switch body or the starter yoke.

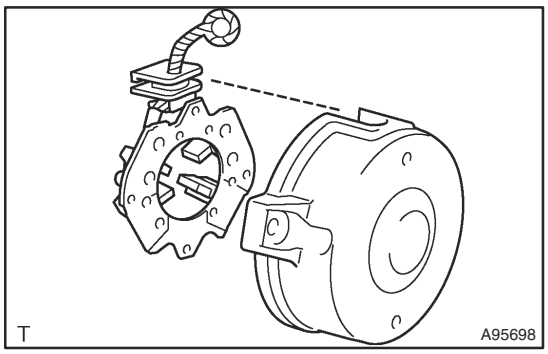




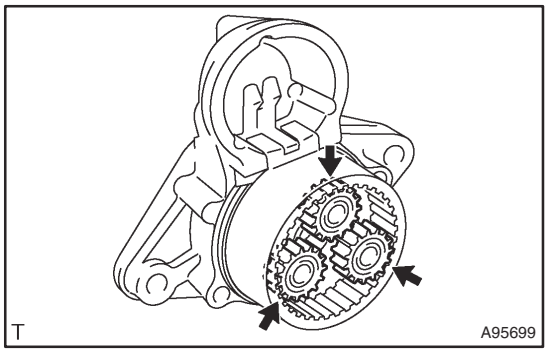
5. REMOVE STARTER BRUSH HOLDER ASSY

(a) Remove the 2 screws from the commutator end frame.

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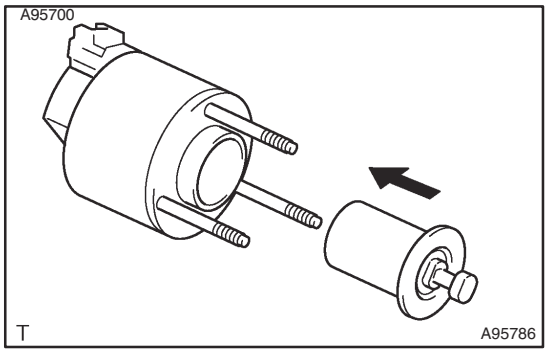


(b) Remove the claw of the clamp, then remove the brush holder from the commutator end frame.



6. REMOVE PLANETARY GEAR

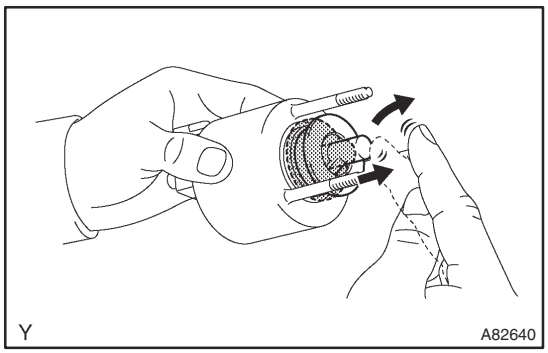
(a) Remove the 3 planetary gears from the magnet switch body.



7. INSPECT STARTER MAGNETIC SWITCH ASSY

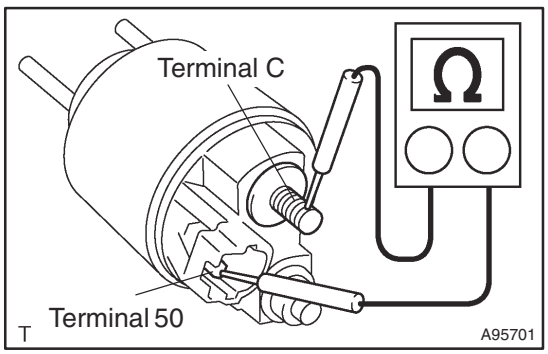
(a) Check the plunger.

(1) Install the plunger onto the switch body.



(2) Push in the plunger, then check that it returns quickly to its original position.

If necessary, replace the starter magnetic switch.



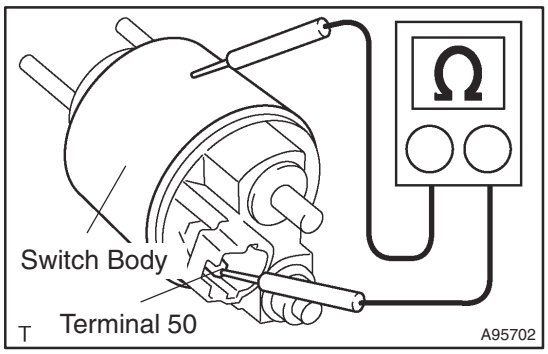
(b) Check the pull–in coil for open circuit.

(1) Using an ohmmeter, measure the resistance between terminals 50 and C.

Standard: Below 1 Ω

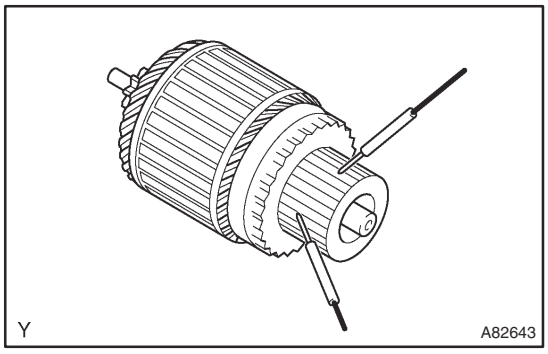
If the standard is not met, replace the starter magnetic switch.

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(c) Check if the hold–in coil has an open circuit.
(1) Using an ohmmeter, measure the resistance between terminal 50 and the switch body.
Standard: Below 1.5 Ω

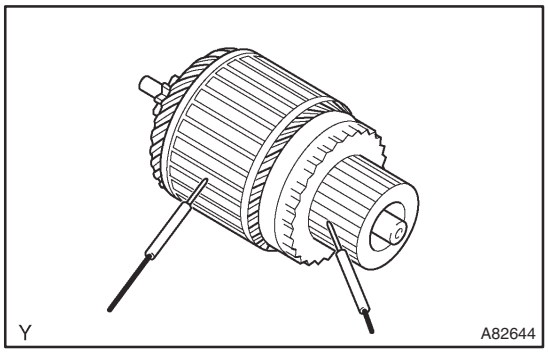
If the standard is not met, replace the starter magnetic switch.



8. INSPECT STARTER ARMATURE ASSY

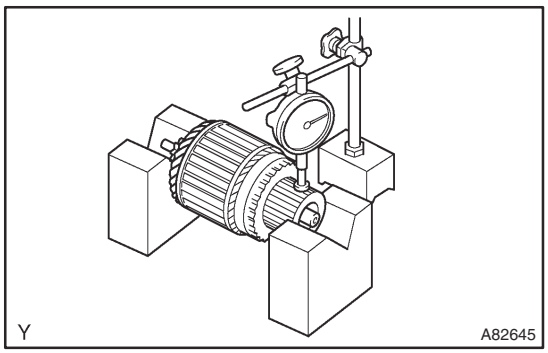
(a) Check the commutator for open circuit.
(1) Using an ohmmeter, measure the resistance between the segments of the commutator.
Standard: Below 1 Ω

If the standard is not met, replace the starter armature.



(b) Check the commutator for ground.
(1) Using an ohmmeter, measure the resistance between the commutator and the armature coil.
Standard: 10 kΩ or higher

If the standard is not met, replace the starter armature.

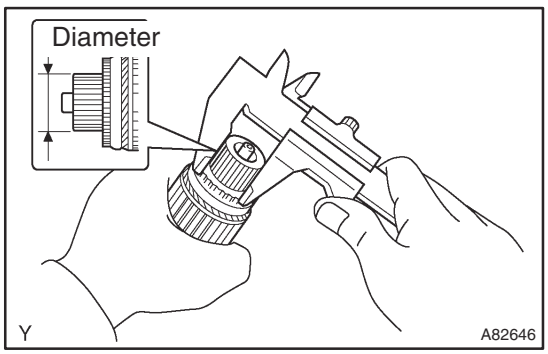


(c) Check the appearance.

If the surface is dirty or burnt, smooth the surface with 400–grit sandpaper.

(d) Check for the commutator circuit runout.
(1) Place the commutator on V–blocks.
(2) Using a dial indicator, measure the circle runout.
Standard runout: 0.02 mm (0.0008 in.)
Maximum runout: 0.05 mm (0.0020 in.)

If the runout is greater than maximum, replace the armature.



(e) Using vernier calipers, measure the commutator diameter.
Standard diameter: 29 mm (1.142 in.)
Minimum diameter: 28 mm (1.102 in.)

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

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9. INSPECT STARTER BRUSH HOLDER ASSY

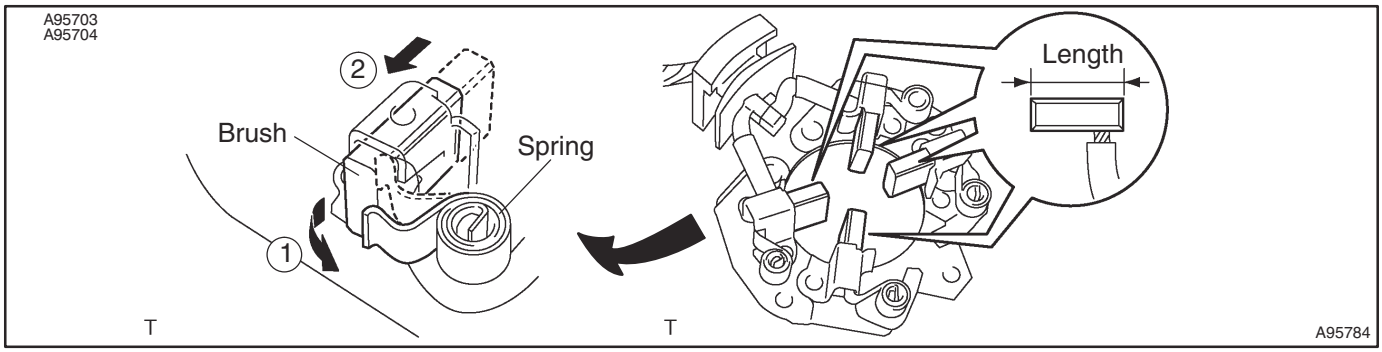
(a) Remove the claw of the spring, then remove the 4 brushes.

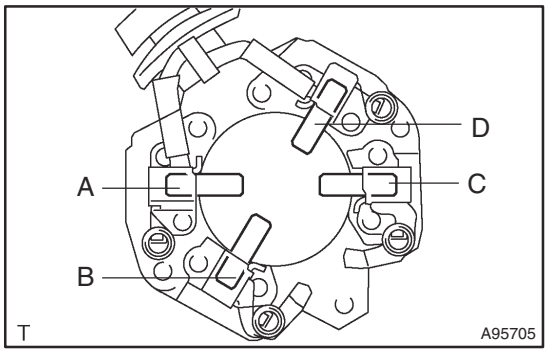
(b) Using vernier calipers, measure the brush length.

Standard length: 15.5 mm (0.610 in.)

Minimum length: 9.0 mm (0.354 in.)

If the length is less than minimum, replace the starter brush holder assembly.





(c) Check the brush holder.

(1) Using an ohmmeter, measure the resistance between the brushes.

