

MITSUBISHI

DIESEL

WORKSHOP MANUAL

FOREWORD

This Workshop Manual contains procedures for removal, disassembly, inspection, adjustment, reassembly and installation, etc. for service mechanics.

All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to make changes at any time without prior notice or obligation.

Fuel System **13A**

Emission Control System **17A**

FILING INSTRUCTION

Please keep these manual pages in the binder No. BN940001.

File these pages according to the signs "Added", "Revised" and "Deleted" on the "List of effective pages" which are interpreted below.

Added: File the pages with this label additionally in your manual.

Revised.Deleted: Replace the existing pages with the corresponding pages with this sign.

Missing sheets will be supplied upon request.

INTRODUCTION

EXPLANATION OF MANUAL CONTENTS

Maintenance and Servicing Procedures

- (1) A diagram of the component parts is provided near the front of each section in order to give the reader a better understanding of the installed condition of component parts.
- (2) The numbers provided within the diagram indicate the sequence for maintenance and servicing procedures; the symbol **N** indicates a non-reusable part; the tightening torque is provided where applicable.

- Removal steps:
The part designation number corresponds to the number in the illustration to indicate removal steps.
- Disassembly steps:
The part designation number corresponds to the number in the illustration to indicate disassembly steps.
- Installation steps:
Specified in case installation is impossible in reverse order of removal steps. Omitted if installation is possible in reverse order of removal steps.
- Reassembly steps:
Specified in case reassembly is impossible in reverse order of disassembly steps. Omitted if reassembly is possible in reverse order of disassembly steps.

Classification of Major Maintenance/Service Points

When there are major points relative to maintenance and servicing procedures (such as essential maintenance and service points, maintenance and service standard values, information regarding the use of special tools, etc.), these are arranged together as major maintenance and service points and explained in detail.

- ◁A▷: Indicates that there are essential points for removal or disassembly.
- ▶A◀: Indicates that there are essential points for installation or reassembly.

Symbols for Lubrication, Sealants and Adhesives

Information concerning the locations for lubrication and for application of sealants and adhesives is provided, by using symbols, in the diagram of component parts, or on the page following the component parts page, and explained.

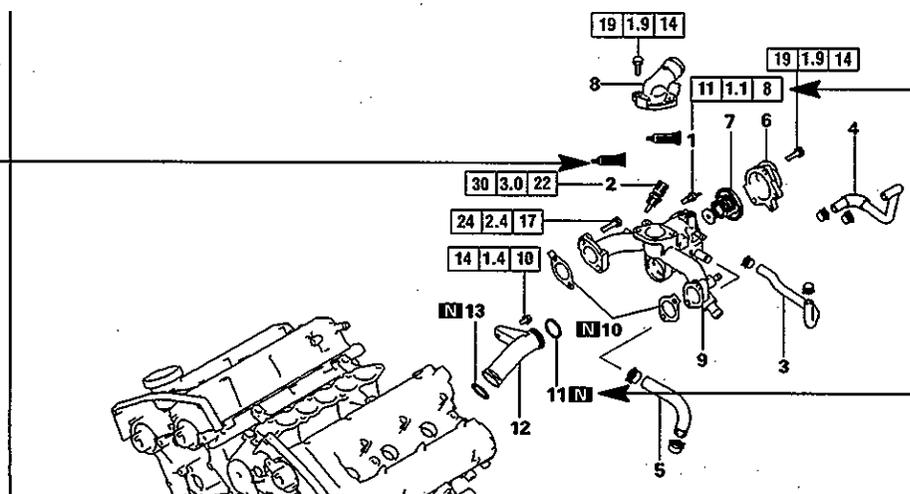
-  Grease
(multipurpose grease unless there is a brand or type specified)
-  Sealant or adhesive
-  Brake fluid, automatic transmission fluid or air conditioner compressor oil
-  Engine oil or gear oil

INTRODUCTION

Indicates the group title. Indicates the section title. Indicates the group number. Indicates the section number. Indicates the page number.

6A1 ENGINE – Water Pump and Water Pipe **11A-7-1**

7. WATER PUMP AND WATER PIPE REMOVAL AND INSTALLATION



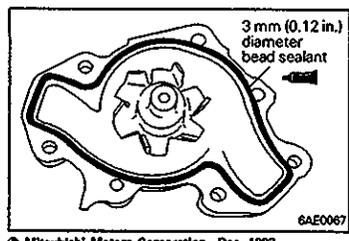
Denotes tightening torque.

Nm	kgm	ft.lbs.
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Denotes non-reusable part.

This number corresponds to the number appearing in "Removal steps", "Disassembly steps", "Installation steps" or "Reassembly steps".

- Removal steps**
- ➡F 1. Engine coolant temperature gauge unit
 - ➡E 2. Engine coolant temperature sensor
 - 3. Water hose
 - 4. Water hose
 - 5. Water hose
 - 6. Water inlet fitting
 - 7. Thermostat
 - ➡C 8. Water outlet fitting
 - 9. Thermostat housing
 - 10. Gasket
 - ➡B 11. O-ring
 - ➡B 12. Water pipe
 - ➡B 13. O-ring
 - ➡A 14. Water pump



INSTALLATION SERVICE POINTS

➡A SEALANT APPLICATION TO WATER PUMP

Specified sealant:
Mitsubishi Genuine Part No. MD970389 or equivalent

Operating procedures, cautions, etc. on removal, installation, disassembly and reassembly are described.

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FUEL SYSTEM

DIESEL

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1. SPECIFICATIONS**FUEL INJECTION PUMP SPECIFICATIONS – ZEXEL TYPE**

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD155249	10 (0.394)	*1	*3	X	–	–	–	X	–	X
MD155251	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD155252	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD155253	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD155254	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD155255	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD155256	10 (0.394)	*1	*4	X	–	–	–	X	–	X
MD155257	10 (0.394)	*2	*4	X	–	–	–	X	–	X
MD155261	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD155262	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD155263	10 (0.394)	*1	*4	X	–	–	–	X	–	X
MD155265	10 (0.394)	*2	*4	X	–	–	–	X	–	X
MD155266	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD155267	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD155269	10 (0.394)	*2	*4	X	–	–	–	X	–	X
MD163890	10 (0.394)	*2	*4	X	–	X	–	X	–	X
MD167342	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD167344	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD167345	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD167346	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD167348	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD171106	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD171999	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD173677	10 (0.394)	*1	*4	X	–	–	–	X	–	X
MD173678	10 (0.394)	*2	*4	X	–	X	–	X	–	X
MD178626	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD178627	10 (0.394)	*1	*4	X	–	X	–	X	X	X
MD180438	10 (0.394)	*2	*4	X	–	–	–	–	–	X
MD186297	10 (0.394)	*1	*4	X	–	X	–	X	–	X
MD188420	10 (0.394)	*2	*4	X	–	–	–	–	–	X

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD188421	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD188422	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD188423	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD188424	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD188425	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD188426	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD188427	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD188431	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD192746	10 (0.394)	*2	*4	X	-	X	-	X	X	X
MD193837	10 (0.394)	*1	*4	X	-	X	-	X	X	X
MD301925	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD301926	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD301927	10 (0.394)	*1	*3	X	-	-	-	X	X	X
MD301928	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD304868	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD304869	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD304870	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD304873	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD304881	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD304882	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD304883	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD306838	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD306840	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD306841	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD306842	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD306843	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD306844	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD306845	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD306846	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD307495	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD310076	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD310079	10 (0.394)	*1	*3	X	-	X	-	X	X	X

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD310080	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD310761	10 (0.394)	*2	*3	X	-	X	-	-	-	X
MD310762	10 (0.394)	*2	*3	X	-	X	-	-	-	X
MD310763	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD310764	10 (0.394)	*1	*3	X	-	X	-	X	X	X
MD310765	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD310766	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD310768	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD311782	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD311783	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD311784	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD312882	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD312885	10 (0.394)	*2	*4	X	-	X	-	X	-	X
MD312886	10 (0.394)	*2	*4	X	-	X	-	X	-	X
MD313031	10 (0.394)	*2	*3	X	-	X	-	-	-	X
MD313032	10 (0.394)	*2	*3	X	-	X	-	-	-	X
MD313033	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD313034	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD313036	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD313037	10 (0.394)	*2	*4	X	-	X	-	X	-	X
MD313038	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD313057	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD313062	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD313865	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD313866	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD313867	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD313868	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD313869	10 (0.394)	*1	*4	X	-	-	-	X	-	X
MD314198	10 (0.394)	*2	*4	X	-	-	-	-	-	X
MD314199	10 (0.394)	*2	*4	X	-	-	-	X	-	X
MD315192	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD315193	10 (0.394)	*2	*3	X	-	-	-	X	-	X

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD315197	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD315198	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD319502	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD323061	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD323062	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD323852	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD325593	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD325594	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD326847	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD329645	10 (0.394)	*1	*4	X	-	X	-	X	-	X
MD329959	10 (0.394)	*1	*4	X	-	-	X	X	-	X
MD329960	10 (0.394)	*2	*4	X	-	-	X	-	-	X
MD329961	10 (0.394)	*2	*4	X	-	-	X	-	-	X
MD331142	10 (0.394)	*2	*4	X	-	X	-	X	-	X
MD331231	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD331232	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD332819	10 (0.394)	*2	*4	X	-	X	-	X	-	X
MD334881	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334882	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334883	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334884	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334885	10 (0.394)	*2	*3	X	-	-	-	-	-	X
MD334886	10 (0.394)	*2	*3	X	-	X	-	-	-	X
MD334887	10 (0.394)	*2	*3	X	-	-	-	X	-	X
MD334888	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD334889	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD334890	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD334891	10 (0.394)	*2	*3	X	-	X	-	X	-	X
MD334892	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334893	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334894	10 (0.394)	*1	*3	X	-	X	-	X	-	X
MD334895	10 (0.394)	*1	*3	X	-	X	-	X	-	X

DIESEL – Specifications

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Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD334896	10 (0.394)	*2	*3	X	–	X	–	–	–	X
MD334897	10 (0.394)	*2	*3	X	–	X	–	–	–	X
MD335352	10 (0.394)	*2	*3	X	–	–	–	–	–	X
ME201105	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201106	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201107	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201108	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201109	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201110	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201111	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201112	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201114	11 (0.433)	*1	*3	X	–	–	–	X	–	X
ME201115	11 (0.433)	*1	*3	X	–	–	–	X	–	X
ME201183	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201603	11 (0.433)	*1	*3	X	–	X	–	X	–	X
ME201614	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201683	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201684	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201685	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201755	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201820	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201821	11 (0.433)	*1	*3	X	–	X	–	X	X	X
ME201845	11 (0.433)	*1	*3	X	–	X	–	X	X	X

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
ME201902	11 (0.433)	*1	*3	X	-	-	-	X	X	X
ME202158	10 (0.394)	*1	*3	X	-	-	X	X	-	X
ME202550	11 (0.433)	*1	*3	X	-	X	-	X	X	X
ME202551	11 (0.433)	*1	*3	X	-	X	-	X	X	X
ME202552	11 (0.433)	*1	*3	X	-	X	-	X	X	X
ME202553	11 (0.433)	*1	*3	X	-	X	-	X	X	X
ME202554	11 (0.433)	*1	*3	X	-	X	-	X	X	X

NOTE

X: Applicable

-: Not applicable

*1: Half all speed

*2: All speed

*3: Automatic (wax type)

*4: Manual

FUEL INJECTION PUMP SPECIFICATIONS – NIPPONDENSO TYPE

Fuel injection pump identification No.	Plunger diameter mm (in.)	Governor	Cold start device	Fuel cut solenoid valve	Dash pot	Boost compensator	Diesel altitude compensator (DAC)	Speed sensor	Lever position sensor (LPS)	Timer
MD128260	9 (0.354)	*1	*3	X	X	–	–	–	–	X
MD133272	9 (0.354)	*1	*3	X	X	–	–	X	X	X
MD133322	9 (0.354)	*1	*3	X	X	–	–	X	–	X
MD133520	9 (0.354)	*1	*3	X	X	–	–	–	–	X
MD133623	9 (0.354)	*1	*3	X	X	X	–	–	–	X
MD133624	9 (0.354)	*1	*3	X	X	X	–	X	–	X
MD133625	9 (0.354)	*1	*3	X	X	X	–	X	X	X
MD133626	9 (0.354)	*1	*3	X	X	X	–	X	X	X
MD133850	9 (0.354)	*1	*3	X	X	X	–	X	–	X
MD170822	9 (0.354)	*1	*3	X	X	X	–	X	–	X
MD189551	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD189552	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD189554	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD189556	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD197075	10 (0.394)	*1	*3	X	X	–	–	X	X	X
MD303642	10 (0.394)	*1	*3	X	X	–	–	X	X	X
MD305651	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD314966	10 (0.394)	*1	*3	X	X	–	–	X	–	X
MD315000	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD320011	10 (0.394)	*1	*3	X	X	–	–	X	–	X
MD325598	10 (0.394)	*1	*3	X	X	X	–	X	X	X
MD326141	10 (0.394)	*1	*3	X	X	X	–	X	X	X

NOTE

- X: Applicable
- : Not applicable
- *1: Half all speed
- *2: All speed
- *3: Automatic (wax type)
- *4: Manual

ELECTRONICALLY CONTROLLED FUEL INJECTION PUMP SPECIFICATIONS – NIPPONDENSO TYPE

Fuel injection pump identification No.	Plunger diameter mm (in.)	Solenoid-type spill valve	Timing control solenoid valve	Diesel fuel temperature sensor	Pump operation sensor	Fuel cut solenoid valve
MD321175	10 (0.394)	X	X	X	X	X

INJECTION NOZZLE SPECIFICATIONS – ZEXEL TYPE

Injection nozzle part No.	Type	Injection spray angle (deg.)	Nozzle type	Holder type
MD074540	A	15	Throttle type	Screw-on type
MD103301	B	0	Throttle type	Screw-on type
MD196607	C	10	Throttle type	Screw-on type
ME200204	D	10	Throttle type	Screw-on type
ME200527	E	0	Throttle type	Screw-on type

Shims for breaking pressure adjustment

Thickness mm (in.)	Part No. (Type A, B, C)
0.1 (0.0039)	MD603901
0.2 (0.0079)	MD603902
0.3 (0.0118)	MD603903
0.4 (0.0157)	MD603904
0.5 (0.0197)	MD603905

Thickness mm (in.)	Part No. (Type A, B, C)
0.52 (0.0205)	MD603906
0.54 (0.0213)	MD603907
0.56 (0.0220)	MD603908
0.58 (0.0228)	MD603909
0.8 (0.0315)	MD603910

INJECTION NOZZLE SPECIFICATIONS – NIPPONDENSO TYPE

Injection nozzle part No.	Type	Injection spray angle (deg.)	Nozzle type	Holder type
MD080288	F	0	Throttle type	Screw-on type
MD165282	G	15	Throttle type	Screw-on type

