

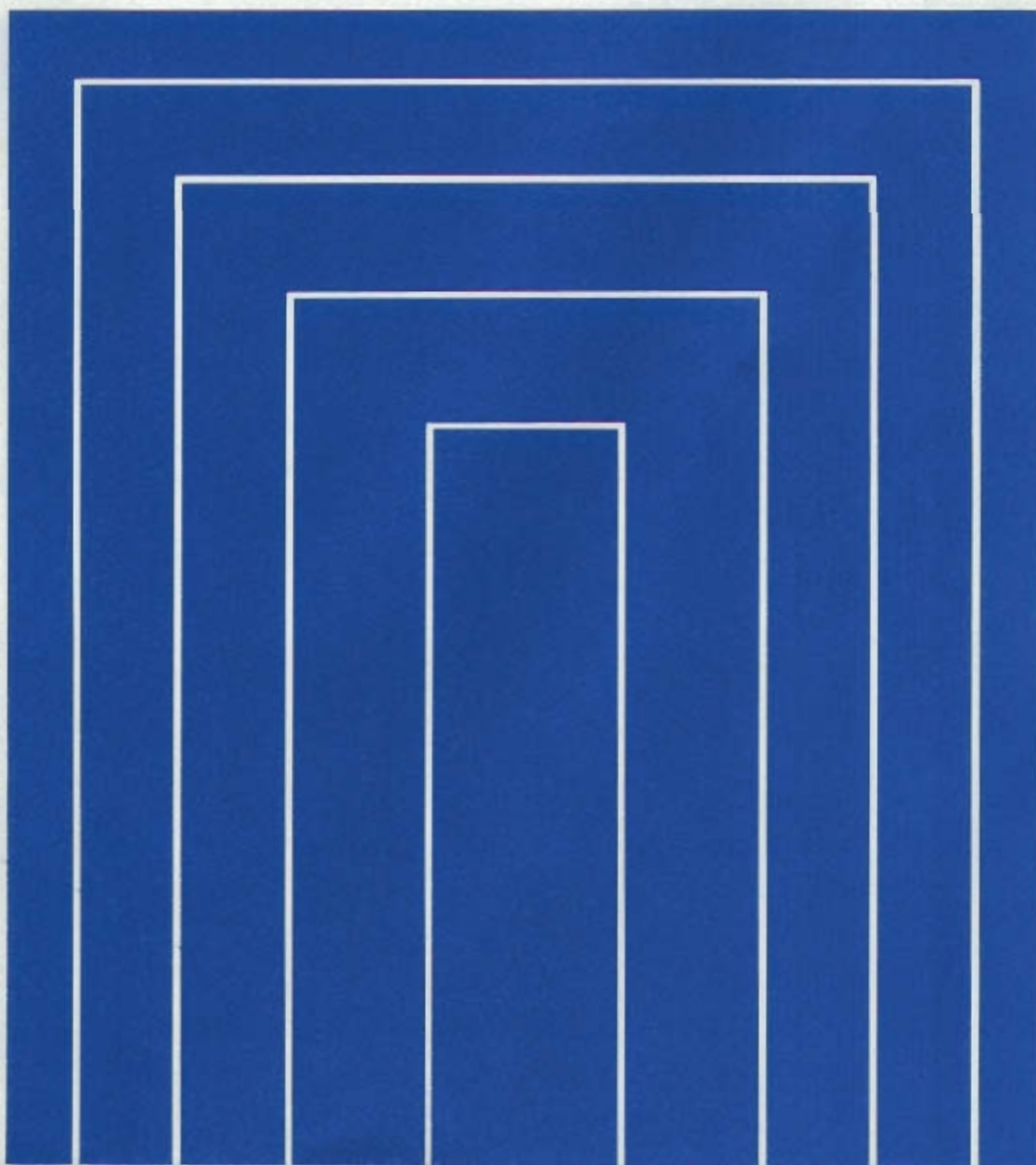


**3S-GE**

**ENGINE**

**REPAIR MANUAL**

**Oct., 1993**



# FOREWORD

This repair manual has been prepared to provide information covering general service repairs for the 3S-GE engine equipped in the TOYOTA CELICA and MR2.

