KOBELCO

SERVICE MANUAL

MITSUBISHI DIESEL ENGINE

6D1

(For Industrial Use)

Applicable Models:

6D14
6D14-T
6D15-T
6D16
6D16-T
6D16-TL

Applicable Machines: SK290
SK330

97821-02030-00 06/96

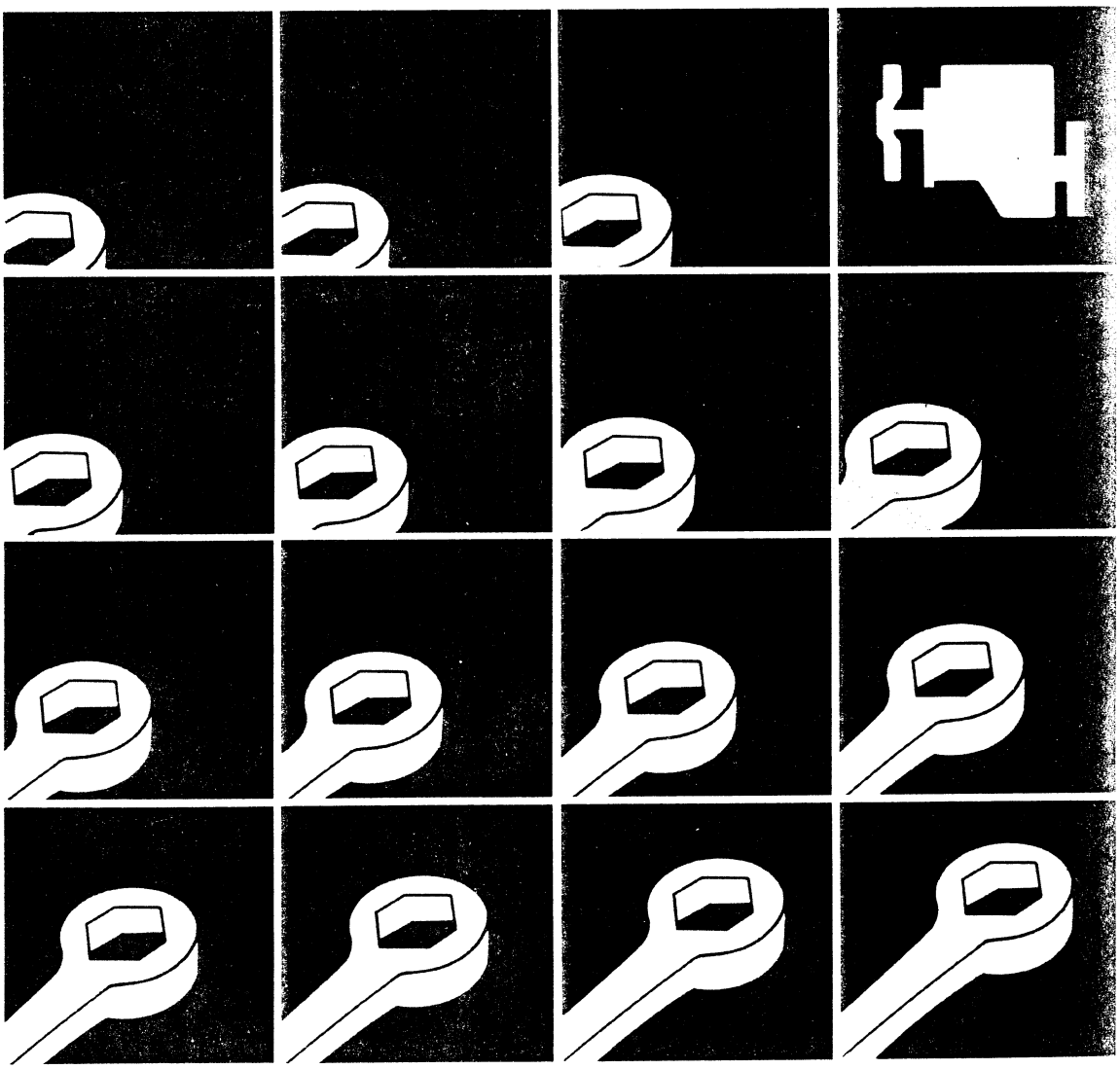
MITSUBISHI MOTORS

Shop Manual

diesel engine

MACHINE MODEL SK 290/330 - DYNAMIC ACCURA

6D1 (for industrial use)



Pub. No. 97821-02030

6D1

diesel engine

Shop Manual

(for industrial use)

FOREWORD

This Shop Manual is published for the information and guidance of personnel responsible for maintenance of Mitsubishi 6D1 series diesel engine, and includes procedures for adjustment and maintenance services.
We earnestly look forward to seeing that this manual is made full use of in order to perform correct service with no wastage.