Shims for breaking pressure adjustment

Thickness mm (in.)	Part No.	Thickness mm (in.)	Part No.
1.20 (0.0472)	MD603489	1.45 (0.0571)	MD603494
1.25 (0.0492)	MD603490	1.50 (0.0591)	MD603495
1.30 (0.0512)	MD603491	1.55 (0.0610)	MD603496
1.35 (0.0531)	MD603492	1.60 (0.0630)	MD603497
1.40 (0.0551)	MD603493	1.65 (0.0650)	MD603498
		1.70 (0.0669)	MD603499

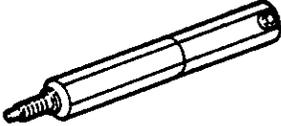
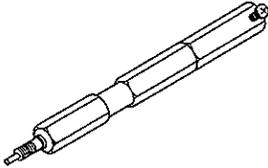
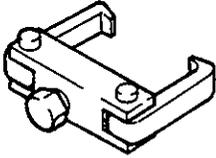
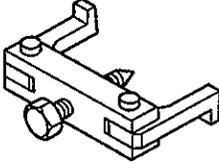
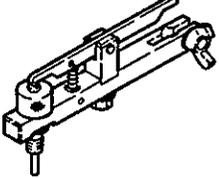
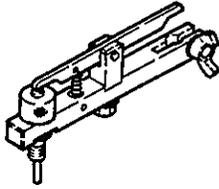
SERVICE SPECIFICATIONS

	Standard	Limit
Adjustment		
Injection timing for 4D56 (*Identification mark: A or B) and 4D65	0.97 – 1.03 (0.038 – 0.041) at 7° ATDC	
Injection timing for 4D56 (*Identification mark: C or D) and 4D68	0.97 – 1.03 (0.038 – 0.041) at 9° ATDC	
Injection timing for 4M40 without turbocharger	0.97 – 1.03 (0.038 – 0.041) at 4° ATDC	
Injection timing for 4M40 with turbocharger (with injection pump other than ME201107, ME201108, ME201109, ME201755, ME201820, ME201821 or ME201845)	0.97 – 1.03 (0.038 – 0.041) at 12° ATDC	
Injection timing for 4M40 with turbocharger (with injection pump ME201107, ME201108 or ME201109)	0.97 – 1.03 (0.038 – 0.041) at 6° ATDC	
NOTE: *Identification mark is stamped on the top surface of the cylinder head.		
Injection nozzle		
Breaking pressure		
Type A, B, F, G	12,000 – 13,000 kPa (120 – 130 kg/cm ² , 1,707 – 1,849 psi)	
Type C, D, E	15,000 – 16,000 kPa (150 – 160 kg/cm ² , 2,133 – 2,276 psi)	

TORQUE SPECIFICATIONS

	Nm	Torque kgm	ft.lbs.
Injection pump nut	19	1.9	14
Pump sprocket nut	85	8.5	62
Pump gear nut	65	6.5	47
Injection pipe clamp bolts (4D56, 4D65, 4D68 – ELECTRONICALLY CONTROLLED FUEL INJECTION PUMP)	5	0.5	3.7
(4D68 Except ELECTRONICALLY CONTROLLED .. FUEL INJECTION PUMP)	9	0.9	6.5
Injection pipe union nuts (4D56, 4D65, 4D68)	30	3.0	22
(4M40)	23	2.3	17
Pump bracket-to-cylinder block bolts (4D56)	22	2.2	16
(4D65, 4D68) ..	36	3.6	26
Injection pump-to-pump bracket bolts (4D56, 4D65) ..	24	2.4	17
Injection pump-to-pump stay bolts (4D68)	24	2.4	17
Injection pump stay bolts (4D68)	19	1.9	14
Fuel return pipe nuts	27	2.8	20
Leak-off pipe nuts	30	3.0	22
Injection nozzle	55	5.5	40
Retaining nut to nozzle body (4D56, 4D65, 4D68) ...	38	3.8	27
(4M40)	40	4.0	29

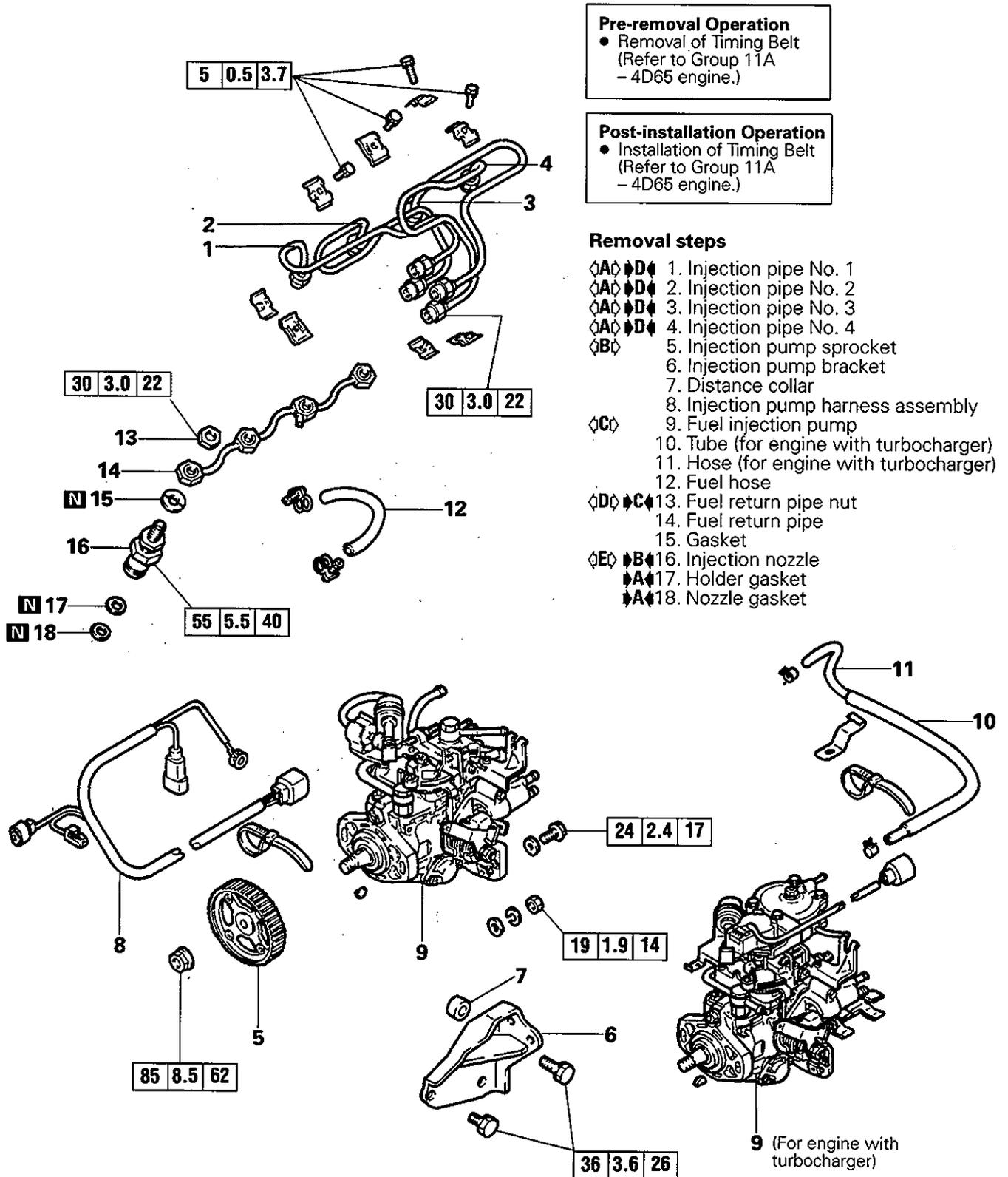
2. SPECIAL TOOLS

Tool	Number	Name	Use
	105789-0010 Zexel	Nozzle cleaning tool	Cleaning fuel injection nozzle assembly (4M40)
	MD998384	Prestroke measuring adapter	Adjustment of injection timing (4D56)
	MH063302	Measuring device	Checking and adjusting fuel injection timing (4M40)
	MD998388	Injection pump sprocket puller	Removal of injection pump sprocket (4D56, 4D65 and 4D68)
	MH062464	Gear puller	Removal of fuel injection pump gear (4M40)
	MD998389	Prestroke measuring adapter	Adjustment of injection timing (4D65 and 4D68 with turbocharger)
	MD998720	Prestroke measuring adapter	Adjustment of injection timing (4D65 and 4D68 without turbocharger)

NOTES

3. FUEL INJECTION PUMP AND INJECTION NOZZLE

REMOVAL AND INSTALLATION – 4D65



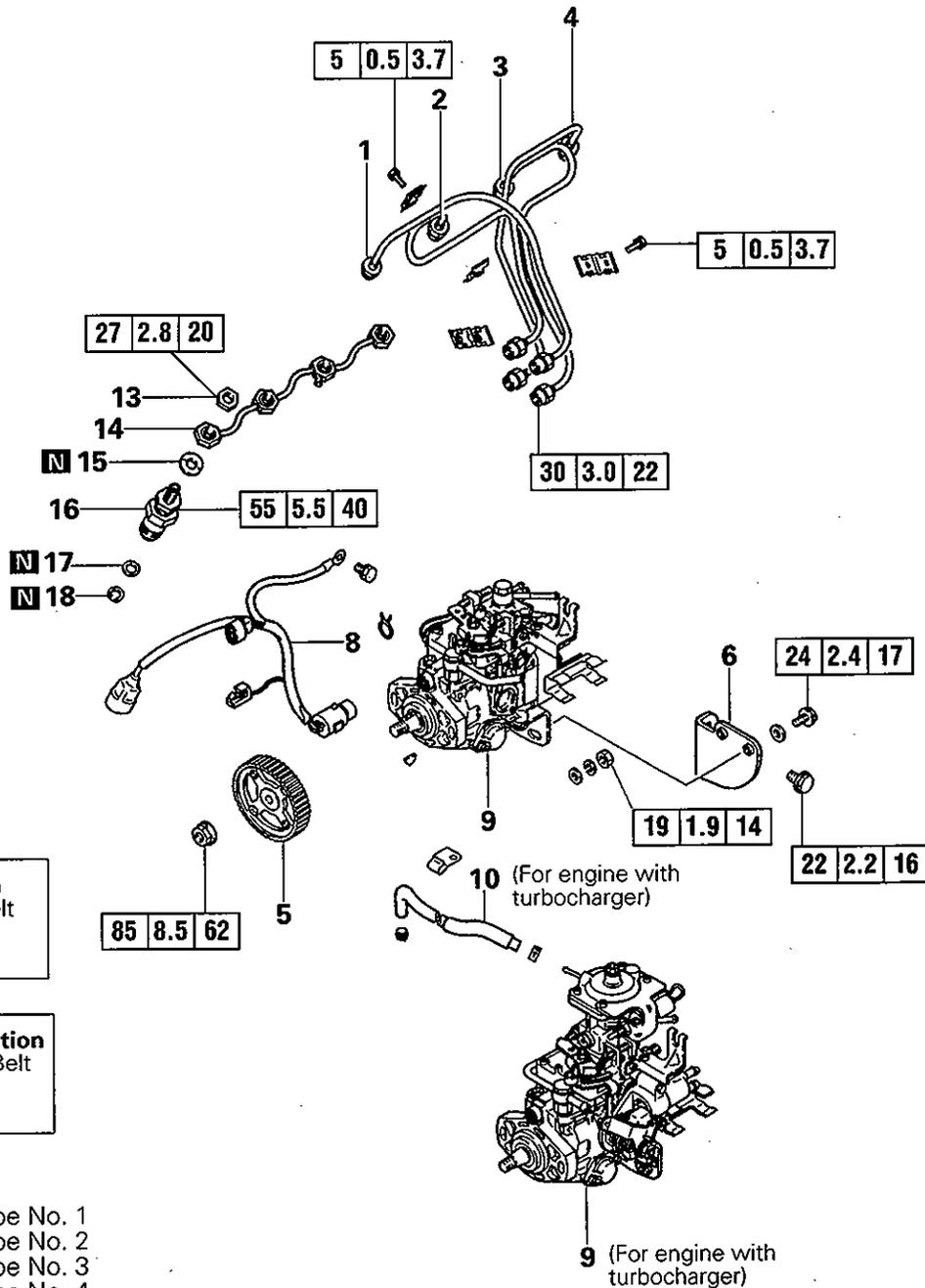
Pre-removal Operation
 • Removal of Timing Belt
 (Refer to Group 11A
 – 4D65 engine.)

Post-installation Operation
 • Installation of Timing Belt
 (Refer to Group 11A
 – 4D65 engine.)

Removal steps

- ◊A◊ ◊D◊ 1. Injection pipe No. 1
- ◊A◊ ◊D◊ 2. Injection pipe No. 2
- ◊A◊ ◊D◊ 3. Injection pipe No. 3
- ◊A◊ ◊D◊ 4. Injection pipe No. 4
- ◊B◊ 5. Injection pump sprocket
- 6. Injection pump bracket
- 7. Distance collar
- 8. Injection pump harness assembly
- ◊C◊ 9. Fuel injection pump
- 10. Tube (for engine with turbocharger)
- 11. Hose (for engine with turbocharger)
- 12. Fuel hose
- ◊D◊ ◊C◊ 13. Fuel return pipe nut
- 14. Fuel return pipe
- 15. Gasket
- ◊E◊ ◊B◊ 16. Injection nozzle
- ◊A◊ 17. Holder gasket
- ◊A◊ 18. Nozzle gasket

REMOVAL AND INSTALLATION – 4D56



Pre-removal Operation
 • Removal of Timing Belt
 (Refer to Group 11A
 – 4D56 engine.)

Post-installation Operation
 • Installation of Timing Belt
 (Refer to Group 11A
 – 4D56 engine.)