Applicable models: ST202 series  
SW20 series

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

| Manual Name  | Pub. No. |
|--|----------|
| ● 3S-GE Engine Emission Control Repair Manual (For CELICA) | ERM107E  |
| ● 3S-GE Engine Emission Control Repair Manual (For MR2)    | ERM102E  |

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

**TOYOTA MOTOR CORPORATION**

**INTRODUCTION**  
**ENGINE**  
**IGNITION SYSTEM**  
**STARTING SYSTEM**  
**CHARGING SYSTEM**

**IN**

**EG**

**IG**

**ST**

**CH**

# HOW TO USE THIS MANUAL

## INDEX

IN00F-01

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

IN

## GENERAL DESCRIPTION

IN00G-01

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

Read these precautions before starting any repair task.

## TROUBLESHOOTING

IN00H-01

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

## PREPARATION

IN00J-01

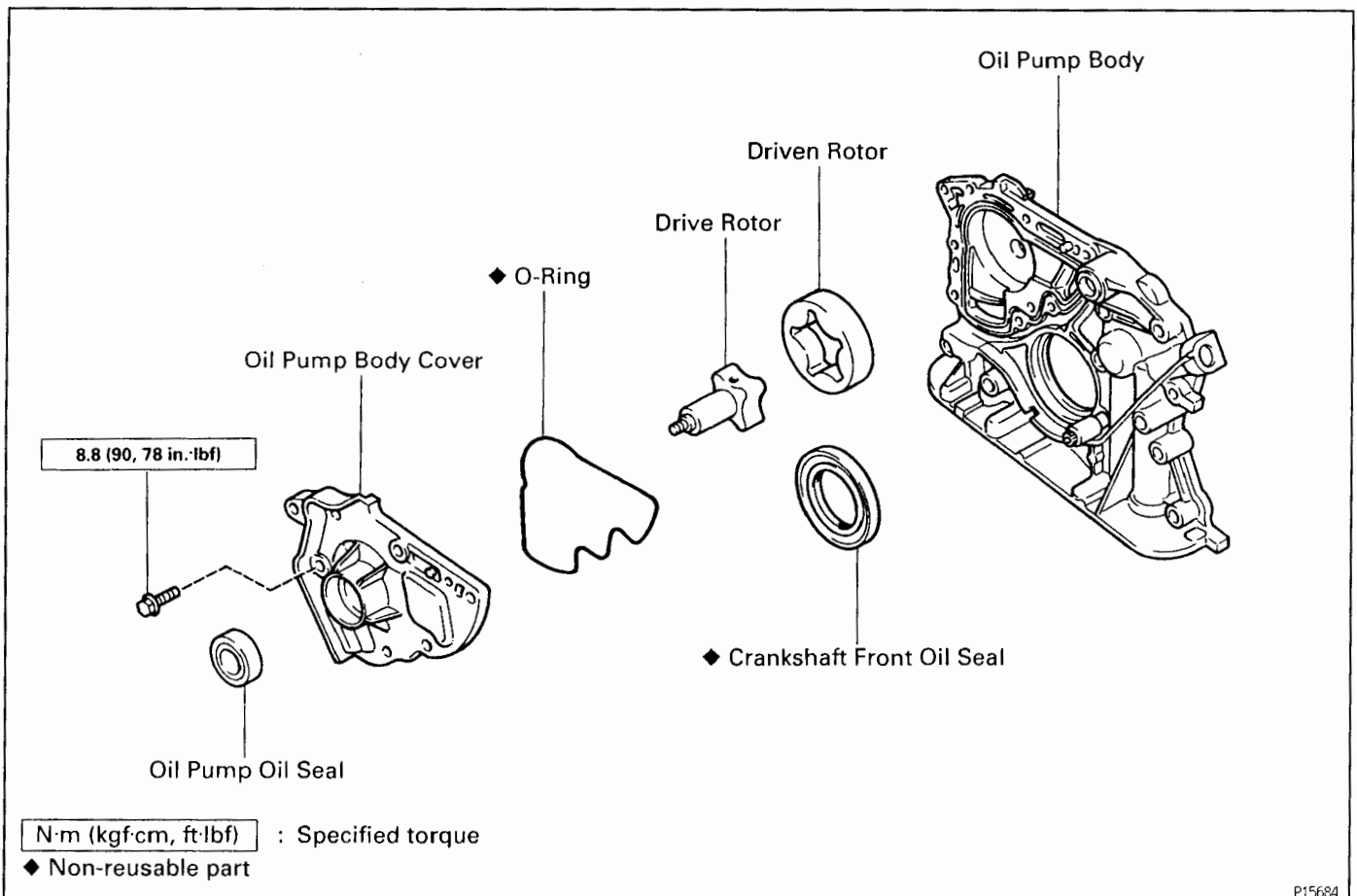
Preparation lists the SST (Special Service Tools), recommended tools, equipment, lubricant and SSM (Special Service Materials) which should be prepared before beginning the operation and explains the purpose of each one.