For more details, please consult your nearest authorized Mitsubishi dealer or distributor.
Kindly note that the specifications and maintenance service figures are subject to change without prior notice in line with improvement which will be effected from time to time in the future.

Applicable models

6D14	6D16
6D14-T	6D16-T
6D15-T	6D16-TL

GROUP INDEX

HOW TO READ THIS MANUAL

HOW TO READ THIS MANUAL

How This Manual Is Compiled

- This manual is compiled by classifying various systems into certain groups.
- Each group contains specifications; troubleshooting; maintenance service standards; ❶ tightening torque; ⚠ lubricant, fluid and sealant; 🔧 special tools; and service procedure.
- Page enumeration is independent by every group where firs page is always 1.

Group No.	Group denomination	Contents
00	General	General specifications, engine No. and name plate, precautions for maintenance operations, table of standard tightening torques
11	Engine	Engine body
12	Lubrication	Lubrication system
13	Fuel and engine control	Fuel system
14	Cooling	Cooling system
15	Intake and exhaust	Intake and exhaust system, turbocharger, intercooler
21	Clutch	Clutch proper, bearing case
54	Electrical system	Alternator, starter, preheating system, engine start system, automatic stop system
61	Special equipment	Air compressor, pressure governor

General Explanation of This Manual

● Specifications

Particulars relative to maintenance service are made.

● Structure and operation

(1) Regarding conventional equipment, descriptions are made in brief.
(2) Regarding new equipment, descriptions of system and operating condition are made in detail.

● Troubleshooting

Symptoms of troubles and possible causes are described comparatively.

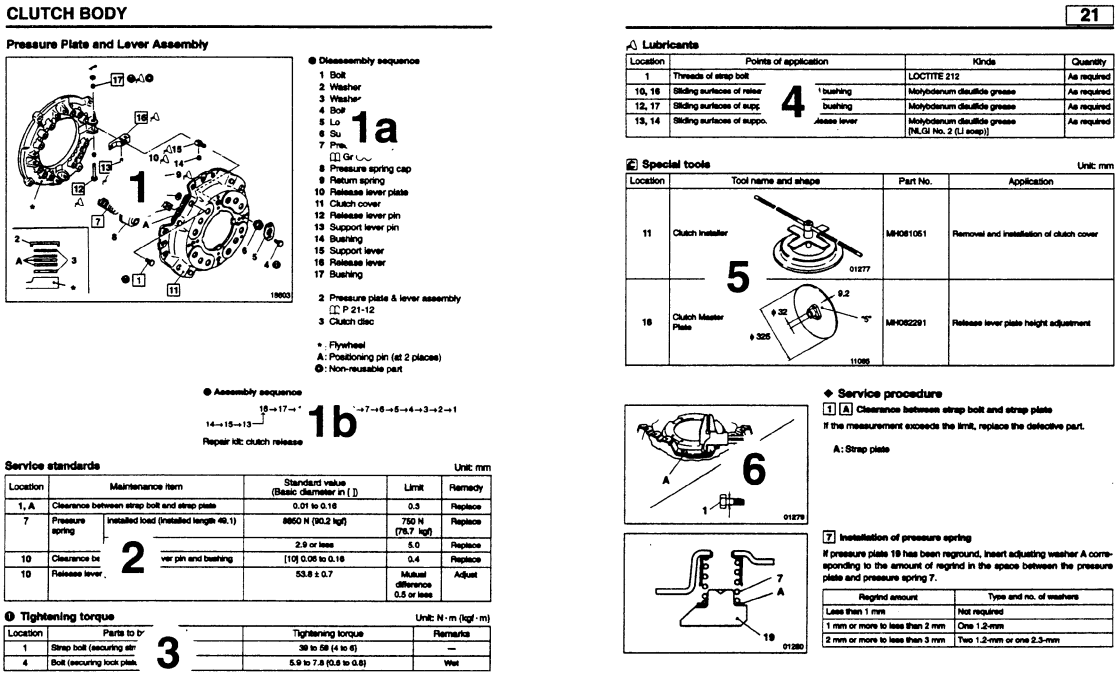
● Inspection and adjustment mounted in vehicle

Descriptions are made regarding inspection and adjustment of units mounted in vehicle.

● Service procedure

In principle, an explanation is given at the spread title page so that the service procedure can be understood. Servicing points are explained as a supplementary explanation.