Removal steps

- ◊A◊ ▶D◊ 1. Injection pipe No. 1
- ◊A◊ ▶D◊ 2. Injection pipe No. 2
- ◊A◊ ▶D◊ 3. Injection pipe No. 3
- ◊A◊ ▶D◊ 4. Injection pipe No. 4
- 5. Injection pump sprocket
- 6. Injection pump bracket
- 7. Not assigned
- 8. Injection pump harness assembly
- ◊C◊ 9. Fuel injection pump
- 10. Tube (for engine with turbocharger)
- 11. Not assigned
- 12. Not assigned
- ◊D◊ ▶C◊ 13. Fuel return pipe nut
- 14. Fuel return pipe
- 15. Gasket
- ◊E◊ ▶B◊ 16. Injection nozzle
- ▶A◊ 17. Holder gasket
- ▶A◊ 18. Nozzle gasket

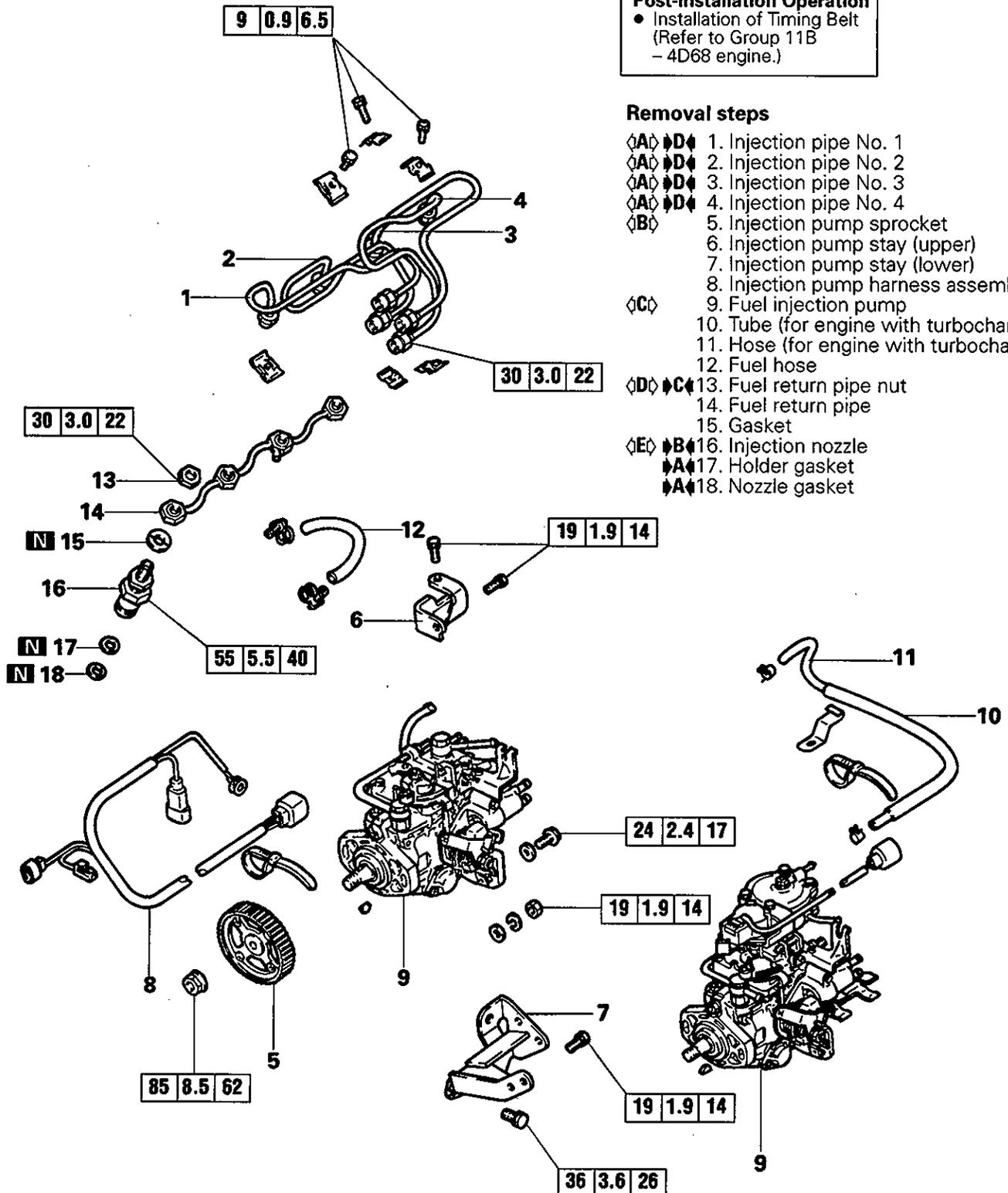
**REMOVAL AND INSTALLATION – 4D68
EXCEPT ELECTRONICALLY CONTROLLED FUEL INJECTION PUMP**

Pre-removal Operation
 • Removal of Timing Belt
 (Refer to Group 11B
 – 4D68 engine.)

Post-installation Operation
 • Installation of Timing Belt
 (Refer to Group 11B
 – 4D68 engine.)

Removal steps

- ◊A◊ ◊D◊ 1. Injection pipe No. 1
- ◊A◊ ◊D◊ 2. Injection pipe No. 2
- ◊A◊ ◊D◊ 3. Injection pipe No. 3
- ◊A◊ ◊D◊ 4. Injection pipe No. 4
- ◊B◊ 5. Injection pump sprocket
- 6. Injection pump stay (upper)
- 7. Injection pump stay (lower)
- 8. Injection pump harness assembly
- 9. Fuel injection pump
- ◊C◊ 10. Tube (for engine with turbocharger)
- 11. Hose (for engine with turbocharger)
- 12. Fuel hose
- ◊D◊ ◊C◊ 13. Fuel return pipe nut
- 14. Fuel return pipe
- 15. Gasket
- ◊E◊ ◊B◊ 16. Injection nozzle
- ◊A◊ 17. Holder gasket
- ◊A◊ 18. Nozzle gasket



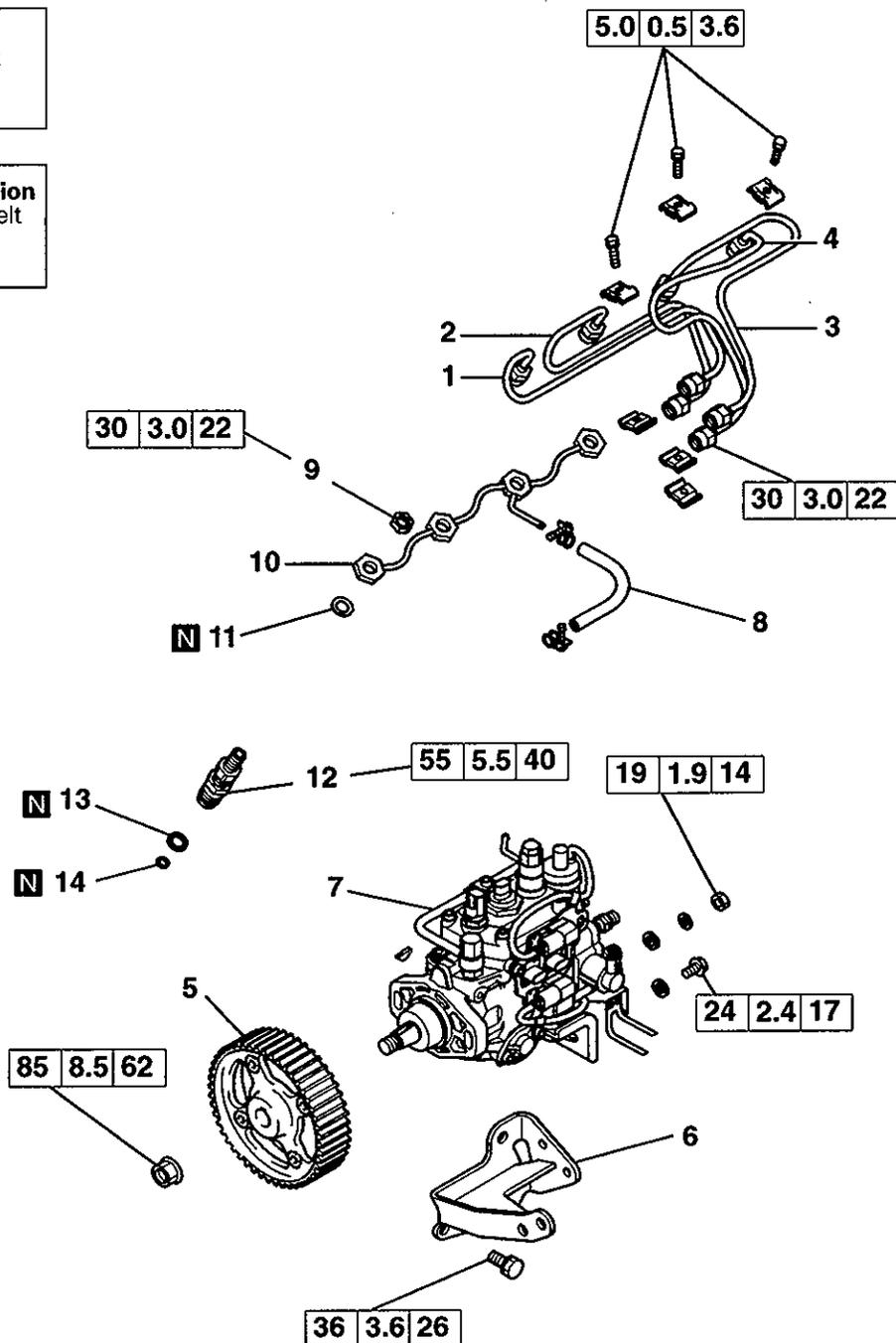
**REMOVAL AND INSTALLATION – 4D68
ELECTRONICALLY CONTROLLED FUEL INJECTION PUMP**

Pre-removal Operation

- Removal of Timing Belt
(Refer to Group 11B
– 4D68 engine.)

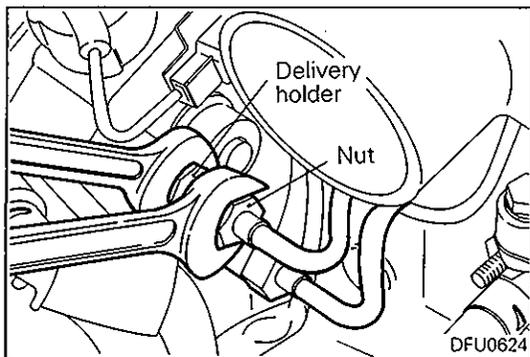
Post-installation Operation

- Installation of Timing Belt
(Refer to Group 11B
– 4D68 engine.)



Removal steps

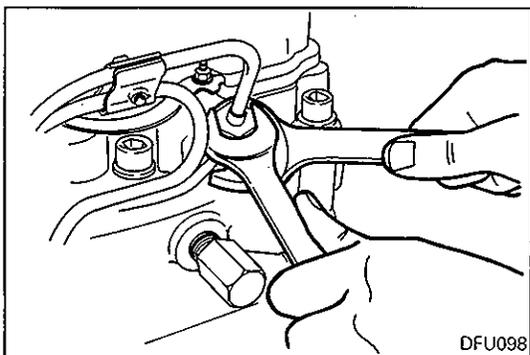
- ◇A◇▶D◇ 1. Injection pipe No. 1
- ◇A◇▶D◇ 2. Injection pipe No. 2
- ◇A◇▶D◇ 3. Injection pipe No. 3
- ◇A◇▶D◇ 4. Injection pipe No. 4
- ◇B◇ 5. Injection pump sprocket
- 6. Injection pump stay
- ◇C◇ 7. Fuel injection pump
- 8. Fuel hose
- ◇D◇▶C◇ 9. Fuel return pipe nut
- 10. Fuel return pipe
- 11. Gasket
- ◇E◇▶B◇ 12. Injection nozzle
- ▶A◇ 13. Holder gasket
- ▶A◇ 14. Nozzle gasket

**SERVICE POINTS OF REMOVAL****◊A◊ REMOVAL OF INJECTION PIPE**

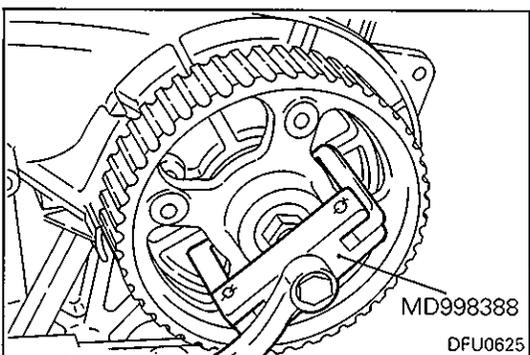
- (1) When loosening the union nuts on the injection pump, hold delivery valve holder on fuel injection pump head with a spanner to prevent it from rotating along with the union nut.

Caution

- If the injection pipe has been removed, plug the delivery valve holder to prevent foreign matter from entering the injection pump.



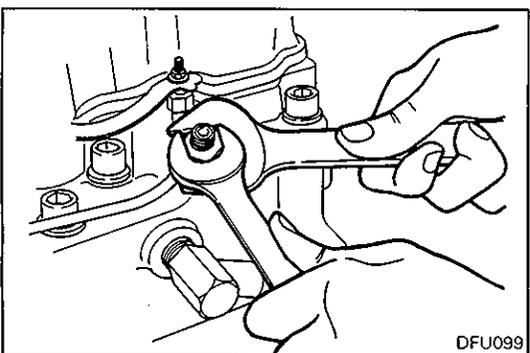
- (2) When loosening the union nuts on the injectors, hold hexagon nut of fuel return pipe with a spanner to prevent it from rotating along with the union nut.

**◊B◊ REMOVAL OF INJECTION PUMP SPROCKET**

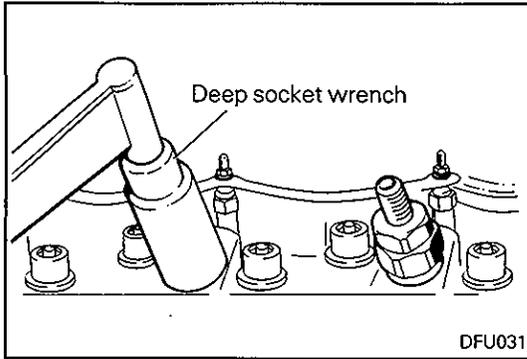
- (1) Do not strike the sprocket and drive shaft to remove these parts.

◊C◊ REMOVAL OF FUEL INJECTION PUMP

- (1) Do not hold the injection pump by the accelerator lever or the fast idle lever. These levers must not be removed.

**◊D◊ REMOVAL OF FUEL RETURN PIPE NUT**

- (1) When removing the fuel return pipe nut, hold the hexagon nut of fuel return pipe with a spanner.



REMOVAL OF INJECTION NOZZLE

- (1) Write the number of the cylinder on the injection nozzle that has been removed.

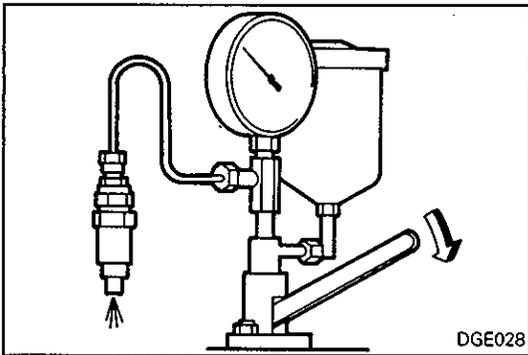
Caution

- Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage and combustion chamber.

INSPECTION OF INJECTION NOZZLE

Warning

- When testing injection nozzles, do not expose your hands or any other parts of your body to the injector spray. Working pressure can cause the fuel oil to penetrate the skin. Do not smoke or work near heaters or other fire hazards. Have a fire extinguisher handy.