## REPAIR PROCEDURES

IN00K-06

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

Example:



P15684

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

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

Example:

IN

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

IN00L-01

## REFERENCES

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

IN00M-01

## SPECIFICATIONS

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

**CAUTIONS, NOTICES, HINTS:**

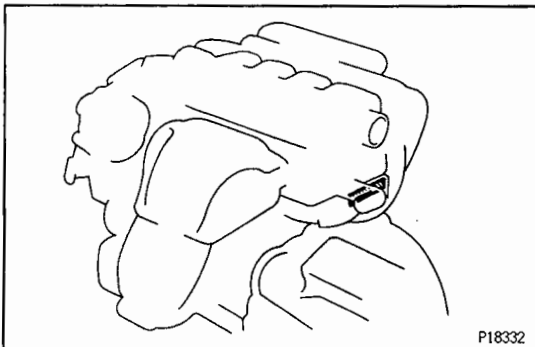
- **CAUTIONS** are presented in bold type, and indicate there is a possibility of injury to you or other people.
- **NOTICES** are also presented in bold type, and indicate the possibility of damage to the components being repaired.
- **HINTS** are separated from the text but do not appear in bold. They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

**SI UNIT**

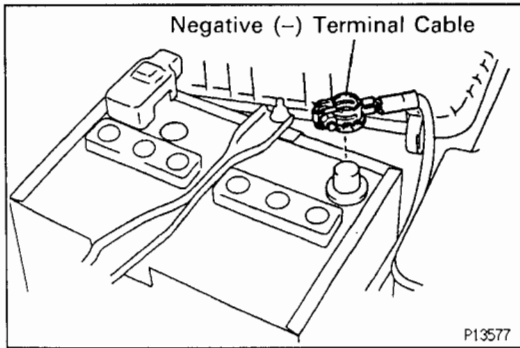
The UNIT given in this manual are primarily expressed with the SI UNIT (International System of Unit), and alternately expressed in the metric system and in the yard/pound system.