Regarding the design of this manual



1. ..... Illustration for disassembly and assembly or removal and installation: 3-D exploded view of component parts is displayed.
   1a. ..... Names of parts show an example of the disassembly (removal) sequence.
   1b. ..... When the assembly (installation) sequence differs from the disassembly (removal) sequence, an example of the assembly (installation) sequence is shown.
2. ..... Service standards are shown collectively, classified by location.
3. ..... Tightening torques are shown collectively, classified by location.
4. ..... Points of lubricant, fluid and sealant application are shown collectively, classified by location.
5. ..... Special tools to be used are shown collectively, classified by location.
6. ..... When it is considered hard to understand the service procedure, just by the foregoing description, a supplementary description of the service procedure is given.

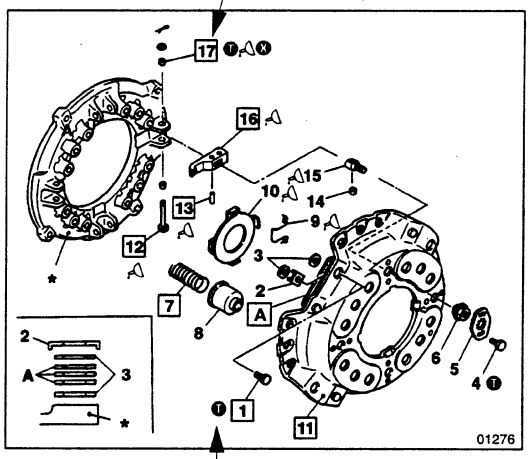
1. Illustration for disassembly and assembly or removal and installation

This shows that the appropriate service procedure is described in the text.

This shows the key No. of the part. In the text, this No. is referred to uniformly throughout.

CLUTCH BODY

Pressure Plate and Lever Assembly



● Disassembly sequence

1 Strap bolt
2 Washer
3 Washer
4 Bolt
5 Lock plate
6 Support nut
7 Pressure spring
🕮 Gr ○○
8 Pressure spring cap
9 Return spring
10 Release lever plate
11 Clutch cover
12 Release lever pin
13 Support lever pin
14 Bushing
15 Support lever
16 Release lever
17 Bushing

2 Pressure plate & lever assembly
🕮 P 21-12
3 Clutch disc

*: Flywheel
A: Positioning pin (at 2 places)
Ⓧ: Non-reusable part

● Assembly sequence

16→17→12→10→9→8→7→6→5→4→3→2→1
14→15→13↑

Repair kit: clutch release lever kit

This shows an example of the disassembly (removal) sequence.

This shows that the service procedure is described in another section.
🕮 P○○-○○
: shows reference page within the same group.
🕮 Gr○○
: shows reference group within the same book.

No service procedure is referred to in this section, but the item can be an objective of various procedures.

This is shown when the assembly (installation) sequence is not the reverse of the disassembly (removal) sequence.

This shows that a repair kit is available.

Meaning of symbols
- Ⓣ : shows that the tightening torque is specified.
- ⚠ : shows that application of lubricant, fluid or sealant is required.
- Ⓧ : shows that the part should not be reused.

2. Service standards table

Only the relevant service standards are shown.

Service standards

Unit: mm

Location	Maintenance item		Standard value	Limit	Remedy
1, 11	Clearance between strap bolt and strap plate		0.01 to 0.16	0.3	Replace
7	Pressure spring	Installed load (Installed length 49.1)	835 N {85 kgf}	710 N {72.3 kgf}	Replace
		Tilt	2.9 or less	5.0	Replace

This shows the key No. of the relevant part.

3. Tightening torque table

This shows specified tightening torque.

Ⓣ Tightening torque

Unit: N·m {kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
1	Strap bolts (Strap bolt mounting)	39 to 59 {4 to 6}	–
4	Bolt (Lock plate mounting)	5.9 to 7.8 {0.6 to 0.8}	Wet

This shows the key No. of the relevant part.

This shows that the item is to be tightened wet.

4. Lubricant, fluid and sealant table

Only the relevant lubricant, fluid and sealant are shown.

This shows the application point.

Lubricant, fluid and sealant

Location	Points of application	Kinds	Quantity
1	Thread area of bolt	LOCTITE 272	As required
10, 16	Friction surfaces of release lever plate and release lever	Molybdenum disulfide grease [NLGI No. 2 (Li soap)]	As required

This shows the key No. of the relevant part.

This shows the specified brand.