Standard:

Tester Connection	Specified Condition
A – B	10 kΩ or higher
A – C	10 kΩ or higher
A – D	Below 1 Ω
B – C	Below 1 Ω
B – D	10 kΩ or higher
C – D	10 kΩ or higher

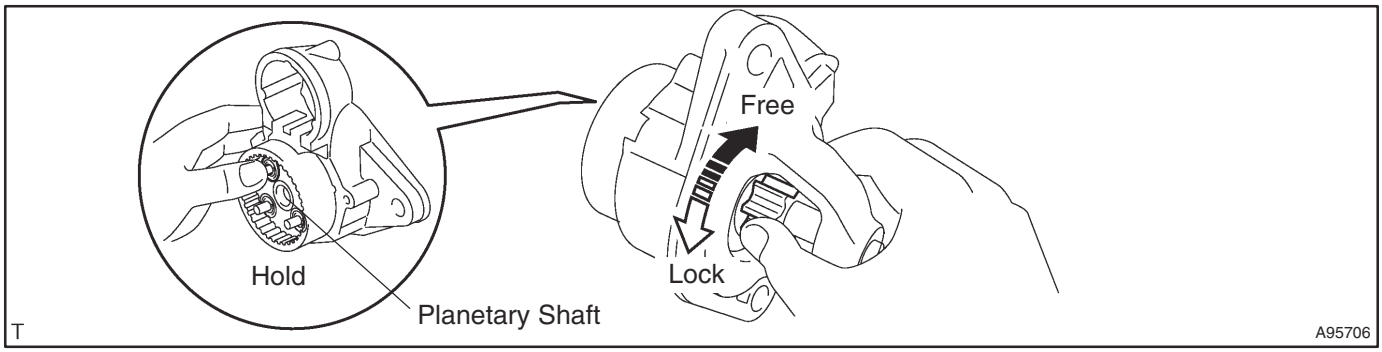
If the standard is not met, replace the starter brush holder.

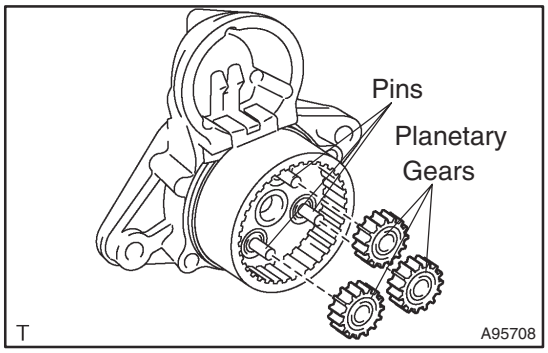
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10. INSPECT MAGNET SWITCH BODY

(a) Check the starter clutch.
  (1) Hold the planetary shaft so that it may not rotate.
  (2) Rotate the clutch pinion gear clockwise and check that it turns freely. Try to rotate the clutch pinion gear counterclockwise and check that it locks.

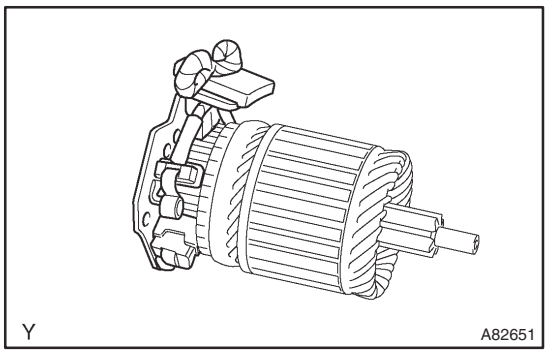
If necessary, replace the magnet switch body.





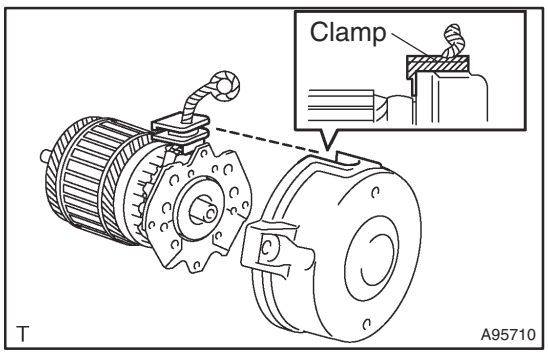
11. INSTALL PLANETARY GEAR

(a) Apply grease to the planetary gears and pin parts of the planetary shaft.
(b) Install the 3 planetary gears.



12. INSTALL STARTER BRUSH HOLDER ASSY

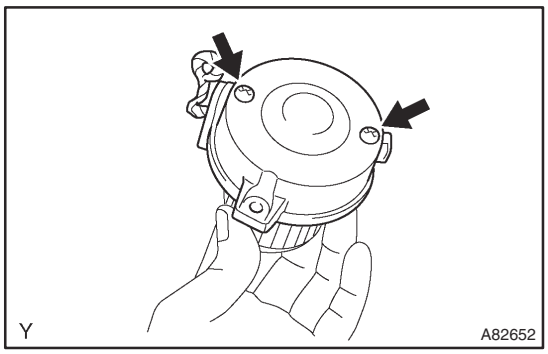
(a) Install the brush holder onto the starter armature assy.



13. INSTALL STARTER COMMUTATOR END FRAME ASSY

(a) Fit the clamp of the brush holder into the starter commutator end frame.

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(b) Install the commutator end frame with the 2 screws.

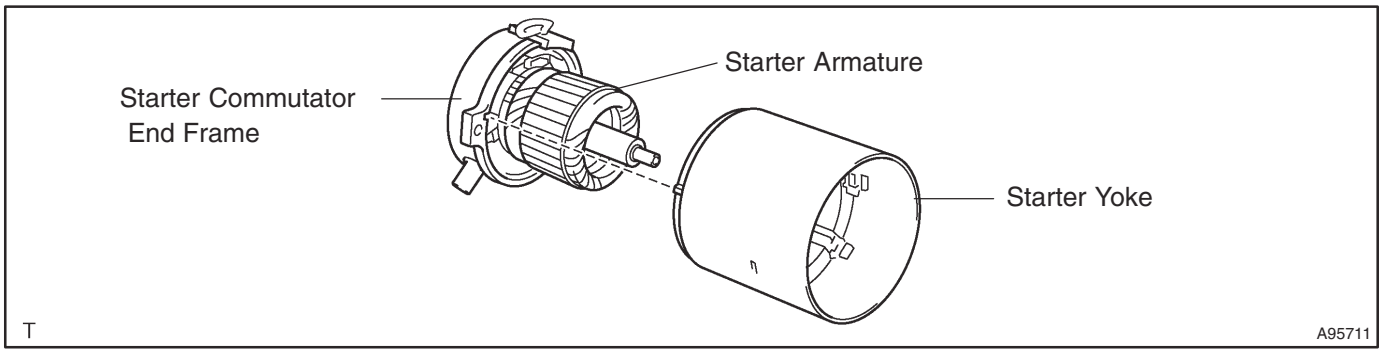
14. INSTALL STARTER ARMATURE ASSY

(a) Align the rubber with the convex cutout of the starter yoke.

(b) Install starter armature with the brush holder onto the starter yoke.

HINT:

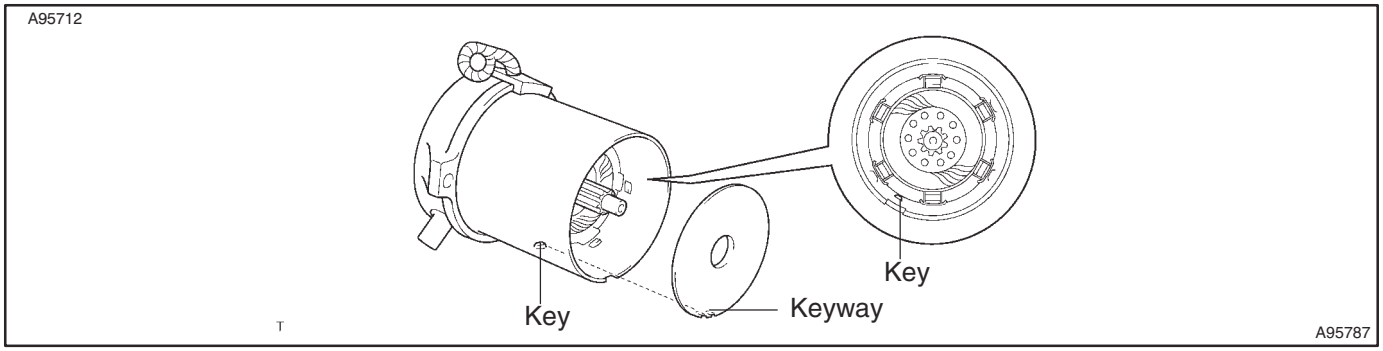
Support the starter armature so that it may not be pulled out from the starter brush holder by magnetic force of the starter yoke.



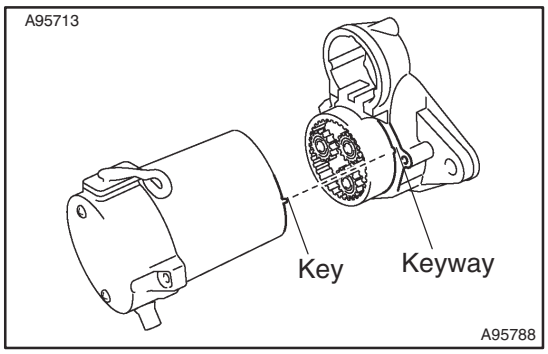
15. INSTALL STARTER ARMATURE PLATE

(a) Insert the starter armature plate onto the starter yoke.

(b) Align the keyway of the starter plate with the key inside the starter yoke, then install the starter plate.

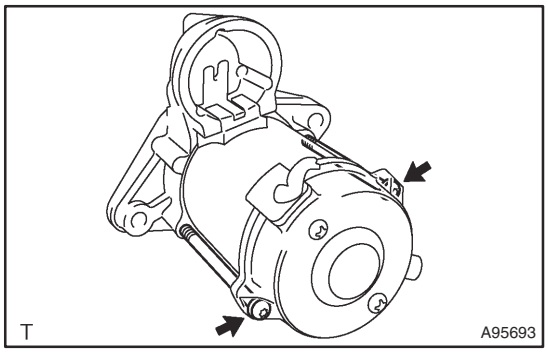


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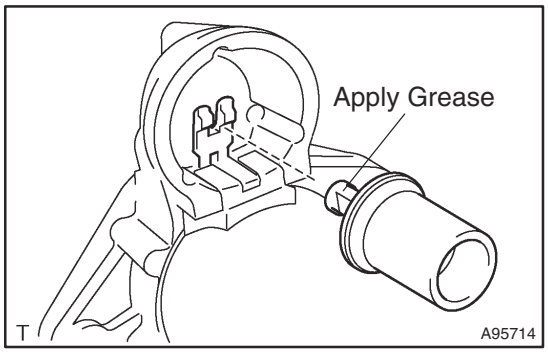


16. INSTALL STARTER YOKE ASSY

(a) Align the key of the starter yoke with the keyway located on the magnet switch body.