**Example:**

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

**IDENTIFICATION INFORMATION  
ENGINE SERIAL NUMBER**

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

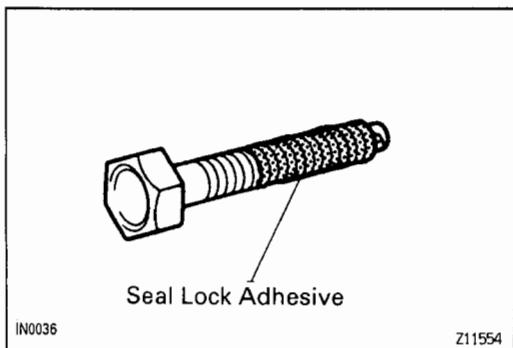


## GENERAL REPAIR INSTRUCTIONS

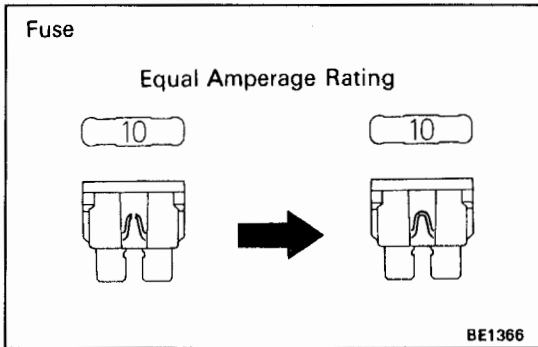
1. Use fender, seat and floor covers to keep the vehicle clean and prevent damage.
2. During disassembly, keep parts in the appropriate order to facilitate reassembly.
3. Observe the following:
  - (a) Before performing electrical work, disconnect the negative (-) terminal cable from the battery.
  -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

Precoated parts are bolts and nuts, etc. that are coated with a seal lock adhesive at the factory.

  - (a) If a precoated part is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.
  - (b) When reusing precoated parts, clean off the old adhesive and dry with compressed air. Then apply the specified seal lock adhesive to the bolt, nut or threads.
  - (c) Precoated parts are indicated in the component illustrations by the "★" symbol.
7. When necessary, use a sealer on gaskets to prevent leaks.
8. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.



9. Use of special service tools (SST) and special service materials (SSM) may be required, depending on the nature of the repair. Be sure to use SST and SSM where specified and follow the proper work procedure. A list of SST and SSM can be found in the preparation part at the front of each section in this manual.



10. When replacing fuses, be sure the new fuse has the correct amperage rating . DO NOT exceed the rating or use one with a lower rating.

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

V00076

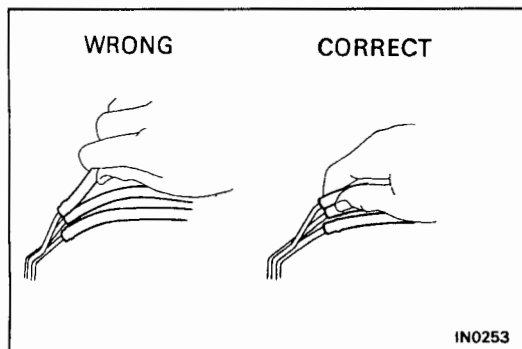
11. Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations.
  - (a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels at the opposite end in order to ensure safety.



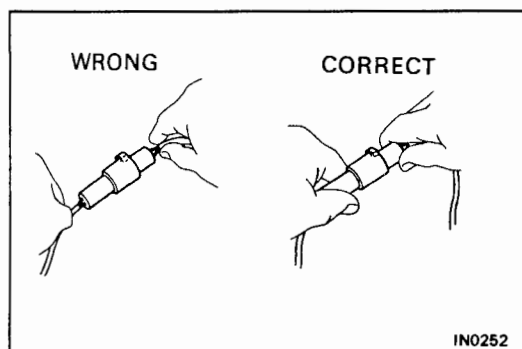
- (b) After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on a vehicle raised on a jack alone, even for a small job that can be finished quickly.

12. Observe the following precautions to avoid damage to the parts:

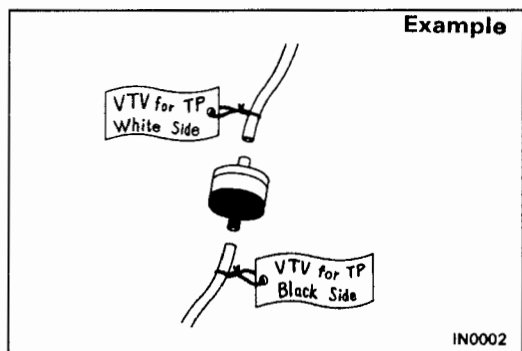
- (a) Do not open the cover or case of the ECU unless absolutely necessary. (If the IC terminals are touched, the IC may be destroyed by static electricity.)