HOW TO READ THIS MANUAL

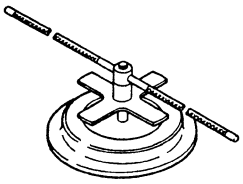
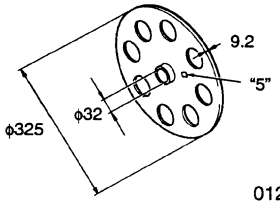
5. Special tools table

Only the relevant special tools are shown.

Purpose of special tools is shown.

Special tools

Unit: mm

Location	Tool name and shape	Part No.	Application
11	Clutch installer  01277	MH061051	Removal and installation of clutch cover
16	Master plate  01278	MH062291	Adjust release lever heights

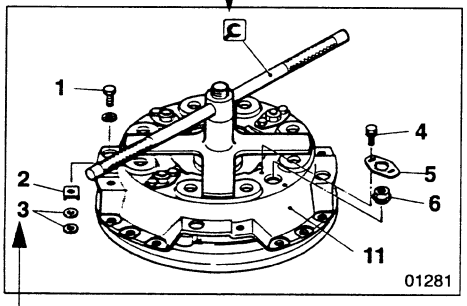
This shows the key No. of the relevant part.

Quote this number when placing an order for the part.

6. Service procedure

This indicates a special service tool.

This shows the key No. of the relevant part.



11 Removal and installation of clutch cover

- Depress pressure spring **7** using clutch installer, then remove the following parts:
  Strap bolt **1**, washer **2**, washer **3**, bolt **4**, lock plate **5**, support nut **6**
- Loosen the clutch installer gradually, then remove clutch cover **11** when the pressure spring is fully released.
- For installation, follow the removal sequence in reverse.

The key No. referred to in the text is always the same as the key No. shown in the illustration.

Servicing procedures of disassembly (removal), assembly (installation), inspection, adjustment, etc. are shown collectively.

Terms and Units

The terms and units in this manual are defined as follows.

● This service manual contains important cautionary instructions and supplementary information under the following four headings which identify the nature of the instructions and information:

DANGER ⚠ ——— Precautions that should be taken in handling potentially dangerous substances such as battery fluid and coolant additives.

WARNING ⚠ ——— Precautionary instructions, which, if not observed, could result in serious injury or death.

CAUTION ⚠ ——— Precautionary instructions, which, if not observed, could result in damage to or destruction of equipment or parts.

NOTE Suggestions or supplementary information for more efficient use of equipment or a better understanding.

● **Front and rear**

The terms "front" is the fan side and "rear" the flywheels side of the engine.

● **Left and right**

The terms "right" and "left" shall be used to indicate the side as viewed from the flywheel side of the engine.

● **Terms of service standards**

(1) Standard value
Standard value dimensions in designs indicating: the design dimensions of individual parts, the standard clearance between two parts when assembled, and the standard value for an assembly part, as the case may be.
The figure in [ ] is the basic diameter.

(2) Limit
When the value of a part exceeds this, it is no longer serviceable in respect of performance and strength and must be replaced or repaired.

● **Tightening torque**

Excessive or insufficient tightening torque has particular importance in respect of performance. Accordingly, tightening torque is specified in locations that are to be tightened.
Where there is no specified figure for tightening torque, follow the table covering standard tightening torques.
When the item is to be tightened in a wet state, wet is indicated. Where there is no indication, read it as dry, and tighten at specified torque.

● **Unit**

Length, weight, surface area and capacity are in SI units. Imperial and metric units are given in brackets. Temperatures are given in degrees Celsius with degrees Fahrenheit given brackets.
For the conversion into the foot-pound system, refer to the following conversion table.

HOW TO READ THIS MANUAL

Unit	Sign of SI unit	Sign of foot-pound unit	Conversion rate
Mass quantity of matter	kg g	lb oz	1 kg = 2.2046 lb 1 g = 0.035274 oz
Dimension	m mm	ft. in.	1 m = 3.2808 ft. 1 mm = 0.03937 in.
Capacity	L cm^3 cm^3	gal. oz cu.in.	1 L = 0.2642 gal. (U.S.) 1 L = 0.220 gal. (Imp.) 1 cm^3 = 0.033814 oz (U.S.) 1 cm^3 = 0.035195 oz (Imp.) 1 cm^3 = 0.061023 cu.in.
Force	N (Newton)	lbf	1 N = 0.2248 lbf
Pressure	kPa (kilopascal)	$lbf/in.^2$	1 kPa = 0.145 $lbf/in.^2$ 1 kPa = 0.2953 in. Hg
Stress	N/cm^2	$lbf/in.^2$	1 N/cm^2 = 1.45 $lbf/in.^2$
Moment of force	N · m	lbf.ft	1 N · m = 0.7375 lbf.ft
Output	kW (kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	t°C = (1.8t°C + 32)°F