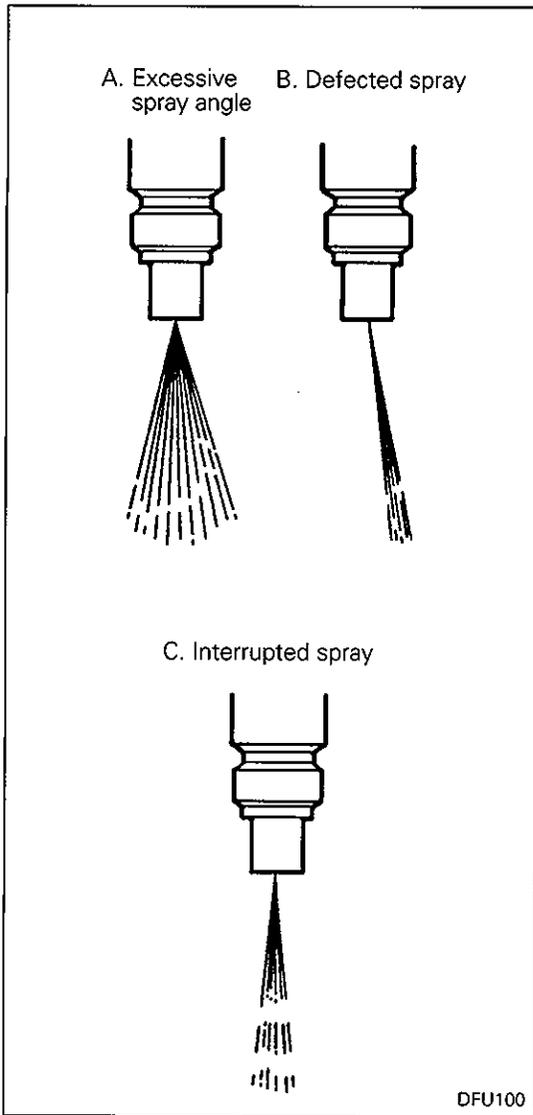


BREAKING PRESSURE TEST

- (1) Install the injection nozzle to the nozzle tester.
- (2) Operate the lever of the nozzle tester to inject fuel oil two or three times and bleed air from the nozzle.
- (3) Slowly push down the nozzle tester lever.
- (4) Monitor the pressure indicated when the injection nozzle starts operation. Be sure that a pressure of standard value is indicated.
- (5) If necessary, adjust the pressure by replacing the shims in accordance with 4. INJECTION NOZZLE HOLDER.

NOTE

1. Every 0.1 mm (0.004 in.) increase in shim thickness will raise the injection starting pressure as follows:
 - 4D56, 4D65 engine:
2400 kPa (24 kg/cm², 341 psi)
 - 4D68 engine:
1500 kPa (15 kg/cm², 213 psi)
2. Shims available for pressure adjustment are shown under INJECTION NOZZLE SPECIFICATION.

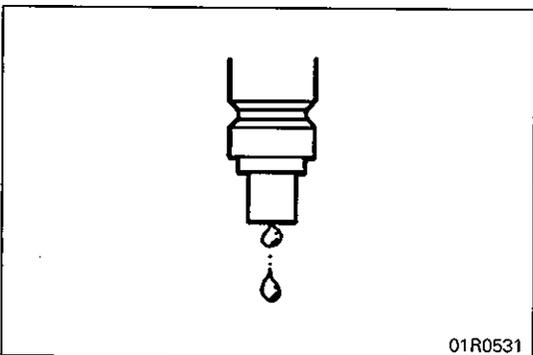


SPRAY TEST

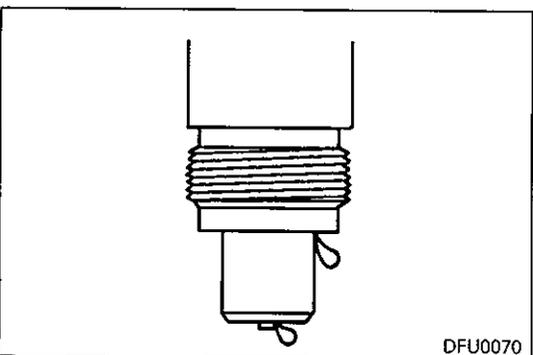
(1) Move the nozzle tester lever with a fast and short stroke (four to six strokes per second) to make sure that the sprays from the nozzle are uniform and have good patterns. The spray patterns shown at left indicate that the nozzle is defective.

Engine	Spray angle (deg.)	Type*
4D56	0	B
	10	C
	15	A
4D65	0	F
4D68	15	G

*: Refer to INJECTION NOZZLE SPECIFICATIONS

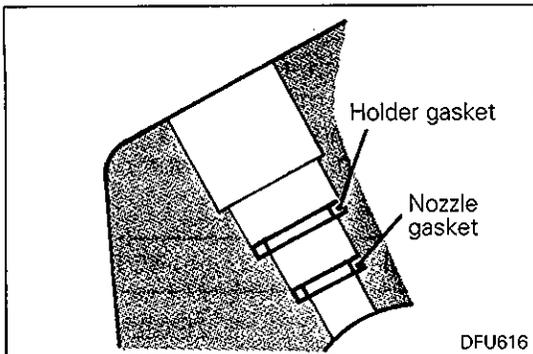


- (2) Be sure that the nozzle has no drip.
- (3) Repair or replace the defective injection nozzle.

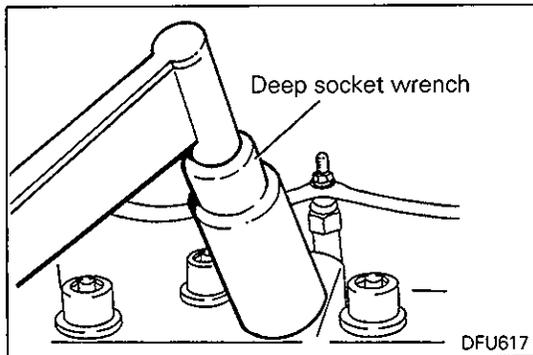
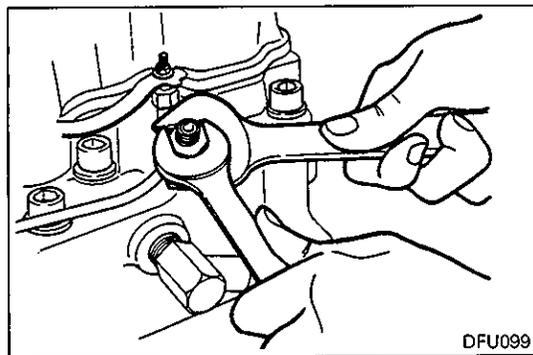


LEAKAGE TEST

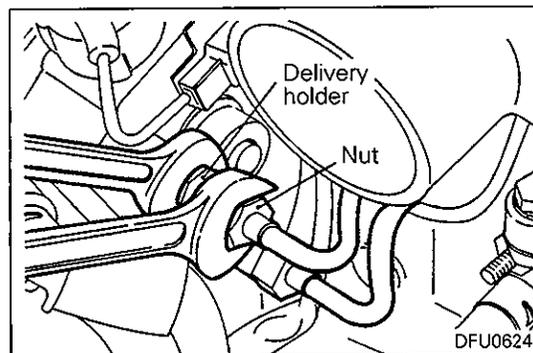
- (1) Slowly push down the nozzle tester lever until the nozzle pressure (pressure gauge reading) reaches a pressure of 2,000 kPa (20 kg/cm², 284 psi) lower than the nozzle breaking pressure and hold the pressure for approx. 10 seconds. Make sure that no fuel oil leaks from the nozzle tip during this period.
- (2) Disassemble the defective injection nozzle and replace the nozzle tip or replace the nozzle holder assembly.

**SERVICE POINTS OF INSTALLATION****▶A▶ INSTALLATION OF NOZZLE GASKET / HOLDER GASKET**

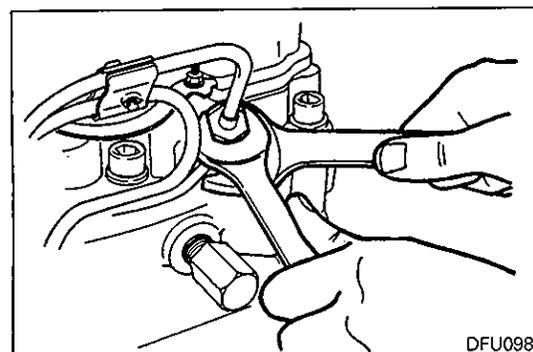
- (1) Clean nozzle holder installation area of the cylinder head.
- (2) Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.

**▶B▶ INSTALLATION OF FUEL RETURN PIPE NUT****▶C▶ INSTALLATION OF FUEL INJECTION NOZZLE**

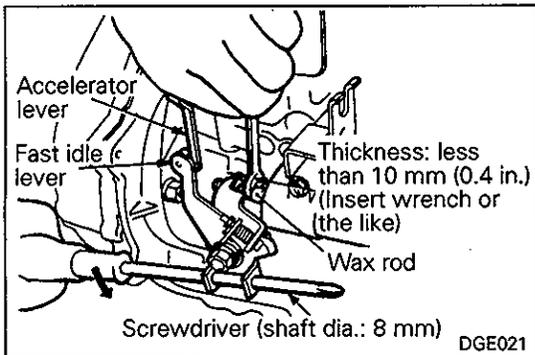
- (1) While holding the fuel hexagon nut of fuel return pipe with a wrench, tighten the fuel return pipe nut to the specified torque.

**▶D▶ INSTALLATION OF INJECTION PIPE**

- (1) When tightening the injection pipe nuts, hold the delivery valve holder with a spanner in order to prevent it from rotating along with the nut.



- (2) When tightening the injection pipe nuts, hold the hexagon nut of return pipe with a spanner in order to prevent it from rotating along with the nut.



ADJUSTMENT OF INJECTION TIMING (4D65, 4D68)

- (1) Release the fast idle mechanism.
 - (a) Insert a screwdriver [shaft dia.: 8 mm (0.3 in.)] into the holes at the bottom of the fast idle lever and turn the lever in the direction of the arrow as shown.

Caution

- In order to prevent weakening of the spring, do not turn the lever any more than necessary.

- (b) Insert a wrench or similar tool [thickness approx. 10 mm (0.4 in.)] between the wax rod and the adjusting screw.

Caution

- Do not turn the adjusting screw.

- (c) Remove the screwdriver.

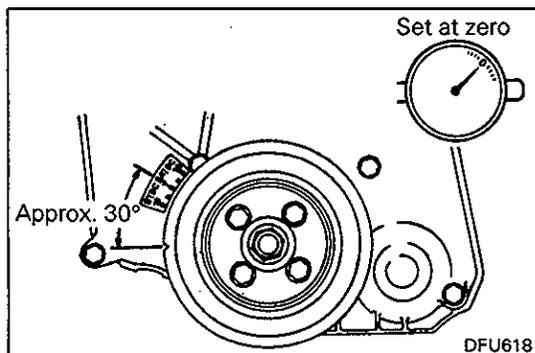
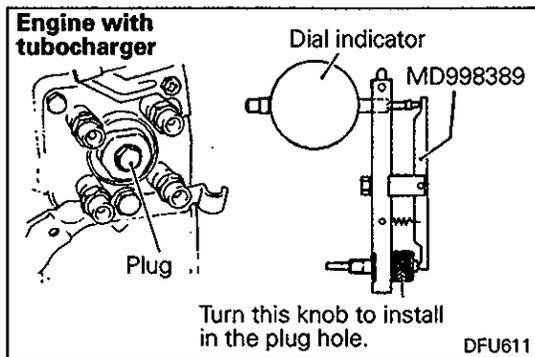
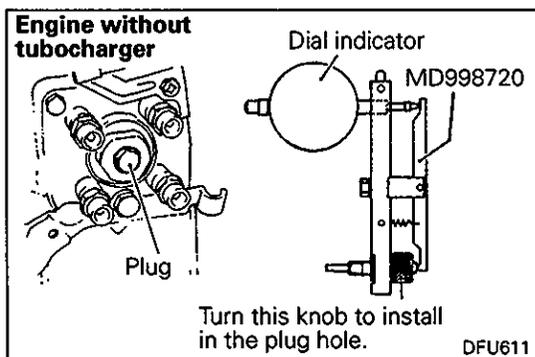
- (2) Loosen (but do not remove) two nuts and two bolts holding the injection pump.

- (3) Loosen (but do not remove) the 4 union nuts of the injection pipes on the injection pump side.

Caution

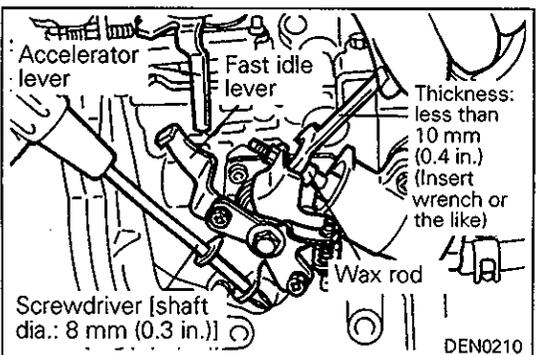
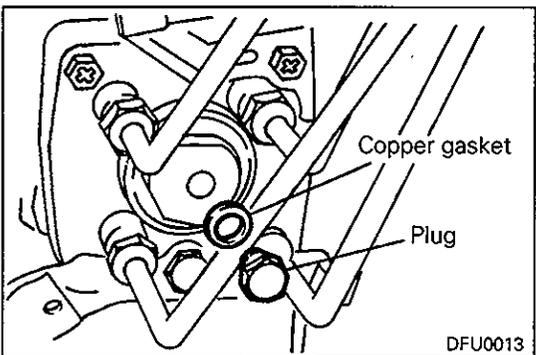
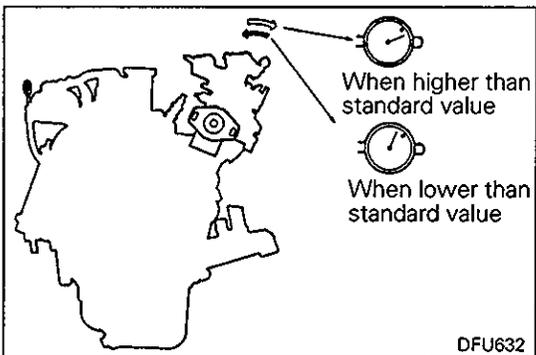
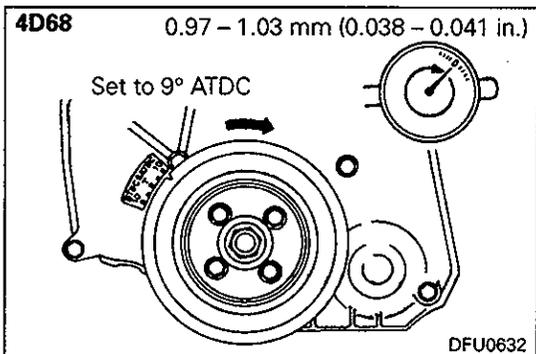
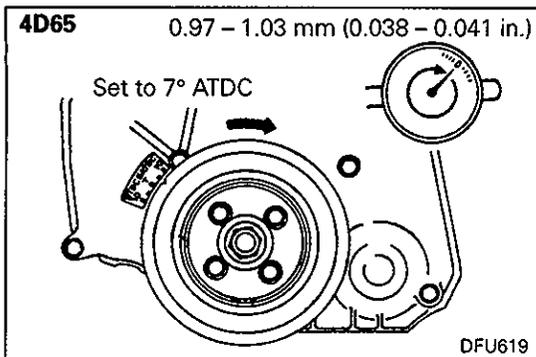
- When loosening the union nuts, hold the delivery valve holder with a wrench in order to prevent it from turning along with the nut.