- (b) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
- (c) To pull apart electrical connectors, pull on the connector itself, not the wires.
- (d) Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard floor, they should be replaced and not reused.
- (e) When steam cleaning an engine, protect the distributor, air filter, and VCV from water.



- (f) Never use an impact wrench to remove or install temperature switches or temperature sensors.
- (g) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.
- (h) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adapter instead. Once the hose has been stretched, it may leak.



13. Tag hoses before disconnecting them:
- (a) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
  - (b) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.

14. Unless otherwise stated, all resistance is measured at an ambient temperature of 20°C (68°F). Because the resistance may be outside specifications if measured at high temperatures immediately after the vehicle has been running, measurements should be made when the engine has cooled down.

## PRECAUTION FOR VEHICLES EQUIPPED WITH A CATALYTIC CONVERTER

IN007-02

**CAUTION:** If large amounts of unburned gasoline flow into the converter, it may overheat and create a fire hazard. To prevent this, observe the following precautions and explain them to your customer.

1. **Use only unleaded gasoline.**
2. **Avoid prolonged idling.**  
Avoid running the engine at idle speed for more than 20 minutes.
3. **Avoid spark jump test.**
  - (a) Perform spark jump test only when absolutely necessary. Perform this test as rapidly as possible.
  - (b) While testing, never race the engine.
4. **Avoid prolonged engine compression measurement.**  
Engine compression tests must be done as rapidly as possible.
5. **Do not run engine when fuel tank is nearly empty.**  
This may cause the engine to misfire and create an extra load on the converter.
6. **Avoid coasting with ignition turned off and prolonged braking.**
7. **Do not dispose of used catalyst along with parts contaminated with gasoline or oil.**

## IF VEHICLE IS EQUIPPED WITH MOBILE COMMUNICATION SYSTEM

IN028-06

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

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

# ABBREVIATIONS USED IN THIS MANUAL








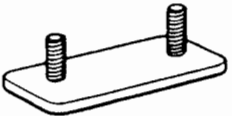


IN031-05

|        |                                   |
|--------|-----------------------------------|
| A/C    | Air conditioner                   |
| ACIS   | Acoustic Control Induction System |
| BTDC   | Before Top Dead Center            |
| BVSV   | Bimetallic Vacuum Switching Valve |
| CB     | Circuit Breaker                   |
| DOHC   | Double Over Head Cam              |
| ECU    | Electronic Control Unit           |
| EFI    | Electronic Fuel Injection         |
| ESA    | Electronic Spark Advance          |
| FIPG   | Formed in Place Gasket            |
| FL     | Fusible Link                      |
| H-Fuse | High Current Fuse                 |
| IG     | Ignition                          |
| ISC    | Idle Speed Control                |
| LH     | Left-Hand                         |
| LHD    | Left-Hand Drive                   |
| M-Fuse | Medium Current Fuse               |
| MP     | Multipurpose                      |
| O/S    | Oversize                          |
| PCV    | Positive Crankcase Ventilation    |
| PS     | Power Steering                    |
| RH     | Right-Hand                        |
| RHD    | Right-Hand Drive                  |
| SSM    | Special Service Materials         |
| SST    | Special Service Tools             |
| STD    | Standard                          |
| SW     | Switch                            |
| TDC    | Top Dead Center                   |
| TEMP.  | Temperature                       |
| TWC    | Three-Way Catalyst                |
| U/S    | Undersize                         |
| VSV    | Vacuum Switching Valve            |
| w/     | With                              |
| w/o    | Without                           |

# STANDARD BOLT TORQUE SPECIFICATIONS

IN008-03

## HOW TO DETERMINE BOLT STRENGTH

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

SPECIFIED TORQUE FOR STANDARD BOLTS

| Class | Diameter<br>mm | Pitch<br>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        |

IN

–MEMO–

IN

# ENGINE

## ENGINE MECHANICAL

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# ENGINE MECHANICAL

## DESCRIPTION

The 3S-GE engine is an in-line, 4 cylinder, 2.0 liter DOHC 16-valve engine.