GROUP 00 GENERAL

GENERAL SPECIFICATIONS

Item	Specifications					
Engine model	6D14	6D14-T	6D15-T	6D16	6D16-T	6D16-TL
Type	6-cylinder in-line, water-cooled 4-cycle diesel					
Combustion chamber type	Direct injection type					
Valve mechanism	Overhead valve (OHV) type					
Bore × Stroke mm	110 × 115		113 × 115	118 × 115		
Total displacement cc	6557		6919	7545		
Compression ratio	17.5	16		17.5	16	
Empty mass kg*	500	540		500	550	560

* Empty mass as measured according to Mitsubishi Motors Corporation standard.

Engine Outputs Classified By Application

Engine model / Application	6D14	6D14-T		6D16	6D16-T	
		Middle-speed specification	High-speed specification		Middle-speed specification	High-speed specification
Intermittent rated output kW (HP)	59 (79)/1500	83 (111)/1500	79 (106)/1500	71 (95)/1500	106 (142)/1500	101 (136)/1500
	70 (94)/1800	98 (132)/1800	95 (127)/1800	85 (114)/1800	123 (165)/1800	121 (163)/1800
	77 (103)/2000	106 (143)/2000	103 (139)/2000	93 (125)/2000	131 (176)/2000	131 (175)/2000
	82 (110)/2200	111 (150)/2200	111 (150)/2200	101 (135)/2200	140 (188)/2200	139 (186)/2200
	87 (117)/2500		120 (161)/2500	111 (149)/2500		147 (197)/2500
	92 (123)/2800		126 (168)/2800	120 (161)/2800		151 (203)/2800
Continuous rated output kW (HP)	53 (72)/1500	75 (101)/1500	72 (96)/1500	65 (87)/1500	96 (129)/1500	92 (123)/1500
	64 (86)/1800	89 (120)/1800	86 (115)/1800	77 (103)/1800	111 (149)/1800	110 (148)/1800
	70 (93)/2000	96 (129)/2000	94 (126)/2000	84 (113)/2000	119 (160)/2000	118 (158)/2000
	74 (99)/2200	101 (136)/2200	101 (136)/2500	93 (125)/2200	127 (170)/2200	125 (168)/2200
	79 (106)/2500		109 (146)/2500	101 (135)/2500		133 (178)/2500
	83 (111)/2800		114 (153)/2800	110 (147)/2800		137 (184)/2800

NOTE

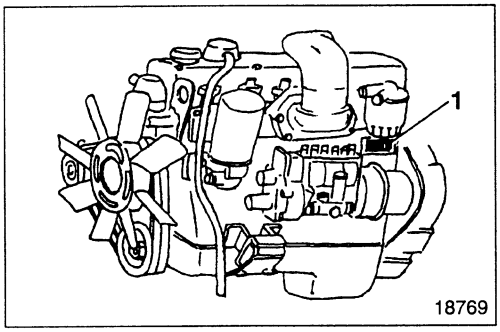
1. The output (SAE, gross) is corrected to standard ambient conditions based on SAE J1349.

2. The continuous rated output allows 10% (one hour) overload operation.

ENGINE NUMBER AND NAME PLATE

The serial number for engine is assigned to the respective engine in manufacturing sequence: every engine has its own number. This number is required for incidental inspection of the engine. Please do not fail to mention this number to the dealers when ordering spare parts.

Engine Number

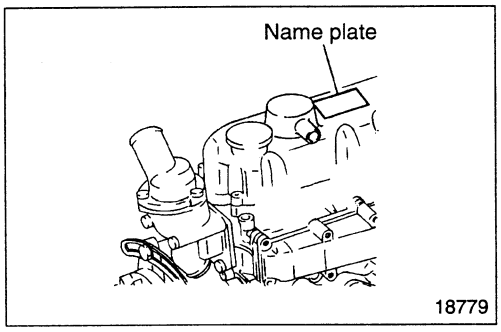


Engine number **1** is punch-marked on the left of the crankcase.