- (4) Remove the plug from the rear of the injection pump, and attach the special tool and a dial indicator.



- (5) Set the notch in the crankshaft pulley at approximately 30° before top dead center of the compression stroke of the No. 1 cylinder. With the notch in this position, set the dial indicator to zero.

Turn the crankshaft pulley slightly in both directions in order to make sure that the dial indicator pointer does not deviate from the zero position. If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.



- (6) Turn the crankshaft clockwise to bring the notch in the pulley to 7° ATDC (for 4D65 engine) or 9° ATDC (for 4D68 engine), and check that the dial indicator reading is within the standard value range.

Standard value:

0.97 – 1.03 mm (0.038 – 0.041 in.)

- (7) If the dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.
- (8) Repeat Steps (4) and (6) to make sure that the adjustment has been correctly performed.
- (9) Tighten the injection pump mounting bolts and nuts to the specified torque.
- (10) Remove the dial indicator and the special tool.

- (11) Install the plug with a new copper gasket attached, then tighten the plug to specified torque.

ADJUSTMENT OF INJECTION TIMING (4D56)

- (1) Release the fast idle mechanism.
- (a) Insert a screwdriver [shaft dia.: 8 mm (0.3 in.)] into the holes at the bottom of the fast idle lever and turn the lever in the direction of the arrow as shown.

Caution

- **In order to prevent weakening of the spring, do not turn the lever any more than necessary.**
- (b) Insert a wrench or similar tool [thickness approx. 10 mm (0.4 in.)] between the wax rod and the adjusting screw.

Caution

- Do not turn the adjusting screw.

(c) Remove the screwdriver.

- (2) Loosen (but do not remove) two nuts and two bolts holding the injection pump.
- (3) Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

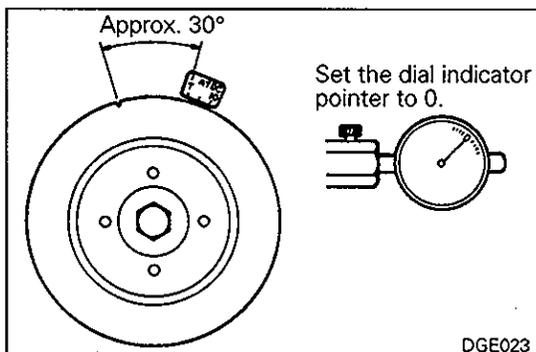
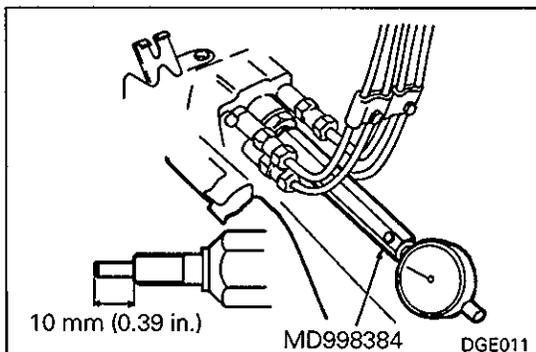
Caution

- When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.

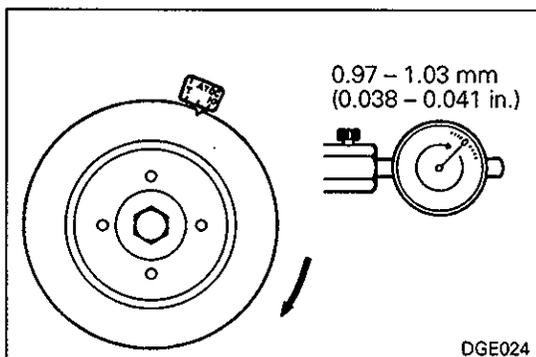
- (4) Remove the plug from the rear of injection pump, and attach the special tool and dial indicator.

Caution

- Before installing the adapter, make sure that the push rod projects 10 mm (0.4 in.). Push rod projection can be adjusted by means of the interior nut.



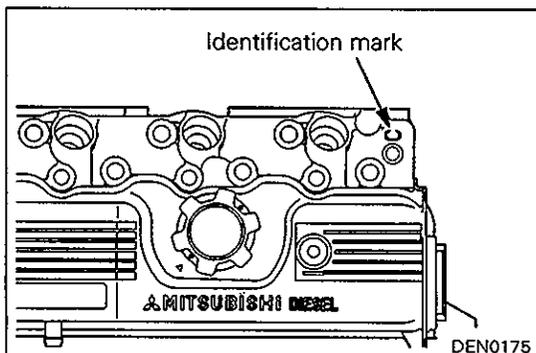
- (5) Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No. 1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero position. If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.



- (6) Turn the crankshaft clockwise to bring the notch on the pulley to 7° ATDC or 9° ATDC and check to be sure that the dial indicator reading is within the standard value range.

Standard value:

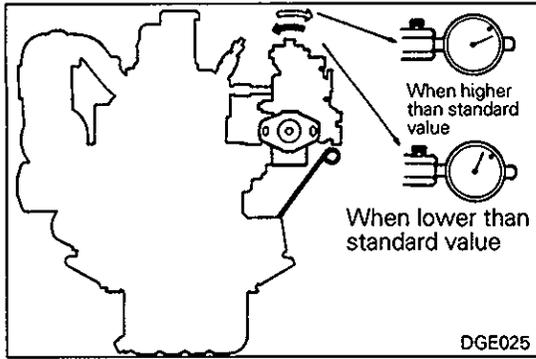
0.97 – 1.03 mm (0.038 – 0.041 in.)



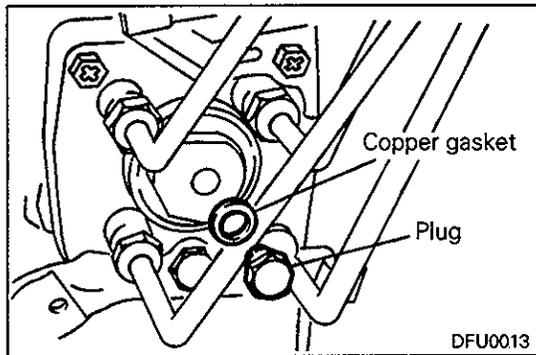
NOTE

The injection timing can be known from the identification mark stamped on the cylinder head at the position shown in the illustration.

Identification mark	Injection timing
A or B	7° ATDC
C or D	9° ATDC



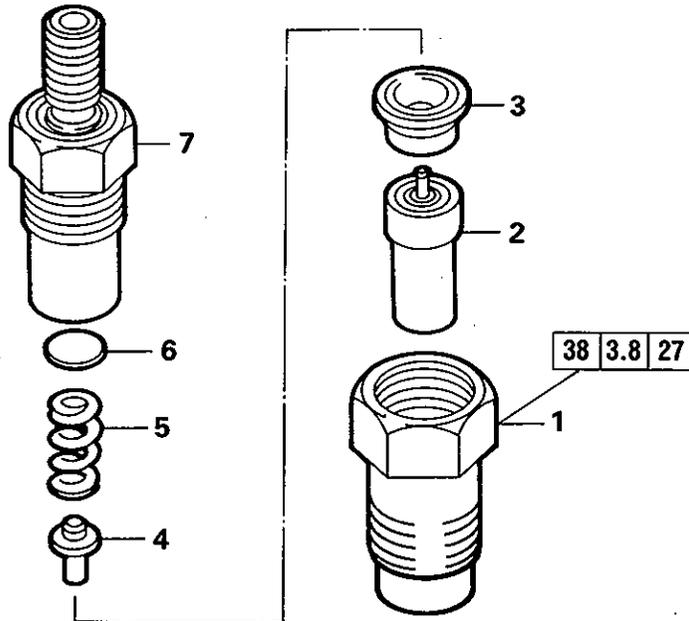
- (7) If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.
- (8) Repeat Steps (5) and (7) to make sure that the adjustment has been correctly performed.
- (9) Tighten the injection pump mounting bolts and nuts to the specified torque.
- (10) Remove the dial indicator and the special tool.



- (11) Install new copper gasket and plug, then tighten the plug to specified torque.

4. INJECTION NOZZLE HOLDER

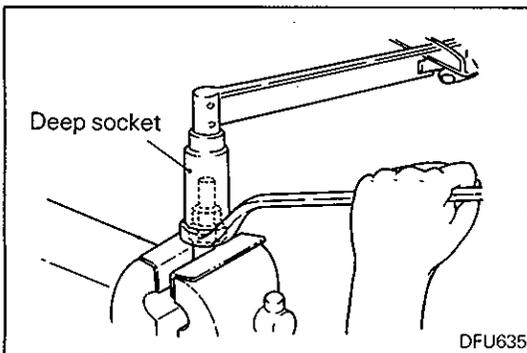
DISASSEMBLY AND REASSEMBLY



Disassembly steps

- ◁A▷ ▷A◁ 1. Retaining nut
- 2. Nozzle tip
- 3. Distance piece
- 4. Retaining pin
- 5. Pressure spring
- 6. Shim
- 7. Nozzle holder body

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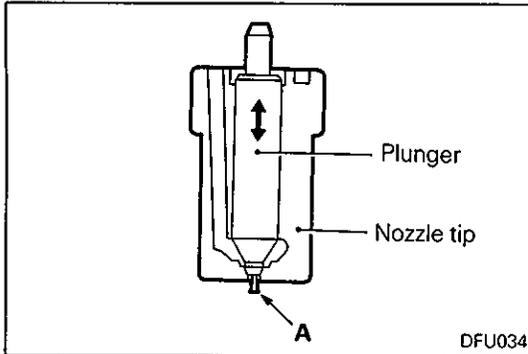


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SERVICE POINT OF DISASSEMBLY

◁A▷ **DISASSEMBLY OF RETAINING NUT**

- (1) Lightly clamp the retaining nut in a vise with soft jaws.
- (2) Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket.



INSPECTION

INSPECTION OF NOZZLE TIP

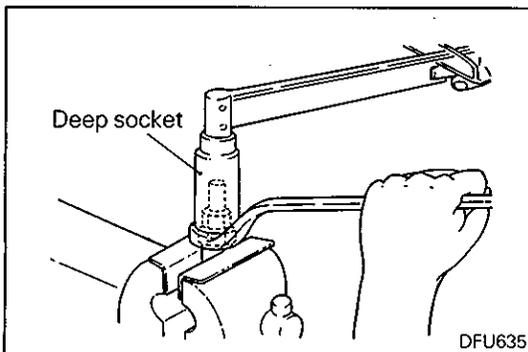
- (1) Check the nozzle tip for carbon deposits. Scrape off carbon deposits with a piece of wood and clean each part with petrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
- (2) While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip. When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.
- (3) Check plunger tip "A" for deformation and breakage. If "A" is damaged or broken, replace it.

INSPECTION OF DISTANCE PIECE

- (1) Check the surface in contact with the nozzle holder body by using minimum.

INSPECTION OF PRESSURE SPRING

- (1) Check spring for weakness and breakage.



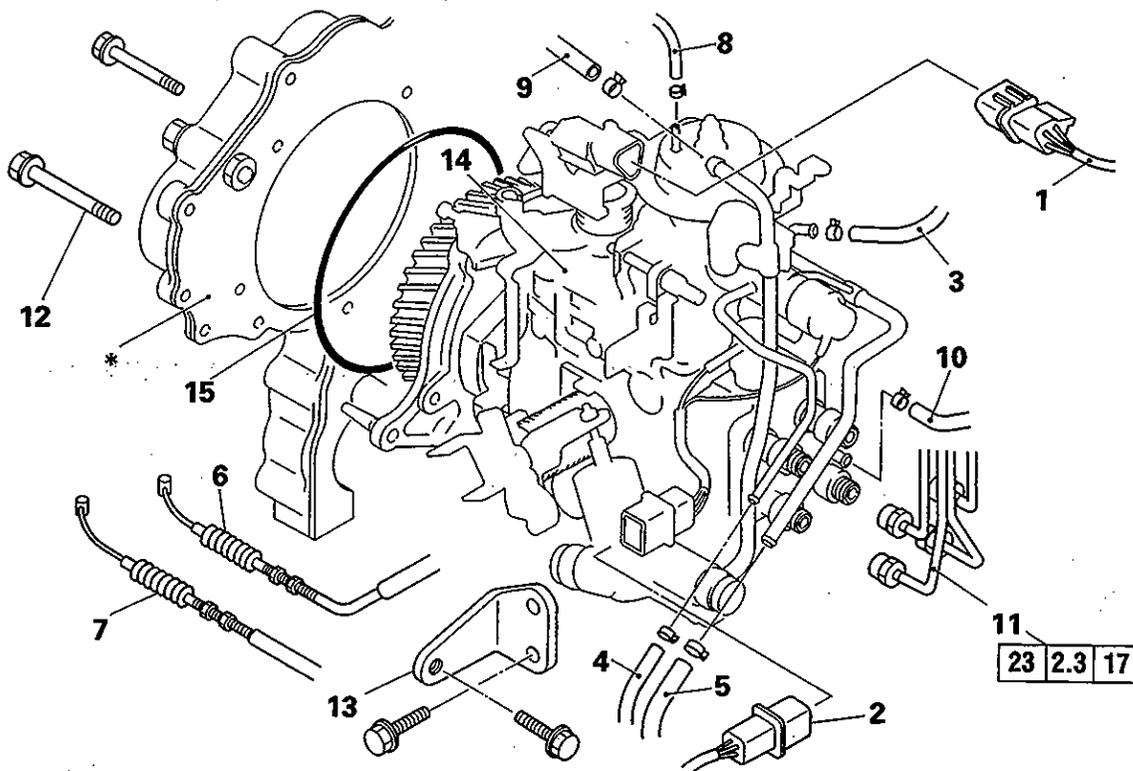
SERVICE POINT OF REASSEMBLY

◆A◆ REASSEMBLY OF RETAINING NUT

- (1) Finger-tighten the nozzle holder body.
- (2) Lightly clamp the retaining nut in a vise with soft jaws.
- (3) While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket.