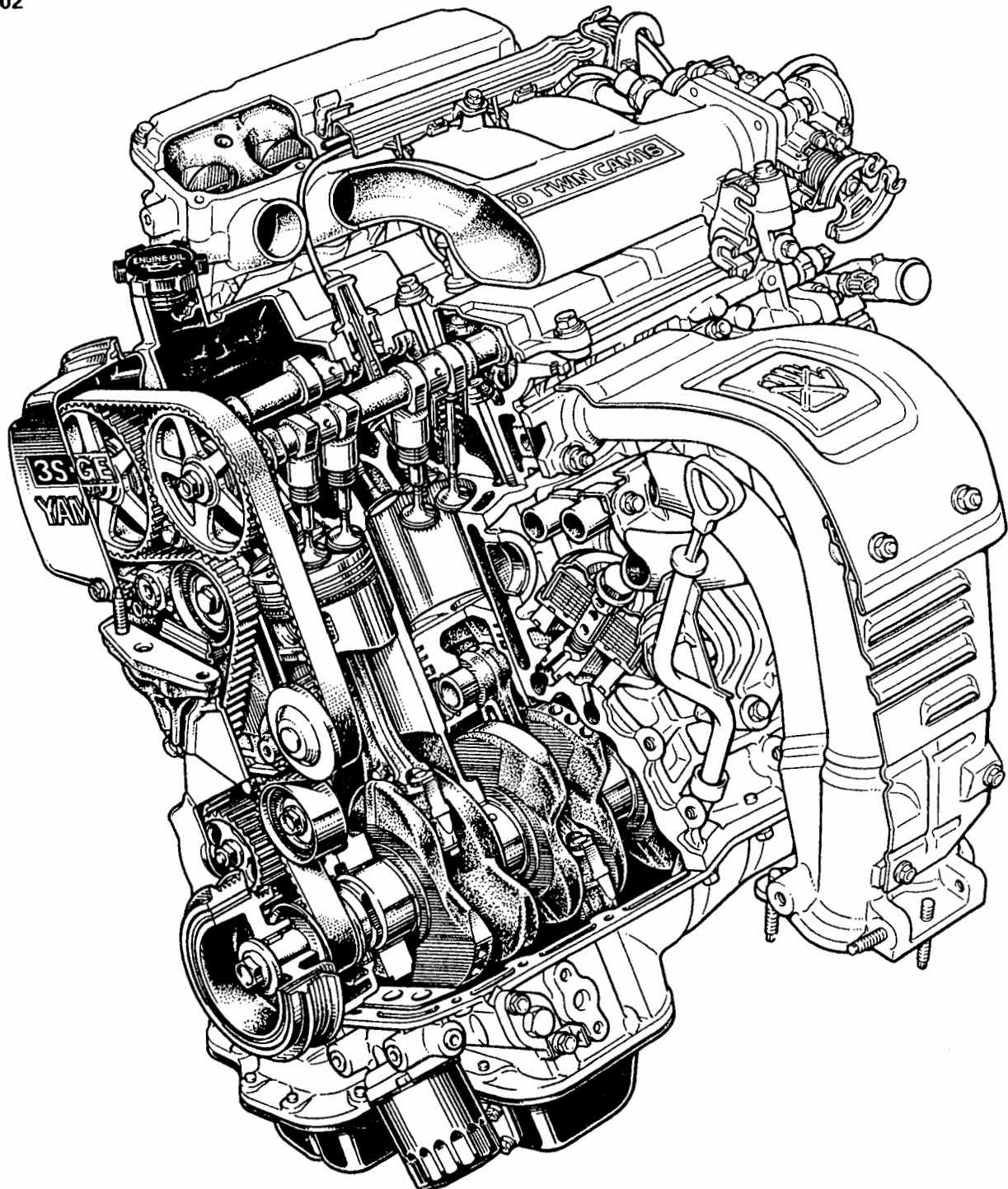
EGOVX-03

## OPERATION

EG

EG42T-01

ST202

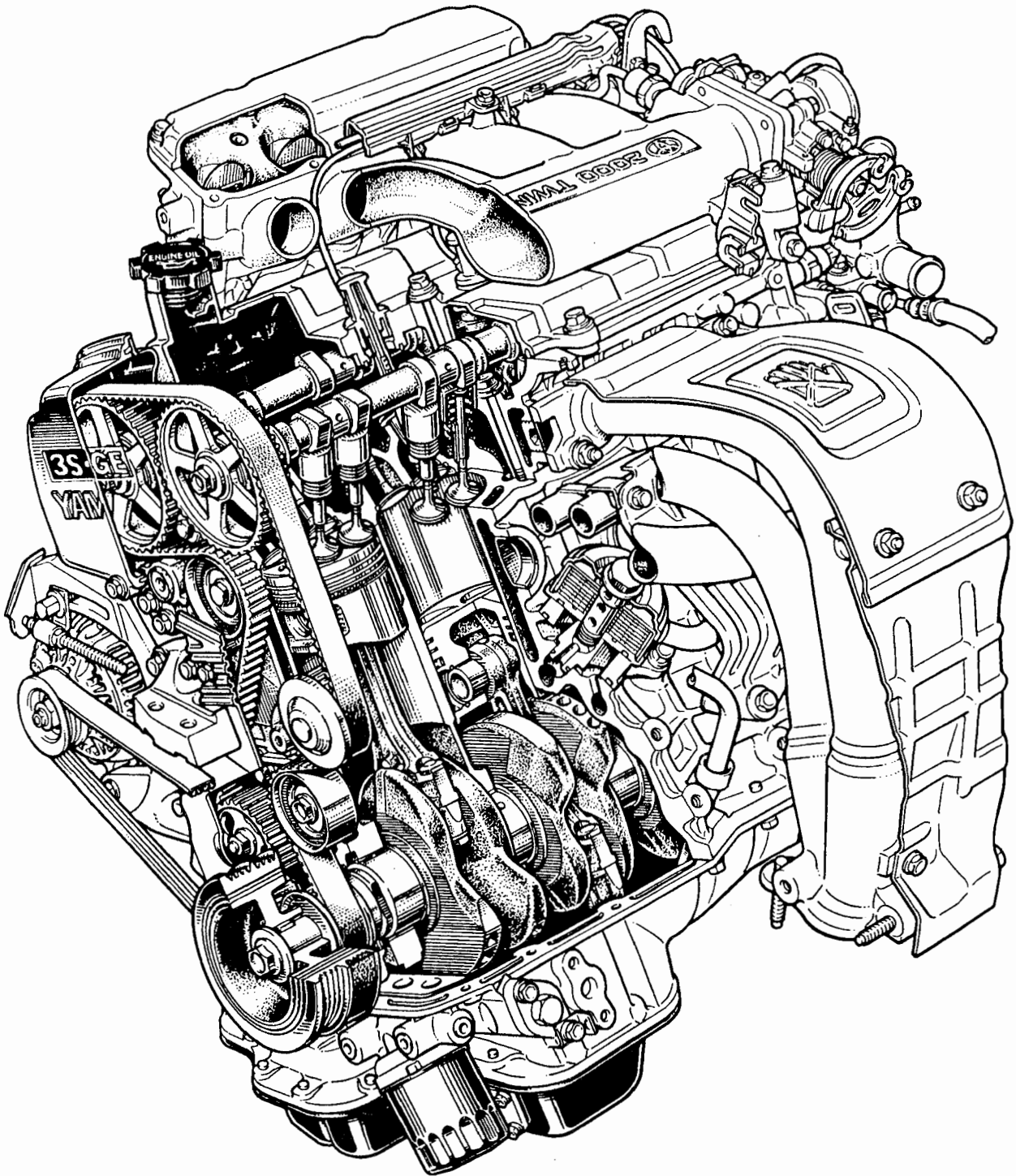


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SW20

EG



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

The crankshaft is integrated with 8 weights for balance. Oil holes are placed in the center of the crankshaft to supply oil to the connecting rods, bearing, pistons and other components.