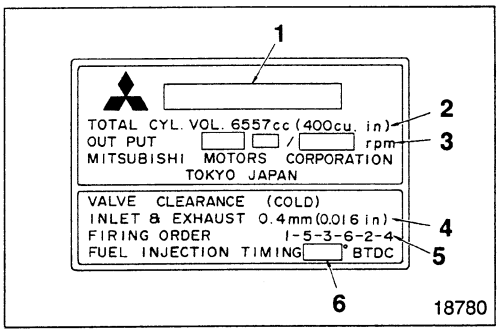
Example: 6D16–□□□□□□

- 6D16 — Engine model
- □□□□□□ — Engine number

Name Plate



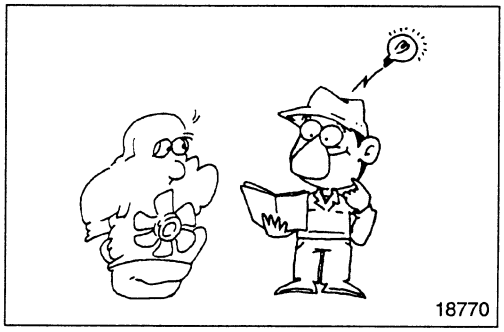
The name plate is attached to the portion shown in the illustration, and indicate the following items.



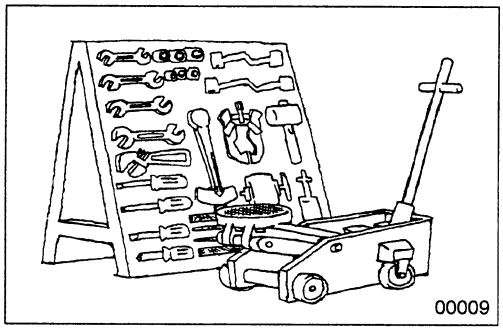
1. Engine model
2. Total displacement
3. Maximum output
4. Valve clearance
5. Firing order
6. Fuel injection timing

PRECAUTIONS FOR MAINTENANCE OPERATION

In order to determine the condition of the vehicle adequately, attend the vehicle beforehand to find and keep record of the accumulated mileage, operating condition, what the customer's demand is, and other information that may be necessary. Prepare the steps to be taken and perform efficient and wasteless maintenance procedure.



Determine where the fault exists and check for the cause to see whether removal or disassembly of the part is necessary. Then follow the procedure specified by this manual.

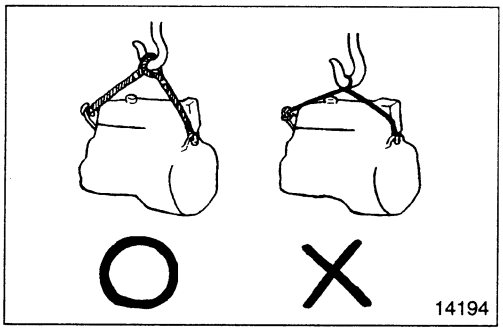


Perform maintenance work at a level area.
Prepare the following.

- Prepare general and special tools necessary for the maintenance work.

WARNING ⚠

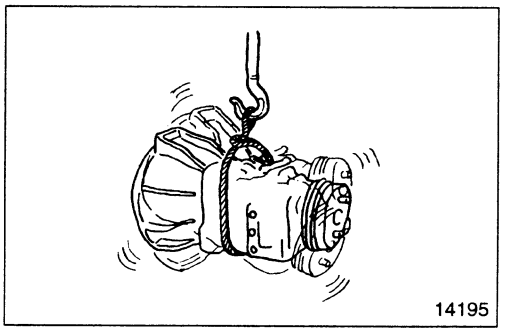
Do not attempt to use tools other than special tools where use of special tools is specified in this manual. This will avoid injury or damage.



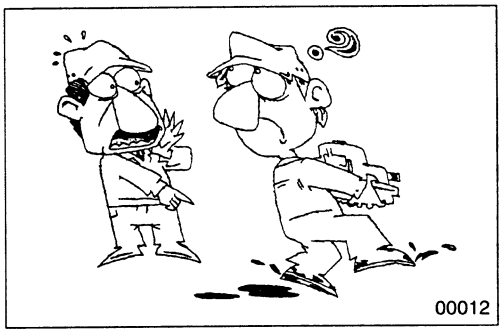
Pay special attention to safety when removing or installing heavy items such as engines, transmissions.

When lifting up heavy items using cables, pay special attention to the following points:

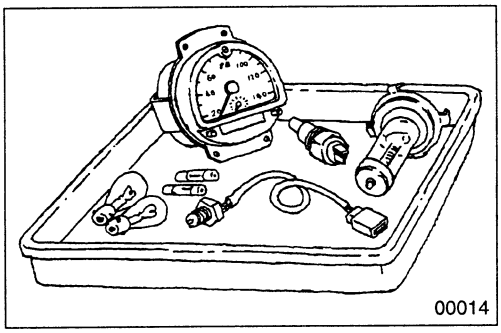
- Check the mass of the item to be lifted and use a cable capable of lifting that mass.