5. FUEL INJECTION PUMP ASSEMBLY (4M40 ENGINE)

REMOVAL AND INSTALLATION

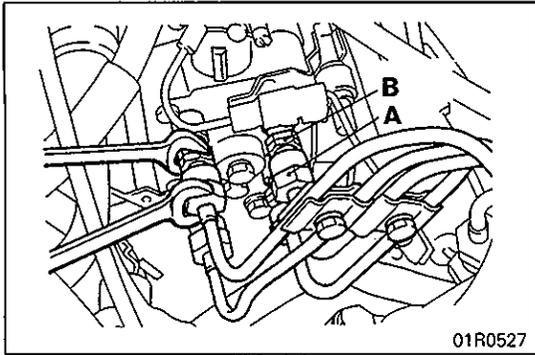


Removal steps

1. Wiring harness
2. Wiring harness
3. Fuel leak-off hose
4. Fuel return hose
5. Fuel feed hose
6. Accelerator cable
7. Throttle cable
8. Boost hose <Turbo>
9. Water hose <with W-CSD>
10. Water hose <with W-CSD>
- ◀A▶▶C▶▶ 11. Fuel injection pipe
12. Bolt
13. Stay
- ▶B▶▶ 14. Fuel injection pump assembly
- ▶A▶▶ 15. O-ring

NOTE
W-CSD: Wax type cold start device

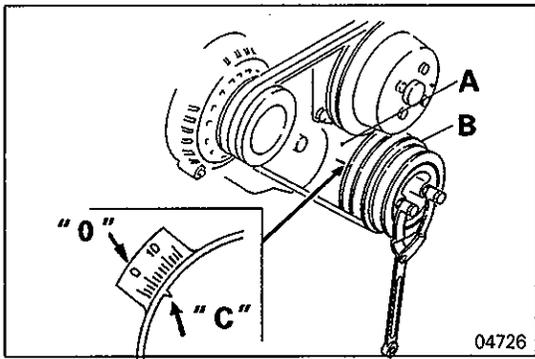
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**REMOVAL SERVICE POINT****◊A◊ FUEL INJECTION PIPE REMOVAL**

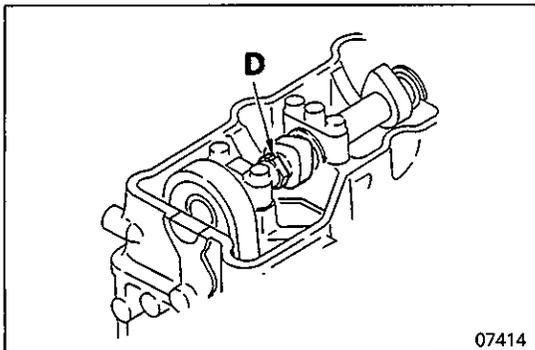
- (1) Loosen the union nut **A** of the fuel injection pipe **11** while locking the delivery valve holder **B** to prevent it from rotating together.

INSTALLATION SERVICE POINTS**▶A▶ O-RING**

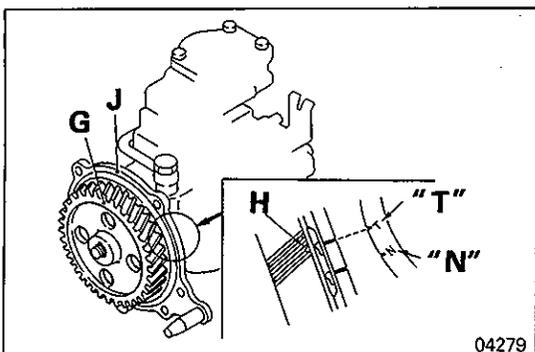
- (1) Apply a thin coat of engine oil evenly to the entire circumferential surface of O-ring before installing it.

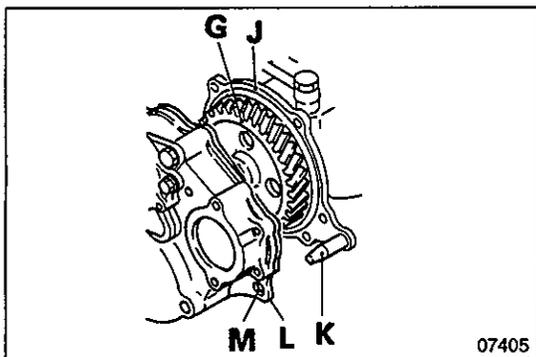
**▶B▶ FUEL INJECTION PUMP ASSEMBLY INSTALLATION**

- (1) Crank up the engine to place the No.1 piston at the TDC on the compression stroke. Align the notch in the crankshaft pulley **B** with the timing mark "0" on the timing gear case **A**.

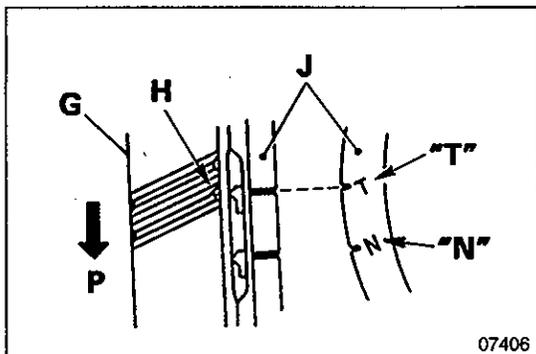
**NOTE**

- (1) If dent **D** on the hexagonal portion of the camshaft is at the top position, then it means that the No. 1 piston is at the top dead center on the compression stroke. If the dent is not at the position, turn the crankshaft clockwise through another rotation.
 - (2) Counter-clockwise rotation of the crankshaft could cause damage to the timing chain tensioner. If the crankshaft was turned counter-clockwise, remove the tensioner and remount it according to the installation procedure.
- (2) Align the notch **H** in the fuel injection pump gear **G** to the match marking "**N**" <Non-turbo> or "**T**" <turbo> on the flange plate **J**.

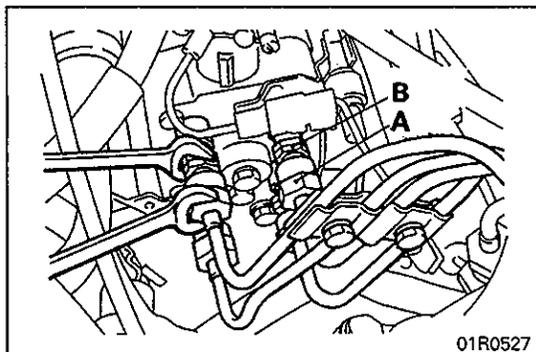




- (3) Insert guide bar **K** of flange plate **J** into guide hole **M** of front plate **L** and press it in up to a point just before injection pump gear **G** comes in mesh with the idler gear.

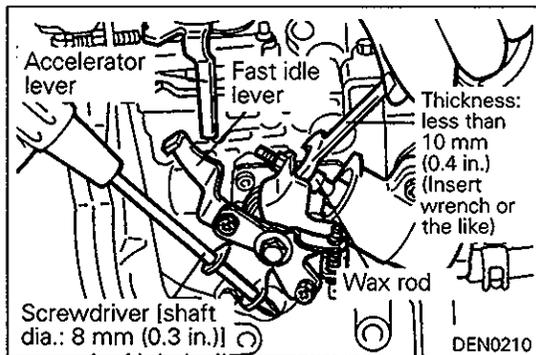


- (4) Check to see that alignment mark "**N**" <non-turbo> or "**T**" <turbo> of flange plate **J** is in alignment with notch **H** of injection pump gear **G**. Then press the injection pump assembly in.
In this case, notch **H** of the gear comes in mesh as it turns in direction **P**.



◆C◆ FUEL INJECTION PIPE INSTALLATION

- (1) Tighten the union nut **A** of the fuel injection pipe while locking the delivery valve holder **B** to prevent it from rotating together.



FUEL INJECTION TIMING CHECK AND ADJUSTMENT

CHECKING

- (1) Release the fast idle mechanism.
 - (a) Insert a screwdriver [shaft dia.: 8 mm (0.3 in.)] into the holes at the bottom of the fast idle lever and turn the lever in the direction of the arrow as shown.

Caution

- In order to prevent weakening of the spring, do not turn the lever any more than necessary.

- (b) Insert a wrench or similar tool [thickness approx. 10 mm (0.4 in.)] between the wax rod and the adjusting screw.

Caution

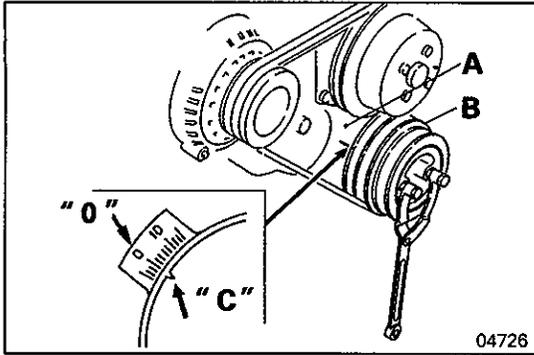
- Do not turn the adjusting screw.

- (c) Remove the screwdriver.

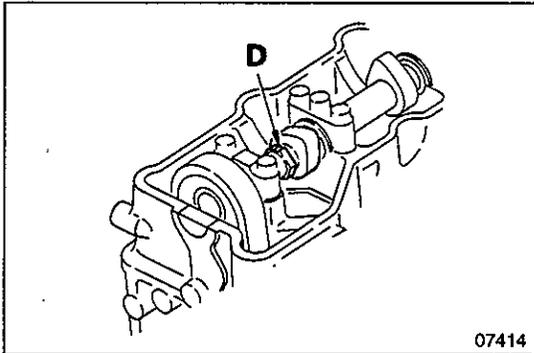
- (2) Loosen (but do not remove) two nuts and two bolts holding the injection pump.
- (3) Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

Caution

- When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.

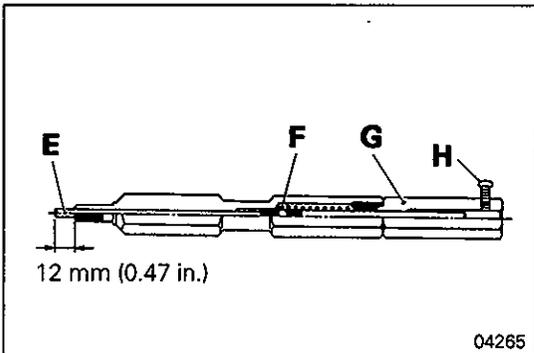


- (4) Remove all the glow plugs.
- (5) Crank up the engine to place No.1 piston at the TDC on the compression stroke. Align the notch **C** in the crankshaft pulley **B** with the timing mark "**0**" on the timing gear case **A**.



NOTE

- (1) If dent **D** on the hexagonal portion of the camshaft is at the top position, then it means that the No. 1 piston is at the top dead center on the compression stroke. If the dent is not at the position, turn the crankshaft clockwise through another rotation.
- (2) Counter-clockwise rotation of the crankshaft could cause damage to the timing chain tensioner. If the crankshaft was turned counter-clockwise, remove the tensioner and remount it according to the installation procedure.



- (6) Check to ensure that push rod **E** of the special tool is projecting 12 mm (0.47 in.) from the end of the body.

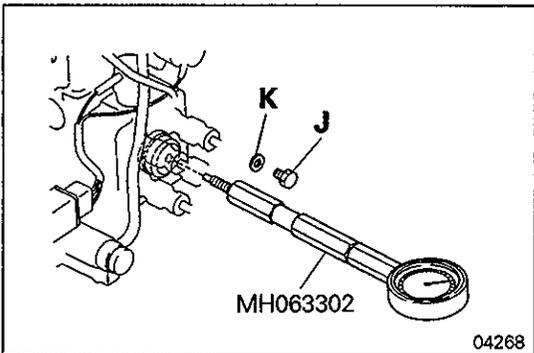
NOTE

Adjust the projecting dimension of the push rod by nut **F** in the body of the special tool.

- (7) Insert a dial indicator (small-size one) into holder **G**.
- (8) When the dial indicator has made contact with the push rod and the pointer has begun to move, secure the dial indicator with the screw.

NOTE

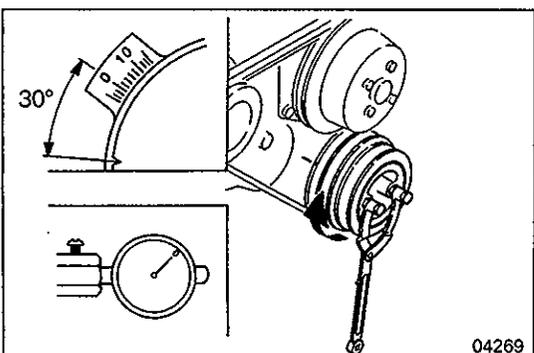
Make use that the amount the pointer operates is 0.5 mm (0.02 in.) or less.



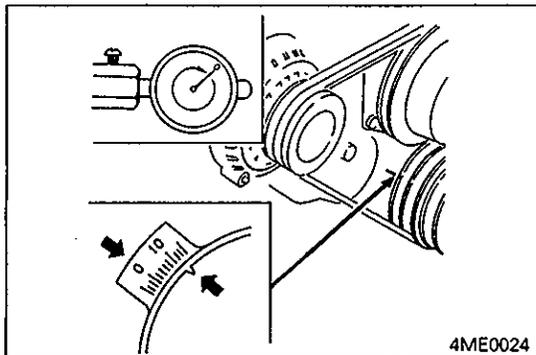
- (9) Remove the head plug **J** and gasket **K** from the fuel injection pump.
- (10) Thread the special tool in until the pointer of the dial indicator begins to move.

NOTE

When the dial indicator is hard to see, the amount the special tool is threaded in should be adjusted within the range of less than a turn from the point where the pointer begins to move.



- (11) Turn the crankshaft clockwise again till No. 1 piston is set 30° before TDC on the compression stroke.
- (12) Zero the dial gauge.
- (13) Turn the crankshaft a little (2 to 3°) clockwise and counter-clockwise and check that the dial gauge still reads "0".



(14) Set No.1 cylinder piston to the fuel injection timing by turning the crankshaft clockwise. At this point, read the dial gauge to measure the valve lift.

NOTE

For the fuel injection timing refer to "SERVICE SPECIFICATIONS".

Plunger lift: 1 ± 0.03 mm (0.039 ± 0.0012 in.)

NOTE

The timing mark scale is graduated 2° apart.

(15) If the reading deviates from the specified standard value, make necessary adjustment as follows:

ADJUSTMENT

(1) Loosen the injection pipe union nut **K** as well as the bolt **L** and nut **M** holding the fuel injection pump in this order.

K: Fuel injection pipe union nut (4 places)

L: Bolt (1 place)

M: Nut (2 places)

Caution

- When loosening the union nuts **K**, lock the delivery valve holder with a wrench to prevent it from turning together.