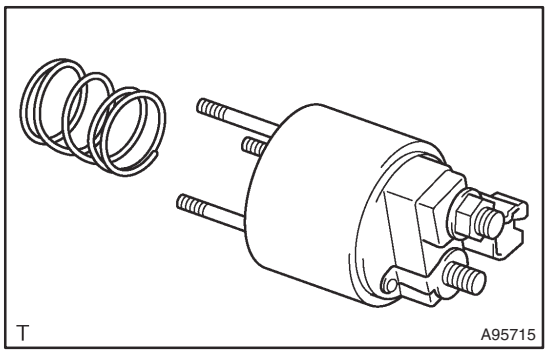
(b) Using a torx driver T25, install the starter yoke using the 2 through bolts.
Torque: 6.0 N·m (61 kgf·cm, 53 in.·lbf)



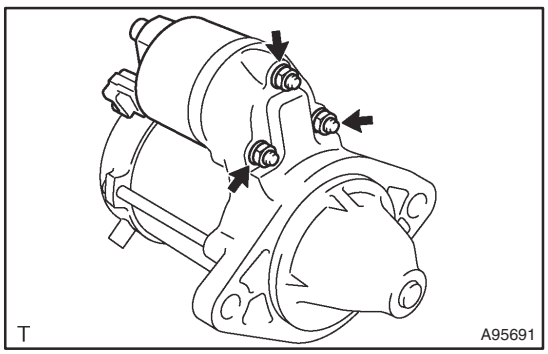
17. INSTALL STARTER MAGNETIC SWITCH ASSY

(a) Apply grease to the hook.

(b) Connect the plunger and hook of the starter housing to the drive lever.

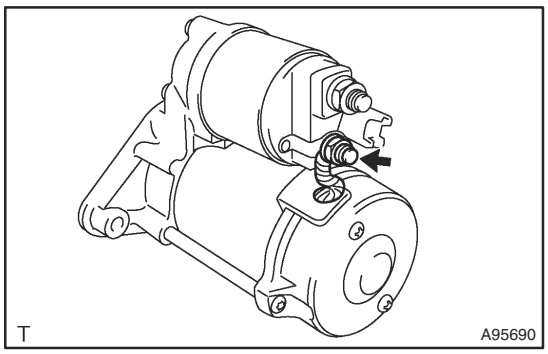


(c) Install the plunger and return spring.



(d) Install the starter magnetic switch with the 3 nuts.
Torque: 2.3 N·m (24 kgf·cm, 21 in.·lbf)

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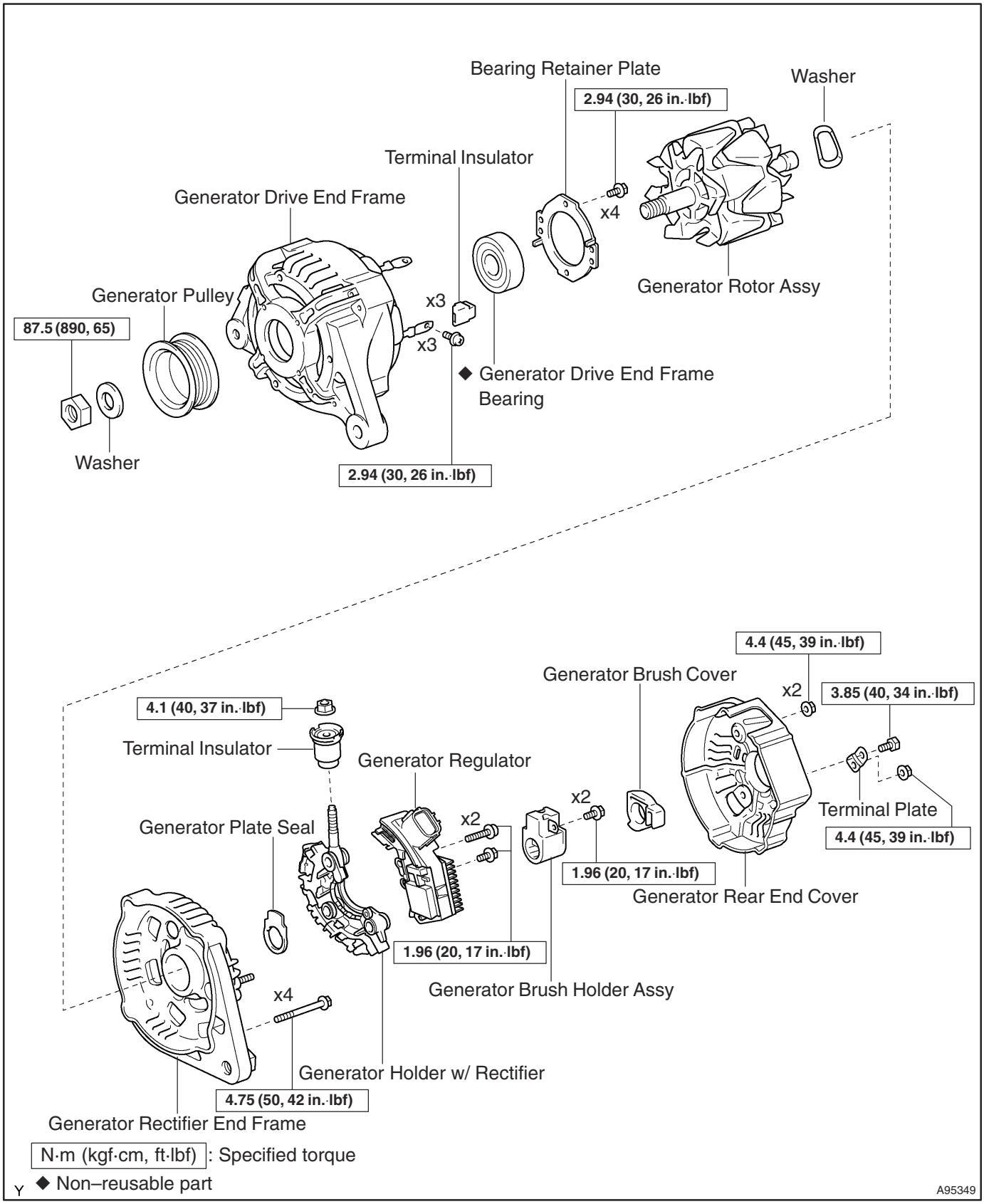
(e) Connect the lead wire to the starter magnetic switch, then fasten it with the nut.
Torque: 5.9 N·m (60 kgf·cm, 52 in.·lbf)

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GENERATOR ASSY (DENSO MADE) (1ZZ–FE/3ZZ–FE)

190ZR–01

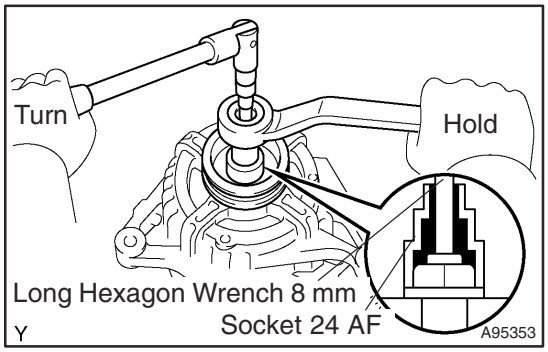
COMPONENTS



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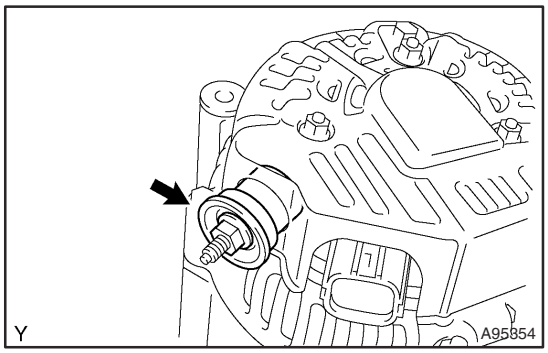
190ZS–01

OVERHAUL



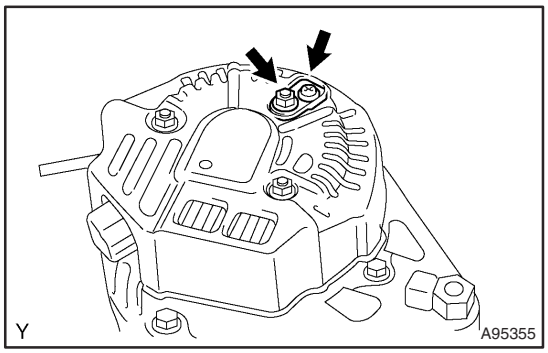
1. REMOVE GENERATOR PULLEY

(a) Using a socket 24 AF and long hexagon wrench 8 mm, remove the nut, then remove the washer and generator pulley.



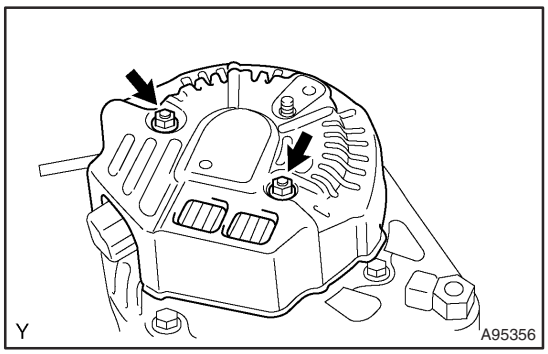
2. REMOVE TERMINAL INSULATOR

(a) Remove the nut, then remove the terminal insulator.



3. REMOVE TERMINAL PLATE

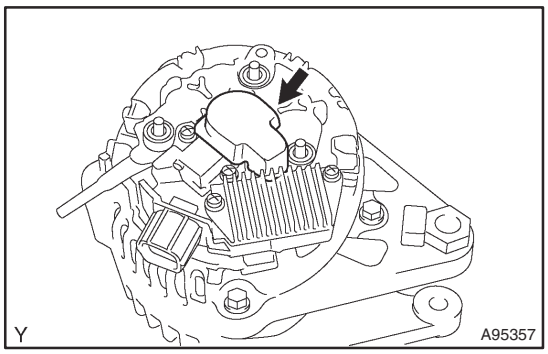
(a) Remove the screw and nut, then remove the terminal plate.



4. REMOVE GENERATOR REAR END COVER

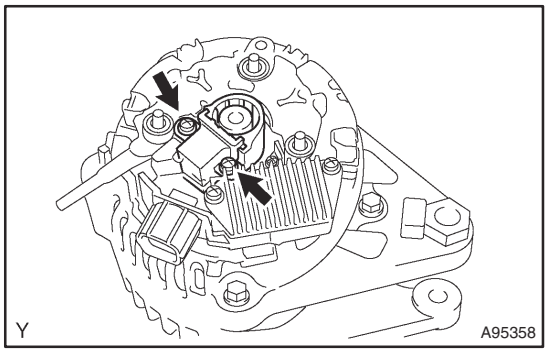
(a) Remove the 2 nuts, then remove the generator rear end cover.

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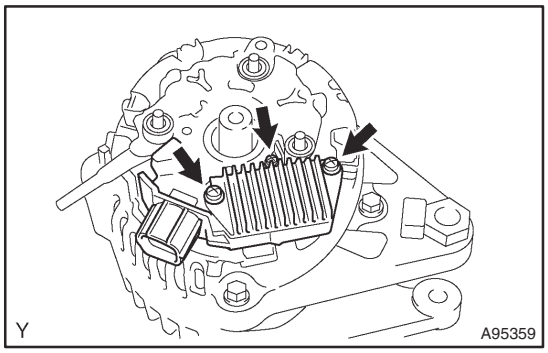
5. REMOVE GENERATOR BRUSH COVER

(a) Remove the generator brush cover from the generator brush holder.



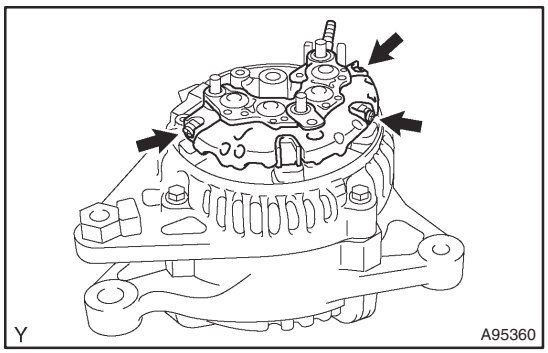
6. REMOVE GENERATOR BRUSH HOLDER ASSY

(a) Remove the 2 screws, then remove the generator brush holder.