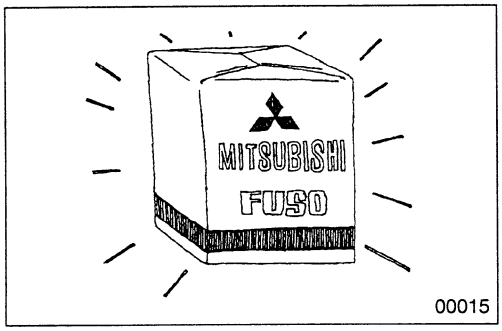
- If you do not have the specified lifting hanger, secure the item using cable taking the point-of-balance of the item into consideration.
- You must work in a position where you will not be injured even if the cable comes undone and the lifted item falls.



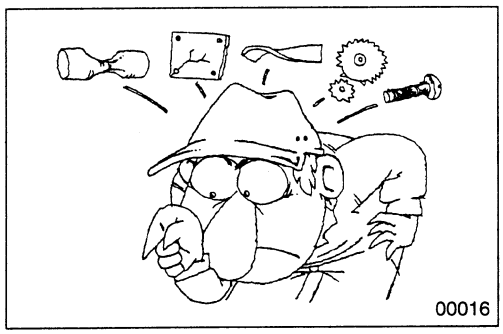
Be particularly careful not to work in shoes that have oily soles and are slippery. When working as a team of two or more, arrange signals in advance and keep confirming safety. Be careful not to accidentally bump switches or levers.



Check for oil leakage before cleaning the area having the fault otherwise you might miss detecting the leakage.
Prepare replacement part(s) beforehand.

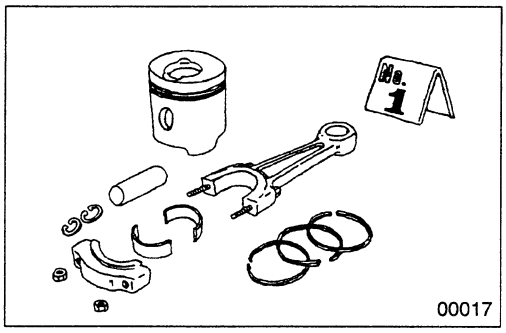


Replace oil seals, packing, O-rings and other rubber parts; gaskets and split pins with new parts whenever any of them has been removed. Use only genuine MITSUBISHI replacement parts.



On disassembly, visually inspect all parts for wear and tear, cracks, damage, deformation, degradation, rust, corrosion, smoothness in rotation, fatigue, clogging and any other possible defect.

PRECAUTIONS FOR MAINTENANCE OPERATION

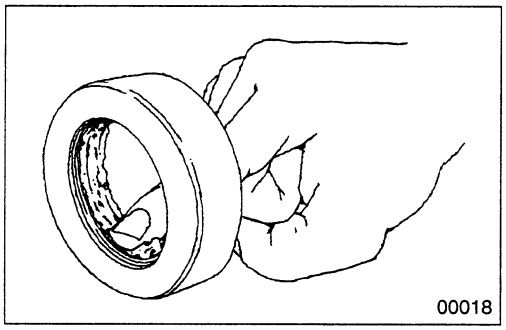


00017

Put alignment marks on part combinations before disassembly and arrange the disassembled parts neatly. This will help avoid mismating of the parts later.
Put the alignment marks, punch marks, etc. where performance and appearance will not be affected.
Cover the area left open after removal of parts to keep it free from dust.

CAUTION ⚠

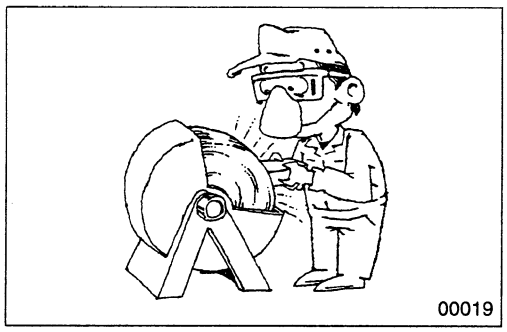
- **Take care to avoid mixing up numerous parts, similar parts, left and right, etc.**
- **Keep new parts for replacement and original (removed) parts separate.**


00018

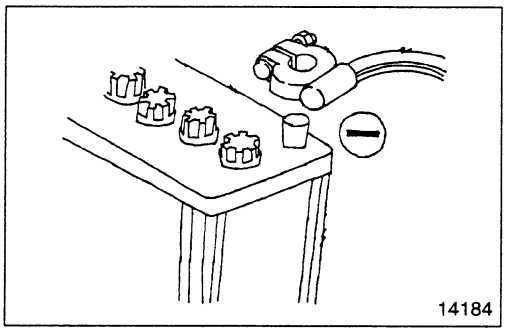
Apply the specified oil or grease to U-packings, oil seals, dust seals and bearings during assembly.
Use only the specified oil, grease, etc. for lubricant, remove the excess immediately after application with a piece of waste, etc.