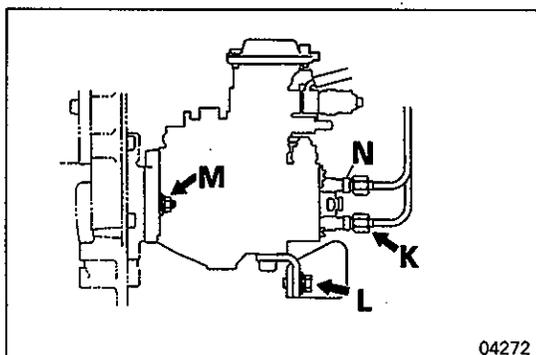
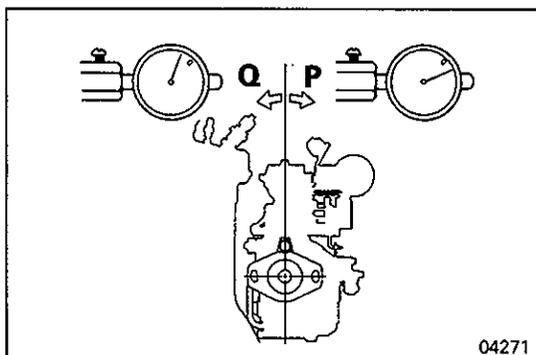
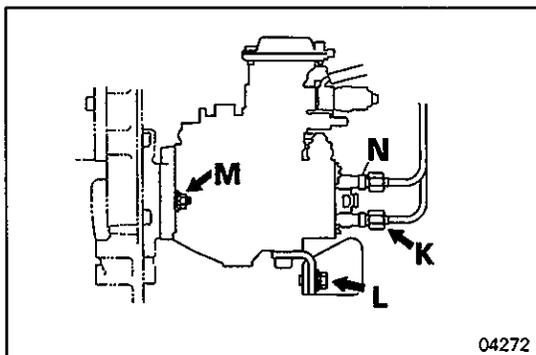
- Do not remove the union nuts **K**, bolt **L** and nuts **M**. Just loosen.

(2) Adjust the fuel injection timing by tilting the fuel injection pump assembly right or left till the dial gauge reads the specified value.

P: In case the reading exceeds the specified standard value.

Q: In case the reading is below the specified standard value.

(3) After the adjustment, check again to see if the dial gauge indicates the specified plunger lift.



(4) Retighten the nuts and bolt in the order of **M**, **L** and **K**.

M: Nut (2 places)

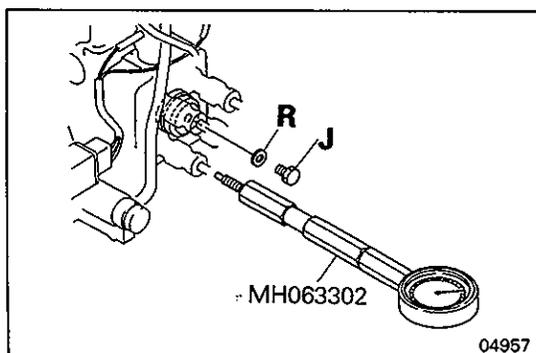
L: Bolt (1 place)

K: Fuel injection pipe union nut (4 places)

T = 23 Nm (2.3 kgm, 17 ft.lbs.)

Caution

- When torquing the union nuts **K**, lock the delivery valve holder with a wrench to prevent it from turning together.



(5) Remove the special tool.

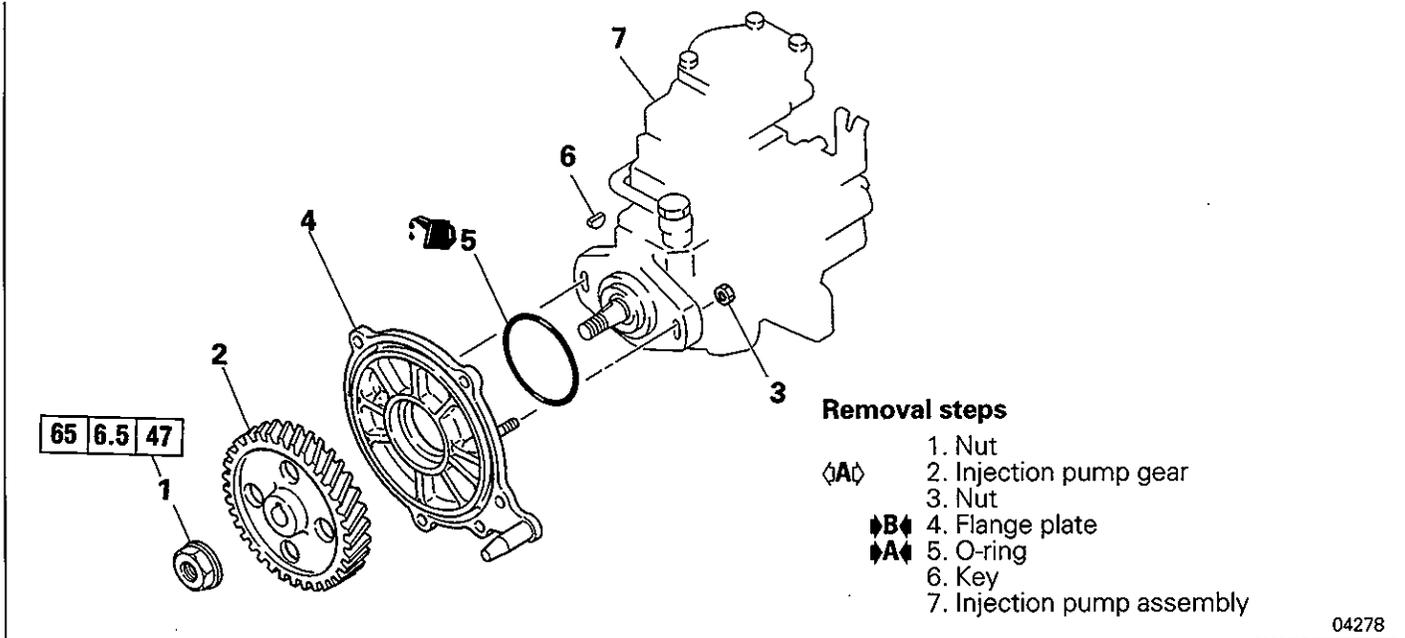
(6) Replace the gasket **R** with a new one, and tighten the head plug **J** to the specified torque.

T = 17 Nm (1.7 kgm, 12 ft.lbs.)

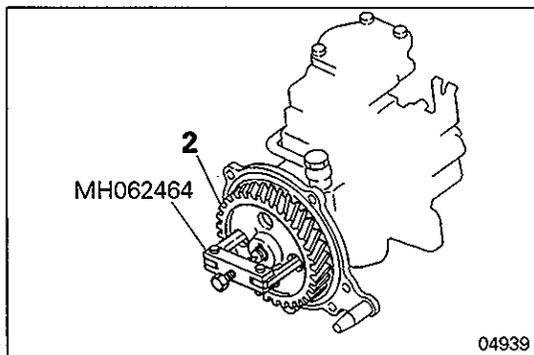
NOTES

6. FUEL INJECTION PUMP GEAR (4M40 ENGINE)

REMOVAL AND INSTALLATION



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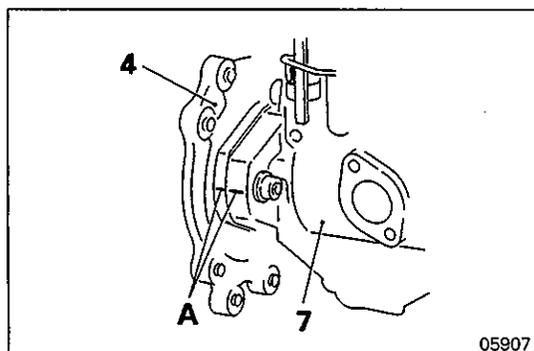
REMOVAL SERVICE POINT

↙A↘ **FUEL INJECTION PUMP GEAR**

INSTALLATION SERVICE POINT

↔A↔ **O-RING INSTALLATION**

- (1) Apply a thin coat of engine oil evenly to the entire circumferential surface of O-ring before installing it.



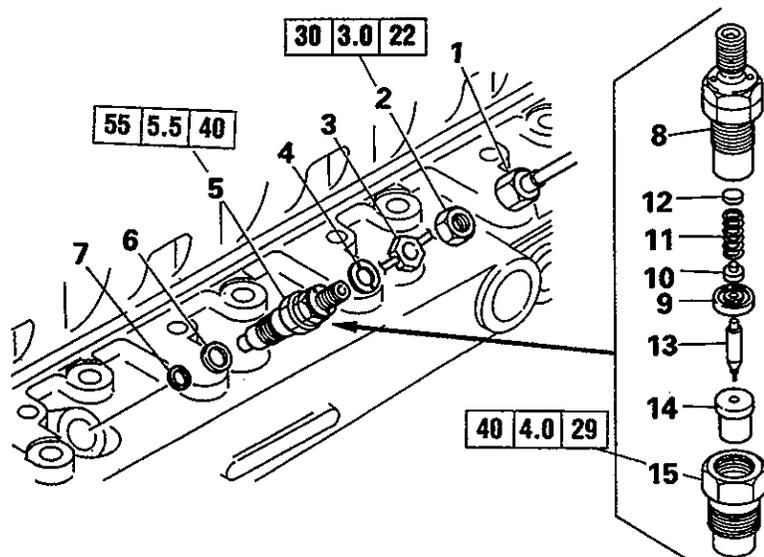
↔B↔ **FLANGE PLATE INSTALLATION**

- (1) When installing flange plate 4, align its alignment mark with alignment mark A of injection pump assembly 7.

NOTES

7. FUEL INJECTION NOZZLE (4M40 ENGINE)

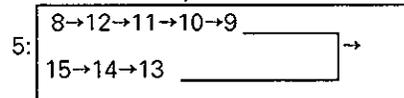
REMOVAL AND INSTALLATION



Removal steps

1. Fuel injection pipe
2. Nut
3. Leak-off pipe
4. Leak-off pipe gasket
5. Fuel injection nozzle assembly
6. Nozzle holder gasket
7. Nozzle gasket
8. Body
9. Spacer
10. Push rod
11. Spring
12. Adjusting shim
13. Needle valve
14. Nozzle tip
15. Retaining nut

Part Assembly Sequence for Fuel Injection Nozzle Assembly 5.



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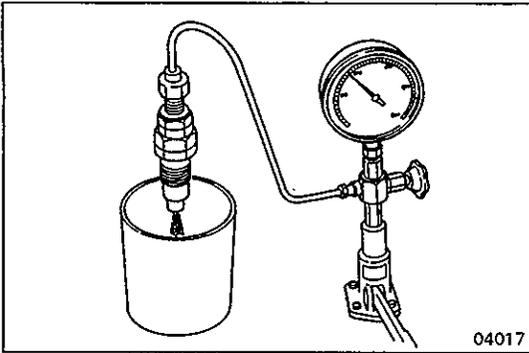
INSPECTION

FUEL INJECTION NOZZLE ASSEMBLY

- (1) Install the nozzle tester to the fuel injection nozzle assembly 5 and perform the following checks:

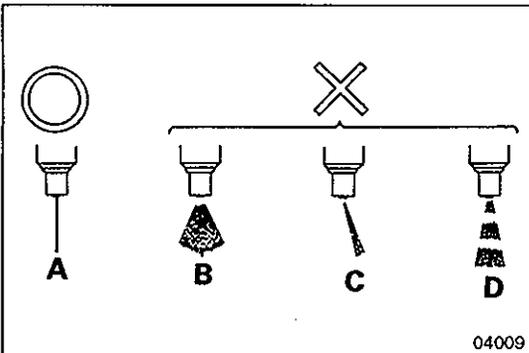
Caution

- Prior to proceeding with the checks, bleed air from the fuel injection nozzle by pumping the nozzle tester lever two or three times.



Valve Opening Pressure Check

- (1) Push down the nozzle tester lever slowly. The pointer of the pressure gauge rises gradually and deflects sharply at a certain point. Read the pressure at that point.
- (2) If the reading deviates from the standard value, disassemble and clean the fuel injection nozzle and test again. If the reading is still out of the standard value, replace the injection nozzle assembly.

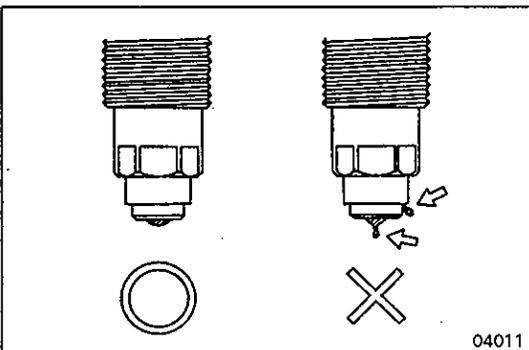


Check Spray Pattern

- (1) Make the fuel injection nozzle inject fuel continuously by pumping the nozzle tester lever quickly (4 to 6 times a second).
 - A:** The spray is a straight and fine streak with a spray angle of approx. 0° <Non-turbo> or 10° <Turbo>. (Acceptable)
 - B:** The angle of spray is too wide. (Unacceptable)
 - C:** The spray is out of the axial line. (Unacceptable)
 - D:** The spray breaks. (Unacceptable)
- (2) Disassemble, clean and recheck the fuel injection nozzle assembly if necessary. If the problem still remains after another check, replace the fuel injection nozzle assembly.
- (3) Check that the fuel injection nozzle does not dribble after injection.

Caution

- Keep away from the fuel jet.



Oil Tightness Check

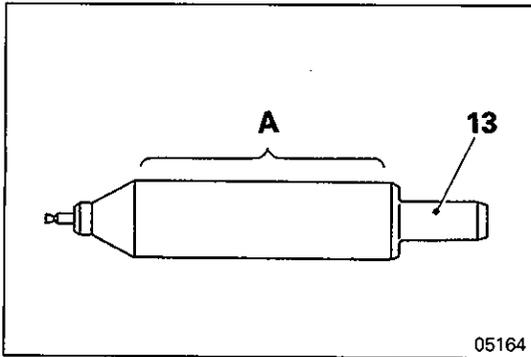
- (1) Hold the internal nozzle pressure at a level 2,000 kPa (20 kgf/cm², 284 psi) lower than the valve opening pressure, and check that the fuel injection nozzle does not start dribbling within 10 seconds.
- (2) If the dribbling begins in less than 10 seconds, disassemble, clean and recheck the fuel injection nozzle assembly. If the problem still remains after another check, replace the fuel injection nozzle assembly.

REMOVAL SERVICE POINTS

◊A◊ FUEL INJECTION NOZZLE ASSEMBLY REMOVAL

Caution

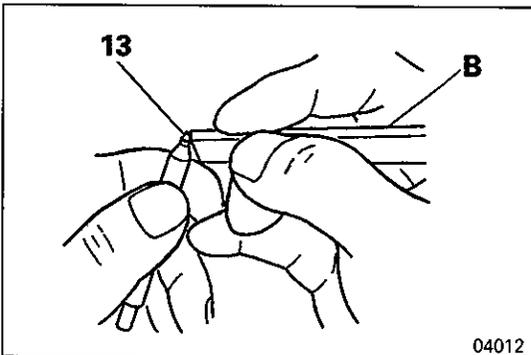
- Remove deposited carbon from the fuel injection nozzle assembly before disassembling, reassembling and adjusting it. Prior to disassembly, check the fuel injection nozzle for abnormal injection pressure, abnormal spray and fuel leaks. If it is found in order, do not disassemble the fuel injection nozzle assembly.