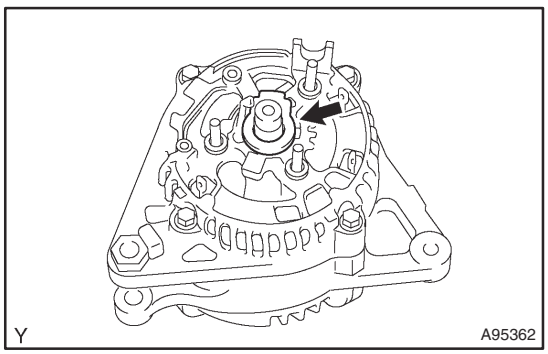
7. REMOVE GENERATOR REGULATOR ASSY

(a) Remove the 3 screws, then remove the generator regulator.



8. REMOVE GENERATOR HOLDER W/ RECTIFIER

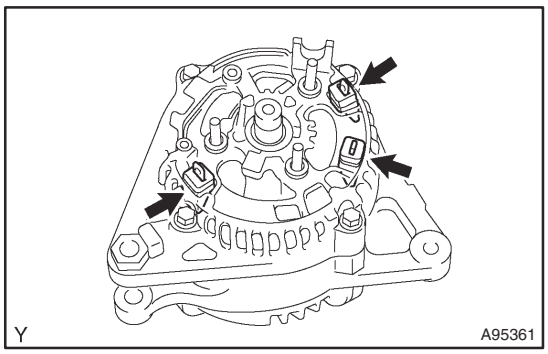
(a) Remove the 3 screws, then remove the generator holder with rectifier.



9. REMOVE GENERATOR PLATE SEAL

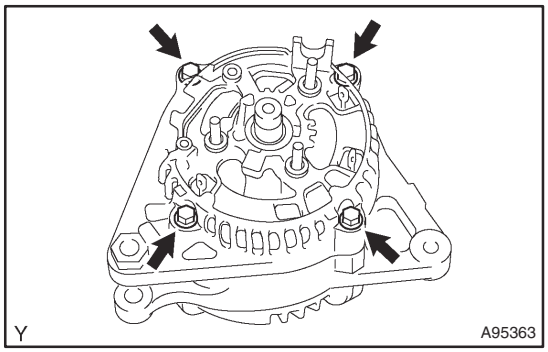
(a) Remove the generator plate seal from the generator rectifier end frame.

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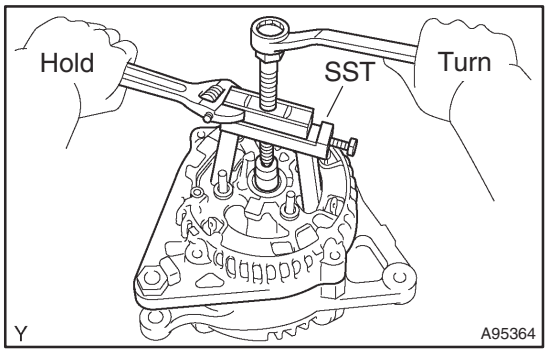


10. REMOVE GENERATOR ROTOR ASSY

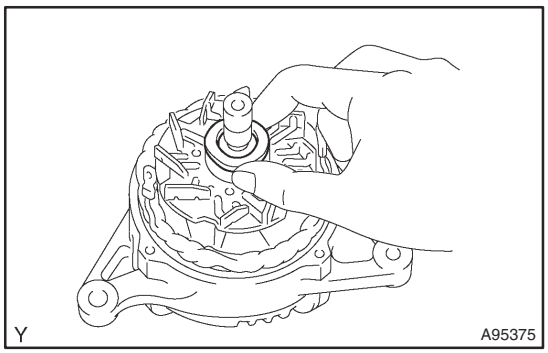
(a) Remove the 3 terminal insulators from the generator rectifier end frame.



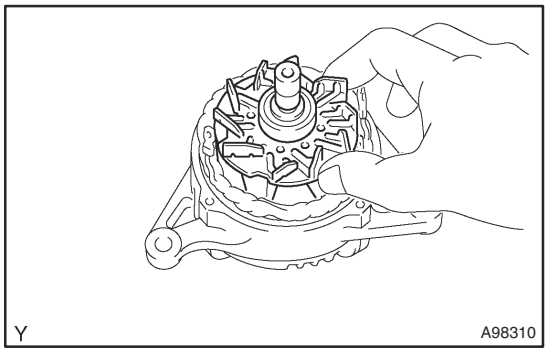
(b) Remove the 4 bolts.



(c) Using SST, remove the rectifier end frame.
SST 09286–46011

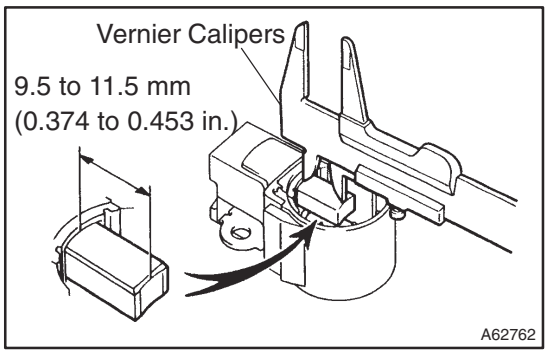


(d) Remove the washer from the generator rotor.



(e) Remove the generator rotor from the generator drive end frame.

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11. INSPECT GENERATOR BRUSH HOLDER ASSY

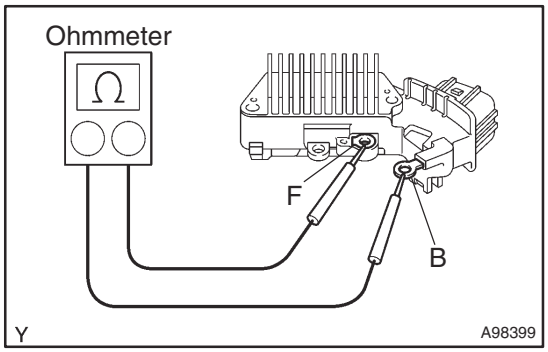
(a) Inspect the brush length.

(1) Using vernier calipers, measure the brush length.

Standard: 9.5 to 11.5 mm (0.374 to 0.453 in.)

Minimum: 4.5 mm (0.177 in.)

If the brush length is less than minimum, replace the generator brush holder.



12. INSPECT GENERATOR REGULATOR ASSY

(a) Inspect the resistance.

(1) Using an ohmmeter, measure the resistance between terminals B and F.

Standard:

When the positive and negative poles of terminals F and B are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction.

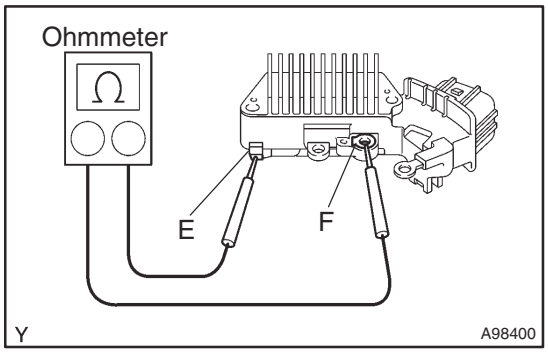
If the result is not as specified, replace the generator regulator.

(2) Using an ohmmeter, measure the resistance between terminals E and F.

Standard:

When the positive and negative poles of terminals F and E are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction.

If the result is not as specified, replace the generator regulator.



13. INSPECT GENERATOR HOLDER W/ RECTIFIER

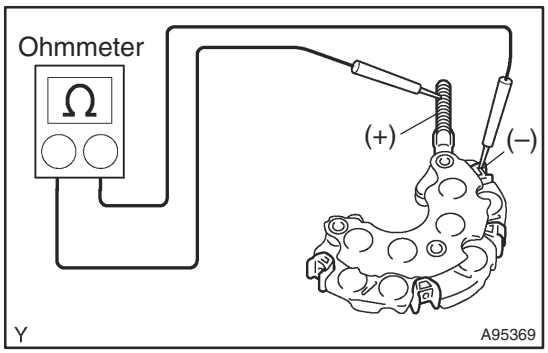
(a) Inspect the resistance.

(1) Using an ohmmeter, measure the resistance between the positive (+) terminal and each rectifire terminal.

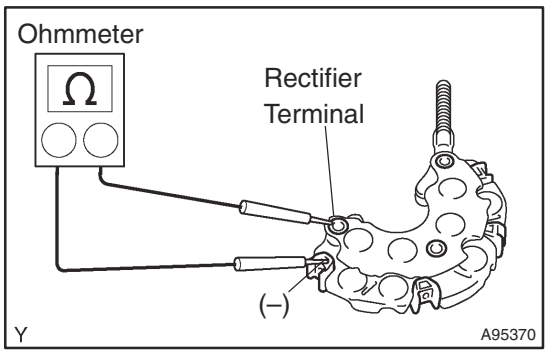
Standard:

When the positive and negative poles of the positive (+) terminal and each rectifire terminal are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction.

If the result is not as specified, replace the generator holder with rectifier.



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(2) Using an ohmmeter, measure the resistance between the negative (–) terminal and each rectifier terminal.

Standard:

When the positive and negative poles of the negative (–) terminal and each rectifire terminal are switched over, there is a resistance of below 1 Ω in one direction but 10 kΩ or higher in the other direction.

If the result is not as specified, replace the generator holder with rectifier.

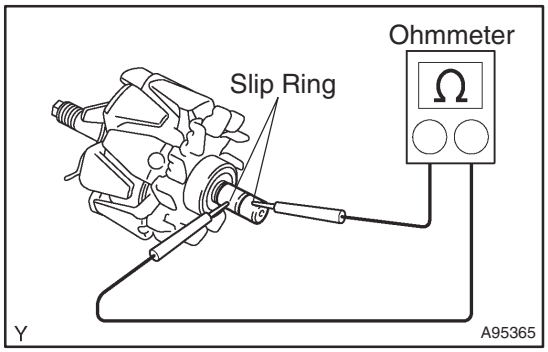
14. INSPECT GENERATOR ROTOR ASSY

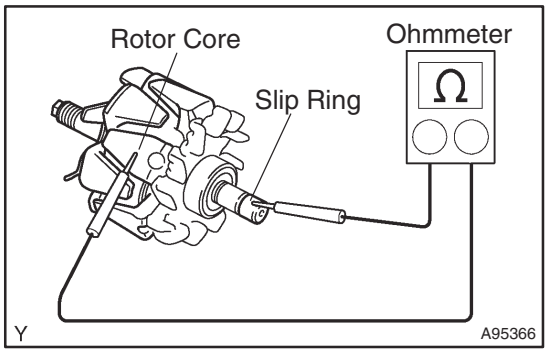
(a) Inspect the resistance.

(1) Using an ohmmeter, measure the resistance between the slip rings.

Standard: 2.55 to 2.95 Ω at 20°C (68°F)

If the result is not as specified, replace the generator rotor shaft.





(2) Using an ohmmeter, measure the resistance between the slip ring and rotor.