CAUTION ⚠

When the specified lubricant, fluid and sealant is not available, you may use an equivalent.


00019

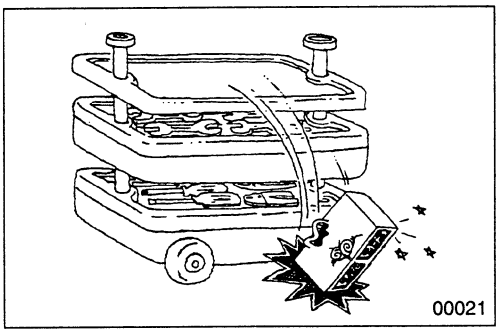
Wear goggles when using a grinder or welder. Pay full attention to safety by wearing gloves when necessary. Watch out for sharp edges, etc. that might injure your hands or fingers.


14184

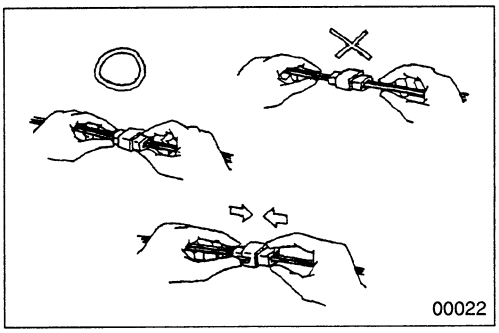
Before carrying out maintenance work on the electric system, disconnect the negative terminals of the batteries to prevent them from short-circuiting and burning-out.

CAUTION ⚠

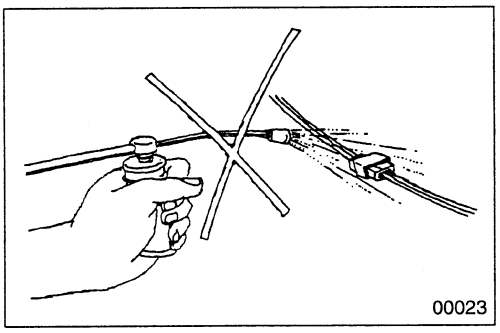
Be sure to turn starter and lighting switches, etc. off before disconnecting or connecting battery terminals, because the semiconductors can be damaged.



Take care when handling sensors, relays, etc. which are vulnerable to shock and heat. Do not attempt to remove the cover from, or apply paint to, the electronic control unit.



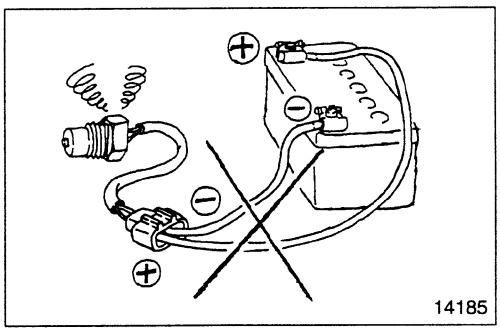
Pull the connector, and not the harness lead, to separate connectors. To separate a lock-type connector, first push toward arrow mark. To reconnect a lock-type connector, press the separated parts until they click together.



When washing the vehicle, cover the electric system parts and instruments with waterproof material beforehand (Cover with vinyl sheet or the like). Keep water away from harness wire connectors and sensors. If any of them should get wet, wipe them off immediately.

When using an electric welder, such electronic parts that are directly connected to the batteries might be damaged due to the flow of current from the welder that flows through the negative circuit. Parts that have switches might be subject to the same danger if the switches are left on.
Therefore, do not fail to observe the following.

- Connect the negative terminal of the welder as near as possible to the area that is to be welded.
- Disconnect the negative terminals of batteries.



To apply voltage for testing, check that the positive and negative cables are connected properly, then increase voltage gradually from 0 volt. Do not apply voltage higher than the specified value.
In particular, pay close attention to the electronic control unit and sensors, since they are not always fed the battery voltage.