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

The intake manifold has 4 independent long ports and utilizes the inertial supercharging effect to improve engine torque at low and medium speeds.

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

Adjustment of the valve clearance is done by means of an inner shim type system, in which valve adjusting shims are located below the valve lifters. To replace the shims, the camshafts must be removed.

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

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

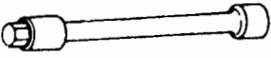

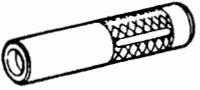


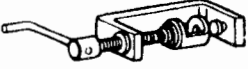


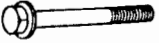




The No.1 compression ring is made of stainless steel and the No.2 compression ring is made of cast iron. The oil ring is made of stainless steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder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

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

The No.1 and No.2 oil pans are bolted onto the bottom the cylinder block. The No.1 oil pan is made of aluminum alloy. The No.2 oil pan is an oil reservoir made of pressed sheet steel. The dividing plate also prevents the oil from shifting away from the oil pump suction pipe when the vehicle is stopped suddenly.

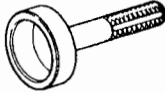

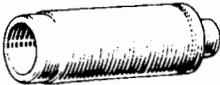





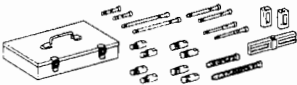
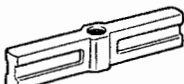
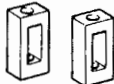



**PREPARATION**  
**SST (SPECIAL SERVICE TOOLS)**

EGDAY-10

|   |   |                           |
|---|---|---------------------------|
|    | <p>09043-38100 Hexagon 10 mm Wrench</p>                           | <p>Cylinder head bolt</p> |
|    | <p>09155-16100 Spark Plug Wrench</p>                              |                           |
|    | <p>09201-41020 Valve Stem Oil Seal Replacer</p>                   |                           |
|    | <p>09201-10000 Valve Guide Bushing Remover &amp; Replacer Set</p> |                           |
|    | <p>(09201-01060) Valve Guide Bushing Remover &amp; Replacer 6</p> |                           |
|    | <p>09202-70010 Valve Spring Compressor</p>                        |                           |
|  | <p>09213-54015 Crankshaft Pulley Holding Tool</p>                 |                           |
|  | <p>(90119-08216) Bolt</p>   | <p>ST202</p>              |
|  | <p>(91651-60855) Bolt</p>   | <p>SW20</p>               |
|  | <p>09216-00021 Belt Tension Gauge</p>                             |                           |
|  | <p>09216-00030 Belt Tension Gauge Cable</p>                       |                           |
|  | <p>09222-30010 Connecting Rod Bushing Remover &amp; Replacer</p>  |                           |
|  | <p>09223-46011 Crankshaft Front Oil Seal Replacer</p>             | <p>Camshaft oil seal</p>  |

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|   |               |  |                     |
|---|---------------|--|---------------------|
|    | 09223-63010   | Crankshaft Rear Oil Seal Replacer        |                     |
|    | 09249-63010   | Torque Wrench Adaptor                    |                     |
|    | 09226-10010   | Crankshaft Front & Rear Bearing Replacer |                     |
|    | 09330-00021   | Companion Flange Holding Tool            | Crankshaft pulley   |
|    | 09608-30022   | Front Hub Bearing Replacer Set           |                     |
|    | (09608-05010) | Handle                                   | Valve guide bushing |
|    | 09816-30010   | Oil Pressure Switch Socket               | Knock sensor        |
|  | 09843-18020   | Diagnosis Check Wire                     |                     |
|  | 09950-50010   | Puller C Set                             |                     |
|  | (09951-05010) | Hanger 150                               | Crankshaft pulley   |
|  | (09952-05010) | Slide Arm                                | Crankshaft pulley   |
|  | (09953-05010) | Center Bolt 100                          | Crankshaft pulley   |
|  | (09953-05020) | Center Bolt 150                          | Crankshaft pulley   |
|  | (09954-05020) | Claw No.2                                | Crankshaft pulley   |