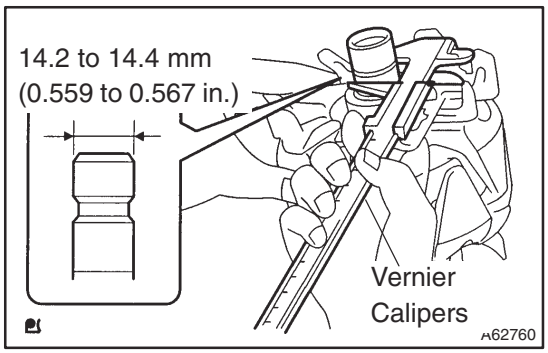
Standard: 10 kΩ or higher

If the result is not as specified, replace the generator rotor shaft.

(b) Check the appearance.

(1) Check that the slip rings are not rough or scored.

If rough or scored, replace the generator rotor.



(c) Inspect the slip ring diameter.

(1) Using vernier calipers, measure the slip ring diameter.

Standard: 14.2 to 14.4 mm (0.559 to 0.567 in.)

Minimum: 14 mm (0.551 in.)

If the slip ring diameter is less than minimum, replace the generator rotor.

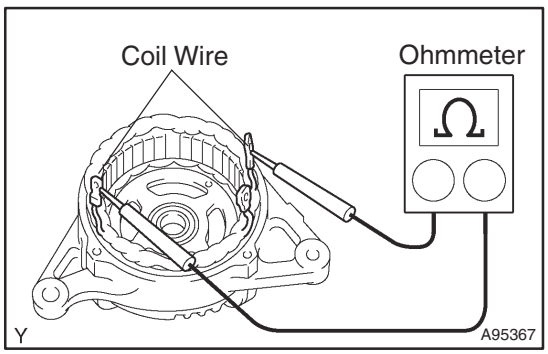
15. INSPECT GENERATOR DRIVE END FRAME

(a) Inspect the resistance.

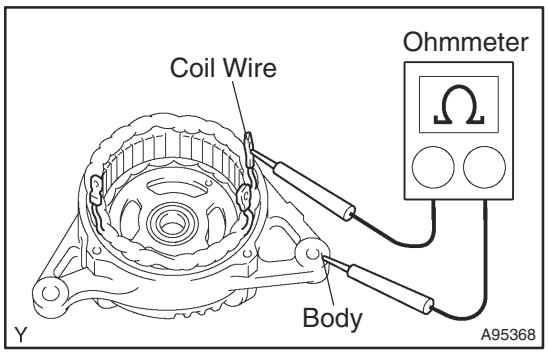
(1) Using an ohmmeter, measure the resistance between the coil wires.

Standard: Below 1 Ω

If the result is not as specified, replace the generator drive end frame.



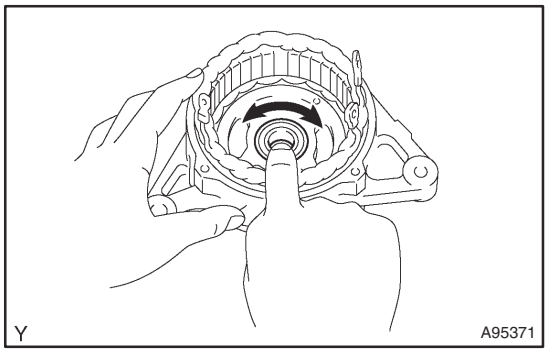
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(2) Using an ohmmeter, measure the resistance between the coil wire and body.

Standard: 10 kΩ or higher

If the result is not as specified, replace the generator drive end frame.

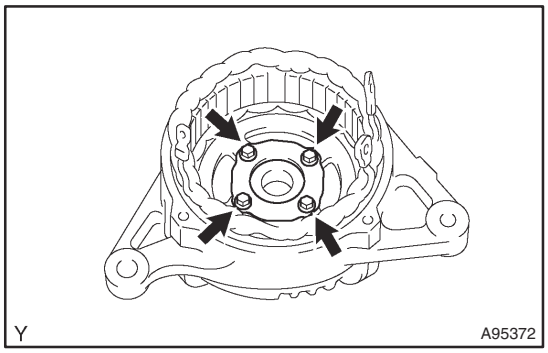


16. INSPECT GENERATOR DRIVE END FRAME BEARING

(a) Check the appearance.

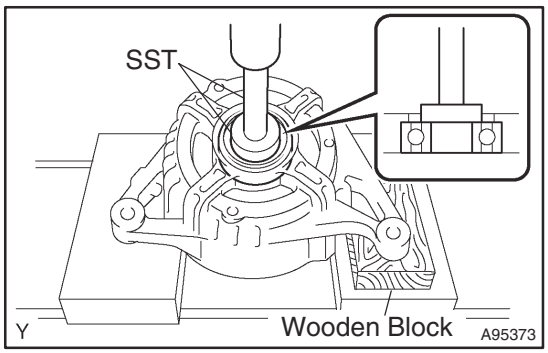
(1) Check that the bearing is not rough or worn.

If necessary, replace the bearing.



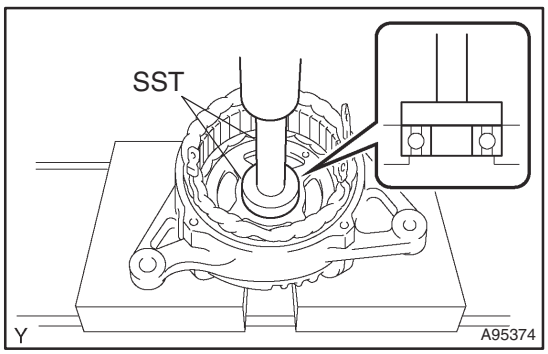
(b) Replace the generator drive end frame bearing.

(1) Remove the 4 screws, then remove the bearing retainer plate.



(2) Using SST and a press, push out the bearing,

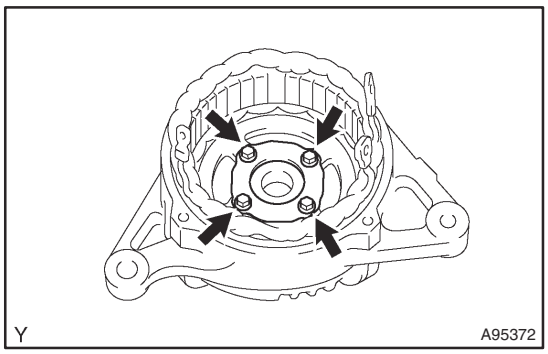
SST 09950–60010 (09951–00250), 09950–70010 (09951–07100)



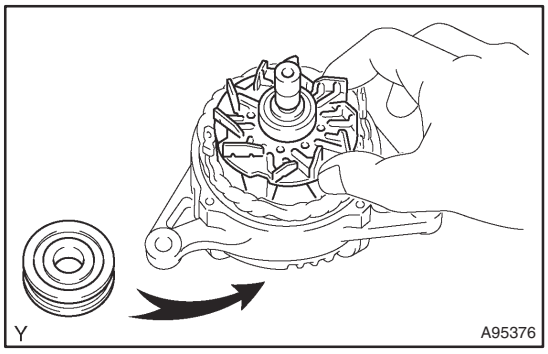
(3) Using SST and a press, press a new bearing into the generator drive end frame.

SST 09950–60010 (09951–00470), 09950–70010 (09951–07100)

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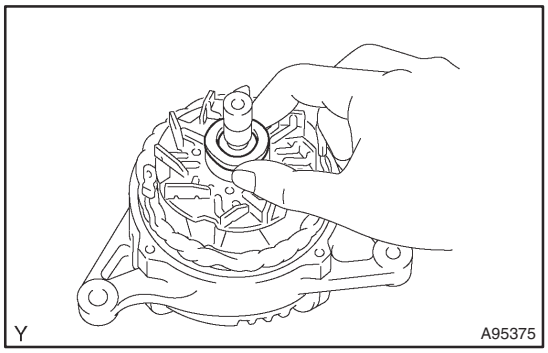
(4) Install the bearing retainer plate with the 4 screws.
Torque: 2.94 N·m (30 kgf·cm, 26 in.·lbf)



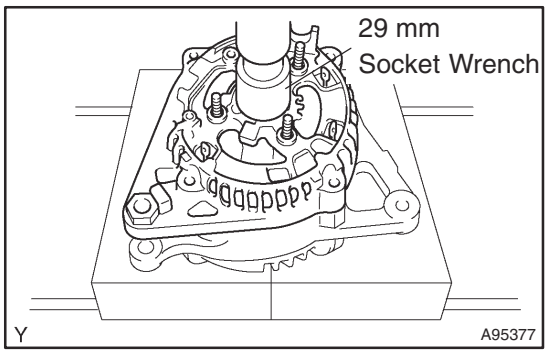
17. INSTALL GENERATOR ROTOR ASSY

(a) Place the generator drive end frame on the generator pulley.

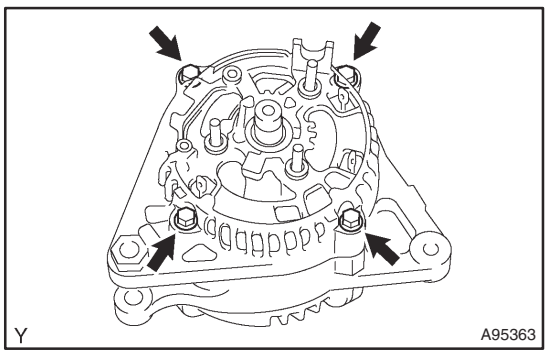
(b) Install the generator rotor onto the generator drive end frame.



(c) Install the washer onto the generator rotor.

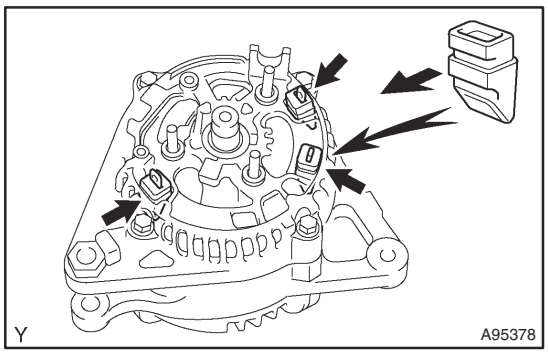


(d) Using a 29 mm socket wrench and press, slowly press the generator rectifier end frame onto the generator drive end frame.



(e) Tighten the 4 bolts.
Torque: 4.75 N·m (50 kgf·cm, 42 in.·lbf)

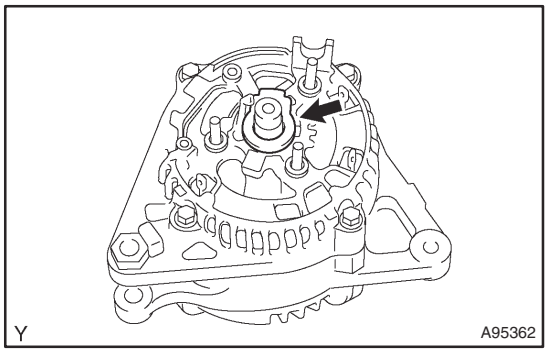
ProCarManuals.com



(f) Install the 3 terminal insulators onto the generator rectifier end frame.

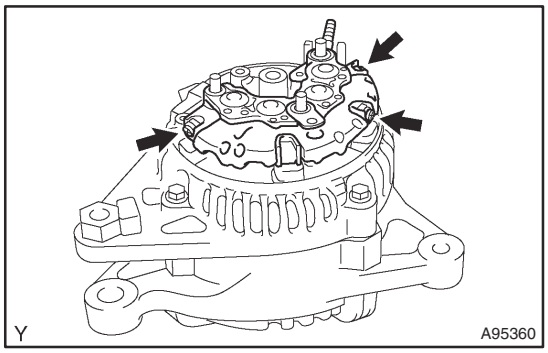
NOTICE:

Be careful of the installation direction of the terminal insulators.