⟨B⟩ NEEDLE VALVE / NOZZLE TIP REMOVAL

Caution

- Be sure not to touch the sliding contact surface A of the needle valve 13.
- Be sure not to change the original combination of the needle valve 13 and nozzle tip 14 removed.



CLEANING

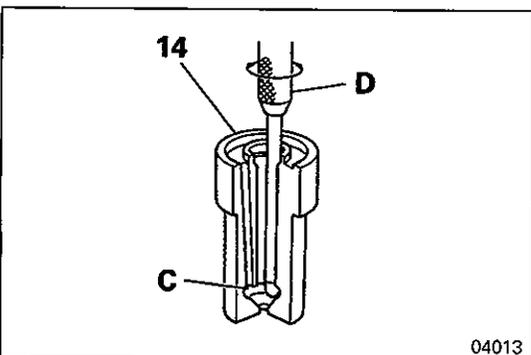
NEEDLE VALVE / NOZZLE TIP

(1) Wash the needle valve 13 and nozzle tip 14 removed in clean kerosene (cleaning oil) and remove deposited carbon from them in the following manners using the specified special tools.

- (a) Remove carbon deposited on the tip of the needle valve 13 using the special tool Cleaning Bar B.

Caution

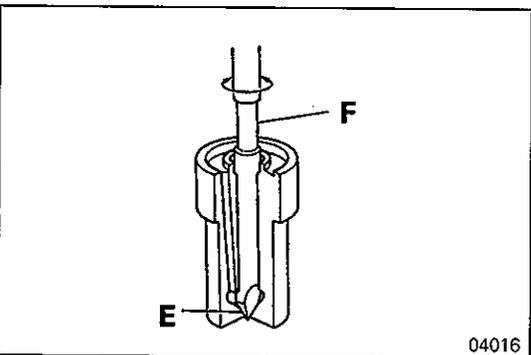
- For cleaning, never use a wire brush or any other hard metal tool.
- (b) Remove carbon accumulated in the oil pit C of the nozzle tip 14 using the Cleaning Scraper D.



- (c) Clean the seat E of the nozzle tip 14 using the special tool Cleaning Scraper F.

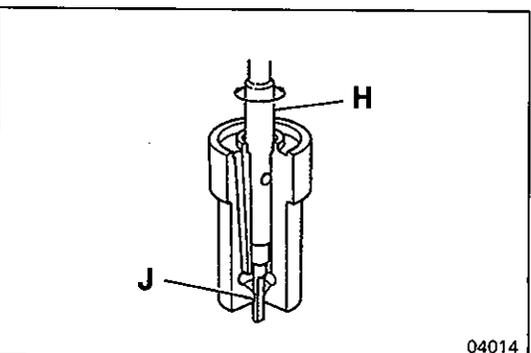
Caution

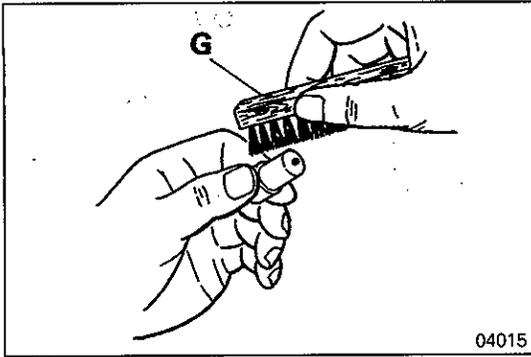
- Use sufficient care not to damage the seat surface.
- (d) To remove baked carbon, use the Fuso Carbon Remover.



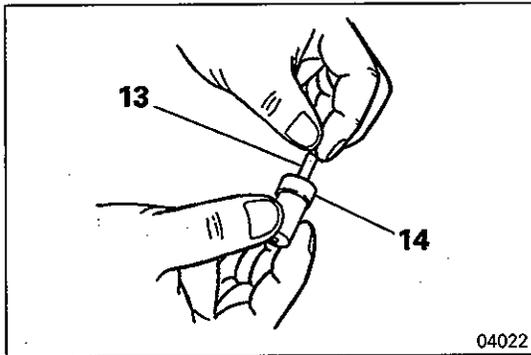
- (e) Remove carbon deposited in the nozzle hole area of the nozzle tip 14 by turning the special tool Needle Cleaner H that runs through the nozzle hole J.

Cleaning needle diameter: Less than 1.0 mm (0.04 in.)





- (f) Remove carbon deposited on the external surface of the nozzle tip **14** using the special tool Wire Brush **G**.



INSPECTION

NEEDLE VALVE / NOZZLE TIP

- (1) Wash the needle valve **13** and nozzle tip **14** clean in clean kerosene (cleaning oil) prior to reassembly.
- (2) Pull out the needle valve **13** to approximately one third of its length, let go of it and see if it slides down by gravity. (Repeat this procedure a few times after turning the needle valve each time.)
- (3) If the needle valve **13** fails to slide down by itself, wash it again and give it another check. Replace needle valve **13** and nozzle tip **14** as a set if necessary.

EMISSION CONTROL SYSTEM

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COOLANT TEMPERATURE SENSOR	17A-3-1
COOLANT TEMPERATURE SWITCH	17A-3-2

1. SPECIFICATIONS

GENERAL SPECIFICATIONS

EGR valve	Single type
Coolant temperature sensor	Thermistor type
Coolant temperature switch	Thermo ferrite type

NOTE

The emission control systems differ in their specifications depending on the models and destinations. From the emission control parts listed in the GENERAL SPECIFICATIONS, the optimum ones have been selected and installed. Refer to the Workshop Manuals of specific models, therefore, for the description of parts that have been mounted.

SERVICE SPECIFICATIONS

EGR valve

Valve closing check pressure	20 mmHg (0.8 inHg)
Valve opening check pressure	570 mmHg (22.6 inHg)

Coolant temperature sensor

Resistance	At 0°C (32°F)	8.6 kΩ
	At 20°C (68°F)	3.3 kΩ
	At 40°C (104°F)	1.5 kΩ
	At 80°C (176°F)	0.3 kΩ

TORQUE SPECIFICATIONS

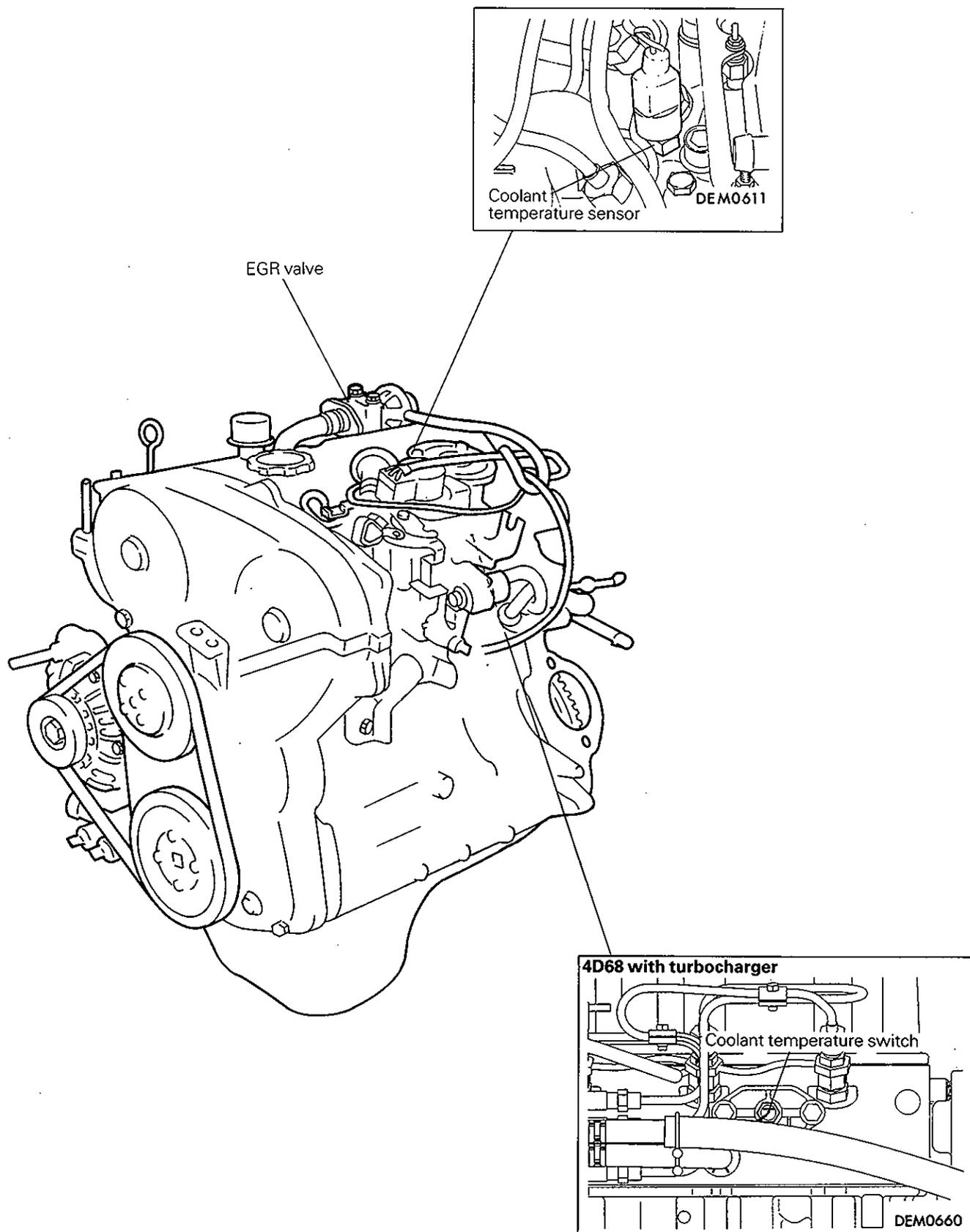
	Nm	Torque	
		kgm	ft.lbs.
EGR valve attaching bolt	25	2.5	18
Coolant temperature sensor	35	3.5	26
Coolant temperature switch	8	0.8	5.8

SEALANTS

	Specified sealant	Quantity
Coolant temperature sensor threaded part	3M NUT Locking Part No. 4171 or equivalent	As required
Coolant temperature switch threaded part	3M ATD Part No. 8660 or equivalent	As required

NOTES

2. PARTS LOCATION



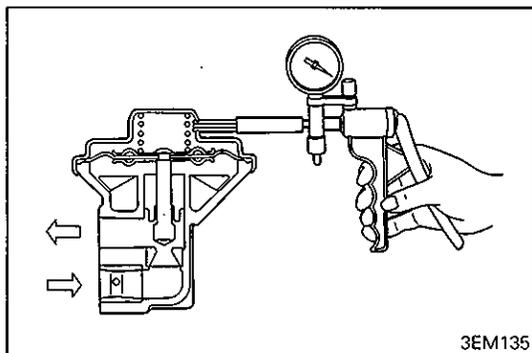
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NOTES

3. INSPECTION

EGR VALVE

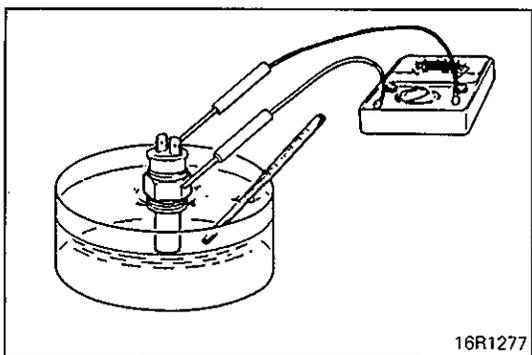
- (1) Remove the EGR valve and check it for sticking, deposit of carbon, etc.
If such condition exists, clean with adequate solvent to ensure correct valve seat contact.



- (2) Connect a hand vacuum pump to the EGR valve.
- (3) Apply a vacuum of 500 mmHg (19.7 inHg) and check air tightness.
- (4) Blow in air from one passage of the EGR to check condition as follows.

Vacuum	Normal condition
20 mmHg (0.8 inHg) or lower	Air does not blow through
570 mmHg (22.4 inHg) or higher	Air blows through

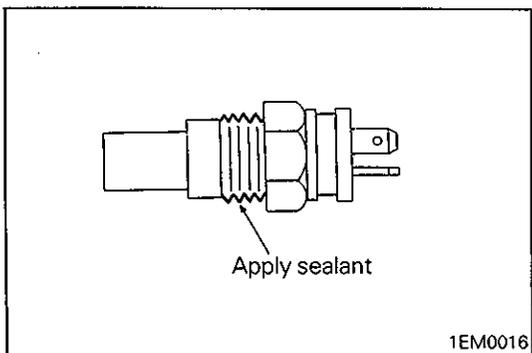
- (5) Replace the gasket with a new one and tighten the EGR valve to specified torque.



COOLANT TEMPERATURE SENSOR

- (1) Remove the coolant temperature sensor.
- (2) Immerse the temperature sensing section in water and measure resistance between terminals 2 and body while heating the water.

Temperature °C (°F)	Resistance (kΩ)
0 (32)	8.6
20 (68)	3.3
40 (104)	1.5
80 (176)	0.3



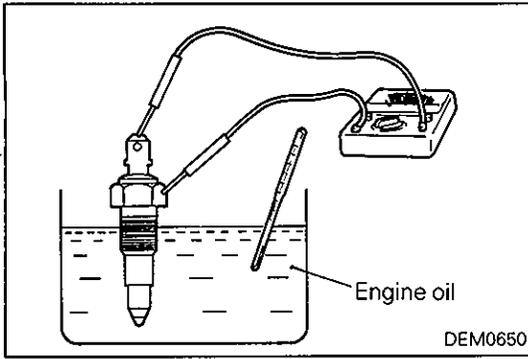
- (3) If the resistance deviates greatly from the standard value, replace the coolant temperature sensor.
- (4) Apply sealant to threaded portion.

Specified sealant:

3M NUT Locking No. 4171 or equivalent

- (5) Install the coolant temperature sensor and tighten it to specified torque.

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**COOLANT TEMPERATURE SWITCH**

- (1) Remove the coolant temperature switch.
- (2) With the temperature sensing element of the coolant temperature switch immersed in engine oil, check for continuity.

Engine oil temperature	Continuity
100°C (230°F) or less	Not present
120°C (248°F) or less	Present

- (3) If the coolant temperature switch does not operate normally, replace the switch.
- (4) Apply sealant to threaded portion.

Specified sealant:**3M ATD Part No. 8660 or equivalent**

- (5) Install the coolant temperature switch and tighten it to specified torque.