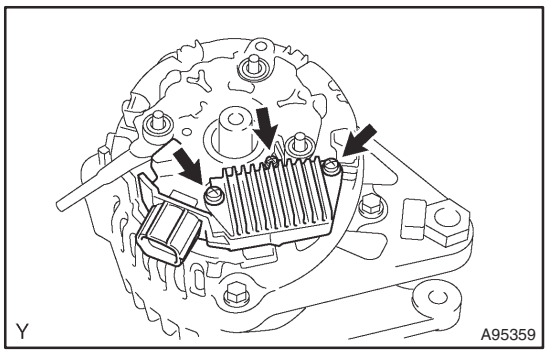
18. INSTALL GENERATOR PLATE SEAL

(a) Install the generator plate seal onto the generator rectifier end frame.



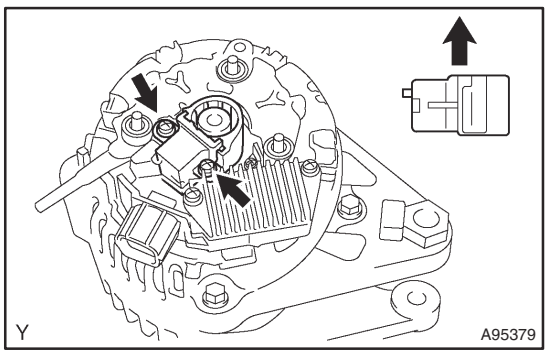
19. INSTALL GENERATOR HOLDER W/ RECTIFIER

(a) Install the generator holder with rectifier with the 3 screws.
Torque: 2.94 N·m (30 kgf·cm, 26 in.·lbf)



20. INSTALL GENERATOR REGULATOR ASSY

(a) Install the generator regulator with the 3 screws.
Torque: 1.96 N·m (20 kgf·cm, 17 in.·lbf)



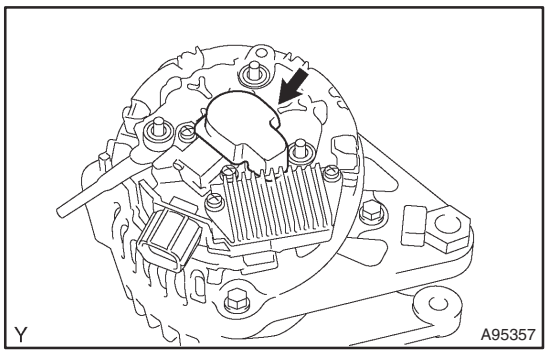
21. INSTALL GENERATOR BRUSH HOLDER ASSY

(a) Install the generator brush holder with the 2 screws.
Torque: 1.96 N·m (20 kgf·cm, 17 in.·lbf)

NOTICE:

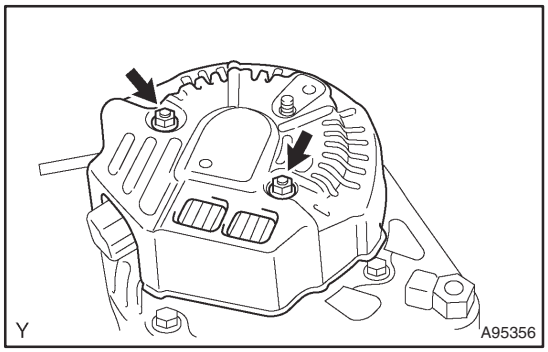
Pay attention to the position of the protrusion as shown in the illustration.

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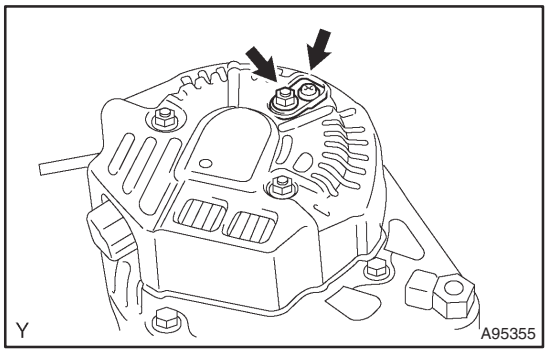
22. INSTALL GENERATOR BRUSH COVER

(a) Install the generator brush cover onto the generator brush holder.



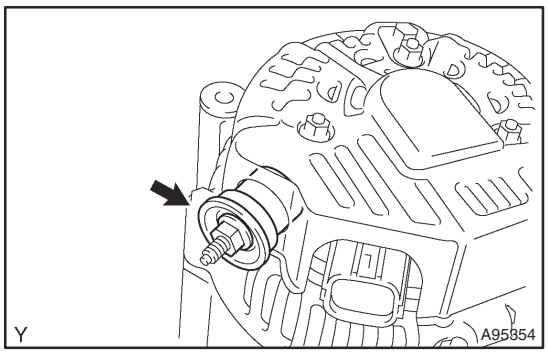
23. INSTALL GENERATOR REAR END COVER

(a) Install the generator rear end frame cover with the 2 nuts.
Torque: 4.4 N·m (45 kgf·cm, 39 in.·lbf)



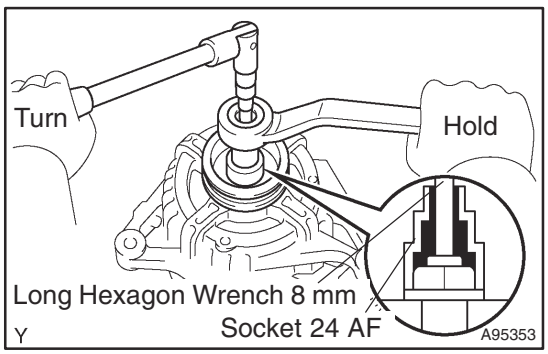
24. INSTALL TERMINAL PLATE

(a) Install the terminal plate with the screw and nut.
Torque:
3.85 N·m (40 kgf·cm, 34 in.·lbf) for screw
4.4 N·m (45 kgf·cm, 39 in.·lbf) for nut



25. INSTALL TERMINAL INSULATOR

(a) Install the terminal insulator with the nut.
Torque: 4.1 N·m (40 kgf·cm, 37 in.·lbf)



26. INSTALL GENERATOR PULLEY

(a) Using a socket 24 AF and long hexagon wrench 8 mm, remove the nut, then remove the washer and generator pulley.
Torque: 87.5 N·m (890 kgf·cm, 65 ft·lbf)

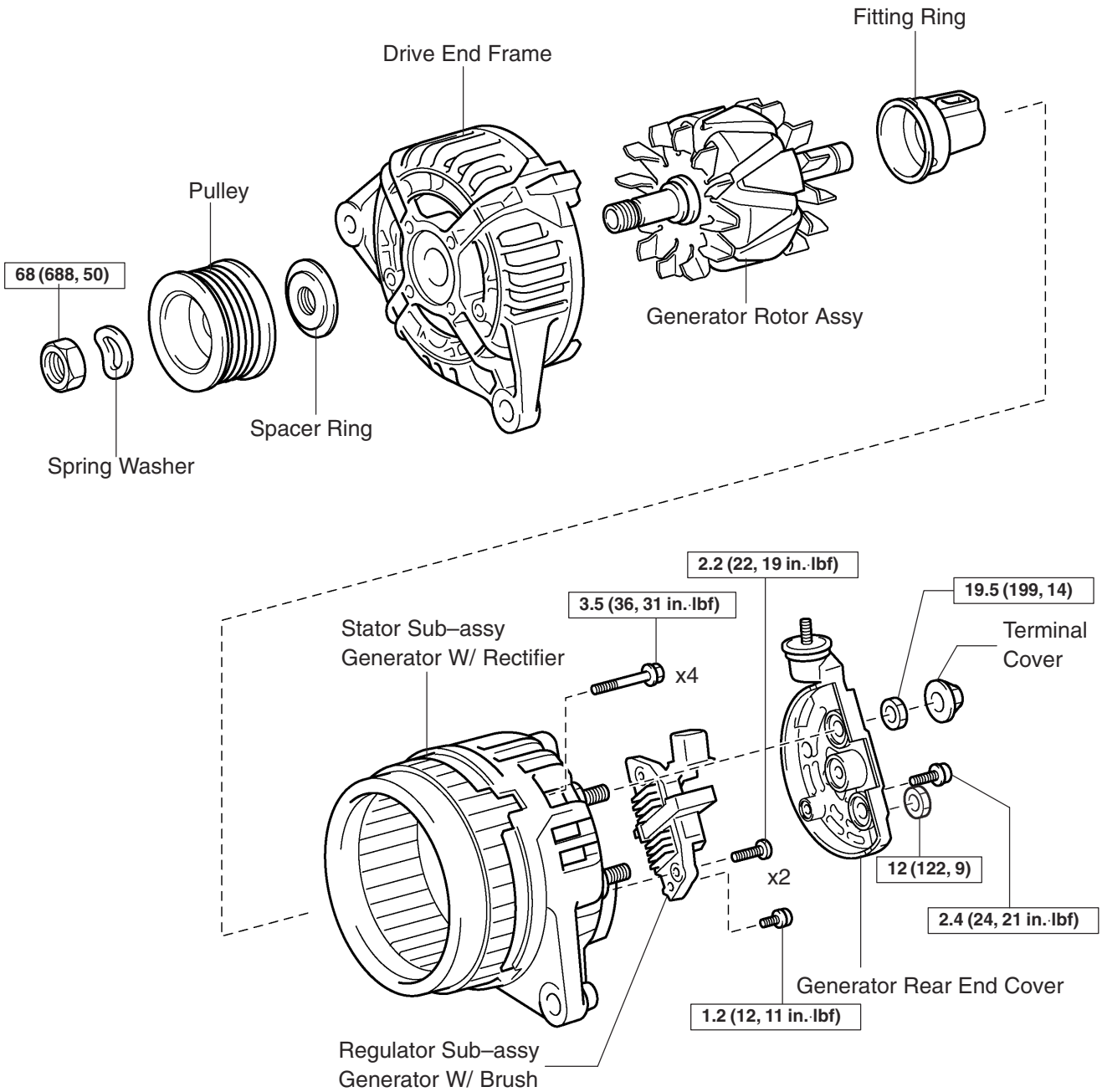
(b) Rotate the generator pulley, then check that the generator pulley moves smoothly.

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GENERATOR ASSY (BOSCH MADE)(1ZZ–FE/3ZZ–FE)

190OJ–03

COMPONENTS



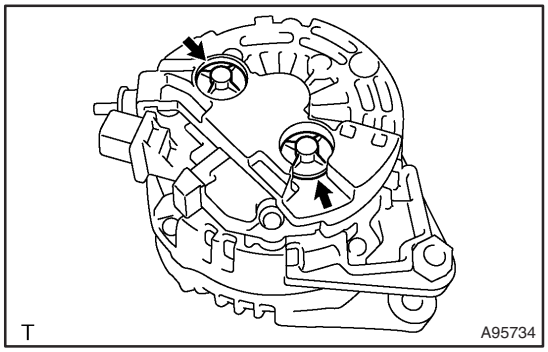
N·m (kgf·cm, ft·lbf) : Specified torque

T ◆ Non–reusable part

A95771

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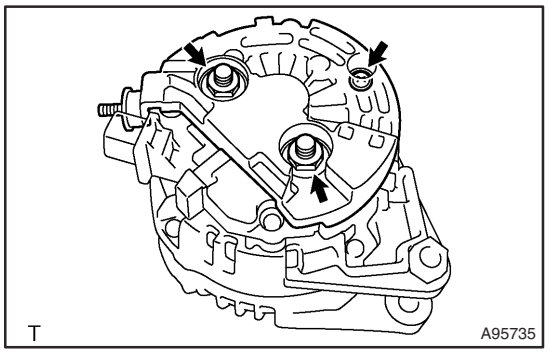
OVERHAUL



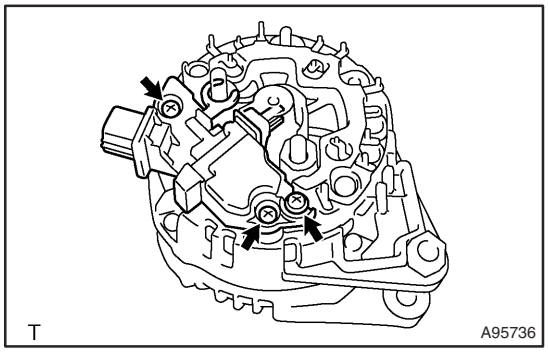
190YJ–01

1. REMOVE GENERATOR REAR END COVER

(a) Remove the 2 terminal covers by turning them counterclockwise.

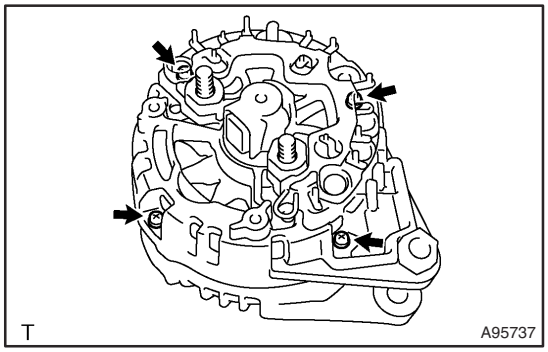


(b) Using a 15 mm socket wrench, remove the screw and 2 nuts, then detach the generator rear end cover.



2. REMOVE REGULATOR SUB–ASSY GENERATOR W/BRUSH

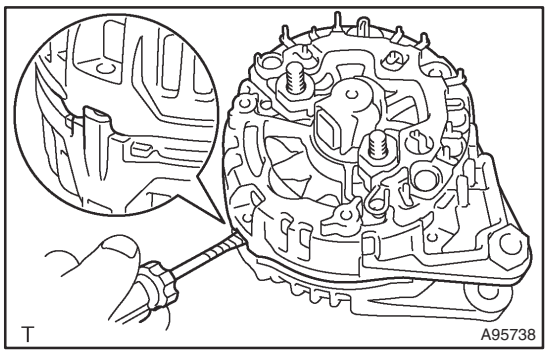
(a) Remove the 3 screws and regulator generator with brush.



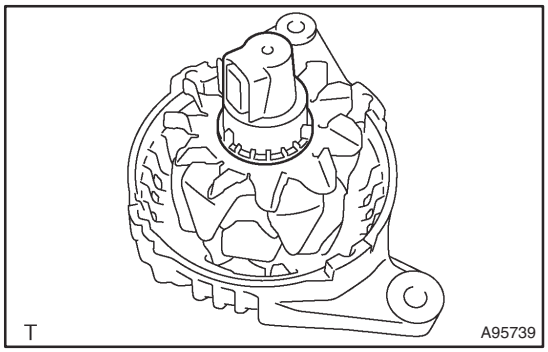
3. REMOVE STATOR SUB–ASSY GENERATOR W/RECTIFIER

(a) Remove the 4 screws.

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(b) Using a screwdriver, pry out the stator generator with rectifier.



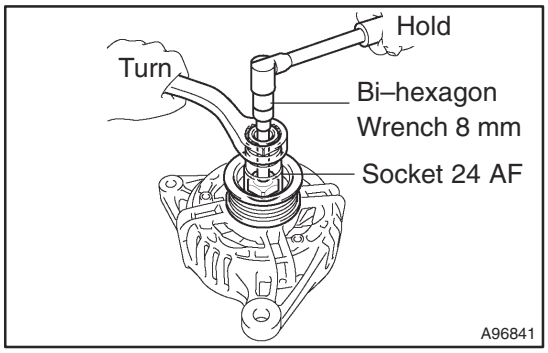
4. REMOVE BEARING SET GENERATOR

5. REMOVE PULLEY SET GENERATOR

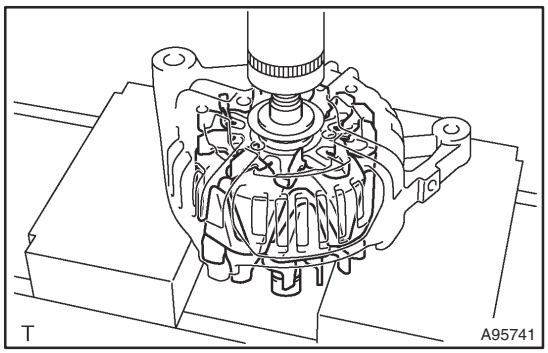
(a) Clamp the swivel arm in a vise.

NOTICE:

Do not clamp the generator rotor in a vise.

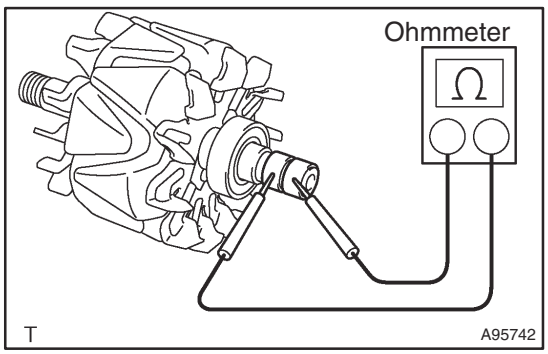


(b) Using a socket 24 AF and bi–hexagon wrench 8 mm, remove the nut and spring washer, then detach the pulley.



6. REMOVE GENERATOR ROTOR ASSY

(a) Using a press, press out the generator rotor assembly and spacer ring.



7. INSPECT GENERATOR ROTOR ASSY

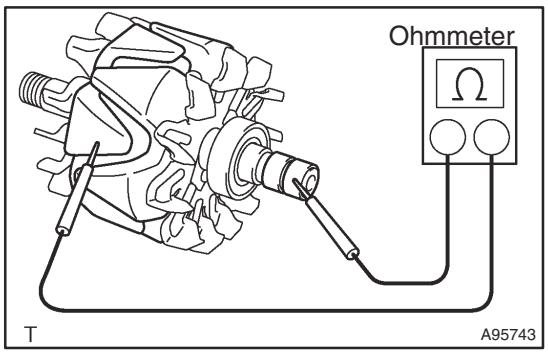
(a) Inspect the generator rotor assy for open circuit.

(1) Using an ohmmeter, measure the resistance between the slip rings.

Standard: 2.27 to 2.53 Ω at 20°C (68°F)

If the standard is not met, replace the generator rotor.

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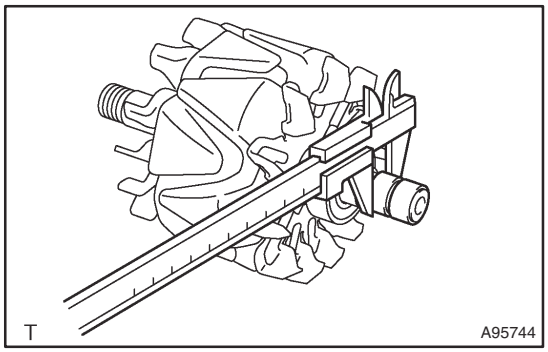


(b) Inspect the generator rotor assy for ground.

(1) Using an ohmmeter, measure the resistance between the slip ring and generator rotor assembly.

Standard: 10 kΩ or higher

If the standard is not met, replace the generator rotor.



(c) Check the appearance.

(1) Check that the slip rings are not rough or scored.

If rough or scored, replace the generator rotor.

(2) Using vernier calipers, measure the slip ring diameter.

Standard diameter: 15.3 to 15.5 mm (0.602 to 0.610 in.)

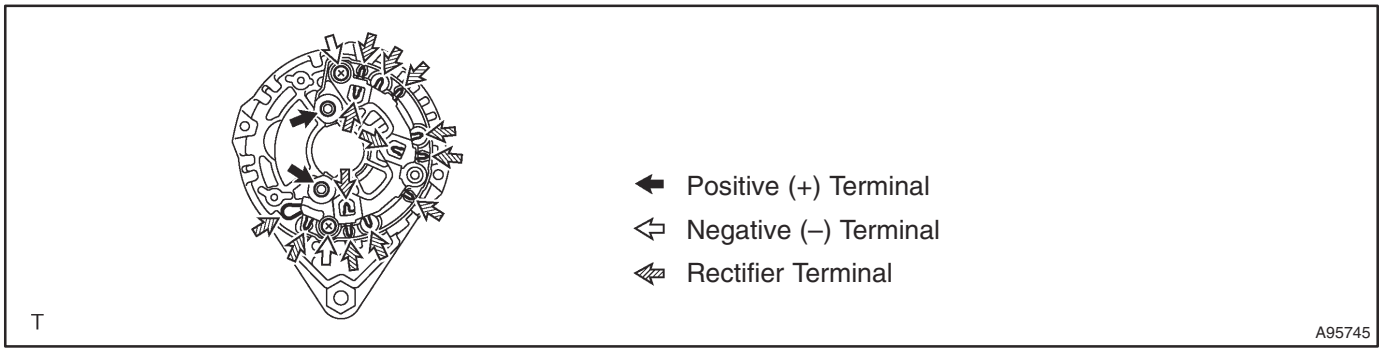
Minimum diameter: 14.3 mm (0.561 in.)

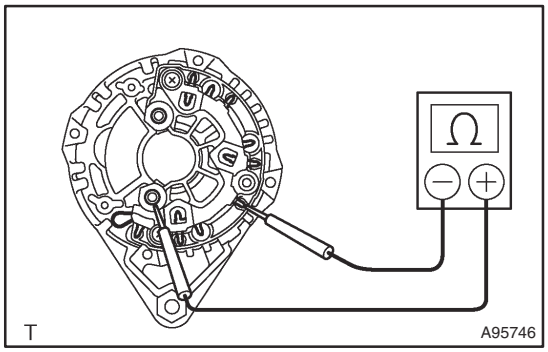
If the diameter is less than minimum, replace the generator rotor.

8. INSPECT STATOR SUB–ASSY GENERATOR W/RECTIFIER

HINT:

According to the terminal position of the stator generator, refer to the illustration below.





(a) Inspect the positive (+) rectifier.

HINT:

Inspect the positive terminal after pulling up.

(1) Using an ohmmeter, connect the positive (+) tester probe to the positive (+) terminal and the negative (–) tester probe to each rectifier terminal.

(2) Measure the resistance between the positive (+) terminal and rectifier terminal.

Standard: Below 1 Ω

If standard is not met, replace the stator generator.

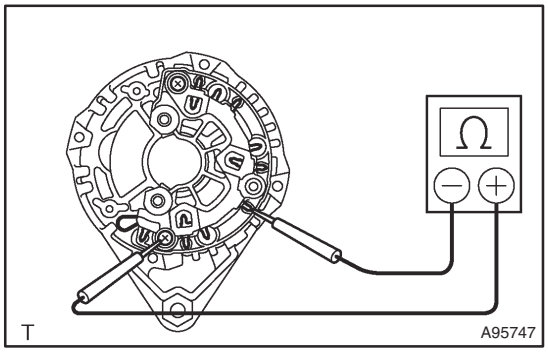
(3) Reverse the polarity of the tester probes and repeat step (1).

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(4) Measure the resistance between the positive (+) terminal and rectifier terminal.

Standard: 10 kΩ or higher

If the standard is not met, replace the stator generator.



(b) Inspect the negative (–) rectifier.

(1) Using an ohmmeter, connect the positive (+) tester probe to each negative (–) terminal and the negative (–) tester prove to each rectifier terminal.

(2) Measure the resistance between the negative (–) terminal and rectifier terminal.

Standard: 10 kΩ or higher

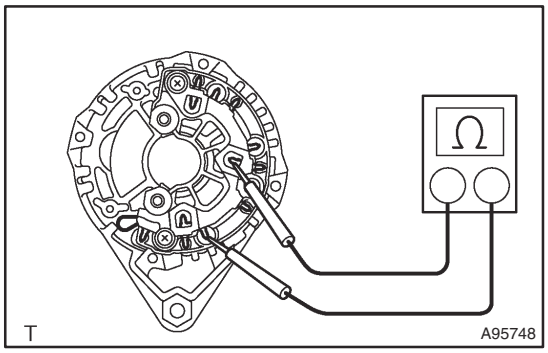
If the standard is not met, replace the stator generator.

(3) Reverse the polarity of the tester probes and repeat step (1).

(4) Measure the resistance between the negative (–) terminal and rectifier terminal.

Standard: Below 1 Ω

If the standard is not met, replace the stator generator.

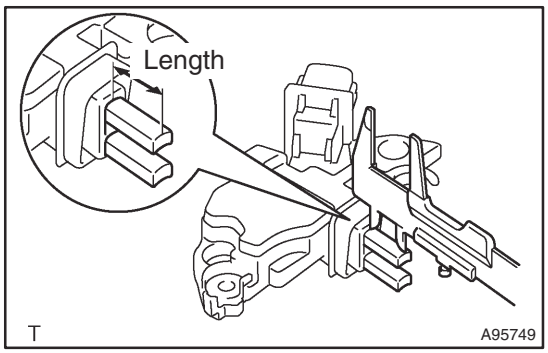


(c) Inspect the stator for open circuit.

(1) Using an ohmmeter, measure the resistance between the rectifier terminals.

Standard: Below 1 Ω

If the standard is not met, replace the stator generator.

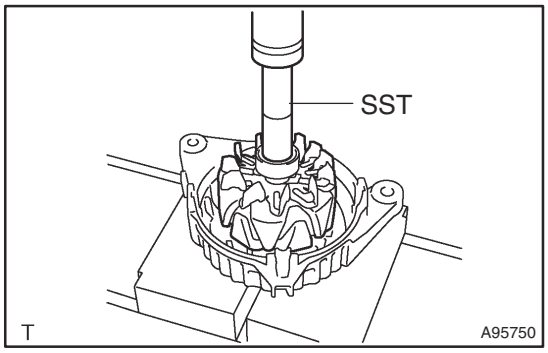


9. INSPECT BRUSH

(a) Using vernier calipers, measure the brush length.

Standard exposed length:
11.0 to 13.6 mm (0.433 to 0.535 in.)
Minimum exposed length: 1.5 mm (0.059 in.)

If the exposed length is less than minimum, replace the voltage regulator and brush assembly.



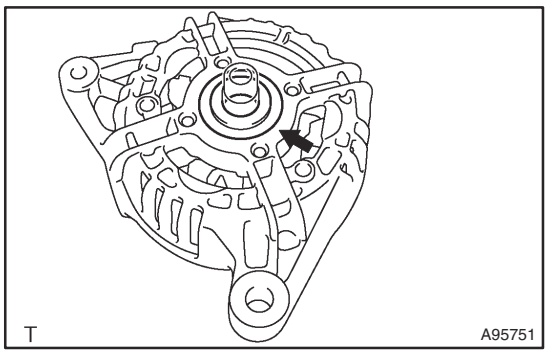
10. INSTALL GENERATOR ROTOR ASSY

(a) Using SST and a press, press in the generator rotor assembly.

SST 09285–76010

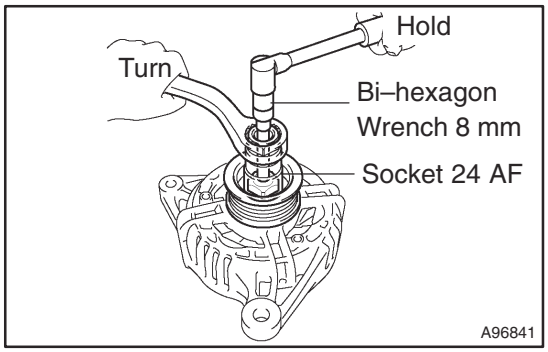
NOTICE:
Avoid misalignment during pressing

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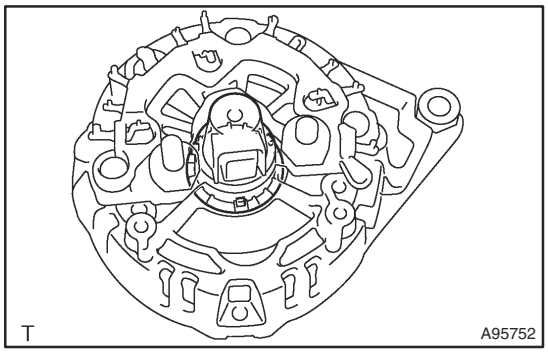


11. INSTALL PULLEY SET GENERATOR

(a) Install the spacer ring.

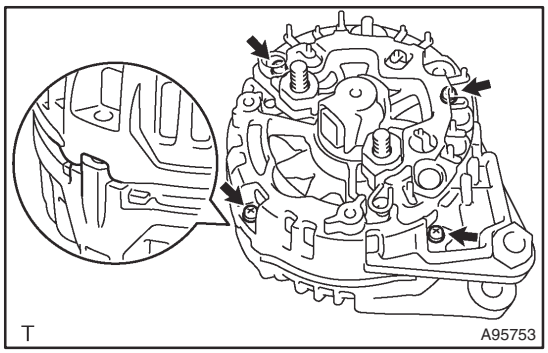


(b) Using a socket 24 AF and a bi–hexagon wrench 8 mm, install the pulley with the spring washer and nut.
Torque: 68 N·m (688 kgf·cm, 50 ft·lbf)



12. INSTALL BEARING SET GENERATOR

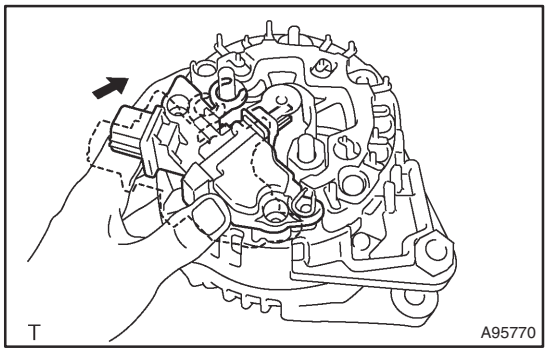
(a) Align the 3 cutouts of the bearing set generator with the stator generator with rectifier.



13. INSTALL STATOR SUB–ASSY GENERATOR W/RECTIFIER

(a) Align the key of the drive end frame with the keyway of the stator sub–assembly generator with rectifier.

(b) Install the stator generator with rectifier with the 4 bolts.
Torque: 3.5 N·m (36 kgf·cm, 31 in.·lbf)



14. INSTALL REGULATOR SUB–ASSY GENERATOR W/BRUSH

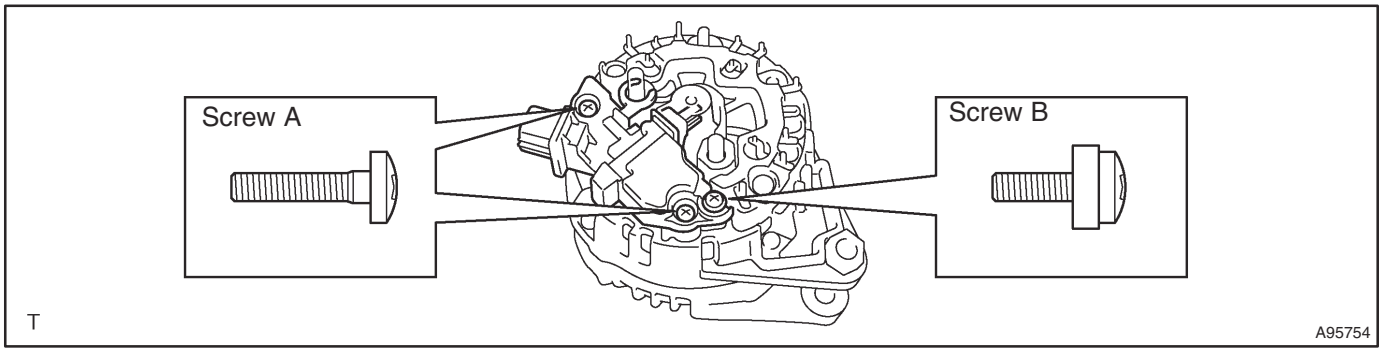
(a) Attach the brushes and terminals to the rectifier end frame of the regulator generator with brush.

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(b) Install the regulator generator with brush with the 3 screws.

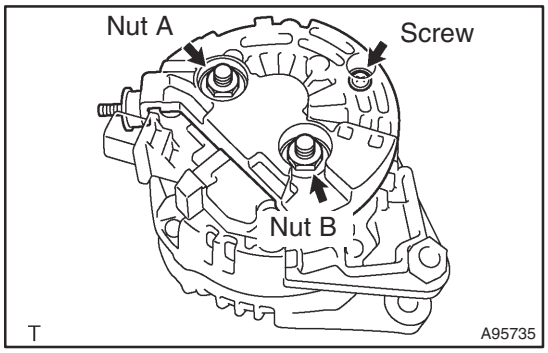
HINT:

Install the screw with the plate washer into the position shown in the illustration.



Torque:
2.2 N·m (22 kgf·cm, 19 in.·lbf) for screw A
1.2 N·m (12 kgf·cm, 11 in.·lbf) for screw B

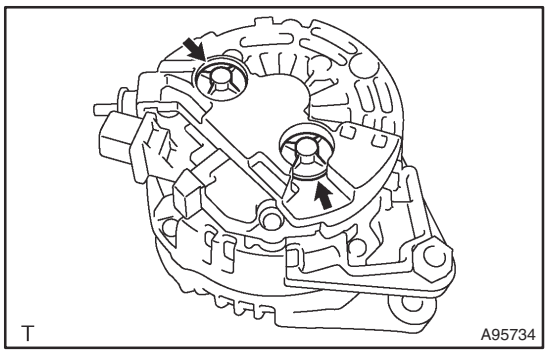
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15. INSTALL GENERATOR REAR END COVER

(a) Install the generator rear end cover with the 2 nuts and screw.

Torque:
19.5 N·m (199 kgf·cm, 14 ft·lbf) for nut A
12 N·m (122 kgf·cm, 9 ft·lbf) for nut B
2.4 N·m (24 kgf·cm, 21 in.·lbf) for screw



(b) Install the 2 terminal covers by turning them clockwise.